The Impact of Education on Economic and Social Outcomes: An Overview of Recent Advances in Economics*

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1. Introduction

This paper surveys recent advances in our understanding of the consequences of human capital for individual and social outcomes. Particular attention is given to recent developments in the economics discipline.

Over the past 10 to 15 years there has been a resurgence of interest among economists in education and human capital. Considerable progress has been made on several fronts. This paper focuses on what I regard as the most important advance in knowledge – that of obtaining credible estimates of the causal influence of education on individual and social outcomes. Distinguishing between correlation and causation has been a major challenge in this area for some time. As a consequence, the substantial recent progress in this area represents an important achievement. Nonetheless, it is worth noting that substantial research effort has also devoted to several other issues relating to education and human capital. These include the consequences of changes in the intensity of resources devoted to schooling through such factors as class size and teacher training and remuneration, the implications of greater school choice and increased competition among schools, the role and implications of various forms of testing of students, and the significance of peer effects. Rather than providing a brief overview of recent research on all of these topics, I choose to focus on the central issue of the causal effect of education on individual and social outcomes.

The paper is organized as follows. The next section provides brief overviews of the leading theories that seek to explain the linkages between human capital formation and labour market and social outcomes. Although the treatment of these theories is necessarily brief and simplified, this section provides useful background for the main parts of the paper. The remaining sections deal with empirical evidence on the relationship between human capital and individual and social outcomes.

Section 3 discusses the challenges that arise in obtaining credible estimates of the causal impacts of education on private outcomes such as employment and labour market earnings. Although this task may seem to be straightforward, it has in fact represented a major challenge to empirical research for several decades. Important advances have recently been made in this area, and these are described in this section. The fourth section surveys recent advances in estimating the non-market and social benefits of education --

impacts on outcomes such as greater civic participation, improved health, and reduced criminal activity. As is the case for empirical research on the private impacts of schooling, important advances have recently occurred in obtaining estimates of a variety of social consequences. The statistical techniques used to advance our understanding of the private consequences of education have also been fruitfully employed to analyse non-market and social impacts.

Most research on the relationship between human capital formation and individual and social outcomes uses relatively crude measures of human capital such as educational attainment and years of work experience. However, education and experience are inputs into the production of human capital rather than outputs such as skills, competencies and knowledge. Only recently has data become available on direct measures of skills for the working age population. Section 5 discusses recent studies that utilize such data to examine two issues. The first relates to the production of human capital – the nature of the relationship between inputs such as schooling and work experience and outcomes such as literacy and numeracy skills. The second issue relates to the way in which literacy and numeracy skills are rewarded in the labour market – the relationship between skills and outcomes such as employment and earnings. The final section concludes.

2. Models of Human and Skills Development

This section briefly outlines several key theories of human and skills development that are frequently used to explain observed relationships between human capital acquisition and labour market and social outcomes.[1] Three leading models are discussed: human capital, signaling or screening, and job-worker matching or information-based models. There are large theoretical and empirical literatures relating to each of these models. The objective here is not to survey these literatures -- a task that would require a major effort -- but to present the central ideas of these theories and their relevance to understanding the mechanisms through which human capital may influence labour market outcomes.

[1] This section draws on Riddell and Sweetman (2004).

2.1 Human Capital Model

Human capital theory is widely used to explain labour market outcomes. The essence of the theory is that investments are made in human resources in order to improve productivity, and therefore employment prospects and earnings. Individuals acquire skills through formal schooling and/or work experience, and these skills increase the individual's value to employers and therefore their future earnings.

Several key elements of human capital theory are worth noting. First, it is a theory of investment decisions: individuals incur costs at the present time in return for benefits in the future. This investment dimension is particularly important because the benefits of human capital acquisition typically accrue over a long period, in the form of a higher earnings stream over many years. Second, because the benefits accrue in the future there will typically be uncertainty about the extent to which the investments will pay off. Human capital investments are generally risky investments. Third, a major component of the costs of acquiring human capital is typically the opportunity cost -- the income foregone by not working.

Decisions about education -- both the amount of time to devote to schooling and choice of educational programs -- will be influenced by both the "investment" and "consumption" components of human capital formation. The latter refers to the fact that learning may be a very enjoyable activity for some, but a less enjoyable or even unpleasant activity for others. Other factors being equal, individuals who enjoy learning are more likely to remain in school longer. Similarly, other things being equal, students are more likely to choose educational programs that they regard as interesting and stimulating.

An important distinction is that between private and social returns to human capital formation. Private returns are those based on the costs incurred by and benefits received by the individual acquiring the education. These benefits include both the consumption and investment consequences of schooling. Social returns are based on the costs incurred by and benefits received by society as a whole. There may be differences between private costs and social costs, as well as between private and social benefits. This distinction is important because individuals can be expected to base their schooling

decisions on the private costs and benefits, whereas it is in the interest of society as a whole to have educational decisions based on the social costs and benefits.

A final important concept is the distinction between general and firm-specific human capital. General human capital refers to skills and knowledge that are useful to many employers, while firm-specific human capital is useful to one employer but not to others. This distinction is useful in understanding the incentives for individual workers and employers to pay for education or training. In a competitive environment, firms will not be willing to pay for workers to acquire general skills because they will not be able to reap the benefits of this investment. Rather, workers will pay for general training because they are the ones who will receive the benefits in the form of higher earnings. On the other hand, workers do not have an incentive to invest in firm-specific skills because doing so does not raise their value to other employers. Firm-specific human capital investments will either be paid for by the employer or these investments will be shared, with both the employer and employee paying some of the costs and receiving some of the benefits.

In between the extreme cases of general and firm-specific human capital are situations in which the skills acquired are industry-specific or occupation-specific. I discuss these circumstances further below.

Lifetime earnings display two well-established patterns. First, the lifetime earnings profile of more educated workers lies above the equivalent earnings profile of less-educated workers. Second, earnings rise with work experience, albeit at a diminishing rate. The increase in earnings with experience is especially pronounced during the first 5-10 years after entering the workforce. Human capital theory accounts for these well-established patterns through the mechanism of skill formation; education and work experience enhance the individual's skills, thereby raising their market value to employers. Human capital investments thus yield a private return in the form of greater employment opportunities and higher lifetime earnings. Because they increase worker productivity human capital investments also yield social benefits – the increase in the total output of goods and services produced. They may also yield social benefits in excess of private benefits, as discussed more fully subsequently.

2.2 Signaling/Screening Model

Human capital theory emphasizes the role of education as enhancing the productive capacities of individuals. A contrasting view of education, where it has no effect on individual productivity, is the signaling/screening model. According to this theory, education may act as a signal of the productive capacity of individuals. Central to this theory is the importance of imperfect information. In their hiring decisions, employers are imperfectly informed about the capabilities of potential employees. They therefore may use education as a signal of a new hire's future productivity. If employers' beliefs are subsequently confirmed by actual experience (that is, if more educated workers turn out to be more productive), employers will continue to use education as a signal. Employers will thus offer higher wages to more educated workers. Facing a positive relationship between education (which is costly to acquire) and wages, individuals will have an incentive to invest in education. A central assumption of the signaling model is that education is less costly to acquire for individuals who are innately more skilled or able. If this assumption holds, higher ability individuals will invest more in education than will lower ability individuals. Both high and low ability individuals face the same potential benefits from investing in schooling, but low ability workers face higher costs and therefore will acquire less education. In these circumstances, employers' beliefs about the relationship between education and worker productivity will be confirmed. Even though schooling has (by assumption) no effect on worker productivity, employers have an incentive to offer higher wages to more highly educated workers and higher ability individuals have an incentive to invest in education. In this model, education serves as a "sorting device", separating the high from the low ability workers.

Like human capital theory, the signaling/screening model can explain the positive relationship that exists between schooling and labour market outcomes such as earnings. However, there are important differences between the two theories. In the human capital model, education is privately and socially productive. In contrast, in the signaling model education is privately productive (high ability individuals benefit from investing in education) but not socially productive because education has no effect on the total goods and services produced by society. Another important difference is that in the human capital model, schooling exerts a causal influence on worker productivity and thus

earnings. In the signaling theory, education has no effect on worker productivity so there is no causal influence of education on earnings. Rather, the positive relationship between schooling and earnings arises because both variables are related to a third factor -- worker ability. In many circumstances, worker ability is unobserved so it is difficult to determine whether the positive relationship between education and earnings arises because schooling enhances workers' productive capacities (the human capital explanation) or because schooling sorts out high and low capacity individuals. However, as discussed subsequently, considerable recent progress has been made on identifying the causal effect of education on earnings. This evidence thus provides insights into the relative importance of skills development versus signaling in determining labour market outcomes.

