MEASURING HUMAN CAPITAL IN CANADA

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ABSTRACT

This paper presents a labour income based 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. Unlike measures of human capital based on average years of schooling, this measure does not assume that the productivity differential among workers is proportional to the differential in educational attainment. It also strives to capture differences in quality of education as well as the market relevance of different types of education and of working experience. This measure of Canada's human capital stock can be used in endogenous growth models, empirical accounting exercises, as well as in the assessment of labour market issues.

RÉSUMÉ

Le document présente une mesure, établie d'après le revenu du travail, du stock de capital humain au Canada, de 1971 à 1996, compte tenu du niveau d'instruction atteint et du nombre d'années d'expérience de travail. Contrairement aux mesures du capital humain établies d'après le nombre moyen d'années de scolarité, cette mesure ne repose pas sur l'hypothèse que l'écart de productivité entre les travailleurs est proportionnel à l'écart relatif au niveau de scolarité. De plus, elle vise à saisir les écarts liés à la qualité de l'éducation et à la pertinence des divers genres d'études et d'expériences de travail par rapport au marché. Cette mesure du stock de capital humain du Canada peut constituer une variable dans les modèles de croissance endogènes et être utilisée aux fins d'activités comptables empiriques et de l'évaluation des questions inhérentes au marché du travail.

I. INTRODUCTION

The emergence of the endogenous growth literature with the seminal papers of Romer (1986) and Lucas (1988) has re-emphasised the importance of human capital as a source of progress and economic growth. This literature underlines many channels by which human capital can enhance economic growth. Among them is the stimulus to domestic activities related to technological creation, invention, and innovation. Human capital also greatly facilitates the absorption and imitation of new technology originating from abroad. As a factor of economic growth, the accumulation of human capital may be of even greater importance than the accumulation of physical capital. Recent empirical studies on economic growth confirm that the skills and knowledge of a nation's population are an important determinant of economic performance.[1]

Despite the growing and convincing evidence of human capital as a source of economic progress, no satisfactory measure of Canada's *human capital stock* exists. This may be an important caveat for economic analysis related to Canadian economic performance. For instance, Jorgenson and Fraumeni (1989) showed that between 1948 and 1984 in the United States, investment in human capital was at least four times the magnitude of investment in physical capital, while the value of human capital exceeded the value of physical capital by more than eleven times. Recently, Kirova and Lipsey (1998) found that a more comprehensive measure of capital formation, which includes human capital formation, can help to explain the fact that, since the early 1990s, economic growth has been more rapid in the United States than in most of the other OECD economies.

In Canada, Beach, Boadway and Bruce (1988) and Macklem (1997) estimated that Canada's *stock of human wealth* is greater than its stock of non-human wealth. Human wealth is defined in these papers as the expected present value of aggregate labour income net of government taxes. The forward-looking nature of human wealth improves our understanding of household behaviour (consumption and savings) but is much less useful for issues related to Canada's current productive capacity.

This paper estimates Canada's *human capital stock* from 1971 to 1996 based on the completion of education levels and the number of years of working experience. Educational attainment is measured using data on annual inflows of high school and post-secondary graduates, as well as on Census observations. This improved measure of human capital has four potential uses.

First, it will allow policy makers to more fully comprehend the role of human capital with respect to economic performance and technological advancement. For instance, a proper measure of human capital will improve the growth accounting assessment of the role of capital accumulation activities and technological changes (Solow residuals).

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[1] A summary of theoretical and empirical contributions in this literature can be found in the symposium of *The Journal of Economic Perspectives* (Spring 1994) and in Barro and Sala-i-Martin (1995).

Second, given its rapidly advancing population ageing, Canada needs to count on an improvement in the quality of its labour force to compensate for the slower rate of growth in the number of workers. Only with a suitable measure of human capital per worker can we assess correctly the evolution of the *effective* labour force.

Third, as a substantial part of human capital accumulation depends on fiscal policies, it is important for governments to be able to assess these policies adequately. These policies include expenditures and transfer programs such as spending on education, but also tax incentives with respect to individuals' efforts towards human capital formation.

Finally, a proper measure of human capital will be useful in accurately specifying economic models. With such a measure, it will be possible to estimate the different parameters associated with the human capital production function.

The paper is organised as follows: Section II reviews the literature on measuring human capital; Section III describes the methodology and the data used to measure Canada's human capital stock; Section IV presents the results; and Section V provides some concluding remarks.

II. LITERATURE REVIEW

Three main approaches have been used in the economic literature to measure the stock and the contribution of human capital (or education) to economic growth. The cost-based approach typically estimates the human capital stock by summing direct expenditures on schools (including the opportunity cost associated with going to school) and other items defined as human capital investments. The output-based approach measures the output of the educational system, while the income-based approach considers the returns individuals receive from the labour market for their investment in education.

A) Cost-Based Approach

The cost-based approach estimates the human capital stock by its inputs. More precisely, the stock of human capital is typically estimated by calculating the depreciated value of investments made in education (including the opportunity cost associated with going to school), general training, and health and safety, as well as the value of investments in rearing and mobility (Kendricks, 1976; Eisner, 1989). This gives a measure of the flow of resources invested in the educational and other human capital related sectors, which can be very useful for cost-benefit analyses. However, the cost-based approach for measuring human capital ignores the lengthy gestation period between the application of educational inputs and the emergence of human capital embodied in the graduates of educational institutions. The cost-based approach relies heavily on the researchers' assumptions regarding the classification of expenditures between consumption and investments. Moreover, this approach is quite sensitive to the depreciation rate used. Kendricks (1976) depreciated his human capital stock using a modified double-declining balance schedule, while Eisner (1989) used the straight-line method. These two

approaches do not allow for the appreciation of human capital; empirical evidence has shown that human capital typically appreciates with working experience.

B) Output-Based Approach

Adult Literacy and School Enrolment Rates

The first attempts to control human capital in cross-countries regressions typically used published measures of school enrolment (Barro, 1991; Mankiw, Romer, and Weil, 1992) and adult literacy rates (Romer, 1989; Azariadis and Drazen, 1990) as proxies for human capital. While the publication of such data by world organisations, such as UNESCO and the World Bank, enables empirical investigations on broad international samples, these measures of human capital have severe shortcomings. First, school enrolment rates are measures of the *flow* of investments in human capital, rather than its stock. Their use only captures a fraction of the continuous accumulation of the stock of human capital. Moreover, as pointed out by Psacharopoulos and Arriagada (1986), investments in education are time-consuming, thereby generating long delays between investments and additions to the human capital stock. Second, while net enrolment ratios are more appropriate for estimating human capital accumulation, gross enrolment ratios are typically used due to their wider availability. The use of gross enrolment ratios as a proxy for human capital accumulation introduces measurement errors related to the presence of grade repetition and dropouts.

Unlike school enrolment ratios, adult literacy rates are a measure of the stock of human capital. However, since they only grasp the first stages of human capital accumulation (reading, writing, and arithmetic), using such a measure assumes that knowledge and skills acquired beyond basic levels do not contribute significantly to productivity.[2]

Average Years of Schooling

In an attempt to provide a more accurate measure of human capital, Psacharopoulos and Arriagada (1986, 1992) developed a measure of the stock of human capital for 99 countries, including Canada, based on the educational attainment of the labour force. This measure is defined as the mean years of formal education embodied in the labour force $(\overline{H}_{PA})$. Algebraically:

$$\overline{H}_{PA} = \sum_i L_i H_i \qquad (1)$$

where L_i is the proportion of the labour force with the ith level of education and H_i is the number of years of schooling associated with the ith level of education. Educational

[2] For further discussions on the limitations of school enrolment and adult literacy rates as measures of the stock of human capital, see Barro and Lee (1993).

attainment was broken down into seven levels of education: no education, incomplete primary, complete primary, incomplete secondary, complete secondary, and higher education.

Lau, Jamison and Louat (1991) developed a time series of the educational capital stock of 58 developing countries from 1965 to 1985 based on the number of years of completed education. More precisely, the educational capital stock is defined as the number of person-school years of the working age population (15 to 64 years of age). To build their measure, the authors first compiled and/or estimated time series of gross annual primary and secondary school enrolments for each countries. They then estimated the stock of human capital (H_{LJL}) in each of these countries using a perpetual inventory approach that assumes that there is no depreciation, mortality, or migration during the working life of individuals.

Kyriacou (1991) computed estimates of the human capital stock of the labour force for a wide-range of countries, including Canada, by linking census data on educational attainment from Psacharopoulos and Arriagada (1986) to gross school enrolment data published in UNESCO's *Statistical Yearbook*. Kyriacou first selected 42 countries for which Psacharopoulos and Arriagada had measures of mean years of schooling that lay between 1974 and 1977. Kyriacou then regressed average years of schooling ($\overline{H}_{PA}$) of the labour force on lagged gross school enrolment ratios:

$$\overline{H}_{PA} = 0.052 + 4.439 PRIM60 + 2.665 SEC70 + 8.092 HIGH70 \qquad (2)$$

where *PRIM60* is the 1960 primary school enrolment ratio, *SEC70* is the 1970 secondary enrolment ratio, and *HIGH70* is the 1970 higher education enrolment ratio. Assuming that the relationship between average years of schooling and enrolment ratios is relatively constant over time and across countries, Kyriacou was able to estimate the average years of schooling of the labour force for other years (1965, 1970, 1975, 1980 and 1985) and other countries. The assumption regarding average years of school and school enrolment implies that the length of time required to complete an education level, as well as the dropout and repeater rates do not vary over time and across countries. However, UNESCO (1978) cautioned that projections of educational attainment based on the relationship between educational attainment and enrolments were not reliable, as this relationship was not stable over time.

Barro and Lee (1993) developed a data set containing measures of educational attainment of the adult population (25 years and over) of 129 countries, including Canada, over five-year periods from 1960 to 1985. These measures are based on Census/survey data on educational attainment mainly found in UNESCO's *Statistical Yearbook*, Kaneko (1986), and the United Nations' *Demographic Yearbook*. These data provided approximately 40 per cent of the data needed between 1960 and 1985. The authors estimated the missing information, using a variety of approaches. First, since adult illiteracy rates are highly correlated with the percentage of individuals with no schooling, the authors mainly used them, when available, to fill in the years for which data on no schooling are unavailable. With respect to the remaining missing data, the

authors applied a perpetual inventory method that used Census/survey data on educational attainment as benchmarks, and gross school enrolment ratios, as well as data on the age structure of the population, to estimate the changes from the benchmarks.

Estimates for the different sub-categories of education were obtained by regressing, for example, the completion ratio for primary education (fraction of individuals who completed primary school, but did not go to secondary school, divided by the fraction of individuals who entered primary school, but did not advance to secondary school) on five- and ten-year lagged values and on regional dummies. Estimated coefficients were then used in a perpetual inventory approach to estimate missing observations. Once these were computed, it was possible to calculate average years of schooling $(\overline{H}_{BL})$:

$$\begin{aligned}\overline{H}_{BL} = DUR_p \cdot \left(\tfrac{1}{2} h_{ip} + h_{cp}\right) + \left(DUR_p + DUR_{s1}\right) \cdot h_{is} + \left(DUR_p + DUR_{s1} + DUR_{s2}\right) \cdot h_{cs} \\ \left(DUR_p + DUR_{s1} + DUR_{s2} + \tfrac{1}{2} DUR_h\right) \cdot h_{is} + \left(DUR_p + DUR_{s1} + DUR_{s2} + DUR_h\right) \cdot h_{ch}\end{aligned} \quad (3)$$

where h_j represents the fraction of the adult population whose highest level of schooling is *j*: *j=ip* for incomplete primary education; *cp* for complete primary education; *is* for first cycle secondary education; *cs* for second cycle secondary education; *ih* for incomplete higher education, and *ch* for complete higher education. The variable DUR_i indicates the number of years required to reach the *i*th level of education, and *i* indexes primary (*p*), first cycle secondary (*s1*), second cycle secondary (*s2*), and higher education (*h*).

