The Return to Investment in Human Capital: The Case of the Value of Educational Attainment beyond the High School Diploma in Canada

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2 December 2011

JOURNAL OF ECONOMIC AND FINANCE EDUCATION · Volume 12 · Number 2 · Winter 2013

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ABSTRACT

Based on 2001 Canadian Census data, we investigate the return to human capital in Canada. Internal rates of return (IRR) imply that the value of education varies by gender, level of education, and field of study. A bachelor's degree yields the highest IRR; the IRR from higher levels of education declines beyond the bachelor's degree. Women derive higher benefits from education than men. Finally, a bachelor's degree in engineering yields the highest IRR, followed by one in business/commerce and then by one in humanities.

Introduction

At various stages of life, rational individuals choose either to pursue more advanced studies/degrees or to work after completing a basic level of formal education. This decision is especially important to a recent high school graduate. Higher levels of educational attainment enhance productivity, and "improved knowledge and skills enable workers to perceive technological change more clearly and to adapt to it more effectively" (Becker 1962; Schultz 1963), thereby leading to improved living standards and improved job security. In general, when the expected benefits of a higher level of education are estimated to exceed the expected costs of obtaining that higher education level, a rational individual would consider pursuing the higher level of education.

Clearly, higher educational attainment plays a significant role in the well-being of the members of any society. However, it is difficult to fully evaluate education due to the associated intangible and non-measurable benefits and costs of education. On the other hand, many of the financial benefits and costs of education are explicit and straightforward. In this study we examine rates of return to post-high-school education by comparing cost/earning profiles of groups with different levels of education, fields of study, and different demographic backgrounds. With such data available from the Canadian Census of 2001, we focus on the value of post-high education in Canada in the year 2000.

In the literature, several studies have investigated the benefits of education from the perspective of earning potential in Canada. Vaillancourt (1995), Vaillancourt and Bourdeau-Primeau (2002), and Dodge and Stager (1972) use internal rates of return (IRR) to education from earnings to evaluate education. Berger (1988), Finnie (1995), Bar-Or, et al. (1995), and Benjamin, et al. (2002) focus on earning variations according to field of study and gender, and adopt a trend analysis method to capture rates of return to education over time. Data sources vary in these studies. For example, Vaillancourt (1995) and Vaillancourt and Bourdeau-Primeau (2002) study the micro-data in the Canadian Census. Finnie (1999) uses data provided by National Graduates Survey of university students by Canadian Colleges to evaluate earning

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differences according to field of study. Appleby, Fougere, and Rouleau (2002) focus on data in the Survey of Consumer Finance (SCF).

In this study, the return to investment in human capital in terms of the value of education in Canada beyond the high school level is investigated. In particular, the internal rate of return (IRR) to investment in human capital in terms of the value of education in Canada beyond the high school level is estimated. We investigate the IRR to education according to field of study, level of education, and gender based on data in the Canadian Census in 2001, which includes data up to 2000. Similar studies of earlier periods, such as Vaillancourt (1995) and Vaillancourt and Bourdeau-Primeau (2002), concentrate on value of education in the 1980s and 1990s. We add to the literature by studying a more recent time period in Canada. Furthermore, similar to Vaillancourt and Bourdeau-Primeau (2002), we use the IRR approach to evaluate return to education and focus on private and public rates of return to education to both individuals and society as a whole. We find that obtaining a bachelor degree provides the greatest public and private return to education in 2000 in Canada. In addition, the return to education is relatively higher for women than men. We also find that rates of return to education decrease with level of education beyond the bachelor degree. Moreover, the IRR to education beyond high school varies according to field of study among bachelor degree holders, with the highest return being in engineering and the lowest in humanities.

The study is organized as follows. In section 2, we review the empirical results in Vaillancourt (1995) and Vaillancourt and Bourdeau-Primeau (2002) and discuss methodology. Definitions of private and public rates ofreturn to education are also provided. In section 3, we explain cost estimation, whereas in section 4, we discuss the return to education by field of study and by level of education. In section 5, our overall conclusions are summarized.

