

Measures of Human Capital

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I. INTRODUCTION

The increasing importance of human capital as a determinant of economic growth is reflected in the literature that has appeared in recent years. From Romer's (1986) and Lucas's (1988) seminal contributions to the OECD's recent emphasis on active labor market policies, human capital has been identified as the main source of progress and economic growth. Given the level of GDP, human capital generates higher growth through at least two channels: (a) enhancing the domestic development of technology and innovation, and (b) facilitating the worldwide diffusion of advanced technologies from leading countries. The quest for a better understanding of the determinants of growth has stimulated interest in the process that leads to the production and effective utilization of human capital. Research on human capital has dealt with the following issues: (1) definition; (2) dimensions; (3) linkages with other forms of capital, and (4) measurement.

The importance of human skills as determinants of the wealth of individuals and of nations was recognized more than two hundred years ago by Adam Smith (1776). It was not until the 1960s, however, that human capital was given formal recognition as a determinant of earnings differentials through the work of Schultz (1961), Becker (1964) and Kiker (1966). Human capital was generally defined as the aggregation of investments in activities that enhance an individual's productivity in the labor market, such as education, health, on-the-job training, and migration. Formal definitions of human capital have been developed and revised over time by the OECD (1996, 1998, 2001). Laroche, Merette and Ruggeri (1999) expanded on the earlier definitions by including the potential to acquire human capital as well as its acquisition. Ruggeri and Yu (2000) have argued that human capital should be analyzed within a dynamic framework that covers a variety of stages because it is

formed in a multi-faceted and dynamic process. To that end, they identified four dimensions of human capital: (a) potential, (b) acquisition, (c) availability, and (c) effectiveness. Researchers have also recognized that human capital has strong links with other forms of capital, namely, natural capital, physical capital and social capital (Ruggeri and Yu (2003)). Finally, researchers have identified two approaches to the measurement of human capital. One approach tries to capture the different stages in the dynamic process that leads to the production and use of human capital (Ruggeri and Yu (2001)). It does so by selecting relevant sets of human capital indicators for various stages of human capital development. The other approach measures directly the stock of human capital in a given year (Jorgenson, and Fraumeni (1989), Mulligan and Sala-i-Martin (1995)).

The latter approach is used in this report to estimate the stock of human capital for Canada and Atlantic Canada during the 1976-2000 period. The results shed some light on trends in human capital over the past twenty-five years and provide a consistent data set for analyzing the contribution of human capital to the process of convergence between Canada and the Atlantic region. Regional disparities have been a longstanding feature of the Canadian federation and economists have searched for explanations of the persistence of such disparities. Initially focusing on differential rates of capital accumulation, economists have more recently recognized the importance of human capital in the process of convergence. In Canada, Coulombe and Tremblay (1999) and Coulombe (2001) found that the convergence of output and income could be explained largely by the convergence of human capital. Ruggeri and Huang (2002) argued that the human capital indicators used in these studies, namely, the share of the population with selected education levels, may not be suitable for analyzing convergence because human capital affects convergence only to the extent that

it is utilized in market activities. For the 1976-1999 period, they found a positive speed of convergence for the share of the employed population with at least grade nine education, but no convergence for the share of the employed population with at least a university degree. The estimates of the human capital stock provided in this paper may help clarify this issue.

Two measures of human capital are developed in this paper. The first (h_q) is based on the level of educational attainment, and the second (h_v) incorporates earning differentials associated with various levels of educational attainment. The value of human capital was calculated by, alternatively, excluding (h_v) and including experience (h_v^*). Each of these measures is calculated for the population of age 15 to 64, labour force and employment. We also measure the labour input separately (L) and in combination with the education level (H_q) and with the earning levels (H_v and H_v^*). The estimates labeled with H will be called “stock of human capital”.

This paper addresses two questions: (a) how fast did human capital (h) and the stock of human capital (H) grow in Canada and Atlantic Canada during the 1976-2000 period?, and (b) which factors determined any differences in their growth rates between Canada and the Atlantic region? The results show that, during the 1976-2001, the labour input (L) increased at a faster rate in Canada than in Atlantic Canada. During the same period, human capital, measured by the level of education (h_q), increased at roughly the same rate in Canada and Atlantic Canada. The value of human capital (h_v), excluding experience, increased at a faster rate in Atlantic Canada. This difference in growth rates expanded when experience was included. The growth of H_v^* based on the labour force was similar for Canada (105.2%) and for Atlantic Canada (99.7%). It seems that the relative

disadvantage for Atlantic Canada with respect to the growth of the population aged 15 to 64 (15.9 percentage points) was almost fully offset by the effect of labour force and demographic dynamics on the value of human capital. The results presented in this paper suggest that studies of comparative growth that incorporate the effects of human capital must identify which of the human capital measures are utilized and the factors that determine the evolution of human capital over time.

This paper is organized as follows. Section II reviews the literature on the measurement of human capital and describes the methodology and the data used to estimate the growth of human capital in Canada and Atlantic Canada during the 1976-2000 period. Section III presents the results, and Section IV provides some concluding remarks.

II. METHODOLOGY AND DATA

A. Background

Since the recent interest in human capital has been stimulated by the development of endogenous models¹, it may be useful to place our measures within the framework of a production function. If workers have minimum skills, for a given technology, we can write the production function as:

$$Y = f(K, L) \tag{1}$$

where Y is output, K is the stock of physical capital and L is “the quantity of raw labour”, to use the expression of Barro, Mankiw and Sala-i-Martin (1995), and is called labour input in this paper. In the knowledge-based age, one is hard-pressed to view the labour input as “raw labour”. One may,

¹Mankiw, Romer and Weil (1992).

therefore, express the production function as:²

$$Y = f(K, hL) \quad (2)$$

where h refers to the skills embodied in the labour input and hL is defined as the labour input adjusted for the human capital it embodies. Alternatively, we can enter the labour input (L) and human capital (h) separately into the production function as follows:

$$Y = f(K, h, L) \quad (3)$$

In this paper, in addition to estimates of L , two separate measures of h are derived for Canada and Atlantic Canada. Estimates of the *labour input* (L) are derived simply by selecting the age group that serves as the basis for measuring the human capital stock. The first measure of human capital is a *quality-based measure*, which can be calculated by using two different approaches. *The cost-based approach* typically estimates human capital by the inputs used. It sums the direct expenditures on education, including the opportunity cost associated with investment in human capital. *The output-based approach* estimates educational attainment, therefore, it measures the level of human capital that has been acquired. In our view, the latter approach is more meaningful in the calculation of human capital because it focuses on outcomes instead of inputs into the educational system. It will be used in our calculations and will be developed by assigning to the selected age groups the number of years of education associated with a certain level of educational attainment.

The second measure is a *value-based measure* of human capital because it incorporates an explicit

² Koman and Marin (1999) used this formulation in order to measure the contribution of human capital to economic growth.

relationship between productivity and educational attainment. While the quality-based measure assumes that the productivity differential among workers is proportional to the differential in completed years of schooling, the value-based measure assumes that a worker's productivity is measured by labour earnings under the assumption that workers are paid the value of their marginal product. Value-based measures of human capital can be developed by, alternatively, including and excluding the human capital acquired through work experience.