In a more recent paper, Barro and Lee (1996) updated their measure of educational attainment to 1990 and modified their approach to include individuals aged 15 to 25 and to correct for the presence of dropouts and repeaters by following an approach developed by Nehru, Swanson and Dubey (1995). Nehru, Swanson and Dubey's measure of human capital is based on the accumulated years of schooling of the working age (15 to 64) population. More specifically, the authors produced a time series of the human capital stock of 85 countries, including Canada, based on net school enrolment data. Net enrolment (E_{it}^N) is calculated by subtracting from gross enrolments (E_{it}^G) the number of dropouts (D_{it}) and repeaters (R_{it}) in each grade:

$$E_{it}^N = E_{it}^G - D_{it} - R_{it} \quad (4)$$

To calculate the stock of human capital created in primary education for example, the authors stipulated that the oldest cohort in the labour force started primary school in the year T-64+6 (assuming that children start school at 6), while the youngest started primary school in T-15+6. Total net enrolments of the 50 cohorts who started primary school between T-58 and T-9 were computed as follows (assuming 6 grades for primary education):

$$H_{N,T}^P = \sum_{T-58}^{T-9} \sum_{i=1}^{6} \theta_{i,T-i-1} E_{i,T-g-1}^N \quad (5)$$

where θ_{iT} represents the probability that each enrolee in grade *i* survives in the year *T*. Assuming constant dropout (*d*) and retention (*r*) rates for all years and grades, the measure of the primary education stock (equation (5)) can be re-written as:

$$H^{P}_{N,T} = \sum_{T-58}^{T-9} \sum_{i=1}^{6} \theta_{i,T-i-1} E^{G}_{i,T-i-1} (1-r-d) \qquad (5')$$

Similar expressions were used to estimate the secondary and higher education stocks. Mean school years of education was then obtained by the normalisation of these education stocks by the working age population.

Table 1 contains estimates of Canada's stock of human capital, measured as average years of schooling, found in the literature. These estimates indicate that the average number of years of education in Canada increased relatively steadily over the years ranging between 9.6 to 12.4 years of schooling in the mid-1980s. However, Barro and Lee (1996) found that there was somewhat of a drop in Canada's educational attainment in the mid-1980s. Nevertheless, this pause in the upward trend was short lived as educational attainment began to rise again toward the end of the decade.

The measurement of a nation's human capital stock by average years of schooling has some drawbacks. First, existing measures of Canada's human capital stock based on average years of schooling were calculated for cross-country comparisons. Focusing on the broadest sample possible has led to the development of measures of human capital which emphasise quantity over quality. Moreover, most of these measures are solely based on Census data. While Censuses are the best source of educational data, they are generally only performed every five or ten years and, in some countries, are infrequent. Studies which make use of enrolment data to build time series of the human capital stock, such as Lau, Jamison and Louat (1991) and Nehru, Swanson and Dubey (1995), do not make use of available data on educational attainment as benchmarks. The absence of such benchmarks may introduce substantial measurement errors in the estimated stocks of human capital.

Second, this approach implicitly assumes that the productivity differential among workers is proportional to the differential in educational attainment. For example, an individual with 12 years of schooling is assumed to be 12-times more productive than an individual with only one year of schooling. Each year of education is assumed to increase an individual's skills always in the same proportion.

Third, workers of different educational attainment are implicitly assumed to be perfect substitutes for each other and the elasticity of substitution across workers is assumed to be constant across regions and over time.

Fourth, this approach does not adjust for the quality of education over time and across regions reflected by, among other things, the length of the school day/year, the educational infrastructure, or the student to teacher ratio.

Finally, some measures based on average years of schooling do not take into account the mortality or migration of individuals, thereby biasing their measure upwards. Furthermore, in some studies, the education of individuals not participating in the labour force is excluded, thereby biasing downwards the human capital stock, particularly that of women.

Table 1. Estimates of Average Years of Education, Canada, Selected Years

Authors	*Years*	*Average Years of Education*
Psacharopoulos and Arriagada	1969	9.1
(1986, 1992)	1981	11.7
Labour force	1987	12.4
Kyriacou (1991)	1965	8.02
Labour Force	1985	9.98
Barro and Lee (1993)	1960	8.07
25 Years and Over	1965	8.32
	1970	8.55
	1975	9.5
	1980	10.16
	1985	10.37
Barro and Lee (1996)	1960	8.07
25 Years and Over	1965	7.8
	1970	8.57
	1975	9.54
	1980	10.23
	1985	9.95
	1990	10.34
15 Years and Over	1960	10.16
	1965	9.73
	1970	9.49
	1975	9.77
	1980	10.32
	1985	10.01
	1990	10.36
Nehru, Swanson, and Dubey (1995)	1960	8.56
15 to 64 years old	1965	8.65
	1970	8.56
	1975	8.90
	1980	9.24
	1985	9.76
	1987	10.01

C) Income-Based Approach

The third approach used to measure a nation's human capital stock is the income-based approach. With this approach, a worker's productivity is measured by his or her remuneration in the labour market, rather than by assuming that productivity increases proportionately with years of education.[3] Moreover, workers with different educational attainment are no longer assumed to be perfect substitutes as the relationship between educational attainment and human capital can now be non-linear.

Mulligan and Sala-i-Martin (1997) developed a *labour-income-based* measure of human capital (LIHK) that they applied to the states of the United States. Since the distribution of skills is not uniform in the labour force, the authors specify an economy's average stock of human capital as the quality-adjusted sum of the labour of its citizens:

$$\overline{H}_{MS,i}(t) = \int_0^{\infty} \theta_i(t,s)\eta_i(t,s)ds \tag{6}$$

where $\eta_i(t,s) = \frac{N_i(t,s)}{N_i(t)}$ indicates the proportion of individuals in economy *i* with *s* years of schooling and $\theta_i(t,s)$ is an efficiency parameter, indicating the contribution of each individual to the stock of human capital.

To determine the nature of the efficiency parameter, the authors assumed that individuals acquire human capital through the combination of some aggregate inputs, such as the stock of physical and human capital devoted to education, and their own time and skills. Since the human and physical content of education may vary across economies and over time, a given number of years of schooling may reflect different amounts of human capital.

The authors assumed that the stock of human capital of an individual with no schooling is identical always and everywhere. This assumption does not imply, however, that the productivity of zero schooling individuals is identical always and everywhere. Zero-schooling individuals' income will vary according to an economy's aggregate stock of physical and human capital as well as of other inputs. This assumption is used to define a numeraire that enables the authors to express their human capital index in a unit

[3] In practice, this approach does not take into account the ability factor (Heckman, Lochner and Taber (1998)), the potential correlation between education and experience (Beaudry and Green (1997)), and the fact that individuals who have attained the same level of education but have studied different subjects may contribute to output differently. It is not clear, however, what is the size and direction of the bias obtained by neglecting the above factors.

that is homogenous across space and time. According to the authors, since any amount of schooling introduces intertemporal and interregional differences in an individual's level of skills, the only sensible numeraire is the zero-schooling worker.

Under the assumption that a worker's marginal product is equal to his wage, the human capital of a worker with *s* years of schooling can be inferred from the wage ratio:

$$\theta_i(t,s) = \frac{w_i(t,s)}{w_i(t,0)} \tag{7}$$

This assumption reflects the idea that a worker's wage rate is composed of two components. The first component depends on the worker's skills, while the second component depends on the physical capital available to him or her. The larger the stock of physical capital in a given economy, the larger will be its impact on productivity due to the complementarity of human and physical capital. Dividing the worker's wage rate by the wage of a worker with zero skills allows the authors to identify the wage's skill component. Thus, the average stock of human capital in a given economy is measured as:

$$\overline{H}_{MS,i} = \left[\int_0^{\infty} w_i(t,s)\eta_i(t,s)ds \right] / w_i(t,0) \tag{8}$$

The term inside the bracket amounts to the average labour income of economy *i* – when abstracting from differences in the participation rates across schooling groups – and can be found in the national accounts. The wage rate of a zero-skilled worker is estimated by the (exponential of the) constant term from a Mincer wage regression.

Average years of schooling can be considered to be a variant of equation (8). When calculating the average years of schooling, the number of years of schooling is used as the efficiency parameter, thereby fixing the weights over time and across regions. Thus, an individual with ten years of schooling is assumed to be ten-times more productive than someone with one year of education. Human capital stocks estimated as average years of schooling are usually lower than those obtained using an income-based approach.

Mulligan and Sala-i-Martin's (1997) measure of human capital has the advantage of capturing the variation in quality and relevance of schooling across regions and over time. This approach nets out the effect of aggregate physical capital on labour income by dividing an individual's wage rate by the wage of a zero-schooling worker. Moreover, this approach allows the elasticity of substitution across workers to vary. However, this measure also has some drawbacks. First, zero-schooling individuals are assumed to be identical across regions and over time and to be perfect substitutes for the remaining workers in the labour force. Second, wages may vary for reasons other than changes in the marginal value of human capital. For instance, fiscal or monetary shocks may be the

cause of changes in relative wages which are, although unrelated, interpreted as changes in the marginal value of human capital.[4]

Koman and Marin (1997) recently developed a measure of the human capital stock of Austria and Germany based on years of completed schooling of the working population aged 15 years and over. This measure uses information on completion of education levels rather than school enrolment data to estimate changes in the human capital stock benchmarks. Using a perpetual inventory approach, the authors estimate the number of individuals of age *i* for whom *j* is their highest level of schooling at time *t* ($H_{KM,i,j,t}$) as:

$$H_{KM,i,j,t} = H_{KM,i-1,j,t-1} \cdot (1-\delta_{i,t}) + H^{+}_{i,j,t} - H^{-}_{i,j,t} \tag{9}$$

where $H^{+}_{i,j,t}$ is the number of individuals aged *i* who completed the education level *j* at time *t*; $H^{-}_{i,j,t}$ is the number of individuals aged *i* whose highest level of schooling was *j* in year *t-1* and who completed a higher educational level in year *t*; and $\delta_{i,t}$ is the proportion of individuals aged *i-1* in year *t-1* who did not survive to year *t*. The survival rate is calculated as:

$$(1-\delta_{i,j,t}) = z_{i,j}\left(\frac{L_{i,t}}{L_{i-1,t-1}}\right) \tag{10}$$

where $L_{i,t}$ is the population of age *i* at time *t* and $z_{i,j}$ permits education-specific survival probabilities.

