Accumulation of Human Capital in Canada, 1970 to 2020:

An Analysis by Gender

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Paper prepared for the 36th IARIW Virtual General Conference
August 23-27, 2021
Session 16: Human Capital and Wealth
Time: Wednesday, August 25, 2021 [16:30-18:30 CEST]

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May 2021

The study is funded by the Department for Women and Gender Equality Canada. I would like to thank Natalie Domey of Statistics Canada and my colleagues at the Economic Analysis Division for helpful comments

Abstract

Human capital is an important determinant of wellbeing of individuals and long term economic and societal progress. This paper provides a gender analysis of human capital in Canada and examines the contribution of women to the level and growth of human capital in Canada over the period from 1970 to 2020. Human capital is estimated using the income–based approach of Jorgenson and Fraumeni (1989 and 1992) and is calculated as the present discounted value of future market income of an individual.

The average human capital per capita of women is found to be lower than that of men. But this gender gap in human capital narrowed over time due to relatively large increases in labour force participation, education and average earnings of women compared with those of men. The ratio of average human capital of women to average human capital of men increased from 35% in 1970 to 70% in 2020. This gap in average human capital between men and women exists for all age groups and education levels. The gender gap in human capital was larger for immigrant women than for native-born women. As a result of rapid growth in human capital of women, the share of total human capital accounted for by women rose from 30% in 1970 to 41% in 2020 and women accounted for about half of the growth in human capital over that period 1970 to 2020.

Executive Summary

Human capital contributes to current wellbeing of individuals through its effect on economic growth and to future wellbeing through its effect on comprehensive wealth. This paper provides a gender analysis of human capital and examines the contribution of women to the level and growth of human capital in Canada over the period from 1970 to 2020. Human capital is estimated using the income–based approach of Jorgenson and Fraumeni (1989 and 1992) and it is calculated as the present discounted value of future market income of an individual over its working life.

Human capital is the most important component of total wealth which is often used to tell if the growth is sustainable where total wealth is defined as a sum of produced capital (both tangible physical capital and intangible knowledge capital), natural capital and human capital. An increase in total wealth per capita arising from increases in female labour force participation, increases in education level of women or increases in earnings of women signal a more sustainable growth path of a nation. On The other hand, a decline in total wealth per capita arising from a decline in human capital due to aging signals the growth path may not be sustainable if that decline is not accompanied by the increase in other form of assets such as physical capital or knowledge capital.

The average human capital per capita of women is found to be lower than that of men. But this gender gap in human capital is getting smaller over time as a result of the relative faster growth of human capital for women arising from large increases in the labour force participation of women, and relatively faster increase in the education level and earnings of women compared with that of men. In 1970, there was a large gap in human capital between women and men when the average human capital of women was only 35% of that of men. This large gap reflects relatively lower labour force participation, lower hours worked and lower hourly earnings of women. By 2020, the average human capital of women reached 70% of that of men.

The gender gap in human capital was larger for immigrant women than for native-born women. In 1970, average human capital for immigrant women was about 31% of immigrant men while average human capital of native-born women was about 36% of native-born men. Over time, this gender gap narrowed for both immigrant and native-born women, at a similar pace. By 2020, average human capital of immigrant women was 66% of immigrant men, while average human capital of native born women was about 71% of the average human capital of native born men. The relatively larger gender gap in human capital for immigrants may reflect that fact that a higher proportion of women immigrants are Spouse and Dependent or Family class and lower proportion as Economic class principal applicant that subject to the point system.

There were gender gaps in average human capital between men and women for all age groups and education levels. Since 1970, the gaps have narrowed significantly for all age groups and all education levels, especially for prime age women, aged 35 to 54 years old.

As a result of rapid growth in human capital of women, the share of total human capital accounted for by women rose from 30% in 1970 to 41% in 2020. The increase in that share was much faster before the mid-1990s than after the mid-1990s due to large increases in labour force participation of women in the period before the mid-1990s. For the period 1970 to 1995, the share of human capital from women rose from 30% to 39%. For the period from 1995 to 2020, the share increased from 39% to 41%.

While the female share of human capital is lower than the male share of human capital for the period 1970 to 2020, women accounted for about half of the growth in human capital due to relatively fast growth in human capital of women. The contribution to aggregate growth in human capital from women declined after the mid-1990s as a result of a decline in the relative growth in human capital for women in that period. Women accounted for about 58% of the growth in human capital before 1995, much larger than their share of human capital in that period (33%). For the period 1995 to 2020 women accounted for 45% of the growth in human capital, which is larger than their share of human capital in that period (40%).

Both immigrant women and immigrant men increased their share of contribution to human capital growth after 1995. In the period after 1995, immigrants accounted for about 40% of growth in human capital in the period. That is much greater than their share of human capital (less than 20%) in that period. For the period before 1995, immigrants accounted for about 18% of the growth in human capital and 14% of human capital.

1. Introduction

Human capital contributes to current wellbeing through its effect on economic growth. It also contributes to future wellbeing through its effect on total wealth which forms the asset base for future economic growth. A good estimate of human capital is required for a better understanding of the sources of economic growth and whether economic growth is sustainable in the future. In 2016, Statistics Canada contributed to the United Nations Economic Commission for Europe's (UNECE) guide on measuring human capital within a National Accounts framework (UNECE 2016). The preferred methodology adopted in that guide for measuring human capital is first developed by Jorgenson and Fraumeni (1989 and 1992) and it will be applied in this paper to examine human capital by gender, and to examine the contribution to the level and growth of human capital by gender.

The gender analysis on human capital in this study complements a larger literature on gender gap in annual earnings (Drolet, 2011 and Pelletier et al. 2019). As gender gap affects individuals throughout their working life, gender difference in this paper is estimated in terms of the difference in the present discounted value of future earnings of the individuals or the difference in human capital. This human capital approach in measuring gender gap is useful as human capital is important for income and economic growth.