B. Studies on the Measurement of Human Capital

Labour input. Measures of the labour input focus on the population group that is considered to embody the overwhelming share of acquired knowledge and skills. For example, Beaudry and Green (1997) chose individuals in the age group between 25 and 56. They selected age 25 as the entry age to the mature labor market to focus attention on those individuals who have completed their major educational investment and have become more permanently attached to the labor market. They used the age of 56 as the upper limit because, in their view, this cut-off age eliminates fluctuations arising from changes in retirement patterns over time. Barro and Lee (1993) developed a data set of the adult population (25 years and over) of 129 countries, including Canada and covering five-year periods from 1960 to 1985. Their selection of the age range was determined by the availability of consistent data for all the countries in the sample. Recognizing that for many developing countries a large portion of the labor force is younger than 25, Barro and Lee (1996) widened the population group to include also individuals aged 15 to 25. Psacharopoulos and Arriagada (1986,1992) developed a measure of the stock of human capital for 99 countries, including Canada, based on the labor force. Because the labor force is not defined identically in each country, they ended up with

different age groups. In some countries, they chose the population 15 years and above, while in other countries they focused on the population 25 years and above. Recently, Koman and Marin (1997) developed a measure of human capital for Austria and Germany based on the population aged between 15 and 64.

Quality. The cost-based approach focuses on the cost of acquiring human capital. Kendricks (1976) and Eisner (1989) estimated human capital by calculating the depreciated value of investment in education, general training, health and safety, and also in child rearing and labour mobility. A drawback of this approach is that it ignores gaps between educational investment and the resulting human capital embodied in the graduates since different students may require different time-spans to complete a certain educational program and some graduates may make little market use of the acquired skills. Furthermore, the estimates depend on the assumptions about the classification of educational expenditures between consumption and investment.

The output-based approach requires the estimation of the number of years of schooling completed, on average, by each age group. Lau, Jamison and Louat (1991) applied a time series estimate of the education-based human capital, which is defined as the number of person-school years of the working age population between 15 and 64, for 58 developing countries over the period from 1965 to 1985. They first estimated time series of gross annual primary and secondary school enrolments for each country. Then, through a so called “perpetual inventory approach”, which assumes no depreciation, mortality, or migration during an individual’s working life, they estimated human capital for each country. Psacharopoulos and Arriagada (1986,1992) measured human capital as

the average years of formal education embodied in the labour force. The education level ranges over illiterates and persons with incomplete primary, completed primary, incomplete secondary, completed secondary, and university education. Kyriacou (1991) estimated the average years of schooling of the labor force, assuming a constant relationship between average years of schooling and enrolment ratios over time and across countries. This assumption means that the length of time required to complete a certain education level is constant and that there are no dropouts or repeats.

Value. The assumption that the returns to human capital are proportional to the level of acquired skills and education, which is implicit in output-based quality measures, has been challenged by various economists. Mulligan and Sala-i-Martin (1997) admit that a person's human capital is related to his/her schooling, but suggest that one cannot assume *a priori* a proportional relationship between years of schooling and the value of human capital. They estimated the value of human capital in the United States with a labour-income-based measure. They argue that total labor income incorporates both human capital and physical capital and suggest that the value of human capital in a given year can be measured by the ratio of the average labour income received by all workers to the wage rate of a zero-schooling worker.

Koman and Marin (1997) measured the value of human capital for Austria and Germany based on years of completed schooling of the population aged 15 to 64. They estimated the number of individuals of age i with the highest level of schooling j at time t with the perpetual inventory approach discussed above. Then, using an aggregate measure of human capital, the authors measured workers' productivity by wage income. Turning each education level into appropriate

years of schooling, the authors applied a Cobb-Douglas aggregator to relate workers with different education levels to human capital. Laroche and Merette (2000) developed a measure of Canada's human capital stock from 1971 to 1996 based on the completion of education levels and the number of years of working experience. Expanding the method used by Koman and Marin (1997), they also tried to capture the differences in education quality, market relevance of different types of education and working experience. The methodology used by Laroche and Merette (2000) will be employed in this report because it provides the most detailed approach to the estimation of value measures. It differentiates between males and females and it allows for the effect of experience. Details of the approach used in this paper are provided in the following sub-section.

C. Approach Used in this Paper.

In this paper we provide estimates of the labour input (L), the quality of human capital (h_q) and the value of human capital without experience (h_v) and with experience (h_v^*). We also include estimates of the quality-based stock of human capital ($H_q = h_q L$) and the value-based stock of human capital without experience ($H_v = h_v L$) and with experience ($H_v^* = h_v^* L$). The various measures of the labour input and human capital presented in this paper are listed in Table II.1. Their derivation is explained below.

Labour input. Two decisions are required for measuring L : (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 people in the selected age groups who are employed.

Table II.1 Measures of the Labour Input and Human Capital.

| Symbol | Measure |
|-------------------|---|
| L | Labour input |
| h_q | Quality of human capital (education based) |
| $H_q = h_q L$ | Quality-based stock of human capital |
| h_v | Value of human capital (earnings-based, excluding experience) |
| h_v^* | Value of human capital (earnings-based, including experience) |
| $H_v = h_v L$ | Value-based stock of human capital (without experience) |
| $H_v^* = h_v^* L$ | Value-based stock of human capital (with experience) |

In the selection of the age groups, we followed the approach used by most researchers and chose the age group between 15 and 64. The initial year represents the age at which individuals are legally eligible to be full members of the labours force. For the terminal year, the issue is whether we confine our measure to those under what is often considered the general age of retirement, namely, 65, or extend it beyond that age and how far. There are good reasons for selecting either option. The vast majority of people decide to exit the labour force by the age of 65. Therefore, although they still possess the human capital acquired in previous years, this human capital may not be available for use since they have voluntarily exited the labour force. It may also be argued that, with the proper

financial incentives, these people may be enticed to rejoin the labour force, even though on a part-time basis. It is difficult, however, to determine the speed at which human capital deteriorates after age 65 and what is the labour supply response of seniors to increases in real wages and other factors such as pensions. Although we recognize the importance of seniors as potential contributors to the stock of human capital, especially as medical advances lengthen life expectancy, we also acknowledge that more research is needed to derive reliable estimates of this contribution. Therefore, following the approach used by most researchers, we used the age of 64 as the upper limit of the age range. We then divided this range into four age groups: 15-24, 25-44, 45-54 and 55-64.

For each age group, and by sex, three separate measures of the labour input are developed. The broad measure includes the population in the age group from 15 to 64 years and provides information on the maximum stock of human capital in a given year. Some of these people are not available for productive activity for a variety of reasons- such as being in a correctional institution or under long-term hospitalization - while others have freely chosen not to participate in the labour force. The second measure includes only those people who are either employed or are actively seeking gainful employment, namely, the labour force. This measure identifies the portion of the maximum stock of human capital that is available for market activity. A narrower measure includes only those who are employed in any given period. This measure is the most appropriate for analysing the economic contribution of human capital to economic growth. Since each measure provides specific information about the stock of human capital, we used all three in our calculations.

The labour input (L) can be derived by aggregating across age groups or across education levels. For the purpose of our analysis, which focuses on the measurement of human capital, the latter aggregation is more meaningful. In this case, the calculation of L can be expressed as:

$$L = \sum_s L_s = \sum_s \rho_s L \quad (4)$$

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 (4) shows that the labour input is simply the sum of the people with different levels of education, where each person is given equal weight regardless of his/her level of education.

Quality. Following Koman and Marin (1997, 1999) and Laroche and Merette (2000), we measure the quality of human capital by the average years of schooling completed by the population, labour force or employment in the age range 15 to 64. We focus on four different levels of education: less than high school graduation; high school graduation; some postsecondary education; and 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. The quality of human capital (h_q) can be expressed as:

$$h_q = \sum_s s \rho_s \quad (5)$$

where s is the average years of schooling associated with each of the selected four education levels and ρ_s is the share of people with s years of schooling.

