**The individual benefits of investing in skills**

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**Introduction**

Acquiring skills through education and training is not a costless process. Individuals who participate incur direct monetary costs, such as course fees, non-monetary costs, such as the mental effort that needs to be exerted to complete the course, and indirect costs, such as the earnings that have been forgone whilst studying and learning. In general, individuals are willing to incur these costs because the rewards they receive from completion (or at least those they expect they will receive) are greater.

The rewards may take several forms. For some people, learning may be an enjoyable end in itself. However, when most people invest in their skills, the benefits they expect to receive are those produced when these newly acquired skills are employed in the labour market. These benefits arise because new skills add to an individual’s existing human capital. They become more productive in the workplace given the extra capabilities their new skills have generated, and as a result find themselves in greater demand by employers. This gives the individual more options when supplying their labour and, to the extent that there are a limited number of people who also make this investment, makes the individual a scarce and highly valued potential recruit for employers.

The higher productivity of skilled workers and willingness of firms and employers to compete for such individuals, combined with the relative scarcity of the skills they possess, imply two individual labour market benefits from investing in skill - a greater likelihood of finding work, and higher wages once in work. This chapter is concerned with quantifying the size of these benefits in different parts of the world and exploring the methodological challenges faced – and often overlooked – in the huge empirical literature around this question.

Many of the skills that an individual might possess, from basic literacy and numeracy to advanced knowledge of foreign languages or computer programming (to give just two examples of high-level skills) comes from formal education in the primary, secondary and tertiary sectors. Therefore, the chapter starts in section 2 with a broad description of the earnings and employment prospects of individuals who have completed different levels of formal education across different countries.

However, just looking at raw differences in earnings or the likelihood of employment is not sufficient for measuring the value labour markets attach to different skills, as we do not immediately know the make-up of the groups being compared. Section 3, explains the way researchers have estimated skills premia after controlling for all other observable explanatory factors that potentially affect labour market outcomes. For wages, this estimation is known as a Mincerian wage equation after economist Jacob Mincer. In this section, I summarise findings from the large literature that has followed, and in some cases adapted, Mincer’s methodology.

However, there are a number of important issues linked to the interpretation of the numbers produced. These issues are, in turn, the relationship between levels of education and acquisition of skills the problem of establishing causation, and the distribution of returns around the average given by wage equations. Sections 4 to 6 discusses these issues. This chapter argues that despite efforts to deal with these problems, much is left unresolved, in part because issues around the demand for the available supply of productive skills are largely overlooked.

The majority of what follows draws on research relating to skills developed in the education and training system. Many of these skills are general in the sense that they raise productivity across a number of potential employers, occupations or industries. Of course, the generality of skills such as being able to speak the native language is greater than the ability to tile bathrooms or argue a legal case in court. However, the common feature is that an employer would be wary of helping towards the cost of such skill investments in case the worker left and took their skills to a rival firm. Hence, general skills are usually produced prior to entering employment and are paid for by individuals or the state. In contrast, firms do pay for training where they feel they can retain the trainee, which is much more likely if the skills produced are only really valuable in that firm. In this final section, I consider the investment in skills that takes place once individuals have entered the workplace.

This section argues that interpreting such research is very difficult, especially from the perspective of policymaking. Workplace training is often closely linked to the unique arrangements within a firm. Employers invest in training where the work they do will employ the skills produced. Government-run or funded training programmes can only be an imperfect substitute for such training unless there is some guarantee that the skills will be used within the jobs that are available. If we believe that the incidence and quality of firm training is too low, it is not simply a case of public investment in programmes. The challenge in this situation is creating both the demand and the supply for skills.

**Education, earnings and employment**

The now-standard way of thinking about the link between education and training on the one hand, and labour market outcomes on the other is known as human capital theory, which was developed by a number of economists in the 1960s and 1970s.[[1]](#footnote-1) From the point of view of human capital theory, skills developed by education and training increase worker productivity and generate higher wages and better employment prospects owing to the higher value employers will subsequently place on that individual. Evidence from across the world is consistent with this expectation – taking the average across all the developed OECD countries, an individual with educational attainment below ISCED level 3 earns, on average, 23% less than an individual with ISCED level 3 or 4.[[2]](#footnote-2) They are also less likely to be in employment – someone with only lower secondary (ISCED level 2) education is 19% less likely to be employed rather than unemployed or economically inactive than someone with ISCED level 3A[[3]](#footnote-3). Those with high levels of vocational education (ISCED 5B) earn, on average, 24% than those at ISCED level 3 or 4 are 11% more likely to be in employment than someone with upper secondary (ISCED 3A) education only. Finally, those with first and higher degrees (ISCED 5A and 6) earn 65% more on average than workers with level 3 or 4, with employment rates 16% higher than a person with upper secondary education.

*Figure 2.1 here*

Figure 2.1 shows that there is considerable variation across countries within the OECD. For higher education, the Scandinavian countries of Norway, Sweden and Denmark have the lowest wage gap of around 30-40% above those with ISCED 3-4 level qualification, while at the upper end countries like the UK, Germany and the USA see earnings premia of around 80-90%, and Ireland, Greece and Hungary show premia in excess of 100%. There is no obvious pattern or correlation between these features and the wage gaps between the low and middle educated groups. For example, the three Scandinavian countries see wage premia between these two groups close to the OECD average, while Belgium, Finland, Germany and Ireland have much smaller labour market penalties for having a low level of education. There as similarly large penalties to having low levels of education in the United States and the United Kingdom as there are in countries with far lower returns to higher qualifications, such as Austria, Korea and Turkey. Finally, there is little obvious correlation between premia to the two types of tertiary education. The wage benefits of vocationally orientated tertiary education are larger than the academically orientated equivalent in Norway, and are twice as large as the OECD average. Similarly, high premia to vocational higher education are seen in the Netherlands (which has moderate premia to academic higher education) and Portugal (which has high returns to academic education). For most countries where there are high wage premia to completing academic tertiary education wage benefits for higher vocational education tends to be more moderate, and in the USA, Korea, Israel and Japan, these benefits are particularly low. .