2.3 Job-Matching or Information-Based Model

In the human capital model, individuals choose among alternative educational programs according to the costs of these programs and the associated lifetime earnings streams (and other benefits) that they generate. Information may play a role in helping to identify or forecast the benefits of alternative educational choices. An alternative view of the educational process is that it helps individuals to determine what types of careers they are most suited for. In this case, education plays the role of providing individuals with information about their comparative advantages -- the types of occupations and jobs they are likely to do well in. This mechanism is characteristic of job-matching and information-based models. The perspective is similar to human capital theory in several ways, including the implication that education has both private and social benefits. However, the emphasis is different. Human capital theory emphasizes the acquisition of skills that are valued by the labour market, while job-matching models emphasize the acquisition of information about one's abilities and aptitudes. Human capital theory focuses on the direct increase in skills provided by schooling, whereas information-based models highlight the role of education in identifying the most productive applications of a given set of skills.

The job matching approach also has important implications for the interpretation of returns to work experience. It views jobs as having an idiosyncratic, or firm-worker

specific, value. The same job may be a better match for some workers than for others. In addition, the quality of the match usually cannot be observed in advance. It takes time for workers and firms to determine whether a particular relationship is a good fit.

One interpretation that follows from this view of the world is that some job instability – especially among young workers -- is not a bad thing. Investment takes the form of workers learning about their comparative advantage by sampling and experiencing a variety of jobs in different industries and occupations. Additionally, there is a search for a good firm-worker match. Further, the model suggests that mobility should decrease with time in the labor market as workers learn about their own abilities and are more likely, as a result of moving from job to job, to find a good match.

This approach has lead to a re-evaluation of the relative importance of general versus firm specific human capital. Much empirical work observes that workers who have been with a firm a long time have higher wages than otherwise similar workers with less tenure. This was previously interpreted to mean that firm-specific human capital was very important and its accumulation was associated with increasing wages. However, the job search/shopping model suggests that causality may also go in the other direction. Good firm-worker matches have high wages because they benefit both parties, and are more likely to endure.

As with many perspectives on the labour market, empirical research has observed that both human capital and job-matching models explain some of what we observe. Related empirical research has altered the interpretation of “specific” human capital by showing that industry- and occupation-specific human capital are probably more important than firm-specific human capital. Industry- and occupation-specific human capital seems to be relatively easily transferred across firms. Further, the research shows the importance of general labour market experience to earnings growth, and the importance of job shopping to earnings growth among young workers.

Overall, the job shopping model points out that early career job transitions are often productive, that training need not be firm-specific and that general labour market experience is especially valuable in the early stages of a career. It also reinforces the long-term value of formal education not only because of its own labour-market productivity enhancing effects, but also in its interaction in making general labour market

experience more valuable. Finally, it emphasizes that educational programs may help people learn about their comparative advantages, in addition to directly enhancing skills and knowledge.

3. Evidence on the Consequences of Education and Skills Development

Many individuals invest in education in the belief that doing so will yield future benefits such as greater employment opportunities, higher earnings and more interesting and varied careers. Similarly, many public policies encourage individual citizens to increase their educational attainment and enhance their skills and knowledge. Increased educational attainment and skills are not necessarily valued for their own sake but often because they are believed to result in better labour market and social outcomes. But is there a solid empirical basis for this belief? How confident can we be that higher educational attainment and enhanced skills development deserve to be treated as objectives, if what we really care about are labour market and social outcomes?

This section addresses these questions. It reviews the empirical evidence on the relationship between education and earnings, including the extent to which schooling exerts a causal effect on employment and earnings versus acting as a sorting device. The studies discussed in this section typically examine the consequences of educational choices made by individuals many years -- often several decades -- ago. Although there is no assurance that the future will be like the past, this evidence nonetheless provides insights into the probable long run consequences of individual decisions and policies designed to increase educational attainment.

Schooling may have numerous consequences for individuals and society. For many people, there is some consumption value from the educational process. Human beings are curious creatures and enjoy learning and acquiring new knowledge. Even focusing on the investment aspects, education may enable people to more fully enjoy life, appreciate literature and culture, and be more informed and socially-involved citizens. Although these and other potential consequences of schooling are important and should not be ignored, the consequences of education for employability, productivity, and earnings are also of substantial importance.

As many studies have documented, schooling is one of the best predictors of

"who gets ahead". Better-educated workers earn higher wages, have greater earnings growth over their lifetimes, experience less unemployment, and work longer. Higher education is also associated with longer life expectancy, better health, and reduced participation in crime. In this section we focus on evidence relating to the private returns to education, specifically those that result from higher lifetime earnings.[2]

Two principal approaches have been used to analyse the relationship between schooling and earnings. Both use standard multivariate methods such as ordinary least squares (OLS) estimation. As discussed below, both approaches suffer from the limitation that they may estimate the correlation between earnings and education, after controlling for other observed influences on earnings, rather than isolating the causal impact of education on earnings.

The first approach is illustrated by recent Canadian studies by Allen (2004), Rathje and Emery (2002) and Vaillancourt and Bourdeau-Primeau (2002). This method estimates life-cycle earnings profiles from data on groups of individuals with different levels of education. Combining these estimated earnings profiles with information on the costs of acquiring additional education -- both the direct costs and the opportunity costs associated with the income foregone by not working -- allows the implied rate of return on the investment in additional education to be estimated. For example, the rate of return to a university degree compared to a high school diploma is estimated using the life-cycle earnings profiles for these two groups together with information on the direct and opportunity costs of attending university compared to entering the labour force after completing high school.

The second approach is based on estimation of an earnings function in which a measure of earnings is regressed on years of completed schooling (or highest level of educational attainment), years of labour market experience, and additional variables that control for other influences on earnings. This earnings function approach is widely used because it readily provides estimates of the rate of return to education, as well as yielding insights into the relative magnitudes of other influences on earnings.

Canadian studies using these conventional OLS methods to analyse the

[2] Earnings is the most commonly used measure of labour market success because it captures both the wage rate or "price" of labour services and employment (hours, weeks and years of work).

relationship between education and earnings obtain estimates of the “return to schooling” that are similar to those obtained in many studies carried out in other developed countries: rates of return (in real terms, i.e. after adjusting for inflation) of approximately 8-10 percent for the labour force as a whole. Such estimates compare favourably with rates of return on investments in physical capital. In Canada, women tend to benefit more from education than men. For example, a recent study found real rates of return to investments in education of approximately 9% for females and 6% for males (Ferrer and Riddell, 2002). Other Canadian research finds similar male-female differences.

The strong positive relationship between education and earnings is one of the most well established relationships in social science. Many social scientists have, however, been reluctant to interpret this correlation as evidence that education exerts a causal effect on earnings. According to human capital theory, schooling raises earnings because it enhances workers' skills, thus making employees more productive and more valuable to employers. However, as discussed previously, the positive relationship between earnings and schooling could arise because both education and earnings are correlated with unobserved factors such as ability, perseverance, and ambition (hereafter simply referred to as “ability”). If there are systematic differences between the less-educated and the well-educated that affect both schooling decisions and labour market success, then the correlation between education and earnings may reflect these other factors as well. According to signaling/screening theory, such differences could arise if employers use education as a signal of unobserved productivity-related factors such as ability or perseverance. In these circumstances, standard estimates of the return to schooling are likely to be biased upwards because they do not take into account unobserved “ability”. More generally, those with greater ability or motivation may be more likely to be successful, even in the absence of additional education. That is, the correlation that exists between earnings and education, after controlling for other observed influences on earnings, may reflect the contribution of unobserved influences rather than a causal impact of education on earnings.

This “omitted ability bias” issue is of fundamental importance not only for the question of how we should interpret the positive relationship between earnings and schooling, but also for the emphasis that should be placed on education in public policies.