In (5), h_q is the weighted average of the years of schooling by educational level, with the weights being the shares ρ_s (of population, labour force, or employment). This measure of human capital assumes that the productivity differential among workers with different levels of education is proportional to their years of schooling. The quality-based stock of human capital (H_q) can then be derived by multiplying (5) by L .

Value. The additional quality of the population (labour force or employment) does not have any value if it does not raise output per worker. The value of the human capital stock over time, therefore, can be determined by tracing the returns to its increasing quality. These returns can be measured by the differences in labour income associated with different levels of education in each age group, under the assumption that labour is paid the value of its marginal product.

Since human capital is necessarily embodied in human beings, the stock of human capital can be related to both the labour input and the associated level of educational attainment. In our estimation of a value-based measure of human capital, we followed the methodology employed by Laroche and Merette (2000) and by Koman and Marin (1997, 1999). Following these authors, we use a Cobb-Douglas aggregator for the relationship between the level of schooling of different workers and the value of the stock of human capital. Therefore, we can write:

$$H_v = \prod_s L_s^{\omega_s} \tag{6}$$

where ω_s is the efficiency parameter of a worker who has completed s years of schooling and $\sum \omega_s = 1$.

Taking the logarithm of (6), remembering that $\rho_s = L_s/L$, and aggregating over all educational attainment groups transforms (6) into

$$\mathbf{Ln}H_v = \sum_s \omega_s \mathbf{Ln}(\rho_s L) \quad (7)$$

Dividing the stock of human capital by L yields the value of human capital per unit of L ,

$$\mathbf{Ln}\left(\frac{H_v}{L}\right) = \mathbf{Ln}h_v = \sum_s \omega_s \mathbf{Ln}\rho_s \quad (8)$$

Comparing (8) with (5) shows how measuring human capital in terms of earnings instead of educational attainment involves replacing the level of educational attainment s , with the efficiency parameter ω_s , based on the relationship between earnings and years of schooling.

Following Koman and Marin (1997, 1999) and Laroche and Merette (2000), we can derive ω_s as the share of the earnings of workers with s years of schooling ($w_s L_s$) in total earnings,

$$\omega_s = \frac{w_s L_s}{\sum_s w_s L_s} \quad (9)$$

where w_s is the wage of the group with s years of schooling.

The response of wages to increasing years of schooling can be derived by estimating a Mincer type equation (Mincer 1974),

$$w_s = e^a e^{\gamma s} \quad (10)$$

where e^a measures the wage of a zero-school worker and γ measures the percentage increase in wages due to an extra year of schooling. The efficiency parameter ω_s can then be expressed as:

$$\omega_s = \frac{e^{\gamma s} L_s}{\sum_s e^{\gamma s} L_s} \quad (11)$$

which produces the mapping from workers with s years of schooling to the value of human capital.

Given potential gender differences in the labour force attachment and potentially different responses of wages to educational attainment by gender, it may be useful to differentiate between males and females in the calculation of the labour input and the estimation of the wage equations. In this case, the efficiency parameter ω_s is expressed as:

$$\omega_s = \frac{e^{\sum_j (\gamma_j s) \cdot \varphi_j} L_s}{\sum_s e^{\sum_j (\gamma_j s) \cdot \varphi_j} L_s} \quad (12)$$

where j indexes sex and φ_j is the share of men and women in the population.

Laroche and Merette (2000) argued that human capital can be acquired through formal education and also through a variety of other formal and informal channels, including work experience. When experience is included, the expression for the efficiency parameter ω_s becomes:

$$\omega_{s,i} = \frac{e^{\sum_j (\gamma_j s + \beta_j x - \alpha_j x^2)} \cdot \varphi_{j,i} L_{s,i}}{\sum_s \sum_i e^{\sum_j (\gamma_j s + \beta_j x - \alpha_j x^2)} \cdot \varphi_{j,i} L_{s,i}} \quad (13)$$

where parameters β_j and α_j measure the change in wages due to experience for males and females, $L_{s,i}$ is the group of individuals of age i with s years of schooling, and $\varphi_{j,i}$ is the share of men and women of age i in the population.

In expression (13), work experience is denoted by x and is defined as age i minus years of education s minus 6, that is, $x=i-s-6$. For example, a person aged 24 with a university degree will have zero years of work experience ($24-18-6=0$); while a person aged 28 with a university degree will have 4 years of work experience. The value of human capital when experience is excluded is estimated by aggregating over education groups and by gender. When experience is included, the aggregation is carried out over education levels, by levels of experience and by gender.

Since we are comparing Canada with Atlantic Canada with respect to the growth of human capital, ideally we should derive estimates of the relevant parameters, for each year of the sample period and separately for the two jurisdictions. In addition to exceeding the scope of this paper, this exercise may not prove to be very fruitful since estimates of the parameters already exist. Koman and Marin

(1997, 1999) used estimates by Hofer (1992) for Austria and Mertens (1995) for Germany while Laroche and Merette (2000) used estimates for Canada derived by Bloom, Grenier and Gunderson (1995), specifically, $\gamma = 0.052$ for males and 0.07 for females; $\beta = 0.043$ for males and 0.0289 for females and $\alpha = 0.00069$ for males and 0.00048 for females. We used the above values in our calculation, both for Canada and Atlantic Canada for practical and theoretical reasons. First, estimates of the relevant parameters for Atlantic Canada are not available. Second, given the absence of borders among Canadian provinces, one would expect that labour mobility would tend to equalize wage rates across the country for workers with equal skills. We acknowledge, however, that in practice, this process may be incomplete due to personal factors, such as location attachment, or institutional factors, such as separate provincial restrictions on accreditation of professional qualifications. We suggest that this issue be explored in further research.

D. 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 labor 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 human capital for Canada and Atlantic Canada for the period from 1976 to 2000 are summarized in Table III-1 in the form of average annual growth rates for the selected measures over the chosen sample period. The underlying data are found in the appendix and are presented in the form of indices, by setting the values in 1976 equal to 100, in order to facilitate the comparison between Canada and Atlantic Canada.

Labour Input (L). The labour input, based on population aged between 15 and 64, increased by 35.9 percent for Canada and 20.0 percent for Atlantic Canada during the 1976 to 2000 period, corresponding to average annual growth rates of 1.29 percent and 0.76 percent, respectively. As

shown in appendix Table A-1, the divergent paths of the population-based labour input between Canada and Atlantic Canada became more pronounced during the past decade. During the thirteen years from 1976 to 1989, the amount of L in Canada increased by about 5 percentage points more than for Atlantic Canada. During the eleven years from 1990 to 2000, this difference more than tripled to nearly 16 percentage points. For both Canada and Atlantic Canada, the amount of L based on the labour force increased more than the one based on population, namely, 52.6 percent for Canada and 41.3 percent for Atlantic Canada (annual growth rates of 1.78% and 1.45%, respectively). The reason for this difference is the increase in labour force participation, especially in the case of women. The difference in the growth of the labour input between Canada and Atlantic Canada is less for the labour force measure of L than for the corresponding population-based measure (11.3 versus 15.9 percentage points). The smaller difference is due to the faster increase in the participation rate for Atlantic Canada (17.8%) than for Canada (12.2%) (see Table III-2). The growth in the employment based labour input was very similar to that of the labour force based measure. The difference between Canada and Atlantic Canada, however, is slightly higher than for the labour force based measure (12.5 versus 11.3 percentage points) because employment growth was lower in Atlantic Canada (see Table III-2).