The gender analysis on human capital stock also addresses the issue of the sustainability of growth that the flow-based analysis on current earnings does not answer. The trend on comprehensive wealth per capita of an economy is often used to tell if the growth is sustainable where the comprehensive wealth is defined as a sum of produced capital (both tangible physical capital and intangible knowledge capital), natural capital and human capital. A decline in total wealth per capita arising from a decline in human capital due to aging signals the growth path may not be sustainable if that decline is not accompanied by the increase in other form of assets such as physical capital or knowledge capital. On the other hand, an increase in total wealth per capita arising from increases in female labour force participation, increases in education level of women or increases in earnings of women signal a more sustainable growth path of a nation.

Immigrants are often considered important for the growth of human capital and sustainability. By 2036, immigrants are projected to account for over a quarter of the Canadian population (Statistics Canada 2017). Therefore, this paper also provides a gender analysis in human capital among immigrant and native-born populations separately and examines the contribution of immigrants and native-born to human capital by gender.

A recent World Bank study on the Changing Wealth of Nations (Lange et al., 2018) has used the Jorgenson and Fraumeni approach to estimate human capital and comprehensive wealth in 141 countries and to examine gender gap in human capital in those countries. It finds that human capital is the most important component of total wealth in those countries. The average human capital of women is lower than that of men due to lower earnings, lower labour force participation, lower investment in education for women and larger share of unpaid household work by women whose value is not included in the World Bank study. The study concludes that the gender gap represents a significant loss to the output potential.

Fraumeni and Christian (2019) provided a gender analysis on human capital for the United States for the period from 1975 to 2012. The study differs from Lange et al. (2018) as it includes both market and non-market component of human capital such as the value of unpaid household work. Their gender analysis

for the United States concludes that although changes in male human capital occur, the changes in female human capital arising from increases in labor force participation, educational attainment, relative wages, and time use are even greater.

The approach in this paper complements the studies on the contribution of women to Gross Domestic Product (GDP) and current income and production (Dabla-Norris and Kochhar, 2019). They find that closing gender inequality represents a huge potential for future growth and could increase GDP by more than 10% in advanced economies.

To our knowledge, this paper is the first paper in Canada to examine the long-term trend in the gender gap in human capital over the last 50 years. It answers following questions:

- What is the gender gap in human capital in Canada?
- To what extent does the gender gap narrow over time?
- What is the share of women in human capital and the contribution of women to growth in human capital?
- What is the gender gap in human capital among immigrant population and native-born population?
- What is the contribution of immigrants and native-born to human capital growth by gender?

The rest of the paper is organized as follows. Section 2 outlines the methodology for estimating human capital. Section 3 presents the data sources used to estimate human capital stock. Section 4 presents the estimates and main findings of the paper and section 5 concludes.

2. Methodology

The estimation of human capital follows the approach developed by Jorgensen and Fraumeni (1989, 1992) and adopted by UNECE as a preferred approach for estimating human capital stock (UNECE 2016). For this approach, human capital stock of an individual is estimated as the present discounted value of the future earnings of the individual.

Gu and Wong (2010) estimated human capital stock for Canada and found that human capital stock is the most important component of Canada's total wealth that includes produced capital, natural capital and human capital.

The remainder of the section presents the methodology of Jorgenson and Fraumeni (1989, 1992) for estimating human capital stock. The presentation follows closely Gu and Wong (2010).

For Jorgenson and Fraumeni's approach, the stock of human capital of an individual is estimated using the income approach that is often used to value other assets such as natural capital. Human capital of an individual is estimated as the present discounted value of future earnings of the individual. This differs from the cost-based approach that estimates human capital stock as the accumulated value of expenditures related to human capital accumulation that leads to increase in future earnings such as expenditures on education and training, value of student time, and expenditures on improvement of individual health.

This approach treats 'individuals' as entities that embody capital with an earning potential that is derived from market activities, and assigns a 'price' to their lifetime labour using their actual earnings profile. In

general, the value of an asset can be estimated either from the stream of earnings it produces or the costs of producing or buying it. For human capital, the income-based approach is often considered a preferred approach as the expenditure data related to human capital accumulation tend to be incomplete and more difficult to estimate.

To construct lifetime labour incomes and human capital embodied in the Canadian population, this paper will exclude the value of non-market work and focus on human capital embodied in the working-age population, aged 15 to 74. While this aligns with the SNA framework that focuses on market activities, the choice of this paper will under-estimate the relative value of human capital of women as women are more likely to engage in unpaid household work such as the caring of children and elders.

The market lifetime income for all individuals aged 15 to 74 during the remainder of the working life is estimated using cross-sectional data on individuals. The expected incomes in future periods are assumed to equal to the incomes of individuals of the same gender and education, with the age that the individuals will have in the future time period, adjusted for increases in real income. The lifetime incomes can be calculated by a backward recursion, starting with age 74, which is assumed to be the oldest age before retirement. The expected income for a person of a given age is their current labour income plus their expected lifetime income in the next period multiplied by survival probabilities. For example, the present discounted value of lifetime income of 74-year-olds is their current labour income. The lifetime income of 73-year-olds is equal to their current labour income plus the present discounted value of lifetime income of the 74-year-olds, adjusted for increases in real income. Formally, the following equation is used for estimating average human capital per capita for a cohort of individuals with gender (s), age (a), and educational attainment (e):

$$h_{s,a,e} = p^1_{s,a,e} y^1_{s,a,e} + p^2_{s,a,e} y^2_{s,a,e} + (1 - senr_{s,a,e}) sr^{a+1}_{s,a} h_{s,a+1,e} (1+g)/(1+r) + \sum_{m=1}^{M_e} \left(senr_{s,a,e} / M_e \right) sr^{a+m}_{s,a} h_{s,a+m,e+1} (1+g)^m / (1+r)^m \quad (1)$$

where

e = educational attainment levels (1 to 5): 1 = 0 to 13 years of schooling, non-graduate, 2 = completed high school, 3 = some post-secondary education below bachelor's degree, 4 = bachelor's degree, 5 = master's degree or above;

a = ages: 15 to 74;

