The Economics of Education

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(1) Introduction

What, exactly, are the benefits of education in terms of the labour market? The aim of this paper is to demonstrate the different roles education serves for workers and firms. For most individuals, education is thought of as a means to an end, i.e., higher wages, better working conditions and so on. By examining the effects education and training have on individual labour incomes over a large sample of the Canadian population, a benchmark for success (or failure) can be established. This study is of interest because the vast array of educational tools and programs available at present is larger than ever before, which makes choosing the best path a daunting task. Along with traditional universities and colleges, there are a large number of private institutions offering training courses and certificate programs on any subject imaginable. This paper will investigate the validity of the two leading economic theories that link education to wage rates, and attempt to determine which model provides greater explanatory power from a positive perspective. Based on these findings, individuals faced with the choice of obtaining further education or entering the workforce can evaluate the returns of either decision.

Years of education have long been thought to be directly linked to human capital through increases in individual productivity. In addition, numerous papers have documented previously unexplained increases in wage rates that correlate with degree completion, frequently labelled sheepskin effects. According to the human capital model, investments in education will raise earnings by improving individual productivity. Skills acquired during schooling are useful to the employer and will be rewarded with higher wages. A more recent addition, which contrasts with the human capital approach, is the signalling/screening model. This approach views education as a sorting mechanism that is used by individuals and firms. The asymmetry of information, regarding the true ability of applicants, between employers and potential employees is essential to this theory. If more educated workers turn out to be more productive workers, firms can use education as a method of screening. Conversely, if

firms are willing to pay higher wages to those with more education, individuals will have an incentive to invest. Central to this relationship is that education is less costly acquire for individuals with greater ability. However, what is not required of education is that it has any effect on individual productivity.

The main findings of this paper suggest that the human capital or signalling theories of education on their own do not provide an accurate estimator of returns. In Canada there exists a high degree of variation among individuals in both years of education and credentials obtained. Based on an estimated earnings function, I uncover empirical evidence of the existence of both conventional human capital effects and sheepskin effects. This lends credence to the fact that education serves a dual role: to enhance human capital and send signals through credentials. This paper finds that in general, women experience the highest returns to both and that sheepskin effects are dissipated when multiple credentials are combined. Thus the benefits from education are maximized by taking the most direct route, whatever the destination.

This paper is organized as follows: section 2 reviews the theoretical foundations on which the empirical research is based. Section 3 describes some of the recent findings in the field of education research. Section 4 describes the data and some basic methodology used in this paper. Sections 5, 6, and 7 present the specific empirical approach taken in the context of human capital, signalling, and the combination of both in a hybrid model. Section 8 contains a review of the results and some concluding remarks.

(2) The Foundations of Research

In his now classic treatise *The Wealth of Nations,* Adam Smith introduced a novel idea that linked human labour and physical capital in terms of economic potential. People, he wrote, were in

some ways a form of capital, not unlike a machine or a plot of land that, with investment and the proper care, will ultimately provide returns and eventually profits. In this book in the section defining forms of capital he, lists three tangible sources: machines (including tools), buildings, land and then notes that

> Fourthly, of the acquired and useful abilities of all the inhabitants or members of the society. The acquisition of such talents, by the maintenance of the acquirer during his education, study, or apprenticeship, always costs a real expense, which is a capital fixed and realized, as it were, in his person. Those talents, as they make a part of his fortune, so do they likewise that of the society to which he belongs. The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labour, and which, though it costs a certain expense, repays that expense with a profit. (Smith 1902, 189)

In his words, an individual (in terms of productivity) is not so different from a machine which can be improved upon through investment. A person's investment in education results in a return in the form of higher wages and productivity. He also notes that there are gains to society - meaning that the total benefits from education are greater than those received by the individual alone; a positive externality to accumulating education exists.

In more recent literature on the subject, these returns are referred to as either public or private returns and together make up the total returns. Public returns arise from the benefits society accrues, monetary and otherwise, from having a more educated population. It is well documented that as the level of education rises (individually and collectively), there is a resulting decrease in incidences of violent crime, improvement in hygiene and health and an increase in social giving through philanthropic means and volunteerism. (Behrman and Stacey 1997)

External (public) benefits of education such as these are often hard if not impossible to measure quantitatively and for the most part are beyond the scope of this paper. The magnitude of the public return is a subject of much debate, as it has wide implications for policy decisions based on micro level cost-benefit analysis.

Returns to education

There is a massive collection of research and literary work that endeavours to explain returns (in terms of public, private and total) to education. Economic works in this area are often carried out employing a methodology that parallels most forms of capital investment research. The school being analogous to a factory takes students as the input, and through education transforms them into productive workers as the output. This increases the value of the inputs, thus providing a return to the investment in schooling. Economic policy advice regarding the public funding of education is rendered by calculating a net present value or internal rate of return from the measured increase in value. The most common metric employed for these studies is earnings, usually of the individual, which are assumed to be directly linked to their respective level of education – by carefully controlling for other deterministic elements such as gender, experience, geography, etc. – the differences in earnings can be attributed to education thus providing a quantifiable rate of return.[1] Different levels of schooling i.e., primary, secondary and so on, are associated with different rates because of the differences in wages that, say, a high school graduate will command versus an individual with a masters level education. In this sense the data shows, with almost no exception, the lowest levels of schooling generate the highest marginal rates of return. This, of course, should come as no surprise as elementary education is just that and provides many of the basic skills in literacy and numeracy that are required in daily life. As the level of education increases the level of specialization also increases which provides skills that are valued in more specific areas. However, increased earning potential is only one of the many different returns to education, and using it alone to form education policy is potentially flawed. Diverting funds to the highest yielding investment is a tenet, of economic efficiency but diverting funds from universities to

[1] Based on marginal revenue product theory where individuals are paid their according to their respective contributions.

primary schools by the same line is surely specious reasoning. A broader understanding of the different benefits afforded to individuals and society is required in this policy debate before such decisions can be justifiably made.

Investment in Human Capital and Personal Income Distribution

Early research into income distribution was confronted with a puzzle; incomes were so highly skewed. Given that ability was assumed to be distributed normally over the population one would expect a similar distribution of incomes. "How can one reconcile the normal distribution of abilities with a sharply skewed distribution of incomes?"[2] (Pigou 1932)

Adam Smith recognized the importance of human capital and how it should affect wages, but until recently (the last 100 years) there was a lack of viable data and analytical tools, so there was considerable debate on what exactly determined the wage a person was paid. Many of the early attempts to understand this subject proposed models that implied chance (random luck) was an explanatory variable (Gibrat 1931). By incorporating certain known observable variables such as sex, race and social status, then considering a random probability influence, a wage function could be constructed.[3] Education was not recognized as one of the primary determinants of wage determination that it is today. For obvious reasons such theories were not sufficiently transparent to satisfy the curiosity of the social scientist. Nor did they provide a robust explanation of wages and income distribution that seemed to 'fit' as new detailed micro level data became available.

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[2] This is often referred to as the Pigouvian paradox of incomes.

[3] Sex, race and social status were often regarded as the main criteria which determined wages in papers of the 18th and 19th centuries. Racism, nepotism and classism were common practice at this time and these factors may have played a stronger role than is the case in today's labour market.