Quality of human capital (h_q). Table III-1 shows that, for the population aged between 15 and 64, the quality of human capital (average years of schooling) increased by almost identical percentages in Canada and Atlantic Canada during the 1976-2000 period (14.0% versus 14.7%). Almost identical percentage increases are also found for both Canada and Atlantic Canada when quality is measured with respect to the labour force and employment. This result is similar to that of Laroche

and Merette (2000), who estimated that Canada's human capital, measured by average years of schooling, increased by 15 percent from 1976 to 1996.

Table III-1. Estimated Average Annual Growth Rate of Human Capital in Canada and Atlantic Canada, 1976-2000

| | | Canada | Atlantic Canada | Difference |
|--|--------------|--------|-----------------|------------|
| Quantity (L) | Population | 1.29 | 0.76 | 0.52 |
| | Labour Force | 1.78 | 1.45 | 0.32 |
| | Employment | 1.79 | 1.43 | 0.36 |
| Quality (h_q) | Population | 0.55 | 0.57 | -0.02 |
| | Labour Force | 0.55 | 0.55 | 0.01 |
| | Employment | 0.55 | 0.55 | 0 |
| Quality-based stock (H_q) | Population | 1.84 | 1.34 | 0.5 |
| | Labour Force | 2.34 | 2.01 | 0.33 |
| | Employment | 2.35 | 1.99 | 0.36 |
| Value (without experience, h_v) | Population | 0.83 | 1.09 | -0.26 |
| | Labour Force | 0.91 | 0.99 | -0.08 |
| | Employment | 0.94 | 0.98 | -0.04 |
| Value (with experience, h_v^*) | Population | 1.1 | 1.54 | -0.44 |
| | Labour Force | 1.21 | 1.51 | -0.3 |
| | Employment | 1.23 | 1.48 | -0.24 |
| Value-based stock (without experience, H_v) | Population | 2.13 | 1.86 | 0.27 |
| | Labour Force | 2.70 | 2.45 | 0.25 |
| | Employment | 2.75 | 2.42 | 0.33 |
| Value-based stock (with experience, H_v^*) | Population | 2.40 | 2.31 | 0.09 |
| | Labour Force | 3.01 | 2.98 | 0.02 |
| | Employment | 3.04 | 2.92 | 0.12 |

Table III-2. Participation Rate and Employment for the Population Aged Between 15 and 64: Canada and Atlantic Canada, 1976-2000.

| | Participation Rate | | Total Employment | |
|----------|--------------------|-----------------|------------------|-----------------|
| | Canada | Atlantic Canada | Canada | Atlantic Canada |
| 1976 | 68 | 60.0 | 9609 | 721 |
| 1977 | 68.4 | 60.3 | 9749 | 720 |
| 1978 | 69.4 | 61.4 | 10046 | 743 |
| 1979 | 70.7 | 62.7 | 10489 | 778 |
| 1980 | 71.5 | 63.0 | 10800 | 797 |
| 1981 | 72.5 | 63.6 | 11126 | 807 |
| 1982 | 71.9 | 63.4 | 10773 | 785 |
| 1983 | 72.4 | 63.6 | 10859 | 794 |
| 1984 | 72.9 | 64.5 | 11130 | 812 |
| 1985 | 73.7 | 65.5 | 11443 | 825 |
| 1986 | 74.5 | 66.2 | 11813 | 848 |
| 1987 | 75.2 | 66.9 | 12149 | 871 |
| 1988 | 75.9 | 67.9 | 12533 | 908 |
| 1989 | 76.5 | 68.9 | 12800 | 931 |
| 1990 | 76.6 | 69.6 | 12891 | 939 |
| 1991 | 76.1 | 68.9 | 12659 | 925 |
| 1992 | 75.3 | 67.8 | 12571 | 905 |
| 1993 | 75.1 | 67.8 | 12671 | 906 |
| 1994 | 74.9 | 67.6 | 12909 | 911 |
| 1995 | 74.7 | 67.6 | 13160 | 929 |
| 1996 | 74.6 | 67.2 | 13266 | 921 |
| 1997 | 74.9 | 68.1 | 13567 | 934 |
| 1998 | 75.2 | 69.2 | 13923 | 962 |
| 1999 | 75.9 | 70.3 | 14318 | 994 |
| 2000 | 76.3 | 70.7 | 14698 | 1013 |
| % change | 12.2 | 17.8 | 53 | 40.5 |

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

Quality-based stock of human capital (H_q). Multiplying the labour input (L) by the quality of human capital (h_q) yields the quality-based stock of human capital. As shown in Table III-1, the

value of H_q , population based, increased by 55.0 percent for Canada and 37.6 percent for Atlantic Canada from 1976 to 2000, corresponding to annual growth rates of 1.84 percent in Canada and 1.34 percent in Atlantic Canada. The labour force based measure increased by 74.2 percent in Canada and by 61.1 percent in Atlantic Canada (annual growth rates of 2.34% and 2.01%, respectively) while the employment based measure increased by 74.7 percent in Canada and 60.4 percent in Atlantic Canada (annual growth rates of 2.35% and 1.99%, respectively). Since h_q rose by nearly equal percentages in Canada and Atlantic Canada, the ratio of H_q between Canada and Atlantic remained unchanged, but the difference widened by about two percentage points.

Value of Human Capital, Excluding Experience (h_v). Two measures of the value of human capital (h_v) are developed in this report: one measure excludes experience and the other includes it. Table III-1 shows that, when experience is not considered, the value of the population-based human capital increased by over 21.9 percent in Canada and by 29.6 percent in Atlantic Canada (annual growth rates of .83% and 1.09%, respectively). The difference from the estimated growth of the quality of human capital is due primarily to the difference in the relationship between earning differentials and education levels. While the level of h_q increases in proportion to the increase in average years of schooling, the value of h_v increases more than in proportion to increases in average years of schooling. The labour force based value of human capital, without considering experience, increased by 24.3 percent for Canada and 26.6 percent for Atlantic Canada (annual growth rates of .91% and .99%, respectively), while the employment based value increased by 25.3 percent for Canada and 26.4 percent for Atlantic Canada (annual growth rates of .94% and .98%, respectively).

Value of Human Capital, Including Experience (h_v^*). Here, both Canada's and Atlantic Canada's value of human capital value increased at a faster rate. From 1976 to 2000, h_v^* rose by over 30.0 percent for the country as a whole and by 44.2 percent for Atlantic Canada (annual growth rates of 1.10% and 1.54%, respectively). The labour force based level of h_v^* increased by 33.4 percent for Canada and 43.1 percent for Atlantic Canada (annual growth rates of 1.21% and 1.51%, respectively), while the employment based value increased by 34.1 percent for Canada and 42.1 percent for Atlantic Canada (annual growth rates of 1.23% and 1.48%, respectively).

Value-based stock of human capital (H_v). This measure is derived as the product of the labour input (L) and the corresponding values of human capital (h_v , excluding experience and h_v^* , including it). When work experience is not taken into account, the population-based measure of H_v increased by 65.7 percent for Canada and 55.5 percent for Atlantic Canada from 1976 to 2000 (annual growth rates of 2.13%, 1.86%, respectively). The labour force based measure increased by 89.6 percent in Canada and by 78.8 percent in Atlantic Canada (annual growth rates of 2.70% and 2.45%, respectively). The employment based measure increased by 91.6 percent in Canada and 77.6 percent in Atlantic Canada (annual growth rates of 2.75% and 2.42%, respectively). When we take work experience into account, the population-based measure of H_v^* increased by 76.7 percent for Canada and 73.1 percent for Atlantic Canada (annual growth rates of 2.40% and 2.31%, respectively). The labour force based value increased by 103.5 percent for Canada and 102.4 percent for Atlantic Canada (annual growth rates of 3.01% and 2.98%), respectively, which is similar to the change for the employment based value.