Literature Review and Methodology

"The social rate of return serves as a point of reference for government authorities in determining whether it is financially cost effective, from the standpoint of society as a whole, to promote access to a given level of education ...It is estimated on the basis of the additional employment income (before taxes) of the most highly educated" (Appleby, Fougere, and Rouleau 2002, pp.2). In this study, the social rate of return is referred to as the 'public rate of return,' where 'The private rate of return pertains to an agent in particular. The benefits associated with one level of education rather than another represent the difference between the respective incomes anticipated during the period of working life in the labour market." (Appleby, Fougere, and Rouleau 2002, pp. 2).

Vaillancourt (1995) examines private and public rates of return to education in Canada using an IRR approach, based on the micro-data in Canadian Census in 1986. Vaillancourt (1995) classified data by gender and fields of study. In particular, individuals were allocated to one of eight levels/categories of education. In addition, among all bachelor degree recipients, each individual was allocated to one of the seven fields of study: education, humanities, social sciences, commerce, pure sciences, engineering, and health. Vaillancourt and Bourdeau-Primeau (2002) re-estimated rates of return to education in Canada using the micro-data of Canadian Census for 1991 and for 1996. Moreover, they simplified the educational attainment criteria and assigned individuals to one of three levels of educational attainment: bachelor, master, and PhD. Vaillancourt (1995) finds that the highest public and private rates of return to education in 1985 are derived from obtaining a high school diploma, with 11.9% for men and 9.1% for women for the public rate of return and with 33.4% and 38.5% for men and women, respectively, for the private rate of return. Vaillancourt and Bourdeau-Primeau (2002) finds the highest public and private rates of return to education in both 1990 and 1995 are from obtaining a bachelor degree, with the highest public rates being 8% (10%) for both men and women, respectively, in 1990 (1995), and the highest private rates being 16% (17%) and 19% (20%), for men and women, respectively, in 1990 (1995).

Furthermore, among bachelor degree recipients, women gamer a higher private rate of return to education than men do. Private rates of return for women are 18.8%, 19% and 20% in 1985, 1990 and 1995, respectively, as compared with 8.3%, 16% and 17%, respectively, for men. Moreover, the rate of return in most cases decreases with the level of education attained. An exception is for women with a PhD degree whose public and private rates of return are higher than those with a master degree in both 1985 and 1995. Lastly, the return to education among bachelor degree holders varies by field of study. The highest

return is for engineering and the lowest is for the humanities. This phenomenon might well be related to the perceived greater difficulties of the various curricula. Mathematics and science are taken for granted as more difficult and time consuming and thus might draw better or more dedicated students, whereas larger numbers of students with concerns over curriculum difficulty may be attracted to the humanities, education, and certain of the social sciences. Support for this perspective is found in the study of undergraduate student choice of major in the U.S. by Cebula and Lopes (1982).

Although the value of education in Canada in the 1980s and the 1990s has been studied in the literature, the value of education in Canada in the 21th century has yet been formally investigated. Hence, one of the contributions of the present study to the literature is simply providing results for the 21st century. Based on micro-data in the Canadian Census of 2001, we adopt an approach similar to that in Vaillancourt and Bourdeau-Primeau (2002); in particular, we calculate rates of return to education by taking several steps.

First, we run OLS regressions of earnings on age within each of the three levels of education in order to control for the impact of age on earning potential. The model is, as follows.

$$Ln\,(earnings) = B_0 + B_1 * Age + B_2 * Age^2 \qquad (1)$$

To evaluate the impact of fields of study on earning, we add a dummy variable for each field of study as well as the interaction term with age. This model is given by:

$$\ln(\text{earnings}) = \ln + \beta_1 \text{Age} + \beta \text{Age}^2 + [\text{tn}_{13}\,\text{rield} + t\,\beta_{1i}\text{Fields x Age}] \qquad (2)$$

Based on the above models, we then calculate earnings by level of education and by fields of study among bachelor degree holders. Next, we estimate costs of education, including the public and private costs. Lastly, we compute IRR using the following equation:

$$0 = \sum_{1=1}^{N} \frac{(A_t - B_t)}{(1+r)^t} - C, \qquad (3)$$

where C represents total costs of earning a post-secondary degree or a diploma; A and B are the net benefits from *after* and *before* possessing a post-secondary degree or diploma; r is the discount rate or TRR; t starts at the anticipated age at the end of the post-secondary studies; and N is the length of working life.

