ABILITY, FAMILIES, EDUCATION AND EARNINGS IN BRITAIN

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Abstract

The paper estimates the returns to education for a cohort of individuals born in Britain in March 1958 who have been followed since birth until the age of 33. The data used has a wealth of information on family background including parental education, social class and interest shown in the child's education as well as measures of ability. These variables are typically missing in studies looking at the returns to schooling. In the paper we …nd that the return to an additional year of full-time education for the UK population as a whole is somewhere between 5 to 7 per cent for men and 8 to 10 per cent for women even after correcting for the e¤ects of measurement error. The paper also presents evidence that the returns to an additional year of schooling in the UK are heterogeneous. The results from the paper suggest that individuals undertaking education involving some sort of formal quali…cation have signi…cantly larger rates of return to an additional year of education than individuals who have obtained no formal education. Individuals whose highest educational quali…cation is an A level (the highest schooling quali…cation in the UK) appear to have the highest average return to an additional year of education at around 15 per cent for both men and women. There is also some evidence that individuals with

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lower tastes for education, have signi…cantly higher marginal returns to education. The results of the paper suggest that recent IV estimates of the returns to schooling in the UK, which exceed typical OLS estimates, may overestimate the average marginal return for the population as a whole.

1. Introduction

Estimates of the returns to education can be upward or downward biased if no account is taken of the fact that education is not randomly determined. Educational attainment depends on individual choices, attributes and circumstances and if we do not control for these factors, then the measured di¤erences in the wages of individuals with di¤erent levels of education may over- or under- estimate the true causal e¤ect of education on wage outcomes. These biases arise because of correlation between unobserved individual attributes which determine an individuals' education decisions and wage outcomes.

It is commonly assumed that the most important unobserved component is unobserved ability and that OLS estimates of the returns to education overstate the true returns because of this "omitted ability bias". This arises because the estimation procedure is unable to separate the contribution of unobserved ability to productivity from that made by education and ascribes it all to education. A number of recent empirical studies looking at this question such as Butcher and Case[10], Ashenfelter and Krueger[4], Card[11] and Harmon and Walker [17], have found evidence that conventional OLS estimates understate the returns to education, once account is taken of the correlation between unobserved components of education and wages. This can arise if education is measured with error. As Card [12] points out, however, it may also arise if the estimation procedure being used relies on "interventions" that a¤ect the schooling choices of children from relatively disadvantaged family backgrounds with high discount rates rather than low ability, as their marginal return to schooling will exceed the average return to schooling for the population as a whole.

In order to estimate the true causal e¤ect of education and earnings we therefore have to …rstly identify the sources of variation in observed education choices and then understand the type of variation that is being exploited by particular estimation procedures to obtain "corrected" estimates of the return to education. These issues are the focus of this paper.

The paper uses an extremely rich British panel data set, the National Child Development Survey (NCDS). The NCDS survey is a continuing longitudinal survey of persons living in Great Britain who were born between 3 and 9 March 1958. In this paper we focus on individuals from this cohort who were employees in 1991 when they were aged 33 and look at what factors were in‡uential in determining their educational outcomes and the returns to this education. We also attempt to control for possible measurement error in our measures of schooling and conclude by looking at whether there is any evidence of heterogeneity in the returns to education in Britain.

Our data has a wealth of family background information which has not generally been available in previous studies looking at the returns to schooling. This includes variables which measure parents' education, social class and interest in the child's education (as assessed by the child's teacher), as well as the families …nancial circumstances and composition. We also utilise the results of ability tests administered at the age of 7. The importance of controlling for these typically unobserved characteristics can therefore be directly assessed. The methodological approach used essentially involves using proxy or matching methods. This type of approach has also been used in related papers using the NCDS on the returns to higher education (see Blundell, Dearden, Goodman and Reed [7]) and the impact of school quality on education and earnings (see Dearden, Ferrier and Meghir [14]). The paper, however, also uses IV methods to deal with possible measurement error in schooling variables which has shown to be important in studies such as Ashenfelter and Krueger [4].

The data also has potential to exploit …xed e¤ect estimation techniques. Because the NCDS sample is a census of all individuals born in one week in March 1958 it includes a number of twins and triplets. This means that we also can use within family …xed e¤ect estimation procedures. Unfortunately, however, the twin and triplet sample by 1991 is very small[1] and it is di¢cult to draw any de…nitive

[1] Our …nal sample consists of 4960 employees in 1991 and this sample only contains 27 pairs of twins.

conclusions from results based on such a small sample. A signi…cant proportion of our sample who were in work in 1981 at the age of 23, have however, undertaken further education between 1981 and 1991. In this paper, however, we concentrate solely on education undertaken before individuals entered the labour market. The returns to subsequent education and training are the focus of the paper by Blundell, Dearden and Meghir [8].

The results of the paper suggest that recent IV estimates suggesting returns to education of around 15 per cent (e.g. Dearden [13] and Harmon and Walker [17]) may be on the high side. In the paper we …nd that the return to an additional year of full-time education is somewhere between 5 to 7 per cent for men and 8 to 10 per cent for women, though there is evidence of some heterogeneity in these returns. In section 2 we look more closely at the NCDS data used in our analysis. In section 3 we outline our estimation methodology. In section 4 the results of our analysis are discussed. Conclusions are o¤ered in section 5.

2. The NCDS Data

2.1. Introduction

The National Child Development Survey (NCDS) is a continuing longitudinal survey of persons living in Great Britain who were born between 3 and 9 March, 1958. There have been 5 waves of the NCDS, the last survey having been undertaken in 1991 when the cohort members were 33 years of age. In this paper we focus on a sample of individuals who participated in waves 4 and 5 of the NCDS in 1981 and 1991 respectively, who were employees in 1991.

2.2. Variables used in the analysis

2.2.1. Education and Ability Variables

The NCDS has information on the individuals highest school quali…cation and post-school quali…cation as at 1981 which we view as “education” or “schooling”. It also has the results from reading and mathematical ability tests undertaken

when the person was seven, eleven and sixteen as well as the information on the years of full-time education.

In looking at the returns to education we use two measures of education. The …rst measures years of full-time education. In constructing this measure we use the monthly economic activity information which identi…es spells of full-time education from 1974 when the individual could …rst leave compulsory education up until the time of from the NCDS4 survey in 1981. The second involves identifying a persons highest education quali…cation as at 1981. A lot of men in our sample undertook apprenticeship quali…cations which were largely taken on a part-time basis. Our measure of years of full-time education will not capture this part-time study. The NCDS, however, also gives us information on the persons highest school and post-school quali…cation as at 1981. We construct this measure using information from NCDS4 and a 1978 exams …le obtained from the individual's school which contains detailed high school examination results. We use this information to identify a person's highest educational quali…cation and follow as closely as possible the schema of Schmitt [25] which has subsequently been used by the OECD [23]. Our education measure based on highest quali…cation are clearly ordered and a full description of these variables is contained in Table 2.1.

Most individuals who have no formal quali…cations will have left school at the minimum school leaving age of 16. Some individuals with other quali…cations and lower vocational quali…cations obtained at school (e.g. CSEs and/or O levels) will also have left school at 16. Others in these two groups will have obtained their quali…cations (e.g. City and Guild quali…cations) after leaving school and will have therefore undertaken longer periods of education than those in the base group. The average di¤erence in years of education[2] between those individuals

[2] If we compare the average full-time years of education undertaken by individuals falling in these 3 groups the di¤erence is 0.1 years between the base group and those with other quali…cations and 0.3 years for those with lower vocational quali…cations. A large number of these quali…cations, however, would have been undertaken on a part-time basis and therefore not captured in this years of full-time education measure. Our estimate of between 0 to 6 months, and all subsequent estimates, attempt to take this into account.

Table 2.1: Description of Highest Education Quali…cation Variables

Variable	Description
Highest Quali…cation at age 23 in 1981:	
Degree	University or CNAA …rst degree, CNAA Post-graduate Diploma, or University or CNAA Higher Degree.
Higher Vocational	Highest Vocational: Full professional quali…cation, part of a professional quali…cation, Polytechnic Diploma or Certi…cate (not CNAA validated), University or CNAA Diploma or Certi…cate, Nursing quali…cation including nursery quali…cation, non-graduate teaching quali…cations, Higher National Certi…cate (HNC) or Diploma (HND), BEC/TEC Higher Certi…cate or Higher Diploma, City and Guilds Full Technological Certi…cate.
A Levels	At least one GCE A Level, Scottish Leaving Certi…cate (SLC), Scottish Certi…cate of Education (SCE), Scottish University Preliminary Examination (SUPE) at Higher Grade, Certi…cate of Sixth Year Studies.
Middle Vocational	Middle Vocational or at least …ve O Level passes: City and Guilds Advanced or Final, Ordinary National Certi…cate (ONC) or Diploma (OND), BEC/TEC National, General or Ordinary, at least …ve GCE O Level passes or grades A–C, or CSE Grade 1 or equivalent.
Lower Vocational	Lower Vocational or O levels: City and Guilds Craft or Ordinary, a Royal Society of Arts (RSA) awards, stage 1, 2 or 3 or other commercial or clerical quali…cations, at least one GCE O Level passes or grades A–C, or CSE Grade 1 or equivalent.
Other	Miscellaneous Quali…cations: All other courses leading to some sort of quali…cation which are not identi…ed above including CSE grade 2–5 or equivalent and miscellaneous apprenticeship quali…cations.
None	No quali…cations including those with no formal schooling.

with no quali…cations and those with other or lower vocational quali…cations will be somewhere between 6 months and a year. The di¤erence between those individuals with no quali…cations and those with middle vocational quali…cations is, on average, somewhere around 2 years. The di¤erence between individuals with no quali…cations and those with A levels is around $2\frac{1}{2}$ to 3 years on average and those with higher vocational quali…cations around $3\frac{1}{2}$ to 4 years. There is however, a large degree of heterogeneity in years of education among individuals with higher vocational quali…cations, particularly between those who have A levels and those who do not. We make no attempt in this paper to distinguish between these individuals[3]. Finally individuals with degrees will have on average around $5\frac{1}{2}$ to 6 years more education than individuals with no quali…cation and 3 years more schooling than those individuals with only A levels.

