Gender Dimensions of Human Capital Growth in Canada

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Abstract

This paper estimates the growth rates of the stock of human capital and its two components - the labour input and the level of educational attainment - for Canada over the period from 1976 to 2000, separately for males and females, to determine the impact of gender differences. Three measures are used: the first is based on the population in the age range 15-64, the second on the labor force, and the third on employment. The results show that gender made little difference in the growth rate of the population based stock of human capital because the gender differences in the growth rates of the labour input and educational attainment were small. Gender differences accounted for over one-quarter of the growth rate of the human capital stock when measured with respect to the labour force or employment. This effect was largely due to the rapid increase in the participation rate of females. The gender effect was not due to higher rates of human capital accumulation by females, but by their increasing willingness to make the human capital they acquired available for market activities.

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I. INTRODUCTION

The increasing importance of human capital as a determinant of economic growth has stimulated interest in its measurement. Two approaches to the measurement of human capital may be identified. One approach focuses on the total stock of human capital in a given year and over a selected period of time. Examples of this approach are Jorgenson and Fraumeni (1989), Kendrick (1976), Koman and Marin (1997), Kyriacou(1991), Laroche and Merette (2000), Mulligan and Sala-i-Martin (1995, 1997) and Ruggeri and He (2003). The other approach tries to capture the different stages in the dynamic process that leads to the production and use of human capital. It does so by selecting relevant sets of human capital indicators for various stages of human capital development. This approach has been proposed by Ruggeri and Yu (2001) who identified four stages of human capital: potential, acquisition, availability, and effectiveness.

The first approach is used in this report since the focus is on the relative contribution of males and females to the growth of the human capital stock in Canada from 1976 to 2000. A defining characteristic of human capital is its inherent embodiment in human beings. Employers cannot purchase human capital separately. If they want to use the services of human capital, they must hire the person into which it is embodied. This means that there is only a rental market for human capital, whereas for physical capital there are both rental and (capital) purchase markets. It also means that the fundamental building block of the stock of human capital is the population of a

certain age. We call this the labour input (L). Each unit of this labour input embodies a specific level of skills, which were acquired over a long period of time through formal and informal education involving both voluntary and involuntary actions. These skill levels represent human capital intensity (h) because h is a measure of the stock of human capital per unit of labour input. We call h simply human capital and we measure it by the level of educational attainment of the selected population. When we combine each unit of the labour input with the associated level of education, we obtain the stock of human capital $H = hL$.

Three bases were used to develop the above three measures (H, h, L), by age group, educational attainment and gender, because each base serves a separate purpose. The broad base includes the population in the age group from 15 to 64 years and sets the limits to the labour input that serves as the foundation for calculating the stock of human capital in a given year. The second base includes only those people who are either employed or are actively seeking gainful employment, namely, the labour force. This base helps measure the stock of human capital that is available for market activity. A narrower base includes only those who are employed in any given period. This base is the most appropriate one for analysing the contribution of the stock of human capital to economic growth.

This paper addresses two questions: (a) did the labour input, human capital, and the stock of human capital grow at different rates for males and females during the 1976-2000 period, and (b) how large was the contribution of gender differences to the growth rate of the human capital stock in Canada?

The results indicate that the stock of human capital in Canada increased at an average annual rate of 1.84%, when measured with respect to the population 15-64, and by 2.32% and 2.33 % per year when measured with respect to the labour force and employment for the same age range, respectively. For the labour force based measure, the largest single contribution to the growth of the human capital stock (50%) was made by the labour input (net of gender differences). The second largest contribution (27%) was made by gender difference, primarily a much faster growth of the labour force participation rate and a slightly higher rate of human capital acquisition by females. The smallest contribution (23%) was made by increases in educational attainment.

Canada may not be able to count on the continuation of the contribution of gender and population growth to the future growth of the human capital stock for two reasons. First, population projections by Statistics Canada indicate a substantial deceleration in population growth over the next twenty-five years. Second, the participation rate of females has converged a long way towards that of males and we cannot expect major increases in the participation rate of females in the future. These two factors can potentially cut in half the growth of the human capital stock in Canada over the next twenty-five years.

This paper is organized as follows: Section II describes the methodology and the data used to estimate the growth of the stock of human capital in Canada, by gender, during the 1976-2000 period; Section III presents the results; Section IV calculates the contribution of various factors to the growth of the stock of human capital, and Section V provides some concluding remarks.