Effect of population dynamics. The different growth paths of the quality and value of human capital highlight the importance of population dynamics and the interactions with average educational attainment and associated earnings. The level of h_q for the selected population can be calculated as the weighted average of the average years of schooling in each age subgroup i (s_i) where the weights are the shares of each population subgroup ($\rho_i=L_i/L$).

$$h_q = \sum_i s_i \rho_i \tag{10}$$

Two regions with identical value of s_i throughout a given period will experience different growth rates of h_q if the age-specific population shares follow diverging paths. That is what happened in the sample period analyzed in this report. As shown in Table III-3, from 1976 to 2000, the share of the age group 45-54 increased by 4.7 percentage points in Canada and 7.1 percentage points in Atlantic Canada. At the same time, the share of the age group 15-24 fell more in Atlantic Canada than for the country as a whole (12.4 percentage points versus 10.3 percentage points). These different demographic changes in the two jurisdictions would generate different time paths in the shares of groups with given educational levels. This effect would be more pronounced when demographic changes affect the relative population share of those in the age group 15-19, which involves a portion of the labour input not old enough to have acquired the desired level of education. As shown in Table III-4, during the period from 1976 to 2000, the share of the group with high school education and less in the population 15 to 64 years of age fell by 27.9 percentage points in Canada and by 28.4 percentage points in Atlantic Canada and, correspondingly, the share of the group with at least some post-secondary education increased by the same percentage points. These different changes in

population shares would, other things remaining unchanged, generate a higher growth of h_q in Atlantic Canada compared to the country as a whole. The effect of these demographic changes on the growth rates of human capital in Canada and Atlantic Canada will be greater on the value measure of human capital (h_v) because wage differentials increase more than in proportion to differential in average educational levels. This effect is further magnified by the inclusion of experience in the measurement of h_v^* because the shift in relative population shares from the group with the least degree of experience to the group with substantial work experience and at the peak of the lifetime earning profile was more pronounced in Atlantic Canada.

Table III-3. Share of the Population, Labour Force and Employment by Selected Age Group: Canada and Atlantic Canada, 1976-2000.

| | | | 15-24 | 25-44 | 45-54 | 55-64 |
|-----------------|--------------|------|--------|--------|--------|--------|
| | | | years | years | years | years |
| Canada | Population | 1976 | 0.2996 | 0.4125 | 0.1618 | 0.1261 |
| | | 2000 | 0.1967 | 0.4606 | 0.2085 | 0.1342 |
| | Labour Force | 1976 | 0.2803 | 0.4543 | 0.1667 | 0.0986 |
| | | 2000 | 0.166 | 0.5194 | 0.2245 | 0.09 |
| | Employment | 1976 | 0.2648 | 0.4614 | 0.172 | 0.1017 |
| | | 2000 | 0.1558 | 0.5241 | 0.2287 | 0.0914 |
| Atlantic Canada | Population | 1976 | 0.3257 | 0.3943 | 0.1468 | 0.1332 |
| | | 2000 | 0.2018 | 0.4427 | 0.2176 | 0.1379 |
| | Labour Force | 1976 | 0.3033 | 0.4454 | 0.1498 | 0.1014 |
| | | 2000 | 0.1684 | 0.5198 | 0.2316 | 0.0803 |
| | Employment | 1976 | 0.2816 | 0.4539 | 0.1579 | 0.1067 |
| | | 2000 | 0.1564 | 0.5243 | 0.2378 | 0.0815 |

Source: As in Table III-1.

Table III-4. Share of the Population, Labour Force and Employment by Education Level: Canada and Atlantic Canada, 1976-2000.

| | | | High School Education and Less | Post-secondary Education and More |
|-----------------|--------------|------|-----------------------------------|--------------------------------------|
| Canada | Population | 1976 | 0.7186 | 0.2814 |
| | | 2000 | 0.4399 | 0.56 |
| | Labour Force | 1976 | 0.6799 | 0.3201 |
| | | 2000 | 0.389 | 0.611 |
| | Employment | 1976 | 0.6725 | 0.3275 |
| | | 2000 | 0.3783 | 0.6216 |
| Atlantic Canada | Population | 1976 | 0.7528 | 0.2472 |
| | | 2000 | 0.4684 | 0.5316 |
| | Labour Force | 1976 | 0.6896 | 0.3104 |
| | | 2000 | 0.3977 | 0.6023 |
| | Employment | 1976 | 0.6741 | 0.3259 |
| | | 2000 | 0.3765 | 0.6235 |

Source: As in Table III-1.

In conclusion, the faster rate of growth of human capital in Atlantic Canada, by a very small margin in the quality measure and by a large margin in the two value measures, was caused by the faster rate of increase in the average age of the population, labour force and employed work force in the 15-64 age range. The higher growth rates of the value of human capital in Atlantic Canada almost offset the lower growth of the labour input. As a result, the stock of human capital, based on the labour force and including experience, increased at similar rates in Canada and Atlantic Canada.

Relative Contribution of Educational Attainment, Earnings and Experience. The information contained in Table III-1 allows the calculation of the relative contribution of educational attainment, earning differentials and experience to the growth of the value of human capital (h_v^*). As shown in Table III-5, the relative contribution of the three components of h_v^* were not equal for Canada and Atlantic Canada. For the country as a whole, years of schooling accounted for about 46 percent of

the growth of h_v^* , with earning differentials contributing 29 percent and experience 25 percent. In Atlantic Canada, the contribution of years of schooling was about 37 percent (80% of the national value) and that of earning differentials and experience was 31 percent and 32 percent, respectively. As discussed in the previous subsection, the above differences between Canada and Atlantic Canada are due largely to different demographic dynamics.

Table III-3. Contribution of Various Components to the Growth of Human Capital in Canada and Atlantic Canada, 1976-2000.

| Component and Base of Measures | Percentage of the Average Annual Growth of the Value of Human Capital Including Experience | |
|---|--|-----------------|
| | Canada | Atlantic Canada |
| Population-Based | | |
| Years of Schooling | 0.5 | 0.37 |
| Earnings Differentials (No Experience) | 0.25 | 0.34 |
| Experience | 0.25 | 0.29 |
| Labour Force-Based | | |
| Years of Schooling | 0.45 | 0.36 |
| Earnings Differentials (No Experience) | 0.3 | 0.29 |
| Experience | 0.25 | 0.35 |
| Employment-Based | | |
| Years of Schooling | 0.45 | 0.37 |
| Earnings Differentials (No Experience) | 0.32 | 0.29 |
| Experience | 0.23 | 0.34 |

Source: As in Table III-1.

IV. CONCLUSIONS

This paper presented estimates of the growth of human capital for Canada and Atlantic Canada during the 1976- 2000 period. Starting with the basic labour input (L), human capital was measured in terms of quality and value. L was measured by the population in the age group 15 to 64, which was divided into four subgroups: 15 to 24, 25 to 44, 45 to 54 and 55 to 64. Quality was measured by the average years of schooling in each subgroup, separately for males and females. Value was measured by assigning to the average individual in each age-education group the market value of his/her human capital on the assumption that workers are paid the value of their marginal product. The labour input and each measure of human capital were calculated for the population, the labour force, and employment. The results lead to the following observations.