To the extent that estimates of the return to schooling are biased upwards because of unobserved factors, estimated average rates of return to education may substantially over-predict the economic benefits that a less-educated person would receive if he/she acquired additional schooling. The estimated average rates of return in the population reflect both the causal effect of schooling on productivity and earnings and the average return to the unobserved ability of the well-educated. However, if those with low levels of education are also, on average, those with low ability or ambition, they can only expect to receive from any additional schooling the return associated with the causal effect of schooling on earnings. That is, average rates of return in the population reflect the causal effect of schooling on earnings and the return to unobserved factors. The marginal return—the impact of additional schooling for someone with low levels of education—may be substantially below the average return. In these circumstances, education may not be very effective in improving the employment or earnings prospects of relatively disadvantaged groups.

Unbiased estimates of the causal effect of education on earnings are thus important for individual decisions as well as for the design of public policies. How can such estimates be obtained? The most reliable method would be to conduct an experiment. Individuals randomly assigned to the treatment group would receive a larger "dose" of education than those assigned to the control group. By following the two groups through time we could observe their subsequent earnings and obtain an unbiased estimate of the impact of schooling on labour market success. Random assignment ensures that, on average, treatment and control groups would not be significantly different from each other in terms of their observed and unobserved characteristics. Thus, on average, the treatment and control groups would be equally represented by "high ability" and "low ability" individuals.

In the absence of such experimental evidence, economists have tried to find "natural experiments" or "quasi-experiments" that isolate the influence of education from the possible effects of unobserved ability. Many of these studies use instrumental variables (IV) methods to estimate the causal impact of education on earnings. These methods can be understood in the context of a simple two equation model of earnings and education. One equation is the earnings equation referred to above, in which the

dependent variable is labour market earnings (often the logarithm of earnings) and the explanatory or right hand side variables include education (usually measured as years of completed schooling or highest level of attainment), work experience and other observed influences on earnings. The dependent variable in the second equation is educational attainment and the explanatory variables include various influences on education such as family background. In this simple setting, unobserved factors such as ability or motivation enter the error terms in each equation because they may affect both educational choices and earnings outcomes. As a consequence, there is a correlation between the error term in the earnings equation and educational attainment, one of the right hand side variables in the earnings equation. Such a correlation implies that OLS estimation of the earnings equation will yield estimates that are biased and inconsistent. Instrumental variables estimation is a method of obtaining consistent estimates in these circumstances.

An instrumental variable (or instrument) refers to a variable that is correlated with the right hand side variable of interest – in this case educational attainment – but that is not correlated with the error term in the earnings equation. If a valid instrument can be found, IV estimation yields consistent estimates of the causal impact of schooling on earnings.

Many recent studies have obtained suitable instruments by finding natural experiments in which some policy change or other event causes changes in educational attainment among some individuals, and does so in a manner that is external to (or independent of) the decisions of the affected individuals. An example of such an external (or exogenous) event – one that has been extensively used in empirical studies – consists of changes in compulsory schooling and child labour laws. Such laws have existed in many countries throughout most of the past century. In Canada these laws operate at the provincial level, and they have been revised at different times in different provinces since the early 1900s. An increase in the minimum school leaving age – for example, from 15 years of age to 16 years of age – is expected to cause some individuals to remain in school longer than they would otherwise have. This policy change is also likely to be independent of the unobserved factors such as ability and motivation that influence the level of education that the individual would choose in the absence of such laws. In these

circumstances, compulsory schooling laws represent a valid instrumental variable because they are correlated with educational attainment but are not correlated with factors that enter the error term in the earnings equation such as individual ability or motivation.

An alternative and useful way of thinking about instrumental variables is as follows. A valid IV influences the right hand side variable that is correlated with the error term – in this case educational attainment -- but does not directly influence the dependent variable, which in this case is labour market earnings. That is, a valid instrument for education in the earnings equation exerts its influence on earnings only indirectly through its effect on education – it does not influence earnings directly. The example of compulsory schooling laws illustrates these properties. Changes in such laws cause changes in educational attainment among some individuals, but it is unlikely that these legal changes would directly alter the earnings of the affected individuals – by which I mean the individuals who stay in school longer as a consequence of the changes in the laws. Thus if the affected individuals experience higher earnings, it is appropriate to infer that the increased earnings are the result of the additional schooling. We can be reasonably confident that the increased earnings are not due to unobserved factors such as individual ability since ability did not change for the individuals affected by the legal changes.

Of course, some – perhaps many – individuals are not affected by changes in compulsory schooling laws. According to human capital theory, those who would have remained in school beyond the new minimum school leaving age will make the same educational choices after the changes in the laws as before the legal changes. This prediction follows because the costs and benefits of education have not changed for these individuals. The fact that only a fraction of the population of interest is directly affected by changes in compulsory schooling laws does not affect the validity of IV estimation, but it does have two important consequences. One relates to the power of the IV estimates. If few people alter their educational choices in response to the legal changes then it is unlikely that precise estimates of the causal impact of education on earnings will be obtained. The second consequence relates to the interpretation of the IV estimates, and is discussed below.

Another variable that has been used as an instrument for education is distance to a

college or university at age 15 or 16. High school graduates who live close to a college or university are more likely to attend a post-secondary educational institution than are those who live far away from a college or university, at least in part because the costs of post-secondary education is lower for such individuals. As a consequence, distance to a post-secondary institution is correlated with educational attainment but is arguably not correlated with unobserved ability. Living close to a university or college thus satisfies the conditions for a suitable IV.[3]

A large number of studies based on the natural experiment / instrumental variable methodology have recently been carried out, using data on sources of variation in education such as those arising from compulsory schooling laws or proximity to a college or university. Table 1 summarizes a number of these contributions, including several Canadian studies.[4] As is evident in Table 1, a consistent -- and perhaps surprising -- result is that conventional OLS estimates of the return to schooling tend to be similar in size or even smaller than their IV counterparts. That is, OLS estimates do not appear to over-estimate the true causal impact of schooling on earnings. Indeed, if anything, they tend to *under-estimate* the causal impact of education on earnings. According to these recent studies the true impact of education on earnings is at least as large as and perhaps larger than was suggested by earlier studies based on conventional OLS estimation.

Why do conventional estimates generally understate the true return to schooling, when the presence of "omitted ability bias" should cause these estimates to be upward biased? Research has provided two principal answers to this question.[5] One is that there is an additional source of bias that operates in the opposite direction. In particular, the presence of measurement error in educational attainment results in downward bias in the coefficient on education in the earnings equation.[6] The downward bias due to measurement error thus acts in the opposite direction to any upward bias associated with unobserved ability.

The second – and perhaps more fundamental – reason why the OLS and IV

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[3] Distance to a post-secondary institution would not satisfy the conditions for being a suitable IV if parents of high ability children were more likely to locate near a university or college than parents of low ability children.

[4] See Card (1999, 2001) for a detailed review of empirical studies and of recent advances in this area.

[5] Other potential explanations are discussed in Card (2001).

[6] Measurement error in an explanatory variable causes the estimated coefficient to be biased toward zero.

estimates may differ is that in the presence of heterogeneity in the net benefits of additional education across individuals the OLS and IV estimates measure different things. In general, there are many reasons to expect that the returns to schooling are not the same for all individuals in the population. Rather, there is likely to be a distribution of such returns, with some individuals facing higher net benefits from acquiring additional schooling than others. For concreteness, consider the returns to acquiring an additional year of schooling. Doing so may raise the lifetime earnings of some individuals by (say) 6% but increase the lifetime earnings of others by 10%. One reason for such heterogeneity could be differential access to funds to finance human capital investments. A general principle of investment behaviour is that individuals should undertake investments as long as the expected rate of return exceeds the market rate of interest. If everyone faced the same market rate of interest and could borrow to finance educational investments, then everyone would invest in education up to the point where the expected rate of return equals the market rate of interest. In these circumstances, if everyone faces a common market interest rate, we would expect rates of return on educational investments to be similar across individuals. However, in contrast to the financing of physical capital investments, it is typically difficult for individuals to borrow to finance human capital acquisition. Some individuals may be able to access funds from family or other sources in order to acquire additional education, while others are unable to do so. As a consequence there may be some individuals who do not invest in additional education even though the expected return from doing so is high. In these circumstances there is likely to be heterogeneity in expected rates of return across individuals, with those who face above-average costs of schooling (perhaps due to credit constraints) also having above-average expected returns relative to market interest rates.