Human capital as an investment tool was pioneered for the most part by Jacob Mincer in his article in *The Journal of Political Economy* (Mincer 1958). He proposed a model based on compensation for the costs incurred by individuals obtaining education and specific training. In essence, training has an explicit cost, but also involves opportunity costs in the form of lost wages. For a rational person to choose training, and thereby forego current income, there must be a reasonable expectation of increased income in the future. In a simplified continuous time framework, the following equation must be satisfied to equality at a minimum, for education to be an optimal choice:

$$V \leq \int_{n}^{T} inc_n(e^{-rt})dt$$

Where:

V is the discounted present value of lifetime earnings before training

inc_n is the income stream after n years of training

T is the last year of work

One of the more interesting results of his model shows that as training requirements increase, so does the inequality of income distribution in the group.

> Differences in the training-mix produce predictable patterns of income inequality. Roughly speaking, the greater the average amount of training in the group, the greater the inequality in its income distribution. (Mincer 1958, 300)

Among his concluding remarks Mincer notes that abilities, which he ruled out of his model, may play a role in wage determination, and to the extent that they do, his model fails to capture that.

> Inter-occupational differences in income levels are not entirely compensatory, once a distribution of 'abilities' is introduced. If there is some degree of positive association between ability and choice of longer training, the compensatory differences are augmented by a differential ascribable to ability alone. The financial outlays incurred in training increase the compensatory differences in a way that magnifies dispersion and particularly skew-ness in the aggregative distribution. They may, indeed, increase the differences beyond the amount necessary for the equalization of the present values by sharply restricting supply. (Mincer 1958, 302)

The significance of this article is that it led to an empirical formulation where wages were linked to education. Now referred to as the Mincerian equation it takes the general form:

$$\ln Wage = \beta_0 + \beta_1 Education + \beta_2 EXP + \beta_3 EXP^2 + Controls + \epsilon$$

Education as a signalling device

Signalling is an alternative approach to interpreting the relationship between wages and educational attainment. The well-known correlation between higher levels education and 'good worker' qualities allows students who obtain certain credentials to 'signal' that they are indeed a part of this group. Similarly, employers, by demanding credentials from applicants, attempt to 'screen' them. In concert this behaviour serves to 'sort' individuals into separate groups.

In his pioneering article Spence proposed that by providing a signal to the employer, an applicant could eliminate the informational asymmetry in certain areas and therefore receive a higher price for his labour services. (Spence 1973) When selecting from different applicants the employer is faced with many unknowns regarding the capabilities of potential employees, capabilities which can only be observed over time. Education is one attribute that is directly observable, through a degree or certificate, and can be used as a signal of unobservable capabilities. If, over time, such a relationship is confirmed by employers, education will be established as a reliable signal of the future productivity of potential employees. The higher wages offered to credential holders provides the incentive required for

rational individuals to invest in costly education. An integral component of signalling is that the cost of sending a signal must somehow conform to individual ability. If a given signal is too easy to obtain and emit, such that anybody can send it, it becomes worthless in the sense that it loses the ability to transmit valuable information. This is one reason that education is such a good signalling device. Higher ability individuals are better suited to the trials of higher education. It is far less costly psychologically, physically and even monetarily for these individuals to obtain further qualifications. In a market where individuals are allowed to choose the level of education they desire, people will tend to sort themselves automatically. By applying a basic cost-benefit analysis on a personal level, those who possess a higher level of ability will find it worthwhile to obtain more education credentials (because of the relatively lower cost) and can effectively signal their abilities.

One of the more interesting aspects of his signalling theory is that education need not have any productive value. In other words a degree which entailed 40 credits of 'free-time' with recess and lunch is equally valuable to any other degree, so long as it comes with a sufficiently high requirement of ability. This idea is understandably unsettling to a student (or professor) that has spent a significant amount of time and resources on education. This may partly explain why the human capital approach has been more popular in terms of the volume of published papers in this area of economics.

Much of the founding literature on signalling and human capital implied exclusivity regarding the source of returns to education; these two theories of education were in direct competition, and one of them would have to prevail. In the case of the sorting model this leads differing views with two extremes. On one end of the spectrum, the view is that education plays no role in forming human capital, and so does not serve to enhance the productivity of the individual. Therefore, "education has no effect on the total goods and services produced by society."[4] (Riddell 2007) Alternatively, in his

[4] The author here is pointing out the argument that is sometimes made; this is not in fact what he is arguing.

paper, *Human Capital vs. Signalling Explanations of Wages,* Weiss (1995) asserts that these two theories are not necessarily mutually exclusive. "Sorting models subsume all the features of human capital models." In fact, sorting models effectively extend human capital models by allowing for unobservable attributes to be correlated with schooling.

(3) Recent Findings

Two findings, consistent within most of the recent empirical literature, are that the positive returns to education are decreasing over time, and the marginal returns are lower as the level of education increases. Two studies that use particularly broad data sets are *Time Trends of the Returns to Education: Cross-National Evidence* (Psacharopoulos 1989) and *Returns to Education in Canada Using New Estimates of Program Costs* (Rathje and Emery 2002). Psacharopoulos reviews the rates of return over time in a large number of countries. He concludes that there is an emerging patter of declining rates of return over time, and that this evidence mainly lends support to the human capital theory of education. Rathje and Emery estimate private and public returns using data from the 1986, 1991 and 1996 census responses and demonstrate that returns indeed decline as the level of education (and specialization) increases.

The time trend behaviour of the returns is relevant to the context of education. If education expenditures are investments, like any other they should exhibit decreasing returns within a long-term dynamic framework. Rational individuals will seek the higher returns provided by education, thus increasing the supply of educated workers. All else being equal, the greater supply will decrease the wage premium, which will decrease the return to the investment in education.

In *The private and total returns to education in Canada, 1985,* by Francois Vaillancourt, now a landmark in Canadian literature on this subject, was a detailed study that broke down returns by level and in the case of Bachelor's Degrees, by field of study. Among his conclusions he reports: returns are greater for women than men, rates of returns vary substantially across fields of study, with health degrees having the highest, and that the lower levels of education have the greatest marginal returns and therefore "the results show the importance of completing a minimum level of schooling [secondary school]." (Vaillancourt 1995)

Since this article was published, there have been numerous updates (Vaillancourt, Carpentier and Henriques 1987), and criticisms (Krashinsky 1987), as new census data sets are published. According to Krashinsky, by using the data available on highest level of schooling and highest degree held to categorize individuals, Vaillancourt fails to account for the significant variation in educational 'paths' that include dropouts and those with multiple types of credentials. The increased level of detail in the 2001 census shows that a full one quarter of individuals, without a secondary school graduation certificate, did go on to take further training. This would certainly bias the resulting estimates of returns to secondary school; the problem here is classification. Also any returns to ability are not explicitly calculated; "we chose to present in this paper rates of return unadjusted for ability differentials leaving to the reader the choice of correcting them if this is felt to be necessary" (Vaillancourt 1995). Therefore, the rates of return calculated in this study are correct if the ability of each individual is either the same – or just as unlikely – if abilities are evenly distributed among all types of degree holders including those with no education at all. If this assumption is not satisfied, and there is a correlation between ability and level of education, one that is known to employers and students, some of the reported returns to education will actually be returns to the level of ability that are signalled. This is an important distinction to make when using wage rates to estimate returns to education.