II. METHODOLOGY AND DATA

A. Methodology

The stock of human capital may be viewed from the perspective of those who acquire it and those who purchase its services. The first perspective focuses on the supply side while the second one generates the demand side. Human capital may be acquired as a consumption item to raise one's enjoyment of life or as an investment in one's earning capacity. The extent to which this potential increase in earning capacity is realized depends on the demand for human capital by employers who require its services in production. When we incorporate the decisions of both groups, we can identify three components of the stock of human capital: (a) the labour input, (b) the intensity of human capital, and (c) the quality of human capital.

The first component is the fundamental building block of the stock of human capital, namely, the human beings that have the potential, opportunity, and willingness to acquire it. This component is called labour input (L) and represents what Barro, Mankiw and Sala-i-Martin (1995) call "raw labour". The second component reflects the skills acquired in a variety of ways by each unit of L. We call this component the intensity of human capital (h) or simply human capital. Since it is impossible to measure the level of the different skills embodied in each person, their measurement is usually approximated by the level of formal education and is measured by the years of schooling completed.

Researchers have recognized that the quality of a given level of educational attainment may not be uniform for a variety of reasons. First, the skills acquired in the educational process depend to a certain extent on performance. For example, one would expect that the quality of education acquired in completing a four-year university degree will be higher for a graduate with an A average than for a graduate with a C average. This difference in quality is formally recognized in the granting of scholarships and in the admission policies for graduate studies. Second, standards may not be uniform among various educational institutions. This quality difference among educational institutions is recognized, for example, in the ranking of universities and in the hiring practices of prospective employers. The labour market also recognizes quality differences among given levels of educational attainment in various fields of learning by offering different levels of remuneration to people with the same degree, such as a bachelor's degree, but in different fields. For example, a recent graduate with a bachelor of computer science and a B grade average may receive offers of a higher salary than a history graduate with an A average.

All these quality differences should be reflected in the wages that people with different intensities and quality of human capital can command in the labour market. Therefore, economists measure these quality differentials in terms of wage differentials on the assumption that workers are paid the value of their marginal product[1]. The term quality of human capital (h_q) is reserved for the educational attainment adjusted for the wage differentials.

We now have the building blocks for the calculation of the stock of human capital. The intensity-based stock of human capital, or simply stock of human capital H, is derived as the product of L and h. The quality-based stock of human capital (H_q) is derived as the product of L and h_q. This approach to the calculation of the stock of human capital is similar to that of Ho and Jorgenson (1999), except for two variations. First, they use labour force terminology, namely, hours for the labour input, quality of the labour input for h_q, and volume of labour input for H_q, while we use human capital terminology to emphasize the parallel with physical capital. Second, we identify three components of the stock of human capital, namely, L, h and h_q, while they focus directly on L and h_q. Their quality index incorporates both educational attainment and the associated earning differentials because their basis is the labour input. Since our focus is on human capital, which is already measured in terms of educational attainment, the quality component refers only to the earning differentials arising from different levels of educational attainment.

In our view, the distinction between intensity-based and quality-based measures of human capital is important, especially in the case of comparative growth studies involving a number of countries or regions within a country. For example, the intensity-based measure of the stock of human capital related to the labour force indicates the supply of labour adjusted for skill levels, the same measure based on employment provides information on the extent to which the stock of human capital is utilized and the quality-based measure related to employment provides information on the effectiveness in the use of human capital, represented by the remuneration it earns.

In this paper, our measurement is confined to L, h and H because the incorporation of earning

differentials raises a variety of issues that require separate analysis, which will be undertaken in future research. Our approach to the measurement of L and h, which in combination determine the value of H, is discussed below.

Labour input. In deciding how to measure L, two issues must be addressed: (a) selecting the relevant age groups, and (b) deciding whether to use a broad measure, such as the population in the selected age groups, or a narrow measure, such as the number of employed people. Traditionally, the age range covered in studies that measure human capital includes the years from 15 to 64[2]. The beginning year is based on the eligibility for participating in the labour force while the end year represents the age when people generally retire from gainful employment. In this paper we also used the traditional age range 15-64. We divided this age range into four age groups: 15-24,25-44,45-54 and 55-64.

