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CAN EDUCATION COMPENSATE FOR LOW ABILITY? EVIDENCE FROM BRITISH DATA

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Can education compensate for low ability? evidence from British data•

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Abstract

This paper uses cross section data to investigate whether the returns to education vary with the level of ability. Using a measure of cognitive ability based on tests taken at ages 7 and 11 we find, unlike most of the existing literature, clear evidence that the return to schooling is lower for those with *higher* ability indicating that education can act as a substitute for observed ability. We also estimate quantile regression functions to examine how the return to schooling varies across the conditional distribution of earnings. The results show that the return is lower for higher quantiles, suggesting that education is also a substitute for unobserved ability.

Keywords: earnings, education, ability

JEL code: J31

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1 Introduction

In the conventional Mincer model the coefficient on schooling is not simply the marginal effect of a year's education on the logarithm of wages but also corresponds to the internal rate of return on investment in an additional year of education and it is this property which has given rise to the view that the parameter is of major significance for policy. The model assumes that the return to schooling is common across individuals. This does not seem particularly plausible and considerable effort has gone into identifying heterogeneity in the returns. Once one allows for such heterogeneity, the estimation of "the return" becomes problematic. From a policy point of view it is necessary to think of estimating the returns to particular groups (such as those who are financially constrained) and how particular estimates yield the relevant parameters.

Within the extensive literature on the private returns to schooling a significant amount of attention has been given to the role of individual ability. In general the focus has been on the implications for the returns to schooling of including or omitting a control for ability [Griliches and Mason, 1972]. "Ability" in the economics literature is virtually synonymous with *cognitive ability* and relies in the empirical work on intelligence measures such as can be constructed from the Armed Forces Qualification Test (AFQT) in the USA[1].

When earnings equations are augmented by the inclusion of ability measures the convention has been for them to be included additively so that the schooling coefficient does not vary with the level of ability. However it is not difficult to think of reasons this might not be so. Schooling is clearly an input into the acquisition of human capital as is individual ability so a "smarter" person may be better able to take advantage of schooling. While this complementarity seems plausible the reverse may also be true. Low ability individuals may make greater efforts at school or receive additional, remedial assistance to compensate them for their lower ability.

Card(1999) surveys the mostly American evidence on the interaction between ability and education. In general the evidence suggest either no relationship or a positive interaction i.e. more able individuals have higher returns to education. We interpret this positive interaction as complementarity and hence a negative interaction

[1] However some recent work has suggested that there has been an over-emphasis on cognitive ability at the expense of more behavioural characteristics of individuals [e.g. Carneiro and Heckman (2003), Bowles, Gintis and Osborne (2001)].

as substitutability. For example Blackburn and Neumark (1993) find that those with higher AFQT scores have a higher returns to education. Ashenfelter and Rouse (2000) use the same dataset but adjust the AFQT scores for the respondent's education level at the time the test was taken. They find no differences in the return to education by ability quartile. Tobias (2003) uses a semi-parametric estimator to recover earnings/ability functions for groups with high and low levels of education but this method does not directly shed light on the issue of substitutability.

The finding of education/ability complementarity has potentially strong implications. If returns to education for the less able are lower it follows that a policy of raising the level of schooling for everyone will generally increase the inequality of earnings. Even those policies which are targeted at the less able may be a poor use of resources if the marginal returns are very low. This issue received renewed interest as a result of the publication of Herrnstein and Murray's *The Bell Curve*. Much of the debate has been about the *increase* in the return to schooling and whether this is associated with an increase in the returns to cognitive ability, for example Cawley *et al* (2000), whereas this paper is concerned only with the *level* of the return. Heckman and Vytlacil(2001) point out that educational sorting by ability may make it difficult to identify the effects of the two variables. If educational sorting subsequently affects measured ability then this will exacerbate the identification problem. This argument would apply, *pari passu*, to the interaction of the two variables. However in this data this appears to be much less of a problem perhaps because the ability measures are taken at such an early age.

The above literature is about the returns to observed cognitive ability. A second strand of literature deals with unobserved ability which may include cognitive ability depending on the availability of test scores. For example Ashenfelter and Rouse (1998) use data on identical twins and find that the return to schooling is slightly higher for those with higher ability. However identical twins are an unusual sibling configuration so it is unclear whether one can generalize much from such data.

An alternative flexible approach to examining the role of unobserved ability is the use of quantile regression (Koenker and Bassett(1978)). By estimating a family of conditional quantile earnings functions one can see how the conventional return to education varies. Since those higher in this conditional distribution have higher unobserved ability, other things being equal, one can interpret an increase in the

schooling coefficient across quantiles as evidence of complementarity between schooling and unobserved ability. There are several papers using this method, for example Buchinski (1994) uses US data and shows the return to education generally increasing across quantiles. Mwabu and Schultz (1996) use South African data and find a mixture of results that depend on ethnicity. Aria, Hallock and Sosa Escudero (2000) apply instrumental variable quantile regression to US twins data and find evidence of education/ability complementarity. Using British data Harmon, Oosterbeek and Walker (2003) also find evidence of complementarity based on quantile regressions. Pereira and Silva-Martins(2002) find complementarity for 13 out of 15 European countries.