Similar information on both monthly economic activity including spells in

[3] This issue was considered in detail by Blundell, Dearden, Goodman and Reed [7].

full-time education (since 1974) and highest education quali…cations (as at March 1981 and 1991) can also be obtained from the 1991 NCDS5 survey. This allows us to also construct another set of education variables based solely on responses in the 1991 survey. It is these variables which we exploit in looking at possible measurement error in our education variables. This is discussed in more detail below.

We also construct measures of reading and mathematics ability which are based on ability tests undertaken when the child was aged seven. We use the seven year old test results, as these are much less likely to be a¤ected by knowledge gained at school. From these verbal and mathematics ability tests we construct 10 dummy variables which rank the individual's results in each of the tests by quintiles[4].

2.2.2. School and Family Background Variables

We use data from the …rst wave of the NCDS to construct dummy variables identifying the teacher's assessment of the interest shown by the mother and father in the education of the child at that age. From the third wave of the survey we construct dummy variables identifying the type of school the individual attended in 1974 (government comprehensive, government grammar (selective), government secondary modern, private or special). We ignore other school quality variables which are available in the data such as teacher/pupil ratios. The e¤ects of these other measured school quality variables on education and earnings was found to be small in the paper by Dearden, Ferrier and Meghir [14].

We also use the data from the third wave of the survey to construct variables identifying fathers' social class; the years of full-time education undertaken by the child's mother and father at that age[5]; variables identifying individuals who had no

[4] We choose quintiles, as 20 per cent of individuals in 1965 when the tests were undertaken obtained maximum marks in the reading ability test. The quintiles refer to quintiles at the time the test was taken and not in our …nal sample.

[5] The variable measures the years of full-time education undertaken by the child's mother and father …gure at the age of 16. This is constructed from a variable which identi…es the age at which the parent's left full-time education, assuming they started school at the age of …ve. If there is no mother or father …gure or parental education is missing, then parental years of

father …gure at that age; whether the family was experiencing …nancial di¢culties in 1969 or 1974[6]; the number of siblings and older siblings the respondent had; and …nally whether the respondent had only brothers or sisters[7].

2.2.3. Wage, Demographic, Employer and Regional Variables

We use data from the NCDS5 survey to construct real hourly gross wage data measured in 1995 prices. We limit our sample to individuals who are employees at the time of the 1991 survey. Since all individuals in the sample are born in the same week of March 1958 age (or potential labour market experience) is controlled for in all of models. We also use the NCDS5 data to identify whether the individual was working in a large …rm (more than 500 workers), in the private sector and whether they were a member of a trade union in 1991. We also use the NCDS3 and NCDS5 surveys to construct 11 regional dummy variables for both 1974 and 1991. We also use 1971 local area Census information to control for local authority[8] demographics. This Census information has been mapped into the local authority in which the individual lived in 1974. The variables we use in the paper measure the proportion of households in the local authority with an unemployed head of household, with a head of household in top social class, who are council tenants and owner-occupiers.

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education are set to zero. We separately identify individual's who have no father …gures as well as those with missing parental education information.

[6] Following Micklewright[22], this identi…es individual's who received free school meals in 1969 or 1974 or whose parents were seriously troubled …nancially in the year prior to the 1969 or 1974 survey.

[7] Dearden [13] looked at the e¤ects of various family composition variables on education and earnings and found that these four composition variables were the most important.

[8] There were approximately 140 local authorities in Britain in 1974. Local authorities are responsible for schools in their area, although they received the majority of their funding for schools from central government.

2.2.4. The Final Sample

We drop individuals who have missing observations on wages, our measures of education and ability at 7[9]. This leaves us with a …nal sample of 2597 males and 2363 females. Summary Statistics for these individuals are given in Table .1 in the Appendix. These show that the sample used in this Chapter under-represents individuals in the bottom quintiles of the reading and arithmetic ability tests undertaken when the child was 7.

3. Methodology

3.1. Estimation Methodology

In this paper, we begin by following the approach of Dearden, Blundell, Goodman and Reed [7] and Dearden, Ferrier and Meghir [14] and assume that schooling decisions are made on the basis of variables that are observable (or well proxied by variables) in our NCDS data. We start with the usual two equation system

$$w_i = s_i^{\prime} \beta + X_i^{\prime} \alpha + \varepsilon_i \tag{3.1}$$

$$s_i = X_i^{\prime} \gamma + v_i \tag{3.2}$$

where s_i is years of full-time education or a vector of dummy variables identifying the person's highest quali…cation, w_i is the log of the real hourly wage rate, X_i is a vector of exogenous observed individual characteristics, β is the return to education and ε_i and v_i are a pair of residuals.

OLS estimation of equation (3.1) gives rise to a unbiased estimate of the return to education if ε_i and v_i are uncorrelated, that is if s_i is exogenous in equation (3.1) ($E(s_i \varepsilon_i) = 0$): This will arise if conditioning on the observable variables (X_i) is su¢cient to control for the endogenous choice of schooling (s_i): We assume that individuals who are the same in the observable dimension X_i but choose di¤erent

[9] Rather than dropping individuals who have missing information on other variables of interest we include missing variable dummies.

values of schooling s_i do not di¤er on average in the unobserved dimension $"_i$: Formally this means that $E("_i|s_i; X_i) = E("_i| X_i)$: The arguments used here are similar to the arguments made for the matching estimators (see Heckman, Ichimura and Todd [21] and Dearden, Ferrier and Meghir[14] for more details). If, however, there are unobserved determinants of wages which are correlated with schooling choices then OLS will produce biased estimates of the returns to schooling.

In equation (3.1) we assume that there is a constant return to schooling. The model could be extended to allow the returns to education to be heterogeneous (i.e. $¯_i = ¯ + e_i$ where $Var(e_i) > 0$). If we assume that only the average population value of e_i; conditional on the observables is known by the person undertaking the choice of s_i then $E(e_i|s_i; X_i)s_i = E(e_i| X_i)s_i$: Hence the average e¤ect $¯$ can be identi…ed by the regression

$$y_i = s_i^{0}¯ + X_i^{0}® + (X_i \otimes s_i)^{0}± + u_i \tag{3.3}$$

where $E(u_i|s_i; X_i) = 0$: In equation (3.3) the coe¢cients ± re‡ect the heterogeneity in the returns to s_i. Given the above assumptions the model can be estimated by Ordinary Least Squares (OLS). The standard errors must be computed using White's (1982) adjustment for heteroskedasticity, if only because the heterogeneous returns imply that the variance of u_i will depend on s_i:

3.2. Controlling for measurement error in schooling

Clearly OLS estimation of equation (3.1) or equation (3.3) will only be consistent if there are no other unobserved individual e¤ects correlated with schooling (or indeed any right hand side variable), that is if $E(s_i"_i) = 0$: If schooling is measured with error (or our methodological approach does not appropriately control for the endogeneity of schooling) then our estimates of the returns to education will still be biased. The biases associated with measurement error in schooling are discussed in detail in Ashenfelter and Krueger [4] and Card[12]. If this is the case then we have to rely on instrumental variable techniques. This requires …nding at

least one instrument which is correlated with the true measure of schooling and uncorrelated with the measurement error. For each individual in our data we have a number of measures of their educational outcome by the age of 23 in 1981. In an attempt to correct for possible measurement error we use the educational measures reported by the individual in 1991 as instruments for the educational outcomes they reported in 1981. If the measurement errors in the 1991 reports of educational outcomes are uncorrelated with the measurement errors in the 1981 variables, this IV procedure should eliminate any downward bias associated with measurement error. This is an open question, but we feel our attempt may give us some ball park …gures on the extent of measurement error in our data. As a check on the robustness of our IV procedure we also compare results obtained when we instead use our 1981 survey measures of education as instruments for our 1991 survey education variables[10]. More generally, any variable which determines schooling, but not wages controlling for schooling, could also be used as an instrument.

For our years of full-time education variable we carry out IV estimation of equation (3.1) treating schooling as endogenous[11]. For our highest quali…cation variable we follow the approach of Vella and Gregory [27] and Harmon and Walker [17] and exploit the fact that this measure of educational outcome is ordered and use a latent variable model of the form

$$s_i^{\alpha} = Z_i^{\prime}\circ + v_i \tag{3.4}$$

where

$$s_{ij} = 1 \text{ if } {}^{1}{}_{j\,i\,1} < s_i^{\alpha} \leq {}^{1}{}_{j} \tag{3.5}$$

[10] The author would like to thank Arthur van Soest for making this suggestion.