Following the estimation of $H_{KM,i,j,t}$, the authors compute an aggregate measure of human capital, which measures workers' productivity by their wage income. Having translated each schooling level *j* into years of schooling, the authors use a Cobb-Douglas aggregator to relate workers with different education levels to human capital:

$$\ln\left(\frac{H}{L}\right)_{KM} = \sum_{s} \omega_s \ln\left(\rho(s)\right) \tag{11}$$

$$\text{where } \omega_s = \frac{e^{\gamma s} L(s)}{\sum_{s} e^{\gamma s} L(s)} \tag{12}$$

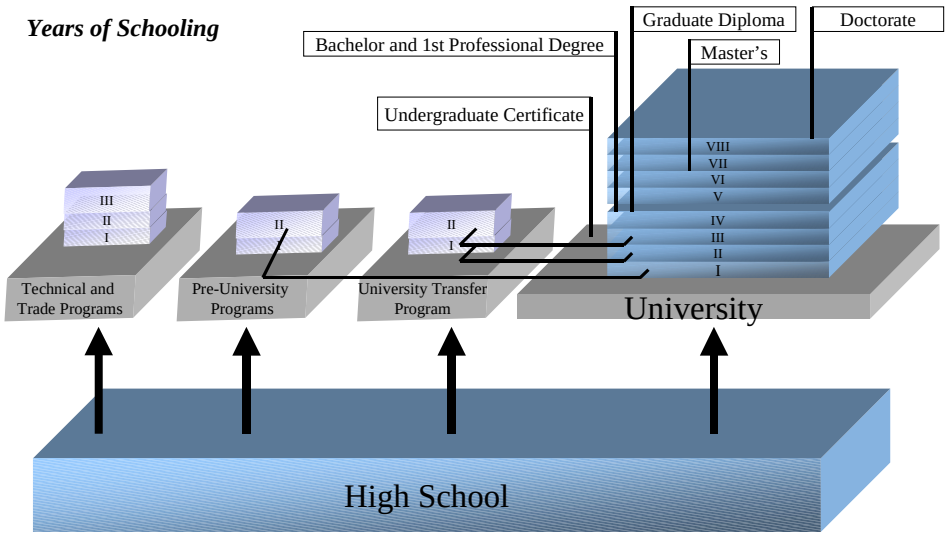
[4] In an attempt to solve some of these shortcomings, Mulligan and Sala-i-Martin (1995) developed another aggregate measure of human capital based on the index number literature. This paper is more a contribution to the index number literature than to the measurement of human capital. Hence, we have omitted it from our literature survey.

where $\rho(s) = L(s)/L$ is the proportion of working age individuals with *s* years of schooling and ω_s is the efficiency parameter of a worker with *s* years of schooling. It is defined as the proportion of the wage income of workers with *s* years of schooling in the total wage bill of the economy. The estimated value of γ is obtained from a standard Mincer regression, in which earnings are regressed on years of schooling and other key explanatory variables. As with Mulligan and Sala-i-Martin (1997), the efficiency parameter nets out the effect of aggregate physical capital on labour income and thus, on human capital. Furthermore, this measure will unwillingly vary if the relative wages of workers vary for other reasons than technological shocks.

III. METHODOLOGY AND DATA

Empirical evidence shows that workers' productivity, and hence the wage, depends on education and experience. The methodology used in this paper to estimate Canada's human capital stock builds upon that of Koman and Marin (1997) by taking into account years of working experience in addition to educational attainment. This approach enables us to develop an annual measure of Canada's human capital stock from 1971 to 1996 of the working age population (15 to 64) based on annual inflows of high school and post-secondary graduates, as well as on Census observations.

Figure 1. Structure of Canada's Education System



In Canada, students typically graduate from high school after 12 years of elementary and secondary education.[5] Following their graduation, Canadians can pursue their education either at a college or university where they are able to choose from several programs of varying lengths (Figure 1). For the purposes of this study, we focus on six different levels of education. These levels are: no degree, certificate, or diploma; high school graduation certificate; college diploma; undergraduate certificate; Bachelor's and first professional degree; and, graduate studies, which combines individuals who obtained either a graduate diploma, a Master's, or a Doctoral degree. Census data from 1971, 1976, 1981, 1986, 1991, and 1996 on Canadians' highest degree, certificate, or diploma obtained by age groups, are used as benchmarks in the estimation of Canada's human capital stock.[6] The following age groups were used: 15 to 19, 20 to 24, 25 to 34, 35 to 44, 45 to 54, and 55 to 64.

Changes from the benchmark Census observations are calculated using data on the number of degrees, certificates, and diplomas awarded and on the educational attainment of Canada's incoming immigrants.[7] The flows of individuals without a degree, certificate, or diploma are obtained by the number of individuals reaching age 15 years, plus the inflow of immigrants entering the country without a degree, certificate, or diploma. The construction of an educational attainment time series therefore has to keep track of the time period, level of education and age. This is done through a perpetual inventory method. Let *t, j,* and *a* represent time, educational level and age, respectively. The number of individuals at time *t* with educational level *j* of age *a, H(t,j,a),* is equal to:

$$H(t,\ j,a) = H(t-1,\ j,a)\cdot(1-\delta(t,a))\cdot(1-\gamma(t,a)) + H(t-1,\ j,a-1)\cdot(1-\delta(t,a-1))\cdot\gamma(t,a-1) + HP(t,\ j,a) - HM(t,\ j,a) + EX(j,a) \quad (13)$$

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[5] Since education falls under provincial jurisdiction in Canada, there are some differences across provincial educational systems. In particular, in Québec, secondary school ends after 11 years of education. High school graduates must then obtain a diploma from a cégep to pursue further their post-secondary education (cégeps also offer professional programs leading to the labour force).

[6] Due to inconsistencies in the 1971 Census data, highest degrees, certificates or diplomas were allocated by age and education level according to the distribution of the population by education level and age found in the 1976 Census. The 1976 Census includes individuals aged 15 years and over not attending school full-time, thereby underestimating the number of 15 to 24 years olds. An adjustment was made using Census data on population by age groups (Statistics Canada, Cat. 92-832). Using census data on highest level of education, we allocated individuals whose highest diploma obtained was a trade certificate between secondary school graduates and college diplomas for the Census years 1981, 1986, 1991 and 1996. Data are found in Appendix A.

[7] Data on the number of degrees, diplomas, and certificate were found in Statistics Canada, Cat. 81-229, while data on the educational attainment of incoming immigrants were provided by Citizenship and Immigration Canada. Due to our lack of data on the educational attainment of incoming immigrants from 1970 to 1979, educational levels were allocated across incoming immigrants according to the distribution found in 1980. Data on secondary school graduates provided to Statistics Canada by the provinces and territories contain inconsistencies. See Statistics Canada, Cat. 81-229. Annual inflows of degrees, certificates, and diplomas are found in Appendix C, while data on incoming immigrants by education level can be found in Appendix D.

where $\delta(t,a)$ is the mortality rate and $\gamma(t,a)$ is the share of the population changing age groups at time *t*.[8] The first two terms of (13) are adjustments made to the stock due to mortality and age-group changes. The term $HP(t,j,a)$ represents the inflow of individuals of aged *a* who completed the education level *j* at time *t*, while $HM(t,j,a)$ is the outflow of individuals of aged *a* whose highest level of schooling was *j* in year *t-1* and who completed a higher educational level in year *t*. Given the variety of data sources used by the perpetual inventory approach, it is *unlikely* that adding the number of new graduates, while taking into account mortality rates and immigration, from a particular benchmark (e.g., 1981) will allow us to reach exactly the succeeding benchmark (1986). To account for inconsistencies between data sources, we add a residual term $EX(j,a)$ to equation (13).[9] The precise determination of *EX* is explained below.

The annual inflows of new degrees are not available by age groups. We thus add equations (14) and (15) to accomplish the distribution of these inflows across age groups. Equation (16) indicates that the distributive parameters $(\lambda_p(j,a), \lambda_m(j,a))$ in equations (14) and (15) must sum to 1.

$$HP(t,j,a) = \lambda_p(j,a) \cdot \left(NDP(t,j) + IM(t,j)\right) \quad (14)$$

$$HM(t,j,a) = \lambda_m(j,a) \cdot NDM(t,j) \quad (15)$$

$$\sum_a \lambda_i(j,a) = 1 \text{ for } i = p,m \quad (16)$$

The inflows data at time *t* for each educational level *j*, consists of new graduates, $NDP(t,j)$, plus new immigrants with the corresponding education level $IM(t,j)$. The outflow data, $NDM(t,j)$, are generated from the inflow data, that is, the outflows at time *t* for the education level *j* equal the inflows at time *t* for the education level *j+1*. To generate these data, we make some assumptions regarding the educational path (from *j* to *j+1*) Canadians can take. Figure 2 presents a simplified picture of Canada's educational system depicted in Figure 1. It is assumed that, if they pursue their education, secondary school graduates can either go to college or university to obtain either a college diploma or an undergraduate certificate or degree. It is also assumed that individuals who obtained either a college diploma or an undergraduate certificate go directly into the labour force. Individuals who obtained an undergraduate university degree can pursue their education by enrolling in graduate studies. As with college graduates, individuals

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[8] The shares of population changing age groups were calculated for the Census years and were used for five-year periods. Annual mortality rates were used. See Appendix B.

[9] $EX(j,a)$ also includes Canadians who obtained their degrees abroad.

who obtain a graduate degree do not pursue their education further and go into the labour force. Let *j* take the acronyms shown within brackets in Figure 2. With the assumed educational path, the outflow data are represented by equations (17) to (22):

$$NDM(t, no) = NDP(t, \sec o) \tag{17}$$

$$NDM(t, \sec o) = NDP(t, coll) + NDP(t, cert) + NDP(t, bacc) \tag{18}$$

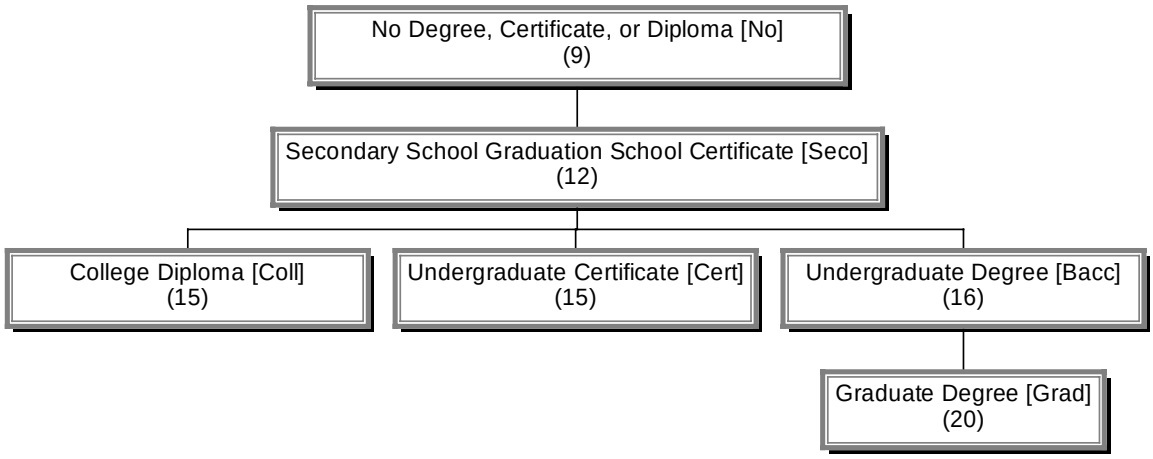
$$NDM(t, coll) = 0 \tag{19}$$

$$NDM(t, cert) = 0 \tag{20}$$

$$NDM(t, bacc) = NDP(t, grad) \tag{21}$$

$$NDM(t, grad) = 0 \tag{22}$$

Figure 2. Canada's Simplified Educational System



The system of equations has interesting recursive properties. The methodology can be applied on sub-periods defined by closed Census benchmarks (e.g., 1981 to 1986) and sub-categories of education. However, unless some of the λ are pre-specified, the system of equations is under-identified, that is, it has more unknowns than equations. Equations (19), (20), and (22) allow us to set $\lambda_m(j, a)$ for these corresponding levels of education to zero. With respect to the distribution of new diplomas by age, we also make some assumptions that allow us to reduce the number of degrees of freedom. For instance, inflows of secondary school graduation certificates are attributed entirely to those of 15 to 19 years of age. In other words, we set $\lambda_p(no, a15) = 1$, where *a15* is for the 15 to 19 age group. The pre-specification of λ_m for the education levels *Coll*, *Cert*, and *Grad*, as well of the λ_p for the education level *No* are sufficient conditions to generate a unique solution for the other λ. The existence of such a solution is attempted by fixing *EX* at zero for each age group, starting with the youngest age group. For the

