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Returns to Education: A Survey of Findings

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A Report

for the

Economic Research Unit
Welsh Assembly Government

May 2003

CONTENTS

EXECUTIVE SUMMARY

- Rapid increases in the supply of students at degree level would be expected to reduce rates of return to education unless matched by increases in demand for educated manpower, but will take some time to impact on the stock of such manpower. Much depends on whether quality has declined, so that the marginal student is less proficient than the average student.
- We need to distinguish between the rate of return (or premium to qualifications) which is the value placed on particular skills by the labour market, the private rate of return which takes into account the costs incurred by the individual and the social rate of return which takes into account the costs incurred by the state.
- The basis of rate of return analysis is the human capital model which may measure education by years of education or qualification dummies or a combination of the two. Qualification dummies allow for the possibility that education is used as a screening device. Rates of return may also be influenced by whether hourly, weekly or annual earnings are the unit of measurement and according to the quality of the degree or diploma and the institution from which it was obtained. But earnings will also be influenced by the structure of jobs and the location of employment. Indeed, some workers may be imperfectly matched so that their qualifications are either less or more than those which are strictly required to perform the job.
- Various biases may occur in estimating rates of return by the standard ordinary least squares (OLS) approach. Thus, the extent of schooling may itself be determined by the level of earnings that are expected to result from it. There may be ability bias, if the more able choose to have more schooling, which may be reinforced by parental and social background. There may also be other forms of measurement error. Some research suggests these effects may cancel each other out so that OLS estimates may not deviate too much from the true rates of return.
- Internationally the rate of return to education varies widely across countries and is in most but not all studies found to be higher for women than for men. It is, however, relatively stable over time. The UK generally has the highest rates of return among OECD countries at all levels of qualifications and this is the case both for private and social rates of return. These figures are high enough to support the view that investment in education is worthwhile both for the individual and the state. This is reinforced by the finding in a number of studies

that there is a positive relationship between increases in educational attainment and the rate of economic growth. However, we need to know more about the return to the marginal as opposed to the average student in order to establish whether further investment in education is called for.

- The relationship between educational attainment and economic growth is complex as it is difficult to disentangle the contributions at pre-school, primary, secondary and tertiary levels of education because of the sequential nature of learning. Indeed, performance tests on children less than two years of age are good predictors of eventual educational attainment, though subject to influence by parental investment in wealthier households. Skill biased technological change suggests that there may be major benefits from higher education, while at the other end of the distribution there may also be a substantial return from an investment in basic skills.
- In Britain too, rates of return have remained rather stable over time despite the rapid increase in student numbers, so that entry into higher education has proved to be a worthwhile investment in most cases, and this is particularly so for women. In contrast the rate of return is lower for members of ethnic minorities than for whites.
- The gender wage gap diminishes the higher the level of qualification, but even where women study the same discipline as men or obtain the same degree classification they earn less than men and these differences remain for more recent cohorts entering the labour market.
- There are also substantial differences in the returns to particular types of degree with business related degrees having much higher rates of return than other degrees, such as some of the humanities. Type of school may also impact on earnings independently of the quality of degree later obtained, as well as class size.
- Rates of return to academic qualifications are higher than those to vocational qualifications even where they are rated as equivalent under the NVQ framework.
- Because of differential impacts across the earnings distribution, education as a whole may serve to increase income inequality. As elsewhere, the private rate of return in Britain exceeds the social rate of return, which supports the argument for transferring some of the costs of education from the state to the individual.
- Analysis of the recent period up to 2001 using the Labour Force Survey suggests some decline in rates of return to education which have been greater for women

than for men. However, rates of return are still higher for women than for men. Rates of return to degree equivalent qualifications are lower than to degrees and have slipped substantially in the case of women. There are also substantial differences in the rate of return to particular types of degree, with high returns in degrees such as Computing and Law and very low returns in some Arts degrees.

- The general pattern of rates of return in Wales is similar to that elsewhere in Britain, but whereas Welsh men fare somewhat worse than their equivalents elsewhere, Welsh women fare rather better. Within Wales, there are also some differences in the degree premia at Unitary Authority level.
- With the transfer of some of the costs of education to students, private rates of return will decline, *ceteris paribus*, and when allowance is also made for progressive taxation the future private rate of return to certain degrees may well become negative. What would happen to the social rate of return with such a transfer of costs depends on the supply response in terms of numbers entering higher education, the demand response in terms of relative earnings and the consequent change in tax revenues. This makes it essential to monitor future trends in rates of return, differentiating between the case of the average and the marginal student.

RETURNS TO EDUCATION: A SURVEY OF THE FINDINGS

1. INTRODUCTION

There has been a substantial increase in educational qualifications in the UK, particularly at degree level, beginning in the 1970s, slowing in the 1980s and then speeding up again in the 1990s. The proportion of young people studying full time in universities increased from 13% in 1980 to 33% in 2000 (Walker and Zhu, 2003). Other things being equal we would expect such a rapid increase in supply to lead to a substantial fall in the rate of return to educational qualifications.[1] That this has not occurred is implied by the fact that the earnings distribution has widened, and particularly so at the upper tail of the distribution. Of course, the rate of return as measured relates to the stock of human capital, while the increase in the number of graduates refers to the flow of human capital. Since the stock is much larger than the flow it would take some time for the increased flow to impact on the rate of return to the stock of qualified manpower. Certainly there is no evidence from our data that the rate of return to the highly qualified is tending to decrease to any great extent, and for men rates of return to higher degrees have risen, when weekly earnings are used as the unit of measurement. This is consistent with a rapid growth in the demand for highly qualified manpower that has more or less matched the increase in supply. Therefore, the evidence is somewhat reassuring in relation to the intention to make students contribute to the costs of their courses on the basis that degrees offer a healthy rate of return in relation to lifetime earnings. However, those students entering higher education now cannot assume that the future will replicate the past. As Ashworth (1996) points out, three factors are important in determining the pay-off to future graduates, namely the future rate of economic growth, future changes in the relative earnings of graduates and non-graduates and differences between the average and the

[1] That substantial increases in supply can lead to falling rates of return to education is clearly shown in the case of Austria where the average return to an additional year of education fell from 9.4% in 1981 to 6.6% in 1997 for men, with the comparable figures for women being 11.3% and 6.6%. (See Festerer and Winter-Ebmer, 2003).

marginal student. Therefore, we should be cautious about the interpretation of summary measures of the additional income earned by a graduate over a non-graduate with two or more A-Levels. The Department of Education and Skills and others have calculated the lifetime earnings differential as £400,000 (see Greenaway and Haynes, 2003), but this likely to change over time. We would also expect changes to occur in the rates of return to lower level qualifications as increasing numbers tend to stay on in the educational system to acquire higher level qualifications. In so far as those choosing to stay on come from the upper end of the ability distribution or are more highly motivated, we would expect the mean level of ability and performance to deteriorate where lower level qualifications are the highest qualifications attained. However, the reduced supply of labour with such qualifications as the highest attained may offset any tendency for rates of return to decline here.

The returns to investment in education comprise three elements. First, there are private financial returns which accrue to the individual in the form of higher earnings and improved prospects of employment. Second, there are private non-financial returns which improve the welfare of the individual other than through increased income. These might include the consumption effects of education and subsequently more interesting work or better working conditions and greater enjoyment of leisure. As this is difficult to capture we do not consider it further here. The third element is the social return to education which involves the benefits accruing to others through positive externalities, such as higher rates of economic growth, improved citizenship and so on.

One way of measuring the benefits of education is to use the internal rate of return which compares the discounted flow of benefits and costs arising from such an investment. More precisely it is given by that discount rate for which the discounted present value of the

benefits net of costs equals zero. The resulting discount rate can then be compared with whatever discount rate is acceptable to policy-makers.

The true private rate of return to the individual should take into account taxes and transfers, so that post-tax earnings and costs minus subsidies or transfers are the relevant measures. In practice, most estimates of rates of return use pre-tax earnings and treat costs either as zero or limited to foregone earnings. They do not, therefore, accurately measure the gain to the individual of obtaining a particular qualification. Rather they estimate the value placed on that qualification in the labour market.

The social rate of return is provided by that discount rate for which the present discounted value of all social benefits equals the present discounted value of all social costs and, if estimated correctly, is the measure which should be used by policy-makers in determining how much to invest in the educational system. This includes all the direct costs of education, whether borne by the individual or the state, and pre-tax earnings. However, if there are positive externalities[2] such as a higher rate of economic growth the social rate of return will under-estimate the true net benefits of education as such externalities are not normally included in calculations. In practice, the social rate of return is found to be lower than the private because of the inclusion of the direct costs of education. The proportion of education costs financed by government ranges between 75 and 95% in most industrialised countries.[3] This reflects the risky nature of returns to education, the possibility that private individuals may under-invest because of their inability to diversify the income risk (Dutta, Sefton and Weale, 1999), and the possibility that individuals face liquidity constraints. However,

[2] For a full discussion of these see Weale (1993).

[3] Overall expenditure rates are difficult to obtain in the UK due to the absence of systematic accounting of private school expenditures. However, over a quarter of expenditure at the secondary school level is accounted for by private schools (Dutta et al., 1999). Since private shares are likely to be lower at the primary level and given that Blöndal et al., (2002) suggest that in 1998 public financing of tertiary education in the UK was about 75%, the UK figure is likely to fall within the lower end of the range indicated above.

evidence produced by Caneiro and Heckman (2002) suggests at least for the US 8% at most of young persons are subject to short-term liquidity constraints which affect their schooling at the tertiary level.

In this survey we first examine theoretical and methodological issues surrounding rate of return estimates. We then examine international evidence on rates of return including the impact, if any, on the rate of economic growth. We then consider estimates carried out for Great Britain. Finally, we produce new evidence-making use in particular of the Welsh booster to the Labour Force Survey.

2. THEORETICAL AND METHODOLOGICAL ISSUES

The basis of rate of return estimates is the augmented Mincer model as outlined in the Technical Appendix. This explains the log of earnings in terms of either years of education or educational qualifications, experience measured in quadratic form to allow for the inverted U shaped nature of experience (or age) earnings profiles and a group of other explanatory variables based on the availability of variables within the particular data set used. Frequently these include variables relating to the nature of employment by industry and size of firm etc. and more rarely some measure of individual ability.

Two immediate issues arise with respect to the measurement of the schooling and experience terms. In the US, there are practical reasons for using years of education as this has been the form in which schooling is measured in the major data sets there. Harmon, Oosterbeek and Walker (2003) also point out that schooling in the US is not based on a national or state system of credentials, but has the feature that grades generally follow years, so that in practice education is a fairly continuous variable, at least up to the level of high school graduation. The imposition of a linear specification is, however, highly questionable, particularly in the European context, and in practice many studies substitute educational qualification dummies for years of education which allow for a non-linear relationship.[4] Recent studies using the so called sheepskin model[5] include both years of education and qualification dummies (see, for instance, Belman and Heywood 1991 and 1997, Hungerford and Solon, 1987, Jaeger and Page, 1996, and Park, 1999). These generally find that returns to

[4] Harmon et al. (2001) note that if the marginal return to a three year degree programme compared to leaving school with A-levels is approximately three times the estimated return to a year of A-level schooling then a linear specification is equivalent to one based on credentials. They argue that "the underlying assumption of linearity, while a strong assumption is nonetheless remarkably hard to reject" (p13). However, Walker and Zhu (2001) tested the linearity restriction using the LFS (with dummies for long degree programmes, gap years and early achievement) and found that this restriction was soundly rejected by the data for women and marginally so by the data for men. This also points to the need to undertake separate estimations of rates of return for men and for women.