*Figure 2.2 here*

Figures 2.2 shows that wage and employment benefits of investing in education and training do not always go hand-in-hand, which means we always need to consider both when talking about the overall payoff to an investment. Tertiary education graduates in countries such as Germany, Greece, Turkey and Ireland experience are over 25% more likely to be in employment than high school graduates, whereas the differences in the likelihood of finding a job is below 10% in countries such as the Czech Republic, New Zealand, the Netherlands, Portugal, Slovakia and the United Kingdom. Only a small number of countries demonstrate both large penalties to low levels of education and large benefits to high levels of education with respect to employment rates, such as Ireland, the United States, Poland and Slovenia. Comparing vocational and academic education at the tertiary level, Germany, Switzerland, Norway and France are among the countries where the two pathways have similar employment rewards, whereas the employment benefits of tertiary graduates in places like New Zealand, Japan and Italy are experienced by those in academic programmes only.

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How can we interpret all of this variation? In the human capital model, wages and employment are determined by supply and demand. The premium on skills is connected to their scarcity – some countries might meet the higher demand for skilled workers with a greater supply, which reduces the wage premium placed on those with the skills. To illustrate, Figure 2.3 compares wage premia for tertiary educational attainment with the proportion of the population with those qualifications. There is a negative correlation between supply and wages, although it is not very strong (r=0.27). Moreover, the figure shows a number of countries with high wage premia and low scarcity, and vice versa, which indicates that different supply is not the only relevant factor.

It could be that Figure 2.3 does not compare like for like if different educational systems produce different types and levels of skills (a point that is looked at in section 4) The productivity of a qualified individual also depends on other factors such as investment in capital that is complementary to work. This might explain why returns to education and training are lower in less wealthy developed countries such as Turkey, but it is not a convincing explanation for the lower returns in the Scandinavian countries (or, for that matter, countries such as Belgium or Australia), compared to similarly rich countries such as the UK and the USA.

Institutional differences across countries that affect wage setting also play a role. For example, the Scandinavian countries and Belgium have highrates of unionisation and union wage agreement coverage. Strong unions, particularly those which bargain over the wages of the lower and middle parts of the labour market, tend to reduce wage inequality (Checchi and García Peñalosa, 2005), which would be reflected in lower educational earnings premia.[[4]](#footnote-4) Minimum wage policy would also have an impact on wages for lower skilled individuals, placing a floor on the potential size of the gap. Minimum wage critics have argued that such policies trade off higher pay for less productive workers with lower employment rates (Wascher and Neumark, 2012), which would act to maintaining the overall return to greater educational attainment, although there is little reliably strong evidence of such effects occurring (Schmidt, 2013).

**Calculating rates of return**

If the only difference between groups were their levels of educational attainment and, by implication, their skills, then we could easily interpret these relative wages and employment rates as the economic benefit an individual would expect to receive for participating in that programme of study. However, it is typically not the case that education is the only difference between groups, and some of these other differences affect wages as well. As a result, some of the differences in wages might be the result of factors other than education which feature more strongly in one group rather than the other. To deal with this, labour economists tend to use wage regressions, which assume a simple but theoretically plausible relationship between wages and factors that affect wages and estimates the standalone effect of each one of these on earnings, whilst holding all of the others constant. The challenge is in choosing the right set of factors.

*3.1 Wage equation regression*

Mincer (1974) proposed a model in which earnings depend on just two things: education, measured in years of full-time education (“schooling”) and labour market experience. In most wage regressions of the form proposed by Mincer, the dependent variable is the natural logarithm of wages (which might be in hourly or annual terms).[[5]](#footnote-5) The model assumes that each year of schooling increases productivity, on average, in a constant fashion – so, for example, going from four to five years of education has the same effect on productivity and wages and does going from 11 years to 12. It also assumed that individual productivity continues to increase after the end of full-time education due to investments in on-the-job training but at a diminishing rate as individuals rationally invest less in their skills as they age. This is due to a combination of declining time to enjoy the benefits of this investment and the rising opportunity cost of learning rather than earning as productivity, and earning potential, increases. Hence, the standard dependent variables are education, experience (which is often approximated using age, less the number of years of completed schooling and the compulsory school starting age) and the square of experience (which we anticipate having a negative effect, capturing the diminishing returns to experience).

An alternative approach is to include variables which indicate attainment of particular levels of education or qualifications. The advantage of this is that is allows for the effect of education on earnings to vary rather than imposing the assumption that an extra year of education, however spent, increases earning potential at a constant rate. However, one practical problem is that many data sets ask for an individual’s highest qualification only,. The coefficient on a variable indicating, for example, the completion of a post-graduate degree would tell you how much more someone earns on average if they possessed such a qualification compared to, say, someone who has completed compulsory secondary education. However, in the time between completing the two qualifications, people may have followed a variety of pathways. Part of the wage premium will capture the other investments in education and training made during this time, although we do not always have the information to work out how much of the wage premium comes from this.

There are many other variables which explain the distribution of wages. Different demographic groups appear to earn experience systematic gaps in their earnings even after controlling for education and experience differences. Women earn less than men on average, even where the two groups have been highly educated and could be expected to possess equivalent levels of skills. The same can be said for people with equivalent levels of human capital from different ethnic or racial groups – some non-white workers, particularly those from the black community, experience lower wages than their white counterparts at all skill levels. There are numerous possible explanations for these two observations, from deliberate discrimination caused by employer prejudice to differences in human capital not captured by measuring years of schooling or work experience – for example, if schools are of a lower quality in areas with larger ethnic populations. It is therefore important to control for these demographic differences as it is likely that part of the raw gap in pay relates how the genders and ethnic groups are spread out across levels of education and training. For example, there may be a heavy concentration of black workers, who experience lower pay on average for any level of education and training, in lower attainment groups, which would widen to raw gap.

Other controls that are commonly included in a wage regression include geographic location (capturing differences in local labour markets other than their supply of skills and human capital) or marital status (as people with families have different priorities and constraints when searching for work). Finally, union status is also often included where those data are available – membership of a union has historically been associated with higher pay compared to an equivalent worker with no union representation. Again, assuming people from these different groups are not randomly allocated across levels of education, the raw differences in pay shown in section 2 will partly reflect the effect of some of these other variables.