A trend visible in more recent work is that education can serve several different functions that blend together to form a package deal. Years of education provide useful skills, beginning with the basics and leading to specialization. Degrees and certificates provide information to potential employers about some of the unobservable characteristics of an applicant. According to Weiss, "Sorting models extend human capital theory models by allowing for some productivity differences that firms do not observe to be correlated with the costs or benefits of schooling." (Weiss 1995) He builds on the fact that "better educated workers are not a random sample of workers" in that they demonstrably posses qualities that are desirable by profit-maximizing firms. The fact is that most developed countries have legislation restricting what information firms are allowed to use as viable criteria for discrimination. Education is one tool that firms are openly allowed to use, and in an environment where there is an asymmetry of information regarding the ability and marginal product of the worker, this tool becomes all the more valuable. This makes education desirable to firms, enough so that they are willing to offer wage incentives to higher educated individuals. These increased wages are actually a return to the qualities firms desire and are often incorrectly interpreted as a return to education. Schooling decisions will thus be distorted by the increased wages offered to graduates beyond what human capital theory would allocate to the productivity enhancements from learning. On the empirical level, ability is an omitted variable in the earnings equation. Since its coefficient is positive, and since the included variable of education is positively correlated with ability, the estimated coefficient on education is thought to be upwardly biased.

The interpretation of sorting was expanded by Weiss to allow firms and individuals to communicate information on a range of issues other than ability. In previous studies the focus was on levels of income stratified by educational credentials, which implicitly assumes there are no significant differences in hours worked. *Sheepskin effects in work behaviour* (Trostel and Walker 2004) explores the relationship between hourly wages, weekly hours, and weekly earnings, which together constitute

income. The authors follow the empirical framework laid out in Jaeger and Page (1996) used to estimate sheepskin effects in wage rates. Using data on the number of hours worked per week, and the number of weeks per year, they proceed to investigate the differences in work behaviour in relation to credentials. They find significant differences in both the number of hours, and weeks worked, that are correlated with degree completion (as opposed to years of education), and these effects are found to be nearly doubled for women. The authors choose to include individuals who are not in the labour force, thus observations of 0 for hours and weeks worked. With the majority of the labour force composed of males, the case in the United States, it is logical that the sheepskin effects for women found by Trostel and Walker are more pronounced because they also capture work intentions. There is very little incentive to obtain credentials with no intention of entering the work force.

Finally, in their article *The Role of Credentials in the Canadian Labour Market* (Riddell and Ferrer 2002) use census data to show how years of schooling and degree completion interrelate to influence earnings. The jump in earnings that is found to correlate with degree completion, and not years of schooling, is attributed to the role of the credential or 'sheepskin effect' in the labour market. Interestingly, they find that these effects for women are not that different from those seen for men. The value of credentials increases steadily to 25% of the total return to education for degrees up to a bachelor's and beyond that rise more dramatically to 60% for holders of medical degrees. Another role of credentials, they find, is that they serve to 'open the door' to otherwise inaccessible opportunities. The entrance into some professions, such as becoming a doctor or a lawyer, require specific credentials as a minimum before being granted a licence to practice. Similarly many levels of education require completion of a previous level before an individual is allowed to move on. This leads to the conclusion that the sheepskin effects found are a manifestation of the dual role credentials have in the labour market. One role is to separate those with the credential from those without, referred to as the 'credentialisation' effect, the other role, is the opening of doors. To investigate the difference in

magnitude of these two effects, they use the case of a high school diploma and separate graduates from dropouts, further separating the sample of graduates into those whose highest degree is high school, and those with credentials above that. They find that "the 'credentialisation' effect is approximately 4% for men and women and the 'opening doors' effect is more than twice as large -- 9% for males and 10% for females." In this context, the signalling value of the credential is not as important as the platform it provides, from which further achievements are possible.

Instrumental Variables

More recently research into education has employed instrumental variables in order to remove what is referred to as the 'omitted ability bias'. The standard OLS techniques for estimating labour market returns use an equation where wages are regressed on education and experience. This estimation is known to suffer from a strong correlation between educational choices and ability, meaning that the estimated value for the return to education will also include the returns to ability, and will therefore be inconsistent.[5] The exact rates of return are of fundamental importance in terms of public funding and future education policy. The best method to separate education and ability would be an experiment of scientific design, with randomly selected individuals assigned differing levels of education, while maintaining a control group with no education at all. This would prevent any 'self sorting' that takes place in the current system and the distribution of ability would be even amongst the two groups. Estimates derived from the study of these two groups would, on average, be unbiased. Obviously such an experiment is not possible in a free society, without the capacity to eliminate ability from the equation entirely; researchers must attempt to find ways of controlling for its influence. One

[5] The omitted covariate means the limit of $(X'X)^{-1}X'\varepsilon$ does not go to zero as the sample size approaches infinity. The OLS estimate is expected to be biased upwards due to higher ability individuals choosing higher levels of education (a positive correlation between ability and educational choices), and the fact that ability is expected to have a positive influence on earnings (the coefficient of the omitted variable will be positive).

such method entails the use of instrumental variables, which if properly used will yield estimates that are consistent. This process requires an instrument to be found that is correlated with individuals' educational choices, but not correlated with the error term in the earnings function. One of the best sources for instruments of this sort is government policy. Through a change in policy, such as increasing the minimum age for mandatory school attendance, a group of individuals will alter their choices in terms of education regardless of personal ability. Such changes have occurred several times in Canada, and because regulation of this area in policy falls mainly to the provinces, it has historically proceeded in a fragmented fashion. A recent study, *The compelling effects of compulsory schooling: evidence from Canada* (Oreopoulos 2006) looks at changes in compulsory schooling laws in Canada from 1920 to 1990 and finds persuasive evidence that increasing the minimum age for leaving school results in higher grade attainment and higher incomes for those affected. The resulting estimates for the effect of grade attainment on earnings and income are 11.5% using OLS and 7% using IV with trend controls and 13% without.[6] By using a policy change that forced students to take an additional year of education as an instrument, Oreopoulos reports in his conclusion a resulting rise in incomes of about 12%, which is strikingly similar 11.5% estimated by OLS. This instrument works because people whose birthdays fall just before the new cut-off are not required to take the extra year of education, while people whose birthday fall just after do get the extra year; ability should be randomly distributed between these two groups. The obvious problem with using this particular instrument is that it has little predictive power beyond the age group affected by the policy change.

Another notable Canadian study, *Education, earnings, and the 'Canadian G.I. Bill'* (Card and Lemieux 2001), uses a completely different set of instruments. After the Second World War a

[6] The IV estimates include controls for province and birth cohorts and trend controls are for second-order polynomial cohorts by province.

substantive effort was made to reintegrate veterans into Canadian society.[7] The veterans' rehabilitation act essentially opened up education to veterans and had a dramatic effect on university attendance rates. The low rate of enlistment of French-speaking men in Quebec, roughly 14% compared to 46% of men from Ontario, allows them to be used as a control group when analyzing the impact of education on earnings. The cohort of men affected by the VRA from Ontario acquired on average an additional 0.2 to 0.4 years of schooling and experienced a subsequent rise in earnings. Card and Lemieux assess that the rises in education and earnings are consistent with a return of 15% using the IV estimate, which is considerably higher than the 7% found using OLS. Again the conclusion is that the IV estimates are typically as big, or bigger, than their OLS counterparts. A survey of the OLS and IV estimates of returns to education by Riddell (Riddell 2007)finds that in the studies reviewed, the IV estimates are consistently similar to, or larger than, the OLS estimates. At first this result would seem to contradict the original hypothesis that ability, educational choice, and wages are all positively correlated, which would result in OLS estimates that are larger than their true values. Using an instrument to remove the omitted ability bias should have produced lower estimates; however, the process of using instrumental variables in estimation relies ultimately on the quality of the instruments employed. The studies mentioned above produce estimates that are localized, in that they apply to a subset of the population, which is affected by the instrument. This is referred to as the local average treatment effect (LATE). Whereas the estimates produced in this paper are concerned with marginal rates of return. Data from the Canadian population is used as a base to provide a summary for estimates of the expected payoffs from education for a random individual. This method is concerned with the evaluation of the average treatment effects (ATE). The estimates by Oreopoulos (Oreopoulos 2006) are obtained using policy changes that generally affect high school tenure by one year – a very small part of most individuals' educational careers. Similarly Card and Lemieux produce estimates that may confound the effects of WWII service and

[7] The Canadian G.I. Bill actually refers to the Veterans Rehabilitation Act.

education on earnings because they were not able to control for the unknown effects that serving in a major war might have on a person's ability to perform in the labour market.