[11] This is equivalent to estimating the following wage equations (ignoring possible heterogeneity in the returns to schooling)

$$\ln w_i = {}^{-\prime}s_i + x_i^{\prime}\circledR + \tfrac{3}{4}\text{b}_i$$

where b_i are the residuals from OLS estimation of years of education on Z_i where $Z_i = (X_i; W_i)$ and W_i are our instruments. A Hausman t test of the exogeneity of schooling is given by testing $\tfrac{3}{4} = 0$ (see Smith and Blundell[26]). Our standard errors need to be corrected to take account of the fact that we have a generated regressor in our wage equation (see Pagan [24] and Arellano and Meghir [3]).

where $j = 0; 1; 2; 3::6$ and s_{ij} is a vector of dummy variables identifying a person with highest quali…cation j, and $^1_{j\,i\,1} < {}^1_j$. The education equations are now estimated as ordered probits and the parameter estimates are used to calculate the usual Heckman [18] selection adjustment term for our ordered quali…cation variables

$$b_{¸qi} = \frac{Á(ª_j - Z_i^{0}ß) - Á(ª_{j+1} - Z_i^{0}ß)}{©(ª_{j+1} - Z_i^{0}ß) - ©(ª_j - Z_i^{0}ß)} \tag{3.6}$$

where the $ª_j$'s and ß are the estimates obtained from the ordered probit maximum likelihood procedures, and Á(:) and ©(:) are the normal probability distribution and normal cumulative distribution functions respectively. We can then estimate the following model

$$w_i = s_i^{0}— + X_i^{0}® + '\,b_{¸qi} + "_i \tag{3.7}$$

where s_i is now a vector of dummy variables identifying the person's highest quali…cation. In this formulation our standard errors are corrected to take account of the generated regressor ($b_{¸qi}$) in the equation. As a check on the robustness of this procedure we also estimate a standard IV model which, by de…nition, uses linear probability models for each of the di¤erent quali…cations rather than an ordered probit in the …rst stage estimation. This IV procedure does not exploit the ordering of our education quali…cation variables.

4. Results

4.1. The determinants of educational outcomes

We begin by looking at the determinants of education. In particular we focus on the impact of family background variables and measures of parental "tastes" for education as well as measures of ability on an individual's education outcome.

From our data we have constructed two measures of educational outcomes. The …rst is years of full-time education and the second involved identifying the highest quali…cation a person has received. In Table 4.1 we present the results of

our various education equations for both males and females. In columns 1 and 2 of these tables we present the results from our reduced form years of education regression for men and women respectively. In the third and fourth column we present analogous results of our highest quali…cation ordered probit equations.

All four columns in Table 4.1 give broadly similar results as to the determinants of educational outcomes for men and women. It is clear that more able men and women do signi…cantly better than less able men and women. Men in the top quintile of the mathematics ability test have on average 0.65 of a year more full-time education than those in the bottom while men in the top quintile of the reading ability test have almost a year more full-time education than those in the bottom quintile of that test. Similarly being in the top quintile of the mathematics ability test increases the probability of undertaking a degree on average by 14.6 percentage points compared to those in the bottom quintile and being in the top quintile of the reading ability test increases the probability of undertaking a degree by 15 percentage points compared to those in the bottom quintile of that test[12]. The type of school attended in 1974 is also an important determinant of educational outcomes. The base group in the table is government comprehensive (non-selective) schools. Children who attend government grammar (selective) schools or private schools have signi…cantly better educational outcomes than those attending comprehensive schools. The estimated probability of undertaking a degree increases by 8.1 percentage points for boys who attended a grammar school and 11.4 percentage points for boys who attended a private school compared to boys who attended a comprehensive school.

Children with more educated father's and mother's have better educational outcomes than children from less well educated parent's. For women in our sample, mother's educational outcomes are particularly important determinants of their educational outcomes. The probability of a women undertaking a degree increases by 1.1 percentage point for every extra year of education undertaken

[12] These marginal e¤ects are evaluated using sample means of all other explanatory variables in the ordered probit model.

Table 4.1: The Determinants of Education Outcomes

Variable	Years of Full-time Education				Highest Quali…cation			
	Males		Females		Males		Females	
Constant	8.755	(0.575)	8.404	(0.562)				
Maths ability:								
5th quintile (top)	0.650	(0.125)	0.570	(0.127)	0.728	(0.077)	0.576	(0.081)
4th quintile	0.301	(0.122)	0.327	(0.121)	0.476	(0.075)	0.416	(0.077)
3rd quintile	0.341	(0.117)	0.181	(0.120)	0.427	(0.072)	0.381	(0.076)
2nd quintile	0.187	(0.119)	0.064	(0.115)	0.302	(0.073)	0.233	(0.073)
Verbal ability:								
5th quintile (top)	0.971	(0.134)	0.632	(0.141)	0.744	(0.083)	0.815	(0.091)
4th quintile	0.520	(0.125)	0.338	(0.137)	0.584	(0.077)	0.686	(0.088)
3rd quintile	0.313	(0.117)	0.110	(0.135)	0.466	(0.072)	0.431	(0.087)
2nd quintile	0.223	(0.112)	0.038	(0.136)	0.301	(0.069)	0.242	(0.087)
Type of school 1974:								
Secondary modern	-0.277	(0.098)	-0.171	(0.101)	-0.192	(0.060)	-0.193	(0.064)
Grammar school	1.034	(0.124)	1.105	(0.120)	0.435	(0.077)	0.581	(0.077)
Private school	1.387	(0.168)	1.081	(0.181)	0.556	(0.108)	0.428	(0.117)
Other	-0.069	(0.251)	0.103	(0.288)	-0.265	(0.155)	-0.262	(0.188)
Father's years of education	0.083	(0.028)	0.039	(0.026)	0.064	(0.018)	0.042	(0.017)
Father's education missing	0.818	(0.371)	0.457	(0.346)	0.688	(0.230)	0.430	(0.220)
Mother's years of education	0.155	(0.032)	0.259	(0.030)	0.045	(0.020)	0.092	(0.019)
Mother's education missing	1.346	(0.411)	2.715	(0.395)	0.202	(0.258)	0.940	(0.253)
Number of siblings	-0.052	(0.035)	-0.017	(0.033)	-0.029	(0.022)	-0.023	(0.021)
Number of older siblings	-0.007	(0.041)	-0.007	(0.040)	-0.053	(0.025)	-0.026	(0.025)
Sisters only	-0.114	(0.099)	0.126	(0.103)	-0.063	(0.061)	0.095	(0.065)
Brothers only	-0.116	(0.098)	0.216	(0.100)	-0.013	(0.060)	0.046	(0.064)
Father's social class 1974:								
Professional	1.158	(0.219)	1.198	(0.210)	0.550	(0.140)	0.460	(0.136)
Intermediate	0.372	(0.132)	0.492	(0.136)	0.259	(0.081)	0.223	(0.087)
Skilled non-manual	0.455	(0.149)	0.038	(0.161)	0.296	(0.091)	0.046	(0.101)
Skilled manual	0.086	(0.107)	0.004	(0.109)	0.174	(0.066)	0.039	(0.069)
Semi-skilled non-manual	-0.488	(0.331)	0.073	(0.327)	-0.053	(0.201)	-0.017	(0.207)
Missing	0.548	(0.308)	0.367	(0.342)	0.101	(0.190)	-0.146	(0.215)
No father …gure 1974	-0.075	(0.212)	0.215	(0.194)	0.114	(0.130)	0.124	(0.123)
Mother employed 1974	-0.114	(0.084)	-0.064	(0.086)	-0.058	(0.052)	0.014	(0.054)
Bad …nances 1969 or 1974	-0.232	(0.105)	-0.207	(0.102)	-0.264	(0.065)	-0.330	(0.065)
Bad …nances missing	0.008	(0.273)	-0.196	(0.272)	-0.092	(0.168)	-0.131	(0.172)
Father's interest in edn:								
Expects too much	0.686	(0.328)	1.008	(0.442)	0.407	(0.206)	0.579	(0.285)
Very interested	0.315	(0.111)	0.134	(0.111)	0.215	(0.068)	0.162	(0.070)
Some interest	0.236	(0.092)	0.077	(0.095)	0.115	(0.056)	0.045	(0.060)
Mother's interest in edn:								
Expects too much	0.415	(0.225)	0.398	(0.265)	0.256	(0.138)	0.329	(0.170)
Very interested	0.326	(0.123)	0.443	(0.125)	0.306	(0.075)	0.369	(0.079)
Some interest	-0.011	(0.104)	0.062	(0.107)	0.190	(0.064)	0.170	(0.068)
θ_1					0.595	(0.359)	1.011	(0.360)
θ_2					1.271	(0.358)	1.708	(0.360)
θ_3					2.076	(0.359)	2.750	(0.361)
θ_4					2.815	(0.360)	3.255	(0.363)
θ_5					3.184	(0.361)	3.568	(0.364)
θ_6					3.690	(0.362)	4.157	(0.365)
Number of observations	2597		2363		2597		2363	
P-value regional dummies	0.726		0.005		0.046		0.135	
P-value demographics	0.283		0.116		0.817		0.013	
Log Likelihood					-4311.46		-3836.96	
(Pseudo) R^2	0.3417		0.3386		0.1169		0.1251	

by her mother. Family size, measured by the number of siblings, has a negative though not particularly signi…cant e¤ect on educational outcomes. Birth order (controlling for family size) is a signi…cant determinant of men's highest quali…cation outcomes with boys with fewer older siblings doing signi…cantly better than boys further down the birth order. In the years of education speci…cation, women with only brothers have signi…cantly better outcomes.