It is often tempting for econometricians to include as many control variables as possible in their wage regression estimations. Doing so is fine providing the variables in question are exogenous – that is, that while different values of these variables help explain and predict outcomes such as wages or employment, these different values are not themselves determined by other variables included in the model. For example, gender is a truly exogenous variable. Male workers tend to experience higher pay than female workers, but nothing about this situation had any role in allocating someone to one gender or the other. The same would apply for ethnicity[[6]](#footnote-6) and it also seems reasonable that marital status is determined by factors other than wages.

For other factors, this is perhaps less clear cut. Angrist and Pischke (2008) use occupation as their example of a ‘bad control’. It might seem like quite a good idea to control for differences in the types of work people with different levels of education and skills have. Some very well trained people end up working in jobs which do not require the full extent of their skills, and it would be strange to expect that they would have the same earning potential as similarly qualified individuals in more demanding jobs. However, a person’s occupation is also, at least in part, an outcome of the system – when someone has more skills and productive potential than another person, this is reflected in the job that they do. Acquiring skills through education and training could lead to an increase in the number of people entering occupations that require those skills. Therefore, including occupation in a regression downplays the return on education – part of the return to investing in more human capital is the ability to work in higher-paying occupations, which is now accounted for separately in the regression. The issue of exogenous and endogenous variables is picked up again in section 5.

*3.2 Wage premia and rates of return*

The types of wage equations discussed above estimate a wage premium – that is, the average percentage increase in wages associated with one level of education compared to another, whist holding everything else constant. When educational differences are captured by years of education, it is common to see this referred to as a rate of return. However, calling it this is only correct under certain restrictive assumptions.[[7]](#footnote-7) Moreover, if education attainment levels or qualifications are used, the wage premia estimated cannot be interpreted as rates of return even if these assumptions were to hold – although this does not prevent the terms being used interchangeably. In most cases, then, it is more accurate to calculate the rate of return of a particular educational investment in the same way a business would when contemplating an investment in new machinery or equipment, i.e. by assessing both the benefits *and* the costs from the moment of purchase onwards. In the case of education and training, the benefits to an individual are those noted previously – an expectation of higher wages and better employment prospects throughout the working life – while the costs include course fees, forgone earnings and non-monetary costs like the effort required to study something challenging. Once these have been quantified, we can calculate the expected net present value (NPV) of the investment as follow:[[8]](#footnote-8)

$$NPV=\sum\_{t=0}^{T}\frac{E(B\_{t}-C\_{t})}{\left(1+r\right)^{t}}$$

where E(.) indicates we are looking at expectations of values at the time of the decision, *Bt* and *Ct* are the benefits and costs at time *t*, and *r* is the individual’s subjective discount rate – we typically assume future benefits and costs are valued less than those experienced in the present as people dislike have to wait for good things and like being able to delay bad things. For any investment where the costs occur early on and the benefits to the investor are delayed, the NPV to a particular individual depends on their own discount rate. The higher the discount rate, the lower the value placed on future outcomes relative to immediate ones, and consequently, the lower the NPV of the investment. The internal rate of return (IRR) of any investment, including those in skills and training, is defined as the rate at which future benefits would need to be discounted in order for the NPV to be equal to zero i.e. for the investment to be just worthwhile. For individuals who discount the future at a lower rate than this, the investment has a positive NPV and should be pursued. For individuals with a high discount rate, such an investment would make them worse off and should not be accepted.

Given the assumptions in footnote 7, the IRR and the wage premium to an extra year of educational or training investment becomes the same thing. To see this, let the wage premium arising from the investment be *b* and suppose earnings before the investment are standardised to 1 (so in the first period, the cost is from forgoing these earnings and in all other periods, the benefits are *b × 1 = b*). Then, the NPV calculation becomes:

$$NPV=-1+b\sum\_{t=1}^{T}\frac{1}{\left(1+r\right)^{t}}$$

The sum of the discount factors for each period in the future can be shown to be approximately equal to *1/r*,*[[9]](#footnote-9)* which means that NPV will be equal to zero if *b = r*, or if the wage premium equals the IRR.

*3.3 Overview of existing wage equation estimates*

There would not be sufficient space in this Handbook, let alone this chapter, to give a detailed survey of the many estimates of wage equations that have been conducted across different countries, time periods and available datasets. In this subsection, I give a brief overview of some recent estimates to illustrate the magnitude of the effects commonly found from a select number of studies. The three studies which give us the broadest range of estimates for the returns to education are two produced for the World Bank (Psacharopoulos and Patrinos, 2004 and Montenegro and Patrinos, 2014) and the OECD’s annual review of educational outcomes (OECD, 2014). The three studies have different approaches – the OECD calculates full internal rates of return while Montenegro and Patrinos (2014) uses the Mincerian wage premium approach. Psacharopoulos and Patrinos (2004), which surveys existing studies, combines both approaches. Table 3.1 shows a range of the estimates from these studies. The first column, taken from Psacharopoulos and Patrinos (2004), gives what was the most recent estimate at time of publication for the Mincerian wage premium on an additional year of education. As it surveys existing work, the timing of these estimates here varies from 1977 in the case of the France to 1995 in the case of the US. The second column gives the more recent set of wage premium estimates produced by Montenegro and Patrinos (2014) for an extra year of education – the column gives the range of estimates from years in the period 2000-2010. The final two columns are from the OECD’s internal rate of return calculations for participation in and completion of academic and vocational programmes at the levels of ISCED 3-4 (compared to ISCED 2) and ISCED 5 (compared to ISCED 3-4). Almost all of these estimates come from 2010 earnings and employment data, with the exception of Australia (2009), Italy (2008) and Japan (2007).