Cost Estimation and IRR

In this study, we investigate the value of education in Canada using data from Canadian Census of 2001. The *2001 Census Public Use Micro-data File (PUMF) on Individuals* provides survey data based on 2.7% of the population in the census. Data for eight variables are collected: age, gender, weeks worked in 2000, highest level of schooling, highest degree, certificate or diploma, major or field of study, wages and salaries, and self-employment income. Following Vaillancourt (1995) and Vaillancourt and Bourdeau-Primeau (2002), we focus on seven majors from among a total of 18 majors for bachelor degree; these are education, humanities, social sciences, commerce, pure sciences, engineering, and health sciences. Furthermore, individuals are allocated to one of four levels of education based on their highest level of schooling and the highest degree held. We use high school level earnings as the benchmark to calculate the

forgone earnings for bachelor studies and beyond. This leaves bachelor degree, master degree, and the PhD as the three levels of education under study.

Earnings are estimated based on models (1) and (2) above. Following Vaillancourt and Bourdeau-Primeau (2002), we estimate gross earnings (before income taxes) and net earnings (after income tax). Moreover, we make assumptions regarding the age at which individuals finish their targeted education, as well as the age at retirement. To be specific, we assume students on the average graduate with a high school diploma, a bachelor degree, a master degree, and a PhD degree at the age of 18, 22, 24 and 28, respectively. Furthermore, each person is expected to retire at the age of 62. The initial regression results are reported in Tables 1 and 2.

Table 1-Regression Results b;r Level of Education in 2000 -Male

	Panel A -Male			
	High school	Bachelor	Master	PhD
Intercept	7.2883***	7.6277***	7.3336***	7.3035***
	(123.15)	*(86.11)*	*(34.78)*	*(14.73)*
Age	0.1392***	0.1466***	0.1613***	0.1423***
	(43.71)	*(33.18)*	*(16.38)*	*(6.61)*
Age Square	-0.0015***	-0.0016***	-0.0017***	-0.0013***
	(-36.75)	*(-30.29)*	*(-15.62)*	*(-5.73)*
Adjusted R^2	0.1374	0.0713	0.0468	0.0662
F	1781.6	*772.58*	151.26	*55.89*
N	22,367	20,136	6,160	1,581
	Panel B – Female			
	High school	Bachelor	Master	PhD
Intercept	7.1827***	7.7865***	8.3405***	8.5197***
	(112.59)	*(92.45)*	*(34.76)*	*(11.22)*
Age	0.1243***	0.1270***	0.1038***	0.0881***
	(36.77)	*(28.86)*	*(8.97)*	*(2.58)*
Age Square	-0.0013***	-0.0014***	-0.0011***	-0.0008***
	(-30.97)	*(-25.87)*	*(-8.27)*	*(-2.15)*
Adjusted R^2	0.1049	0.0653	0.0258	0.0369
F	1210.22	656.28	55.47	10.72
N	20,664	18,805	4,189	563

Note: t- statistics are in italics. *** indicates statistical significance at the 1% level.