For each age group, and by gender, we used three separate measures of L. The first is a broad measure and includes the population of working age in the age range 15-64. This broad measure of L, therefore, excludes the population in the above age range that is institutionalized (in hospitals or penal institutions) in accordance with the labour force statistics that are used in our calculations. It identifies the population in the selected age range that is capable of engaging in productive activity, market and non-market. The second measure is the labour force in the same age range and identifies the portion of the working age population that is available for market activity. The third measure includes only the population 15-64 that is employed. This is the most appropriate measure for calculating the contribution of human capital to economic growth.

The total amount of L can be derived by aggregating across age groups or across educational levels.

Since our analysis focuses on the measurement of human capital, it is more meaningful for analytical purposes to use the latter aggregation. In this case, L can be expressed as:

$$L = \sum_{s} L_s = \sum_{s} \rho_s L \tag{1}$$

where L_s is the number of people with s years of education, $\rho_s = L_s/L$, and L denotes the population, labour force or employment in the age range 15-64. Equation (1) shows that the labour input is simply the sum of people with different levels of education, where each person is assigned equal weight regardless of his/her level of education.

Human Capital. We measure the intensity of human capital (or simply human capital) by the average years of schooling completed by the population, labour force or employment in the age range 15 to 64 in a manner similar to other studies[3]. We identify four levels of education: s_1 represents less than high school graduation, s_2 = high school graduation, s_3 = some post-secondary education and s_4= university degree. Each level of education is translated into years of schooling according to the following procedure: those who did not complete high school have 9 years of education; persons with a high school graduation certificate have 12 years of education; persons with some secondary school education have 14 years of education (two years of college); to those with a university degree, we assigned 18 years of education - as in Koman and Marin (1999) - to account for both

undergraduate and graduate degrees. To each level of educational attainment corresponds a proportion of the labour input $\rho_s = L_s/L$. Accordingly, human capital h, measured by the average years of schooling of the labour input, can be expressed as:

$$h = \sum_s s\,\rho_s \qquad (2)$$

where s is the average years of schooling associated with each educational level.

Expression (2) shows that h is the weighted average of the years of schooling by educational level, with the weights being the shares ρ_s (population, labour force, or employment). In our calculations, as an example, the value of h for 2000 for the population based measure in the case of males was calculated as

$$h = s_1 L s_1/L + s_2 L\, s_2/L + s_3 L\, s_3/L + s_4 L\, s_4/L$$

$$= 9\,(.2457) + 12\,(.1956) + 14\,(.3886) + 18\,(.1701) = 13.06 \qquad (3)$$

Stock of Human Capital. The labour input and the human capital it embodies may be separated for analytical purposes only. In the labour market, employers cannot acquire the services of human capital without hiring the person that embodies the human capital. From a labour market's perspective, the most meaningful measure is the stock of human capital (H), which is derived as the product of h and L or as the sum of this product for each age group by gender. As the outcome of a product of two factors, the value of H measures the total number of years of schooling of the

working-age population, labour force or employment. In the economic sense, however, it represents the combination of a number of persons and the skills they embody. This distinction will become clearer when, in future research, the market value and the social value of human capital are evaluated. Having developed the time series for L, h and H for the population of working age, the labour force and employment, by gender and by selected age group, we can calculate (a) the growth rates of L, h and H over the period from 1976 to 2000, (b) the relative contribution of L and h to the growth rate of H, and (c) the contribution of gender differences to the growth of H.

The Growth of the Human Capital Stock. Since the stock of human capital is measured as the product of the labour input L and the human capital it embodies, the growth rate of H can be calculated as the sum of the growth rates of its components (see Ho and Jorgenson (1999)). In this paper we use three different measures of L, therefore, there are different components of the growth rate of H associated with the labour input. There are also three different levels of the average educational attainment as the relative shares of each of the four educational groups is likely to differ for each measure of L.

When we use the population of working age in the age group 15-64 as labour input (L_p) and take the logarithm of the three variables, we can write:

$$ln\, H_p = ln\, L_p + ln\, h_p \qquad (4)$$

and the growth rate of the population-based stock of human capital (H_p) can be derived as the sum

of the growth rates of the working age population (L_p) and its educational attainment (h_p), i.e.,

$$\Delta ln\, H_p = \Delta ln\, L_p + \Delta ln\, h_p \qquad (5)$$

where Δ represents the change between periods, in our case one year.