The use of instrumental variables gives valuable insight into the causal relationship between education and labour market outcomes but requires careful analysis when forming broader conclusions about the effects of education for the entire population. A pattern emerges in the general findings of the studies using unique events and policy changes as instruments, that is, returns for the groups affected are slightly higher than conventional OLS estimates which themselves are thought to be biased upwards. These results suggest that some individuals would receive higher than average benefit from extra education but are leaving school too early. Why this is the case and who these individuals are is an important area for future research.

A noticeable trend in recent literature, 1995 to present, is that the popularity of signalling models has declined while the use of instrumental variables has risen in its place. In a signalling model the estimated return is associated with the information that certain qualifications send about the holder. The credential is able to signal a package of information, however, any characteristics not observed by firms cannot be separated out by the use of even the most ingenious instrument; there is simply no way to measure these individual effects (Weiss 1995). Neither the firm nor the applicant need be concerned with such distinctions; it is in the mind of the social scientist that such issues become important. This 'need' to itemize rates of return appears as one of several sources of resistance to the adopting of signalling models. Another reason, which again seems to be a product of researcher bias, is that these models can exist in a manner that is Pareto inefficient.[8] Most economists accept it as dogma that such a system could not exist in a state of equilibrium because markets would naturally rise, disposing of any inefficiency. However, the complications involved in creating such a market are

[8] In (Spence 1973) he demonstrates multiple, separating equlibria, depending on the initial setup of the model; some of which can result in permanent inefficiencies.

immense. Large firms and government offices often have their own methods of screening applicants in the form of written or performance-based tests. Of course the ability of these tests to accurately measure desirable qualities is limited - where mathematical aptitude can be determined reasonably well in a 3 hour test, an attribute such as perseverance probably cannot. As well, laws in Canada (and many other developed nations) are highly restrictive as to what criteria an employer is allowed to use to discriminate between potential applicants. Even the word discrimination carries with it negative connotations. Questions pertaining to education are allowed, and are a dominant feature of the screening requirements for many jobs. In this way schooling is used as a discriminatory tool and has many benefits for firms looking to sort potential applicants. The variety of credentials available gives individuals a freedom to choose their own path, and facilitates a process whereby firms can make better selections.

A more general (and less easily corrected) problem with any of these studies is that they deal with certain supply and demand factors that change as the structure of labour markets evolve. The results obtained in even the most current study point to labour market conditions in an earlier period in time and may by no means be an accurate projection of future trends. In recent times the supply of university graduates has increased dramatically as developed economies move from industrialized (labour intensive) to service based (knowledge intensive). "In the last decade, from 1996 until 2006, full-time student enrolment grew by 40 percent. That's 245,000 more students than we had a decade earlier." (Charbonneau 2007) If the continued increase in supply is not met by similar increases in demand, the returns to all levels of education will inevitably decrease. Although there is no guarantee that the future will be like the past when it comes to education and wages, all of these studies find important links between the two and suggest that investments in education are likely to remain an important source of individual earnings.

(4) The Data set

In order to determine the roles education serves for workers and firms in terms of the Canadian labour market, a large, detailed, and current sample of the population would be ideal. Fortunately, just such a data set is available from Statistics Canada in the form of the 2001 Canadian census individual Public Use Micro data file, often abbreviated as the PUMF. This set contains individual responses to the 'long' census questionnaire, which contains a significantly higher level of detail than the general one. The sample provided in this file is representative of 2.7 % of the Canadian population, which works out to 801,055 individual observations.

Most research of this type is carried out on cross sectional data sets simply because there is a lack of longitudinal data. Following a representative sample over the course of their schooling and working lives would certainly produce more robust estimates. It would be possible, with longitudinal data, to estimate a fixed effects model that controls for unobservable influences. However, this would require individuals to be matched between samples, a labyrinthine task when using the Canadian census PUMF.[9] Resulting estimates would then be accurate to the extent that labour market conditions in the following years were similar to those previous. The tumultuous nature of the economy plainly cannot be accounted for and this must simply be accepted.

One of the consequences of using the 2001 census (as with any census) is that the data is representative of the labour market conditions of 2000. This appears to be a reasonably good year for the Canadian economy.[10] Unemployment did rise by roughly 1% in late 2001, which would not have been reflected in the census, but has continued to decrease in the following years – currently around

[9] Attempting to match individuals in the census would be impeded by the fact that the any given individual has a very low probability of receiving the long-form questionnaire in successive census years. Also, in the name of confidentiality, the census incorporates certain measures of obfuscation, with the intention of making any individual identification impossible.

[10] Unemployment was 7%, real GDP up 3.3%, and CPI inflation was 2.1% as reported by StatsCan. Retrieved from CANSIM tables.

6%. The economic conditions reflected in the 2001 census remain fairly representative of recent years. A more problematic feature of this particular data set may be distortions surrounding areas of the economy linked to information technology. In years leading up to 2001, the IT sector of the Canadian economy was experiencing unprecedented growth which quickly reversed into a contraction and sizable restructuring (off-shoring) measures took place. There were rapid industrial composition shifts occurring.

The Sample

An appropriate selection of individuals is important when working with a data set as inclusive as the Canadian census. Observations in the sample for the following estimations include all native-born Canadians of working age, in this paper defined as 18 to 64, with a positive income, who report working full-time, and not currently registered as a full-time student. The returns will be estimated for men and women separately because of the intrinsic differences in their earnings profiles, in particular, their labour supply patterns. This is a common practice in the literature – their labour force participation patterns are very different (though not as much as their earnings profiles).

Immigrants were eliminated from the sample because many of them have completed at least some of their education outside of Canada. To keep the focus solely on education in Canada they are excluded. Also, this will prevent any differences inherent in the earnings profiles of immigrants from distorting the results.

The definition of 'working age' in the literature generally employs 64 years as the upper bound; however, the choice for the lower bound differs somewhat from author to author. Although the Canadian census reports labour statistics for those 15 and over, many studies choose to exclude

individuals from the sample until at least the age of 18. Years below 18 are considered to be highly transitional with large numbers graduating from high school and many going on to a university or college. Many of those who do work in this age group earn wages at or near the mandated minimum wage, making it hard to disentangle the returns to education from the effects of wage regulation. The upper limit is set at 64, after which many individuals withdraw from the labour force, either partially or fully, and the main source of income for this group shifts away from labour earnings to other sources such as pensions or investments. Excluding individuals, below 18 and over 64, should reduce the amount of possible distortion in wages that occurs in the sample.

Selecting individuals with only positive income will effectively eliminate employable persons who have voluntarily chosen to withdraw from the labour force for whatever reason (positive bias) along with persons who are currently unemployed who have not chosen to voluntarily withdraw. It is well documented that labour force participation and employment are both positively correlated with education. Therefore eliminating non-workers and the unemployed will increase the estimated returns to education, most notably in the lower levels.

Only persons who identified themselves as working mainly full-time are included in the sample, effectively eliminating all part-time workers. The Census questionnaire considers this to be 30 hours or more per week, for the majority of the weeks worked in the reference year. This will exclude those who work part-time by choice and those who would prefer fulltime work (underemployed). Since there is no way to distinguish between these two groups, the direction of bias is indeterminate, and it is appropriate to eliminate them altogether.