Table 2 - Regression Results at Bachelor's Level by Fields of Study in 2000

	Male		Female	
	Estimate	t Value	Estimate	t Value
Intercept	7.5356***	*67.25*	7.6034***	*78.08*
Age	0.1437***	*30.66*	0.1319***	*28.4*
Age Square	-0.0016***	*-29.99*	-0.0014***	*-25.79*
Fields of Study				
Humanities	-0.3091***	*-3.13*	0.0021	*0.03*
Social Sciences	-0.0002	*0*	0.0984	*1.5*
Commerce	0.2074**	*2.36*	0.4640***	*5.98*
Pure Sciences	0.3123***	*3.41*	0.1777**	*2.15*
Engineering	0.3552***	*4.06*	1.0948***	*7.48*
Health sciences	0.0768	*0.49*	0.2389***	*2.96*
Others	-1.0830**	*-1.95*	-0.0420	*-0.11*
Fields of Study*Age				
Humanities*age	0.0038*	*1.61*	-0.0030*	*-1.71*
Social Sciences*age	0.0039*	*1.87*	-0.0026*	*-1.57*
Commerce*age	0.0006	*0.3*	-0.0100***	*-4.99*
Pure Sciences*age	-0.0038*	*-1.75*	-0.0033*	*-1.56*
Engineering*age	-0.0014	*-0.66*	-0.0300***	*-7.39*
Health sciences*age	0.0014	*0.37*	-0.0032*	*-1.63*
Others*age	0.0242**	*1.93*	-0.0026	*-0.26*
Adjusted R^2	0.1011		0.0772	
F	141.41		98.4	
N	20,136		18,805	

Note: t- statistics are in italics. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

The after-tax income of individuals is equal to gross income minus personal income tax liabilities, including employment insurance (EI), the Canada or Quebec Pension Plan (CPP/QPP) credit, and the allowable *registered retirement savings plan* (RRSP). Of note, not everyone contributes 100% of the *allowed* deduction of 18% of earnings to their RRSP. To estimate the annual contributions to the RRSP account, we adopt the RRSP data provided by Statistics Canada (2001, CANSIM, Table 111-0040), from which we obtain total RRSP room (potential), total unused RRSP, and total *new* RRSP[2]. According to the footnote of Table 111-0040, total RRSP room equals the sum of total unused RRSP plus total new RRSP. By adding total RRSP room of the previous year to the total new RRSP and then subtracting total RRSP room of the current year, we calculate the annual contribution and report it in the 2nd column in Table 3. Total employment income is collected from CANSIM Table 111-0014[3]. We calculate the percentage of taxable income contributed to RRSP using the annual RRSP contribution divided by total employment income. Using the above approach, we calculate the six contribution rates from 2000 to 2005 and report them in the 3rd column of Table 3. Additionally, in the 5th column in Table 3, we report the annual RRSP contributions collected from *"Registered retirement savings plan contributions"* published by The Daily of Statistics Canada in November 28, 2001[4], November 19, 2002[5], October 23, 2003[6], November 2, 2004[7],

[2] Registered Retirement Savings Plan (RRSP) room, annual,
[3] Family characteristics, by family type and sources of income, annual, http://estat.statcan.ca/cgi-win/CNSMCGI.EXE
[4] http://www.statcan.ca/Daily/English/011128/d011128f.htm
[5] http://www.statcan.ca/Daily/English/021119/d021119b.htm
[6] http://www.statcan.ca/Daily/English/031023/d031023b.htm
[7] http://www.statcan.ca/Daily/English/041102/d041102b.htm

October 26, 2005[8], and November 22, 2006[9]. The contribution amounts as shown in the 2nd and the 5th columns collected from two different resources are comparable. Thereby, we assume that the average of the RRSP contribution rates from 2000 to 2005, i.e. 5.04%, is a reasonable estimate of the lifetime RRSP contribution rates.

Table 3 - RRSP Annual Contribution Rates

Annual Contribution to RRSP(*1 000)[1]	Contribution rate (%):	Total employment income (*I OOOf	Annual Contribution to RRSP (13illion)[4]
29,008,881	5.74	505,502,178	29.3
28,915,787	5.37	538,251,346	28.4
27,268,291	4.95	550,562,134	27.1
27,255,455	4.77	571,927,467	27.6
29,070,981	4.82	603,091,295	28.8
29,352,724	4.60	637,652,144	30.5
	5.04		

1. Annual contribution to RRSP calculated !Tom CANSIM Table 111-0040

2. Contribution rate calculated (annual contribution to RRSP / total employment income)

3. Total employment income obtained from CANSIM Table 111-0014

4. Annual contribution to RRSP obtained from the articles, *Registered retirement savings plan contributions,* in The Daily of Statistics Canada

Similar to Vaillancourt and Bourdeau-Primeau (2002), we estimate the personal income tax rates based on the federal income tax system and the Ontario tax system for provincial rates in 2000. This information is available at Canadian Revenue Agency 2000. We assume that the tax rates are fixed from graduation to retirement.