[5] Sheepskin effects are returns specific to educational credentials in contrast to accumulated years of education. The origin of the term is found in the Asian tradition in the second century BC of presenting diplomas in the form of parchments made out of sheepskins.

education are significantly higher in years in which qualifications are normally attained, consistent with the view that part of the return is due to signalling or credentialism. However, even given the presence of sheepskin effects there are a number of possible interpretations of this outcome in addition to the screening hypothesis, which suggests that education is simply used as a filter to identify high capacity individuals.[6] Thus, Chiswick (1993) argued that drop-outs may be inefficient learners who realise that staying on in the education system will do little to improve their potential capacity. Similarly, graduates may be overwhelmingly efficient learners who complete their studies precisely because they believe further education will raise their productivity and hence earnings. Such studies require direct information on both years of education and diploma attainment if they are to obtain unbiased estimates, since some individuals may fail to obtain the qualifications for which they are registered and others may take either shorter or longer periods of time than the norm to obtain a particular qualification. Not all data sets provide such information. For example, the UK Labour Force Survey only allows one to infer the years of education of any individual from the age at which that individual left full-time continuous education, which will provide inaccurate data for those who interrupt their schooling. In one of the few studies able to divide actual years of education into different components, Groot and Oosterbeek (1994), using Dutch data, were able to identify effective years, repeated years, skipped years, inefficient routeing years and drop-out years (i.e. ones in which no diploma results). This classification proved to be statistically superior to the more usual classification of actual and effective years of schooling. The finding of negative effects of class skipping, the neutral

[6] The term sheepskin effects, credentialism, signalling and screening tend to be used inter-changeably. Johnes (1993) distinguishes however, between two distinct models. First assume there is only one task to be performed, but some workers are more productive than others and the level of educational attainment is a good predictor of this. Rather than pay a wage equal to the average marginal revenue product (MRP) of the workforce, the employer may pay each worker the value of his or her own MRP, leaving output unaffected but changing the allocation of rewards to workers. This he refers to as the signalling model. If we now assume there is a range of tasks and again that educational attainment is a reasonable proxy for expected productivity, then education is likely to be used by employers as a means of sorting (or screening) workers into different tasks. This, Johnes refers to as the screening model. Since in this case workers are allocated to tasks where they are more efficient output rises, so that screening has a socially useful role, though the question remains whether education is the cheapest type of screen available. The signalling model can be regarded as a special case of the screening model.

effect of repeated years and the positive effect of drop-out years are consistent with the human capital theory, but not with the screening hypothesis which would lead one to expect a positive effect from class-skipping and a negative effect from both repeated years and drop-out years.[7] In general, UK data sets do not enable one to conduct a similar analysis to this Dutch study.

There are also issues related to whether one should use hourly, weekly or annual earnings. Since individuals with higher earnings potential tend to work longer hours one would expect the measured rate of return to education to be higher for annual and weekly earnings than for hourly earnings. Thus, using US data, Card (1999) found that for men there was a difference of 4.2 percentage points in the rate of return between hourly and annual earnings, while for women the corresponding figure was 5.6 percentage points. Further, few data sets allow one to control for the quality of a particular qualification, which can vary according to the grading or the institution from which it was obtained, or the type of qualification (e.g. a humanities degree is likely to be valued less in the marketplace than a business-based degree). Thus, Battu, Belfield and Sloane (1999) found that class of first degree had a significant effect on graduate earnings up to eleven years after graduation, with a first class degree having a premium of between 8 and 13% over a lower second class honours degree. Similarly those graduating from a long established university earned between 8 and 11% more than those graduating from universities which were formerly polytechnics.

As noted above experience is included in quadratic form in the Mincer model in order to capture the inverted U-shape nature of the relationship between log of earnings and experience (or age, which is often used as a proxy). In some formulations tenure is added (also in quadratic form) to capture the acquisition of specific as opposed to general skills.

[7] Drop-out years would provide a signal of leaver ability if they were the result of poor examination performance, whereas under the human capital model each year of education increases the amount of human capital and attracts a return.

Where data are not available on actual experience this is often replaced by potential experience (measured as age minus years of education minus pre-school years). However, while this may be a reasonable proxy for men, for married women this can give highly misleading results as a consequence of time spent out of the labour force. In an attempt to overcome this problem several studies use a measure of imputed work experience, which in essence uses the determinants of participation based on one particular year to predict a woman's probability of participation for each of the post-schooling years. This provides an imputed cumulative measure of potential experience. This has been found to be a better proxy than potential experience, but its performance is dependent on the specification of the initially estimated employment model which is the basis of its construction and also on the cohort adjustment procedure which is utilised (Skatun, 1998).

The Mincer human capital model in its simplest form is entirely supply side driven, but there is substantial evidence that the level of earnings can be substantially influenced by the location of employment. Thus, Krueger and Summers (1986) find that the pattern of inter-industry wage differentials across countries appears to follow a regular pattern with manufacturing industries tending to pay about 20% more than service industries for comparable workers. Similar regularities are found for gender, age group and occupation. In contradistinction to the above Thurow (1975) argued that the demand side of the market was the major determinant of relative earnings. His job competition model (see the Technical Appendix) assumed that employers used personal characteristics including education as a criterion or screen for hiring workers on the supposition that employing more educated workers in a job would require a lower investment in training by the firm. In the extreme case education simply serves to obtain a job and there is a zero return to surplus human capital, as all workers in a given job are paid the same wage. This model is consistent with the screening hypothesis. Brown and Sessions (1998) identify two versions of this. The

strong screening hypothesis (SSH) presumes that productivity is immutable and screening is used exclusively as a signal. In contrast, the weak screening hypothesis (WSH) simply holds that while the primary role of education may be to act as a signal, it can also serve to augment inherent productivity. If it were true that the only purpose of education was to provide signals to potential employers of the employability of certain individuals, this would raise serious questions about the appropriateness or otherwise of public investment in education. Thus Brown and Sessions suggest

> "If evidence is found in support of the SSH then student centred funding policies are justified because there is a divergence between the private and social marginal benefit of higher education. If, however, evidence is found in support of WSH then the debate should centre upon which certificates are typically acquired as screens (and perhaps have little affect on productivity) and which augment productivity to a greater extent. Finally, if evidence is found to reject screening in favour of human capital theory then student-centred funding may be criticised since increased productivity via increased education represents both an individual and social benefit", (page 587).

Since they find evidence for WSH rather than SSH, it is the degree to which the costs of education are shared between the taxpayer and the student which is the central issue here.[8]

The Mincer and Thurow models are better seen as special cases of a more general problem of matching individual workers to particular jobs. This is illustrated in the job assignment model, associated with Roy (1951), Tinbergen (1956) and Sattinger (1993) and based upon the proposition that there is an allocation problem in assigning heterogeneous workers to jobs which differ in their complexity. (See Technical Appendix)

Recently a number of studies have focused on the fact that not all workers with particular qualifications may be able to find employment which actually requires the level of education they possess. Imperfect matching may take two forms – workers may be *over-educated*

[8] Their test is based on the hypothesis that screening will not be relevant in the case of the self employed, if they have planned to became self employed, which seems in practice to be fairly common. According to the WSH version the rate of return to education should be significantly higher to the employed relative to the self employed. In the SSH version there should be no return to education for the self employed. Their analysis of the British Social Attitudes Survey finds higher returns to employees for qualifications, for degrees and A-levels, but lower returns for O-levels and GCSE/CSEs.

meaning that the requirements of the job imply a lower level of qualifications than they currently possess or *under-educated*, implying that the job requires a higher level of education than they currently possess. A number of studies in several countries[9] have found that there are certain stylised facts. The rate of return is highest for those who are properly matched, while those who are over-qualified earn more than those who are properly matched in the job they currently occupy but less than those with identical qualifications to themselves who are properly matched. Similarly, those who are under-educated earn less than those who have the required level of education in the job they currently occupy, but more than those with identical qualifications to themselves, who are properly matched in a job with that lower level of qualifications.[10] If as a consequence of an expansion of education the mean educational level of workers rises without a corresponding rise in the educational requirements of jobs, we would expect the rate of return to education to fall.

In a recent paper Chatterji et al. (2003) model signalling as a form of over-education in which firms set job requirements higher than those strictly necessary to perform the job in order to lower supervision and monitoring costs (essentially an efficiency wage argument). On the workers' side signalling enables them to obtain a job higher up the job hierarchy. The effect appears to be stronger for women than for men.

A great deal of the literature has focused on how to deal with various biases in the estimates that are likely to result if reliance is placed simply on ordinary least squares (OLS) estimation. These include the endogeneity of schooling, ability bias, sample selection issues, publication bias, and measurement error.

[9] A survey of such studies can be found in Sloane (2002).
[10] Attention should also be paid to the type as well as the level of qualification obtained. McGuinness (2003) notes that the existence of a raft of graduate conversion programmes in Northern Ireland suggests that policy-makers recognise that labour market mismatches can occur at degree level where the degree obtained does not match the requirements of employers.

In the standard OLS approach the quantity of schooling is exogenous (or determined by factors outside the model). However, if schooling results in higher earnings, these higher earnings may themselves result in an increase in the amount of education consumed and this is more likely the higher the ability of the individual (which is referred to in the literature as endogeneity bias). One way of dealing with this is to find real world events that can assign individuals to randomly different treatments. This requires a suitable instrument for education which is uncorrelated with earnings. Thus, Harmon and Walker (1995) compared the earnings of those who left school at 16 when the minimum school leaving age was raised to 16 with those who left school at 15 just before the minimum school leaving age in Britain was raised in 1973. One can then compare the effect of an extra year's schooling on those who would not have chosen it with the effect on those who would have chosen it. An alternative is to group observations according to childhood smoking behaviour on the grounds that those who choose to smoke at an early age have a higher discount rate in terms of time preference than those who do not (Chevalier and Walker, 2000). A schooling equation is then estimated and the predicted values from this are then inserted into the earnings function in place of the actual schooling levels to produce unbiased estimates. The evidence is that such an instrumental variable (IV) approach produces much higher estimates of the rate of return to education than the standard OLS approach, However, if one believes that OLS imparts an upward bias through omitted ability one would expect the IV estimates to yield lower rates of return not higher. Card, (1999) suggests these findings should be treated with care and that part of the explanation for this finding might be that the marginal returns to schooling for certain groups, including those who are both disadvantaged and have low educational attainment, are higher than the marginal returns for the population as a whole. This could occur if low income families were credit constrained, so that at the margin returns to schooling should be higher for this group as they are investing a sub-optimal amount in their own education. In fact Caneiro and Heckman (2002) find no evidence that

this is the case in practice. Further, they argue that most of the instruments used in the literature are invalid, often being correlated with schooling and ability. Further, when one allows for the fact that constrained individuals may select low quality schools and have a lower rate of return to education rather than a higher one the instruments may themselves be determinants of potential earnings. This points to the need to treat IV estimates of the rate of return to education with a degree of caution.

Most data sets do not contain information on ability, so that ability bias is in these cases a type of omitted variable bias. One exception is the National Child Development Survey (NCDS) which analyses periodically a cohort of individuals born in 1958. So far there have been 5 waves with the last of them in 1991 when the cohort members were 33 years of age. The survey includes measures of both reading and mathematical ability.[11] Other data sets sometimes have a direct measure of IQ, but evidence regarding the relationship between intellectual capacity and earnings is not entirely consistent (Zax and Rees, 2002). This is at least in part because economic success depends on the context in which the individual is placed , including family, school and community background, as well as on the work effort expended.[12] Using the Wisconsin Longitudinal Study with waves in 1957, 1964, 1975 and 1993 Zax and Rees find that when controls for family and high school background are introduced into their model the estimated effect of IQ on earnings is dramatically reduced, and the introduction of high school class rank reduces it still further. Indeed, as 85% of the variation in earnings at age 35 and 75% of it at age 53 is independent of explanatory variables

[11] Thus, in one such study based on the NCDS Currie and Thomas (1999) examined the relationship between mathematics and reading test scores at age 7 and earnings at age 33. Their results imply that a one standard deviation (SD) increase in the mathematics test score is associated with 7.6% higher earnings, while a one SD increase in the reading test performance is associated with 8% higher earnings.

[12] Using the NCDS Robertson and Symons, (2003) find strong evidence for the importance of peer groups, parental social class and parental academic achievement on future earnings. Zimmerman (2003) used data on room-mates at Williams College and found there is a link between academic performance and SAT scores of room-mates, who are randomly assigned. Peer effects are almost always linked more strongly with verbal SAT scores than with maths SAT scores. Students in the middle of the SAT distribution were found to perform worse if they shared a room with a student who was in the bottom 15% of the SAT distribution, though the effects were not large.

included at age 18, there is plenty of scope for individuals to overcome any deficiencies in their own endowments and environment or fail to gain when these are favourable. The importance of personality traits is also emphasised by Cawley, Heckman and Vytlacil, (2001). Excluding human capital measures they find that measured cognitive ability can explain between 14 and 20% of the variance in earnings, but when controlling for human capital measures this falls to between 0.7 and 2.7%. This difference is the result of personality and social skills, which are strongly associated with future educational attainment. The rate of return to ability also varies across different race and gender groups, with black females having the highest return followed by Hispanic males.[13] Unfortunately, there are no similar studies to these two US studies for the UK. However, it does seem clear that social skills are very important in determining future employment and earnings opportunities. This may explain why parents are prepared to invest large sums in the private education of their offsprings.