$h_{s,a,e}$ = average human capital or average present discounted value of lifetime labour income per capita for individuals with, gender (s), age (a) and education level (e);

$p^1_{s,a,e}$ = probability of engaging in paid employment for individuals with gender (s), age (a) and education level (e), defined as the number of paid workers over the population for that cohort;

$y^1_{s,a,e}$ = annual labour compensation of paid workers with gender (s), age (a) and education level (e);

$p^2_{s,a,e}$ = probability of engaging in self-employment for individuals with gender (s),age (*a*) and education level (*e*), defined as the number of self-employed workers over the population for that cohort;

$y^2_{s,a,e}$ = annual labour compensation of self-employed workers with, gender (s), age (*a*) and education level (*e*);

$sr^{a+1}_{s,a}$ = the probability of surviving one more year from age (*a*) for individuals with gender (s);

$senr_{s,a,e}$ = school enrolment rate, which is defined as the proportion of individuals with gender (s),age (*a*) and education level (*e*) who are studying for a higher education level (*e*+1);

M_e = number of years that the individuals with education level (*e*) spend to complete a higher education level (*e*+1).

g = real income growth rate;

r = discount rate.

This formula is then applied to each cohort of individuals at a point in time—assuming that each individual progresses through time using the relative incomes of all succeeding cohorts and the relevant probabilities of moving to different states of education and employment status that are applicable at that point in time.

During schooling years, individuals may pursue further studies to increase their earnings. When individuals are enrolled in schools and pursue further studies, they face two possible earnings streams: one with the current education level (e), and the other with the higher education level (e+1) with a delay because of schooling. Average human capital per capita among a cohort of the individuals is a weighted sum of these two earnings streams, with weights being the probability of school enrolment.

In Equation (1), it is assumed that students enrolled in an education level are evenly distributed across different study years, except for certain young ages. For example, the 22-year-old students with a bachelor's degree studying for a master's degree are assumed to be in their first year.

The equation is estimated separately for immigrants and non-immigrants. This formula requires estimates of the future growth rate of real income. Here it is assumed to equal labour productivity growth in the Canadian business sector, which was about 1.7% per year for our estimation period of 1970 to 2020. Real income growth in the past follows the growth in productivity very closely over long periods of time (Baldwin and Gu, 2007). We will set the real discount rate equal to 5.1%, which is the weighted average of real rates of return to equity and debt (Baldwin and Gu 2007).

To estimate human capital for Canada, the individuals are classified into five education levels: zero to thirteen years of schooling without high school diploma, completed high school, some post-secondary school below bachelor's degree, bachelor's degree and master's degree or above. It is assumed that individuals with some or completed high school take two years to complete some post-secondary education; that individuals with some post-secondary education take two years to complete a bachelor's degree and that individuals with a bachelor's degree take two years to complete a master's degree or above. The grades that younger individuals enrolled in are inferred from their ages.

The total nominal value of human capital is just the sum across all individuals in the population being counted (in our case, 15-74 year olds). The changes may reflect the changes in the volume of human capital or price of human capital. For many purposes, the nominal value of human capital needs to be decomposed into movements in prices or volumes. A volume estimate provides a measure that abstracts from changing prices and can be considered as a measure of human capital in efficiency units.

The decomposition of human capital into the price and volume change has been a major challenge. A number of ways have been proposed to deflate the nominal value of human capital to derive the volume index of human capital. Jorgenson and Fraumeni (1989 and 1992) constructed the volume of human capital using the Tornqvist aggregation method. For that method, the growth rate of the volume index of aggregate human capital stock is calculated as the weighted sum of the growth rates of the number of individuals across different categories of the population (gender, age and education) using their share of the nominal value of human capital stock as weights. This index of human capital volume will increase if the number of individuals increases over time or there are shifts in the composition of population towards those that have large average lifetime earnings such as younger and more educated individuals. Gu and Wong (2010) adopted that deflation method.

This approach assumes that the human capital embodied in individuals with the same demographic characteristics such as age, gender and education is at the same level and does not change over time. Therefore, the changes in the nominal value of human capital of an individual with the same age, gender and education over time reflects the change in the price not the quantity of human capital of that individual. The issue has been debated in the literature on the quality of education and the efficiency unit of human capital. For example, Atkinson (2005) and Diewert (2011) all argued that there is a need to account for the changes of quality of education and human capital and proposed methods used to account for those changes. Bowlus and Robinson (2012) proposed a model-based approach for accounting for these changes in quality of human capital and found that increase in earnings and human capital partly if not mostly reflect an increase in the efficiency unit of human capital.

This paper starts with the assumption that there are changes in the quality or efficiency unit of human capital over time and the changes in earnings over time can be partially attributed to the changes in the quality of human capital. The paper deflates the nominal value of human capital by Consumer Price Index (CPI) to derive human capital in constant dollars. Essentially, the paper assumes that any changes in the earnings and nominal values of human capital of an individual with the same age, gender and education above the changes in CPI reflect the changes in the quantity of human capital. The deflation method is adopted by Wei (2007, 2008) in his estimate of human capital for Australia.

The GDP deflator has also been used to deflate nominal human capital stock in previous studies such as Lange et al, (2018) for their estimates of human capital and total wealth for 141 countries and Gang (2014) in his estimates of human capital in a number of Organisation for Economic Co-operation and Development (OECD) countries.

3. Data Sources

Human capital are estimated using data tables on population counts, paid employment, self-employment, school enrolment, annual labour compensation and annual hours worked for different types of individuals who are cross-classified by 2 sexes, 60 ages (15 to 74), 5 education levels (below high school, high school

graduate, some post-secondary below bachelor's degree, bachelor's degree, and master's degree or above), and immigrants and native-born for a total of 1200 groups of individuals.