Consider the case of individuals who do not pursue higher education—perhaps because of low family income, limited ability to borrow in order to finance human capital formation, or a family background in which the importance of education is not emphasized. The low levels of completed schooling among these individuals may be principally due to above-average costs of additional education rather than below-average expected returns. For these individuals, who I will refer to as the “high potential return” group, a policy intervention that results in increased educational attainment could have a

substantial payoff. Indeed, the return to the investment may exceed the average return in the population. In these circumstances, the average return from existing investments in education may understate the payoff to incremental investments. That is, policy interventions that focus on increasing education among those with relatively low levels of schooling may be able to achieve rates of return that exceed those experienced by those who would invest in education even in the absence of any intervention.

When returns to education are heterogeneous there are several different concepts of rate of return that may be of interest. One is the average rate of return to additional schooling in the population. This measure provides a useful summary of the payoff to additional schooling for the population as a whole. It also provides an estimate of the expected rate of return that would be experienced by an individual chosen at random from the population. Using the language of program evaluation this concept is referred to as the average treatment effect (ATE).

Another concept of interest is the rate of return that would be experienced by a specific subset of the population. For example, consider a policy that would subsidize post-secondary education among students from less advantaged backgrounds. In order to determine whether this expenditure is worthwhile on cost-benefit grounds, analysts need to know the returns that would be experienced by the individuals affected by the policy rather than the rate of return for the population as a whole. For policy purposes it is thus important to estimate the impact of additional schooling for this subset of the population. Such an estimate is referred to as a local average treatment effect (LATE), the term local referring to the fact that the estimate applies to a specific subset of the population. The LATE is an estimate of the expected rate of return that would be experienced by an individual chosen at random from the subset of the population affected by the intervention.

The relationship between OLS and IV estimation and the above concepts is as follows. When OLS is applied to a sample representative of the overall population, it yields an estimate of the ATE. In contrast, IV estimation provides an estimate of the LATE for the subset of the population affected by the instrument used to obtain the IV estimates. For example, in the case of changes in compulsory schooling laws discussed above the IV estimate relates to the local average treatment effect for the subset of the

population who stayed in school longer as a consequence of the changes in the law.

With these concepts in mind, let us now return to the summary of recent OLS and IV estimates in Table 1. These estimates indicate that the LATE of past educational interventions (accidental or otherwise) has generally been as large as or even greater than the average rate of return to education in the population as a whole. This suggests that policy and other interventions that caused some groups to acquire more education than they otherwise would have chosen to acquire have typically affected high potential return individuals. In the case of changes to compulsory schooling laws these are individuals who would have dropped out of secondary school prior to graduation.

Three recent Canadian studies provide good illustrations of this "natural experiment" approach. Lemieux and Card (2001) study the impact of the Veterans Rehabilitation Act—the Canadian "G.I. Bill". In order to ease the return of World War Two veterans into the labour market, the federal government provided strong financial incentives for veterans to attend university or other sorts of educational programs. Because many more young men from Ontario than Quebec had served as soldiers, those from Ontario were significantly more likely to be eligible for these benefits. Lemieux and Card estimate that the VRA increased the education of the veteran cohort of Ontario men by 0.2 to 0.4 years. Further, their IV estimate of the rate of return to schooling is 14 to 16 percent, substantially higher than the OLS estimate with their data of 7 percent.

Sweetman (1999) investigates the impact on education and earnings of the education policy change in Newfoundland that raised the number of years of schooling required for high school graduation from 11 to 12. He estimates that this intervention increased educational attainment of affected Newfoundland cohorts by 0.8 to 0.9 years. Estimated rates of return to the additional schooling are substantial: 17.0% for females (versus an OLS estimate of 14.6%) and 11.8% for males (compared to an OLS estimate of 10.8%).

Perhaps the most compelling Canadian evidence comes from Oreopoulos (2006) research on the effects of changes in compulsory schooling laws in Canadian provinces over the past century. He also concludes that the causal impact of additional schooling at the secondary school level is large, with associated rates of return in the 12 to 15 percent range.

As with this growing body of international research, these Canadian studies conclude that conventional OLS estimates of the return to schooling are likely, if anything, to be biased downwards, as opposed to being inflated by unobserved ability. These studies provide strong evidence that policy interventions that raised the educational attainment of certain groups many years ago had large beneficial effects on the subsequent lifetime earnings of these individuals.

Two principal conclusions follow from this body of research. First, rates of return to investments in education are high—and possibly higher than has generally been believed on the basis of previous studies of the impact of education on earnings. Second, the payoff to incremental investments in education may exceed the average return in the population. In the past, interventions that raised educational attainment among groups with relatively low levels of schooling did not show evidence of diminishing returns to education because they required society to "reach lower into the ability barrel." This general finding is consistent with the view that these individuals stopped their schooling because they faced above-average costs of additional education rather than below-average expected returns. As a consequence, policy interventions that result in additional schooling being acquired by individuals from disadvantaged backgrounds, or those who face other barriers to acquiring human capital, may yield a substantial return in the form of enhanced earnings, in addition to contributing to equity objectives.

4. Social Consequences of Education

This section reviews recent research on the social consequences of education and skills development. It is a lengthy section because there are numerous potential social benefits associated with education, because much of the relevant empirical literature is very recent and not well known, and because it is difficult to write a brief review without being superficial in nature. Readers who are not interested in the details can skip to the conclusions at the end of the section.

4.1 Social Returns to Education

Social returns to education refer to positive or negative outcomes that accrue to individuals other than the person or family making the decision about how much

schooling to acquire. These returns are therefore benefits (potentially also costs) that are not taken into account by the decision-maker. If such "external benefits" are quantitatively important they could result in significant under-investment in education in the absence of government intervention. Many prominent social scientists, from Adam Smith to Milton Friedman to Kenneth Arrow, have suggested that education generates positive external benefits. A substantial amount of empirical evidence is now available on at least some of these outcomes. Most of the empirical evidence comes from the U.S. Much of the earlier literature focused on the correlation between educational attainment and various outcomes. Recent contributions have paid more attention to distinguishing between correlations and causal impacts.

It is also important to note that the social returns to education are not necessarily as high as the private returns. To the extent that education plays a signaling or screening role in the labour market, social returns can be less than private returns (Spence, 1974). In the extreme case where schooling acts only as a signal and has no effect on individual productivity, the social returns to education are zero but private returns continue to be positive.

The content of education clearly matters. In totalitarian societies schooling is often used as a form of indoctrination. The discussion here presumes that the nature of education is similar to that in Canada and other Western democracies.

We first discuss social benefits that take the form of market outcomes such as productivity, earnings and output of goods and services. This is followed by an examination of non-market outcomes such as health, civic participation and criminal activity.

4.2 Innovation, Knowledge Creation and Economic Growth

The factors that determine long term growth in living standards have received substantial attention in the past two decades. Much of this research has been dominated by "new growth theory" that emphasizes the contribution of knowledge creation and innovation in fostering advances in living standards over time.[7] The influence of these new

[7] Previous theories of economic growth placed greater emphasis on "inputs" into production -- i.e. on the accumulation of physical and human capital.

perspectives has been reinforced by empirical evidence that supports the view that education plays an important role in economic growth (see, for example, Barro, 2001).

The importance of economic growth (growth in average living standards) deserves emphasis. Even apparently small differences in growth rates will, if they persist over extended periods of time, make huge differences to the living standards of the average citizen. For this reason many economists have noted that understanding the determinants of long term growth is one of the most significant economic problems. As stated for example by Lipsey (1996, p. 4):

> All the other concerns of economic policy -- full employment, efficiency in resource use, and income redistribution -- pale into significance when set against growth...All citizens, both rich and poor, are massively better off materially than were their ancestors of a hundred years ago who were in the same relative position in the income scale. That improvement has come to pass not because unemployment or economic efficiency or income distribution is massively different from what it was a century ago but because economic growth has increased the average national incomes of the industrialized countries about tenfold over the period.