youngest group, a unique solution exists if the solution for the other λ remains in the closed interval [0,1]. In other words, the system of equations and restrictions defines an implicit function for the other λ that is continuous on a closed interval. An intermediate value theorem can thus be applied. If the closed interval is between [0,1], there exists a solution for λ in the appropriate domain for the youngest age group. However, the closed interval over which the intermediate value theorem can be subsequently applied is reduced for the following age group, as the sum of λ over all age groups must equal one. When a solution does not exist, $EX(j,a)$ is then allowed to be different from zero and to adjust to accord with the binding constraint set by the benchmark. For the other categories of education (*Seco* and *Bacc*), reasonable predetermined values were attributed to λ_p before proceeding as in the other categories. Assumptions and estimates of the distribution of new diplomas by age $(\lambda_p(j,a), \lambda_m(j,a))$ and $EX(j,a)$ can be found in Appendix E.

Once the number of individuals for each education level has been estimated, we translate each level of education into years of schooling. As shown in Figure 2, we assume that those with no degree, certificate or diploma have nine years of education; a secondary school graduation certificate requires 12 years of education; a college diploma and an undergraduate diploma each require 15 years of education; an undergraduate degree 16 years of education; and a graduate degree 20 years of education. We then construct a measure of the stock of human capital for each year by following the approach taken by Koman and Marin (1997):

$$\ln\left(\frac{H}{L}\right) = \sum_s \omega_s \ln(\rho_s) \tag{11a}$$

$$\text{where } \omega_s = \frac{e^{\sum_i (\gamma_i s)\cdot\varphi_i} L_s}{\sum_s e^{\sum_i (\gamma_i s)\cdot\varphi_i} L_s} \tag{12a}$$

where *i* indexes sex and φ_i gives the share of men and women in the population.[10] The coefficients γ were taken from Bloom, Grenier and Gunderson (1995). [11] As in Koman and Marin (1997), we assume that one year of schooling generates the same amount of skills over time by using a fixed-weight measure based on the income shares of 1996.[12]

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[10] Given that the share of men and women in the Canadian population is relatively stable over time, we used the share of each sex from the 1996 Census.

[11] The year 1996 was chosen to compensate for the fact that Bloom, Grenier and Gunderson's (1995) estimate of the impact of schooling on wages are based on data covering the beginning of our sample period (1971, 1981 and 1986 Census data). The estimated coefficient for men is γ=0.052, while γ=0.07 for women. These coefficients have likely changed over time.

[12] As in all empirical studies of this nature, Bloom, Grenier and Gunderson (1995) asssume a constant marginal impact of schooling on log wages over time. This restricts the human capital production function to be locally unit elastic in accumulated stocks of capital (see Macdonald (1981)). Ideally, one would like

While formal education is the main channel by which human capital is acquired, the latter can also be accumulated through a variety of other formal and informal channels. In particular, a significant amount of knowledge and skills is acquired while working. As workers acquire knowledge and skills, their increased productivity is reflected by higher wages. To account for human capital acquired while working, equations (11a) and (12a) are re-written as:

$$\ln\left(\frac{H}{L}\right)_{KM} = \sum_{s}\sum_{a} \omega_{s,a} \ln\left(\rho_{s,a}\right) \tag{11b}$$

$$\omega_{s,a} = \frac{e^{\sum_{i}(\gamma_i s+\beta_i x-\alpha_i x^2)\cdot\varphi_{i,a}} L_{s,a}}{\sum_{s}\sum_{a} e^{\sum_{i}(\gamma_i s+\beta_i x-\alpha_i x^2)\cdot\varphi_{i,a}} L_{s,a}} \tag{12b}$$

where $\rho_{s,a} = {}^{L_{s,a}}\!/_{L}$ is the proportion of working age individuals of age *a* with *s* years of schooling, $\omega_{s,a}$ is the efficiency parameter defined as proportion of wage income of workers of age *a* with *s* years of schooling in the total wage bill of the economy and *x* represents working experience. Given the lack of data on work experience over the period covered by the measure, years of experience is defined as age minus years of education minus 6, that is, $x = a - s - 6$. The use of age as a proxy for years of work experience has some limitations. In particular, age tends to be a better proxy of work experience for men than it is for women. Women tend to have more interruptions in their working life, due mainly to child bearing, and lower participation rates than do men.[13] Thus, the use of age as a proxy for experience will tend to overestimate the value of human capital for women. The estimated parameters β and α, which measure how wages change with working experience, were also taken from Bloom, Grenier and Gunderson (1995).[14]

The measure of human capital stock obtained using the above methodology can be described as Canada's *broad* stock of human capital, as the calculations of the efficiency parameters and ultimately the stock are based on the number of working-age Canadians, regardless of their status in the labour force. An alternative measure is Canada's *active* stock of human capital, which attempts to measure Canada's stock of human capital available for market production purposes. To calculate Canada's *active* human capital stock, we adjusted the distribution of Canada's working age population

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to use a gamma that is evolving over time. If such a gamma were available, we would then also use evolving income shares. As a result, the efficiency parameter omega would also evolve over time reflecting labour market conditions for the various levels of schooling.

[13] However, the gap between the participation rates of men and women has declined significantly over the years.

[14] The estimated coefficients for men are β=0.043 and α=0.00069. Their estimated coefficients for women are β=0.0289 and α=0.00048.

using participation rates ($PR_{s,a}$) by level of education and age.[15] Algebraically, equations (11b) and (12b) become:

$$\ln\left(\frac{H}{L}\right)_{KM} = \sum_s \sum_a \omega'_{s,a,t} \ln\left(\rho'_{s,a}\right) \tag{11c}$$

$$\omega'_{s,a} = \frac{e^{\sum_i (\gamma_i s + \beta_i x - \alpha_i x^2)\cdot \varphi_{i,a}} L'_{s,a}}{\sum_s \sum_a e^{\sum_i (\gamma_i s + \beta_i x - \alpha_i x^2)\cdot \varphi_{i,a}} L'_{s,a}} \tag{12c}$$

where $L'_{s,a} = (L_{s,a} \cdot PR_{s,a})$, $L' = (L \cdot PR_{s,a})$ and $\rho'_{s,a} = \frac{L'_{s,a}}{L'}$. This measure gives us a better insight into the evolution of the stock of human capital available for production purposes.

IV. RESULTS

a) Results from the Perpetual Inventory Approach

To calculate the various measures of Canada's human capital stock, the perpetual inventory approach described in Section III was first used to estimate the distribution of Canada's working age population (15 to 64) by highest degree, certificate or diploma granted. As shown in Table 2, the share of working age Canadians with no degree, certificate or diploma, has declined markedly over the years, from over 58 per cent in 1971 to 32 per cent in 1996. On the other hand, Canadians with a post-secondary diploma or degree accounted for approximately 39 per cent of the working age population in 1996, up from 35 per cent in 1991 and 28 per cent in 1981.

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[15] Participation rates by age and level of education are from the Labour Force Survey (LFS). Information on educational attainment is available from 1976. In 1990, the LFS adopted a new set of questions to determine educational attainment. Among other things, a question was added on high school graduation (see the January issue of Statistics Canada (1990), cat. 71-001 for more detail). In order to have a time series as compatible as possible with the education categories used in this paper, education categories pre- and post- 1990 from the LFS were combined as follows. For 1976 to 1989, participation rates for the category *No* calculated using the LFS's *0 to 8* and *9 to 10 years of schooling* categories. For the category *Seco*, the LFS's *11 to 13 years of schooling and Some post-secondary* were used. The *Post-secondary trade or certificate* category was used for *Coll* and *Cert*, while LFS's *University degree* was used for *Bacc* and *Grad.* For 1990 to 1996, participation rates for the category *No* was calculated using the LFS's *0 to 8* and *Some high school* categories, while the category *Seco* was calculated using the LFS's *High school graduate* and *Some post-secondary*. For the remaining education categories, data are from the corresponding LFS's categories.

Table 2. Population Aged 15 to 64 by Highest Degree, Certificate, or Diploma Obtained, 1971 to 1996

	No degree, Certificate or Diploma *'000*	*Secondary School Graduation Certificate* *'000*	*College Diploma* *'000*	*Undergraduate Certificate* *'000*	*Undergraduate Degree* *'000*	*Graduate Degree* *'000*	*Total* *'000*
1971	7,819.4	3,195.8	1,350.6	201.1	644.8	169.3	13,381.0
1972	7,988.3	3,259.8	1,379.1	201.6	656.6	171.7	13,657.2
1973	8,137.6	3,344.1	1,412.4	208.2	669.8	175.8	13,947.9
1974	8,324.0	3,438.1	1,449.5	216.5	688.7	180.0	14,296.8
1975	8,502.9	3,521.2	1,486.0	221.0	710.7	184.4	14,626.2
1976	8,666.4	3,600.2	1,523.0	225.2	732.5	188.8	14,936.1
1977	8,523.1	3,682.7	1,789.1	235.3	783.9	235.9	15,250.1
1978	8,371.3	3,755.0	2,055.7	246.3	834.7	282.9	15,546.3
1979	8,222.4	3,829.5	2,323.9	259.2	884.9	329.4	15,849.8
1980	8,067.1	3,915.8	2,590.3	274.1	935.9	375.9	16,159.9
1981	7,859.3	4,002.5	2,856.3	290.8	991.9	422.8	16,425.5
1982	7,796.9	4,093.7	2,920.6	301.6	1,045.3	440.3	16,598.3
1983	7,733.7	4,154.5	2,984.1	308.6	1,095.5	457.7	16,734.2
1984	7,663.4	4,201.1	3,056.2	318.5	1,146.7	475.4	16,861.4
1985	7,612.3	4,231.7	3,128.4	326.5	1,202.0	493.5	16,994.4
1986	7,567.7	4,261.2	3,197.2	337.8	1,261.8	512.6	17,138.3
1987	7,355.5	4,473.1	3,295.1	339.5	1,313.9	542.6	17,319.7
1988	7,149.6	4,671.4	3,391.5	344.6	1,368.2	573.0	17,498.3
1989	6,956.0	4,869.7	3,490.2	353.3	1,425.9	604.6	17,699.7
1990	6,783.7	5,069.8	3,590.1	364.4	1,490.9	637.9	17,936.9
1991	6,618.1	5,273.6	3,691.9	376.9	1,560.2	672.5	18,193.2
1992	6,551.0	5,323.5	3,825.6	397.3	1,637.1	706.1	18,440.5
1993	6,478.1	5,369.2	3,962.6	416.3	1,717.7	741.1	18,685.0
1994	6,403.9	5,392.2	4,099.5	432.6	1,800.1	777.5	18,905.8
1995	6,321.0	5,421.9	4,235.9	446.2	1,885.0	815.0	19,125.0
1996	6,240.0	5,477.1	4,371.5	456.2	1,962.8	850.1	19,357.7

b) Canada's Broad Human Capital Stock[16]

The human capital stock measures presented in this paper are indices. As indices, these measures describe the *evolution* of Canada's human capital stock over time.