The data tables on those different types of populations are derived from the Census of the Population conducted every five years starting with the Census in 1971 to the most recent Census in 2016. The 1976 Census is not used as the microdata for that year is not available. The immigrant status is collected for all Census of the Populations. The data between the census years are derived using the straight line interpolation.

Starting in 2006, the monthly Labour Force Survey (LFS) also collects the immigrant status for individuals. Therefore, for the years from 2006 to 2020, the monthly LFS is used to derive data on different types of individuals. The Census of the Population is used for the years before 2006.

For self-employed, only the data on hours worked and employment are available. Their earnings are not available from the LFS and censuses. The annual earnings of self-employed workers are estimated using the assumption that the hourly earnings of self-employed workers are equal to those of paid workers with the same level of education and experience and immigrant status.

The earnings from the LFS and Census of Population do not capture the full labour compensation to workers as supplementary benefits are not included in the earnings. To ensure the concept of earnings reflect total compensation to the individuals, the data on hours worked and earnings are then benchmarked to total labour compensation and hours worked at the national level from the National Accounts of Statistics Canada.

The classification of education in the LFS and Census has undergone changes over time. There is one change in 1989 in the LFS and one change in the 2006 Census. To ensure the consistency of education level over time, five education levels are used to classify individuals: less than high school, high school graduate, some post-secondary education below bachelor's degree, graduate certificates (master's or doctor's degrees).

The changes in education classification in 2006 Census of the Population resulted in an increase in the number of individuals with some post-secondary education from high school diploma. It caused a break in data for year 2005 and also for years 2001 to 2004 as the data for those years are interpolated using straight line Interpolation between the Censuses from 2001 to 2006. The data from the LFS is used for the years 2006 to 2020 for which the classification of education does not change for that period.[1]

The data on school enrolment are from the LFS and Census. The studies by Jorgenson and Fraumeni (1989, 1992) and World Bank wealth report (Lange et al. 2018) assumed that individuals only attend school before they have reached a certain age (35 years). The paper does not make that distinction. But there is little effect on human capital estimate if that restriction is imposed.

For younger individuals attending primary and secondary education, the grades in which they are enrolled are inferred based on their ages. For older adults, it is assumed that individuals with less than high school will get a high school diploma in 2 years. The individuals with some post-secondary education will obtain a bachelor's degree in 3 years if they are enrolled in school. The individuals with a bachelor's degree will obtain their graduate certificate in 2 years when enrolled in school.

[1] A change in classification was made in the LFS in 1989.

The data on school enrolment makes a distinction between full time and part time education. The estimate of human capital in this paper does not make that distinction and assumes that all individuals attend school full time. This is a reasonable approximation for primary and secondary education. But it may introduce a biased estimate of human capital for individuals attending post-secondary education. To account for the impact of part-time studies, information is required on the number of years individuals will need to enrol in school part time in order to move on to the next education level. That data is currently not available, but is required to provide an accurate estimate of human capital and to examine the full extent of bias from the assumption adopted in this paper on school attendance.

Finally, the data on survival rates are obtained from Life Tables, Canada, Provinces and Territories published by Statistics Canada. While education tends to increase survival rates, no such data exist for Canada. We assume the survival rates do not vary across education levels and only depend on age and gender only.

4. Main findings

The estimates of human capital in the paper covers the period 1970 to 2020. But the main discussion will cover the period 1970 to 2019. The estimates for 2020 will be discussed in the last part of this section to examine the impact of Covid-19 on human capital and examine which segment of population is most affected by Covid-19 in in terms of annual earnings and human capital.

Long term trend in gender gap in average human capital per capita

Figure 1 shows the ratio of average human capital of the female population in 2012 dollars to that of the male population over the period 1970 to 2020. There has been significant progress made closing the gender gap in human capital since 1970. Average human capital per capita among the female population was about 30% that of the male population in 1970. By 2020, average human capital per capita of women was 70% of the average human capital of men.

The large decline in the gender gap in human capital over that period is due to the increase in labour force participation of women in that period, the increase in the education level of women relative to that of men, and the decline in earning gaps between male and female workers (Gu and Wong, 2010).

The decline in the gender gap in human capital was much faster in the period before 1995. The narrowing of the gender gap slowed after 1995. From 1970 to 1995, the ratio of female to male human capital per capita increased from 30% to 62%. That ratio rose from 62% to 70% from 1995 to 2020.

The size of the gender gap in average human capital per capita by types of individuals in 2019

Table 1 presents average lifetime labour income or human capital per capita in 2012 dollars by types of individuals in the working-age population in 2019.

In 2019, average human capital per capita among the population aged 15 to 74 (which will be called working age population) was 780,000 dollars in 2012 prices. There are large differences in human capital across the types of population.

The average future lifetime income or human capital tend to increase with education level. This is due to the combined effect of an increase in earnings from education that is only partially reduced by a decline

in the working life from the increase in the time those individuals spend in schooling. For example, an individual with less than high school can expect a lifetime income of 618,000 dollars in 2019, which is about 65% of the lifetime earnings that an individual with a bachelor's degree can expect to have (995,000 dollars).

Human capital of younger people (aged 15 to 34) was higher than that of older people because of the longer working life for young people. A young individual (aged 15 to 34) in 2019 can expect to have a lifetime income of 1,321,000 dollars in 2012 prices. The prime-age individuals (aged 35 to 54) in 2019 can expect to have lifetime income of 825,000 dollars during their remaining working life.

There was a 30% gap in human capital or average lifetime income between women and men in 2019. That gap reflects the relatively lower earnings and lower labour market attachments for women. In 2019, the average human capital embodied in women was 642,000 dollars in 2012 prices which is about 30% lower than that of men in that year (919,000 dollars).

Human capital per capita for immigrants was lower than the average human capital for the native-born population. In 2019, immigrants could expect to have a lifetime income of 697,000 dollars during their remaining working life, which is about 15% lower than the human capital of native-born individuals in 2019. This gap occurred despite the fact that the immigrants tend to be more educated and younger than the native born population (Grossman, Feng and Picott, 2021).