A central tenet of the new growth theories is that knowledge creation and innovation respond to economic incentives, and can thus be influenced by public policy. The education and skill formation systems play an important role in fostering innovation and advancing knowledge. There are three main dimensions to this role. One is related to the research function of educational institutions, particularly universities. Such research can be an important source of new ideas and advances in knowledge. The other dimensions are related to the teaching function of universities and colleges. These educational institutions train many of the scientists and engineers who will make future discoveries. They also play a central role in the transfer of accumulated knowledge to new generations -- not just in science and engineering but also across a wide range of fields of study. The human capital of the workforce is thus regarded as a crucial factor facilitating the adoption of new and more productive technologies.

The transfer of knowledge function should be reflected in the private returns to education. Those receiving education will become more productive and thus more valuable to employers. The "return" to this investment takes the form of higher earnings than would have been possible without additional education.

In contrast, there will generally be social benefits associated with encouraging innovation and scientific advances that arise from the "public good" nature of knowledge. The potential market failure associated with the public good nature of knowledge is recognized by adoption of patent laws and other institutional arrangements to encourage invention and innovation. In addition to these "dynamic externalities" that may contribute to greater growth in living standards over time, there may also be "knowledge spillovers" of a more static form if more educated individuals raise the productivity and earnings of those they work with or interact with in the community.

The magnitudes of these "knowledge spillovers" -- both the dynamic and static types -- has been the subject of substantial recent research. Davies (2002) provides a careful review of this literature. He concludes that there is substantial evidence of dynamic externalities associated with education, although he cautions that there remains considerable uncertainty about their magnitudes. These dynamic externalities appear to operate primarily via technology adoption and innovation. His estimate of the magnitudes of these growth-enhancing social returns in excess of private returns is 1-2 percentage points. This estimate is consistent with the results of a number of studies of the relationship between education and growth. For example, the ambitious study of both static and dynamic impacts of education on economic growth by McMahon (1999) covering 78 countries over the 1965-1990 period obtains estimates of total returns to education for the U.S. of 14% of which private returns constitute 11-13%. Comparable estimates for the U.K. are total returns of 15% and private returns of 11-13%.

Another noteworthy finding in this literature is that post-secondary education is relatively more important for explaining growth in OECD countries, while primary and secondary schooling is more important in developing countries (Gemmell, 1995; Barro and Sala-i-Martin, 1995). This result is consistent with the view that tertiary education has a special role to play in preparing workers for technological adoption and innovation in the more advanced countries.

4.3 Knowledge Spillovers

Static knowledge spillovers arise if more education raises not only the productivity of those receiving the education but also the productivity of those they work with and

interact with. For example, in *The Economy of Cities*, Jane Jacobs (1969) argues that cities are an "engine of growth" because they facilitate the exchange of ideas, especially between entrepreneurs and managers. Such knowledge spillovers can take place through the exchange of ideas, imitation, and learning-by-doing. Evidence of the role of knowledge spillovers in technological change has resulted in substantial attention being focused on the clustering of the agents of innovation -- firms, end users, universities and government research facilities (Bekar and Lipsey, 2002).

Rauch (1993) was the first study of human capital spillovers employing cross-sectional evidence on U.S. cities. He found evidence that higher average education levels in cities is correlated with both higher wages of workers (even after controlling for the individual's own education) and higher housing prices. Similarly, Glaeser, Scheinkman and Shleifer (1995) found that income per capita grew faster in U.S. cities with high initial human capital in the post-war period. In one of several studies of specific industries, Zucker, Darby and Brewer (1998) note an impact of the concentration of outstanding scientists in particular cities on the location decisions of new biotech firms. These studies provide some indirect evidence of human capital externalities. However, they are not conclusive because cities with higher average schooling levels could also have higher wages for a variety of reasons other than knowledge spillovers. In addition, the direction of causation could be the reverse -- higher incomes could lead to more schooling. Recent contributions have used "natural experiments" and instrumental variables methods to assess whether there is evidence of knowledge spillovers that is causal in nature.

Acemoglu and Angrist (2001) use variation in educational attainment associated with compulsory schooling laws and child labour laws in the U.S. to examine whether there is evidence of external returns to higher average schooling at the state level.[8] They find small (about 1%) social returns in excess of private returns but these are imprecisely estimated and not significantly different from zero. Because compulsory schooling laws principally influence the amount of secondary schooling received, these results suggest that there are not significant knowledge spillovers associated with additional high school

[8] As discussed in the previous section, such laws result in variation in educational attainment (in this case, additional secondary schooling) that is independent of individuals' educational choices.

education. However, subsequent studies by Moretti (1998, 2003a, 2004) and Ciccone and Peri (2002) find stronger evidence of externalities associated with post-secondary education (graduates of four-year colleges in U.S.). These studies use a variety of data sources and focus on spillovers at the city level. Moretti (2003b) provides a useful survey of evidence on these city-level spillovers. Although this literature is still in its infancy, the most recent research indicates moderately large social returns due to knowledge spillovers from post-secondary (college in U.S. or university in Canada) education. For example, Ciccone and Peri (2002) estimate social returns of 2%-8% in excess of private returns. A cautious assessment of this recent literature would be that there are social returns of 1%-2% associated with static knowledge spillovers from post-secondary education in advanced economies. Together with the growth-enhancing dynamic effects, this evidence suggests that social benefits associated with technological adoption, innovation, and productivity enhancement from knowledge spillovers may yield social returns in the range of 2-4%.

4.4 Non-Market Effects of Education

Berhman and Stacey (1997), McMahon (1997), Wolfe and Zuvekis (1997) and Wolfe and Haveman (2001) provide recent surveys of the literature that attempts to quantify the social and non-market effects of education. The non-market benefits of education considered are consequences other than those received in the form of higher wages or non-wage benefits from working. Some of these non-market effects -- such as improved own health or child development -- may be considered private in nature, or at least private to the family, and thus may be taken into account by individuals in choosing the amount of education to acquire. If so, they should not be treated as social benefits. Nonetheless, they are benefits that accrue to the individual or family, and thus should be added to the private benefits associated with higher lifetime earnings. In addition, even effects such as improved health outcomes may be of some public value if they reduce reliance on publicly funded programs.

The empirical studies that these authors survey generally find considerable impacts of education on a wide variety of non-market and social benefits, even after controlling for such factors as income, age, race, etc. The research analyzed data from

both developed and developing countries. Here is a list of the benefits (other than those discussed previously) that are considered:

- Effect of wife's schooling on husband's earnings.
- Effect of parents' education on child outcomes (intergenerational effects): education, cognitive ability, health, and fertility choices.
- Effect of education on own health and spouse's health.
- Effect of education on consumer choice efficiency, labour market search efficiency, adaptability to new jobs, marital choice, savings, and attainment of desired family size.
- Effect of education on charitable giving and volunteer activity.
- Effect of schooling on social cohesion: voting behaviour, reduced alienation and smaller social inequalities.
- Effect of education on reducing reliance on welfare and other social programs.
- Effect of schooling on reduced criminal activity.

Many of the studies surveyed also found relationships between the average education levels in the community and positive non-market benefits. For example, higher average education levels in the community (particularly young adults) lowered school dropout rates of children. Note, however, that not all of this research was able to control appropriately for unobserved factors that may impact both education and these non-market outcomes. Thus considerable care needs to be exercised in treating correlations between education and various outcomes as being causal in nature.

Brief summaries of the state of knowledge relating to these non-market social benefits of education are provided below. Special attention is devoted to recent research, which has generally devoted considerable attention to trying to estimate the causal impacts of education on various outcomes.