As Card (1999) observes, there is a long tradition of utilising family background data such as father and mother's educational attainment to control for unobserved ability. There is indeed, a high correlation between children's educational attainments and those of their parents.[14] Data from the US General Social Survey (GSS) suggest that each additional year of education of a parent raises completed years of education of a child by 0.4 years, and no less than 30% of the variation in education is explained by parental education.[15] Similar relationships have been found in the UK (see for instance, Dearden, Machin and Reed, 1997). An alternative to the above is to focus the comparison on siblings or twins as these are more alike than randomly drawn individuals, enabling one in theory to eliminate omitted variable bias. This procedure is more plausible for identical twins who share the same genetics and the same

[13] This may simply reflect the fact that returns to low ability are lower for these groups, so that we cannot infer that there is discrimination in these cases.
[14] Lemke and Rischall (2003) find that when the wage equation includes skill and parental income instrumenting with parental education produces lower IV estimates than OLS in line with prior expectations.
[15] The GSS has ability measures of the respondents based on reasoning abilities and vocabulary tests.

family background. However, twins may represent a quite distinct population grouping and often sample size is small (see Ashenfelter and Krueger, 1992). Even where sample size is larger (as in Miller, Mulvey and Martin, 1995) a substantial proportion of the sample of twins report the same level of education, thus frustrating the experiment. Thus in the one substantial study of UK twins (Bonjour et al. 2002) it was found that 55% of the twin pairs had the same education years. This study is based on 6,600 individuals (3,300 same sex, female pairs), but only 214 identical twins pairs have complete wage and schooling information. They attempt to correct for ability bias, given that ability is influenced by more than just genes, by using a number of instruments.[16] They conclude that ability bias raises their pooled estimates, that measurement error biases their estimates downwards and that the returns to education of 7.7% are very similar to those obtained from OLS, suggesting that ability bias and measurement error cancel each other out.

Another issue which is not very often addressed in the literature is self selection into employment. If the characteristics of those in gainful employment are different from those who are out of the labour market this may produce inconsistent estimates, particularly for women. In practice, sample selection does not appear to greatly affect the estimated rate of return (see Dearden, 1999 and Chevalier and Walker, 2001). The Heckman-correction for dealing with sample selection requires a valid exclusion restriction, as well as a continuous variable, but in order to ensure identification unearned income is often used for this purpose, though this can be problematical in a life cycle context. An alternative is to estimate median regressions, as the median is unlikely to be influenced by any truncation of the sample. Finally, the questions of measurement error and publication bias need to be addressed. In the former case Card, (1999) suggests that research over the previous three decades points to the reliability of self-reported schooling being no more than 90%. In the latter case Ashenfelter,

[16] One of their instruments is smoking, as used in other studies to which reference has been made, but they reject the view that smoking is a valid instrument for education and suggest it is more likely to reflect family background rather than the discount rates of individuals.

Harmon and Oosterbeek note that reporting bias is likely to be common because of the tendency to report only those statistical results that reject the hypothesis of no effect. In practice, however, they find that this does not distort results to any great extent. As a postscript, perhaps the correct inference to be drawn from all of this is as Card observes that "the human capital earnings function is alive and well", and reliance on OLS estimation is not likely to produce estimated rates of return that differ too much from the true rates.

To summarise, it would appear that the traditional human capital model holds up quite well. Screening is non-negligable but not substantial enough to overthrow the human capital model. The various biases referred to appear roughly to cancel one another out, so that OLS estimates are reasonably reliable. There is also a positive return to job matching.

3. INTERNATIONAL EVIDENCE

Recent relevant surveys include Harmon, Walker and Westergaard–Nielsen, (2001), Trostel, Walker and Woolley, (2002), Sianesi and Van Reenan, (2000) and de la Fuente and Ciccone, (2002). An extensive coverage is found in Trostel et al. who estimate the rate of return in 28 countries using comparable micro-data over the period 1985 to 1995 based on the International Social Survey Programme. As shown by the OLS results reproduced here as Table 1 there is considerable cross country heterogeneity, with the rate of return to men ranging from 2.3% in Norway to 17.4% in Northern Ireland, while for women the equivalent figures are 1.9% in the Netherlands and 19.2% in the Philippines. Overall the mean rate of return is higher for women at 5.7% than for men – 4.8%.[17] Instrumental variable estimates are then derived using spouse's education as an instrument for education and suggest that if this is a valid instrument we can add a percentage point or so to the above rate of return estimates. As the authors note, much of the cross-section variation in the rate of return to education "defies ready explanation". However, countries with the highest rate of female participation (such as the Scandinavian countries) have the lowest differences in schooling returns between men and women, whilst countries with the lowest participation have the largest differences.

As important as the level is the trend in the rate of return to education. Much of the literature making international comparisons suggested until comparatively recently that the rate of return was rising over time as a consequence perhaps of technology requiring more high level skills. However, Trostel et al. find no evidence for this, if anything there is a slight decline over the decade from 1985 to 1995. We, of course, must allow for the rapid increase in the numbers gaining educational qualifications in many countries over the recent past in attempting to evaluate the long-run return to education. Recent data for 1995 – 2000 show

[17] The higher return for women relative to men occurs despite the fact that the absolute return to education is higher for men. It indicates that earnings for the un-educated are substantially lower for women than for men. Nonetheless more education for women will tend to narrow the gender pay gap.

that enrolments in tertiary education in OECD countries have gone up by 25% over this short period and this is entirely due to changes in enrolment rates as opposed to changes in population (Table 2).

The regression based rates of return reported above do not take into account the costs of education, though they are able to control for factors other than educational attainment that affect earnings which are neglected in internal rates of return estimates. A detailed analysis of both private and social internal rates of return to education at the upper-secondary and tertiary levels in OECD countries has been carried out by Blöndal, Field and Gronard (2002). They note that net benefits are strongly influenced by policy-related factors such as study-length, tuition fee subsidies and student support grants, so there is little reason to expect internal rates of return to be similar across countries given differences in policies towards these aspects. Thus foregone earnings are influenced by course duration which is much longer in some countries than others, being 3 or 4 years in the UK compared to 6 or 7 years in Germany. Private tuition costs tend to be low in most European countries because of public subsidies. Similarly, financial support to students in the form of grants and favourable loan support is more generous in some countries than others. The net gains to individuals, i.e. the comprehensive private internal rate of return, summarised in Table 3 for ten countries for post-compulsory education ranges between 9 and 19% with the UK and US having higher rates than elsewhere.[18] In some cases adjusting for taxes, unemployment risk, tuition fees and student support increases the internal rate of return because public benefits outweigh taxes, but in the UK the difference between the narrow and comprehensive rates is much smaller than in some other countries. Because of the difficulties of estimating comprehensive

[18] In the comprehensive form of the private internal rate of return the costs incurred include tuition fees, foregone earnings net of taxes, adjusted for being in employment minus grants and loans made available to students. The benefits include the increase in post-tax earnings as a consequence of education, adjusted for higher employment probability, minus the repayment, if any, of public financial support during the period of study. The calculations assume full-time study, successful completion of the course and no earnings during the period of study.

social rates of return Blöndal et al. limit themselves to the narrow definition which does not incorporate externalities or non-economic benefits and assume that any wage gains from education represent associated productivity gains (Table 4). Reflecting the fact that social costs exceed private costs of education through the use of educational subsidies social internal rates of return are generally much lower than the private rates. Nonetheless, they are typically well above 5% in real terms both for upper secondary and tertiary education, suggesting that public investment in education is worthwhile, and this is particularly so in the US and UK. Indeed the presence of super-normal returns might indicate that there is a disequilibrium in the educational market or a situation of temporary excess demand, with the expectation that in due course returns to education will decline to match returns on other productive assets. However, an alternative possibility is that returns to marginal students with less ability and motivation are much lower than returns to the average student, so that the market is in fact in equilibrium. The recent over-education literature suggests that the latter interpretation may in fact be correct.[19]

Macroeconomic models of growth have found a significant role for human capital in explaining economic development. The augmented Solow neo-classical model extends the basic production function approach by incorporating human capital as an additional input. The more recent endogenous growth theories model the investment in education more explicitly by relating technological change to the stock of human capital. One important difference in these two approaches is that, whereas in the neo-classical model a one-off increase in the stock of human capital results in a one-off increase in the rate of economic growth, according to the new growth theories this results in a permanent increase in the rate of economic growth.

[19] Returns may be lower also for older individuals undertaking educational courses as they will have a shorter period to amortise their investment costs as their remaining working life shortens. Blöndal et al. estimate, for instance, that the private internal rate of return for older men in the UK aged 40 is 11.1%, for those aged 45 – 8.8% and for those aged 50 – 5.5%.

There is now a sizeable literature focusing on externalities arising from increases in human capital. Workers do not in general work autonomously, but in teams, so that the productivity of an individual worker may be related to the level of education of co-workers. Organisational cultures associated with high performance management may depend on the average skill level of the workforce being high. Skill complementarity, information-sharing and informal training by co-workers can all lead to improvements in productivity. The possibility of positive spillovers is at least indirectly suggested by evidence of positive clusters of high skilled professionals with high skilled non-professionals in the U.S. (Bronars and Famulari, 1997); a positive association between increasing proportions of skilled workers in a workplace and earnings (Troske, 1999); a positive correlation between individual earnings across all workers and the educational qualifications level of a region (Rauch, 1993); a brain drain of educated workers to areas where there are high intensities of other educated workers (Borjas et al., 1992); and substantial unexplained firm-level heterogeneity in earnings (Bayard and Troske, 1999). Battu, Belfield and Sloane, (2002) found using a matched employer-employee sample from the 1998 British Workplace Employment Relations Survey (WERS) that workplace education levels had strong effects on the earnings of individual workers independently of the effect of those workers' own education. Thus, in one formulation an increase of one standard deviation in the level of education across the workplace was predicted to lead to an increase in earnings for the average individual worker of 11.3%. The OECD (1998) also identified more indirect externalities arising from increases in human capital across the economy. This can lead to better public health and parenting, lower crime, an improved environment and greater social cohesion, amongst other things. These improvements themselves can feed back into higher rates of economic growth. The extent to which these effects take place is, however, very much dependent on the stage of a particular country's economic development and on the level at which education expansion

is concentrated, with tertiary education being more important in developed countries and school education being more important in developing countries.

There are a number of methodological issues which arise from aggregate studies of education and economic growth (Sianesi and Van Reenan, 2003). The measurement of human capital is often based on inputs rather than outputs, on formal education to the relative neglect of informal education or on-the-job training and without considering the quality of education. Further, the possibility of reverse causation must be considered. Given, in particular, that the demand for education is likely to include an element of consumption, its income elasticity may be high, so that growth leads to an increase in the demand for education as well as an increase in its supply. Available evidence suggests, however, that increases in human capital are associated with increases in investment in physical capital, with faster adoption of new technologies and with reduced fertility and hence lower population pressures. Sianesi and Van Reenan summarise the results of cross-country studies as a whole as implying that a one percentage point increase in the level of school investment will lead to an increase in per capital GDP of between one and three percentage points, while an increase in the stock of human capital in the population as a whole by one year will lead to a one percentage point faster rate of economic growth. De la Fuente and Ciccone (2002) find that an extra year of intermediate education increases aggregate productivity by 5% immediately and a further 5% in the long-run as a consequence of the adoption of new technology and the continuous improvement in existing production processes. On the most plausible assumptions they estimate that in a typical OECD country human capital accounted for 22% of productivity growth between 1960 and 1990 – a comparable figure to that for physical capital. A recent study by Bassanini and Scarpetta (2001) suggests that earlier failures to find a positive effect of human capital on growth may be a consequence both of data deficiencies and the econometric techniques used. Their own study uses a panel of 21 OECD countries (including

the UK) over the period 1971 to 1998. The main advantage of using panel data is that one can control for country specific effects. Their sophisticated estimation technique also allows short-run coefficients, the speed of adjustment and error variances to differ across countries. Their results point to a positive and significant long run effect of an additional year of education on output of about 6%, which is in line with micro-economic evidence in the private returns to schooling. Further, though the results do not support the human capital augmented versions of the Solow model, they do support an endogenous growth model with constant returns to scale.

To summarise rates of return to education are higher in the UK and US than in other OECD countries. This is not a consequence of lower returns at the upper secondary school level as these are also relatively higher. Earnings differentials and the length of education are generally the prime determinants of the private internal rate of return and together these factors tend to be favourable in the UK and the US relative to many other countries. The high rate of return to education in the UK sits uneasily with the lower rate of labour productivity observed in relation to some European countries and is likely to be explained by differences in the stock of physical capital. Given uncertainties about the relationship between rates of return to average and marginal students we cannot infer that there is an under-investment in education in the UK or the US, but as technological change tends to have a skill bias literacy and numeracy are likely to become even more important factors in determining pay and employment. A robust finding is that the human capital model appears to work in all countries.

4. PREVIOUS STUDIES IN THE UK

The U.K. has a number of data sets which enable us to estimate the rate of return to education. These include the Labour Force Survey, the British Household Panel Survey, the General Household Survey, the National Child Development Survey, the Family Expenditure Survey and the Family Resources Survey. These are summarised in Annexe 1.