When the labour input is measured with respect to the labour force (L_{lf}), expression (5) is transformed into:

$$\Delta ln\, H_{lf} = \Delta ln\, L_p + \Delta ln\, L_{lf}/L_p + \Delta ln\, h_{lf} \qquad (6)$$

where L_{lf}/L_p is the labour force participation rate (PR), and the growth rate of H_{lf} equals the sum of the growth rates of the working-age population, the participation rate and the average educational attainment of the labour force.

Finally, when the labour input is measured with respect to employment, expression (5) becomes:

$$\Delta Ln\, H_e = \Delta Ln\, L_p + \Delta Ln\, L_{lf}/L_p + \Delta Ln\, L_e/L_{lf} + \Delta Ln\, h_e \qquad (7)$$

where L_e/L_{lf} is the employment rate (ER), and the growth rate of H_e equals the sum of the growth rates of the working-age population, the participation rate, the employment rate, and the average educational attainment of the working population.

The Gender Effect. We calculate the gender effect on the growth of the stock of human capital by asking the following question: what would have been the growth rate of H if the growth rate of the female portion of each component, say the population-based labour input, or any combination of components had been equal to that of males? This question is answered by comparing the actual growth rate of H with that under the counterfactual associated with the absence of gender differences[4]. When the labour input is measured with respect to the working-age population, the counterfactual level of the stock of human capital, expressed in logarithms, can be written as:

$$ln\, H^{*}_{p} = ln\, L^{*}_{p} + ln\, h^{*}_{p} \qquad (8)$$

where the superscript * identifies counterfactual values. Parallel counterfactual can be derived for the labour force and employment based measures of the stock of human capital. We can then apply the principle contained in (4) to derive the counterfactual equivalents of (5) - (7).

We can also derive partial counterfactuals by equalizing, i.e. equating the growth rate of a component for females to the growth rate for males, for one component at a time. For example, in the case of the population-based measures, we can estimate the separate effect of equalizing L by replacing $ln\, h^{*}p$ in (8) with ln hp. In this case, we can calculate two components of the gender effect (Working age population and human capital) and the combined effect as the sum of the two components. For the measures based on the labour force, we calculate three components of the gender effect, the above two plus the participation rate. Finally, in the case of the employment-based measures, we calculate three components of the gender effect, the above three plus the employment rate (the ratio of employment to the labour force).

Data. To estimate the average years of schooling, we used data on population aged 15 to 64 by highest degree, certificate or diploma obtained, from 1976 to 2000, from the labour force survey. The data are available at the University of Western Ontario's Internet Data library System, Labour Force Historical Review, Education, CD2T02AN & CD1T02AN. The data on labour force and employment by highest degree, certificate or diploma obtained are also available in the same data set.

The classification of education level in the two files is not identical. CD1T02AN, which contains data from 1976 to 1989, is structured as : 0-8 years of education; 9-10 years of education; 11-13 years of education; some post-secondary education; post-secondary certificate or diploma; university degree. We combined those with 0-8 years of education and those with 9-10 years of education and named the new education group as less than high school graduate. We named those with 11-13 years of education as high school graduate. We combined persons with some post-secondary education and those with post-secondary certificate or diploma and we named the new education group as people with post secondary education. CD2T02AN, which contains data from 1990 to 2000, is structured as: 0-8 years of education; some high school education; high school graduate; some post-secondary education; post-secondary certificate or diploma; university degree. We combined the first two groups and named it as "less than high school graduate". We also combined those with some post-secondary education and post secondary certificate or diploma and named the new education group "post secondary education".

III. RESULTS

The estimates of the growth rates of the human capital stock and its components for Canada by gender for the period from 1976 to 2000 are summarized in Table III-1.

Labour Input (L). The labour input for the population aged between 15 and 64 increased at nearly identical rates for males and females during the period from 1976 to 2000. The growth rate of the female labour input based on the labour force was more than double that for males. The reason for this difference is the different trends in labour force participation by gender. As shown in Table III-2, the participation rate of males fell from 84.5% to 82.1% during the 1976-2000 period while the participation rate of women increased from 49.0% to 66.8%. As a result, the gap between the two fell from 35.5 percentage points in 1976 to 15.3 percentage points in 2000 and the participation rate of females as percent of that of males increased from 58.0% in 1976 to 81.4% in 2000.