4.5 Intergenerational Effects

Parents' education has strong effects on children, resulting in large intergenerational effects. As a consequence, the benefits of higher education accrue over extended periods. Surveys by Greenwood (1997) and Maynard and McGrath (1997) summarize the earlier

literature on these effects. The research shows an impact of parental education on a number of child outcomes, including:

- Higher parental education is associated with lower fertility, via increased efficiency of contraception, as well as via raising the age of both marriage and first pregnancy. The resulting lower population growth is positive for economic growth in developing countries.
- The incidence of teenage childbearing is much higher for children of less educated parents. Teenage parents have elevated probabilities of dropping out of high school, demonstrate lower parenting skills, and experience higher rates of poverty. This has subsequent negative impacts on the children of teenage parents as outcomes for these children are generally worse than for other children.
- Child abuse and neglect are also associated with parental education levels.
- Higher parental education is associated with more substantial family investments in children, and these investments have an effect far greater than the societal educational investments made when the child enters school. Children of more educated parents generally perform better in school and in the labour market, and have better health. These impacts are significant even after controlling for parental income. The higher family investments typically take the form of parental time and expenditures on children.
- Children of less educated parents generally cost more to educate, needing special compensatory programs, as well as being more likely to require expensive programs like foster care and juvenile diversion.
- Higher parental education is associated with lower criminal propensities in children. It is also associated with lower probabilities of parental abuse and neglect, which also may reduce criminal behaviour and the need for the removal of children from the home.
- Higher parental education is associated with improved child health.

Although many of these consequences are internal to the family, and thus should be treated as private benefits, a number of these intergenerational effects of education also

have benefits for society. These include: lower education costs, less use of foster care and juvenile diversion, lower crime, lower health costs, and lower dependence on welfare transfers.

4.6 Health and Longevity

Grossman and Kaestner (1997) and Wolfe and Haveman (2001) survey a huge amount of empirical research on the causal effects of education on health. The overriding conclusion of these authors is that the empirical evidence supports the belief that education has a causal impact on health outcomes in the U.S., other developed countries, and in developing countries. Many studies are careful in uncovering causal impacts rather than simply correlations between education and health outcomes (which are known to be strong). In addition, as noted previously, there is also considerable evidence that child health is positively related to parents' education (Wolfe and Haveman, 2001).

There is less evidence on the actual pathways by which education impacts health. Education may impact how individuals assess information on how to improve health, and it may increase the efficiency by which individuals use that information in lifestyle choices. It may also impact the rate of time preference of individuals, with more educated individuals discounting the future less, and thus undertaking actions that improve health (e.g. smoking less). In a widely cited study, Kenkel (1991) found that education is not only associated with better health outcomes but also superior health behaviours such as reduced smoking, more exercise and lower incidence of heavy drinking. Interestingly, however, the influence of schooling does not mainly operate through its impact on health knowledge -- the estimated impact of additional education did not decline substantially when controls were included for health knowledge. This suggests that the effect of education on health occurs mainly through the utilization of health knowledge rather than the acquisition of such knowledge.[9]

Recent research by Lleras-Muney (2002) reinforces the conclusion that there is a strong causal effect of education on mortality in the U.S. She finds that an extra year of

[9] An important exception is the case of smoking, where Kenkel (1991) found evidence of an important interaction between health knowledge and education. Those with more schooling reduced their smoking more for a given increase in knowledge of the consequences of smoking. He also points out that prior to the report of the U.S. Surgeon General in the 1960s (which had a major impact on knowledge about the health consequences of smoking) higher education was not related to lower incidence of smoking.

schooling results in a decline in mortality of at least 3.6% over a ten-year period, an impact that is larger than prior estimates of the effect of education on mortality. To deal with unobserved characteristics that impact both education and health she uses variation in educational attainment due to compulsory schooling laws as employed by Acemoglu and Angrist (2001) and others. This methodology results in estimates that focus on the impact of additional high school on mortality, rather than on higher levels of post-secondary education.

Lleras-Muney and Lichtenberg (2002) examine one of the mechanisms by which education may impact health outcomes. They investigate whether education is correlated with adoption of newer prescription drugs. If more educated people are more likely to adopt newer drugs, due to more information or better ability to learn, and those newer drugs improve health, then this may be one mechanism by which education leads to better health. They find that education is correlated with the purchase of drugs that are more recently approved, after controlling for the medical condition, individual income and health insurance status. The impact of education is generally felt only for chronic conditions, where prescriptions are bought regularly for the same condition. This suggests that the more educated are better able to learn from experience.

Although better health is principally a private return, it may also be a social benefit if it means less reliance by people on publicly provided health care or welfare payments. In this respect, there is an important difference between morbidity and mortality. From the perspective of the public finances, reduced morbidity has a positive effect whereas increased longevity is more likely to negatively affect publicly funded programs such as pensions and medical care.

4.7 Criminal Activity

Until recently the evidence from empirical studies of the impact of education on crime was mixed. For example, in their reviews of the literature Witte (1997) and McMahon (1999) concluded that the available evidence does not find that education impacts crime once other factors are controlled for.[10] However, recent work by Grogger (1998),

[10] There is however strong evidence of a link between time spent productively occupied -- either employed or in school -- and crime.

Lochner (1999) and Lochner and Moretti (2004) focuses specifically on the role of education and does find an impact of schooling on crime. Higher education levels may lower crime by raising wage rates, which increase the opportunity cost of crime. Education may also raise an individual's rate of time preference (the extent to which future consequences are discounted), thus increasing the cost of any future punishment as a result of crime. Lochner (1999) estimates the social value of high school graduation through reductions in crime, taking into account the costs of incarceration and costs to victims. The extra social benefits amount to almost 20% of the private returns to increases in high school completion. This may even be a conservative estimate as a number of crimes are not included in the analysis, nor are the potential benefits to citizens associated with feeling safe. In addition, some of the costs (such as criminal justice and law enforcement costs) are also not taken into account.

In subsequent research, Lochner and Moretti (2004) utilize a variety of data sets to examine whether increasing education levels cause reductions in crime among adult males in the U.S. They employ three sources of information: incarceration, arrests and self-reports of criminal activity. The authors find that higher education levels, particularly graduating from high school, consistently lower the probabilities of incarceration, of criminal arrests, and of self-reports of undertaking criminal activity. In U.S. Census data the probability of incarceration is negatively correlated with education levels, and is much higher for blacks than whites. This correlation may not be causal, however, if there are unobserved individual characteristics which both raise education and lower criminal activity. Following the methods used by Acemoglu and Angrist (2001) discussed previously, the authors employ compulsory school attendance laws as an independent source of variation in educational attainment. Their casual estimates of the impact of education on incarceration indicate that high school graduation lowers incarceration probabilities by 0.8 percentage points for white males and 3.4 percentage points for black males. Differences in educational attainment can explain as much as 23% of the black-white gap in male incarceration rates.

Data from the FBI's crime reports allows the impact of education on different types of crime to be estimated. Education was most effective in lowering violent crime

rates like murder and assault, as well as motor vehicle theft. The third data set employed was a longitudinal survey that asked respondents about crimes they have committed. This source of information usefully supplements the data on arrests and incarceration because it is possible that more educated people commit as much crime as less educated people, but are better at avoiding arrest or obtaining lighter sentences. The evidence, however, is that education has very similar impacts on self-reported criminal activity to that which it had on arrests and incarceration.

On the basis of this evidence, Lochner and Moretti (2004) calculate that raising the high school graduation rate by 1% will reduce the costs of crime by approximately $1.4 billion dollars per year in the U.S.

4.8 Civic Participation[11]

The impact of education on civic participation has been analyzed by political scientists for a long time. The correlation between education and voting is strong. Higher education is also associated with greater charitable giving and more volunteerism. Helliwell and Putnam (1999) also find that education is correlated with typical measures of social capital: trust and social participation (club memberships, community work, hosting dinner parties). However, only recently have studies attempted to determine whether education exerts a causal influence on civic participation, or whether the correlation arises because both education and civic participation are jointly influenced by unobserved factors. Two recent papers that attempt to do so are Milligan, Moretti and Oreopoulos (2003) and Dee (2003).

Milligan, Moretti and Oreopoulos (2003) analyse the question of whether education improves citizenship. The authors focus on the U.S. and the U.K., but provide some results for Canada also. The main question is whether people who have more education are more likely to vote in elections. Analysis is also conducted on whether education raises the "quality" of people's involvement in society. Here "quality" is measured by such things as whether people:

1. follow the news and political campaigns,
2. attend political meetings,

[11] The issues discussed in this section are examined more fully by O'Neill (2005).

3. work on community issues,
4. try to persuade others to share their views,
5. discuss political matters with friends,
6. consider themselves politically active,
7. consider themselves close to a political party, and/or
8. trust the federal government.

As in previously discussed studies by Acemoglu and Angrist (2001) and others, Milligan, Moretti and Oreopoulos (2003) use variation in educational attainment generated by compulsory school attendance laws and child labour laws. The estimates thus relate to the impact of additional secondary schooling on civic participation.