[16] While the most of the measures of Canada's human capital stock have been calculated from 1971 onwards, the series from 1971 to 1976 are essentially linear estimations due to data limitations. Thus, results presented in this section are for 1976 onwards. Series from 1971 to 1996 are available from the authors upon request.

Canada's Average Stock of Human Capital

The most common measure of human capital found in the literature is average years of schooling. As shown in Figure 3, according to this measure, Canada's average human capital stock has increased by 15 per cent since 1976. When Canada's average human capital stock is measured using the labour income-based approach described in Section III, the stock is substantially higher than average years of schooling, as the labour market places a higher value on higher education levels. From 1976 to 1996, Canada's average human capital increased by over 33 per cent. The increase in the average stock of human capital is higher for women (35 per cent) than for men (30 per cent). This result (not shown in the Figure) only captures the impact of sex on the efficiency parameter through the rate of returns to education obtained by Bloom, Grenier, and Gunderson (1995). If annual data on educational attainment by sex were readily available, the spread between the evolution of the average human capital stock of men and women would likely increase further.[17]

Table 3 compares our results with those obtained by Koman and Marin (1997) for Austria and Germany using essentially the same methodology. These authors also find that the average stock of human capital measured using an income-based approach is higher than that measured by average years of schooling. From 1980 to 1992, Austria's average human capital stock increased by 4%, compared to 8% for Germany and 13% for Canada.

When experience is taking into account, Canada's average human capital stock increases even more. From 1976 to 1996, Canada's human capital stock with experience increased by over 45 per cent. It is interesting to note that human capital measured using experience surpassed the standard income-based measure of human capital in 1981, and the gap between the two measures has been widening ever since. The crossing point suggests that before 1981, educational attainment contributed more to human capital than years of working experience, whereas after that year, the opposite relationship applies. This can be deduced from the fact that new educational attainments by the young age group have higher weight in the determination of ω in the standard income-based measure (equation 12a) than in the measure that includes experience. In contrast, the acquisition of labour market experience only shows up in the augmented income-based measure. This contributing role shift factor may be due to the changing age composition of the Canadian population. As Canada's population is expected to continue to age, the gap between these two measures is expected to keep widening.

[17] While data on university degrees awarded are available by sex, data on secondary school graduation certificate awarded are not available by sex.

Figure 3. Canada's Average Stock of Human Capital, 1976 to 1996

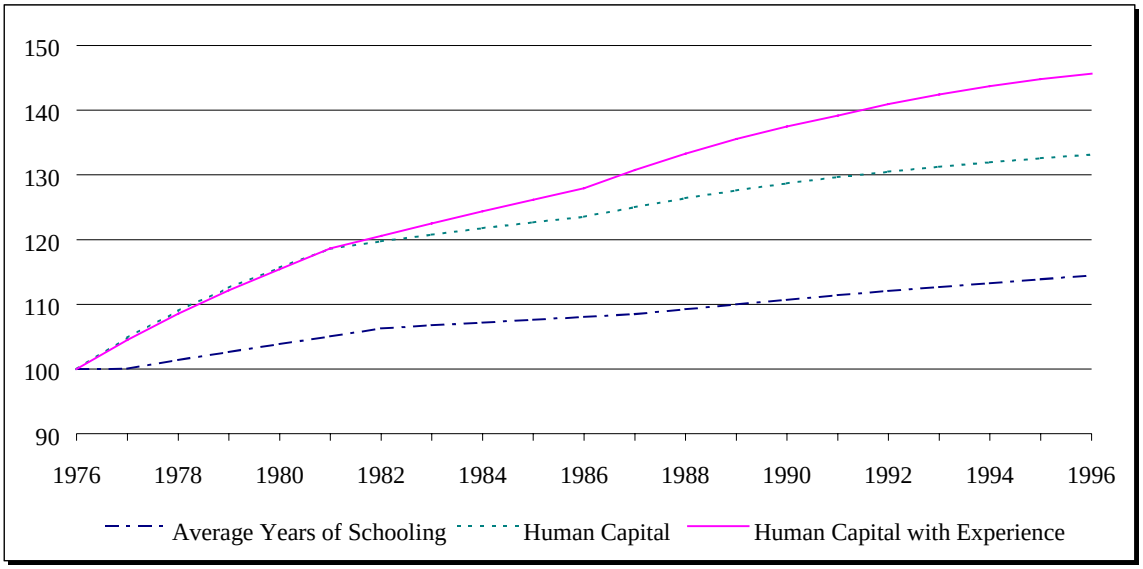


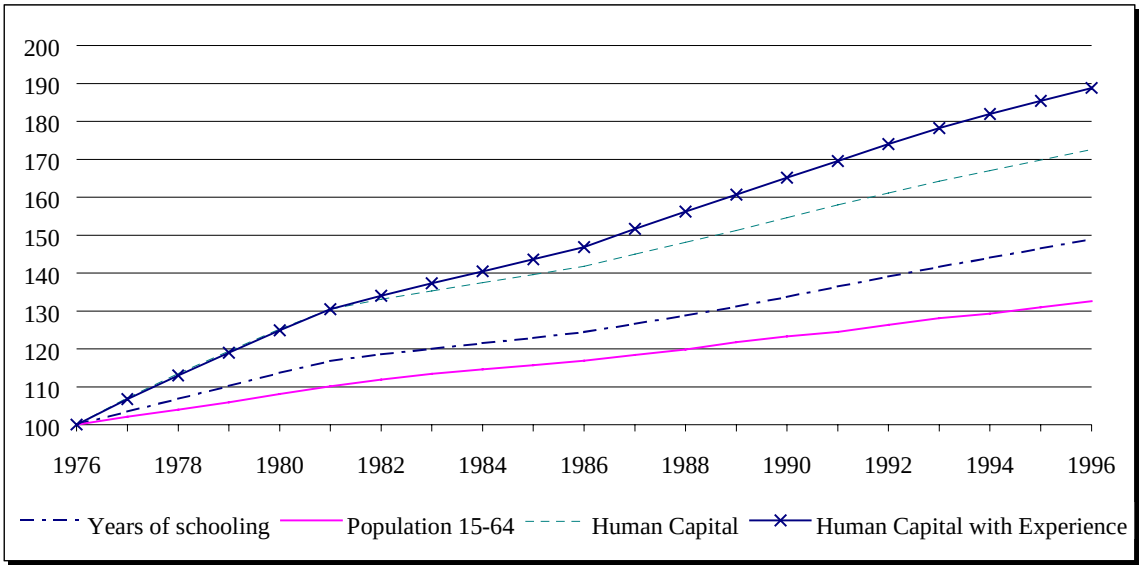
Table 3. Comparison of human capital stocks calculated using similar approaches

	Koman and Marin (1997)				*Laroche and Mérette (1999)*	
	Average Years of Schooling		*Average Human Capital*		*Average Years of Schooling*	*Average Human Capital*
	Austria	Germany	Austria	Germany	Canada	Canada
1980	100	100	100	100	100	100
1985	101.2	102.3	102.1	105.2	103.6	106.1
1990	102.7	104.3	103.7	107.6	106.6	111.3
1992	103.4	105.0	104.3	108.0	107.9	112.8

Canada's Total Human Capital Stock

Figure 4 presents four potential measures of Canada's *total* human capital stock. The first measure is simply Canada's working age population, that is, individuals aged between 15 and 64. Canada's working age population increased by about 33 per cent since 1976. The second measure is years of schooling. This measure simply multiplies years of schooling by the working age population. Taking years of schooling into account increases this potential measure of Canada's total human capital stock by a further 12 per cent. The third and fourth measures are the labour-income-based measures of human capital with and without work experience. Between 1976 and 1996, these measures increased by 73 per cent and 89 per cent, respectively.

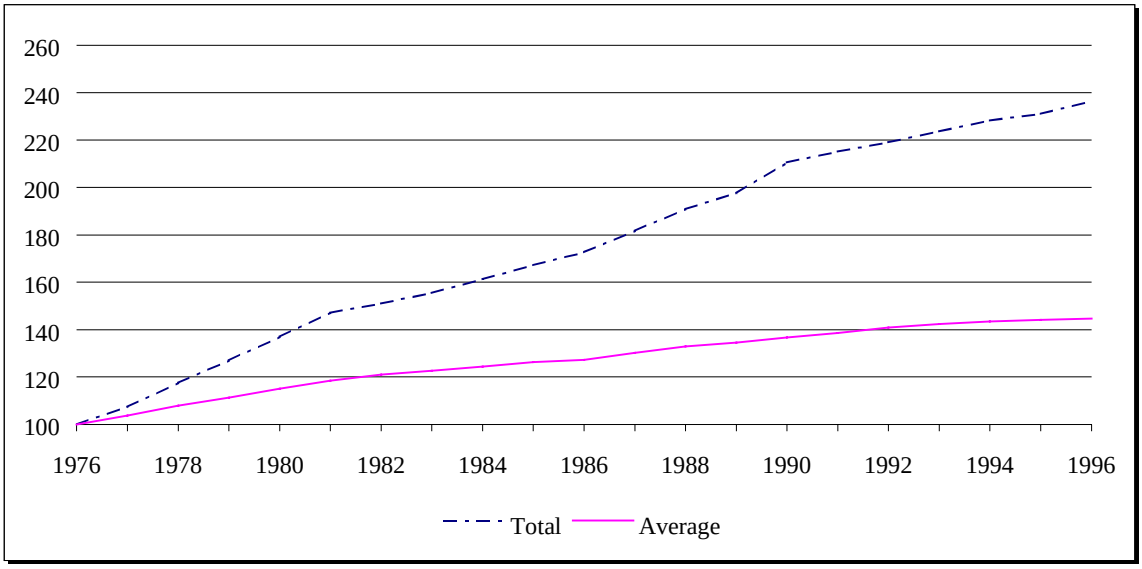
Figure 4. Evolution of Canada's Total Human Capital Stock, 1976 to 1996



c) Canada's Active Human Capital Stock

The above measures of Canada's human capital can all be considered as *broad* measures of human capital as they are measures based on Canada's working age population. This sub-section presents Canada's *active* human capital stock, which is based on Canada's labour force. This measure provides a better insight of the evolution of Canada's human capital stock available for market production purposes. Participation rates used to calculate this measure can be found in Appendix F. As one should expect, participation rates increase with age (up to age 54 and then decline) and with educational attainment. Adjusting for participation rate reduces the number of less-educated, young and old individuals in our population universe. However, given the nature of the measures presented in this paper, the active measure of Canada's human capital stock does not capture any *level* effects generated by the fact that this measure is based on a more restrictive population universe that that used.