Individuals who reported attending an educational institution full-time within the last 9 months were eliminated from the sample. It is reasonable to conclude that persons, transitioning from, or

currently in, school full-time are not yet able to realize the true gains from their education. Also it is reasonable to conclude that attending school full-time will have a negative impact on earnings.

Income, for the purposes of this paper, is defined as wages plus self-employment income. The choice to include self-employment income is perhaps debatable, as there are undoubtedly returns to physical capital included in this field. However, there are many professionals with a great deal of education such as doctors and lawyers who are self-employed. Most of the literature includes self-employment income when constructing earnings profiles.[11] To exclude this group entirely would be to eliminate many individuals that receive some of the highest returns to their education. One of the works reviewed which notably did not include self-employment income, Rathje and Emery (2002), reported estimates that were consistently lower than studies which did include this source of income.

The choice of which individuals to include in the sample varies considerably across the literature. Certainly it is prudent to eliminate some groups from the sample, for example, infants are of no use when estimating the returns to education using labour income and may as well be discarded. However, care must be taken not to pare the sample down to a point where it no longer accurately reflects the population of interest. Illustrating this point are two studies, both using the Canadian census PUMF to form their samples, are Vaillancourt (1995) and Riddell and Ferrer (2002).[12] Vaillancourt eliminates very few individuals and so includes observations representative of roughly 52% of the population in his study, while Riddell and Ferrer impose much tighter restrictions and end up including observations representative of only 18%. The categories eliminated in this paper are based on

[11] See: Bloom, Grenier and Gunderson (1995), Jaeger and Page (1996), Oreopoulos (2006), Riddell and Ferrer (2002) Vaillancourt (1995).

[12] Vaillancourt includes all individuals with positive income between the ages of 15 and 64, while Riddell and Ferrer drop immigrants, anyone who did not report as working full-time, or with a weekly income less than $90, or working less than 49 weeks, and older than 64.

a general consensus found in the literature reviewed. The resulting sample is representative of roughly 31% of the Canadian population.[13] The resulting samples contain 144,951 males and 104,449 females.

(5) Human Capital

The human capital theory of education tells us that each additional year of education will increase the amount of human capital that exists in a person, thereby increasing their productivity. In a (perfectly) competitive labour market, standard neo-classical economic theory dictates that a person is paid (because he/she is able to receive) the value of their marginal product. All else being equal, the increased productivity brought about by a higher level of human capital will generate an increase in wages. Ordinary least squares can be used to estimate the relationship between years of education and wages signifying the value of education in terms of human capital formation.

Restrictions

For the results of this model to accurately reflect the role of education in forming human capital, and to test the validity of the human capital theory of earnings, a number of assumptions must hold. Foremost is that years of education are not associated by firms to be directly linked to unobserved ability. In other words the increased wages reflect increased productivity as a direct result of schooling. This also implies that the stock of initial human capital is identical among all individuals, and exogenous with respect to earnings. Finally, a model that utilizes a net present value function in order to calculate individual returns requires education to have no consumption value in terms of utility.

[13] It is not overly important that the resulting sample represent a large proportion of the whole population, however, this measure is useful for illustrating the relative differences between the restrictions invoked by the authors in the different studies.

The following table provides a summary of the years of education completed as reported by individuals in the sample, native-born Canadians who are currently employed full-time and not in school. It is interesting to note that half of the women, and over half of the men, in this sample have 13 years or less. This would suggest that a significant portion of the population has not gone on to complete university, this does not, however, allow any inference about the portion with college or other training.

TABLE 1: DISTRIBUTION OF TOTAL YEARS OF SCHOOLING IN THE SAMPLE

	Females			Males		
	Frequency	Percent	Cumulative	Frequency	Percent	Cumulative
< Gr 5 or never	325	.3	.3	832	.6	.6
5-8 years	1938	1.9	2.2	5607	3.9	4.4
9 years	2070	2.0	4.1	4909	3.4	7.8
10 years	4425	4.2	8.4	9935	6.9	14.7
11 years	6617	6.3	14.7	10814	7.5	22.1
12 years	24466	23.4	38.1	33530	23.1	45.3
13 years	13307	12.7	50.9	16295	11.2	56.5
14-17 years	38541	36.9	87.8	47063	32.5	89.0
18 + years	12760	12.2	100.0	15966	11.0	100.0
Total	**104449**	**100.0**		**144951**	**100.0**	

Method

The census PUMF provides groupings of responses as to the respondents' total years of education in the range of 0 to 18 years or more. Income will be used as the dependent variable, which will be regressed on categorical variables for years of education, experience and experience squared, and a set of controls. Experience is calculated as: AGE – YEARS OF SCHOOLING – 6. This value must be non-negative and so it is truncated at 0. This method is widely used as a measure of experience when using the Canadian census, as there is no specific value reported for labour force tenure.[14]

[14] As followed in Mincer (1958), Bloom, Grenier and Gunderson (1995), Riddell and Ferrer (2002).

$$(\ln) INC = \beta_0 + \sum_{i=1}^{8} \alpha_i + \beta_1 EXP + \beta_2 EXP^2 + \gamma \boldsymbol{X} + \epsilon$$

Each α_i will be a dummy variable representing one of the groupings for total years of education reported by the census. The minimum category is for those with 0-5 years, and this will be used as the reference category.[15] A set of controls is included for marital status, minority status and languages in the vector $\boldsymbol{X}$ that will be included in all specifications.

TABLE 2: MARGINAL EFFECTS IN WEEKLY WAGE

	Men				Women			
	Wage		Log Wage		Wage		Log Wage	
Years of Education								
5 to 8	17.230	(33.433)	0.072*	(.031)	1.059	(37.691)	0.102*	(.048)
9	42.189*	(17.681)	0.045**	(.016)	-15.943	(19.885)	0.0060	(.025)
10	15.353	(15.711)	0.024	(.014)	46.807**	(16.762)	0.102**	(.021)
11	48.778**	(12.520)	0.051**	(.012)	41.490**	(12.215)	0.116**	(.016)
12	47.162**	(9.974)	0.098**	(.009)	59.215**	(8.750)	0.133**	(.011)
13	19.631*	(8.586)	0.014*	(.008)	49.732**	(6.776)	0.081**	(.009)
14 to 17	199.558**	(8.184)	0.235**	(.008)	164.341**	(6.330)	0.282**	(.008)
18 or more	281.650**	(8.242)	0.224**	(.008)	226.153**	(6.419)	0.300**	(.008)
EXP	37.252**	(1.019)	0.053**	(.001)	29.178**	(0.865)	0.051**	(.001)
EXP^2	-0.462**	(0.018)	-0.001**	(.000)	-0.391**	(0.016)	-0.001**	(.000)
R^2		.075		.116		.075		.125
N				144,951				104,449

Standard errors in parentheses. ** and * denote 99% and 95% significance. Controls were included for marital status, race, and dummy variables for all categories reported by the census for years of education. 0 to 5 years was the reference category.

The results of the estimation summarized in table 2 appear to do a poor job of thoroughly explaining the returns to education. Individuals who reported years in the lower categories tend to have especially high variation in their wages, and the estimates reflect this fact in their low significance. Unfortunately

[15] Everyone has at least 0 years of education.

the way in which the census reports years of education is not conducive to this method of estimation, resulting in groupings that are large at the margins and correlated with credentials. As can be seen in table 5, most individuals complete high school in either 12 or 13 years, and university, college, and trades credentials are chiefly concentrated in the 14 to 17 years category. If there is a connection between receipt of these credentials and wages, the strong correlations that exist in the sample will affect the estimates of human capital formation.