Men and women whose fathers who worked in more highly skilled occupations do signi…cantly better than those whose fathers work in relatively unskilled jobs. Mother's employment status in 1974 is not a signi…cant determinant of educational outcomes.

Women and men whose families were in serious …nancial trouble in 1969 or 1974 have signi…cantly worse educational outcomes than those from families not experiencing …nancial di¢culties. The probability of undertaking a degree is 3.5 percentage points lower for men and 3.4 percentage points lower for women from families experiencing …nancial di¢culties. Finally parental interest in the child's education at the age of 7 (as assessed by the child's teacher) is also an important determinant of educational outcomes for men and women in our sample. Individual's whose parents showed interest in their education at an early age have signi…cantly better educational outcomes than individuals whose parents showed little or no interest. This result holds for both men and women. The results from this section suggest that factors like "access to funds" and "tastes for education" along with ability are all important determinants of educational outcomes.

4.2. Estimates of the Returns to Education

4.2.1. The Returns to Years of Education

Table 4.2 reports the results for men of our OLS estimation procedure. In the …rst column (speci…cation 1) we report the raw return to years of full-time education for men when no other factors are controlled for. In column 2 we control for region of residence in 1974 and 1991 only. This column is taken as a benchmark

of typical OLS estimates of the returns to education when only gender, age and region have been controlled for. In column 3 we include our measures of ability as well as school type variables. Finally in column 4 we also include demographic variables, family background and composition variables and variables identifying what we term "employer characteristics" (whether the …rm employed more than 500 workers, whether it was in the private sector and whether the individual was a union member).

From Table 4.2 we see that the raw return to an additional year of full-time education for men in our sample is around 8 per cent. When we control for region of residence the return falls to 7.2 per cent. When we also control for ability and school type it drops to 5.2 per cent and …nally when we also control for family background and work characteristics the return is estimated at 4.8 per cent. The full set of results for speci…cation 4 are given in Table .2 in the Appendix.

Table 4.2: Returns to Years of Education: Males

Variable	Speci…cation:							
	1		2		3		4	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.076	(0.044)	1.335	(0.057)	1.364	(0.060)	1.235	(0.133)
Years of Education	0.080	(0.004)	0.072	(0.004)	0.052	(0.004)	0.048	(0.004)
Maths ability at 7:								
5th quintile (top)					0.180	(0.028)	0.171	(0.027)
4th quintile					0.114	(0.026)	0.109	(0.026)
3rd quintile					0.111	(0.025)	0.109	(0.025)
2nd quintile					0.069	(0.026)	0.066	(0.025)
Reading ability at 7:								
5th quintile (top)					0.152	(0.028)	0.132	(0.029)
4th quintile					0.162	(0.026)	0.139	(0.026)
3rd quintile					0.131	(0.025)	0.111	(0.025)
2nd quintile					0.114	(0.023)	0.096	(0.023)
Number of observations	2597		2597		2597		2597	
P-value, 1991 regional variables			0.000		0.000		0.000	
P-value, 1974 regional variables			0.062		0.060		0.015	
P-value, ability variables					0.000		0.000	
P-value, school type variables					0.102		0.282	
P-value, family variables							0.007	
P-value, parental interest							0.145	
P-value, demographics							0.180	
P-value, employer characteristics							0.000	
R^2	0.1494		0.2139		0.2635		0.2949	

The important point to emerge from this table is that ability is an important determinant of the level of wages for men and that when we do not control for

ability, our OLS estimates of the returns to full-time education are signi…cantly higher than when we do. Focussing on speci…cation 4, we see that men who were in the top quintile of the mathematics ability test at the age of 7, have on average 17.1 per cent higher wages than those men who were in the bottom quintile. From Table .2 we see that other family background factors such as father's education, father's social class, the family's …nancial situation and mother's interest in the child's education, are also important determinants of wages, and when these are controlled for, our OLS estimates of the return to education falls. Some of these family background variables are typically used as instruments for education in wage equations and the results from this Table suggest that this may not be appropriate.

The corresponding results for women are given in Table 4.3. We see from the Table that the raw return to an additional year of full-time education is 12.2 per cent. This is signi…cantly higher than the raw return for men in our sample. As we control for more factors, the return once again falls, but even in speci…cation 4 we have a return of around 8.3 per cent, some $3\frac{1}{2}$ percentage points higher than that found for men. A full set of results for speci…cation 4 is again given in Table .2 in the Appendix. As was the case for men, ability is an important determinant of the level of wages for women in our sample and OLS estimates of the returns to education which do not control for this are signi…cantly higher than estimates obtained when ability is controlled for. Again family background variables are also important, in particular family composition, father's social class, family …nancial circumstances as a child and mother's interest in the daughter's education.

It should be remembered, however, that our years of education variable measures years of full-time education only and is probably a poor measure of true educational outcomes (particularly for men), as mentioned earlier. Also if our education variable is measured with error then we will have underestimated the return to education. This problem is especially serious when we have a large number of other explanatory variables such as in Speci…cation 4. All of these issues

Table 4.3: Female Returns to Years of Education

Variable	Specification: 1		2		3		4	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Constant	0.189	(0.052)	0.478	(0.070)	0.494	(0.077)	0.722	(0.147)
Years of Education	0.122	(0.004)	0.116	(0.004)	0.100	(0.005)	0.083	(0.005)
Maths ability at 7:								
5th quintile (top)					0.067	(0.032)	0.042	(0.031)
4th quintile					0.043	(0.030)	0.033	(0.028)
3rd quintile					0.026	(0.030)	0.024	(0.029)
2nd quintile					0.016	(0.028)	0.021	(0.026)
Reading ability at 7:								
5th quintile (top)					0.214	(0.032)	0.166	(0.032)
4th quintile					0.194	(0.033)	0.144	(0.032)
3rd quintile					0.166	(0.031)	0.124	(0.030)
2nd quintile					0.119	(0.031)	0.091	(0.029)
Number of observations	2363		2363		2363		2363	
P-value, 1991 regional variables			0.000		0.000		0.000	
P-value, 1974 regional variables			0.439		0.493		0.322	
P-value, ability variables					0.000		0.000	
P-value, school type variables					0.386		0.732	
P-value, family variables							0.001	
P-value, parental interest							0.168	
P-value, demographics							0.252	
P-value, employer characteristics							0.000	
R^2	0.2502		0.2878		0.3131		0.4138	

are looked at in more detail below.

4.2.2. The Returns to Highest Qualifications

Our estimates of the returns to highest qualifications for men are given in Table 4.4. The base group in these equations are individuals with no school or post-school qualifications by the age of 23. The four specifications reported are the same as in the previous sub-section. A full set of results for specification 4 is given in Table .3 in the Appendix.

The OLS estimates presented in the table suggest that there are significant returns to all types of qualifications for men in our sample. We see from column 1 that the raw return to a degree for the men in our sample (compared to individuals with no qualifications) is 71 per cent, whereas the return to undertaking A levels is around 55 per cent, a difference of 16 percentage points. As we control for more factors, these returns become smaller as was the case for our years of education results in the previous sub-section. Once again our ability variables

are positive and signi…cant, and result in a downward revision of our estimated returns to various quali…cations. In Speci…cation 4, the return to a degree is 50.1 per cent compared to a return for A levels of 37.6 per cent, a di¤erence of just over 10 percentage points. These results suggest that there is a return of around 15 per cent per year for undertaking A level quali…cations (assuming that an A level quali…cation takes $2\frac{1}{2}$ years more than obtaining no quali…cations) and 9 per cent per year for undertaking a degree (assuming that a degree quali…cation takes $5\frac{1}{2}$ years more than obtaining no quali…cations). Since almost all individuals with degrees also have A levels the results suggest that there are much higher returns to undertaking A levels than continuing on after taking A levels and undertaking a degree. It is clear from the Table that all quali…cations are associated with signi…cant annual returns compared to the base group who have no quali…cations. The annual return to a middle vocational quali…cation is around $12\frac{1}{2}$ per cent (assuming that this quali…cation takes 2 years more than obtaining no quali…cation) and for a higher vocational quali…cation around 12 per cent (assuming that this quali…cation takes $3\frac{1}{2}$ years more than obtaining no quali…cation). These annual returns are much larger than those estimated in the previous section and suggests that the group of men with no quali…cations have very low annual returns to their time spent in school.