Next, we calculate the costs of education, from two perspectives. Direct costs include tuition and expenses for textbooks. Indirect costs include foregone earnings due to schooling. Tuition fees are provided by Statistics Canada, *SURVEY OF TUITION AND LIVING ACCOMMODATION COSTS FOR FULL-TIME STUDENTS AT CANADIAN DEGREE-GRANTING INSTITUTIONS 1999-2000 actual.* Students from outer provinces generally pay higher tuition fees than local residents. Therefore, tuition fees are not uniform, especially among universities in Quebec. To be consistent, we use the average tuition and fees in this study. Furthermore, we combine agriculture and science together as pure sciences. Art and music are grouped into humanities. Likewise, household sciences and law, dentistry and medicine, and architecture and engineering are combined together as social sciences, health sciences, and engineering, respectively. Including education and commerce, we have a total of seven fields of study, rather than 12 as in Statistics Canada. Tuition fees for all fields of graduate education are the average of all tuition fees for full time Canadian graduate students in the period 1999-2000. Additionally, the out-of-pocket expenses are based on Vaillancout and Bourdeau-Primeau (2002, Table A-2). The breakdown of private costs of college education is reported in Table 4.

[8] http://www.statcan.ca/Daily/English/051026/d051026b.htm

[9] http://www.statcan.ca/Daily/English/061122/d061122f.htm

Table 4 - Annual Private Costs in 2000

Tuition	Dollar Amount
Undergraduate	
All fields	3,447
Education	2,857
Humanities	3,384
Social sciences	3,665
Commerce	3,300
Pure sciences	3,290
Engineering	3,567
Health	7,459
Graduate	
All fields	3,177
Other out of pocket expenses	
University, all levels	1,957

Public costs are collected from the postsecondary education column in Statistics Canada, CANSTM Table 385-0007[10] Enrollments at each level of study are from Statistics Canada, CANSIM Table 477-013[11]. Based on the above information, we estimate the reference point which is equal to total costs divided by the number of enrolled students. Furthermore, we break down public costs by level of education and by fields of study using the same ratios as in Vaillancourt and Bourdeau-Primeau (2002). Specifically, bachelor degrees in education, in the humanities, in social sciences, in commerce, and in mathematics are used as the benchmark. Undergraduate education in pure sciences, engineering, and health science have costs that are 1.5 times, 2.0 times, and 3.33 times as high as the benchmark, respectively. Among master degrees, those in education, humanities, social sciences, and commerce have costs that are 2.0 times that of the benchmark, whereas mathematics, pure sciences, engineering, and health are 3.0 times the value of the benchmark. Lastly, among all disciplines of PhD studies, the public costs are 6.0 times as high as the benchmark. We believe that the above ratios reflect the fact that studies at higher levels and in certain fields require government to provide more resources than others do. The public costs of education are reported in Table 5.

Table 5 - Public Annual Costs in 2000

	Method of Calculation	
General	Public costs are from Statistics Canada, Table 385-0007. Enrollments are from Statistics Canada, Table 477-0013.	
	Breakdowns by Program and Level	Public Costs
Reference point		16,414
Undergraduate	Education, humanities, social sciences, commerce, mathematics(benchmark); pure sciences(1.5); engineering(2); health(3.33)	28,232*
Graduate		
Master	Education, humanities, social sciences, commerce(2); mathematics, pure sciences, engineering, health(3)	40,325**
PhD	All disciplines (6)	98,484***

Source: • the average public annual costs of seven fields of study at bachelor's level
•• the average public annual costs of all fields of study at master level
••• the average public annual costs at PhD level

[10] University and college revenue and expenditures
[11] University enrolments, by registration status, program level, classification of instructional programs, primary grouping and gender, annual

Forgone earnings are estimated using equation (I) combined with coefficients from Table 1. It is assumed that everyone takes four years to earn a bachelor degree, two more years for a master degree, and four extra years to graduate with a PhD degree. For post-secondary students, we assume that they spend eight months in the program and thus the foregone earnings are two-thirds of the annual earnings. Tables 6 and 7 report the direct and indirect costs as well as the total costs by level of education and by field of study.