(6) Signalling

A particular component of signalling theory, referred to as the 'credentialist' model, contains the most strict views on the subject and states that years of education have no intrinsic productive value and all that matters is the end result – evidenced by the credentials obtained. Consistent with that conjecture is the fact that when forming a wage contract (applying for a job), there is heavy emphasis placed on the highest degree an individual has, and little or no emphasis on the total years of education. Numerous studies have shown disproportionate increases in earnings that come from receiving a degree versus the expected increase, which is be explained by the additional year of education.[16] These 'sheepskin' effects are evidence that firms are using education as a sorting mechanism. Therefore the return to a credential should capture the market value of the signals that it sends.

Restrictions

For the results of this model to accurately reflect the role of education as a sorting mechanism, it must hold that years of education are not considered by firms to be productivity-enhancing. The extra

[16] See Jaeger and Page (1996) for a good survey of sheepskin effects in empirical research.

wages offered based on credentials reflect increased productivity as a result of individuals having the signalled qualities.

The following table provides a summary of the highest degree completed by individuals in the sample. Since the sample consists of individuals who are employed full-time and not currently in school, this table should be reasonably representative of the distribution of credentials in the Canadian workforce. Notably 47%, or almost half, of the men and 41% of the women have a high school certificate or less. Also of interest is that in the higher echelons of education, masters, medical, doctoral, there are significantly more men than women.

TABLE 3: HIGHEST DEGREE, CERTIFICATE OR DIPLOMA

	Females			Males		
	Frequency	Percent	Cumulative	Frequency	Percent	Cumulative
None	17157	16.4	16.4	33978	23.4	23.4
Secondary School GC	26344	25.2	41.6	34415	23.7	47.2
Trades Cert	10249	9.8	51.5	25557	17.6	64.8
College Cert	25373	24.3	75.8	23257	16.0	80.9
Univ. below Bach.	3332	3.2	78.9	2821	1.9	82.8
Bachelor's Degree	15462	14.8	93.7	16608	11.5	94.3
Univ. above Bach.	2585	2.5	96.2	2211	1.5	95.8
Medical Degree	462	.4	96.7	982	.7	96.5
Master's Degree	3134	3.0	99.7	4350	3.0	99.5
Doctorate	351	.3	100.0	772	.5	100.0
Total	**104449**	**100.0**		**144951**	**100.0**	

Method

The data available in the Canadian census report both years of education and information on the highest degree received. Using the same order of classification as was issued in the census questionnaire, an equation is constructed to capture the threshold effect when moving from one level to the next. In a similar fashion as was utilized for the human capital specification above, income will be

dependent on the same set of components, with degree received inserted in place of years of education.

$$(\ln) INC = \beta_0 + \sum_{i=1}^{9} \alpha_i + \beta_1 EXP + \beta_2 EXP^2 + \gamma \boldsymbol{X} + \epsilon$$

Each α_i will be a dummy representing the highest degree received and category 2 - a secondary school graduation certificate - will be used as the reference category.

TABLE 4: MARGINAL SHEEPKSIN EFFECTS IN WEEKLY WAGE

	Men				Women			
	Wage		Log Wage		Wage		Log Wage	
Qualification								
Secondary Cert.	76.614**	(6.952)	.126**	(.006)	85.572**	(6.217)	.215**	(.008)
College / Trades	70.674**	(6.306)	.116**	(.006)	72.752**	(5.087)	.134**	(.007)
Univ. below Bach.	119.967**	(17.294)	.097**	(.016)	115.621**	(11.330)	.207**	(.015)
Bachelor's Degree	220.936**	(18.197)	.218**	(.017)	152.378**	(11.974)	.212**	(.015)
Univ. above Bach.	69.209**	(20.214)	.032	(.019)	86.840**	(13.277)	.087**	(.017)
Master's Degree	109.730**	(23.314)	.077**	(.022)	94.315**	(16.599)	.081**	(.021)
Doctorate	25.630	(34.864)	.058*	(.032)	121.833**	(35.153)	.065	(.045)
Medical Degree	789.230**	(42.936)	.299**	(.040)	338.222**	(44.231)	.239**	(.057)
EXP	36.899**	(1.004)	.053**	(.001)	28.432**	(.854)	.051**	(.001)
EXP^2	-0.495**	(0.017)	-.001**	(.000)	-0.409**	(0.015)	-.001**	(.000)
R^2		.087		.119		.085		.129
N				144,951				104,449

Standard errors in parentheses. ** and * denote 99% and 95% significance. Dummy variables for all categories reported by the census for highest degree earned. No degree was the reference category.

The resulting estimates, summarized in table 4, show a marked improvement in terms of statistical significance over those reported for years of education in table 2. It would appear from the comparison of these two equations that credentials have a slight advantage in explanatory power in terms of the wage effects of education. This may be an indication that the signalling theory of education is superior

to that of human capital. However, even after ignoring the likely data problems in the first estimation, the results in table 4 are not conclusive evidence of that fact. Again there exist strong correlations between qualifications received and years of education. If human capital acquired through years of education is an important determinant of future wages, the returns attributed to the various credentials above may be capturing the value of the years of schooling it took to complete the degree.

(7) Hybrid Equation

While the results of both sections above are significant, the validity of each theory relies on a set of assumptions – one generally competing with the other. A logical extension of these two approaches is to combine both the human capital and signalling effects into one equation. As shown in Table 5, there is considerable variation among the population in the number of years of schooling and the subsequent degrees received.

In higher education especially, many students begin their studies without knowing if they have made the correct choice. Inevitably some students will change their minds, need to retake failed courses, take time off, move from one type of educational program to another, or drop out entirely. Because of the amount of possible variation at the individual level, a detailed approach is required to capture all of the different effects personal choices may have on future labour incomes. Fortunately the 2001 census reveals information about many aspects of an individual's education. Categories include years of education at the elementary, secondary, university, and college levels. Also included is information on the credentials received, with separate variables reporting graduation from secondary, college, and the highest level of university. Empirically this means the components of the earnings profile can be disentangled and their separate influences more closely examined. The inclusion of variables for the human capital approach as well as the signalling approach should reveal the magnitude

of each role and provide a superior understanding of where the returns to education (as measured in wage effects) are than either one could on its own. Years of education can now have a credential component separate from the returns to human capital. The following table, table 5, is a cross-tabulation of the years of education and the highest degree received, which exemplifies the diversity of the Canadian population in this respect. Obviously at least some of this variation is measurement error, with 4 individuals earning a doctorate in 13 years or less, and 71 individuals spending 18 or more years in school without receiving even a high school graduation certificate. The point of this table is simply to illustrate the fair amount of variation in years of schooling required to obtain various credentials. Similar results are found in Jaeger and Page (1996) and Trostel and Walker (2004), which use Current Population Survey data from the United States.