1. Atlantic Canada experienced a substantially lower growth rate of the population aged 15-64 than the country as a whole, a shortfall from the national average of half a percentage point per year on average. This shortfall was reduced to about one-third of a percentage point for the labour force and employment, as the participation rate increased at a faster rate in Atlantic Canada while employment increased at a slightly lower rate.
2. The quality of human capital, measured by the average years of schooling per unit of the labour input, increased at the same rate in Canada and Atlantic Canada for the labour force and employment measures, and at a slightly higher rate in Atlantic Canada for the population-based measure.
3. The value of human capital, measured by its earnings, grew at a faster rate in Atlantic Canada

than in Canada even when experience is not included, by a quarter of a percentage point in the population-based measure and by about 0.08 percentage points in the labour force and 0.04 in the employment measures. When experience is included, the difference in growth rates between Atlantic Canada and Canada increased to 0.44 percentage points for the population-based measure and by about a quarter of a percentage point in the labour force and employment measures.

4. When the labour input is combined with the value based measures of human capital including experience, the result is very similar average annual growth rates of the value-based stock of human capital. The growth rate for Canada is only about 0.1 percentage points higher than for Atlantic Canada under the population and employment measures, and only 0.02 percentage points higher in the labour force measure.

5. Our calculations indicate that the shortfall in the growth rate of the labour input in Atlantic Canada relative to the national average was almost entirely offset by different labour force developments and demographic dynamics between Canada and the Atlantic region, which generated above-average growth in the value of human capital.

The analysis presented in this paper has important implications for at least two areas of research, namely, comparative economic growth and future trends in human capital. In their attempt to explain the economic forces that may lead to convergence among Canadian provinces, economists have turned their attention to human capital and measured it by the share of the population, the labour force or employment that has obtained a certain level of education. This paper provides a

time series of human capital values for the 1976-2000 period, for Canada and Atlantic Canada, which incorporates information on the different levels of educational attainment of the population 15-64 years of age. Therefore, it offers a more meaningful data set for analyzing the contribution of human capital to the process of convergence of Atlantic Canada to the national average. The estimates of human capital suggest that care must be taken in selecting the appropriate measure of human capital. For example, the quality measures show no tendency towards convergence, as human capital per unit of the labour input increased at similar rates in Canada and Atlantic Canada. However, the value of human capital indicates convergence, especially when experience is taken into account. In the latter case, one must explain why demographic developments should be considered as part of the economic forces that drive the convergence process.

The analysis contained in this paper is also useful in developing forecasts of human capital. The need for these forecasts has become more urgent due to the expectation of future labour shortages resulting from low fertility rates and population aging. Predictions of labour shortages are based on population projections that focus on the labour input. One may argue that, in the knowledge-based age, what matters is the economic contribution that can be made by each unit of the labour input, and this contribution depends on the levels of human capital embodied in the labour input. Economic growth in the knowledge based age is not necessarily impaired by the lack of growth in the number of people of working age. Supplementing population projections with projections of human capital, a task that will be performed in future research, has potentially significant implications for government policies in a variety of fields, involving health care, social services, labour training, and immigration.

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Appendix

Table A-1. Labour Input

| | Population | | Labour Force | | Employment | |
|------|------------|--------|--------------|--------|------------|--------|
| | Canada | Atl. | Canada | Atl. | Canada | Atl. |
| 1976 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1977 | 101.85 | 101.35 | 102.54 | 101.72 | 101.47 | 99.82 |
| 1978 | 103.72 | 102.80 | 106.05 | 105.13 | 104.55 | 103.14 |
| 1979 | 105.51 | 104.30 | 109.72 | 108.93 | 109.16 | 107.87 |
| 1980 | 107.46 | 105.64 | 113.00 | 110.92 | 112.40 | 110.52 |
| 1981 | 109.21 | 106.48 | 116.49 | 112.79 | 115.79 | 111.90 |
| 1982 | 110.73 | 107.41 | 117.15 | 113.26 | 112.12 | 108.96 |
| 1983 | 112.04 | 109.09 | 119.41 | 115.62 | 113.02 | 110.10 |
| 1984 | 113.23 | 110.46 | 121.49 | 118.61 | 115.84 | 112.64 |
| 1985 | 114.33 | 111.38 | 123.98 | 121.52 | 119.09 | 114.46 |
| 1986 | 115.44 | 112.04 | 126.53 | 123.61 | 122.94 | 117.58 |
| 1987 | 116.50 | 112.59 | 128.93 | 125.32 | 126.44 | 120.82 |
| 1988 | 117.69 | 113.29 | 131.46 | 128.17 | 130.43 | 125.93 |
| 1989 | 119.00 | 114.21 | 133.98 | 131.13 | 133.22 | 129.12 |
| 1990 | 120.47 | 115.19 | 135.80 | 133.39 | 134.17 | 130.29 |
| 1991 | 121.96 | 116.13 | 136.62 | 133.19 | 131.75 | 128.34 |
| 1992 | 123.60 | 116.87 | 136.93 | 132.00 | 130.83 | 125.55 |
| 1993 | 125.18 | 117.47 | 138.33 | 132.61 | 131.87 | 125.71 |
| 1994 | 126.48 | 117.78 | 139.35 | 132.66 | 134.35 | 126.43 |
| 1995 | 127.91 | 117.96 | 140.63 | 132.78 | 136.97 | 128.87 |
| 1996 | 129.45 | 118.24 | 142.08 | 132.25 | 138.07 | 127.73 |
| 1997 | 131.12 | 118.55 | 144.44 | 134.47 | 141.20 | 129.58 |
| 1998 | 132.69 | 118.65 | 146.90 | 136.81 | 144.90 | 133.42 |
| 1999 | 134.24 | 119.15 | 149.88 | 139.40 | 149.01 | 137.85 |
| 2000 | 135.91 | 120.00 | 152.58 | 141.31 | 152.97 | 140.50 |

Table A-2. Quality of Human Capital.

| | Population | | Labour Force | | Employment | |
|------|------------|--------|--------------|--------|------------|--------|
| | Canada | Atl. | Canada | Atl. | Canada | Atl. |
| 1976 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1977 | 100.33 | 100.32 | 100.38 | 100.24 | 100.50 | 100.39 |
| 1978 | 100.49 | 100.86 | 100.54 | 100.84 | 100.64 | 101.05 |
| 1979 | 100.56 | 101.23 | 100.53 | 101.23 | 100.59 | 101.35 |
| 1980 | 101.20 | 101.62 | 101.24 | 101.54 | 101.37 | 101.68 |
| 1981 | 101.75 | 102.08 | 101.77 | 102.10 | 101.90 | 102.25 |
| 1982 | 102.48 | 102.70 | 102.64 | 102.80 | 102.98 | 103.16 |
| 1983 | 103.32 | 103.62 | 103.49 | 103.79 | 103.88 | 104.16 |
| 1984 | 103.86 | 104.10 | 104.08 | 104.19 | 104.44 | 104.69 |
| 1985 | 104.43 | 104.67 | 104.63 | 104.78 | 104.98 | 105.35 |
| 1986 | 105.07 | 105.39 | 105.17 | 105.41 | 105.45 | 105.95 |
| 1987 | 105.75 | 105.91 | 105.80 | 105.96 | 106.04 | 106.31 |
| 1988 | 106.61 | 106.70 | 106.68 | 106.65 | 106.83 | 106.92 |
| 1989 | 106.92 | 107.38 | 106.97 | 107.29 | 107.15 | 107.62 |
| 1990 | 107.60 | 108.10 | 107.76 | 108.07 | 107.95 | 108.37 |
| 1991 | 108.05 | 108.56 | 108.37 | 108.70 | 108.74 | 109.00 |
| 1992 | 108.77 | 109.39 | 109.30 | 109.71 | 109.75 | 110.14 |
| 1993 | 109.78 | 110.57 | 110.46 | 110.92 | 110.86 | 111.36 |
| 1994 | 110.50 | 111.04 | 111.12 | 111.45 | 111.45 | 111.83 |
| 1995 | 111.09 | 111.79 | 111.78 | 112.07 | 112.06 | 112.20 |
| 1996 | 111.56 | 112.05 | 112.20 | 112.44 | 112.46 | 112.63 |
| 1997 | 112.41 | 112.87 | 112.96 | 113.00 | 113.25 | 113.38 |
| 1998 | 112.81 | 113.67 | 113.29 | 113.29 | 113.50 | 113.54 |
| 1999 | 113.36 | 114.10 | 113.63 | 113.49 | 113.76 | 113.63 |
| 2000 | 114.04 | 114.66 | 114.14 | 113.98 | 114.20 | 114.19 |