Looking first at cross-section results for rates of return as a whole Walker and Zhu (2001) summarise earlier studies as suggesting that

> "the finding that more educated people have higher earnings seems a strong and robust feature of the OLS literature. Despite the differences in specification and time periods covered the estimated size of the effect of years of education in the OLS studies lies within a relatively narrow range – all but two studies for men lie within the 4.1 to 6.1% range. However, there is less agreement about the effect of qualifications across studies.
> There is also some agreement that (the few U.K.) IV estimates …….. are higher than OLS." (page 22).

Their own hourly earnings OLS estimates of returns to years of education over the period 1993 to 2000 yield an average return of 8.4% for men (with a range between 8.1 and 9.4%) and 7.7% for women (with a range from 7.2 to 7.7%). Dearden (1999 a and b), using NCDS hourly wage data for 1991, finds, however, considerable heterogeneity in the estimated return to an extra year of education and argues that in the U.K. context it is essential to examine qualifications rather than years of education. Her results show that individuals with qualifications have significantly higher returns than those with equal years of education but no qualifications, consistent with the presence of sheepskin effects.[20]

There is a consensus that rates of return over time have not changed dramatically. Thus, Walker and Zhu conclude that return to men have changed little over the period 1993 to 2000, but that there is a slight fall in the return to women of about –0.9 percentage points. Chevalier and Walker (2000) using FES hourly wage data over an earlier period 1978 – 1995,

[20] Further, she finds that with all ability and family background controls included in her model the estimated return to an extra year of full-time education for men is 4.8%. This is significantly lower than the raw return of 8% and about 30% less than the estimated return of 7.2% when only controlling for age and region of residence, which are the typical controls used in most OLS estimates of the rate of return to education.

report that for men there is a modest, but significant trend increase in the OLS returns of approximately 0.07% per annum

A number of studies have focussed on rates of return to degrees. Alternative possibilities are to compare the return to a degree with those resulting from A levels or with those without qualifications. These can give different results over time if the return to A levels are unstable. Thus, Harkness and Machin (1999), who compared the earnings of degree and higher vocational qualification holders with those of the less qualified over the period 1974 to 1995, using General Household Survey data, report that the biggest increases in education based wage premia occurred relative to the no qualification group. More particularly, the degree/no qualifications wage differential rose twice as fast in the 1980s as the degree/A levels and the degree/no degree premium, whereas in the 1990s the degree/no qualifications wage differential continued to rise, as the degree/A levels differential stabilised. They also found that female graduates improved their relative wage position by more than men from the beginning of the 1980s, pointing again to the need to examine rates of return separately for men and for women. Their results are consistent with the presence of skill biased technological change with advances in technology increasing the demand for skilled workers relatively to that for the unskilled, and particularly so in the case of computer usage.

Blundell et al. (1997 and 2000) estimate rates of return to graduates in 1991 at age 33 using the NCDS against a comparison group who obtained at least one A-level, but did not proceed into higher education. Men with first degrees had hourly wages which were an average 21% higher than men with just A-levels. Taking account of other factors influencing wage rates suggests that the mark-up for a first degree lies within the range of 12% to 18%. For women with first degrees hourly wages were on average 39% higher than for women with just A-levels. Taking account of other factors suggests a mark-up in their case within the range 34

to 38%. For higher degrees the rate of return was 16% for men and 43% for women. Their main conclusion is, therefore, that there are significant and substantial rates of return for typical graduates and a large difference in the returns to men and women. Further the gender wage differential narrows as one moves up the educational hierarchy. Thus the gender gap is 38% for those without higher education qualifications in their raw specification and this declines to only 11% for those with higher degrees. This is consistent with the fact that gender segregation is more marked in occupations with lower levels of education such as hotels and restaurant occupations, secretarial work and retail distribution. Also women with qualifications tend to have shorter periods out of the labour force to raise a family.

More recent estimates are contained in Blackaby, Murphy and O'Leary (1999) using pooled quarterly LFS data for 1993 quarter 1 – 1995 quarter 4. They find that, compared with an individual who left full-time education without any formal qualifications, the rates of return to O-levels based on weekly earnings for those in full-time employment were 25.0% for men and 25.7% for women. The corresponding figures for A-levels were 50.1% and 48.0%; and for first degrees 88.9% and 112.5%. Thus both the level of the mark-ups and the gender gap seem to have been maintained over time.

Since men and women tend to have different academic backgrounds, do different degrees, enter different occupations and possess different skills it follows that marked differences in gender earnings are not necessarily an indication of discrimination. However, Purcell (2002) has challenged this on the basis of the 1998 Moving On survey of UK graduates three years after graduation. She notes that whatever subject men and women study, there is a gender salary differential and whatever class of degree female graduates achieve males with the same level of qualification earn more on average. However, these differences may reflect the fact that women are less income-orientated than men and have different values and

expectations of employment. Even in the youngest (21-24) age group average male graduate earnings were 15% higher than those for women in the above study. Manning (2003) has noted that for all workers the gender pay gap is zero on labour market entry but then starts rising and the latest cohorts of women are doing no better than slightly older cohorts. The main explanation is the gender gap in on-the-job wage growth.

Various studies have found that the rate of return to education is lower for members of ethnic minorities than for whites. Thus McNabb and Psacharopoulos (1981) found a rate of return to members of ethnic minorities of 6.1% compared to 8.5% for whites using 1972 GHS data. Blackaby et al. (1994), using pooled data for the 1970s and 1980s and controlling for selectivity into employment, found a rate of return varying between 2.3% in the 1970s to 2.7% in the 1980s for members of ethnic minorities compared to corresponding figures for whites of 5.4% and 5.2%. Finally, Blackaby et al. (2002) using 14 quarters of the LFS 1993-96 obtained a rate of return of 5.0% for ethnic minorities compared to 7.4% for whites. However, there were also substantial differences in rates of return to particular racial groups with that for native ethnic minorities being 6.2%, and, whether native born or not, for blacks 3.6%, for Indians 3.9% and for Pakistanis 7.9%. Similar differences were found for particular qualifications including 'O' levels, A levels and degrees (though the gap was narrower here).

There is also considerable variance in the returns to particular types of degree and changes in them over time. As Harkness and Machin (1999) note, this may be influenced by changes in the numbers entering particular types of degree. While the number of graduates increased continuously between 1980 – 2 and 1993 – 5 the proportion studying in arts degrees fell from 15% to 11% for men and from 38% to 25% for women. In contrast the proportion studying in science and engineering rose from 40% to 45% for men and from 15% to 24% for women.

Subsequently, this pattern seems to have been reversed. Our LFS data show that the proportion of students obtaining science based degrees fell from 45.3% in 1993-1995 to 40.0% in 1999-2001. The proportion with degrees in economics, business and financial studies also declined with the increases being located in humanities, education and combined studies. As far as rates of return are concerned Blundell et al. (2000) note, at least on the basis of NCDS data, that men do particularly worse in Biology, Chemistry, Environmental Sciences and Geography than the base group (no information available), while for women the pattern is somewhat different with higher returns in particular in economics, accountancy and law. Chevalier and Walker using GHS data and pooling successive years find using returns to women in Arts/Humanities and in Science (including Medicine and Engineering) and decreasing returns to other categories. Returns to men rose across all subjects until the late 1980s and then fell for all subjects other than Arts/Humanities where the returns were never significantly different from zero. Differences in rates of return by discipline are dramatic. Thus Blackaby, Murphy and O'Leary (1999) show for broad subject groups rates of return for men varying between 9.0% in Arts to 34.2% in Economics, Accountancy, Law and Management (with Medicine at 51.5%) and for women from between 26.2% in Other Social Sciences to 46.9% in Architecture or Building (with Medicine at 55.4%). Machin and Puhari (2002) show that controlling for subject of degree explains a significant part of the male/female gender wage gap amongst graduates. Adding subject of degree to a single Mincer human capital model more than doubles the explained part of the gap.

Some studies differentiate between academic and vocational qualifications – Robinson (1997) found that the return to academic qualifications was significantly higher than that to vocational qualifications at an equivalent National Vocational Qualifications (NVQ) level. For instance, the earnings of men whose highest qualification was 'Other' Higher Education degree were 16% higher than those with an HND/HNC, though both were assigned to the

same level in the NVQ framework. This, however, does not take into account time taken to obtain such qualifications, which itself is complicated by the fact that these may be taken part-time, or influenced by ability and family background. Dearden et al. (2000) attempted to correct for this and found that whilst these brought the returns closer, returns to academic qualifications remained higher. There were also gender differences in the types of vocational qualifications which provided the highest returns. For men these were HNC/HNDs, ONC/ONDs and higher level City and Guilds specifications, while for women they were teaching and nursing qualifications. Using NCDS and 1992 – 1998 LFS data Conlon (2001) found a statistically significant earnings differential between academic and vocational qualifications at all levels, irrespective of the method of estimation. At NVQ levels 1 and 2 the differential was of the order of 8 – 10% and at NVQ levels 3 and 4 of the order of 12 – 18%. Amongst the explanations put forward for these differences are the greater ability of those pursuing academic qualifications, the greater potential mobility of those with general as opposed to specific skills and the possibility that academic qualifications give clearer signals. A further possibility is that the allocation to NVQ levels is inappropriate.

Another factor to be considered is whether type of school impacts on the rate of return independently of its effect on qualifications obtained. Harmon and Walker (2000) make use of the fact that the NCDS includes some individuals who were educated in the public, grammar and secondary modern stratification that existed up to the late 1960s and others who were educated in the new comprehensive system. They find that selective schooling has no effect on earnings conditional on the quantity of schooling, but there is a large positive effect for high ability children attending a grammar school relative to a comprehensive on the quantity of schooling and a large negative effect for all children in secondary modern schools

relative to comprehensive schools.[21] In other words comprehensive schools seem beneficial for low ability pupils, but detrimental to high ability pupils. Smith and Naylor (2001) and McNabb et al. (2002) find that attendance at an independent school is associated with an inferior level of academic performance at degree level controlling for A level performance. Finally, Naylor, Smith and McKnight (2002) estimate that there is an earnings premium for males of 3.1% and for females of 3.4% for those graduates who attended an independent school, *ceteris paribus*, though there is considerable variation over different independent schools. A plausible explanation for this result is that certain schools give better access to employment networks than others.

Recently, there has been considerable discussion on whether class-size has long-run implications for individual's experience in the labour market (see the Feature on Education in the Economic Journal 2003). As noted by Todd and Wolpin (2003) there is in fact considerable disagreement over whether schooling inputs such as class size, teacher education or experience and term length really do influence children's educational development, which they attribute to data limitations. This is crystalised in the debate between Krueger and Hanushek (2003) who derive different conclusions from their analysis of 59 US studies, based on how one chooses to weight the data. Krueger estimates an internal rate of return of between 5.2 and 7.3% from reducing class size from 22 to 15, while Hanushek suggests that there would be a greater pay-off to changing incentives for teachers to perform better. Finally, Dustmann, Rajah and Van Soest (2003) examine the impact of class size on the decision to stay on at school beyond 16 by pupils in England and Wales and subsequently on earnings at ages 23, 33 and 42, using several waves of the NCDS. They find that class size has a significant negative effect on the decision to stay on at school, controlling for a rich set of background variables. Further, staying on has a significant effect on earnings

[21] Dustmann, Rajah and Van Soest (2003) find that school type effects are quite strong. Pupils who attend grammar school have a 12% higher probability of staying on in full-time education than those in secondary modern schools, while the corresponding figure for private schools is 17%.

for men aged 33 and 42 and women aged 23. Combining these two effects implies that larger class sizes have a significant negative effect on earnings later in the life cycle.[22] Their results imply that a reduction in class size from 17 (the average in their sample) to 12 would increase earnings over the life cycle by £3,415 for men and £2,445 for women in 1991 prices. Thus, the impact is limited in terms of lifetime earnings and would be costly to implement. For policy purposes an important question, however, is whether the pay-off to improving educational quality is higher at primary, secondary or tertiary levels. This is a complex issue given the sequential nature of the educational process, but it does appear that improvements made early on in a child's education do have long-run effects (see, for instance, the analyses of the NCDS discussed above). Indeed, there is a body of literature which suggests that educational interventions after children have already entered school may be too late to change educational outcomes. Thus, Feinstein (2003) used the 1970 British Cohort Survey (BCS) to develop an index of development, using principal components analysis, for children assessed at 22 months, 42 months, 5 years and 10 years. The score at 22 months is a good predictor of educational qualifications attained by age 26, and is related to family background in so far as children in the bottom quantile of the development index are significantly less likely to get any qualification than these in the top quantile. Further, while children of educated or wealthy parents who score poorly in the early tests have a tendency to catch up, if with difficulty, children of parents from lower socio-economic groups who scored poorly in these tests were extremely unlikely to catch up and there is no evidence that entry into school reverses this pattern. Regression analysis suggests that mother's education is the best predictor of expected development and can be used to determine at risk groups. Feinstein suggests that Government programmes such as Sure-Start which focus on early intervention may not be very successful in their current form in reducing the level of early educational inequality as they do not focus sufficiently on parental education.