This gender gap in human capital was especially large for high school graduates and older women (55 or older). Human capital embodied in women that are older or with a high school diploma was only about 55% of human capital in men with the same age and education level.

The gender gap in human capital was the smallest for those women who successfully obtained graduate degrees. For those women, their human capital was about 15% lower than men with a graduate degree.

The gender gap in human capital was also lower for younger women than for older women. Younger women in 2019 could expect to have a future lifetime income that was 24% lower than that of younger men. This gap is lower than the overall 30% human capital gap between men and women. The lower gender gap in human capital in the younger population may reflect an increase in education and an increase in relative earnings among younger women.

The gender gap in human capital was higher among the immigrant population than among the native-born population. Human capital among immigrant women was 35% lower than immigrant men in 2019. In contrast, human capital of native-born women was about 28% lower than native born men. The relatively larger gender gap in human capital for immigrants may reflect that fact that a higher proportion of women immigrants are Spouse and Dependent or Family class and lower proportion as Economic class principal applicant that subject to the point system (Lu and Ng, 2019).

Changes in gender gap in average human capital by types of individuals

For the period 1970 to 2019, human capital per capita among the working age population increased at 0.71% per year (Table 2). This overall change in human capital reflects the combined effects of changes in

the demographic composition of the population and the changes in human capital per capita within the particular group of the population.

To partially control for demographic changes, table 2 also presents the changes in human capital by age, education and immigrant status for males and females separately. It should be noted that those estimates only partially control for the composition effects. For example, relative changes in human capital per capita by education level includes the effect of the differences in the age composition of population between those two education levels.

For the period 1970 to 2019, human capital per capita increased in all age groups. But the increase was the highest among the prime age population, followed by the older population. The increase was the slowest among the younger population despite the overall increase in the education level of the younger population. For the period 1970 to 2019, human capital per capita increased at 1.52% for the prime age population, at 1.30% for older population, and 1.07 for the younger population.

Average human capital per capita increased more for the population with less education than those with more education for the period 1970 to 2020. The slower growth in human capital among the population with more education could be due to the increase in the average age of people with more education that was faster than the increase in the average age of the population with less education.

Human capital also increased for both immigrant and native-born populations over the last half century. The growth was similar between those two groups: 0.77% for immigrants, 0.73% for native-born. This occurred despite the fact that immigrants tend to be younger and more educated compared with the native-born over time.

For the period 1970 to 2019, human capital per capital increased much faster for the female than for the male population. Over that period, average human capital rose by 1.74% per year for women while it only increased by 0.10% for men.

The faster growth of human capital per capita for women compared with that of men occurred for all age groups, for all education levels and for both immigrants and native born. But human capital for prime age women increased fastest compared with the prime age male population.

As a result of faster growth in human capital for women for each group compared with that of men, the gender gap in human capital declined for all age groups, education levels and for both immigrants and native-born.

Table 3 presents the growth of human capital per capita in two periods - 1970 to 1995 and 1995 to 2019. The relative growth in human capital of women compared with that of men was faster before 1995 for all demographic groups. After 1995, the growth in human capital for women was still higher than that of men, but the difference in the growth rates was smaller.

Contribution to the growth in aggregate human capital stock by gender and types

This section examines the contributions of different groups of the Canadian population to overall growth in human capital stock in constant dollars. The contribution of a group of population is estimated as the growth in human capital stock in that group times the average share of the group in nominal human capital stock.

Table 4 presents the contribution for the period 1970 to 2019. Over the period, total human capital stock increased at 1.81% per year. The male and female population each accounted for about half of that growth (0.90 for male and 0.91 for female). The contribution of the female population to growth in human capital was much higher than their share of human capital in that period (33%). That is because human capital of women increased much faster than that of men.

Immigrants contributed about 0.51 percentage points or 28% of the 1.81 percent growth in human capital for the period 1970 to 2019. Their contribution to growth in human capital is disproportionate and is more than their share of human capital which was about 22% over that period. Of the 0.51 percentage point contribution of immigrants to human capital growth in the period 1970 to 2019, 0.27 percentage points or 53% is from immigrant men, and the remainder 0.25 percentage points is from immigrant women.

Tables 5 and 6 present the contribution to aggregate human capital growth by demographic groups for two periods - 1970 to 1995 and 1995 to 2019. Women accounted for more than half of the growth in human capital before 1995 due to the dramatic increase in labour force participation of women in that period. After 1995, women accounted for less than half of the growth in human capital. Women accounted for about 58% of the growth in human capital before 1995, larger than their share of human capital in that period (33%). For the period 1995 to 2020 women accounted for 45% of the growth in human capital, which is larger than their share of human capital in that period (40%).

Both immigrant women and immigrant men increased their share of contribution to human capital growth after 1995. In the period after 1995, immigrants accounted for about 40% of growth in human capital in the period. That is much greater than their share of human capital (less than 20%) in that period. For the period before 1995, immigrants accounted for about 18% of the growth in human capital and 14% of human capital. Of the contribution of immigrants to human capital growth in the period 1995 to 2019, 56% is from immigrant men, and the remainder 44% is from immigrant women

The Impact of COVID-19 on gender gap in average human capital

Table 7 presents the percent change in average human capital by types of the population in 2020 to examine the impact of COVID-19 on annual earnings and human capital by types of population. Those estimates should be considered preliminary as the data on hours worked and labour compensation are subject to revision.

Hours worked showed a large decline in 2020, while labour compensation declined only slightly due to wage subsidies and other support programs for workers by the government. In 2020, the data from the national accounts of Statistics Canada show that hours worked declined by 12.5% in 2020 while labour compensation declined only by 1.4%. As human capital is based on labour compensation, COVID-19 is expected to have a small effect on the value of human capital for the entire working age population. That is what is shown in Table 7.

While the overall decline in human capital is small in 2020, the decline is a little bit larger for women and immigrant populations. The decline was especially large for older women and for both men and women with a high school diploma and with some post-secondary education below a bachelor's degree.