Figure 5. Canada's Active Human Capital Stock, 1976 to 1996



As shown in Figure 5, Canada's *average* active stock of human capital has increased by approximately 45 per cent since 1976, an evolution similar to that of the average broad stock of human capital. This result is attributable to the fact that most working age Canadians are in the labour force and that the adjustment made to $\rho_{s,a}$ affects both its numerator and denominator. However, Canada's *total* active stock of human capital has increased more rapidly than the broad measure and has more than double since 1976. This significant increase is mainly driven by large numbers of increasingly educated women entering the labour force over the period covered by our measure.

V. CONCLUSION

This paper proposes a measure of Canada's human capital stock based on the completion of education levels, as well as on working experience. An ideal measure of human capital would consider all individuals' activities related to the acquisition and maintenance of skill and knowledge.[18] This measure of human capital, even augmented by the consideration of years of working experience, falls short of an ideal measure. Nonetheless, our measure builds upon and improves existing measures and hopefully will attract attention and stimulate future efforts for the development of what may become an important instrument for the understanding of economic performance. In the near term, this measure will be used in various applications to gauge its value.

[18] See Laroche, Mérette and Ruggeri (1997).

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Appendix A

Population Aged 15 to 64 by Highest Degree, Certificate or Diploma Obtained, 1971 to 1996

Age	*Total*	*No Degree, Certificate, Diploma*	*Secondary School Graduation Certificate*	*College Diploma*	*Undergraduate Certificate*	*Undergraduate Degree*	*Graduate Degrees*
1971[1]							
15-19	2,104,730	1,622,267	443,736	32,350	1,533	1,292	249
20-24	1,877,765	784,432	764,016	231,910	20,031	74,367	2,979
25-34	2,881,725	1,198,468	812,477	463,734	65,073	279,232	62,720
35-44	2,519,010	1,461,759	508,411	300,420	51,192	141,058	56,155
44-54	2,282,850	1,517,467	404,598	196,422	38,160	94,749	31,455
55-64	1,719,125	1,235,702	262,630	125,840	25,141	54,100	15,726
1976[2]							
15-19	2,345,255	1,807,656	494,446	36,047	1,708	1,440	278
20-24	2,133,805	891,393	868,192	263,532	22,762	84,507	3,385
25-34	3,509,330	1,459,480	989,425	564,730	79,245	340,045	76,380
35-44	2,570,830	1,491,830	518,870	306,600	52,245	143,960	57,310
45-54	2,459,605	1,634,960	435,925	211,630	41,115	102,085	33,890
55-64	1,920,765	1,380,640	293,435	140,600	28,090	60,445	17,570
1981							
15-19	2,303,575	1,611,335	602,880	85,995	2,410	770	180
20-24	2,334,420	817,300	856,835	486,080	22,920	136,580	14,705
25-34	4,199,980	1,332,780	1,149,940	1,008,335	84,560	465,380	158,975
35-44	2,956,780	1,270,865	615,125	632,010	84,540	213,825	140,405
45-54	2,487,420	1,427,510	441,975	389,295	55,465	104,050	69,125
55-64	2,142,485	1,400,390	335,720	254,855	40,855	71,230	39,430
1986							
15-19	1,917,245	1,361,800	496,185	55,415	2,850	825	165
20-24	2,243,945	706,745	837,445	500,225	34,560	152,275	12,690
25-34	4,505,810	1,423,255	1,245,975	1,101,445	77,090	511,270	146,770
35-44	3,626,840	1,287,830	839,835	822,165	109,015	366,760	201,240
45-54	2,532,990	1,323,500	469,980	433,960	67,090	139,175	99,285
55-64	2,312,105	1,465,010	371,840	284,375	47,060	91,430	52,385
1991							
15-19	1,855,265	1,265,390	544,350	48,035	2,880	895	135
20-24	1,928,090	459,145	848,020	418,360	31,380	156,325	14,845
25-34	4,762,405	1,219,250	1,430,915	1,279,680	79,345	585,935	167,275
35-44	4,317,710	1,172,385	1,251,365	1,041,075	116,210	486,600	250,070
45-54	2,947,950	1,168,065	717,465	577,810	92,975	224,500	167,140
55-64	2,377,730	1,335,075	482,815	326,660	54,135	105,995	73,050
1996							
15-19	1,956,115	1,364,985	534,220	50,755	4,175	1,600	380
20-24	1,892,910	401,005	822,220	423,515	39,925	185,490	20,755
25-34	4,481,315	945,015	1,241,025	1,316,570	93,540	683,390	201,775
35-44	4,843,025	1,179,830	1,396,255	1,311,385	123,635	570,030	261,880
45-54	3,697,970	1,126,770	958,855	855,580	125,005	381,135	258,620
55-64	2,477,815	1,221,680	524,760	413,590	69,985	141,190	106,600

n/a: not applicable

[1] Due to inconstencies in the 1971 Census data, highest degrees, certificates and diplomas were allocate by age and education level according to the distribution of the population by age and education level found in the 1976 Census.

[2] The 1976 Census data include individuals aged 15 years and over not attending school, thereby underestimating the number of 15 to 24 year olds. An adjustment was made using Census data on the population by age groups (Cat. 92-832): 1,164,385 individuals were added to the 15 to 19 year old group and allocated to the no degree, certificate or diploma and secondary school graduation certificate categories. For the 20 to 24 year old age group, 373,540 individuals were added. These individuals were allocated across education level according to the proportion of 20 to 24 year olds having attained each education level (Statistics Canada (Cat. 92-827).

Sources: Statistics Canada, Cat. 92-827, 93F0028XDB960000, 93-110, 92-832, and Special Tabulations, 1971, 1981, and 1991 Census.

Appendix B

Mortality Rates

	15-19	*20-24*	*25-34*	*35-44*	*45-54*	*55-64*
1971	0.001	0.0012	0.0011	0.00235	0.0057	0.0139
1972	0.0011	0.0013	0.0012	0.00235	0.00575	0.01395
1973	0.0012	0.0013	0.00115	0.0023	0.0057	0.0141
1974	0.0011	0.0012	0.0011	0.0022	0.0056	0.0136
1975	0.0011	0.0012	0.0011	0.0022	0.0055	0.01335
1976	0.001	0.0011	0.00105	0.002	0.00535	0.01305
1977	0.001	0.0011	0.00105	0.00205	0.0054	0.0129
1978	0.0009	0.0011	0.00105	0.00195	0.00525	0.0127
1979	0.001	0.0012	0.00105	0.00195	0.00515	0.0123
1980	0.0009	0.0011	0.00095	0.00175	0.00495	0.01195
1981	0.0009	0.001	0.00095	0.0018	0.0047	0.01175
1982	0.0008	0.0009	0.0009	0.0016	0.0045	0.0115
1983	0.0007	0.0009	0.0009	0.0016	0.00435	0.0111
1984	0.0007	0.0008	0.00085	0.00155	0.0042	0.01105
1985	0.0007	0.0009	0.0009	0.00155	0.0042	0.01085
1986	0.0007	0.0008	0.00085	0.0015	0.00415	0.01065
1987	0.0007	0.0008	0.00085	0.0015	0.00395	0.0105
1988	0.0007	0.0008	0.00085	0.00145	0.00375	0.0104
1989	0.0007	0.0008	0.00085	0.00145	0.0037	0.0101
1990	0.0006	0.0008	0.0009	0.00145	0.00365	0.00975
1991	0.0007	0.0008	0.00085	0.00145	0.00355	0.0096
1992	0.0006	0.0007	0.00085	0.00145	0.00345	0.00945
1993	0.0006	0.0007	0.0009	0.0015	0.0034	0.0092
1994	0.0006	0.0007	0.0008	0.00145	0.0033	0.00915
1995	0.0006	0.0007	0.0008	0.00145	0.00335	0.0088
1996*	0.0006	0.0007	0.0008	0.00145	0.00335	0.0088

* Data not available. Same mortality rates as 1995 was assumed.

Sources: Statistics Canada, Cat. 84-211, 84-210.

Share of the Population Changing Age

	1971	*1976*	*1981*	*1986*	*1991*
15-19 to 20-24	0.1882683	0.1969602	0.2083719	0.2085296	0.2048912
20-24 to 25-34	0.2046801	0.1891047	0.1953278	0.2063056	0.2057373
25-34 to 35-44	0.0847893	0.0812643	0.0963814	0.0899207	0.0987575
35-44 to 45-54	0.0983556	0.0979214	0.0841557	0.0809289	0.0946805
45-54 to 54-64	0.0850413	0.0977717	0.0966435	0.0976676	0.0827804
54-64 to 65+	0.0823496	0.0883169	0.0825528	0.0935194	0.0942107

Source: Statistics Canada, Cat. 93-537.

Appendix C

Degrees, Certificates and Diplomas, Canada, 1970 to 1996

					Graduate Studies			
	Secondary Graduation Diploma	*College Diploma*	*Undergraduate Certificate/Diploma*	*Undergraduate Degree*	*Graduate Certificate/Diploma*	*Master's Degree*	*Doctorate Degree*	*Total*
1970	191,633	38,632	5,215	60,523	1,044	8,424	1,372	10,840
1971	227,339	43,633	5,708	66,951	955	9,609	1,625	12,189
1972	232,873	47,709	8,159	72,416	966	10,277	1,724	12,967
1973	239,258	50,052	9,045	70,664	948	10,603	1,929	13,480
1974	250,068	53,384	8,621	74,851	1,085	10,196	1,896	13,177
1975	255,010	54,348	7,887	80,754	1,112	11,068	1,840	14,020
1976	266,445	56,655	10,327	83,292	1,395	11,555	1,693	14,643
1977	288,193	60,687	9,261	87,356	1,270	12,375	1,702	15,347
1978	294,246	64,891	12,376	89,349	1,771	12,637	1,819	16,227
1979	292,013	67,883	12,339	87,238	1,531	12,351	1,803	15,685
1980	296,180	67,343	12,238	86,410	1,621	12,432	1,738	15,791
1981	304,772	68,744	14,519	89,770	1,417	12,903	1,816	16,136
1982	305,933	71,818	16,711	87,106	1,504	13,110	1,715	16,329
1983	289,099	75,841	16,115	89,770	1,654	13,925	1,821	17,400
1984	289,662	83,557	16,190	92,586	1,796	14,568	1,878	18,242
1985	277,200	84,281	16,521	97,551	1,615	15,208	2,004	18,827
1986	275,708	81,761	18,288	101,670	1,642	15,948	2,220	19,810
1987	267,398	82,419	17,568	103,078	1,673	15,968	2,375	20,016
1988	257,800	80,096	19,235	103,606	1,635	16,320	2,418	20,373
1989	253,432	82,190	19,922	104,981	1,883	16,750	2,573	21,206
1990	257,213	82,506	20,815	109,777	1,877	17,653	2,673	22,203
1991	260,668	83,824	21,791	114,820	2,215	18,033	2,947	23,195
1992	272,918	85,949	23,316	120,745	2,240	19,435	3,136	24,811
1993	281,350	92,515	24,044	123,202	2,430	20,818	3,356	26,604
1994	280,378	95,296	24,341	126,538	2,351	21,292	3,552	27,195
1995	295,333	97,211	23,472	127,331	2,191	21,356	3,716	27,263
1996	297,622	100,978	22,293	127,989	2,348	21,558	3,928	27,834