[22] They attribute insignificant results found by other authors to the reliance on reduced forms of analysis whereas their own structural analysis incorporates the staying on decision as the mechanism through which class size impacts on educational attainment and subsequently earnings.

The extent to which education reduces or increases inequality depends on the relative returns at different points on the wage distribution and provided that there are sufficient observations for those in the top deciles with low levels of education and similarly for those in the bottom deciles with high levels of education, this can be examined by quantile regression, which examines the whole distribution rather than just focusing on its mean. Using such an approach based on FES data for 1980, 1985, 1990 and 1995 Harmon, Oosterbeek and Walker (2000) show that the returns are higher at the very top of the earnings distribution compared to those at the very bottom, but that returns have risen relatively more over time at the bottom of the distribution. Walker and Zhu (2001) conducted a similar analysis using LFS data and found that for men the returns were constant across the distribution with a modest upward drift in the returns to the top decile. For women, in contrast, the returns fell slightly, but the fall was concentrated in the bottom half of the distribution. Added to this dispersion has widened because, both in the case of men and women returns are lower for those who are single, non-white, non-union, are in poor health and in each case this group has increased in size over time. We must conclude that overall education has served to increase inequality in the sense of widening earnings differences.

This outcome has been influenced by the fact that there is a basic skills problem in the UK as identified by a recent report on the basic skills of adults by Sir Claus Moser (DfEE, 1999). This report suggested that approximately 20% of adults in England had severe literacy problems and no less than 40% numeracy problems (these percentages are even higher in Wales), figures which compare unfavourably with other European countries. McIntosh and Vignoles (2001), using NCDS data, found that ignoring other factors influencing earnings individuals with level 1 numeracy skills earn 15-19% more than those without such skills. Even after controlling for family background, workers with level 1 numeracy skills earn 6-7% more than those lacking such skills. They also estimate that for a given level of

numeracy and literacy at 16 improving an adult's numeracy skills to level 1 will raise earnings by 6% as well as improving the likelihood of being in employment. Similar benefits can be obtained from improving literacy.

British studies of private and social internal rates of return have been relatively limited in number. Steel and Sausman (1997) conducted such an analysis for the National Committee of Inquiry into Higher Education, based on GHS data averaged over 1989-95. They adopt an approach based on evidence from earlier studies as a rule of thumb that between 20 to 40% of the graduate earnings premium reflects underlying ability and background factors, to assume a so-called 'alpha' factor (the proportion of the graduate pay premium which reflects education) of 60 to 80% for men and 100% for women. On the cost side they allow for the costs of teaching and the output foregone, and non-completion. Private rates of return are estimated at 9% (alpha = 0.6) and 11% (alpha = 0.8) for men and 14% (alpha = 0.6), 17% (alpha = 0.8) and 20% (alpha = 1) for women, averaged over entrants for all ages in academic year 1995/96 who studied full-time. For 18 year old male entrants the corresponding figures were higher at 11% (alpha = 0.6) and 13% (alpha = 0.8). Social rates of return were lower because of free tuition and heavily subsidised student support. For men these were 6% (alpha = 0.6) and 8% (alpha = 0.8) for all entrants, and 7% and 9% respectively for 18 year old entrants. For women the corresponding figures were 8%, 10% and 12%

Ashworth (1996 a) attempted to estimate the private rate of return to graduates based on assumed annual earnings streams and taking account of the implications of moving from a grant system to a loan system while at the same time expanding student numbers, with different assumed rates of economic growth and graduate unemployment rates relative to the rest of the population. Assuming no graduate debt, 2% growth and 4% graduate unemployment he obtains a private rate of return of 25.6% for a traditional graduate. With an

alpha factor of 0.6 this reduces to 19.0%. However, for a likely marginal graduate after expansion and assuming 0% growth, 7% graduate unemployment and a loan of £35,000 he obtains a negative return of 7.2% (alpha = 0.6). In a separate paper Ashworth (1996 b) he obtains social rates of return varying between 6.4% for the average traditional graduate (assuming 2% growth, 4% graduate unemployment and alpha = 0.6) and 2.8% for the likely marginal graduate after expansion. This illustrates the importance of identifying average and marginal cases and making appropriate assumptions about the economic environment. The results are shown to be highly sensitive to the assumptions made in this respect.

Dutta, Sefton and Weale (1999) allow for the risky nature of entering higher education courses, deriving their private and social rates of return estimates from a regression equation, (based on annual equivalent earnings from the GHS, 1995-96), which by its nature has coefficients which are uncertain. They quote figures for different types of degree with rates of return based on the estimated parameters from the model, after taking account of the parametric uncertainty and after compounding the effects of parametric uncertainty with those of individual uncertainty. Model estimates provide returns in 1995 varying from –11.7% in Group C (Biological Sciences and Humanities) to 16.2% in Group A (including some Sciences, Social Sciences and Business Studies). Allowance for uncertainty makes little difference to Groups A and B and actually improves the position in relation to Group C (perhaps because the solution method can fail to converge where returns are very poor). Social rates of return are lower than private rates but very acceptable apart from Group C (11.4% Group A, 7.5%, Group B and –3.5% Group C). When we compare these results with those results of Blöndal et al. for a later period it can be seen that there is no evidence that either private or social rates of return in the UK have been declining over time. But there is considerable variation depending on the type of degree or type of student under consideration.

Finally, Layard, McIntosh and Vignoles have attempted to estimate the social rate of return for various academic and vocational qualifications using hourly earnings from the 1997 and 1998 LFS. They recognise that their methodology is 'incredibly imprecise', but the results are instructive. They obtain social rates of return of 9% for both first and higher degrees and 7% for both HE Diplomas and 'A' Levels. Much higher estimates are obtained for vocational qualifications such as City and Guilds, RSA and HNC/D ranging from 12 to 21%. It is clear that these results are driven by the much shorter assumed years of study of the vocational courses of 0.4 to 1.2 years as opposed to 1.5 to 3 years for the academic qualifications. Thus the Government's intention to expand two year Foundation degrees may have a high social return provided that this qualification is acceptable to employers.[23]

Finally, we must consider the possibility that rates of return have been influenced by increases in the number of workers with particular qualifications. As Green, McIntosh and Vignoles (2002) point out, the proportion of workers in Britain with no qualifications fell from 35% in 1985 to 19% in 1997, while at the same time those in higher education continued to increase with roughly one third of school-leavers pursuing higher education by the end of the 1990s with the forecast that the stock of graduates in the labour market would rise well above the 1997 level of 12%. Using Social Change and Economic Life Initiative (SCELI) data Sloane et al. (1999) estimated that 31% of the labour force were over-educated in 1986 and by 2001 Felstead, Gallie and Green (2002) suggest this figure had risen to 37% with the increase concentrated disproportionately among those with intermediate qualifications (i.e. levels 2 and 2 on the NVQ scale). Given this increase we would expect a decline in the rate of return to education, but this has not happened at least in terms of degree level qualifications. How then can we explain this puzzle? One explanation is that those who are over-educated have low ability or skills given their level of education and as

[23] See the White Paper on the Future of Higher Education, cm 5735, Chapter 5.

education has expanded the heterogeneity of holders of particular qualifications has increased (Chevalier 2000). If this were the case the labour market may be performing its allocation function well and in reality the over-educated, or at least some of them, are not genuinely over-educated as their education is compensating for lack of other forms of human capital. It would not necessarily follow, therefore, in terms of public policy that there has been an over-provision of education.

To summarise performance tests on children less than two years of age are good predictors of eventual educational attainment and children who perform badly in these and are in poor households find it difficult to improve later. Lack of basic skills in literacy and numeracy has detrimental effects on both earnings and employment. School effects resulting from type of school and class size remain even after completion of degree programmes, though the effects are not quantitatively large. The UK studies confirm, however, that the returns to education are relatively high and particularly so for women, though less for members of certain minority groups. At degree level there is considerable variability in the returns to particular types of degree and these also fluctuate over time, but in general returns to academic qualifications are higher than those to vocational qualifications. Estimates of both private and social rates of return are sensitive to the assumptions made about the state of the economy and the tax/subsidy position in relation to student support. Increasing participation rates in higher education still further will not necessarily, therefore, lead to high returns in the future.

5. SOME NEW RESULTS FOR BRITAIN AND WALES

In order to provide a detailed focus upon the position in Wales, aggregate level analysis for GB is supplemented with estimates from the Welsh boost to the Labour Force Survey for 2001 using individual observations (see Annexe 2). Estimates from this data source permit not only a comparison to be drawn between Wales and the rest of Britain, but they also allow for some conclusions to be drawn as to the returns to education within Wales.

We estimate returns separately by gender for both gross weekly and gross hourly earnings and for net weekly and net hourly earnings, all in constant prices (though the results for gross weekly earnings and net earnings, after tax, are not presented here).[24] We control for a vector of individual, job specific and demographic characteristics. In addition to specific educational attainment indicators these include age and its square, ethnic origin (a 0/1 dummy), marital status (three categories), region of residence (twelve categories), year dummies, tenure with current employer (three categories), size of workplace (seven categories) and industrial sector (nine categories). Full details of all the variables used and their definitions may be found in Appendix Table 1.

By way of illustration, detailed results for 2001 are provided in Appendix Table 4 for Great Britain and Wales (booster). These results confirm the expected nature of age-earnings profiles, being convex from below, with the profiles for women being flatter than for men. They are also flatter for workers in Wales relative to those in Britain as a whole. Male ethnic minority employees earn over seven per cent less than white workers in Britain as a whole and nearly nine per cent less in Wales, while the disadvantage of ethnic minority women in Wales is rather lower. Meanwhile, for ethnic minority females in Britain as a whole, there is

[24] It should be noted, however, that hourly and weekly returns, particularly at a disaggregated level, can show divergent trends over time and differences in relative rates of return.

no statistically discernable earnings disadvantage.[25] Workers who are single or widowed, divorced or separated earn less than those who are married with the sole exception of single women in Britain as a whole. There are strong regional effects on earnings with the Northern region of England being the omitted region. While the signs on the coefficient are positive for both Welsh men and women, they are only significant in the former case with Welsh men earning 4.6% more than men in Northern England. There are strong tenure with current employer effects with those who have been with their current employer more than five years (Jobyrs 3) earning substantially more than those with two to five years tenure (Jobyrs 2), who in turn earn more than those with less than 2 years tenure. There are also strong industry effects on earnings, with those in Wales employed in Energy and Water Supply attracting the greatest premium upon their hourly earnings. Finally, working part-time has a very strong negative effect on earnings. In Britain as a whole, part-time men earn 15.7% less than full-time men and part-time women earn 12.3% less than full-time women. For Wales, the corresponding figures are 15.4% and 8.1% respectively. Since many more women work part-time than men, this factor must be borne in mind when considering the lifetime rate of return to education for women as a group.

The rates of return implied by the modelling exercise are set out in Tables 5-10. All returns reported in these tables are either measured relative to those without any formal qualifications (Tables 5, 7, 9 and 10) or relative to those with two or more A-levels (Tables 6 and 8). We may summarise these results as follows:

[25] Due to the semi-logarithmic functional form of the earnings equation, the percentage effect upon earnings (D) is given by $D=(\exp(\alpha)-1)x100$, where α is the coefficient estimate. So, for example, the coefficient of –0.074 in Appendix Table 4 equates to an earnings disadvantage of 7.1% with regard to gross hourly earnings. All coefficients in Appendix Table 4 will be interpreted in this way, although the rate of return estimates reported subsequently in Tables 5-10 will relate directly to coefficient estimates, as reported in the existing literature and as suggested by economic theory.

1) For men, the highest rate of return is obtained in relation to gross hourly earnings which are significantly higher for Hqual1, 2, 3 and 5 compared to gross weekly earnings.[26] This reflects the fact that paid hours are generally shorter for more highly qualified workers, and the less qualified may gain more from paid overtime working which is reflected in gross weekly earnings.[27]

For women, the situation is reversed with the highest returns being obtained for gross weekly earnings for all qualification levels, suggesting that women with fewer qualifications work longer hours.