Table III-1. Average Annual Growth Rate of Human Capital by Gender in Canada, 1976-2000.

	Male	Female	Difference
Labour Input (L)			
Population	1.29	1.28	0.01
Labour Force	1.17	2.63	-1.46
Employment	1.14	2.70	-1.56
Human Capital (h)			
Population	0.49	0.60	-0.11
Labour Force	0.53	0.57	-0.04
Employment	0.53	0.57	-0.04
Stock of Human Capital (H)			
Population	1.78	1.88	-0.10
Labour Force	1.70	3.20	-1.50
Employment	1.67	3.27	-1.60

The gender differences widen when we move from the labour force to employment. As shown in Table III-2, during the 1976-2000 period the employment rates for males were almost identical in 1976 and 2000 while the rate for females increased from 91.8% to 93.3% and in 2000 it was slightly higher than that of males.

Table III-2. Participation Rate and Employment Rate for the Population Aged Between 15 and 64 by Gender: Canada, Selected Years from 1976 to 2000.

	Participation Rate		Employment Rate	
	Males	Females	Males	Females
1976	84.5	49	93.5	91.8
1981	85.9	56.2	92.8	91.7
1986	84.9	60.8	90.4	90.1
1991	83.8	64.6	89	90.3
1996	81.3	64.2	89.9	90.7
2000	82.1	66.8	93	93.3
Average Annual Growth Rate	- 0.12	1.30	-0.02	0.07

Source: Authors' calculations based on data from the University of Western Ontario's Internet Data Library System, Labour Force Historical Review, Education, CD2T02AN & CD1T02AN.

More details on participation rates by gender and by age group are found in Table III-3. It is evident that, during the 1976-2000 period, the participation rate of females increased in all age groups while that of males fell in all age groups. As a result, the ratio of the female to male participation rate for the selected four age groups reached levels of 95.4%, 86.9%, 84.9% and 68.2%, respectively, in 2000. It seems that the substantial increase in the participation rate of females during the 1976-2000 period was largely due to the rise in the participation rate of prime-age females (age 25-54).

Table III-3. Participation Rate by Gender and Age Group, 1976 and 2000.

	1976		2000	
Age Group	Male	Female	Male	Female
15-24	68.9	58.2	65.9	62.9
25-44	95.4	53.9	92.1	80.0
45-54	92.2	48.2	88.9	75.5
55-64	75.9	31.9	61.0	41.6

Human Capital (h). Table III-1 shows that, for the population aged between 15 and 64, human capital, measured by the average years of schooling of the working-age population, increased at a higher rate for females than for males during the 1976-2000 period (0.60% per year versus 0.49% per year). The difference of 0.11 percentage points for the population-based growth rate was reduced to 0.04 percentage points for the growth rates based on labour force and employment. This smaller difference suggests that the proportion of females with increasing levels of education who did not participate in labour force activities was larger than that for males.

Table III-4. Average Annual Growth Rates of Years of Schooling by Gender and Age in Canada, 1976-2000.

	Male			Female		
Age Group	Population	Labour Force	Employment	Population	Labour Force	Employment
15- 24 years						
1976 level	11.09	11.29	11.38	11.27	11.74	11.81
2000 level	11.57	11.96	12.07	11.93	12.41	12.53
Growth Rate	0.18	0.24	0.25	0.24	0.23	0.25
25-44 years						
1976 level	12.24	12.28	12.34	11.75	12.18	12.23
2000 level	13.62	13.72	13.78	13.84	14.07	14.13
Growth Rate	0.45	0.46	0.46	0.68	0.6	0.6
45-54years						
1976 level	11.21	11.3	11.34	10.83	11.24	11.29
2000 level	13.48	13.64	13.7	13.21	13.58	13.63
Growth Rate	0.77	0.79	0.79	0.83	0.79	0.79
55-64years						
1976 level	10.88	10.99	11.05	10.61	11.13	11.17
2000 level	12.7	13.02	13.06	12.16	12.85	12.89
Growth Rate	0.65	0.71	0.7	0.57	0.6	0.6