Generally the authors find that having a higher level of education does raise the probability of voting in the U.S., but not in the U.K. They suggest that this may be due to different voter registration methods in the two countries. In the U.S., registration is the responsibility of the individual, and thus many people are not registered. In the U.K., registration is undertaken by local authorities, and registration is required. Thus the vast majority of citizens are registered. If estimates of the impact of education on voting are made conditional on registration, the effect of education becomes much less in the U.S. There is little change in the U.K., as we would expect given the high level of registration. Canada has registration laws more closely resembling the U.K., and the impact of education on voting behaviour is much more muted than in the U.S. Having graduated high school raises the probability of voting by close to 30% in the U.S. (not conditional on registration), while the estimated impact is around 9% in Canada. The authors also find strong impacts of education on the measures of the "quality" of citizenship listed above.

Dee (2003) analyzes the impact of education on voting and civic behaviour in the U.S., using comparable methods to Milligan et. al. (2003) but with different data sources. He also finds a strong causal impact of education on voting behaviour, the probability of reading newspapers and support for free speech by various groups. Some of his results also provide evidence on the impact of post-secondary education on voting behaviour. For example, he finds that college entrance raises the probability of voter participation by approximately 20 to 30 percentage points. He also concludes that an additional year of

high school increases the probability of voting in Presidential elections by around 7 percentage points. Education also increases certain measures of civic engagement and knowledge: the frequency of newspaper readership, and support for free speech by anti-religionists, communists and homosexuals. He also finds that additional education does not increase support for free speech by militarists (someone who advocates outlawing elections and letting the military run the country) or racists.

In addition to these studies based on individual data, cross-country studies find that higher education has a positive effect on democratization and political stability. For example, McMahon (1999, 2001) finds significant effects of secondary schooling on measures of democratization, human rights, and political stability, after controlling for income per capita and military spending as a proportion of total public expenditure. McMahon also finds strong feedback effects on economic growth that operate through democratization and political stability.

4.9 Tax and Transfer Effects

Several studies discussed by Wolfe and Haveman (2001) find that those with more education are less likely to rely on public transfers, even when eligible for benefits. Indeed, evidence indicates that the mother's education even lowers take-up of welfare by eligible children. Although these consequences of education should not be ignored, the quantitatively most important effect is the impact of higher lifetime earnings on government tax receipts (Davies, 2002). For example, in Canada the modal marginal tax rate on university graduates -- taking into account sales, excise and income taxes -- is in excess of 50%. Thus each additional $1,000 in labour market earnings generates an additional $500 in tax revenue. Collins and Davies (2001) recently estimated the gap between before-tax and after-tax rates of return to a university bachelor's degree in Canada and the U.S. In Canada, for men and women together, the median reduction in the rate of return due to taxes was 1.9 percentage points. In the U.S. the corresponding reduction was 1.1 percentage points. On the basis of these calculations, Davies (2002) notes that the tax revenue associated with higher earnings adds approximately 2 percentage points to the social benefits of higher education.

Because of the progressive nature of income tax, the reductions in the rate of return due to taxation are larger at higher income levels. For example, Collins and Davies (2001) estimate reductions of 2.8 percentage points for Canadian men at the 90th percentile of the earnings distribution and 1.9 percentage points for corresponding U.S. men. This calculation highlights an important point made by Allen (2005). The combination of higher earnings associated with additional education and a progressive income tax system implies that those who earn more as a consequence of additional education also pay more over their lifetimes in tax revenue.

5. Education, Skills and Labour Market Outcomes

Education and labour market experience are "inputs" into the production of human capital, not direct measures of the "outcomes" -- a set of skills, competencies and knowledge. Although the relationships between inputs such as education and experience and outcomes such as employment and earnings have been extensively investigated, relatively little is known about the relationship between direct measures of skills and labour market outcomes.

Green and Riddell (2003) use the Canadian component of the International Adult Literacy Survey (IALS) to investigate the relationship between education, skills and labour market earnings. The IALS data contains standard questions on demographics and labour force behaviour, but also measures literacy in three domains: prose, document and quantitative literacy. Ferrer, Green and Riddell (2006) carry out a similar analysis for immigrants to the province of Ontario using the Ontario Immigrant Literacy Survey (OILS).

Conventional estimates of the return to schooling and to labour market experience confound two effects. The first is the impact of education and experience on skill production -- the relationship between human capital inputs such as education and experience and outputs such as literacy skills or problem-solving skills. The second is the value placed on various skills in the labour market -- the relationship between literacy or problem-solving skills and market earnings.

When skills are not directly observed, the best researchers can do is to analyse the relationship between human capital inputs and labour market outcomes. However, the

availability of directly observed skills in data sets that also contain information on labour force behaviour allows researchers to "unpack" these two effects to some extent -- to obtain estimates of both the skill production effect and the market valuation effect.

Green and Riddell (2003) find that formal education exerts a substantial effect on the production of literacy skills in Canada. However, they conclude that labour market experience has essentially no net effect on literacy production. These results suggest that policies aimed at improving cognitive skills such as literacy should focus on formal schooling. Policies designed to increase work experience can lead to earnings growth but they appear unlikely to enhance the cognitive skills of the workforce. Ferrer, Green and Riddell (2006) find a similar strong relationship between formal education and literacy skills among immigrants. However, in the case of immigrants they conclude that work experience in Canada also has some effect on literacy skills. Given that these surveys assess literacy skills in English or French, this finding may reflect the acquisition of language skills with work experience in the new country.

Another important result is that the Canadian labour market places a high value on literacy skills. A 20-point increase in the literacy score -- equivalent to 1/3rd of a standard deviation of the literacy score distribution -- produces an increase in earnings equal to that associated with an extra year of formal schooling. Furthermore, Ferrer, Green and Riddell (2006) find that immigrants receive returns to literacy and numeracy skills that are as large as those received by native-born Canadians.

Together these results imply that a significant amount of the "return to education" as conventionally measured represents the combined effects of the contribution of schooling to producing literacy skills and the value placed on literacy in the labour market. Indeed, Green and Riddell (2003) estimate that about one-quarter to one-third of the "return to education" is associated with these effects. The remainder reflects the impact of education on the production of other (unobserved) skills that are valued in the labour market.

6. Summary and Conclusions

Many researchers have produced estimates of the economic return to schooling using conventional multivariate methods in which a relationship is estimated between

earnings (or some other measure of labour market success) and education, after controlling for other observed factors that influence earnings. Canadian studies using such conventional methods to analyse the relationship between education and earnings obtain estimates of the return to schooling that are similar to those obtained in many studies carried out in other developed countries: approximately 8-10 percent rate of return when the analysis is based on annual earnings and 6-9 percent when the analysis is based on weekly earnings. Such estimates compare favourably with rates of return on physical capital investments. However, many social scientists have been skeptical about these estimates because they do not control for unobserved factors such as ability, motivation and perseverance that may influence both educational attainment and labour market success. Such unobserved factors are likely to imply that conventional estimates of the return to schooling are biased upwards. Furthermore, according to signaling/screening theory one may observe a positive correlation between education and earnings even when education has no causal effect on individual productivity and earnings. These concerns raise important questions about the nature and magnitude of public investments in education.

Important advances have recently taken place in our understanding of the relationship between education and labour market success. These advances have occurred from the use of natural experiments and instrumental variables methods that employ variations in educational attainment brought about by policy changes or unique events, variations that are arguably unrelated to the unobserved factors that influence both schooling and labour market outcomes. Such variations allow one to identify the causal impact of education on earnings and other measures of labour market success. A large number of such studies have now been carried out in numerous countries. A distinct pattern is evident from this research. One common finding is that conventional OLS estimates of the return to schooling are not biased upwards. Indeed, these estimates appear, if anything, to be biased downward. Thus the causal effect of education on earnings is at least as large as – and possibly larger than – what was previously believed. Further, the return to incremental investments in education – especially those that affected groups with relatively low levels of education -- often exceed the average return for the labour force as a whole. These results suggest that investments in human capital

remain an important potential source of growth in earnings.