The extent to which those changes are transitional or permanent depends on industry adjustment post pandemic and the transition of the workers associated with those structural changes. If the individuals

impacted are able to make a successful transition into a post-pandemic economy, the current decline in earnings and human capital will be temporary.

5. Conclusions

Human capital contributes to current wellbeing through its effect on economic growth and to future wellbeing through its effect on comprehensive wealth. This paper provides a gendered analysis of human capital and examines the contribution of women, and other population groups such as immigrants, to the level and growth of human capital in Canada. Human capital is estimated using the income–based approach of Jorgenson and Fraumeni (1989 and 1992) and it is calculated as the present discount value of future market income of an individual over its working life.

Human capital is the most important component of total wealth which is often used to tell if the growth is sustainable where total wealth is defined as a sum of produced capital (both tangible physical capital and intangible knowledge capital), natural capital and human capital. An increase in total wealth per capita arising from increases in female labour force participation, increases in education level of women or increases in earnings of women signal a more sustainable growth path of a nation. On The other hand, a decline in total wealth per capita arising from a decline in human capital due to aging signals the growth path may not be sustainable if that decline is not accompanied by the increase in other form of assets such as physical capital or knowledge capital.

The average human capital per capita of women is found to be lower than that of men. But this gender gap in human capital is getting smaller over time as a result of the relative faster growth of human capital for women arising from increases in labour force participation of women, and relatively faster increase in the education level and earnings of women compared with that of men. In 1970, there was a large gap in human capital between women and men when the average human capital of women was only 35% of that of men. This large gap reflects relatively lower labour force participation, lower hours worked and lower hourly earnings of women. By 2020, the average human capital of women reached 70% of that of men due to increases in labour force participation of women, relatively higher growth in hourly earnings and hours worked.

The gender gap in human capital was larger for immigrant women than for native-born women. In 1970, average human capital for immigrant women was about 31% of immigrant men while average human capital of native-born women was about 36% of native-born men. Over time, this gender gap narrowed for both immigrant and native-born women, at a more or less similar pace. By 2020, average human capital of immigrant women was about 66% of immigrant men, while the average human capital of native-born women was about 71% of the average human capital of native born men.

There were gender gaps in average human capital between men and women for all age groups and education levels. Since 1970, the gaps narrowed significantly for all age groups and all education levels, especially prime age women.

As result of rapid growth in human capital of women, the share of total human capital accounted for by women rose from 30% in 1970 to 41% in 2020. The increase in that share was much faster before the mid-1990s than after the mid-1990s. For the period 1970 to 1995, the share of human capital from women rose from 30% to 39%. For the period from 1995 to 2020, the share increased from 39% to 41%.

While the female share of human capital is lower than the male share of human capital for the period 1970 to 2020, women accounted for about half of the growth in human capital. The contribution to aggregate growth in human capital from women declined slightly after the mid-1990s as a result of a decline in the relative growth in human capital for women in that period. Women accounted for about 58% of the growth in human capital before 1995, much larger than their share of human capital in that period (33%). For the period 1995 to 2020 women accounted for 45% of the growth in human capital, which is larger than their share of human capital in that period (40%).

Both immigrant women and immigrant men increased their share of contribution to human capital growth after 1995. In the period after 1995, immigrants accounted for about 40% of growth in human capital in the period. That is much greater than their share of human capital (less than 20%) in that period. For the period before 1995, immigrants accounted for about 18% of the growth in human capital and 14% of human capital.

The estimate of human capital in this paper includes the market component of human capital but excludes the non-market component of human capital. This is done to be more in line with the framework of the national accounts that focuses on market transactions. In addition, there are substantial data and methodology challenges that need to be overcome to have appropriate estimates of the non-market component of human capital. As women are more likely to engage in non-market activities such as the care of children and elders, the approach in this paper will under-estimate more of the human capital for women than that of human capital of men. This suggests that the relative human capital of women compared with that of men will be higher that the estimate in this paper.

This gender gap presents potential for future growth. If the gender gap in human capital was to be removed, there would be significant increases in both human capital and total wealth and future GDP growth. The policies that increase labour force participation of women, and the earnings and hours worked of women will also increase the human capital of women. A comprehensive assessment of policies for overall wellbeing and its sustainability require an estimate of human capital that includes both the market component and the non-market and unpaid household component of human capital. The estimation of the nonmarket component of human capital in women remains an area of important future analysis.

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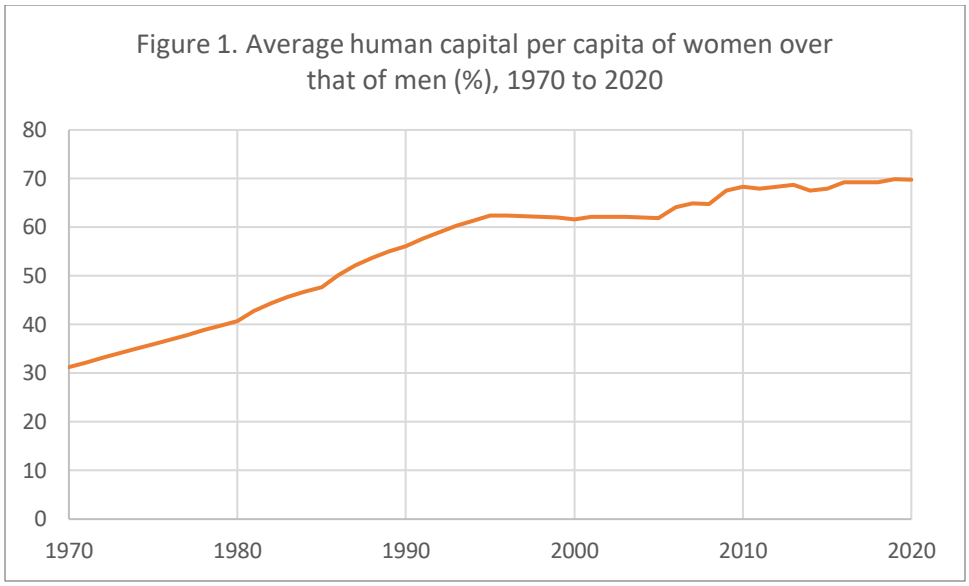
Figure 1. Average human capital per capita of women over that of men (%), 1970 to 2020
80
70
60
50
40
30
20
10
0
1970
1980
1990
2000
2010
2020