*Table 3.1: Selected wage premia and rates of return*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Country | Wage premium, years of education (Psacharopoulos and Patrinos, 2004) | Wage premium (Montenegro and Patrinos, 2014) | IRR, upper secondary or post-compulsory education, (OECD, 2014) | IRR, tertiary education, (OECD, 2014) |
| United Kingdom | 6.8% | 7.6 – 11.9% | 18.2% (male)6.7% (female) | 14.3% (male)12.3% (female) |
| United States | 10.0% | 11.8 – 13.8% | 19.4% (male)16.7% (female) | 15.4% (male)12.9% (female) |
| Australia | 8.0% | 9.8 – 14.1% | 19.9% (male)12.7% (female) | 9.0% (male)8.9% (female) |
| France | 10.0% | 8.0 – 9.2% | 10.6% (male)8.1% (female) | 11.4% (male)10.9% (female) |
| Germany | 7.7% | 11.0 – 15.2% | 7.5% (male)6.4% (female) | 13.4% (male)8.5% (female) |
| Hungary | 4.3% | 11.9 – 14.7% | 19.3% (male)15.8% (female) | 28.5% (male)24.6% (female) |
| Italy | 2.7% | 6.4 – 7.0% | 8.1% (male)8.4% (female) | 8.1% (male)6.9% (female) |
| Sweden | 5.0% | 4.4 – 5.7% | 16.5% (male)11.5% (female) | 7.4% (male)7.1% (female) |
| Japan | 13.2% | 9.9 – 14.0% | - | 7.4% (male)7.8% (female) |
| South Korea | 13.5% | 13.2% | 13.1% (male)11.3% (female) | 12.8% (male)11.0% (female) |

A few general points can be made from scanning this table. Firstly, there is significant variation in wage premia to years of education between developed countries and in some instances, within a country over time. Secondly, there is no clear pattern between wage premia estimates and full internal rate of return calculations – Sweden, for example, has consistently low wage premia relative to all the other countries included, yet when the full costs, taxation system and employment prospects are factored in has far higher estimated returns than the Mincerian approach would otherwise suggest. In Germany, the relationship is the other way around – there is a high wage premium from Mincerian estimates but lower rates of return. Secondly, patterns in the difference of returns experienced by men and women vary across countries. In general, the estimates point to lower returns to women than men, but there are some exceptions to this. The size of the gap also varies quite a lot, often only for one level of education – for example, secondary education but not tertiary education in Australia. Thirdly, there is a lot of variation in estimated returns at different levels – while in general it would seem that secondary education is associated with higher returns than tertiary education for both men and women, this is not true in Germany, France or Italy. This variation in estimated returns exists within countries as well. Table 3.2 shows just for the case of the UK how widely estimated returns to higher education (compared to an individual with 2 or more A-Levels or their equivalent) have varied, due to differences in time period, data set and methodology.

The World Bank studies can help put the experience of these select developed countries in the global context. Looking at the OECD specifically, the estimated wage premium is 7.5%, which is predictably lower than places with lower educational attainment, such as Latin America (12.0%), Asia (9.9%) and Sub-Saharan Africa (11.7%).

Looking at different levels of education, Montenegro and Patrinos find average global wage premia of 10.6, 7.2 and 15.2% for primary, secondary and tertiary education respectively, although these returns tend to be lower where participation is higher . For example, in the OECD the average returns to primary education are 4.9%, whereas in South Asia and Latin America, , average returns are 6.0 and 7.8% respectively. They also find that wage premia are, in almost all cases, larger for women than for men. As shown in Table 3.1, internal rates of return tend to show the opposite. This again highlights how estimates of the return to education and training can look different based on the choice of methodology – in the case of women and men, there are differences in the pattern of lifecycle earnings, periods of time out of the labour market and retirement which can all be accounted for in a full internal rate of return calculation, but for which the Mincerian approach may be too restrictive.

*Table 3.2: Wage premia and rates of return to higher education in the UK*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Study | Earnings data | Wage premium | IRR (if given) | NPV (£1000s) |
| Harkness and Machin (1999) | General Household Survey, 1974-1995 | 14.2 – 23.0% (male)20.5 – 26.7% (female) |  |  |
| Blundell et al (2000) | National Child Development Study, 1991 | 20.8% (male)39.1% (female) † | - | - |
| O’Leary and Sloane (2005) | UK Labour Force Survey, 1994-2002 | 20.2% (male)35.5% (female) | - | - |
| Bratti, et al (2008) | British Cohort Study, 2000 | 14.6% (male)17.8% (female) †† | - | - |
| Walker and Zhu (2008) | UK Labour Force Survey, 1994-2006 | 18.2% (male)27.9% (female) ††† | - | - |
| Conlon and Patrignani (2011) | UK Labour Force Survey, 1996-2009 | 21.1% (male)26.2% (female) | 15.6% (male)14.8% (female) | 121 (male)82 (female) |
| Walker and Zhu (2013) | UK Labour Force Survey, 1993-2010  | 20.5% (male)26.8% (female)  | - | 168 (male)252 (female) |

Notes: † - For comparability with the rest of the table, the raw estimate without ability, test score or family background controls are given. Controls reduce the male premium to 17.1 and 36.8% respectively This is discussed further in section 5. †† - The authors only report the return controlling for ability and family background, although they state that dropping ability measures has no effect on the premia. ††† - Authors test for changes in the premium for pre- and post- expansion cohorts and find zero change for men but a 4% increase in the wage premium for women.

**Return to skills**

One of the problems with most attempts to investigate the return to investment in skills comes from accurately measuring the skills that a given amount of education produces. Largely due to data availability, the literature has focused on the return to years of schooling or completion of a particular programme or qualification, as section 3 shows. These act as proxies for the skills which attract rewards in the labour market but they are obviously imperfect. Two people may have different levels of skills if the quality of that education or training were different even if their numbers of years of education or highest qualification were the same. This problem is particularly large in cross-country comparisons, as researchers would have to deal with different curricula, teaching methods and quality of institutions to fully captures skills differences.

It has become possible in recent years to directly measure the skills possessed by individuals due to the propagation of large scale international tests by organisations such as the OECD of the actual competencies of workers across different countries. While the Programme for International Student Assessment (PISA) attracts more headlines – typically as a measure of various educational systems relative performance through the maths and science abilities of their 15 year old children, assessing labour market outcomes requires testing of working age individuals, such as the International Adult Literacy Survey (IALS) and the more recent International Assessment of Adult Competencies (PIAAC).

Hanuschek *et al* (2013) use PIAAC to provide the most recent internationally comparable data about the returns to cognitive skills across 22 OECD countries. In this analysis, the authors adapt the standard Mincer earnings equation to replace years of schooling with a measure of individual skill taken from tests of literacy, numeracy and problem solving.When included separately, the estimated wage premia were 17.8%, 17.1% and 14.3% for the three skill groups across all of the countries[[10]](#footnote-10) – skills are highly correlated so it is unsurprising these effects are similar. However, they are not so correlated that it was not possible to include all three skills in one regression. In this case, the wage premia to each skill category was 7.8%, 7.6% and 3.7% respectively.