The corresponding results for women are given in Table 4.5. For women, there are also clear returns to ability, particularly reading ability. This once again results in a downward revision of our OLS estimates of the returns to education. It is clear from Table .3 in the Appendix that family background variables, such as father's social class and family composition variables are also important determinants of the level of women's wages. As was the case with years of education, the returns to quali…cations are higher for women than for men. In speci…cation 4, the return to a degree is 63.6 per cent compared to the return for undertaking A levels of 37.2 per cent, a di¤erence of just over 26 percentage points. These results suggest that there is a return of around 15 per cent per year for under-

Table 4.4: The Returns to Quali…cations: Males

Variable	Speci…cation: 1		2		3		4	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.685	(0.025)	1.880	(0.038)	1.790	(0.041)	1.656	(0.127)
Highest Quali…cation 1981:								
Other	0.157	(0.031)	0.132	(0.030)	0.109	(0.030)	0.097	(0.029)
Lower vocational	0.284	(0.029)	0.270	(0.028)	0.216	(0.028)	0.194	(0.028)
Middle vocational	0.353	(0.029)	0.342	(0.029)	0.274	(0.029)	0.251	(0.029)
A Levels	0.552	(0.037)	0.506	(0.036)	0.405	(0.037)	0.376	(0.038)
Higher vocational	0.549	(0.034)	0.526	(0.033)	0.444	(0.033)	0.419	(0.034)
Degree	0.707	(0.031)	0.658	(0.031)	0.530	(0.034)	0.501	(0.036)
Maths ability at 7:								
5th quintile (top)					0.129	(0.027)	0.123	(0.026)
4th quintile					0.075	(0.025)	0.071	(0.025)
3rd quintile					0.080	(0.024)	0.077	(0.024)
2nd quintile					0.045	(0.025)	0.043	(0.024)
Reading ability at 7:								
5th quintile (top)					0.095	(0.028)	0.092	(0.028)
4th quintile					0.100	(0.025)	0.095	(0.025)
3rd quintile					0.081	(0.024)	0.074	(0.024)
2nd quintile					0.081	(0.022)	0.073	(0.022)
Number of observations	2597		2597		2597		2597	
P-value, 1991 regional variables			0.000		0.000		0.000	
P-value, 1974 regional variables			0.033		0.040		0.020	
P-value, ability variables					0.000		0.000	
P-value, school type variables					0.116		0.286	
P-value, family variables							0.219	
P-value, parental interest							0.669	
P-value, demographics							0.257	
P-value, employer characteristics							0.000	
R^2	0.2263		0.2892		0.3106		0.3352	

Table 4.5: The Returns to Quali…cations: Females

Variable	Speci…cation: 1		2		3		4	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.343	(0.023)	1.611	(0.040)	1.532	(0.045)	1.582	(0.133)
Highest Quali…cation 1981:								
Other	0.079	(0.030)	0.058	(0.030)	0.047	(0.030)	0.027	(0.028)
Lower vocational	0.173	(0.027)	0.157	(0.027)	0.122	(0.028)	0.084	(0.027)
Middle vocational	0.374	(0.033)	0.356	(0.032)	0.302	(0.035)	0.229	(0.034)
A Levels	0.562	(0.038)	0.541	(0.037)	0.479	(0.039)	0.372	(0.039)
Higher vocational	0.671	(0.034)	0.655	(0.034)	0.606	(0.036)	0.452	(0.037)
Degree	0.882	(0.032)	0.832	(0.032)	0.754	(0.037)	0.636	(0.040)
Maths ability at 7:								
5th quintile (top)					0.025	(0.030)	0.011	(0.030)
4th quintile					0.012	(0.028)	0.011	(0.028)
3rd quintile					-0.017	(0.029)	-0.005	(0.028)
2nd quintile					-0.001	(0.027)	0.007	(0.026)
Reading ability at 7:								
5th quintile (top)					0.142	(0.032)	0.128	(0.032)
4th quintile					0.120	(0.032)	0.105	(0.032)
3rd quintile					0.130	(0.031)	0.111	(0.030)
2nd quintile					0.099	(0.030)	0.085	(0.029)
Number of observations	2363		2363		2363		2363	
P-value, 1991 regional variables			0.000		0.000		0.000	
P-value, 1974 regional variables			0.065		0.066		0.070	
P-value, ability variables					0.000		0.008	
P-value, school type variables					0.641		0.939	
P-value, family variables							0.005	
P-value, parental interest							0.376	
P-value, demographics							0.475	
P-value, employer characteristics							0.000	
R^2	0.3333		0.3702		0.3788		0.4447	

taking A level quali…cations (which is almost the same as the return for men) and 12 per cent per year for undertaking a degree (which is higher than that for men). Again it is clear from the Table that all except other quali…cations are associated with signi…cant annual returns compared to the base group who have no quali…cations. For women, the annual return to a middle vocational quali…cation is around 11 per cent (assuming that this quali…cation takes 2 years more than obtaining no quali…cation) and for a higher vocational quali…cation is around 13 per cent (assuming that this quali…cation takes $3\frac{1}{2}$ years more than obtaining no quali…cation). These are, with the exception of degree and other quali…cations, very similar to those obtained for men. For women, those with no quali…cations and other quali…cations have very poor returns to their investment in education. This heterogeneity in both male and female annual rate of returns to investment in education was not captured in the results of the previous section. This issue of heterogeneity is explored in more detail below.

The results obtained to this point suggest that there are signi…cant returns to ability and other factors such as family background variables and that estimates which do not take this into account over-estimate the returns to education and quali…cations. The results suggest that IV estimators which use family background variables such as father's years of education, father's social class and family composition variables may not be appropriate in the UK.

However, this is not the end of the story. As pointed out earlier, if there remains unobserved individual determinants of wages, which are correlated with educational outcomes, then our OLS estimates may still be biased. This will arise if education is measured with error, in which case our OLS estimates of the returns to education will be too low. We look at this issue in the next section.

4.3. Correcting for Measurement Error in Education

In this section we use instrumental variable methods in an attempt to correct for possible measurement error which may be biasing our estimates of the returns

to education. The results of doing this are presented in Tables 4.6, 4.7 and 4.8. In these Tables, we present our OLS results from speci…cation 4 in the previous section and IV estimates which attempt to correct for any measurement error in our education variables.

The educational measures we have used in this paper so far come from responses from the 1981 (NCDS4) survey. Almost identical questions were also asked of individuals in the 1991 (NCDS5) survey including details of quali…cations and labour market activity before and up to 1981. If the measurement errors in the 1991 reports of educational outcomes are uncorrelated with the measurement errors in the 1981 variables, then these variables can also be used as instruments to correct for possible measurement error. The results of doing this are reported in Tables 4.6, 4.7 and 4.8.

Looking at the years of education results for men presented in Table 4.6 we see that both of our IV estimation procedures suggest that our earlier OLS estimates may have been downward biased. When we use our 1991 education measures as instruments for our 1981 years of education measures, the return increases from 4.8 to 5.5 per cent. A Hausman test suggests that this di¤erence is signi…cant. If we instead use our 1991 full-time education measure and instrument it with our 1981 full-time education measure our estimated return increases from 4.7 per cent (OLS) to 5.8 per cent (IV)[13]. This suggests that it is important to control for measurement error and that the return to a year of full-time education for men is between 5 $\frac{1}{2}$ to 6 per cent rather than just below 5 per cent.

A similar story emerges from Table 4.6 for women. When we attempt to correct for measurement error our original OLS estimate increases from 8.3 per cent to 9.3 per cent. Once again a Hausman test suggests this di¤erence is signi…cant. If we instead use our 1991 measure and instrument this with our 1981 measure our estimate increases from 7.6 per cent (OLS) to 9.7 per cent (IV).

A similar story emerges when we repeat the exercise for our highest quali…ca-

[13] These results are not presented in the paper and are available from the author.

Table 4.6: Measurement Error and Returns to Education

Variable	Males				Females			
	OLS		IV		OLS		IV	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.235	(0.133)	1.169	(0.134)	0.722	(0.147)	0.622	(0.149)
Years of education	0.048	(0.004)	0.055	(0.005)	0.083	(0.005)	0.093	(0.006)
Number of observations	2597		2597		2363		2363	
P-value, 1991 regional variables	0.000		0.000		0.000		0.000	
P-value, 1974 regional variables	0.015		0.014		0.322		0.378	
P-value, ability variables	0.000		0.000		0.000		0.000	
P-value, school type variables	0.282		0.405		0.732		0.894	
P-value, family variables	0.007		0.010		0.001		0.001	
P-value, parental interest	0.145		0.168		0.168		0.226	
P-value, demographics	0.180		0.163		0.252		0.280	
P-value, employer characteristics	0.000		0.000		0.000		0.000	
R^2	0.2949		0.2942		0.4138		0.4127	

tion speci…cations as seen from Tables 4.7 and 4.8. Our IV estimates of the returns to di¤erent quali…cations are above our OLS estimates and Hausman tests suggest these di¤erences are signi…cant in both our ordered probit and linear probability models. For men we see that our IV estimates of the return to a degree is now between 56.2 and 57.4 per cent compared to our original OLS estimate of 50.1 per cent. This suggests an annual return of around 10 per cent. Our estimated return to undertaking an A level is now estimated to be between 41.7 and 42.1 per cent, an annual return of approximately 17 per cent.

Again for women a similar story emerges, with the estimate of a return to a degree increasing from 63.6 per cent to between 73.8 and 77.8 per cent, and the return to A levels increasing from 37.2 per cent to between 42.1 and 43.9 per cent.