TABLE 5: TOTAL YEARS OF SCHOOLING * HIGHEST DEGREE, CERTIFICATE OR DIPLOMA

	None	High school GC	Trades cert	College cert	Univ. cert < bachelor	Univ. degree : Bachelor	Univ. cert > bachelor	Medical degree	Master's degree	Doctorate	
< 5 or never	6670	0	177	54	0	0	0	0	0	0	**1.3%**
5 - 8 years	23921	0	1394	198	0	0	0	0	0	0	**5.0%**
9 years	13491	1480	1398	219	3	0	0	0	0	0	**3.2%**
10 years	24327	3224	3665	658	17	0	1	0	0	0	**6.2%**
11 years	19484	8593	4902	1451	43	1	0	0	0	0	**6.7%**
12 years	28853	59008	14739	6325	252	19	3	0	2	1	**21.2%**
13 years	7263	29398	12791	11520	794	80	12	0	7	3	**12.0%**
14 -17 years	2344	28514	21190	63418	10286	38404	4043	316	2278	171	**33.2%**
18 + years	71	682	1085	5262	2622	22936	5316	2518	13752	2853	**11.1%**
Total	**24.6%**	**25.4%**	**11.9%**	**17.3%**	**2.7%**	**11.9%**	**1.8%**	**.6%**	**3.1%**	**.6%**	

2001 PUMF all individuals between 18 and 65.

Method

Relaxing the assumption that each year of education has the same value is accomplished by separating the human capital wage effects of different levels of schooling. The combination of human capital and signalling allows for a more detailed analysis of both components individually. The number of years completed at the elementary and secondary level is calculated by subtracting years of university plus college from the total years of education reported. Unfortunately years of elementary and secondary cannot be satisfactorily distinguished to make their separate estimations a worthwhile task; the census data reports the number of elementary years as either 0 to 5 or 5 to 9. Controlling for the sheepskin effects of 13 different credentials, the values for an additional year by type of education are reported in table 6. In table 7 the wage effects are estimated for the many different combinations of credentials. Following a specification similar to that of Jaeger and Page (1996) and Riddell and Ferrer (2002) the following equation was estimated:

$$\ln INC = \beta_0 + \boldsymbol{\delta} yrs + \boldsymbol{\theta} cred + \beta_1 EXP + \beta_2 EXP^2 + \gamma \boldsymbol{X} + \epsilon$$

In this formulation:

$\boldsymbol{\delta}, \boldsymbol{\theta}, \gamma, \boldsymbol{\beta} = (\beta_0 \beta_1 \beta_2)$ are vectors of parameters

yrs is the number of years

cred is a set of credential dummies

TABLE 6: WAGE EFFECTS OF MARGINAL YEARS OF SCHOOLING CONDITIONAL ON HAVING RECEIVED CERTAIN CREDENTIALS

	Men		Women	
	Log Wage		Log Wage	
Education Type				
Elementary and Secondary	.033	(.002)	.057	(.002)
Years of University only	.052	(.003)	.081	(.003)
Years of College / Trades only	.031	(.002)	.047	(.003)
Additional year of C / T having been to University	.025	(.004)	.052	(.004)
Additional year of University having been to C/T	.030	(.004)	.054	(.004)

Standard errors in parentheses. All estimates significant at the 99% level.

TABLE 7: RETURNS TO EDUCATION AND ASSOCIATED SHEEPSKIN EFFECTS

	Men				Women			
	Wage		Log Wage		Wage		Log Wage	
Qualification								
Secondary Cert.	15.296	(6.982)	0.044	(0.006)	18.83	(5.927)	0.091	(0.008)
College / Trades only	14.567	(6.841)	0.046	(0.006)	19.31	(6.343)	0.058	(0.008)
With Secondary	46.096	(7.458)	0.093	(0.008)	23.968	(6.853)	0.089	(0.008)
Bachelor's Degree	331.089	(12.367)	0.323	(0.011)	221.031	(9.909)	0.378	(0.013)
With C/T	136.288	(15.405)	0.153	(0.014)	116.141	(11.531)	0.177	(0.015)
Univ. above Bach.	383.511	(23.622)	0.338	(0.022)	289.303	(16.119)	0.431	(0.021)
With C/T	139.466	(41.823)	0.119	(0.039)	153.422	(27.847)	0.188	(0.036)
Master's Degree	478.538	(18.664)	0.393	(0.017)	358.582	(15.819)	0.463	(0.020)
With C/T	229.718	(30.239)	0.179	(0.028)	232.846	(23.288)	0.241	(0.030)
Doctorate	474.746	(36.961)	0.420	(0.034)	486.107	(38.400)	0.518	(0.049)
With C/T	293.170	(77.327)	0.289	(0.072)	268.695	(73.924)	0.244	(0.095)
Medical Degree	1288.425	(32.924)	0.739	(0.030)	854.433	(34.795)	0.802	(0.044)
With C/T	996.783	(70.842)	0.545	(0.066)	596.539	(57.920)	0.456	(0.074)
Marginal Effects								
C/T and Secondary Over C/T (no Secondary)			0.047	(0.007)			0.031	(0.009)
Bachelors Over Secondary			0.279	(0.011)			0.287	(0.013)
Bachelor's with C/T Over Bachelor's			0.060	(0.014)			0.177	(0.015)
Post graduate qualifications (Bach.+) Over Bachelor's			0.015	(0.002)			0.053	(0.003)
Post graduate qualifications (Bach.+) Over Bachelor's with C/T			-0.034	(0.003)			0.011	(0.003)
Master's Over Bachelor's			0.070	(0.006)			0.085	(0.007)
Master's Over Bachelor's with C/T			0.026	(0.004)			0.064	(0.015)
Years of Education	24.681	(1.110)	.031	(0.001)	29.329	(0.982)	.054	(0.001)
EXP	35.782	(1.004)	.051	(0.001)	27.999	(0.851)	.050	(0.001)
EXP^2	-.451	(0.017)	-.001	(0.000)	-.377	(0.015)	-.001	(0.000)
R^2		.091		.125		.091		.141
N				144,951				104,449

Standard errors in parentheses. All estimates significant at 99% except weekly wages for men with only HS diploma which is significant at 95%. Wages of individuals in this category are highly variable.

The marginal effects here are presented in terms of log wage only as the resulting figures in terms of absolute wage have little economic meaning. In terms of marginal effects, log wage provides a much better idea of the magnitude and direction resulting from the distinction in credentials.

(8) Results

The evaluation and comparison of the empirical approaches employed in this paper help to illustrate the efficacy of the different theories in explaining labour market outcomes visible in the data. Education, it appears, has significant effects on wages through learning and skills formation, and by signalling information about those who achieve certain credentials. It is important to note that the results presented in this remain uncorrected for ability. If ability differences do exist, and these differences are correlated with years of education, the human capital model will suffer from the omitted ability bias mentioned earlier. However, the fully augmented model which includes both degrees received and years of education is slightly more complicated in this regard. By including credentials in the model, distinctions can be made between completers and dropouts, and the different levels of credentials, which can be interpreted by employers as signals of unobservable attributes.

The results of the first two empirical models used in this paper provide insights, important for understanding the results from the third approach – the hybrid model. Table 2 presents the marginal wage estimates based on the human capital model. The greatest marginal increase in wages for men and women occurs after 13 years; presumably this group contains individuals who have continued on to post-secondary education. This visible change could be the result of human capital formation dramatically increasing after 13 years, and it could also reflect sheepskin effects, which are not specified

and are thus unaccounted for.[17] The high variation of individual wages in the categories for years of education combined with the correlation between certain categories and sheepskins results in a number of estimates that are not significantly different from zero, especially in terms of weekly wages. For women the first three marginal effects are 1, -15 (insignificant), and 47, which would almost certainly imply that there is a problem with the model specification.