Figure 4.1 shows the estimated results for each country separately, looking at numeracy skills only. It compares this wage premia to that found in a standard earnings regression using years of schooling. Clearly, the two estimates are connected, although the correlation is not perfect.

*Figure 4.1 here*

The analysis also estimates a wage regression using both numeracy – as the proxy for cognitive skills – and the standard years of education. Including numeracy lowers the estimated returns to years of schooling from 7.5% to around 6% when all countries are included together, but the years of schooling measure remains significant. This could be interpreted as saying that a lot of the return to education isn’t about skill differences, and that the amount of education may also be capturing characteristics that employers care about which are typically found amongst the better educated, but which are not produced within education directly. On the other hand, it is possible that the test is not a perfect way of measuring an individual’s actual numeracy skills, and that this measurement error lowers the return on skills directly and allocates some of it to years of education. Just as likely is that there are other skills and abilities not captured by just looking at numeracy – for example, creativity or communication skills – which are also rewarded in the labour market. Hence, while including direct measures of particular skills gives us a partial insight into what the return to qualifications or the amount of education and training is capturing, it does not give us as unambigious a conclusion as similar estimates at the macro-level, whereas related research has shown that after controlling for a countries average level of cognitive skills, the effect of average years of education on growth vanishes (Hanushek and Woessmann, 2008)

**Interpreting wage equations: are they causal?**

*5.1 The ability bias problem*

Returning to the more conventional wage regression approach, perhaps the most substantial problem for labour market researchersis causality. The theory of human capital suggests that investment in education and training increases worker productivity, which raises demand for those workers, which improves wages. In the regression analysis shown in section 3, we observe a wage premium for workers with more education and training, holding all other sources of earnings difference constant, which would support the human capital model and indicate the extra productivity gained from investing in skills. However, it is not possible to control for all factors that affect wages, as some things are difficult for a researcher to observe (for example, an individual’s self-motivation or their innate talents). This becomes a problem when these characteristics are themselves correlated with educational attainment because those with higher earning potential due to unobservable characteristics tend to invest more in their education. In this case, education ceases to be an exogenous variable (as defined earlier in this chapter) Consequently, the researcher ends up attributing too much of the variation in wages to the educational attainment variable as it captures some of these other unobserved differences in workers.

To illustrate, suppose there are just two levels of ability – high and low – and that education has a constant linear effect that adds to this ability and gives the individual’s final productivity (and wage). Imagine education has been randomly assigned – that is, an individual of low ability is as likely to receive a given level of education as someone of high ability. We could collect data on education and wages and use a Mincerian wage equation to establish the effect of education on wages, as shown in Figure 5.1 (a) – notice the estimated (dashed) line has the same slope as the true relationships.

*Figure 5.1: Education, ability and wages*

However, if higher ability individuals complete more education and training than lower ability individuals (i.e. if educational attainment is determined, at least in part, by ability), then any observational data collected would have far less points in the top left and bottom right of the diagram, meaning there are just not that many high-ability, low-education or low-ability, high-education types in this labour market. Estimating a wage equation now would look like Figure 5.2(b) – the estimated line has a steeper slope than the true effect of education. This is known in the literature as ability bias and implies that the correlation between education and wages is not entirely causal.[[11]](#footnote-11)

Card (1999) provides a comprehensive survey of the various techniques used to deal with this issue. There are a number of approaches that have been used, for example twin studies (e.g. Ashenfelter and Krueger, 1994), instrumental variables (e.g. Angrist and Krueger, 1991; Card, 1993; Harmon and Walker, 1995) and natural experiments. What Card’s review suggests is that evidence from twin studies and instrumental variable estimates – which attempt to exploit a source of exogenous variation in schooling that is plausibly unconnected to ability to find the effect on earnings – is that estimates of wage premia are not very different from those found in simple OLS, and in many cases are actually larger. However, there are many studies which would imply the ability bias is large. For example, studies which include measures of prior ability have shown significant drops in the estimated effect of education and training on earnings. (Blackburn and Neumark, 1995; Blundell et al, 2000). Natural experiments around the effect of military service drafts or compulsory education laws show mixed results. Angrist and Krueger (1992) find large returns to education resulting from increased participation in education to delay Vietnam military service in the US; however Mouganie (2014) does not find such effects for peacetime conscription in France. Oreopolous (2006) analysed the students affected by the 1947 change in the age of compulsory education in the UK from 14 to 15 and finds a large return to the additional year of schooling possessed by students just after the law was introduced. However, Devereux and Hart (2010) found errors in this study, and using alternative data find a very small effect. This finding is consistent with other studies of similar law changes elsewhere, such as in Germany (Pischke and von Wachter, 2008).

 *5.2 Signalling and screening*

The ability bias problem is often conflated with a similar sounding but ultimately separate issue – that education is a signal, rather than a determinant, of an individual’s productive potential. In both cases, individuals may differ in their innate talents and abilities. In the problem discussed in section 5.1, employers are assumed to be rewarding these abilities with higher pay although the econometrician running a wage regression does not see this, and ends up predicting too high a return for human capital investments. It is also possible that employers are not better at discerning the unobservable productivity differences than econometricians are. In this case, more able individuals would want to signal their superior abilities to prospective employers – if they did not, they would end up being paid less than their productivity would deserve. Education and training may serve this signalling role (Spence, 1973), assuming that the effort and time-cost required to reach a certain level of educational attainment is greater for less able workers. In this case, more able workers might be able to pursue education that others would not find worthwhile (given the higher costs of completion) imitating. If employers recognise this signal, they would then increase pay to those completing higher levels of education and training. In the educational signalling model, acquiring more education has a causal impact on wages (those with the signal get paid more) but not as much of a causal impact on productivity, which is still, at least in part, dictated by the initial set of talents and abilities.

As a result, many of the approaches to deal with ability bias do not help distinguish between signalling and human capital explanations of wage premia to education and training. For example, if two twins acquire different levels of education, they will experience different wages in the signalling model, even though they have the same natural ability. The twin with more education will be paid the average productivity of his group, which on average contains more high ability individuals. The signalling model would suggest that one of the twins made a mistake – either the more educated one acquired a signal that was too costly for him, given the rewards or the other twin failed to acquire a signal that would have given them more benefits than its cost – but that is irrelevant for the final distribution of wages.