2) For both men and women, net returns (whether hourly or weekly) are significantly lower than gross returns, consistent with the effects of progressive taxation. For men, net hourly returns tend to be higher than net weekly returns (apart from Hqual6), whereas for women net weekly returns tend to be higher than net hourly returns

3) In general, gross rates of return to both men and women have declined over the period (see Table 5). In addition, women's rates of return have slipped relative to those of men, but they still remain higher than those of men. It would also appear that degrees are not quite so attractive as they were for those considering whether to enter higher education. (In the weekly earnings equations the returns to higher degrees actually increased for men. This implies that hours of work must have increased relatively over the period for those with higher degrees).

[26] These results are not presented in the tables that follow but are available upon request.
[27] Whilst this might seem to contradict the statement in section 2 that the more qualified work longer hours, it should be remembered that we here we are talking about *paid* hours, which excludes unpaid overtime.

4) For both men and women, rates of return to degree equivalent qualifications are much lower than those to degrees, reflecting the diverse nature of these qualifications and implying that it is not appropriate to group these two categories together (see Table 5). Further, the return to Degree Equivalent qualifications has declined between the two periods, but much more substantially for women than for men (- a decline of over 15% points as opposed to six percentage points for men).

5) There are substantial differences in the rates of return to different degree programmes relative to those with two or more A-levels (see Table 6 for results and Appendix Table 2 for details of the degree classifications used). Ignoring medicine (contained within Health), which has a much higher return than any other discipline, the highest gross hourly rates of return for men in 1993-5 were obtained in Mathematical Sciences and Computing (25.0%) and Law (24.0%). This remained the case in 1999-2001 with the rate of return to the latter increasing to over 27%. In contrast, men graduating in the Arts received a rate of return of just 3.2% in 1993-5 and this only rose marginally over the period to 6.0%. It should be remembered, though, that this was at a time when the returns to many other degree programmes fell.

For women, the highest rates of return in 1993-95 were obtained in Architecture and Related Studies, Law and Education at over 40%. In 1999-2001, returns were generally lower with Maths and Computing, Law and Education offering the highest returns of between 35 and 40%.

6) Over the two time periods there has been some tendency for rates of return to different degrees to converge both for men and women. For men the range in rates of return

in the earlier period (excluding health) was between 3 and 25% and in the later period between 6 and 25%, while the corresponding figures for women were between 26 and 42% and between 18 and 39%.

7) While rates of return are higher in the Health disciplines, these are not out of line if account is taken of the longer duration of study (five years as opposed to three in the case of medical degrees). It is also noticeable that the return to women in such disciplines fell over the period.

The Welsh booster to the 2001 LFS enables us to make regional comparisons (see Table 7). The pattern of higher returns to females relative to males for all degree level qualifications is reflected across the four regions we identify. Welsh men received lower returns to Higher and First Degrees than in Britain as a whole, while in contrast Welsh women obtain slightly higher returns.

Turning to returns to particular types of degree across regions (see Table 8), returns seem to vary considerably, though in the Scottish case in particular this may be influenced by small sample size. Cases with fewer than 15 observations have been excluded from the Table. In general, the returns to particular types of degree in Wales compare favourably with those for Britain as a whole, being notably better in the science-based disciplines (including Social Sciences).

We can also make a comparison between vocational and academic qualifications (see Table 9). Both in Britain as a whole and in Wales, returns are considerably greater at Higher and First Degree level for academic qualifications than they are for any NVQ level, suggesting

that the treatment of such academic and vocational qualifications as equal may be misguided.[28] Interestingly, though, the return on an NVQ level 5 for men in Wales (at 56.4%) is much closer to the return on a First Degree (58.7%) than it is to the return on a Degree Equivalent qualification (47.3%). Such a pattern is repeated for neither women in Wales nor for either gender in Great Britain.

Further, and with only the exception outlined above, the returns to NVQs are consistently lower than their equivalent academic qualifications. So, for example, the returns to an NVQ at levels 3, 4 or 5 (at 28.2%, 39.9% and 32.2% respectively) for men in Great Britain as a whole are less than the return to a Degree Equivalent academic qualification (at 48.9%). Likewise, for men in Great Britain again, the return to NVQ level 2 (at 11.5%) is below that of A-levels (26.4%) and the return to NVQ level 1 (at 3.0%) is below that of the Other academic qualification level (7.4%).

Interestingly, though, there is evidence of increased relative returns to NVQs in Wales in comparison to Great Britain. For both men and women, the returns to NVQ level 5 (at 56.4% and 49.9% respectively) are well in excess of the comparable figures for Great Britain. There is further evidence of increased labour market valuation of NVQs in Wales at the opposite end of the qualifications spectrum, where again there are greater returns to NVQ level 1 for both men and women in Wales than there are in Great Britain.

As a final comparison, the Welsh boost to the LFS enables us to identify the degree premium across Welsh Unitary Authorities (Table 10). We can see that the degree premium varies between 73.2% in Flintshire to 41.8% in Pembrokeshire for men and between 91.4% in

[28] To maintain consistency between the two time periods used in the analysis, NVQ levels 3, 4 and 5 have been classified as Degree Equivalent qualifications. Indeed, the validity of grouping NVQ level 5 in particular below First Degree level is clearly supported by the evidence of Table 9.

Carmarthenshire and 49.5% in Ceredigion for women relative to those without any formal qualifications in these UAs. Relative to the premium to graduates in Cardiff, a number of UAs have significantly different coefficients including Gwynedd and Pembrokeshire for both sexes and Caerphilly for men. These data are for place of residence and some individuals will have a place of work in a different UA than their place of residence. For example, 16.7% of those who work in Cardiff live outside it. If we estimate returns to degree by place of work, only Pembrokeshire has a significantly different coefficient from Cardiff for men and Ceredigion for women. The message is that someone living in Caerphilly and working in Cardiff does just as well as someone both living and working in Cardiff. Reasons why returns should differ by UA include the fact that institutional degree affiliations may differ by UA or the extent to which graduates are mobile both into and out of UAs may differ, but our data set does not enable us to control for this. These results suggest that by and large there is little variability across unitary authorities and most of the variance is just noise.

6. CONCLUSIONS

The analysis in section 5 has focused on the mark-up obtained from educational qualifications relative to lower qualifications or no qualifications. Changes in these over time reflect the value placed on such qualifications in the labour market. This is not the same as either the private or the social rate of return because no allowance is made for the cost to the individual or to the state in acquiring or providing such qualifications. We have seen some, though not dramatic, evidence for returns to some qualifications to decline over time. Further focusing on degree qualifications, returns vary widely across different disciplines, with returns being rather low in some cases. Here, it is clear that when due allowance is made for the effects of progressive taxation and the opportunity cost of foregone earnings in the case of private returns and for the opportunity cost of foregone output in the case of social returns net returns are in fact likely to be negative. This has implications both for students' choice of disciplines and for the Government's intention to ensure that students pay for a substantial part of their costs of education. The intention to introduce increased fee charges for students will increase the importance of monitoring rates of return, particularly at degree level. Their effect will be to reduce the gap between the private and social rate of return. It is also crucial to differentiate between average and marginal students to establish whether there is any divergence between rates of return for traditional students and those who have been attracted into higher education as a consequence of the policy to increase student numbers.

The general picture in Wales is similar to that in the rest of Britain, but there are some important differences in the way in which returns to education differ by industry and personal characteristics including gender, with Welsh men having lower returns than elsewhere in Britain and Welsh women rather higher returns. There are, however, higher returns for NVQ Level 5 for Welsh men and women than is the case elsewhere in Britain and the same applies in the case of NVQ Level 1. Yet, in general the trends in Wales tend to follow those in Great

Britain as a whole suggesting that policies for intervening in the education market should be similar.

It is clear that in general the human capital model is a powerful tool in explaining differences in earnings in the labour market and that rates of return are sufficiently high to make education a worthwhile investment. Yet some important gaps in our knowledge remain. First, early childhood intervention is critical in determining later labour market outcomes, but the precise extent to which the effects of early childhood education can be moderated by later educational interventions is unclear, as is the relative return to be gained from investments at the different stages of education – primary, secondary and tertiary. Second, we need to establish the extent to which quality of the average and marginal student has diverged in order to say more about the optimal size of the higher education system. Third, cohort analysis is required to establish the extent to which the trend in rates of return over time is influenced by increases in respectively the supply of graduates, changes in the quality of graduates and changes in returns to comparator groups. Fourth, we need to examine the effect of variances in the distribution of earnings for different types of degree and other qualifications on the mean rate of return. Finally, in the Welsh context we need to examine the effect of education on participation rates as well as on earnings and to consider the effects of migration. While relative returns to education are high in Wales absolute levels of earnings are low relative to other regions and it is the latter that will determine the extent of regional migration.

Future research should focus, in addition to the above issues, on how to influence early childhood education to best effect, particularly in developing basic skills in literacy and numeracy. At a later stage we need to establish which forms of intervention can improve basic skills in school and beyond. At degree level we need to investigate why returns to

particular degrees are so much higher than to others. The search for better instruments to identify schooling needs to continue, and in their absence reliance should be placed on OLS estimates. Finally, we should bear in mind that the literature summarised in this report focuses almost exclusively on the quantity of formal schooling and provides quantitative estimates of only partial benefits from increasing the stock of human capital.

TECHNICAL APPENDIX

The starting point of all the work on the estimation of rates of return to education is Mincer's path breaking study (1974). Following Mincer assume that *n* represents the length of the working life, E_s the annual earnings for an individual with *s* years of education, *r* is the discount rate and *t* is time. We can then write the present value of an individual's lifetime earnings at the start of the working life, represented by V_s, as

$$V_s = E_s \sum_{t=1}^{n} \left(\frac{1}{1+r}\right)^t \qquad [1]$$

from which is derived

$$\ln E_s = \ln E_0 + r_s \qquad [2]$$

where $\ln E_0$ equals the log of earnings at the start of the working life.

Equation 2 states that percentage increases in earnings are strictly proportional to the absolute difference in time spent in education, with *r* representing the rate of return. Further, after entering the labour force in year *j* the worker will invest additional resources (C_j) in on-the-job training, such that

$$AE_j = r_j C_j \qquad [3]$$

These investments will be concentrated at the start of the working life, since the later in the working life an investment is made the shorter the payback period. Hence education, normally a full-time activity, precedes on-the-job training, normally a part-time activity, and the latter will diminish rapidly with age. There are several implicit assumptions in this model (Polachek 1995). Specifically human capital is assumed to be homogeneous; individuals are assumed identical with regard to time preferences, discount rates and other aspects; individuals know with certainty the length of their working lifetime and are assumed to work throughout it; finally, individuals are assumed to be risk neutral, so that stochastic factors

play no part in decision-making.

Based on the above assumptions Mincer derived the standard human capital earnings function which has been the basis of nearly all the empirical work which followed

$$\ln E_t = a + \alpha_1 S + \alpha_2 X + \alpha_3 X^2 + \varepsilon_1 \qquad [4]$$

where E_t equals earnings at time *t*, *S* equals years of schooling, *X* equals years of experience, measured in quadratic form, *a* equals the intercept term, α equals the values of the coefficients of the variables and ε_1 equals a stochastic error term

One advantage of this formulation is that the schooling coefficient, α_1 can be interpreted as the return to the investment in schooling. However, as Björklund and Kjellström (2002) point out this relies on a number of assumptions which are rarely made explicit in the literature. The first assumption is that the measure of earnings captures the full benefits of the investment, including the non-pecuniary advantages of jobs. Second, the only costs of schooling are foregone earnings. Third, the earnings function is separable in *S* and *X*, so that $\delta \ln E / \delta S$ is independent of years of work experience (i.e. the two do not interact). Fourth, the length of working life is the same, independently of the length of schooling (i.e. an additional year of schooling postpones retirement by one year). Fifth, schooling precedes work. Finally, the economy is in a steady state without any wage or productivity growth. These assumptions must be kept in mind, particularly when making comparisons over time or across countries.

The Thurow job competition model, unlike the Mincer model, focuses on the demand side of the labour market. This formulation is given by

$$\text{Log } E_t = \alpha_0 + \alpha_1 q^r + \varepsilon_2 \qquad [5]$$

Where q^r equals the qualification required to obtain the job. Any qualifications in excess of q^r are essentially unrewarded.

In the job assignment model Tinbergen supposes that *Si* equals the degree to which a skill i is required and T_1 the degree to which it is present among potential employees. On the demand side of the labour market employers will specify a frequency distribution $M\ (S_1 S_2 - - S_n)$ of the number of employees they require at particular levels of skill. On the supply side of the labour market potential employees will offer a similar frequency distribution $N\ (T_1 T_2 - - T_n)$ representing the availability of particular skills. In practice, the frequency distributions are unlikely to be perfectly matched and mismatch will occur linked to the degree to which the job structure is relatively unresponsive to changes in relative supplies of educated workers. Earnings then are a function of both worker and job characteristics.