Source: Statistics Canada, Cat. 81-229,

Appendix D

Incoming Immigrants by Education Level, Canada, 1971 to 1996

LEVEL OF EDUCATION	*1971*[1]		*1972*[1]		*1973*[1]		*1974*[1]		*1975*[1]		*1976*[1]		*1977*[1]		*1978*[1]		*1979*[1]	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
0 to 9 years of schooling	39,397	41.30	38,982	41.30	59,912	41.30	67,886	41.30	56,481	41.30	45,971	41.30	36,232	41.30	28,152	41.30	36,037	41.30
10 to 12 years of schooling	31,193	32.70	30,865	32.70	47,437	32.70	53,750	32.70	44,720	32.70	37,052	33.29	28,688	32.70	22,290	32.70	28,533	32.70
13 or more years of schooling*	6,945	7.28	6,871	7.28	10,561	7.28	11,966	7.28	9,956	7.28	8,103	7.28	6,387	7.28	4,962	7.28	6,352	7.28
Trade Certificate	10,112	10.60	10,005	10.60	15,377	10.60	17,424	10.60	14,496	10.60	11,799	10.60	9,299	10.60	7,225	10.60	9,249	10.60
Non-university diploma	5,247	5.50	5,191	5.50	7,979	5.50	9,041	5.50	7,522	5.50	6,122	5.50	4,825	5.50	3,749	5.50	4,799	5.50
Bachelor's degree	7,154	7.50	7,079	7.50	10,880	7.50	12,328	7.50	10,257	7.50	8,348	7.50	6,580	7.50	5,112	7.50	6,544	7.50
Master's degree	1,536	1.61	1,520	1.61	2,336	1.61	2,646	1.61	2,202	1.61	1,792	1.61	1,412	1.61	1,097	1.61	1,405	1.61
Doctorate	649	0.68	642	0.68	986	0.68	1,118	0.68	930	0.68	757	0.68	597	0.68	464	0.68	593	0.68
Total	95,392	100.00	94,387	100.00	145,066	100.00	164,374	100.00	136,759	100.00	111,310	100.00	87,730	100.00	68,165	100.00	87,256	100.00

LEVEL OF EDUCATION	*1980*		*1981*		*1982*		*1983*		*1984*		*1985*		*1986*		*1987*		*1988*	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
0 to 9 years of schooling	45,772	41.31	34,990	34.36	30,413	31.30	26,212	35.57	25,228	34.53	23,456	33.77	25,459	31.10	35,576	29.10	35,599	28.44
10 to 12 years of schooling	28,201	25.45	26,385	25.91	24,439	25.15	18,551	25.18	16,550	22.65	17,422	25.08	21,613	26.40	32,900	26.91	32,716	26.14
13 or more years of schooling*	8,070	7.28	8,284	8.14	8,662	8.92	6,680	9.07	6,684	9.15	6,891	9.92	8,165	9.97	12,565	10.28	10,857	8.68
Trade Certificate	11,744	10.60	11,453	11.25	11,389	11.72	8,362	11.35	11,082	15.17	9,058	13.04	10,644	13.00	14,516	11.87	15,945	12.74
Non-university diploma	6,132	5.53	7,319	7.19	7,080	7.29	4,111	5.58	4,625	6.33	3,847	5.54	4,817	5.88	7,806	6.39	8,729	6.97
Bachelor's degree	8,353	7.54	10,427	10.24	11,649	11.99	7,286	9.89	6,588	9.02	6,623	9.54	8,543	10.43	14,908	12.19	17,026	13.60
Master's degree	1,779	1.61	2,010	1.97	2,426	2.50	1,682	2.28	1,537	2.10	1,390	2.00	1,759	2.15	2,916	2.39	3,367	2.69
Doctorate	759	0.68	959	0.94	1,102	1.13	800	1.09	770	1.05	767	1.10	870	1.06	1,066	0.87	913	0.73
Total	110,810	100.00	101,827	100.00	97,160	100.00	73,684	100.01	73,064	100.00	69,454	99.99	81,870	99.99	122,253	100.00	125,152	99.99

LEVEL OF EDUCATION	*1989*		*1990*		*1991*		*1992*		*1993*		*1994*		*1995*		*1996*	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
0 to 9 years of schooling	41,566	27.68	48,458	28.23	52,168	27.34	53,745	25.77	54,319	26.15	43,447	24.2	34,319	20.5	34,238	19.7
10 to 12 years of schooling	40,010	26.64	43,744	25.49	50,878	26.66	63,338	30.37	62,889	30.27	53,359	29.8	48,251	28.8	45,806	26.3
13 or more years of schooling*	13,912	9.26	17,023	9.92	21,167	11.09	22,785	10.93	20,806	10.02	16,810	9.4	16,000	9.6	40,524	23.3
Trade Certificate	18,586	12.38	20,456	11.92	21,278	11.15	20,968	10.05	19,210	9.25	16,723	9.3	15,205	9.1	11,481	6.6
Non-university diploma	11,052	7.36	11,897	6.93	13,294	6.97	15,494	7.43	14,629	7.04	12,159	6.8	12,290	7.3	9,805	5.6
Bachelor's degree	20,152	13.42	23,820	13.88	24,970	13.08	25,827	12.38	29,220	14.07	28,880	16.1	31,532	18.8	24,606	14.1
Master's degree	3,681	2.45	4,819	2.81	5,396	2.83	4,795	2.30	4,900	2.36	6,036	3.4	7,705	4.6	5,951	3.4
Doctorate	1,215	0.81	1,421	0.83	1,684	0.88	1,599	0.77	1,757	0.85	1,914	1.1	2,137	1.3	1,630	0.9
Total	150,174	100.00	171,638	100.01	190,835	100.00	208,551	100.00	207,730	100.01	179,328	100.0	167,439	100.0	174,041	100

* Individuals in this group do not have either a trade certificate, non-university (college) diploma, or a undergraduate or graduate degree, certificate, or diploma.

[1] From 1971 to 1980, the distribution of incoming immigrants' educational attainment was assumed to be identical to that of 1980.

Source: Citizenship and Immigration Canada

Appendix E

	No Degree, Certificate, Diploma		*Secondary School Graduation Certificate*		*College Diploma*	
	$\lambda_p(j,a)$	$\lambda_m(j,a)$	$\lambda_p(j,a)$	$\lambda_m(j,a)$	$\lambda_p(j,a)$	$\lambda_m(j,a)$
1971 to 1976						
15-19	1.00*	0.65	0.50*	0.35	0.12	0.00*
20-24	0.00	0.35	0.40*	0.13	0.84	0.00*
25-34	0.00	0.00*	0.05*	0.49	0.04	0.00*
35-44	0.00	0.00*	0.05	0.03	0.00*	0.00*
45-54	0.00	0.00*	0.00*	0.00*	0.00*	0.00*
55-64	0.00	0.00*	0.00*	0.00*	0.00*	0.00*
1976 to 1981						
15-19	1.00*	0.67	0.50*	0.20	0.30	0.00*
20-24	0.00	0.33	0.40*	0.46	0.70	0.00*
25-34	0.00	0.00*	0.04*	0.33	0.00*	0.00*
35-44	0.00	0.00*	0.06	0.005	0.00*	0.00*
45-54	0.00	0.00*	0.00*	0.00*	0.00*	0.00*
55-64	0.00	0.00*	0.00*	0.00*	0.00*	0.00*
1981 to 1986						
15-19	1.00*	0.55	0.50*	0.32	0.10	0.00*
20-24	0.00	0.45	0.35*	0.32	0.90	0.00*
25-34	0.00	0.00	0.10*	0.34	0.00*	0.00*
35-44	0.00	0.00	0.05	0.01	0.00*	0.00*
45-54	0.00	0.00	0.00*	0.00*	0.00*	0.00*
55-64	0.00	0.00	0.00*	0.00*	0.00*	0.00*
1986 to 1991						
15-19	1.00*	0.64	0.60*	0.34	0.10	0.00*
20-24	0.00	0.36	0.30*	0.13	0.73	0.00*
25-34	0.00	0.00*	0.10	22.00	0.17	0.00*
35-44	0.00	0.00*	0.00	0.31	0.00	0.00*
45-54	0.00	0.00*	0.00*	0.00	0.00*	0.00*
55-64	0.00	0.00*	0.00*	0.00*	0.00*	0.00*
1991 to 1996						
15-19	1.00*	0.51	0.60*	0.46	0.10	0.00*
20-24	0.00	0.49	0.30*	0.21	0.72	0.00*
25-34	0.00	0.00*	0.01	0.33	0.18	0.00*
35-44	0.00	0.00*	0.09	0.00*	0.00	0.00*
45-54	0.00	0.00*	0.00*	0.00*	0.00*	0.00*
55-64	0.00	0.00*	0.00*	0.00*	0.00*	0.00*

* Assumptions made the authors.

Appendix E (continued)

	Undergraduate Certificate		*Undergraduate Degree*		*Graduate Degree*	
	$\lambda_p(j,a)$	$\lambda_m(j,a)$	$\lambda_p(j,a)$	$\lambda_m(j,a)$	$\lambda_p(j,a)$	$\lambda_m(j,a)$
1971 to 1976						
15-19	0.01	0.00*	0.003	0.00*	0.003	0.00*
20-24	0.20	0.00*	0.27*	0.40	0.04	0.00*
25-34	0.20	0.00*	0.35*	0.58	0.48	0.00*
35-44	0.48	0.00*	0.38	0.02	0.01	0.00*
45-54	0.10*	0.00*	0.00*	0.00*	0.47	0.00*
55-64	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
1976 to 1981						
15-19	0.02	0.00*	0.001	0.00*	0.001	0.00*
20-24	0.17	0.00*	0.40*	0.46	0.21	0.00*
25-34	0.16	0.00*	0.40*	0.10	0.78	0.00*
35-44	0.29	0.00*	0.06*	0.40	0.00*	0.00*
45-54	0.05	0.00*	0.14	0.03	0.00*	0.00*
55-64	0.29	0.00*	0.00*	0.00*	0.00*	0.00*
1981 to 1986						
15-19	0.02	0.00*	0.002	0.00*	0.002	0.00*
20-24	0.27	0.00*	0.34*	0.20	0.11	0.00*
25-34	0.03	0.00*	0.40*	0.68	0.47	0.00*
35-44	0.20	0.00*	0.10*	0.10	0.42	0.00*
45-54	0.01	0.00*	0.08*	0.02	0.00*	0.00*
55-64	0.46	0.00*	0.09	0.00*	0.00*	0.00*
1986 to 1991						
15-19	0.02	0.00*	0.001	0.00*	0.001	0.00*
20-24	0.14	0.00*	0.28*	0.18	0.12	0.00*
25-34	0.02	0.00*	0.38*	0.73	0.57	0.00*
35-44	0.09	0.00*	0.09	0.09	0.31	0.00*
45-54	0.11	0.00*	0.01	0.00*	0.00*	0.00*
55-64	0.62	0.00*	0.24	0.00*	0.00*	0.00*
1991 to 1996						
15-19	0.02	0.00*	0.003	0.00*	0.003	0.00*
20-24	0.21	0.00*	0.27*	0.03	0.14	0.00*
25-34	0.09	0.00*	0.40*	0.54	0.62	0.00*
35-44	0.11	0.00*	0.11	0.43	0.24	0.00*
45-54	0.11	0.00*	0.05	0.00	0.00*	0.00*
55-64	0.45	0.00*	0.17	0.00	0.00*	0.00*

* Assumptions made the authors.