Additional information on levels of educational attainment by gender and selected age groups is shown in Table III-4. A number of general observations may be derived from this table. First, the gender differences in educational attainment in the initial year of the sample period are fairly small. For the population 15-64, the level of educational attainment is slightly higher for females in the age group 15-24, and slightly lower in the remaining three age groups. For the labour force and employment, the level of educational attainment for females is slightly higher in the age groups 15-24 and 55-64. Second, the average annual growth rate of educational attainment by age group

follows a lopsided inverted-U shape for both males and females. It is low for the age group 15-24, increases substantially for the next two groups (25-44 and 45-54) and then falls for the age group 55-64, but remains much higher than for the first age group. Third, the gender differences in growth rates differ by age group and by measure of labour input. The growth rates are higher for females in the age groups 15-24 and 25-44, roughly equal in the age group 45-54 and higher for males in the age group 55-64.

Stock of Human Capital (H). The stock of human capital (H) is derived as the product of the labour input *(L)* and human capital *(*h). As shown in Table III-1, the population-based level of H increased at a slightly faster rate for females (average annual growth rate of 1.88% compared to 1.78% for males). This gender difference is due entirely to different rates of educational attainment. The labour force based level of H increased at a much higher rate for females (3.20% versus 1.70% for males). Since the growth rate of educational attainment for the labour force was only slightly higher for females, the above difference was due almost entirely to the faster rate of increase in the participation rate of females. The gender difference in the labour force measure is closely paralleled by the difference in growth rates in the employment-based level of H. In conclusion, the human capital stock in Canada, measured with respect to the labour force or employment, increased at nearly double the rate for females than for males during the 1976-2000 period. This difference was largely due to different trends in labour force activity for males and females and not to major gender differences in the educational attainment. For the population 15-64, females did acquire human capital at a slightly higher rate than males, but flocked into the labour force at a much faster rate than males.

IV. COMPONENTS OF THE GROWTH OF HUMAN CAPITAL

As discussed in Section II, the contribution of various components to the growth of the stock of human capital were calculated by comparing the actual rates with those of a counterfactual that assumes the absence of gender differences. In this section, the calculation of these contributions is shown in two steps. First, we show the relevant growth rates of the stock of human capital, actual and counterfactual in Table IV-1 and then we present the estimates of the contributions in Table IV–2.

The first part of Table IV-1 shows the actual average annual growth rates of the stock of human capital as the sum of the growth rates of its major components. During the 1976-2000 period, the population-based stock of human capital in Canada increased at an average rate of 1.84% per year. This rate was raised to 2.32% per year by the growth of the participation rate. A nearly identical growth rate was found for the employment-based measure because the employment rate (the ratio of employment to the labour force) increased at virtually the same rate as the participation rate.

The second part of Table IV-1 shows the average annual growth rates of counterfactual H for a variety of cases. For each component of the gender effect, the term "equalized" is used to identify the replacement of the actual growth rates for females with those of males so as to eliminate the gender effect. For each major measure of H^* (population based, labour force based and employment based) we calculated the associated growth rate for complete "equalizing", where the growth rates of all relevant factors are equalized, and for partial gender effects by "equalizing" only one factor at a time. For the partial growth rates we equalized the elements of the labour input relevant to each

measure first and then derived the gender effect of human capital as the residual between complete and partial equalizing. Calculating the effect of gender differentials on the growth of h as a residual is warranted by the fact that human capital is an attribute of the labour input and its contribution changes as the labour input is modified.

Table IV-1. Average Annual Growth Rates of the Stock of Human Capital and its major Components: Actual and Counterfactual: 1976-2000, Percent.

	L-Based	LF-Based	E-Based
Actual (H)			
L_p	1.29	1.29	1.29
PR	na	0.48	0.48
ER	na	na	0.01
h	0.55	0.55	0.55
H	**1.84**	**2.32**	**2.33**
Counterfactual (H*)			
Equalized L_p, actual h	1.84	na	na
Equalized L_p, h	**1.78**	**na**	**na**
Equalized L_p, actual PR and h	na	2.32	na
Equalized PR and L_p, actual h	na	1.72	1.72
Equalized PR, L_p and h	**na**	**1.70**	**na**
Equalized L_p, actual PR, ER and h	na	na	2.33
Equalized PR and L_p, actual ER and h	na	na	1.73
Equalized ER, L_p and PR, actual h	na	na	1.69
Equalized ER, L_p, h and PR	**na**	**na**	**1.67**

In the case of the population based measure, equalizing the growth rates of the population-based labour input (L_p) yields a growth rate of H^* of 1.84%, the same as the growth rate of H because, in our calculations, rounding growth rates in percentage points at the second decimal point eliminates the small gender difference in L_p. This neutral effect of equalizing the growth rate of the working age population applies equally to the labour force based and employment based measures. Equalizing both L_p and h yields a growth rate of H^* of 1.78%. The effect of equalizing the growth rate of h on the growth rate of H^*, therefore, is calculated as 1.84 - 1.78 = 0.06 of a percentage point.