The recent literature on over-education has recognised that both the Mincer and Thurow models can be encompassed in a more general model which allows returns to vary according to whether an individual is matched in a job which has requirements consistent with that individual's qualifications, one such model is

$$\text{Log } E_t = b_0 + \beta_1 q^r + \beta_2 q^s + \beta_3 q^u + \varepsilon_3 \qquad [6]$$

In which actual qualifications (*q*) are decomposed into those required for the job (q^r), those surplus to job requirements (q^s) and those which are below those required (q^u).

Table 1
OLS Estimates of Returns to Years of Education:
ISSP Data 1985-1995

	Males		Females	
USA	0.074	*0.004*	0.096	*0.005*
Great Britain	0.127	*0.006*	0.130	*0.006*
West Germany	0.036	*0.002*	0.043	*0.004*
Russia	0.044	*0.004*	0.053	*0.004*
Norway	0.023	*0.002*	0.025	*0.003*
Australia	0.051	*0.004*	0.052	*0.006*
Netherlands	0.031	*0.002*	0.019	*0.004*
Austria	0.038	*0.004*	0.064	*0.006*
Poland	0.073	*0.005*	0.100	*0.005*
East Germany	0.026	*0.003*	0.045	*0.004*
New Zealand	0.033	*0.004*	0.029	*0.005*
Italy	0.037	*0.003*	0.053	*0.005*
Ireland	0.085	*0.006*	0.090	*0.008*
Japan	0.075	*0.007*	0.094	*0.014*
Hungary	0.075	*0.007*	0.077	*0.006*
N. Ireland	0.174	*0.011*	0.146	*0.011*
Sweden	0.024	*0.004*	0.033	*0.005*
Slovenia	0.080	*0.007*	0.101	*0.007*
Israel	0.053	*0.007*	0.061	*0.008*
Czech Rep.	0.035	*0.007*	0.043	*0.007*
Bulgaria	0.040	*0.009*	0.057	*0.010*
Slovak Rep.	0.052	*0.012*	0.064	*0.009*
Canada	0.038	*0.008*	0.045	*0.008*
Czechoslovakia	0.031	*0.010*	0.036	*0.007*
Spain	0.046	*0.005*	0.038	*0.010*
Switzerland	0.045	*0.007*	0.048	*0.012*
Latvia	0.067	*0.020*	0.078	*0.014*
Philippines	0.113	*0.015*	0.192	*0.030*
Pooled	0.048	*0.001*	0.057	*0.001*

Source: Trostel, Walker and Woolley (2002).

Notes: Robust standard errors are in italics. The estimating equations include year dummies, union status, marital status, age and age squared and, in the case of aggregate equation, country-year dummies.

Table 2
Changes in Enrolment in Tertiary Education - OECD Countries

	Change in enrolment 1995-2000 (1995=100)		
		Attributable to:	
	Total tertiary education	Change in population	Change in enrolment rates
OECD Countries			
Australia	108	102	106
Austria	109	69	144
Belgium	111	94	117
Canada	101	m	m
Czech Republic	150	102	147
Denmark	115	95	121
Finland	116	100	116
France	98	91	107
Germany	95	89	107
Greece	143	96	151
Hungary	180	110	164
Iceland	133	101	131
Ireland	125	109	116
Italy	103	m	m
Japan	m	m	m
Korea	148	87	161
Luxembourg	m	m	m
Mexico	128	106	121
Netherlands	m	m	m
New Zealand	m	m	m
Norway	105	94	112
Poland	208	119	173
Portugal	124	98	127
Slovak Republic	m	m	m
Spain	120	93	129
Sweden	122	95	129
Switzerland	m	m	m
Turkey	86	110	79
United Kingdom	112	97	115
United States	m	m	m
Country Mean	***124***	***98***	***127***

Table 3
Private Internal Rates of Return to Education in the OECD
1999-2000 %

	Men				Women			
	Upper Secondary		Tertiary		Upper Secondary		Tertiary	
	Narrow	Comprehensive	Narrow	Comprehensive	Narrow	Comprehensive	Narrow	Comprehensive
Canada	11.9	13.6	8.4	8.7	10.8	12.7	10.6	9.9
Denmark	11.3	11.3	7.9	11.5	8.3	10.5	6.0	11.1
France	7.5	13.5	13.3	14.3	10.5	17.9	12.1	15.8
Germany	10.0	10.8	7.1	9.1	6.1	7.0	7.0	8.4
Italy	9.5	11.2	8.0	7.5	7.9	8.4	9.4	10.8
Japan	4.4	6.8	8.0	7.9	6.6	9.4	8.0	7.2
Netherlands	6.9	7.9	11.7	12.1	7.9	8.4	9.4	12.5
Sweden	3.9	6.4	9.4	11.4	-	-	7.4	10.8
U.K.	12.4	15.1	18.1	18.5	-	-	16.4	16.1
U.S.	14.4	16.4	18.9	14.9	10.6	11.8	18.8	14.7
Unweighted Average	9.2	11.3	11.4	11.6				

Source: Blöndal, Field and Gírouard (2002)

Notes: Narrow rate is based on pre-tax earnings and the length of studies
Comprehensive rate adjusts for the impact of taxes, unemployment rate, tuition fees and public student support where relevant.
For the UK data on earnings of women up to age 30 with lower-secondary education were not available. For Sweden earnings differentials for women between upper and lower secondary levels are not large enough to allow a positive rate of return estimate to be made.

Table 4
Narrow Estimates of Social Rates of Return to Education, 1999-2000, OECD Countries, (%)

	Upper Secondary		Tertiary	
	Men	**Women**	**Men**	**Women**
Canada	-	-	6.8	7.9
Denmark	9.3	8.7	6.3	4.3
France	9.6	10.6	13.2	13.1
Germany	10.2	6.0	6.5	6.9
Italy	8.4	-	9.7	-
Japan	5.0	6.4	6.7	5.7
Netherlands	6.2	7.8	10.0	6.3
Sweden	5.2	-	7.5	5.7
U.K.	12.9	-	15.2	13.6
U.S.	13.2	9.6	13.7	12.3

Source: Blöndal, Field and Gïrouard (2002)

- Reliable data lacking

Table 5
Percentage Returns to Qualifications in Great Britain:
Labour Force Survey, Gross Hourly Earnings

	1993 -1995		1999 - 2001	
	Men	**Women**	**Men**	**Women**
Higher Degree	73.46	86.06	70.93	78.11
First Degree	66.09	77.15	62.59	66.45
Degree Equivalent	51.72	61.83	46.01	46.29
A-Level	25.47	26.55	25.93	23.92
O-Level	26.15	23.91	24.99	19.44
Other	6.66	10.91	7.37	7.75

Note: all returns measured relative to no formal qualifications.

Table 6
Percentage Returns to Degree Subjects in Great Britain:
Labour Force Survey, Gross Hourly Earnings

	1993 -1995		1999 - 2001	
	Men	**Women**	**Men**	**Women**
Health	32.59	48.74	36.28	45.03
Nursing	14.39	35.40	9.36	22.42
Sciences	17.93	31.36	14.00	21.14
Maths and Computing	24.97	39.01	25.13	38.26
Engineering and Technology	18.90	37.19	22.18	25.62
Architecture and Related Studies	13.97	42.13	9.57	22.68
Social Sciences	13.97	26.54	11.46	22.33
Economics, Business and Financial Studies	22.41	33.73	21.11	32.64
Law	23.97	45.26	27.45	39.69
Arts	3.19	28.71	6.02	18.81
Languages	24.12	39.86	16.72	25.69
Education	16.64	44.62	16.05	36.60
Combined	15.42	29.24	15.75	24.05

Notes: all returns measured relative to two or more A-levels.

Table 7
Percentage Returns to Qualifications Across Regions:
Labour Force Survey 2001, Gross Hourly Earnings

	BRITAIN		WALES* (Booster)		SCOTLAND		REST OF ENGLAND		SOUTH EAST ENGLAND	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Higher Degree	70.99	78.20	68.64	80.29	74.38	78.42	72.60	81.30	65.92	74.80
First Degree	62.69	65.60	58.79	66.98	58.14	66.82	63.61	66.61	57.60	62.61
Degree Equivalent	44.55	43.14	44.15	45.69	44.99	37.66	42.86	44.77	43.33	40.38
A-Level	25.70	23.65	25.00	20.07	24.36	20.32	24.12	22.35	27.27	26.79
O-Level	23.44	19.17	20.71	17.79	20.10	16.17	22.94	19.79	23.22	18.37
Other	7.24	6.27	11.00	6.04	6.41	5.77	7.44	7.45	3.69	3.42

Notes: all returns measured relative to no formal qualifications;
* weighted data.

Table 8
Percentage Returns to Degree Subjects Across Regions:
Labour Force Survey 2001, Gross Hourly Earnings

	BRITAIN		WALES* (Booster)		SCOTLAND		REST OF ENGLAND		SOUTH EAST ENGLAND	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Health	35.79	43.04	-	47.06	-	74.46	57.58	53.11	-	25.56
Nursing	-1.70	27.11	-	31.24	-	-	-	-	-	-
Sciences	11.40	21.86	19.93	29.95	-16.89	60.87	16.75	26.91	9.40	7.50
Mathematics and Computing	26.21	35.54	23.23	-	20.27	-	27.43	38.78	26.19	-
Engineering and Technology	22.46	22.30	30.60	-	29.23	-	21.28	-	20.28	-
Architecture	14.63	36.57	18.10	-	-	-	15.29	-	6.28	-
Social Sciences	8.39	20.71	15.26	23.66	-	54.27	5.13	25.35	5.64	13.29
Economics, Business and Finance	21.66	31.04	15.35	27.68	22.05	67.75	26.38	24.43	12.80	33.25
Law	38.30	35.20	-	-	-	-	46.83	32.46	-	35.70
Arts	10.02	20.88	-2.06	22.07	-	58.18	18.08	22.44	-0.19	13.67
Languages	15.56	28.34	-	10.55	-	-	-	38.53	-	12.53
Education	20.90	30.58	20.20	38.59	-	72.84	31.49	27.93	2.01	32.84
Combined Studies	18.93	24.25	13.05	29.32	16.85	45.52	23.79	26.95	9.90	23.89

Notes: all returns measured relative to two or more A-levels;
- less than 15 observations in the sample;
* weighted data

Table 9
Percentage Returns to Vocational Versus Academic Qualifications: Labour Force Survey 2001, Gross Hourly Earnings

	GB		WALES*	
	Men	**Women**	**Men**	**Women**
Higher Degree	73.14	82.09	68.75	80.37
First Degree	64.64	68.48	58.72	66.87
Degree Equivalent	48.92	49.25	47.29	51.46
NVQ 5	*32.20*	*38.35*	*56.39*	*49.87*
NVQ 4	*39.85*	*44.82*	*42.32*	*46.41*
NVQ 3	*28.16*	*20.80*	*29.75*	*19.24*
A-Level	26.43	27.86	26.61	22.78
NVQ 2	*11.46*	*11.27*	*7.65*	*10.87*
O-Level	23.78	20.40	20.41	17.67
Other	7.35	8.21	11.05	6.28
NVQ 1	*3.00*	*-3.52*	*8.16*	*1.88*

Notes: all returns measured relative no formal qualifications;
* weighted data.

Table 10
Percentage Returns to First Degrees by Unitary Authority in Wales: Labour Force Survey 2001, Gross Hourly Earnings

	Men			Women		
	Return	**T-stat**	**Rank**	**Return**	**T-stat**	**Rank**
Anglesey	56.00	1.10	15	73.86	0.58	4
Gwynedd	47.66	2.46	18	60.80	2.70	17
Conwy	47.12	1.33	20	59.62	1.26	18
Denbighshire	58.49	0.88	11	62.09	1.65	15
Flintshire	73.16	0.48	1	62.98	1.88	12
Wrexham	62.40	0.47	5	67.49	1.53	9
Powys	51.83	1.42	16	67.67	1.27	8
Ceredigion	56.00	0.90	14	49.52	3.58	22
Pembrokeshire	41.80	2.83	22	58.79	2.08	20
Carmarthenshire	64.18	0.30	4	91.37	1.37	1
Swansea	58.98	0.92	10	59.60	2.47	19
Neath Port Talbot	51.62	1.90	17	69.15	1.28	6
Bridgend	62.02	0.67	6	64.46	1.72	11
Vale of Glamorgan	72.15	0.48	2	68.74	1.49	7
Rhondda,Cynon,Taff	58.05	1.01	12	62.45	2.11	13
Merthyr Tydfil	61.46	0.64	7	70.91	0.95	5
Caerphilly	47.21	2.21	19	86.75	0.86	2
Blaenau Gwent	42.19	1.39	21	64.70	1.22	10
Torfaen	59.27	0.89	9	50.93	1.77	21
Monmouthshire	59.44	0.94	8	62.09	1.81	14
Newport	56.84	1.09	13	61.24	1.98	16
Cardiff	67.07		3	79.28		3

Notes: all premiums measured relative to no formal qualifications in Unitary Authority; robust t-statistics measured relative to premium in Cardiff UA.