Appendix E (continued)

	No Degree, Certificate, Diploma	*Secondary School Graduation Certificate*	*College Diploma*	*Undergraduate Certificate*	*Undergraduate Degree*	*Graduate Degree*
	EX (j,a)	*EX (j,a)*	*EX (j,a)*	*EX (j,a)*	*EX (j,a)*	*EX (j,a)*
1971 to 1976						
15-19	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
20-24	-40.50	0.00*	0.00*	0.00*	0.00*	0.00*
25-34	-4.97	0.00*	11.32	0.00*	0.00*	0.00*
35-44	42.80	-32.10	-11.40	-11.50	-43.50	0.00*
45-54	21.11	-5.68	-8.04	-3.10	-3.19	-10.00
55-64	19.40	-3.07	-1.69	-0.23	-1.64	-0.78
1976 to 1981						
15-19	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
20-24	-94.60	0.00*	52.18	0.00*	0.00*	0.00*
25-34	-74.10	0.00*	80.98	0.00*	0.00*	9.81
35-44	-19.20	-30.50	48.47	0.00*	0.00*	16.72
45-54	-19.10	-8.48	21.37	0.00*	-18.80	2.86
55-64	-7.60	-2.70	14.26	-5.16	-1.04	2.47
1981 to 1986						
15-19	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
20-24	-49.20	0.00*	8.79	0.00*	0.00*	0.00*
25-34	-0.40	0.00	24.53	0.00*	0.00*	0.00*
35-44	-20.50	-22.70	-1.99	0.00*	0.00*	3.02
45-54	11.08	-9.13	-10.30	0.00*	-12.68	0.09
55-64	13.24	-3.12	-8.06	-13.00	-8.32	-1.04
1986 to 1991						
15-19	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
20-24	-103.00	0.00*	0.00*	0.00*	0.00*	0.00*
25-34	-40.60	0.00	33.10	0.00*	0.00*	0.00*
35-44	-42.50	111.40	12.03	0.00*	0.00*	5.90
45-54	-4.42	24.65	4.77	0.00*	0.00	8.64
55-64	-3.04	9.48	-8.67	-25.00	-33.16	-2.25
1991 to 1996						
15-19	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
20-24	-53.20	0.00*	0.00*	0.00*	0.00*	0.00*
25-34	-33.40	0.00	31.07	0.00*	0.00*	0.00*
35-44	6.63	-8.80	37.54	0.00*	0.00*	0.51
45-54	-21.80	-6.57	5.10	0.00*	0.00*	12.10
55-64	14.42	-8.42	-2.90	-17.70	-31.70	-1.64

* Assumptions made the authors.

Appendix F

Participation Rates by Education Level and Age

	No Degree, Certificate, Diploma						*Secondary School Graduation Certificate*						*College Diploma*					
	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64
1976	0.40	0.67	0.66	0.71	0.66	0.49	0.56	0.79	0.75	0.83	0.74	0.58	0.70	0.83	0.79	0.90	0.77	0.59
1977	0.40	0.68	0.68	0.71	0.66	0.49	0.58	0.80	0.76	0.78	0.75	0.58	0.67	0.83	0.80	0.81	0.78	0.60
1978	0.40	0.70	0.68	0.73	0.67	0.49	0.59	0.80	0.79	0.79	0.76	0.57	0.63	0.83	0.82	0.81	0.77	0.61
1979	0.42	0.70	0.69	0.73	0.68	0.50	0.62	0.82	0.79	0.80	0.76	0.58	0.64	0.83	0.83	0.81	0.79	0.58
1980	0.43	0.71	0.69	0.73	0.69	0.49	0.64	0.82	0.79	0.81	0.77	0.58	0.66	0.84	0.84	0.83	0.81	0.59
1981	0.45	0.70	0.70	0.75	0.69	0.49	0.64	0.83	0.81	0.82	0.78	0.57	0.67	0.84	0.86	0.84	0.82	0.62
1982	0.41	0.70	0.68	0.74	0.69	0.48	0.60	0.81	0.80	0.82	0.78	0.57	0.64	0.83	0.87	0.86	0.82	0.62
1983	0.39	0.70	0.70	0.73	0.70	0.48	0.60	0.82	0.81	0.83	0.79	0.55	0.67	0.83	0.86	0.85	0.83	0.60
1984	0.40	0.70	0.70	0.74	0.69	0.47	0.61	0.82	0.81	0.83	0.79	0.55	0.71	0.83	0.87	0.87	0.83	0.59
1985	0.40	0.70	0.70	0.74	0.70	0.47	0.62	0.82	0.82	0.84	0.80	0.54	0.67	0.84	0.89	0.88	0.83	0.59
1986	0.43	0.71	0.73	0.75	0.70	0.46	0.63	0.83	0.84	0.85	0.79	0.54	0.66	0.84	0.89	0.89	0.82	0.55
1987	0.44	0.70	0.72	0.75	0.71	0.45	0.65	0.83	0.84	0.85	0.81	0.54	0.64	0.85	0.90	0.89	0.85	0.57
1988	0.46	0.70	0.73	0.76	0.72	0.45	0.65	0.83	0.84	0.86	0.81	0.54	0.68	0.85	0.90	0.90	0.87	0.59
1989	0.47	0.69	0.73	0.76	0.72	0.45	0.66	0.84	0.85	0.86	0.82	0.53	0.65	0.85	0.91	0.91	0.86	0.58
1990	0.51	0.71	0.75	0.77	0.77	0.46	0.71	0.82	0.85	0.87	0.87	0.53	0.64	0.87	0.91	0.91	0.90	0.56
1991	0.49	0.70	0.73	0.76	0.76	0.45	0.69	0.80	0.85	0.87	0.86	0.51	0.68	0.86	0.90	0.91	0.91	0.57
1992	0.46	0.69	0.71	0.74	0.75	0.44	0.66	0.79	0.83	0.85	0.86	0.52	0.66	0.84	0.89	0.90	0.90	0.56
1993	0.43	0.65	0.70	0.74	0.74	0.43	0.65	0.78	0.83	0.86	0.85	0.51	0.61	0.83	0.89	0.90	0.90	0.56
1994	0.42	0.65	0.70	0.74	0.74	0.43	0.65	0.77	0.82	0.86	0.85	0.50	0.63	0.84	0.89	0.90	0.89	0.55
1995	0.41	0.64	0.69	0.74	0.73	0.41	0.66	0.77	0.82	0.85	0.85	0.50	0.70	0.84	0.88	0.89	0.89	0.54
1996	0.39	0.64	0.69	0.74	0.74	0.42	0.65	0.77	0.83	0.85	0.85	0.50	0.70	0.84	0.89	0.89	0.89	0.53

Appendix F (Continued)

Participation Rates by Education Level and Age

	Undergraduate Certificate						*Undergraduate Degree*						*Graduate Degree*					
	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64
1976	0.70	0.83	0.79	0.90	0.77	0.59	0.00	0.81	0.87	0.89	0.87	0.74	0.00	0.81	0.87	0.89	0.87	0.74
1977	0.67	0.83	0.80	0.81	0.78	0.60	0.00	0.80	0.87	0.90	0.88	0.74	0.00	0.80	0.87	0.90	0.88	0.74
1978	0.63	0.83	0.82	0.81	0.77	0.61	0.00	0.81	0.88	0.91	0.90	0.73	0.00	0.81	0.88	0.91	0.90	0.73
1979	0.64	0.83	0.83	0.81	0.79	0.58	0.00	0.83	0.88	0.92	0.88	0.75	0.00	0.83	0.88	0.92	0.88	0.75
1980	0.66	0.84	0.84	0.83	0.81	0.59	0.00	0.81	0.89	0.91	0.91	0.74	0.00	0.81	0.89	0.91	0.91	0.74
1981	0.67	0.84	0.86	0.84	0.82	0.62	0.00	0.84	0.90	0.92	0.91	0.75	0.00	0.84	0.90	0.92	0.91	0.75
1982	0.64	0.83	0.87	0.86	0.82	0.62	0.00	0.83	0.89	0.92	0.91	0.73	0.00	0.83	0.89	0.92	0.91	0.73
1983	0.67	0.83	0.86	0.85	0.83	0.60	0.00	0.85	0.90	0.93	0.92	0.72	0.00	0.85	0.90	0.93	0.92	0.72
1984	0.71	0.83	0.87	0.87	0.83	0.59	0.00	0.84	0.90	0.93	0.90	0.72	0.00	0.84	0.90	0.93	0.90	0.72
1985	0.67	0.84	0.89	0.88	0.83	0.59	0.00	0.83	0.91	0.92	0.92	0.72	0.00	0.83	0.91	0.92	0.92	0.72
1986	0.66	0.84	0.89	0.89	0.82	0.55	0.00	0.85	0.91	0.92	0.91	0.71	0.00	0.85	0.91	0.92	0.91	0.71
1987	0.64	0.85	0.90	0.89	0.85	0.57	0.00	0.85	0.91	0.93	0.92	0.66	0.00	0.85	0.91	0.93	0.92	0.66
1988	0.68	0.85	0.90	0.90	0.87	0.59	0.00	0.84	0.91	0.93	0.93	0.70	0.00	0.84	0.91	0.93	0.93	0.70
1989	0.65	0.85	0.91	0.91	0.86	0.58	0.00	0.85	0.92	0.93	0.92	0.58	0.00	0.85	0.92	0.93	0.92	0.58
1990	0.52	0.73	0.89	0.93	0.91	0.57	0.00	0.84	0.91	0.91	0.92	0.66	0.00	0.83	0.92	0.95	0.96	0.73
1991	0.60	0.65	0.89	0.93	0.92	0.56	0.00	0.81	0.91	0.91	0.93	0.59	0.00	0.84	0.92	0.95	0.97	0.74
1992	0.68	0.68	0.88	0.92	0.92	0.54	0.00	0.83	0.90	0.91	0.92	0.62	0.00	0.85	0.92	0.96	0.97	0.77
1993	0.65	0.70	0.89	0.93	0.93	0.53	0.00	0.81	0.90	0.92	0.93	0.63	0.00	0.83	0.92	0.94	0.95	0.79
1994	0.63	0.68	0.86	0.91	0.93	0.60	0.00	0.81	0.90	0.91	0.92	0.62	0.00	0.85	0.88	0.93	0.95	0.71
1995	0.49	0.62	0.86	0.90	0.93	0.55	0.00	0.80	0.91	0.91	0.92	0.61	0.00	0.80	0.90	0.94	0.95	0.71
1996	0.34	0.66	0.86	0.91	0.91	0.53	0.00	0.78	0.90	0.91	0.91	0.59	0.00	0.79	0.90	0.94	0.94	0.70

Source: Statistics Canada's Labour Force Survey (LFS).
In 1990, Statistics Canada adopted a new set of questions to determine educational attainment, thereby creating a break in the time series. See Statistics Canada (January 1990) (cat. 71-001) for more detail. For information on how the LFS's educational categories were combined to replicate the categories used in this paper, see footnote 13.