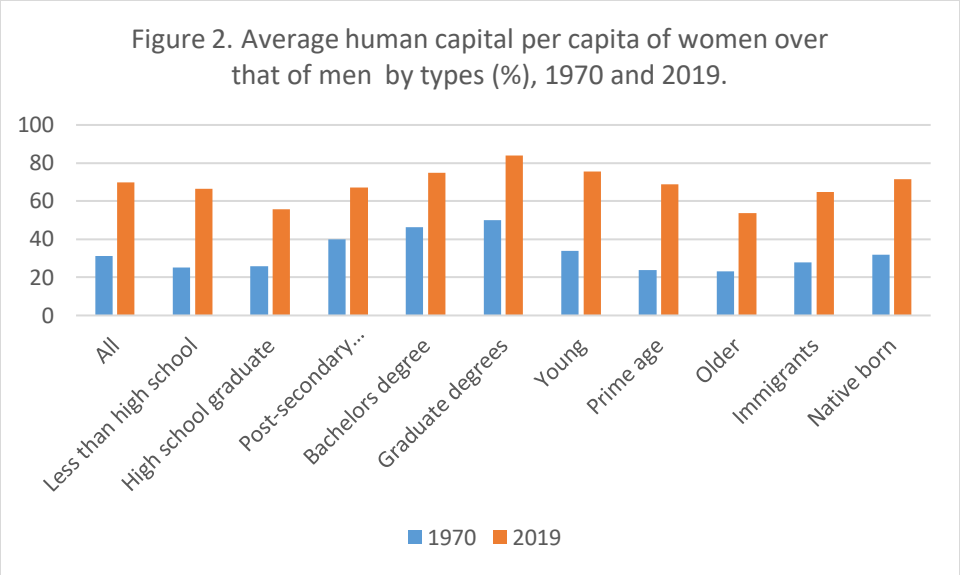
Figure 2. Average human capital per capita of women over that of men by types (%), 1970 and 2019.
100
80
60
40
20
0
All
Less than high school
High school graduate
Post-secondary...
Bachelors degree
Graduate degrees
Young
Prime age
Older
Immigrants
Native born
1970
2019

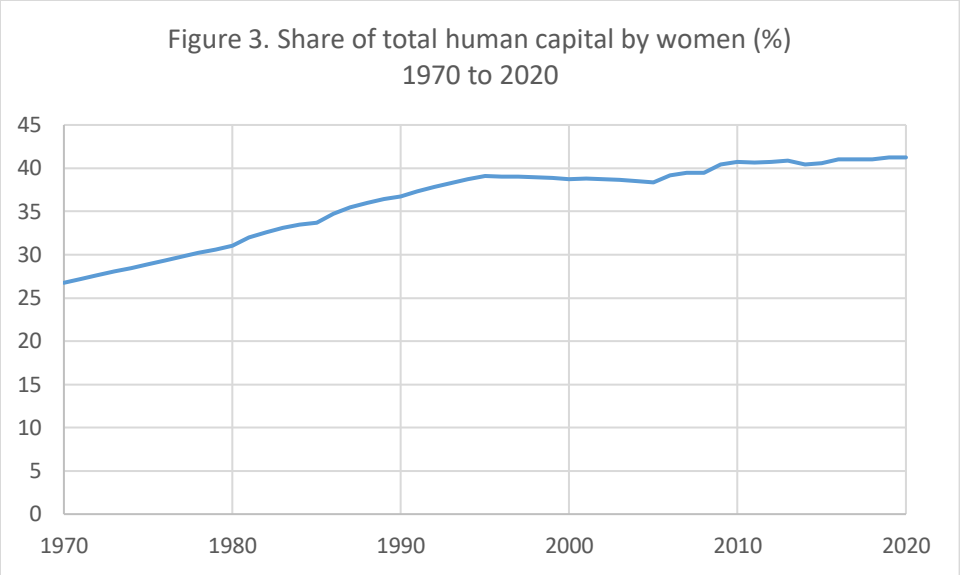
Figure 3. Share of total human capital by women (%)
1970 to 2020
45
40
35
30
25
20
15
10
5
0
1970
1980
1990
2000
2010
2020

Table 1. Average human capital per capita in 2012 dollars in thousands, 2019

	All	Male	Female	Ratio of female to male human capital
All	780	919	642	0.70
Less than high school	618	731	485	0.66
High school graduate	631	801	447	0.56
Post-secondary below BA	776	929	623	0.67
Bachelor's degree	955	1,107	830	0.75
Master's degree or above	998	1,088	912	0.84
Young, 15 to 34	1,321	1,500	1,134	0.76
Prime age, 35 to 54	825	980	673	0.69
Older, 55 or above	145	191	102	0.54
Immigrants	697	853	552	0.65
Native born	808	940	674	0.72

Table 2. Average annual growth in human capital per capita in constant dollars (%), 1970 to 2019

	All	Male	Female	Difference between female and male
All	0.71	0.10	1.74	1.64
Less than high school	0.78	0.03	2.02	1.99
High school graduate	0.37	-0.15	1.42	1.57
Post-secondary below BA	0.05	-0.37	0.68	1.05
Bachelors degree	-0.02	-0.20	0.79	0.98
Graduate degrees	-0.42	-0.44	0.62	1.05
Young, 15 to 34	1.07	0.44	2.07	1.63
Prime age, 35 to 54	1.52	0.79	2.96	2.17
Older, 55 or above	1.30	0.74	2.45	1.71
Immigrants	0.77	0.22	1.95	1.73
Native born	0.73	0.09	1.76	1.66