The results from this section suggest that measurement error in our education variables results in a signi…cant downward bias in our OLS estimates of the returns to education and quali…cations. In the …nal part of the paper we look in more detail at whether there is any further evidence of heterogeneity in the returns to education and quali…cations.

4.4. Is there heterogeneity in the returns to education?

In the …nal part of the paper we take a further look at whether there is any evidence of heterogeneity in the returns to education by interacting our education

Table 4.7: Measurement Error and the Returns to Quali…cations: Males

Variable	OLS		IV - Ordered Probit		IV - Linear Probability	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.656	(0.127)	1.638	(0.127)	1.642	(0.129)
Highest Quali…cation 1981:						
Other	0.097	(0.029)	0.117	(0.030)	0.115	(0.068)
Lower vocational	0.194	(0.028)	0.226	(0.030)	0.246	(0.044)
Middle vocational	0.251	(0.029)	0.297	(0.033)	0.285	(0.046)
A Levels	0.376	(0.038)	0.417	(0.040)	0.421	(0.056)
Higher vocational	0.419	(0.034)	0.489	(0.042)	0.481	(0.057)
Degree	0.501	(0.036)	0.562	(0.041)	0.574	(0.048)
$\beta_{,i}$			-0.029	(0.010)		
Number of observations	2597		2597		2597	
P-value, 1991 regional variables	0.000		0.000		0.000	
P-value, 1974 regional variables	0.020		0.022		0.021	
P-value, ability variables	0.000		0.000		0.000	
P-value, school type variables	0.286		0.331		0.370	
P-value, family variables	0.219		0.341		0.326	
P-value, parental interest	0.669		0.780		0.767	
P-value, demographics	0.257		0.249		0.240	
P-value, employer characteristics	0.000		0.000		0.000	
R^2	0.3352		0.3375		0.3335	

Table 4.8: Measurement Error and the Returns to Quali…cations: Females

Variable	OLS		IV - Ordered Probit		IV - Linear Probability	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.582	(0.133)	1.570	(0.134)	1.525	(0.137)
Highest Quali…cation 1981:						
Other	0.027	(0.028)	0.064	(0.029)	0.141	(0.062)
Lower vocational	0.084	(0.027)	0.150	(0.030)	0.173	(0.041)
Middle vocational	0.229	(0.034)	0.298	(0.037)	0.355	(0.047)
A Levels	0.372	(0.039)	0.439	(0.041)	0.421	(0.057)
Higher vocational	0.452	(0.037)	0.563	(0.046)	0.627	(0.055)
Degree	0.636	(0.040)	0.738	(0.045)	0.778	(0.052)
$\beta_{,i}$			-0.050	(0.011)		
Number of observations	2363		2363		2363	
P-value, 1991 regional variables	0.000		0.000		0.000	
P-value, 1974 regional variables	0.070		0.054		0.058	
P-value, ability variables	0.008		0.066		0.080	
P-value, school type variables	0.939		0.954		0.919	
P-value, family variables	0.005		0.008		0.011	
P-value, parental interest	0.376		0.500		0.474	
P-value, demographics	0.475		0.539		0.591	
P-value, employer characteristics	0.000		0.000		0.000	
R^2	0.4447		0.4498		0.4371	

variables with ability and family background variables. We split …rstly split our sample into high ability and low ability groups. A person is taken to be of high ability if they are in the top two quintiles of either the mathematics or reading ability tests. We then interact all our education variables with this high ability dummy variable. We then interact our education variables with two of our family background variables: the dummy variable identifying individuals coming from families with …nancial di¢culties and the father's years of education variable. Card [12] has speculated that children from relatively disadvantaged family backgrounds (which should be picked up from our …nancial di¢culties dummy variable) and/or with relatively low tastes for education (possibly children whose father has low levels of education) may choose low levels of education because they have high discount rates rather than low ability. If this is the case then the marginal return to schooling for these individuals will exceed the average return to schooling for the population as a whole.

The results of doing this suggest …nd no evidence of heterogeneity in the returns to education according to ability and family …nancial circumstances as a child. There is, however, evidence that the returns to education and quali…cations signi…cantly decrease as father's education increases. Father's education, however, has a large and generally signi…cant positive e¤ect on the overall level of wages received by individuals. The results of interacting years of full-time education with father's years of education are given in Tables 4.9 and 4.9 and quali…cations with father's years of education in Tables 4.11 and 4.12.

If we focus on the results for men in Table 4.9 we see that the estimate return to an additional year of full-time education decreases by around 0.23 percentage points for every additional year of father's education. The overall level of wages, however, increases by 4.5 percentage points for every additional year of father's education. A similar result is found for women in Table 4.9.

A similar result is found for men when we look at the returns to quali…cations as can be seen in Table 4.11. For women, we see from Table 4.12 that only the

Table 4.9: Heterogeneity and Returns to Education: Males

Variable	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.235	(0.133)	0.949	(0.167)
Years of Education:	0.048	(0.004)	0.067	(0.008)
£ (Father's years of education/10)			-0.023	(0.007)
Father's years of education			0.045	(0.013)
Number of observations	2597		2597	
P-value, 1991 regional variables	0.000		0.000	
P-value, 1974 regional variables	0.015		0.019	
P-value, ability variables	0.000		0.000	
P-value, school type variables	0.282		0.345	
P-value, family variables	0.007		0.001	
P-value, parental interest	0.145		0.150	
P-value, demographics	0.180		0.190	
P-value, employer characteristics	0.000		0.000	
R^2	0.2949		0.2974	

Table 4.10: Heterogeneity and Returns to Education: Females

Variable	Coef.	(S.E.)	Coef.	(S.E.)
Constant	0.722	(0.147)	0.497	(0.173)
Years of Education:	0.083	(0.005)	0.096	(0.008)
£ (Father's years of education/10)			-0.019	(0.009)
Father's years of education			0.033	(0.014)
Number of observations	2363		2363	
P-value, 1991 regional variables	0.000		0.000	
P-value, 1974 regional variables	0.322		0.282	
P-value, ability variables	0.000		0.000	
P-value, school type variables	0.732		0.679	
P-value, family variables	0.001		0.000	
P-value, parental interest	0.168		0.204	
P-value, demographics	0.252		0.240	
P-value, employer characteristics	0.000		0.000	
R^2	0.4138		0.4153	

Table 4.11: Heterogeneity and Returns to Quali…cations: Males

Variable	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.656	(0.127)	1.517	(0.134)
Highest Quali…cation 1981:				
Other	0.097	(0.029)	0.171	(0.051)
Lower vocational	0.194	(0.028)	0.266	(0.049)
Middle vocational	0.251	(0.029)	0.345	(0.050)
A levels	0.376	(0.038)	0.500	(0.075)
Higher vocational	0.419	(0.034)	0.574	(0.057)
Degree	0.501	(0.036)	0.625	(0.062)
Father's years of education£				
Other			-0.013	(0.007)
Lower vocational			-0.013	(0.006)
Middle vocational			-0.016	(0.006)
A levels			-0.020	(0.008)
Higher vocational			-0.024	(0.007)
Degree			-0.020	(0.007)
Father's years of education			0.028	(0.009)
Number of observations	2597		2597	
P-value, 1991 regional variables	0.000		0.000	
P-value, 1974 regional variables	0.020		0.023	
P-value, ability variables	0.000		0.000	
P-value, school type variables	0.286		0.382	
P-value, family variables	0.219		0.009	
P-value, parental interest	0.669		0.583	
P-value, demographics	0.257		0.263	
P-value, employer characteristics	0.000		0.000	
P-value, interaction terms			0.039	
R^2	0.3352		0.3390	

Table 4.12: Heterogeneity and Returns to Quali…cations: Females

Variable	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.582	(0.133)	1.530	(0.144)
Highest Quali…cation 1981:				
Other	0.027	(0.028)	0.101	(0.058)
Lower vocational	0.084	(0.027)	0.084	(0.050)
Middle vocational	0.229	(0.034)	0.259	(0.060)
A levels	0.372	(0.039)	0.319	(0.076)
Higher vocational	0.452	(0.037)	0.451	(0.066)
Degree	0.636	(0.040)	0.741	(0.063)
Father's years of education£				
Other			-0.010	(0.007)
Lower vocational			0.000	(0.006)
Middle vocational			-0.004	(0.007)
A levels			0.006	(0.008)
Higher vocational			-0.001	(0.008)
Degree			-0.014	(0.007)
Father's years of education			0.006	(0.009)
Number of observations	2363		2363	
P-value, 1991 regional variables	0.000		0.000	
P-value, 1974 regional variables	0.070		0.049	
P-value, ability variables	0.008		0.009	
P-value, school type variables	0.939		0.927	
P-value, family variables	0.005		0.003	
P-value, parental interest	0.376		0.382	
P-value, demographics	0.475		0.478	
P-value, employer characteristics	0.000		0.000	
P-value, interaction terms			0.068	
R^2	0.4447		0.4479	

average return to a degree decreases with father's years of education. In this speci…cation, father's education has no signi…cant impact on the level of wages received by women.

The results from this part of the paper provide further evidence of heterogeneity in the returns to education and some support for the idea that individual's with less taste for education may gave higher average marginal returns to education than the population as a whole. This suggests that IV procedures which rely on interventions that a¤ect schooling choices of children with low tastes for education, may overestimate the true average marginal return to education. This might in part explain why the results obtained in the earlier UK studies of Dearden[13] and Harmon and Walker [17] found somewhat higher returns. This issue clearly need further investigation.