In the case of the labour force based measure, equalizing the participation rate PR, given the equalized value of L_p and the actual value of h yields a growth rate of H^* of 1.72%, 0.6 of a percentage point lower than the growth of H. When all three factors (L_p, PR and h) are equalized, the growth rate of H* is further reduced to 1.70%. Therefore, the effect of equalizing the growth rate of h can be calculated as 1.72 - 1.70 = 0.02 of a percentage point, one-third its value in the case of the population based measure. Finally, for the employment based measure, the growth rate of H^* when the gender difference in the employment rate is equalized, given the equalized values of PR and L_p and the actual value of h, is 1.69%, or 0.04 percentage points lower than the growth rate when PR and L_p alone is equalized. The effect of equalizing h remains at 0.02 of a percentage point since the growth rate of H^* when all factors are equalized is 1.67%.

Table IV-2. Contribution of Major Components to the Growth of the Stock of Human Capital in Canada, 1976-2000.

	Percentage Point			Percent		
	H_p	H_{lf}	H_e	H_p	H_{lf}	H_e
A. No Gender Effect						
L, total	1.29	1.29	1.29	70.1	55.6	55.4
PR, total	na	0.48	0.48	na	20.7	20.6
ER, total	na	na	0.01	na	na	0.4
h, total	0.55	0.55	0.55	29.9	23.7	23.6
B. Separating the Gender Effect						
Equalized L	1.29	1.17	1.14	70.1	50.5	48.9
Equalized h	0.49	0.53	0.53	26.6	22.8	22.8
Gender Effect						
Total	0.06	0.62	0.66	3.3	26.7	28.3
L_p	0	0	0	0	0	0
PR	na	0.60	0.60	na	25.9	25.8
ER	na	na	0.04	na	na	1.7
h	0.06	0.02	0.02	3.3	0.8	0.8

The first part of Table IV-2 shows the contribution of the major factors to the growth of H, including the gender effect which is incorporated into each of those factors. For the population based measure, 70% of the average annual growth rate of H (1.29% out of 1.84%) was accounted for by the growth of the labour input. The growth of human capital contributed 30% or about half a percentage point to the growth rate of H. For the labour force based measure, the labour input is disaggregated into its two main components, namely, the population of working age and the participation rate. For this

measure, population growth accounted for 55.6% of the growth of H and the participation rate added 20.7% or nearly half a percentage point. The contribution of h remained at 0.55 percentage points, but its percentage contribution was reduced to 23.7% because of the higher growth rate of H. Almost identical results are obtained for the employment based measure because the employment rate increased at approximately the same rate as the participation rate.

The second part of Table IV-2 focuses on the contribution of the gender differences. The gender effect is measured as the difference between the growth rate of H and the growth rate of H^*, which is given by the sum of the equalized growth rates of the labour input L and human capital h. The labour input L includes, where applicable, all its components, namely L_p, PR and ER. For the population based measure, the gender effect is quite small (0.06 of a percentage point or 3.3%) because the labour input in this case does not contain gender differences and the gender differences in the growth of human capital are quite modest. The gender effect is much larger in the case of the labour force based measure. It accounts for 0.62 of a percentage point or 26.7% of the growth of H. The gender effect is slightly higher (28.3%) for the employment based measure. It may be worth noting that, in the case of both the labour force and employment measures, the contribution of gender differences to the growth of human capital exceeded the contribution of the growth of human capital, equalized or actual.

The gender effect is decomposed into its major components in the last four rows of Table IV-2. For the population based measure, the small gender effect was entirely in the form of higher growth rates of human capital for females. In the case of the labour force and employment based measures, the

gender effect was almost entirely in the form of a much higher participation rate of females. For measures based on the labour force or employment, females made a major contribution to the growth of human capital, not by acquiring human capital at a much faster rate than males, but by flocking into the labour market with educational levels similar to those of males.