Table 3. Average annual growth in human capital per capita in constant dollars (%), 1970 to 1995 and 1995 to 2019

	All	Male	Female	Difference between female and male
		1970 to 1995		
All	0.52	-0.48	2.28	2.76
Less than high school	-0.47	-1.37	1.14	2.51
High school graduate	-0.15	-0.73	1.63	2.36
Post-secondary below BA	0.00	-0.83	1.26	2.09
Bachelors degree	-0.35	-0.81	1.20	2.01
Graduate degrees	-1.06	-1.16	0.86	2.03
Young, 15 to 34	0.75	-0.31	2.51	2.82
Prime age, 35 to 54	1.41	0.32	3.65	3.32
Older, 55 or above	-1.01	-1.56	0.24	1.81
Immigrants	0.31	-0.62	2.37	2.99
Native born	0.58	-0.44	2.31	2.75
		1995 to 2019		
All	0.63	0.49	0.83	0.33
Less than high school	1.47	1.05	2.08	1.02
High school graduate	0.64	0.32	0.84	0.53
Post-secondary below BA	0.08	0.07	0.05	-0.02
Bachelors degree	0.23	0.31	0.25	-0.06
Graduate degrees	0.17	0.22	0.25	0.03
Young, 15 to 34	0.99	0.86	1.13	0.27
Prime age, 35 to 54	1.16	0.90	1.58	0.68
Older, 55 or above	2.62	2.22	3.36	1.14
Immigrants	0.88	0.77	1.07	0.30
Native born	0.62	0.46	0.83	0.37

Table 4. Average share of human capital and contributions to human capital growth by demographic groups, 1970 to 2019

	All	Male	Female
Share			
All	1.00	0.66	0.34
Less than high school	0.29	0.22	0.08
High school graduate	0.09	0.06	0.03
Post-secondary below BA	0.41	0.26	0.15
Bachelors degree	0.14	0.08	0.06
Graduate degrees	0.07	0.04	0.03
Young, 15 to 34	0.67	0.44	0.23
Prime age, 35 to 54	0.29	0.19	0.10
Older, 55 or above	0.04	0.03	0.01
Immigrants	0.18	0.12	0.06
Native born	0.82	0.54	0.28
Contribution (pps per year)			
All	1.81	0.90	0.91
Less than high school	-0.39	-0.37	-0.04
High school graduate	0.58	0.37	0.22
Post-secondary below BA	0.68	0.37	0.31
Bachelors degree	0.67	0.32	0.38
Graduate degrees	0.36	0.17	0.23
Young, 15 to 34	0.82	0.35	0.46
Prime age, 35 to 54	0.84	0.45	0.42
Older, 55 or above	0.15	0.09	0.06
Immigrants	0.51	0.27	0.25
Native born	1.30	0.62	0.67

Table 5. Average share of human capital and contributions to human capital growth by demographic groups, 1970 to 1995

	All	Male	Female
Share			
All	1.00	0.67	0.33
Less than high school	0.33	0.25	0.09
High school graduate	0.05	0.03	0.02
Post-secondary below BA	0.49	0.30	0.18
Bachelors degree	0.09	0.06	0.03
Graduate degrees	0.04	0.03	0.01
Young, 15 to 34	0.71	0.47	0.24
Prime age, 35 to 54	0.27	0.19	0.08
Older, 55 or above	0.02	0.02	0.01
Immigrants	0.14	0.10	0.04
Native born	0.86	0.57	0.28
Contribution (pps. per year)			
All	1.93	0.80	1.13
Less than high school	-0.64	-0.59	-0.06
High school graduate	0.46	0.27	0.19
Post-secondary below BA	1.43	0.71	0.73
Bachelors degree	0.48	0.23	0.26
Graduate degrees	0.21	0.12	0.11
Young, 15 to 34	0.93	0.23	0.69
Prime age, 35 to 54	0.99	0.55	0.45
Older, 55 or above	0.02	0.01	0.01
Immigrants	0.34	0.15	0.19
Native born	1.59	0.65	0.94

Table 6. Average share of human capital and contributions to human capital growth by demographic groups, 1995 to 2019

	All	Male	Female
Share			
All	1.00	0.60	0.40
Less than high school	0.14	0.10	0.05
High school graduate	0.12	0.08	0.04
Post-secondary below BA	0.47	0.28	0.19
Bachelors degree	0.18	0.10	0.08
Graduate degrees	0.08	0.05	0.04
Young, 15 to 34	0.62	0.36	0.26
Prime age, 35 to 54	0.34	0.21	0.13
Older, 55 or above	0.04	0.03	0.01
Immigrants	0.19	0.11	0.08
Native born	0.81	0.48	0.33
Contribution (pps per year)			
All	1.68	0.92	0.77
Less than high school	-0.10	-0.09	-0.01
High school graduate	0.52	0.35	0.17
Post-secondary below BA	0.14	0.12	0.03
Bachelors degree	0.74	0.36	0.38
Graduate degrees	0.40	0.19	0.22
Young, 15 to 34	0.70	0.40	0.31
Prime age, 35 to 54	0.75	0.37	0.37
Older, 55 or above	0.25	0.15	0.10
Immigrants	0.63	0.35	0.28
Native born	1.06	0.57	0.49

Table 7. The changes in average human capital per capita in constant dollars from 2019 to 2020

	All	Male	Female
All	-1.30	-1.26	-1.33
Less than high school	-1.54	-1.84	-1.16
High school graduate	-2.74	-2.87	-2.92
Post-secondary below BA	-3.09	-2.92	-3.41
Bachelors degree	-1.25	-0.91	-1.47
Graduate degrees	2.83	4.28	1.20
Young, 15 to 34	-0.56	-0.69	-0.40
Prime age, 35 to 54	-0.25	-0.53	0.12
Older, 55 or above	-5.08	-3.21	-8.14
Immigrants	-1.96	-2.64	-1.46
Native born	-1.04	-0.77	-1.27