5. Conclusion

The paper has attempted to estimate the returns to full-time years of education and quali…cations for a sample of individuals born in Britain in March 1958 who have been followed since birth. The data used has a wealth of information on family background including parental education, social class and interest shown in the child's education as well as measures of ability. These variables are typically missing in studies looking at the returns to schooling. The results of the paper suggest that recent IV estimates of the average return to schooling in the UK of around 15 per cent may be slightly high for the population as a whole. The estimates obtained in this paper suggest returns of between 5 to 6 per cent for men and 9 to 10 per cent for women, even after controlling for measurement error in education.

The paper also presents evidence that the returns to an additional year of schooling in the UK are heterogeneous. The results from the paper suggest that individuals undertaking education involving some sort of formal quali…cation have signi…cantly larger rates of return to an additional year of education than individu-

als who have obtained no formal education. Individuals whose highest educational quali…cation is an A level (the highest schooling quali…cation in the UK) appear to have the highest average return to an additional year of education at around 15 per cent for both men and women. There is also some evidence that individuals with lower tastes for education, have signi…cantly higher marginal returns to education. This suggests that IV procedures which rely on interventions that a¤ect schooling choices of children with low tastes for education, may overestimate the true average marginal return to education in the UK.

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Appendix

Table .1: Summary Statistics

Variable	Males 2597 Observations		Females 2363 Observations	
	Mean	(Std Dev.)	Mean	(Std Dev.)
Real log hourly wage 1991	2.053	(0.428)	1.682	(0.491)
Education measures from 1981 survey:				
Years of full-time education by 1981	12.260	(2.076)	12.248	(2.014)
Highest Quali…cation 1981:				
None	0.092	(0.289)	0.108	(0.311)
Other	0.122	(0.328)	0.140	(0.347)
Lower Vocational	0.225	(0.418)	0.298	(0.457)
Middle Vocational	0.226	(0.418)	0.145	(0.352)
A Levels	0.099	(0.299)	0.082	(0.274)
Higher Vocational	0.105	(0.306)	0.115	(0.319)
Degree	0.131	(0.338)	0.113	(0.317)
Education measures from 1991 survey:				
Years of full-time education by 1981	12.168	(2.000)	12.205	(1.974)
Highest Quali…cation 1981:				
None	0.091	(0.288)	0.111	(0.314)
Other	0.116	(0.320)	0.127	(0.333)
Lower Vocational	0.260	(0.439)	0.307	(0.461)
Middle Vocational	0.197	(0.398)	0.127	(0.333)
A Levels	0.119	(0.324)	0.099	(0.298)
Higher Vocational	0.106	(0.308)	0.132	(0.339)
Degree	0.111	(0.314)	0.098	(0.297)
Maths ability at 7:				
5th quintile (highest)	0.243	(0.429)	0.215	(0.411)
4th quintile	0.211	(0.408)	0.212	(0.409)
3rd quintile	0.213	(0.409)	0.197	(0.398)
2nd quintile	0.175	(0.380)	0.209	(0.406)
1st quintile (lowest)	0.158	(0.365)	0.167	(0.373)
Reading ability at 7:				
5th quintile (highest)	0.186	(0.389)	0.278	(0.448)
4th quintile	0.218	(0.413)	0.234	(0.423)
3rd quintile	0.209	(0.407)	0.208	(0.406)
2nd quintile	0.210	(0.408)	0.169	(0.375)
1st quintile (lowest)	0.177	(0.382)	0.111	(0.314)
Type of school 1974:				
Comprehensive	0.476	(0.500)	0.485	(0.500)
Secondary modern	0.164	(0.371)	0.160	(0.367)
Grammar school	0.104	(0.305)	0.111	(0.315)
Private school	0.052	(0.223)	0.045	(0.208)
Other	0.019	(0.136)	0.015	(0.121)
Father's years of education	7.549	(4.641)	7.493	(4.650)
Father's education missing	0.246	(0.431)	0.252	(0.434)
Mother's years of education	7.659	(4.443)	7.712	(4.452)
Mother's education missing	0.234	(0.423)	0.231	(0.422)
Number of siblings	1.688	(1.735)	1.766	(1.789)
Number of older siblings	0.830	(1.256)	0.857	(1.254)
Sisters only	0.200	(0.400)	0.185	(0.388)
Brothers only	0.204	(0.403)	0.202	(0.401)

Continued next page....

Table .1 continued

Variable	Males 2597 Observations Mean	(Std Dev.)	Females 2363 Observations Mean	(Std Dev.)
Father's social class 1974:				
Professional	0.045	(0.207)	0.042	(0.200)
Intermediate	0.150	(0.357)	0.146	(0.353)
Skilled non-manual	0.085	(0.279)	0.072	(0.258)
Skilled manual	0.315	(0.465)	0.314	(0.464)
Semi-skilled non-manual	0.011	(0.105)	0.012	(0.108)
Missing	0.089	(0.284)	0.088	(0.284)
No father …gure 1974	0.037	(0.190)	0.055	(0.228)
Mother employed 1974	0.538	(0.499)	0.536	(0.499)
Bad …nances 1969 or 1974	0.149	(0.356)	0.179	(0.384)
Bad …nances missing	0.019	(0.137)	0.021	(0.143)
Father's interest in edn:				
Expects too much	0.014	(0.119)	0.008	(0.087)
Very interested	0.291	(0.455)	0.278	(0.448)
Some interest	0.243	(0.429)	0.222	(0.416)
Mother's interest in edn:				
Expects too much	0.035	(0.183)	0.024	(0.153)
Very interested	0.397	(0.489)	0.423	(0.494)
Some interest	0.389	(0.488)	0.375	(0.484)
Large employer 1991	0.231	(0.422)	0.183	(0.387)
Union member 1991	0.447	(0.497)	0.359	(0.480)
Private sector …rm 1991	0.698	(0.459)	0.568	(0.495)
Local Authority Census demographics:				
% Unemployed/sick	4.609	(2.666)	4.722	(2.734)
% Professional/managerial	11.446	(6.278)	11.557	(6.528)
% Unskilled manual	6.783	(3.586)	6.864	(3.598)
% Owner occupiers	29.219	(19.626)	29.536	(19.689)
% Council tennants	42.779	(21.423)	42.712	(21.539)
Missing	0.107	(0.310)	0.103	(0.304)
Region 1991:				
North	0.060	(0.238)	0.056	(0.230)
North West	0.103	(0.304)	0.110	(0.313)
Yorkshire and Humberside	0.097	(0.296)	0.097	(0.296)
West Midlands	0.094	(0.291)	0.099	(0.299)
East Midlands	0.083	(0.276)	0.062	(0.242)
East Anglia	0.037	(0.189)	0.043	(0.203)
South West	0.077	(0.267)	0.090	(0.286)
South East	0.239	(0.426)	0.220	(0.414)
London	0.056	(0.230)	0.056	(0.231)
Wales	0.055	(0.229)	0.047	(0.212)
Scotland	0.095	(0.293)	0.112	(0.316)
Region 1974:				
North Western	0.102	(0.302)	0.117	(0.321)
North	0.074	(0.261)	0.068	(0.252)
East and West Riding	0.077	(0.266)	0.078	(0.268)
North Midlands	0.079	(0.270)	0.066	(0.248)
Eastern	0.079	(0.270)	0.074	(0.262)
London and South East	0.134	(0.341)	0.138	(0.345)
Southern	0.061	(0.239)	0.056	(0.231)
South Western	0.063	(0.243)	0.060	(0.237)
Midlands	0.089	(0.284)	0.094	(0.292)
Wales	0.056	(0.230)	0.049	(0.216)
Scotland	0.099	(0.299)	0.112	(0.316)