Important advances have also taken place in our knowledge regarding the non-market and social consequences of education. A central, if not the primary, reason for public funding -- and in many cases also provision -- of education has been the belief that there are major social benefits from additional schooling, in addition to the private benefits. Policy interventions designed to raise educational attainment among youth have also sometimes been justified on this basis. Evidence on the magnitudes of these external benefits has, however, been lacking until recently. Beginning in the 1960s and 1970s, with the availability of large micro data files on individuals, social scientists have confirmed that educational attainment is correlated with numerous individual and social outcomes such as lifetime earnings, health and civic participation. However, it remained unclear to what extent the positive correlation between schooling and outcomes such as earnings and health reflected a causal impact of education or was due to both schooling and individual outcomes being related to some unobserved factors. Resolution of this issue is crucial as the case for public subsidization or intervention is much stronger if education leads to social benefits in addition to private benefits. Recent research using natural experiments and instrumental variables estimation methods has strengthened the case for believing that the social benefits of education are substantial.

Summarizing the evidence surveyed in the paper yields the following approximate estimates of the social returns to schooling:

1. Dynamic externalities associated with economic growth	1-2 percentage points
2. Static knowledge spillovers	1-2 percentage points
3. Non-market external benefits	3-4 percentage points
4. Social benefits associated with taxation	2 percentage points
Total	7-10 percentage points

The quantitative estimate for non-market benefits is based on calculations by Wolfe and Haveman (2001) after removing benefits associated with intergenerational effects and health, both of which are arguably principally private to the individual or family. The other estimates were discussed previously.

These estimates suggest that the social benefits of education may be similar in magnitude to the private benefits associated with higher lifetime earnings, which are also

in the range of 7-10 percent. If so, the social returns to education are substantial and justify significant public subsidization of this activity.

The estimated (real) social return of 7-10 percent is arguably a conservative estimate. After a detailed survey of the available evidence, Wolfe and Haveman (2001) conclude that the social return from non-market effects of schooling are of the same order of magnitude as the private returns to education from higher earnings. They do not, however, include the social benefits from higher tax revenue or the growth-enhancing effects of knowledge creation and innovation. On the other hand, they do include in their calculations the intergenerational effects and the impacts of education on health, both of which are excluded from the above estimates on the basis that they are principally private in nature. Similarly, Davies (2002) also concludes that the social returns are similar in size to the private returns. His estimates are similar to those above except that he estimates a value of zero for static knowledge spillovers. The main reason for this different conclusion is that Davies (2002) did not have access to the very recent research by Moretti (2003a, 2004) and Ciccone and Peri (2002) that finds evidence of knowledge spillovers associated with post-secondary education in U.S. cities. Davies' conclusion was principally based on earlier research by Acemoglu and Angrist (2001), who concluded that additional secondary schooling did not have positive external effects on the earnings of other workers in the same state.

Several additional observations are warranted. First, there remains considerable uncertainty about the magnitudes of the social benefits of schooling. In contrast to the substantial amount of research that has been carried out on the relationship between schooling and earnings, much less is known about the causal impact of education on other outcomes. This is particularly the case with respect to Canadian evidence. As indicated in this literature survey, most of the evidence on causal impacts comes from U.S. studies. Some of the impacts of schooling may be universal in nature, but others are likely to depend on the social and institutional setting. This situation was evident in the case of civic participation, where education appears to have a much larger effect on voting behaviour in the U.S. than it does in Canada and the U.K., for reasons that seem to be related to systems of voter registration in the respective countries. It is quite possible that the magnitudes of the impacts of education on Canadian criminal activity and health

outcomes are different from those in the U.S., even if the direction of the influence is the same in the two countries.

Second, there is substantial uncertainty about the size of the social benefits associated with post-secondary education. Much of the U.S. evidence on causal impacts of schooling uses as a source of independent variation in educational attainment the changes in compulsory school attendance laws and child labour laws. As discussed, these studies provide evidence on the causal impact of additional schooling at the secondary level. The clearest evidence of positive social benefits from post-secondary education is that associated with growth-enhancing effects from technological change and innovation and knowledge spillovers from more educated workers. There is also some evidence that post-secondary education enhances civic participation. Many of the studies of intergenerational effects also report evidence of significant impacts associated with post-secondary education.

A third observation is that we have not included in the above calculation of social benefits the evidence of intergenerational effects such as those on child development, health and education associated with the educational attainment of the parents. Nor have the effects on the individual's health behaviours and health outcomes (as well as those on the spouse) been included. Whether these are appropriately viewed as private or social benefits depends to an important extent on whether individuals take these consequences into account at the time they choose how much education to acquire. The case for regarding these consequences of additional schooling as private benefits is based on the argument that a rational individual should take these effects into account in making their educational choices (even if they do not yet have a spouse or children). Although many individuals appear to be motivated in part by career prospects in making their educational decisions, it is less clear that they take into account these other benefits. If they generally do not do so, there is a case for including these consequences as social benefits, as scholars such as Wolfe and Haveman (2001) do. In these circumstances, the above estimates understate the social benefits from education. On the other hand, if we treat the intergenerational effects and health and longevity consequences as being strictly private benefits, then the total private benefits are much larger than is commonly believed. This conclusion would enhance the case for government involvement in the financing of post-

secondary education, in order to help ensure that individuals from disadvantaged backgrounds can take advantage of investments with potentially high returns. In addition, there may also be a case for governments providing more information than is currently available on the non-market consequences of additional schooling, rather than focusing principally on the consequences for future employment and earnings.

In summary, although more research on these issues is needed (especially more Canadian research), the social benefits of education appear to be substantial, perhaps as large as the private market returns to education from higher lifetime earnings. Thus the benefits of education are considerable, and any decisions regarding public support for education and the design of educational policies should take social and non-market benefits into account.

Advances in the collection of data on the skills of the workforce have also resulted in progress in our understanding of the acquisition of human capital and its labour market consequences. Conventional estimates of the return to schooling and to work experience confound two effects: the impact of education and experience on skill production and the value placed on skills in the labour market. The availability of data on directly observed skills allows researchers to "unpack" these two effects. Recent evidence indicates that formal education exerts a substantial effect on the production of literacy skills in Canada. However, work experience has no net effect on literacy production. In addition, Canada's labour market places a high value on literacy skills. A 20-point increase in the literacy score -- equivalent to 1/3rd of a standard deviation of the literacy score distribution -- produces an increase in earnings equal to that associated with an extra year of formal schooling. These results imply that a substantial fraction -- one-quarter to one-third -- of the "return to education" as conventionally measured represents the combined effects of the contribution of schooling to producing literacy skills and the value placed on literacy in the labour market.

At the present time we can be more confident than in the past that education has large and wide-ranging impacts on a variety of individual and social outcomes. Much less is known, however, about the pathways through such effects occur. Does education alter the way that individuals access and process information? Does it improve the quality of the decisions that are made on the basis of a given amount of information? Does

education result in more “forward-looking” behaviour – so that individuals are more likely to make investments that will yield dividends in the future? Does increased education enable people to adapt more readily to changing circumstances? Addressing these questions about causal pathways is an important subject for future research.

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Table 1
OLS and IV Estimates of the Return to Education

Study	Country, instruments	Returns to schooling OLS	IV
Angrist & Kreuger (1991)	U.S. compulsory schooling laws	0.070 0.063 0.052	0.101 0.060 0.078
Staiger & Stock (1997)	U.S. compulsory schooling laws	0.063 0.052	0.098 0.088
Harmon & Walker (1995)	UK compulsory schooling laws	0.061	0.153
Kane & Rouse (1993)	U.S. tuition, distance to college	0.080 0.063	0.091 0.094
Card (1995)	U.S. distance to nearest college	0.073	0.132 0.097
Conneely & Uusitalo (1997)	Finland, living in university town	0.085 0.083	0.110 0.098
Lemieux & Card (2001)	Canada, WWII Veterans Rehabilitation Act	0.070 0.062	0.164 0.076
Meghir & Palme (2000)	Sweden education reforms	0.028	0.036
Sweetman (1999)	Canada, Newfoundland education reform		
	females	0.146	0.170
	males	0. 108	0.221
Oreopoulos (2006)	Canada, compulsory schooling laws		
	without trends controls	0.115	0.070
	with trends controls	0.115	0.131