Table A-3. Quality-based Stock of Human Capital.

| | Population | | Labour Force | | Employment | |
|------|------------|--------|--------------|--------|------------|--------|
| | Canada | Atl. | Canada | Atl. | Canada | Atl. |
| 1976 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1977 | 102.18 | 101.67 | 102.93 | 101.97 | 101.97 | 100.20 |
| 1978 | 104.22 | 103.69 | 106.62 | 106.01 | 105.22 | 104.22 |
| 1979 | 106.10 | 105.59 | 110.30 | 110.26 | 109.81 | 109.33 |
| 1980 | 108.74 | 107.36 | 114.40 | 112.63 | 113.94 | 112.37 |
| 1981 | 111.13 | 108.70 | 118.55 | 115.15 | 117.99 | 114.42 |
| 1982 | 113.47 | 110.31 | 120.25 | 116.43 | 115.46 | 112.41 |
| 1983 | 115.75 | 113.05 | 123.58 | 120.00 | 117.40 | 114.68 |
| 1984 | 117.60 | 114.99 | 126.45 | 123.58 | 120.97 | 117.92 |
| 1985 | 119.40 | 116.59 | 129.72 | 127.33 | 125.01 | 120.58 |
| 1986 | 121.29 | 118.09 | 133.07 | 130.30 | 129.65 | 124.57 |
| 1987 | 123.20 | 119.24 | 136.41 | 132.79 | 134.08 | 128.45 |
| 1988 | 125.47 | 120.88 | 140.24 | 136.69 | 139.34 | 134.65 |
| 1989 | 127.23 | 122.63 | 143.32 | 140.68 | 142.74 | 138.96 |
| 1990 | 129.63 | 124.52 | 146.33 | 144.16 | 144.83 | 141.19 |
| 1991 | 131.78 | 126.08 | 148.06 | 144.78 | 143.26 | 139.89 |
| 1992 | 134.44 | 127.85 | 149.67 | 144.82 | 143.58 | 138.29 |
| 1993 | 137.43 | 129.88 | 152.80 | 147.10 | 146.19 | 139.99 |
| 1994 | 139.75 | 130.78 | 154.84 | 147.84 | 149.74 | 141.39 |
| 1995 | 142.09 | 131.87 | 157.20 | 148.81 | 153.49 | 144.59 |
| 1996 | 144.42 | 132.48 | 159.41 | 148.71 | 155.28 | 143.87 |
| 1997 | 147.39 | 133.81 | 163.15 | 151.94 | 159.91 | 146.91 |
| 1998 | 149.70 | 134.86 | 166.42 | 154.99 | 164.47 | 151.49 |
| 1999 | 152.18 | 135.95 | 170.30 | 158.20 | 169.51 | 156.63 |
| 2000 | 155.00 | 137.59 | 174.15 | 161.07 | 174.69 | 160.43 |

Table A-4. Value of Human Capital, Excluding Experience.

| | Population | | Labour Force | | Employment | |
|------|------------|--------|--------------|--------|------------|--------|
| | Canada | Atl. | Canada | Atl. | Canada | Atl. |
| 1976 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1977 | 99.74 | 100.41 | 99.82 | 100.33 | 100.27 | 100.82 |
| 1978 | 100.04 | 102.08 | 99.97 | 101.91 | 100.37 | 102.52 |
| 1979 | 98.90 | 101.00 | 98.45 | 100.44 | 98.76 | 100.72 |
| 1980 | 100.08 | 101.67 | 100.03 | 101.06 | 100.52 | 101.49 |
| 1981 | 102.02 | 102.91 | 102.10 | 102.52 | 102.65 | 103.01 |
| 1982 | 103.82 | 104.53 | 104.52 | 104.26 | 105.80 | 105.35 |
| 1983 | 106.29 | 107.43 | 107.02 | 107.24 | 108.37 | 108.26 |
| 1984 | 107.51 | 108.78 | 108.49 | 108.37 | 109.72 | 109.57 |
| 1985 | 108.58 | 110.02 | 109.71 | 109.82 | 110.94 | 111.31 |
| 1986 | 110.29 | 112.57 | 111.11 | 111.87 | 112.25 | 113.04 |
| 1987 | 111.74 | 113.34 | 112.75 | 112.46 | 113.81 | 113.20 |
| 1988 | 113.71 | 116.19 | 114.90 | 115.29 | 115.74 | 115.76 |
| 1989 | 114.67 | 118.43 | 115.96 | 117.31 | 116.83 | 117.80 |
| 1990 | 115.54 | 119.67 | 117.04 | 118.52 | 117.95 | 118.91 |
| 1991 | 116.20 | 120.87 | 118.01 | 119.92 | 119.24 | 120.25 |
| 1992 | 117.19 | 122.49 | 119.42 | 121.70 | 120.75 | 122.20 |
| 1993 | 118.44 | 124.80 | 120.96 | 123.83 | 122.22 | 124.19 |
| 1994 | 119.40 | 125.06 | 121.87 | 124.07 | 123.05 | 124.33 |
| 1995 | 119.98 | 126.08 | 122.57 | 124.74 | 123.69 | 124.58 |
| 1996 | 120.39 | 126.52 | 122.94 | 125.18 | 124.06 | 125.16 |
| 1997 | 120.97 | 127.46 | 123.48 | 125.63 | 124.62 | 125.74 |
| 1998 | 121.23 | 128.60 | 123.70 | 125.95 | 124.78 | 125.90 |
| 1999 | 121.56 | 128.81 | 123.94 | 125.87 | 124.97 | 125.70 |
| 2000 | 121.90 | 129.60 | 124.25 | 126.55 | 125.26 | 126.38 |

Table A-5. Value of Human Capital, including Experience.