Similarly, proxying for ability makes no difference on the estimated return to education if employers are unable to see those same test scores. Instead, they base their wages on the signal presented to them at the point of recruitment. Moreover, the simplest version of the signalling model implies that employers have no incentive to seek out more information unless it is free, as wages adjust to reflect the average ability of the groups possessing the signal.[[12]](#footnote-12)

**The distribution of returns**

Much of the debate around the returns to skills, education and training has centred on the competing ideas of the human capital and the signalling model discussed in the last sub-section (see, for example, Chevalier et al, 2004). However, both of these theories are concerned with what is happening on the supply side of the labour market to determine wages – individual marginal productivity, whether determined by skill investment, prior ability or a combination of the two, is key. This tends to mean less attention is placed on the demand for skills. As Rubery (2006) argues:

"[H]uman capital theory provided a much more benign interpretation of the role of employers in shaping labour market outcomes; it placed the responsibility firmly back on the individual to develop their skills and productivity, with the apparent prospect that organisations would smoothly adjust their employment systems to utilise all new potential productivity on the labour market."

However, firms and employers can affect the productivity of workers– and hence the return to their investments in education and training – through the jobs they design and create, and the skills that are then needed and put to work (see, for example, the job competition model of Thurow, 1976). Of course, some jobs will require skills to be developed before recruitment, as in the human capital interpretation of educational wage premia. In other cases, skills may be developed on the job, either through formal training or working experience and more informal learning. Employers may then use educational signals as indications of suitability for learning the job once hired, and so prospective employers will invest in education to compete against other workers for the available distribution of jobs. As with the pure signalling model, this educational investment can lead to higher wages but not due to a premium paid to skills created through this investment.

Incorporating the demand side of skills has important implications for the discussion of the returns to skill investments. One of these is that once there are sufficient skills produced in the labour market to meet the existing demand, the distribution of wages can be fixed unless something changes on the employers’ side – for example, if a new production technology is adopted. Further skill investments beyond that point will tend to lead to under-utilised skills, which by definition do not attract any financial return, and may lower overall returns (including non-monetary returns) if they lower the life satisfaction of those who are working below their capabilities. By contrast, both the human capital model and the signalling model do not say anything about the phenomena of overeducation because all skills are assumed to be fully utilised.[[13]](#footnote-13) In the human capital model, any alteration in the supply of skills is brought into equilibrium through fluctuations in wages, at least in the short-run, because these skills are now less scarce (relative to the existing amount of capital, equipment and other factors of production that individuals work with). Similarly, increasing educational participation of lower ability workers in the signalling model reduces wages to that group because the value of the signal has been reduced. In the demand-constrained job competition model, however, there is no wage adjustment mechanism – instead, some educated, trained and skilled workers lose out and are pushed to instead find less demanding, less well-paid work.

Recognising this possibility is important for taking anything meaningful away from the many estimates of the return to education. Firstly, in the human capital model, wage premia can be interpreted as proxies for the greater productivity of skilled workers, and hence social value of skills. Moreover, if these premia do not fluctuate over time, this could be interpreted as saying that demand for these skills is keeping up with their supply, as is the often the case when looking at the returns to a university degree (see, for example, Katz and Murphy, 1992, for the US and Walker and Zhu, 2008; 2013, for the UK). In the job competition model, it would be more accurate to think about wage premia reflecting the average productivity of the jobs secured by one group compared to another. A constant premium over time, even when the supply of skills is increased need not mean there is an increasing demand – instead, individuals with more qualifications find themselves working in a wider array of jobs, but in doing so, they push out the less qualified. Consequently, the average wages and productivity of both groups fall which leads to stable wage differentials and increased levels of overeducation.

There will also be different effects on the distribution of returns around the estimated wage premium, which captures the average or expected wage benefit of making the investment. However, in a world with uncertainty, investors, including people investing in their education and skills, care about the spread of returns around this average and the probabilities associated with ending up at different points of this spread. In human capital theory, the distribution of wages for people who have made similar educational and training investments reflects qualitative (and potentially unobserved) differences in either their unobserved abilities or the quality of the educational institution or the specific types of skills produced by different courses at the same level. With enough data, this could be added into the calculation, leading to rates of return by subject of study or institution. Over time, the distribution of the return to a particular type of education or training may change if these things alter.. This might be because increased provision comes at the expense of teaching quality, for example, or because some courses grow more rapidly than others.[[14]](#footnote-14)

In the job competition model, the distribution of returns changes if the jobs offered by employers change, or if the amount of people with the comparable education and training increases. Specifically, if nothing else changes to the structure of jobs, increasing participation extends the distribution at the low end as people with those qualifications compete for a wider range of jobs from the overall distribution. The distribution will widen even if an expansion of that level of education or training was achieved without compromising the quality of provision or even the mix of skills.

From the perspective of public policy, it is the return to the marginal student rather than the average that is relevant – that is, the student who is on the cusp of participating or not participating. Carneiro *et al* (2011) have shown that the marginal returns to expanding US college attendance are far lower than the returns estimated from Mincerian wage equations, even when the return is estimated using sophisticated instrumental variable techniques (see section 5.1). Such a finding is also consistent with some of the natural experiments discussed at the end of section 5.1 where a policy shift that increases participation produces low or zero returns. Both sets are findings are predicted by the job competition model where the demand for skills and the structure of jobs are rigid.

**Workplace training**

Up until this point, this chapter has largely focused on the returns to skills which are, to varying degrees, general, in the sense that they might raise the productivity of workers across a number of potential employers, occupations or industries. Becker (1962) explained how such skills would be underprovided by employers themselves as they would worry that once they had made the investment, a different firm would poach the worker. Hence, either workers or the state should pay the cost of general skill investments, largely in primary, secondary and tertiary education.

However, individuals continue to invest in their skills beyond the formal education and training system. Becker argued that firms will provide training in specific skills – that is, skills which rival firms are unlikely to poach – but workers will likely be given a share in the proceeds of that investment in order to create incentives for them to stay in their current job so that the firm can maximise its own return on its skill investment. In this last section, we consider the return to these sorts of investments..