V. CONCLUSION

This paper estimated the growth rates of human capital in Canada over the period from 1976 to 2000, separately for males and females in the age range 15-64 in order to determine the impact of gender differences. The results show that gender had no impact on the growth rate of the population-based labour input because population growth was nearly identical for males and females. Increased participation rates of females, which were translated into higher employment rates, had a major impact in raising the growth rate of the labour force and employment based labour input by more than one-third. The educational attainment grew at a slightly faster rate for females, therefore, gender differences made only a small contribution to the growth of the quality of human capital. When the labour input is combined with the associated level of educational attainment to obtain the stock of human capital, the results show that gender made very little difference to the growth of the population-based measure. This is because there were very minor gender differences in the growth of the population 15-64 and their educational attainment. Gender differences, however, accounted for over one-quarter of the growth rate of the stock of human capital when measured with respect to the labour force and employment. This effect was largely due to the rapid increase in the participation rate of females during the 1976-2000 period. The gender effect on the growth of the

stock of human capital was not due to higher rates of human capital acquisition by females, but by their increasing willingness to make the human capital they acquired available for market activities.

This source of growth of the human capital stock is close to being exhausted because participation rates of males and females have nearly converged. A depressing effect on the growth of the human capital stock will also result from the projected deceleration in population growth. Unless ways of offsetting the substantially reduced contribution of these two major sources of growth of the human capital stock are found, its average annual growth rate in the future will be cut in half.

ENDNOTES

1. See, for example, Koman and Marin (1997) and Ho and Jorgenson (1999). The latter reference also contains a discussion of factors, such as union power and signalling, that may lead to deviations of wages from the value of worker's marginal product.

2. See, for example, Barro and Lee (1996), Koman and Marin (1997) and Laroche and Merette (2000).

3. See, for example, Lau, Jamison and Luat (1991), Psachaopoulos and Arriagada (1992), Kyriacou (1991), Koman and Marin (1997,1999) and Laroche and Merette (2000).

4. The gender contribution can be calculated in an alternative way (see also Ho and Jorgenson (1999). In the case of the population-based measured, for example, the gender contribution (G) in percentage points to the average annual growth rate of the stock of human capital can be expressed as:

$$G = \Delta ln\ H - \Delta ln\ H^* = \Delta ln\ L + \Delta ln\ h - \Delta ln\ L^* - \Delta ln\ h^* \quad (1)$$

where Δ refers to the change from one period to the other such that $\Delta ln\ H = \Delta ln\ H_t - \Delta ln\ H_{t-1}$. Since the growth rate of a given variable is the weighted average of the growth rates of its gender components and since the calculation of the counterfactual growth rates assumes that the growth rates for females are equal to that of males, we can express (1) as:

$$G = (w_m \Delta ln\ L_m + w_f \Delta ln L_f + w'_m \Delta ln hm + w'_f \Delta ln h_f) - (\Delta ln L_m - \Delta ln h_m) \quad (2)$$

where w and w' are the weights for the population and human capital (which are the relative shares of the population in both cases, respectively, and m and f refer to males and females, respectively, and $w_m + w_f = 1$, $w'_m + w'_f = 1$.

Since $w_m \Delta ln\ L_m - \Delta ln\ L_m = - w_f \Delta ln\ L_m$ and $w_m' \Delta ln\ h_m - \Delta ln\ h_m = - w'_f \Delta ln h_m$, we can transform (2) into:

$$G = w_f\ (\Delta ln\ L_f - \Delta ln\ L_m\ ) + w'_f\ (\Delta ln\ h_f - \Delta ln\ h_m) \quad (3)$$

Expression (3) indicates that the contribution of each gender component, in this case population and

human capital, is the weighted difference between the growth rates of males and females, where the weights are the relative share of females. In the case of the population-based stock of human capital, the gender contribution can be calculated as follows:

$$A = .5\ (1.28 - 1.29) + .5\ (.61 - .49) = -\ 0.005 + 0.06 = .055.$$

Since in our calculations the growth rates were rounded to the second decimal point, we used a zero contribution for the population component of the gender effect, so that the total effect was .06 and was due entirely to the human capital component of the gender effect.

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