| | Population | | Labour Force | | Employment | |
|------|------------|--------|--------------|--------|------------|--------|
| | Canada | Atl. | Canada | Atl. | Canada | Atl. |
| 1976 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1977 | 99.94 | 100.37 | 99.96 | 99.79 | 100.47 | 100.65 |
| 1978 | 100.21 | 102.50 | 100.11 | 102.76 | 100.54 | 103.56 |
| 1979 | 99.12 | 102.17 | 98.56 | 101.66 | 98.84 | 102.17 |
| 1980 | 100.51 | 103.47 | 100.32 | 103.58 | 100.78 | 103.97 |
| 1981 | 102.77 | 105.22 | 102.78 | 105.26 | 103.24 | 105.57 |
| 1982 | 104.91 | 107.12 | 105.87 | 108.02 | 107.42 | 109.54 |
| 1983 | 107.76 | 111.09 | 108.69 | 112.14 | 110.24 | 113.84 |
| 1984 | 109.23 | 112.72 | 110.28 | 113.84 | 111.51 | 115.52 |
| 1985 | 110.78 | 114.23 | 112.14 | 115.73 | 113.25 | 117.68 |
| 1986 | 113.39 | 117.85 | 114.24 | 119.13 | 115.21 | 120.61 |
| 1987 | 115.33 | 119.28 | 116.56 | 119.36 | 117.31 | 120.10 |
| 1988 | 118.29 | 123.09 | 119.91 | 123.98 | 120.31 | 124.10 |
| 1989 | 119.90 | 126.32 | 121.71 | 127.10 | 122.15 | 127.15 |
| 1990 | 121.21 | 128.31 | 123.32 | 129.06 | 123.81 | 128.98 |
| 1991 | 122.44 | 130.48 | 125.05 | 131.38 | 125.99 | 131.74 |
| 1992 | 123.99 | 133.26 | 127.24 | 134.10 | 128.31 | 134.47 |
| 1993 | 125.78 | 136.48 | 129.39 | 137.26 | 130.37 | 137.48 |
| 1994 | 127.16 | 137.20 | 130.71 | 138.20 | 131.56 | 138.15 |
| 1995 | 127.97 | 138.74 | 131.69 | 139.29 | 132.45 | 138.53 |
| 1996 | 128.63 | 139.67 | 132.32 | 140.24 | 133.10 | 139.43 |
| 1997 | 129.30 | 141.53 | 133.04 | 141.69 | 133.93 | 141.19 |
| 1998 | 129.58 | 142.95 | 133.26 | 142.30 | 134.07 | 141.53 |
| 1999 | 129.88 | 143.38 | 133.34 | 142.38 | 134.12 | 141.56 |
| 2000 | 130.01 | 144.24 | 133.39 | 143.19 | 134.13 | 142.13 |

Table A-6. Value-based Stock of Human Capital, excluding Experience.

| | Population | | Labour Force | | Employment | |
|------|------------|--------|--------------|--------|------------|--------|
| | Canada | Atl. | Canada | Atl. | Canada | Atl. |
| 1976 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1977 | 101.58 | 101.76 | 102.35 | 102.06 | 101.74 | 100.64 |
| 1978 | 103.76 | 104.94 | 106.02 | 107.13 | 104.93 | 105.73 |
| 1979 | 104.35 | 105.34 | 108.02 | 109.40 | 107.81 | 108.64 |
| 1980 | 107.54 | 107.41 | 113.03 | 112.09 | 112.98 | 112.16 |
| 1981 | 111.42 | 109.59 | 118.93 | 115.63 | 118.86 | 115.28 |
| 1982 | 114.96 | 112.28 | 122.44 | 118.08 | 118.62 | 114.79 |
| 1983 | 119.08 | 117.20 | 127.79 | 124.00 | 122.48 | 119.19 |
| 1984 | 121.73 | 120.15 | 131.80 | 128.54 | 127.09 | 123.42 |
| 1985 | 124.14 | 122.54 | 136.02 | 133.45 | 132.11 | 127.41 |
| 1986 | 127.31 | 126.13 | 140.59 | 138.28 | 138.00 | 132.91 |
| 1987 | 130.19 | 127.61 | 145.37 | 140.93 | 143.91 | 136.77 |
| 1988 | 133.83 | 131.63 | 151.04 | 147.77 | 150.96 | 145.78 |
| 1989 | 136.46 | 135.26 | 155.36 | 153.82 | 155.64 | 152.11 |
| 1990 | 139.20 | 137.85 | 158.93 | 158.09 | 158.25 | 154.92 |
| 1991 | 141.71 | 140.37 | 161.23 | 159.73 | 157.09 | 154.33 |
| 1992 | 144.85 | 143.16 | 163.53 | 160.65 | 157.97 | 153.42 |
| 1993 | 148.27 | 146.60 | 167.32 | 164.21 | 161.17 | 156.12 |
| 1994 | 151.01 | 147.29 | 169.82 | 164.59 | 165.31 | 157.19 |
| 1995 | 153.46 | 148.73 | 172.37 | 165.63 | 169.42 | 160.55 |
| 1996 | 155.85 | 149.59 | 174.68 | 165.56 | 171.29 | 159.87 |
| 1997 | 158.61 | 151.11 | 178.36 | 168.93 | 175.96 | 162.94 |
| 1998 | 160.87 | 152.58 | 181.72 | 172.31 | 180.80 | 167.98 |
| 1999 | 163.19 | 153.47 | 185.76 | 175.45 | 186.22 | 173.27 |
| 2000 | 165.67 | 155.52 | 189.59 | 178.84 | 191.61 | 177.55 |

Table A-7. Value-based Stock of Human Capital, including Experience.

| | Population | | Labour Force | | Employment | |
|------|------------|--------|--------------|--------|------------|--------|
| | Canada | Atl. | Canada | Atl. | Canada | Atl. |
| 1976 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1977 | 101.79 | 101.72 | 102.49 | 101.51 | 101.94 | 100.47 |
| 1978 | 103.93 | 105.37 | 106.16 | 108.03 | 105.11 | 106.81 |
| 1979 | 104.59 | 106.56 | 108.14 | 110.73 | 107.89 | 110.21 |
| 1980 | 108.01 | 109.31 | 113.36 | 114.89 | 113.28 | 114.91 |
| 1981 | 112.23 | 112.04 | 119.73 | 118.72 | 119.54 | 118.13 |
| 1982 | 116.17 | 115.06 | 124.04 | 122.34 | 120.43 | 119.36 |
| 1983 | 120.73 | 121.19 | 129.79 | 129.67 | 124.59 | 125.34 |
| 1984 | 123.68 | 124.51 | 133.98 | 135.03 | 129.16 | 130.13 |
| 1985 | 126.66 | 127.23 | 139.04 | 140.63 | 134.87 | 134.70 |
| 1986 | 130.90 | 132.04 | 144.54 | 147.25 | 141.64 | 141.81 |
| 1987 | 134.36 | 134.30 | 150.29 | 149.58 | 148.34 | 145.11 |
| 1988 | 139.21 | 139.45 | 157.64 | 158.89 | 156.93 | 156.28 |
| 1989 | 142.68 | 144.27 | 163.06 | 166.66 | 162.72 | 164.18 |
| 1990 | 146.03 | 147.80 | 167.46 | 172.15 | 166.11 | 168.04 |
| 1991 | 149.32 | 151.53 | 170.84 | 174.99 | 165.99 | 169.08 |
| 1992 | 153.25 | 155.74 | 174.23 | 177.02 | 167.87 | 168.84 |
| 1993 | 157.46 | 160.32 | 178.99 | 182.02 | 171.92 | 172.83 |
| 1994 | 160.83 | 161.59 | 182.15 | 183.34 | 176.75 | 174.66 |
| 1995 | 163.69 | 163.66 | 185.20 | 184.95 | 181.41 | 178.52 |
| 1996 | 166.52 | 165.14 | 188.00 | 185.47 | 183.77 | 178.10 |
| 1997 | 169.54 | 167.78 | 192.16 | 190.53 | 189.11 | 182.96 |
| 1998 | 171.94 | 169.61 | 195.75 | 194.68 | 194.26 | 188.83 |
| 1999 | 174.36 | 170.84 | 199.85 | 198.47 | 199.85 | 195.13 |
| 2000 | 176.70 | 173.08 | 203.53 | 202.35 | 205.17 | 199.69 |