Table 6 - Private and Public Costs at Various Levels of Education in 2000

	Direct Cost"	Forgone Earningsb		Totale	
		Men	Women	Men	Women
		Private Constituent			
Bachelor	21,616	32,381	21,528	53,997	43,144
Master	10,268	29,260	24,231	39,528	34,499
PhD	20,536	7L,125	70,660	91,661	91,196
		Public Constituent			
Bachelor	112,928	36,247	23,961	149,175	136,889
Master	80,650	32,920	27,226	]13,570	107,876
PhD	393,936	80,513	76,241	474,449	470,177

a. Private and public costs in Table 4 and Table 5 times the number of years of education necessary

b. Two-third times the annual earnings if the person did not pursue higher education.

c. Sum of direct costs and forgone earnings

Table 7- Private and Public Costs by Fields of Study in 2000

	Direct Cost•	Forgone Earningsb		Totalc	
		Men	Women	Men	Women
		Private Constituent			
Education	19,256	32,381	21,528	51,637	40,785
Humanities	21,364	32,381	21,528	53,745	42,893
Social Sciences	22,488	32,381	21,528	54,869	44,017
Commerce	21,028	32,381	21,528	53,409	42,557
Pure Sciences	20,988	32,381	21,528	53,369	42,517
Engineering	22,096	32,381	21,528	54,477	43,625
Health Sciences	37,664	32,381	21,528	70,045	59,193
		Public Constituent			
Education	98,484	36,247	23,961	134,731	122,445
Humanities	98,484	36,247	23,961	134,731	122,445
Social Sciences	98,484	36,247	23,961	134,731	122,445
Commerce	98,484	36,247	23,961	134,731	122,445
Pure Sciences	98,484	36,247	23,961	134,731	122,445
Engineering	131,312	36,247	23,961	167,559	155,273
Health Sciences	393,936	36,247	23,961	430,183	417,897

a. Private and public costs in Table 4 and Table 5 times the number of years of education necessary

b. Two-third times the annual earnings if the person did not pursue higher education.

c. Sum of direct costs and forgone earnings

We calculate IRRs based on Equation (3). We first calculate the differences in wages for various combinations of the variables. The difference in wages is the total benefit gained from education. For example, we calculate the incremental wages males earned from obtaining a bachelor degree when compared to the earnings from a high school degree at every age from age 22 to age 62. The total costs are taken directly from Table 6 and Table 7. The IRR is calculated by setting the incremental cost of a bachelor degree equal to the incremental benefit and solving for the interest rate. We repeat the above procedure for the comparison between master level and bachelor level, as well as between PhD level and master level,

among males. We follow the same procedure to estimate the IRRs among females. The details regarding the estimation of the incremental benefits are available upon request.

The Return to Investment in Education

In this section, we analyze rates of return to education by level of education and by fields of study. Table 8 summarizes the incremental returns to education by level of educational attainment.

Table 8-Return to Education by Level of Educational Attainment in 2000

	Bachelor	Master	PhD
Men			
Pretax TRRs	15.9%	3.7%	-0.3%
Net of Tax IRRs	9.4%	0.9%	-3.2%
Women			
Pretax IRRs	19.2%	8.8%	2.0%
Net of Tax IRRs	9.3%	3.7%	-2.6%

The results tend to show that the highest public and private incremental returns to education in 2000 are from earning a bachelor degree. To be specific, the highest public (private) incremental rates of return for obtaining a bachelor degree in Canada for men and women are 9.4% (15.9%) and 9.3% (19.2%), respectively. Furthermore, both private and public rates of return among women are higher than those among men, with one exception: at the bachelor level, where degree holders make similar returns for both men and women. Lastly, rates of return to education tend to decrease with the level of education attained beyond the bachelor degree.