In theory, the methodological approaches and problems discussed previously to general education and training apply equally to workplace training. In a wage regression, the variable of interest will usually capture participation in some form of training or could measure the amount of time spent in a training programme, which leads to issues about what types and levels of skills are actually being measured. As before, there are issues relating to unobserved differences between participants and non-participants. Those who complete a training programme are unlikely to be a random selection of all potential trainees – they may be more motivated or have other abilities which both improve their future earning potential (even without the training) and make it more likely they participate in and complete training. Hence, simple estimates of the wage premium to training are affected by the same ability biases shown in Figure 5.1.

Unlike general education and training, individuals typically work before and after episodes of firm-based training. As a result, researchers can use panel data to attempt to deal with ability bias. Specifically, if we assume that the unobservable factors which affect wages and are correlated with participation in training do not change over time, then the change in wages before and after training for trainees compared to non-trainees would estimate the true return on the investment.[[15]](#footnote-15) , This approach tends to significantly reduce the measured return relative to a naïve regression of participating on wages. For example, Cedefop (2011) finds a significant wage premium across European data for employees who experienced some training in a 12 month period relative to those that do not – for men this was estimated as 9.6% using one data set and 15.5% using another, with 10.2% and 12.4% being equivalent figures for women. Once fixed effects were used, all estimates reduced and none remained statistically significantly different from zero.

This approach has been popular in the literature and has found significant, positive effects of training on wages (for a survey, see Leuven, 2004) To give one example, Blundell *et al*. (1996) find a cohort of UK males wages grow by 3.6% more between 1981 and 1991 if they have participated in employer-funded on-the-job training. For women, the premium was 4.8%. Moreover, for employer funded off-the-job training, the premia were 6.6% and 9.6% respectively. Similarly, Loewenstein and Spletzer (1998) found a 3.5% premium to participating in formal company training using US panel data. Note that the wage premia captured by these regressions typically represent a training period that can be measured in weeks, rather than years. Frazis and Loewenstein (2005) estimate (for their baseline specification) a wage premium of 4.5% for the median training period of 60 hours. This would imply rates of return that far exceed anything found in formal education – in this example, the authors calculate a rate of return of around 150%.

However, fixed effects regressions will not identify the true effect of training on wages if the unobserved differences between individuals are not the same before and after training (for example, if those who participate in training tend to have faster wage growth already). There is some evidence that this matters. Leuven and Oosterbeek (2008) use a unique survey that can identify those who wanted to participate in training but were unable to due to a random event from within the non-trained control group. This reduces the unobserved differences between those who receive training and those that do not. Doing this reduces the wage premium for participating in a training programme from 12.5% to a statistically insignificant 0.6%.

Some governments, such as that of the UK, are heavily involved in workplace training due to a concern that currently firms are underinvesting, which largely follows from some of the higher estimates of wage returns. Even if these estimates were true – and reasons to worry about them have certainly been advanced in this section – recognising the role of the demand side of the labour market when interpreting wage premia is as important here as I argued it was for formal education and training. When firms offer training, they are able to match up the programme with the specific skill requirements of the jobs their trainees will ultimately move into. If they do not have greater skill needs that would generate the greater productivity that allows for the payment of higher wages to try to retain those they train, they will not offer training. Hence, unobserved differences in the types of firms offering training to their employees is as important to consider as unobserved differences in individual abilities – so, for example, larger firms with hierarchies of increasingly demanding jobs tend to provide more training (to meet the needs of the different levels) and offer greater wage growth (through internal promotion of those who have sufficient skills to progress). If governments provide or subsidise additional training that firms would otherwise have not provided (as in the case of the UK Train to Gain scheme under the 1997-2010 Labour government), then they rely on something changing about the available jobs and the demand for skills. If it does not, which has been a concern about UK training policies that goes back at least as far as Finegold and Soskice (1988), then little wage return can be expected for participants. It is perhaps no coincidence that the estimate wage premia to the lower level qualifications which tend to accompany such schemes are essentially zero (Conlon, Patrignani and Chapman, 2011; McIntosh, 2006).

**Conclusion**

In principle, the individual rates of return to education and training are valuable pieces of information to have, not only for individual’s considering whether or not to participate in a particular programme, but also for policy makers and governments as a justification for public investment in skills. As a result, there is a huge array of studies which have looked to estimate them for all sorts of skill investments. This chapter has explained the main approaches employed to generate these estimates, and showed that a wide range of returns have be found over the past couple of decades, depending on country, level of education as well as methodological choices made by researchers. A lot of effort has gone into dealing with the issue of ability bias, but as this chapter has explained, no consensus exists of the size of this bias.

Whatever estimates result, however, are almost invariably interpreted through the lens of human capital theory, where the existence of a wage premium indicates additional productivity due to skill investment. Far too little attention is given to the possibility that the results of these regressions may actually represent a world where skill demands are relative constant and constrain labour market outcomes, so that the main function of education is to compete for whatever jobs the labour market is providing. However, in terms of the issues surveyed in this chapter, much of it can be well explained by this alternative view. Increased variability in the distribution of returns, coupled with low marginal returns would certainly be predicted by such a model. An inability to explain returns to education as solely being related to skill differences would also fit. Moreover, this model suggests that ability bias ceases to be the main omitted variable of concern – employer demand for skill and job design are far more relevant.

These issues should be a concern for individuals looking to make investments in skills – they still imply that private rewards exist on average for those that make investments, but they might be lower or more risky that currently assumed. From the perspective of policymakers, the problems are much greater, as they would mean that private returns cannot be easily equated to the broader benefits to society. This chapter has argued that when demand for skills do not increase in line with supply, estimated wage premia no longer indicate where further investment could raise productivity or reduce inequalities in the distribution of income, as the situation becomes closer to a zero-sum game. From there, it is not a large leap to argue that, at present, too much emphasis is placed on producing and reporting rate of return analyses whenever skills, education or labour market policy is being discussed. If they are not to be discarded entirely, at the very least they should be combined with a greater awareness of or – more preferably – a variety of additional evidence that speaks to the existing and future demand for skills.

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**Figures**

*Figure 2.1: Earnings differences by level of education and country*

Source: OECD
Note: Mean earnings relative to ISCED 3 and 4.