Table 4 shows marginal estimates for sheepskin effects. Moving upward from no qualifications, there is great variation in the marginal differences, with a large increase at a bachelor's degree and another large increase at the level of medical degree. Not surprisingly the highest increase in returns goes to those who hold a health degree. Interestingly the lowest return for any credential (that is statistically significant from 0) is received by holders of a college or trades certificate. This may be a direct result of the fact that nearly 25% of those with college or trades credentials do not have a secondary school diploma. The lack of distinction in this group, essentially an omitted variable, will bias the results for this category downwards, as high school drop-outs tend to have lower wages. The estimates for those with a doctorate appear unreliable for both men and women, with large standard errors most likely caused by the relatively small sample sizes of the two groups, combined with unobservable heterogeneity. The wage value of experience is greater for men than women, and not surprisingly these estimates do not change between the sheepskin and human capital models.

Tables 6 and 7 draw on a model that combines both human capital and multiple sheepskin effects. This procedure results in estimates that capture discrete differences in types of education, and for a combination of credentials. There is strong evidence that both theories are contributing components of returns to education. Interestingly, years of college appear to have the same or less value in terms of their impact on wages as years of elementary and secondary conditional on achieving a

[17] There is good evidence that these sheepskin effects are highly correlated with years of education, especially in secondary school where many students graduate with the same total number of years. This will produce OLS results which are less precise, and therefore it is an empirical challenge to disentangle these two effects.

given level. Considering however that the early years of education are focused on basic skills that are of fundamental importance to almost all jobs and the building blocks of higher education, this result is not so surprising. These results suggest the value of elementary and secondary school in the forming of human capital. Without a working knowledge of reading, writing and basic math, individual productivity will for most purposes be very low.

The human capital effects of years completed at different levels of schooling are given in table 6. The resulting marginal values of human capital generated at the level of either university or college, as measured in wages, imply that combining the two, is a less efficient method to achieving a higher income. This would seem to indicate that there is a degree of overlap between college and university when it comes to increasing individual productivity. Logically, any commonalities between the two institutions, in their methods to increase human capital, will not provide the same marginal benefits to an individual who has chosen to attend both, thus diminishing the labour market value of the time spent.

Since it cannot be readily determined whether someone moves from university to college or the other way around, the additional years of education in these categories should be viewed as marginal values conditional on already having been to one institution before the other. Interestingly when considering the marginal wage effects present in a cumulative sense, a college and university category, the resulting increase lies close to the average of the two exclusive categories, as would be expected if they are truly representing human capital formation.

In table 7, moving upward from a bachelor's degree, the marginal sheepskin effects are consistently larger for the group without the college/training certifications. This seems to indicate the signalling value of multiple (varied) credentials is not cumulative but is in fact decreasing. Indicating that there is some overlap in the information transmitted by different schooling credentials, as would be

expected, this result is consistent with the signalling theory of education. Each additional accreditation signals only a small set of new attributes, thus its labour market value is marginally smaller. Another explanation consistent with the decreasing returns found when combining credentials is that firms view not only the highest credential as important, but additionally are concerned with the educational path taken en route. A linear progression from secondary school to a Bachelor's or Master's degree may signal certain qualities like ambition or direction that firms are willing to pay for; a kind of signal within the signal. In their paper, Riddell and Ferrer (2002) propose that those students who go directly from high school to university tend to be a group with a generally higher level of ability.

In this model where the wage effects years of education are accounted for, the signalling value of multiple credentials can be low, but this does not reflect that the years are lost; human capital will obviously have a larger impact on these individuals with more years of education. What it does reveal is the most efficient path – given, of course, that all students are free to choose (and can afford) the length and level of schooling they desire. In reality there are many constraints individuals face in regards to education such as finances, time, abilities and so on that are not considered here. These constraints will of course alter their optimal paths accordingly.

Based on the most general specification (the hybrid model), secondary school graduation is associated with an increase in weekly earnings of 4% for men and 9% for women, highlighting the worth of staying in school to complete this designation as a minimum. The group with college or trades certificates who did not complete high school is the same or lower at 4% for men and 6% for women. Obviously these credentials are not a good alternative to a high school diploma. Having completed high school first, post secondary programs have additional marginal impacts on earnings of 5% in men and 3% for women. This is consistent with the view that employers use high school completion in combination with college or trades certificates as a signal of unobservable attributes. The value of a bachelor's degree is practically the same for both men and women at 28% and 29% respectively.

Further credentials result in smaller marginal increases, except in the case of medical degrees which indicate increases in excess of 30%. The marginal effects of a master's degree are between 7-9%, and surprisingly, the marginal effects of a doctorate are small in this estimation and not significantly different from zero.[18] There is a noticeable difference in the overall role of credentials, in that they become drastically more important once the level of bachelor's degree is reached; from less than 10% below this level, jumping to 30% at a bachelor's and then rising to 74% – 80% at the level of a medical degree. This may reflect an occupational premium and a human capital effect that the number of years of training fails to capture, illustrated by the fact that the signalling component of a medical degree is so high.

The question of whether it is wise to mix credentials primarily at the college and university levels, is less clear. The marginal difference between the degree at the university level with and without college for men is the highest at 6%, marginal over a bachelor's degree, and even negative for the BA+ category. In terms of signalling value this appears to be a poor path to choose.[19] For women, the highest difference is again at the margin between a bachelor's degree, with and without college, as otherwise the results are similarly close to zero.

Conclusions

These findings complement earlier empirical studies that found strong evidence for human capital and sheepskin effects; that is, wage increases associated with both years of education and degrees received. The estimates in this paper are similar to those reported in the studies of Jaeger and

[18] However, this does not seem to come as a surprise to either of the doctorate holders who reviewed this paper so far.

[19] Some students may not have the grades required for admission to a university, in which case going to college first is their only option; optimality is again relative in an individual context.

Page (1996) and Riddell and Ferrer (2002), both of which used data sets that contained years of education and credentials. Both studies find that the largest sheepskin effects are present in medical and professional degrees, followed by a bachelor's degree. The findings of Jaeger and Page are based on data from the United States and generally tend to be larger than results in this paper, which are more closely aligned with Riddell and Ferrer, who use Canadian census data from 1996. As previously mentioned in section 4, the sample included in this study is much broader than the one employed by Riddell and Ferrer. There are significant sheepskin effects found in working habits in terms of hours per week and weeks per year, which increase as the level of credentials goes up (Trostel and Walker 2004). The choice to exclude individuals working fewer than 30 hours per week or fewer than 49 weeks per year, will have greater a greater effect on the lower credentials. This causes a slight difference to appear between the estimated sheepskin effects, which increase with the level of credential.

Beyond lending credibility to the human capital and signalling theories of education, the findings of this paper lead to two solid conclusions. First, education at elementary and secondary levels is of primary importance both in terms of years and degree completion. Therefore a great effort should be made by individuals (parents) and the public (government) to persuade marginal students against dropping out. Second, to maximize the wage benefits from schooling, a direct path should be taken from high school graduation to either college or university but not both.

Ideally, determining what the returns are, to the many different educational programs, will provide a more informed basis for research and public policy on the subject. The number and diversity of educational tools and programs is growing, and so is the rhetoric between students and policy makers over tuition versus funding. As the Canadian economy changes focus and embraces globalization, this area of research is becoming more important than ever.

Many other studies (Vaillancourt 1995) take this area of research one step further, calculating public and private expenditures on education and using this information to assign a particular rate of return to each level. The results represent a sort of accounting style, cost-benefit analysis, which is then used to give advice on funding policy. A critical flaw exists in that public benefit is estimated from private wage gains, which are themselves only one component of the total private benefits. Education serves many roles to the individual and to society, only a few of which can be captured in measurable quantities. Art, music and literature often register poorly when measured in terms of wages or productivity, yet these subjects have given society some of its greatest treasures. Education should not be justified based solely on its ability to increase labour productivity and as such it is left to the reader to decide what the true returns are.

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