Lnterestingly, rates of return to education in 2000 at the bachelor level are comparable to those in the 1980s and in the 1990s. However, at the master level and at the PhD level, the results differ from the results of Vaillancourt (1995) and Vaillancourt and Bourdeau-Primeau (2002); in particular, the results presented here imply lower rates of return to the master and PhD degrees than found by Vaillancourt (1995) and Vaillancourt and Bourdeau-Primeau (2002).

We also investigate the return to education by fields of study among bachelor degree holders in comparison with high school graduates in the same field. Table 9 summarizes the incremental rates of return to education at the bachelor level by fields of study.

Table 9 - Return to Education at Bachelor Level b Fields of Stud in 2000

	Education	Humanities	Social Sciences	Commerce	Pure Sciences	Engineering	Health Sciences
Men							
Private	11.40%	3.80%	15.20%	19.60%	18.80%	22.90%	12.30%
Public	6.30%	1.30%	9.80%	12.30%	11.30%	12.00%	1.90%
Women							
Private	18.10%	14.40%	17.70%	24.50%	20.50%	29.00%	17.20%
Public	9.50%	7.30%	9.80%	12.70%	11.00%	10.00%	2.80%

Not surprisingly, the results tend to show that the return to education at the bachelor level varies by field of study, as found in the earlier study for the U.S. by Cebula and Lopes (1982). Engineers with a bachelor degree earn the highest returns to education, whereas humanities majors earn the lowest returns. Furthermore, private rates of return are about twice as high as public rates of return, with the exception of health science, whose private rates are much higher than public rates. These results are compatible with those in Vaillancourt and Bourdeau-Primeau (2002) and Vaillancourt (1995) for the 1980s and 1990s study periods.

Using the same approach, we analyze the marginal return to education by level of education and by gender. First, we compare the rate of return to education by level of education. We find that a master degree graduate makes slightly higher wages than a bachelor degree holder, whereas the latter obtains much higher returns than a high school diploma holder. Interestingly, a PhD graduate earns less than a master graduate at the beginning of his/her career. At about 45 years of age, PhD level wages tend to rise

above their peers and the gap increases each year until retirement. This phenomenon might be due to the much higher total private and public costs at the PhD level than at the master level.

We conduct a similar study on the rate ofreturn to education among females. We find that the shapes of the wage pattern for females are similar to those for males, except at the PhD level. Female PhDs are better off on average than their male counterparts. Not only are the differences in earnings between female masters and female PhDs smaller than those among males during their early career, but also female PhDs catch up with female masters 10 years earlier than male PhDs do. Of note, we ignore earnings received during PhD studies, such as teaching and research assistantships. Therefore, we slightly underestimate the rate of return to education at the PhD level.

Based on the previously calculated IRR for each field of study, we find that the largest difference is among engineers, followed by a major in commerce. The smallest difference is for the humanities major, followed by the education major. The findings tend to demonstrate that for engineers and businessmen, it is worthwhile to earn a bachelor degree. Furthermore, the differences in earnings between bachelor degree holders and high school graduates among women within each field are relatively lower than those among men. The difference is lowest for the humanities major for females. An interesting finding is that the earning profiles of female engineers are quite different from women in other fields and from their male engineer counterparts. Until the age of 30, female engineers with a bachelor degree earn more than those with a high school diploma. However, the earning gap decreases with age after that. Indeed, at about age 54, the trend is actually reversed. This is a bit surprising. In order to see whether our results are robust, we refer to Tables A-3, A-4, A-5 and A-6 in Vaillancourt and Bourdeau-Primeau's (2002, pp. 232-235), to calculate differences in earnings between bachelor degree holders and high school graduates by fields of study among females in both 1990 and 1995. We in fact find similar patterns. The results may reflect the fact that the knowledge and the skills required for engineers, such as software engineers, are updated more frequently than others; however, female engineers with a bachelor degree are left behind after turning 30 years old since they tend to become family oriented rather than career oriented as compared on average to men. The results are also consistent with the well known phenomenon that there are fewer female engineers than female educators and female artists. The latter is a very interesting finding, which may well deserve further attention, although such analysis is clearly beyond the scope of the present study.