Table .2: Detailed Education Wage Equations

Variable	Males		Females	
	Speci…cation 4		Speci…cation 4	
	Coef.	(S.E.)	Coef.	(S.E.)
Constant	1.235	(0.133)	0.722	(0.147)
Years of full-time education by 1981	0.048	(0.004)	0.083	(0.005)
Maths ability at 7:				
5th quintile (highest)	0.171	(0.027)	0.042	(0.031)
4th quintile	0.109	(0.026)	0.033	(0.028)
3rd quintile	0.109	(0.025)	0.024	(0.029)
2nd quintile	0.066	(0.025)	0.021	(0.026)
Reading ability at 7:				
5th quintile (highest)	0.132	(0.029)	0.166	(0.032)
4th quintile	0.139	(0.026)	0.144	(0.032)
3rd quintile	0.111	(0.025)	0.124	(0.030)
2nd quintile	0.096	(0.023)	0.091	(0.029)
Type of school 1974:				
Secondary modern	-0.013	(0.021)	-0.001	(0.024)
Grammar school	0.012	(0.027)	0.042	(0.030)
Private school	0.079	(0.039)	0.008	(0.044)
Other	-0.026	(0.068)	0.014	(0.071)
Father's years of education	0.011	(0.006)	0.005	(0.007)
Father's education missing	0.124	(0.080)	0.118	(0.082)
Mother's years of education	-0.016	(0.008)	-0.019	(0.007)
Mother's education missing	-0.143	(0.092)	-0.208	(0.094)
Number of siblings	0.000	(0.007)	-0.013	(0.007)
Number of older siblings	-0.006	(0.008)	0.020	(0.009)
Sisters only	0.003	(0.021)	0.021	(0.023)
Brothers only	0.022	(0.021)	-0.007	(0.023)
Father's social class 1974:				
Professional	0.068	(0.051)	0.189	(0.052)
Intermediate	0.077	(0.028)	0.076	(0.032)
Skilled non-manual	0.079	(0.031)	0.072	(0.035)
Skilled manual	0.040	(0.022)	0.041	(0.023)
Semi-skilled non-manual	0.117	(0.094)	0.015	(0.076)
Missing	-0.050	(0.067)	-0.127	(0.082)
No father …gure 1974	0.063	(0.043)	0.012	(0.051)
Mother employed 1974	0.022	(0.018)	0.012	(0.019)
Bad …nances 1969 or 1974	-0.041	(0.022)	-0.037	(0.023)
Bad …nances missing	-0.050	(0.062)	-0.027	(0.067)
Father's interest in edn:				
Expects too much	0.062	(0.079)	-0.093	(0.126)
Very interested	0.014	(0.025)	-0.002	(0.026)
Some interest	0.011	(0.019)	-0.026	(0.022)
Mother's interest in edn:				
Expects too much	-0.009	(0.053)	0.070	(0.059)
Very interested	0.043	(0.026)	0.063	(0.027)
Some interest	0.051	(0.021)	0.035	(0.023)
Large employer 1991	0.117	(0.017)	0.176	(0.020)
Union member 1991	0.027	(0.015)	0.211	(0.017)
Private sector …rm 1991	0.021	(0.016)	-0.067	(0.018)

Continued next page....

Table .2 continued

Variable	Males Speci…cation 4 Coef.	(S.E.)	Females Speci…cation 4 Coef.	(S.E.)
Local Authority Census demographics:				
% Unemployed/sick	-0.004	(0.005)	-0.006	(0.005)
% Professional/managerial	0.004	(0.002)	0.004	(0.002)
% Unskilled manual	0.007	(0.005)	0.007	(0.005)
% Owner occupiers	0.001	(0.001)	0.000	(0.001)
% Council tennants	0.000	(0.001)	-0.001	(0.001)
Missing	0.139	(0.112)	0.117	(0.119)
Region 1991:				
North	-0.297	(0.055)	-0.362	(0.066)
North West	-0.211	(0.048)	-0.229	(0.053)
Yorkshire and Humberside	-0.228	(0.047)	-0.297	(0.051)
West Midlands	-0.192	(0.053)	-0.174	(0.057)
East Midlands	-0.200	(0.048)	-0.216	(0.060)
East Anglia	-0.165	(0.051)	-0.200	(0.055)
South West	-0.157	(0.050)	-0.251	(0.054)
South East	0.009	(0.036)	-0.108	(0.040)
Wales	-0.287	(0.070)	-0.305	(0.101)
Scotland	-0.153	(0.058)	-0.283	(0.057)
Region 1974:				
North Western	-0.002	(0.046)	0.024	(0.054)
North	-0.004	(0.050)	-0.009	(0.061)
East and West Riding	-0.058	(0.046)	0.008	(0.053)
North Midlands	-0.010	(0.045)	-0.067	(0.059)
Eastern	-0.071	(0.040)	-0.094	(0.046)
Southern	-0.118	(0.035)	-0.080	(0.040)
South Western	-0.084	(0.047)	-0.090	(0.060)
Midlands	-0.086	(0.050)	-0.075	(0.057)
Wales	0.000	(0.066)	0.009	(0.104)
Scotland	-0.140	(0.057)	-0.013	(0.058)
Number of observations	2597		2363	
R^2	0.2949		0.4138	

Table .3: Detailed Quali…cation Wage Equations

Variable	Males Speci…cation 4 Coef.	(S.E.)	Females Speci…cation 4 Coef.	(S.E.)
Constant	1.656	(0.127)	1.582	(0.133)
Highest Quali…cation 1981:				
Other	0.097	(0.029)	0.027	(0.028)
Lower Vocational	0.194	(0.028)	0.084	(0.027)
Middle Vocational	0.251	(0.029)	0.229	(0.034)
A Levels	0.376	(0.038)	0.372	(0.039)
Higher Vocational	0.419	(0.034)	0.452	(0.037)
Degree	0.501	(0.036)	0.636	(0.040)
Maths ability at 7:				
5th quintile (highest)	0.123	(0.026)	0.011	(0.030)
4th quintile	0.071	(0.025)	0.011	(0.028)
3rd quintile	0.077	(0.024)	-0.005	(0.028)
2nd quintile	0.043	(0.024)	0.007	(0.026)
Reading ability at 7:				
5th quintile (highest)	0.092	(0.028)	0.128	(0.032)
4th quintile	0.095	(0.025)	0.105	(0.032)
3rd quintile	0.074	(0.024)	0.111	(0.030)
2nd quintile	0.073	(0.022)	0.085	(0.029)
Type of school 1974:				
Secondary modern	-0.001	(0.020)	0.008	(0.023)
Grammar school	0.009	(0.026)	0.021	(0.028)
Private school	0.083	(0.038)	0.015	(0.043)
Other	-0.004	(0.066)	0.029	(0.068)
Father's years of education	0.008	(0.006)	0.001	(0.006)
Father's education missing	0.093	(0.080)	0.081	(0.079)
Mother's years of education	-0.013	(0.007)	-0.012	(0.007)
Mother's education missing	-0.102	(0.090)	-0.144	(0.094)
Number of siblings	0.001	(0.007)	-0.013	(0.007)
Number of older siblings	0.000	(0.008)	0.021	(0.009)
Sisters only	0.003	(0.021)	0.013	(0.022)
Brothers only	0.018	(0.021)	-0.007	(0.023)
Father's social class 1974:				
Professional	0.066	(0.050)	0.221	(0.052)
Intermediate	0.064	(0.028)	0.075	(0.031)
Skilled non-manual	0.066	(0.031)	0.070	(0.034)
Skilled manual	0.025	(0.021)	0.043	(0.022)
Semi-skilled non-manual	0.101	(0.094)	0.047	(0.079)
Missing	-0.040	(0.063)	-0.096	(0.086)
No father …gure 1974	0.044	(0.043)	0.015	(0.049)
Mother employed 1974	0.024	(0.018)	0.009	(0.019)
Bad …nances 1969 or 1974	-0.024	(0.021)	-0.022	(0.023)
Bad …nances missing	-0.034	(0.058)	-0.024	(0.061)
Father's interest in edn:				
Expects too much	0.057	(0.077)	-0.115	(0.124)
Very interested	0.007	(0.024)	-0.011	(0.025)
Some interest	0.008	(0.019)	-0.025	(0.021)
Mother's interest in edn:				
Expects too much	-0.024	(0.051)	0.058	(0.059)
Very interested	0.023	(0.025)	0.054	(0.026)
Some interest	0.030	(0.020)	0.034	(0.022)
Large employer 1991	0.116	(0.016)	0.144	(0.020)
Union member 1991	0.030	(0.015)	0.186	(0.017)
Private sector …rm 1991	0.023	(0.015)	-0.036	(0.018)

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Table .3 continued

Variable	Males Speci…cation 4 Coef.	(S.E.)	Females Speci…cation 4 Coef.	(S.E.)
Local Authority Census demographics:				
% Unemployed/sick	-0.003	(0.005)	-0.002	(0.005)
% Professional/managerial	0.004	(0.002)	0.004	(0.002)
% Unskilled manual	0.008	(0.004)	0.004	(0.005)
% Owner occupiers	0.001	(0.001)	0.000	(0.001)
% Council tennants	-0.001	(0.001)	-0.001	(0.001)
Missing	0.117	(0.110)	0.046	(0.120)
Region 1991:				
North	-0.290	(0.053)	-0.321	(0.065)
North West	-0.219	(0.046)	-0.226	(0.051)
Yorkshire and Humberside	-0.239	(0.045)	-0.299	(0.049)
West Midlands	-0.181	(0.050)	-0.180	(0.055)
East Midlands	-0.203	(0.045)	-0.218	(0.057)
East Anglia	-0.174	(0.049)	-0.181	(0.053)
South West	-0.155	(0.046)	-0.259	(0.053)
South East	0.008	(0.034)	-0.119	(0.039)
Wales	-0.259	(0.065)	-0.274	(0.099)
Scotland	-0.156	(0.056)	-0.287	(0.058)
Region 1974:				
North Western	0.001	(0.045)	-0.006	(0.053)
North	0.004	(0.048)	-0.058	(0.060)
East and West Riding	-0.050	(0.044)	-0.012	(0.051)
North Midlands	-0.010	(0.044)	-0.073	(0.056)
Eastern	-0.058	(0.039)	-0.131	(0.045)
Southern	-0.109	(0.035)	-0.122	(0.040)
South Western	-0.089	(0.045)	-0.098	(0.061)
Midlands	-0.077	(0.047)	-0.094	(0.056)
Wales	-0.004	(0.061)	-0.028	(0.104)
Scotland	-0.147	(0.056)	-0.063	(0.061)
Number of observations	2597		2363	
R^2	0.3352		0.4447	