Appendix Table 1
Classification of Variables for LFS Analysis

Variable	***Variable Description***
Age	Age in years of respondent (entered in quadratic form).
Coloured	Dummy variable indicating that respondent is of an ethnic origin other than white.
Marital status	Dummy variable indicating marital status of respondent. 1: married or cohabitating; 2: single; 3: widowed, divorced or separated.
Region	Dummy variable indicating region of residence of respondent. 1: Northern; 2: Yorkshire and Humberside; 3: East Midlands; 4: East Anglia; 5: Inner London; 6: Outer London; 7:South East (excluding London); 8: South West; 9: West Midlands; 10: North West; 11 : Wales; 12: Scotland.
Part-time	Dummy variable indicating that respondent works on a part-time basis.
Year	Dummy variable indicating year of interview.
Job years	Dummy variable indicating job tenure with current employer. 1: less than 2 years; 2: between 2 and 5 years inclusive; 3: greater then 5 years.
Employment numbers	Dummy variable indicating size of establishment where the respondent is employed. 1: 1-10 employees; 2: 11-19 employees; 3: 20-24 employees; 4: DK, <25 employees; 5: 25-49 employees; 6: DK, >24 employees; 7: 50+ employees.
Industry	Dummy variable indicating industry in which the respondent works. 1: agriculture, forestry and fishing; 2: energy and water supply; 3: manufacturing; 4: construction; 5: distribution, hotels and catering; 6: transport and communications; 7: banking and financial services; 8: public administration 9: other services.
Hqual	Dummy variable indicating highest educational qualification of the respondent. 1: higher degree; 2: first degree; 3: degree equivalent; 4: A-level; 5: O-level; 6: other; 7: none.

Appendix Table 2
Classification of Equivalent Qualifications

Equivalent Qualification	***LFS Classification***
Higher Degree	Higher degree
First Degree	First degree
Other Degree	**93-95**: other degree; diploma in higher education; HND/HNC, BTEC etc higher; teaching-further education; teaching-secondary; teaching-primary; teaching-level not stated; nursing; other higher education degree
	99-01: NVQ level 5; other degree; NVQ level 4; diploma in higher education; HND/HNC, BTEC etc higher; teaching-further education; teaching-secondary; teaching-primary; teaching-level not stated; nursing; RSA higher diploma; other higher education below degree level; NVQ level 3; GNVQ advanced
A-Level	**93-95**: RSA higher diploma; A-level or equivalent; RSA advanced diploma; OND/ONC, BTEC etc national; City and Guilds advanced craft; Scottish 6th year certificate or equivalent; SCE higher or equivalent; AS-level or equivalent; trade apprenticeship; RSA diploma; City and Guilds craft; BTEC etc first or general diploma
	99-01: A-level or equivalent; RSA advanced diploma or certificate; OND/ONC, BTEC/SCOTVEC national; City and Guilds advanced craft; Scottish 6th year certificate; SCE higher or equivalent; AS-level or equivalent; trade apprenticeship; NVQ level 2 or equivalent; GNVQ intermediate; RSA diploma; City and Guilds craft; BTEC/SCOTVEC first or general diploma
O-Level	O-level, CSE grade 1, GCSE grade A*-C or equivalent
Other	**93-95**: CSE below grade 1; BTEC etc first or general certificate; YT/YTP certificate; SCOTVEC national certificate; RSA other; City and Guilds other; other
	99-01: NVQ level 1 or equivalent; GNVQ/GSVQ foundation level; CSE below grade 1, GCSE below grade C; BTEC first or general certificate; SCOTVEC modules or equivalent; RSA other; City and Guilds other; YT/YTP certificate; other
None	No qualifications

Appendix Table 3
Classification of Degree Subject

Degree Subject	***LFS Classification***
Health	Medicine; medical related subjects (excluding nursing)
Nursing	Nursing
Sciences	Biological sciences; agricultural sciences; physical/environmental sciences
Mathematics and Computing	Mathematical sciences and computing
Engineering and Technology	Engineering; technology
Architecture and Related Studies	Architecture and related studies
Social Sciences	Social sciences (excluding economics and law)
Economics, Business and Financial Studies	Economics; business and financial studies
Law	Law
Arts	Librarianship and information studies; linguistics, English, Celtic and ancient languages; humanities; arts
Languages	European languages; other languages
Education	Education
Combined	Any joint or combined degree

Appendix Table 4
Full Regression Results for GB and Wales (Boost): Labour Force Survey 2001, Gross Hourly Earnings

	Men				Women			
	Great Britain		Wales*		Great Britain		Wales*	
	coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat
Constant	0.089	*1.74*	0.352	*40.80*	0.341	*6.80*	0.439	*49.35*
Age	0.069	*28.78*	0.055	*126.11*	0.051	*21.30*	0.045	*100.99*
Age squared *1000	-0.767	*26.76*	-0.590	*112.32*	-0.597	*20.14*	-0.530	*95.54*
Ethnic origin	-0.074	*2.57*	-0.087	*12.22*	-0.012	*0.47*	-0.045	*5.30*
Marital status 2	-0.121	*11.57*	-0.154	*86.01*	-0.020	*1.96*	-0.032	*16.36*
Marital status 3	-0.072	*4.90*	-0.064	*24.50*	-0.003	*0.24*	-0.024	*12.64*
Region 2	0.046	*2.46*	-	-	0.005	*0.30*	-	-
3	0.081	*4.15*	-	-	0.025	*1.37*	-	-
4	0.122	*5.05*	-	-	0.084	*3.44*	-	-
5	0.317	*11.63*	-	-	0.334	*11.57*	-	-
6	0.307	*13.94*	-	-	0.273	*13.25*	-	-
7	0.222	*12.85*	-	-	0.151	*9.38*	-	-
8	0.096	*5.15*	-	-	0.031	*1.76*	-	-
9	0.106	*5.60*	-	-	0.048	*2.77*	-	-
10	0.068	*3.61*	-	-	0.033	*1.95*	-	-
11	0.045	*2.18*	-	-	0.034	*1.70*	-	-
12	0.071	*3.71*	-	-	0.014	*0.79*	-	-
Part-time	-0.171	*7.52*	-0.167	*43.52*	-0.132	*17.02*	-0.085	*61.47*
Year 02	0.006	*0.63*	0.017	*10.32*	0.021	*2.28*	0.014	*8.79*
Job years 2	0.082	*7.99*	0.057	*31.39*	0.064	*7.25*	0.070	*41.00*
Job years 3	0.189	*18.57*	0.176	*99.35*	0.207	*23.09*	0.208	*126.09*
Employment numbers 2	0.042	*2.51*	0.080	*26.34*	0.040	*2.90*	0.022	*8.86*
3	0.040	*2.14*	0.069	*22.01*	0.050	*2.94*	0.054	*18.10*
4	-0.027	*0.87*	-0.039	*8.25*	-0.002	*0.08*	0.001	*0.15*
5	0.079	*5.62*	0.097	*41.53*	0.066	*5.32*	0.048	*22.16*
6	0.051	*2.74*	0.139	*47.65*	0.082	*4.28*	0.112	*36.22*
7	0.146	*12.68*	0.166	*86.74*	0.118	*11.74*	0.110	*63.40*
Industry 1	-0.129	*3.42*	-0.024	*3.53*	0.013	*0.20*	0.158	*10.79*
2	0.171	*6.52*	0.279	*78.73*	0.232	*6.39*	0.278	*41.45*
3	0.109	*9.03*	0.145	*69.52*	0.121	*9.07*	0.105	*46.72*
4	0.126	*8.71*	0.124	*46.54*	0.290	*8.55*	0.200	*31.57*
6	0.048	*3.14*	0.030	*10.18*	0.180	*10.06*	0.207	*45.78*
7	0.222	*15.45*	0.203	*68.38*	0.265	*21.77*	0.194	*81.86*
8	0.063	*4.73*	0.134	*58.26*	0.119	*12.21*	0.150	*86.74*
9	-0.038	*1.77*	-0.027	*7.12*	0.038	*2.08*	-0.013	*4.23*
Hqual 1	0.710	*37.13*	0.686	*225.60*	0.782	*41.46*	0.803	*241.64*
2	0.627	*39.33*	0.588	*223.30*	0.656	*42.83*	0.670	*237.81*
3	0.446	*30.59*	0.441	*200.63*	0.431	*31.81*	0.457	*196.65*
4	0.257	*20.71*	0.250	*127.10*	0.236	*19.44*	0.201	*94.80*
5	0.237	*16.30*	0.207	*89.62*	0.192	*16.95*	0.178	*93.21*
6	0.072	*4.95*	0.110	*48.21*	0.063	*5.01*	0.060	*27.61*
No. of observations	12,174		352,606		12,832		339,142	
F	264.46		10406.44		266.63		10545.53	
R-squared	0.45		0.45		0.44		0.46	

Notes: robust standard errors are in italics;
* weighted data.

ANNEXE 1

The Labour Force Survey (LFS) is a quarterly survey of households in Great Britain. Each quarter a sample of 60,000 households (120,000 individuals) are interviewed for five consecutive quarters. Its two main strengths are the large sample size and frequency of collection. It has extensive data on qualifications which enable one to isolate different types of higher degrees from first degrees, where the qualification was obtained and the type of course. It provides the age at which full-time education was completed. In its present form the LFS has been running since 1992. The British Household Panel Survey consists of some 5,500 households and 10,300 individuals drawn from 250 different areas of Great Britain who are surveyed each year and followed up wherever they move to within the U.K. New members of households found by original panel members are included also. This allows for panel estimation, though there is some attrition, especially since the panel started in 1991 and we now have 11 waves. The education data are comparable to those in the LFS. The General Household Survey started in 1971 and has been carried out continuously since then except for a break in 1997-98 and 1999-2000. Data are collected from approximately 9,000 households in Great Britain. Whilst the GHS has information on highest qualification obtained the wage data are less reliable than in the above data sets and it is only possible to obtain a consistent series on the usual weekly earnings of full-time employees for the period between 1974 and 1991. The National Child Development Survey (NCDS) examines a cohort born in 1958 who are periodically re-examined. The last wave (the fifth) was carried out in 1991. The data include type of qualification and subject studied, age at which started and whether passed, failed or dropped out, school qualifications, family and school background and uniquely , the results of maths and reading ability tests. The Family Expenditure Survey contains information on around 10,000 households and has high quality wage data. However,

educational data have only been collected since 1978. It provides information on the age individuals left full-time education, but not on the qualifications obtained, so that reliance must be placed on years of education. It was replaced by a new Expenditure and Food Survey in 2001. The Family Resources Survey is a survey of households in Great Britain, south of the Caledonian Canal and has been conducted annually from 1993 by the Department of Social Security.

ANNEXE 2

It is important to establish what has been happening to rates of return to educational qualifications, particularly at degree level, in recent years when the numbers entering higher education have risen sharply.[29] In section 5 we attempt to update earlier work using individual level data from the Quarterly Labour Force Survey for Britain pooled over a three year period between the Spring Quarter of 1993 and the Winter Quarter of 1995 (Blackaby, Murphy and O'Leary 1999).[30] The pooling is necessary to ensure adequate sample size in order to provide evidence on which degree courses provide the greatest return to graduates in the labour market. We repeat this exercise using over the period covering the Spring Quarter of 1999 to the Winter Quarter of 2001. This enables us to compare the outcome some 6 years later. In order to ensure comparability it has been necessary, however, to adjust the earlier analysis. First, the earlier analysis was limited to full-time employees. In order to obtain as complete a picture as possible we have now included part-time employees, but controlled for their inclusion in the analysis. Further, a new coding frame for degree subjects was incorporated into the LFS starting in the Summer of 1997 and as far as possible we have applied this to the earlier data. Again, the highest qualification obtained has been recoded to differentiate among higher degrees, first degrees, 'degree equivalent' qualifications, A-Levels, O-Levels, other qualifications and no qualifications (see Appendix Table 2 for details).

[29]In our sample the number of first degree graduates increased by 17% over the two periods and the numbers with higher degrees by over 80%. We use rate of return here loosely since we make no allowance for the cost of education to the individual.

[30] Our data are different from those used by Walker and Zhu (2003) since they exclude those living in Scotland and those aged below 25 and above 59, all of which are included in our analysis. Further, the controls used in the econometric analysis differ somewhat. For example, Walker and Zhu control for having a work limiting health problem and being a union member. Furthermore, the results for graduates given in Walker and Zhu are measured relative to a Language degree holder and are therefore not comparable with our own.

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