Conclusion

In this study, we investigate investment in human capital in terms of the incremental rate of return to education by gender, level of educational attainment, and field of study, using the Canadian Census of 2001. Prior studies have investigated the same topics in Canada in the 1980s and 1990s. The results in our study show that obtaining a bachelor degree provides the greatest public and private rates of return to education in 2000 in Canada. Furthermore, on average, the rate of return to education is higher for women than for men. However, rates of return to education decrease with level of education beyond the bachelor degree. Lastly, the rate of return to education to a bachelor degree holder varies by field of study when compared with a high school graduate, with the highest return being in engineering and the lowest being in the humanities.

Comparing with the prior studies for return to education in the 1980s and in the 1990s, we conclude that an individual consistently makes the highest marginal rate of return to education from obtaining a bachelor degree than from other degrees, including high school diploma only, a master degree, and a PhD degree. This pattern of the rate of return to investment in human capital in a bachelor degree appears to be quite stable over time. However, rates of return at the master and PhD levels appear to vary over time. An interesting avenue for further research would be to check whether the choice of pursuing a master or a PhD degree is more sensitive to the state of economy than that of pursuing a bachelor degree. Another interesting direction for future research is to investigate why female engineers with a bachelor degree have a different career path when compared with their male counterparts. This path of investigation may involve the application of the tools of sociology to provide a satisfactory explanation.

References

Appleby, John, Maxime Fougere, and Manon Rouleau. 2002. "Is Post-Secondary Education in Canada Cost-Effective Proposition?" *The Applied Research Branch Strategic Policy, Human Resources Development Canada series* working paper.

Bar-Or, Yuval., John Burbidge, Lonnie Magee, and A. Leslie Robb. 1995. 'The Wage Premium to a University Education in Canada: 1971-1991." *Journal of Labor Economics* 13:762-94.

Becker, Gary. 1962. "Investment in Human Capital: A Theoretical Analysis." *The Journal of Political Economy* 70 (5): 9-49.

Benjamin, Dwayne, Morley Gunderson, Thomas Lemieux and Craig Riddell (2002) *Labor Market Economics, 5th Ed.* Canada: McGraw Hill Ryerson.

Berger, Mark C. 1988. "Cohort Size Effects on Earnings: Differences by College Major." *Economics of Education Review* 7(4): 375-83.

Cebula, Richard J., and Jerry Lopes. 1982. "Determinants of Student Choice of Undergraduate Major Field." *American Educational Research Journal* 19(2): 303-12.

Dodge, David and David A. A. Stager. 1972. "Economic Returns to Graduate Study in Science, Engineering and Busines." *Canadian Journal of Economics* 5(2): 182-98.

Finnie, Ross. 1995. *"Steppin' Out: An Analysis of Recent University Graduates Into the Labour Market."* paper prepared for Industry Canada, Working Paper No. 5: 129.

Finnie, Ross. 1999. "Earnings of University Graduates in Canada by Discipline What You Study Matters-An Econometric Analysis of Earnings Differences of Bachelor's Level Graduates." *Applied Research Branch R-99-13E.b*

Schultz, Theodore W. 1963. *"The Economic Value of Education".* New York: Columbia University Press.

Vaillancourt, Franois. 1995. "The Private and Total Returns to Education in Canada, 1985." *Canadian Journal of Economics 28 (3): 532-554*

Vaillancourt, Frarn;pis, and Sandrine Bourdeau-Primeau. 2002. "The Returns to University Education in Canada, 1990 and 1995, in Laidler, David (editor), *Renovating the ivory tower: Canadian universities and the knowledge economy,* C.D. Howe Institute, Toronto: 215-40.