*Figure 2.2: Employment rate differences by level of education and country*

Source: OECD
Notes: Employment rates relative to ISCED 3A (upper secondary education). Differences are expressed in relative rather than absolute terms – e.g. If the two employment rates being compared were 80% and 90%, the difference would be 12.5%, not 10 percentage points. Missing data: Tertiary type B - Czech Republic, Poland, Portugal, Turkey; Lower secondary – Japan.

*Figure 2.3: Relative wages and tertiary education attainment*

Source: OECD (2014)
Notes: OECD averages marked on diagram

*Figure 4.1: Returns to schooling and skills*

Source: Hanushek et al (2013)

*Figure 5.1: Ability bias and the return to education*

High ability

Estimated returns

Low ability

Education

Wages

1. Estimated returns when education is not correlated to unobserved ability

High ability

Estimated returns

Low ability

Education

Wages

1. Estimated returns when education is correlated to unobserved ability
1. See, for example, Becker (1962), Schultz (1961) and Mincer (1958, 1970). [↑](#footnote-ref-1)
2. The International Standard Classification of Education (ISCED) had, in its 1997 version used in this chapter, 7 levels of educational attainment. Level 3 is, broadly speaking, the completion of an upper secondary education. For example, in the UK the completion of GCSEs or A-Levels would place a student at level 3 – the latter is given a higher status within the level due to the progression opportunities it provides to higher study. Level 4 qualifications are post-compulsory but pre-tertiary, such as the final stages of the German vocational education Dual system. Individuals below level 3 will typically not have completed compulsory education in most developed countries. Level 5 corresponds to the first stage of tertiary education (such as a bachelor’s degree or a higher vocational or professional qualification), while level 6 covers higher degrees such as Master’s or PhD qualifications. [↑](#footnote-ref-2)
3. ISCED 3 covers all upper secondary education. Level 3A are general education programmes (rather than vocational programmes) which allow access into tertiary education. 3B is the equivalent for vocational programmes, whilst 3C covers shorter programmes at this level that do not provide access to higher education. [↑](#footnote-ref-3)
4. There are a number of channels for this effect to take place, from the union effects on productivity for less educated workers through demands for more training, to solidaristic bargaining principles which pursue more egalitarian outcomes across covered workers. [↑](#footnote-ref-4)
5. The natural logarithm of wage is used as the dependent variable as it fits the data better for a linear function (i.e. a function that has the form Y = a + bX + cZ, where Y is the dependent variable and X and Z are explanatory variables). When log wages are used, the regression coefficients (b and c) approximately capture percentage increases rather than absolute increases in the dependent variable for a change in X and Z respectively. [↑](#footnote-ref-5)
6. Although if ethnicity was linked to migration it might not might not be – people may decide to migrate or not based on their expectation of the wages they will receive should they move to that country for work, meaning that those who expect higher wages - perhaps because they possess some skills in limited supply in the destination country – would be, on average, more likely to move. This would mean that the usual negative effect of ethnicity on wages might be understated. [↑](#footnote-ref-6)
7. For example, that forgone earnings are the only cost of spending additional time in education and training, and that individuals choose their education and training optimally so that the benefits of further human capital investment at that point are just equal to the cost of doing so. [↑](#footnote-ref-7)
8. We talk about expected net present value because there is some uncertainty around the realisation of the size of the benefits and costs, and the time period over which they will be enjoyed and incurred. For simplicity, these can be thought of as some form of average experience of an individual making the decision to invest in their skills. [↑](#footnote-ref-8)
9. This is from a mathematical result called the sum of an infinite geometric series. This is a finite series (as people do not continue to earn for ever) so the approximation is acceptable assuming T is sufficiently large that the discount factor has become close to zero. For example, if r = 10%, the discount factor for t=40 is 0.02, and beyond that it becomes increasingly small. [↑](#footnote-ref-9)
10. As scores are standardised in each country, these wage premia can be interpreted as the change in earnings from increasing skill by one standard deviation. To illustrate the size of this marginal effect, if skill was normally distributed, a one standard deviation increase is equivalent to going from the median to the 84th percentile of the distribution, or from the 74th percentile to the 95th. [↑](#footnote-ref-10)
11. Ability bias is a specific example of omitted variable bias. A similar problem is created when looking at the effect of having a particular level of education within a particular occupation. In this case, however, there is an selection bias which goes in the opposite direction to the more general ability bias discussed before. For any given occupation that requires some skill, those that have less observed education and training are likely to have a more natural ability in that specific job. If they had neither training nor natural ability, they would be very unlikely to be able to perform the job, at least not for very long. For those with more education and training, we are likely to see a range of personal characteristics. Some might be both well trained and have a range of personal characteristics that help with the job – these people are probably the most productive or capable workers, and likely command the highest wage. Others might be using the skills they acquired to compensate for lower natural abilities. The end result is that when looking at people with more or less education and training within an occupation, we are not comparing like-for-like. This pushes down the estimated return on education below the true effect that would be found if we were able to compare two groups of otherwise identical individuals.. [↑](#footnote-ref-11)
12. A more realistic model might suggest that matching particular types of individual to particular jobs is good for employers too, so that it is in their interest to find out individual abilities before hiring. [↑](#footnote-ref-12)
13. Overeducation is meant here to mean people participating in education and training longer than is necessary to perform their job. This is sometimes conflated or confused with other phenomena. For example, a person may have more qualifications than is necessary to acquire a job given the criteria set out by the hiring firm, but their additional abilities and skills may be useful once hired. This obviously depends on the nature of the work. A second phenomenon is where high qualifications are required to even get an interview for a job opening, possibly because prospective employees use educational credentials to compete for jobs and employers formally recognise this to reduce the applicant pool, but where the job requires far fewer skills than candidates possess. This type of situation would fit with our definition of overeducation, although workers may not consider themselves overeducated given that their education was a requirement of the job. [↑](#footnote-ref-13)
14. For the researcher, the observed distribution might change because the group is becoming more heterogeneous in terms of pre-education abilities but it should be noted that is less relevant for the individual concerned who presumably has some knowledge of their own pre-investment capabilities and considers returns from that starting point. [↑](#footnote-ref-14)
15. The specific technique used here is called fixed effect regression. [↑](#footnote-ref-15)