This paper takes a fresh look at the question of heterogeneity of returns with respect to observed and unobserved ability. Using a flexible interaction of education and ability we find clear evidence that the return is higher for the less able. Using quantile regression we find that the return to schooling is clearly higher for the lower quantiles of the conditional wage distribution. Those at the lower end of the conditional wage distribution will, *ceteris paribus*, have unobserved characteristics which lead to lower earnings. We interpret these findings as providing strong evidence of substitutability between education and ability.

This paper uses the British National Child Development Survey a cohort study based on individuals born in a single week in 1958. We use the data for male full time workers in 1991. The first column of Table 1 shows a standard Mincer equation, augmented by a small number of covariate namely dummy variables for whether the individual is married, has children, is in a trade union, employer size and regional dummies (the latter two sets of coefficients are not shown[2]) and the age at which the respondent's father left full time education. We abstract from any potential issues of endogeneity not least because of the absence of plausible instruments. Column 2 simply adds ability linearly. The resulting fall in the schooling (the last parameter in the table) is very small, about 1/3 of one percentage point. Column 3 adds a measure of cognitive ability and its interaction with years of schooling[3]. The direct effect of ability is positive and the return to education is clearly decreasing in ability. The interaction implies the return to school varies: evaluated at the mean it is .038, very slightly *higher* than in

[2] Full results and descriptive statistics available on request.

[3] Ability is the first principal component over 4 measures of ability: mathematics at age 7, verbal, non-verbal and comprehension at age 11. It is normalised to have a mean and standard deviation of 0 &1 respectively. Unlike the AFQT the issue of adjusting for the education level at the time of test does not arise.

column 1 and the inter-quartile range is 0.44 – 0.29. For someone two standard deviations of ability above average the return to a year's education is only .014 (=.038 – 2*.012) This simple interaction is restrictive so in column 4 we allow the interaction to be cubic, adding education by ability squared and education by ability cubed.. From the F test one can see that the three interaction terms are jointly significant.

Figure 1 graphs the implied return to schooling against ability and again it is clear that those of lower ability enjoy higher returns to education. So one can conclude that the evidence clearly points to schooling and observed ability being substitutes[4]. Interestingly, the graph suggests that the linearity assumption in column 3 is not too bad. Other parameterisations of the interaction (using higher powers of ability or step functions) lead to essentially the same result.

We then estimated the specification in column 2 by quantile regression at the 9 decile points and graph the schooling returns coefficients. Figure 2 shows the declining return across quantiles with the OLS estimate superimposed and the respective confidence bands[5]. At the 90th percentile the return to education is close to zero. Unlike the existing quantile estimates in the literature we include a measure of cognitive ability so the falling return is with respect to non-cognitive ability. However omitting cognitive ability does not change the graph noticeably other than shifting the curve up slightly.

Conclusions

The interrelation between earnings, ability and education has been widely studied by labour economists. While much of the focus has been on the bias that arises when ability is not controlled for, the possibility that the return to schooling varies with (amongst other things) individual ability has also been analysed. Most of the evidence points to complementarity: "smarter" students benefit more from a given level education. The evidence presented here the direct opposite: parameterising the problem in several ways we always find that they are substitutes. This holds for both measured cognitive ability and unobserved ability. This suggests the importance of the remedial rôle of education and that for those not endowed with high ability, education is by no means wasted.

[4] Dearden(1999) using the same data as this paper failed to find significant interactions largely because the interaction was parameterised as discrete rather than continuous.

[5] For the quantile regressions these are based on bootstrapping with 1000 replications.

Table 1:Returns to schooling and ability

	1	2	3	4
Experience:	0.157	0.122	0.12	0.095
	2.39	*1.83*	*1.94*	*1.5*
Experience Squared:	-0.006	-0.005	-0.004	-0.004
	2.47	*1.86*	*1.95*	*1.54*
Union Member:	0.014	0.016	0.016	0.014
	0.84	*0.98*	*0.96*	*0.84*
Married:	0.063	0.06	0.06	0.06
	3.31	*3.21*	*3.21*	*3.22*
Has children:	0.028	0.027	0.033	0.031
	1.49	*1.48*	*1.77*	*1.68*
Poor health:	-0.121	-0.109	-0.106	-0.085
	2.52	*2.34*	*2.31*	*1.89*
Age father left education:	0.01	0.009	0.008	0.007
	2.00	*1.87*	*1.79*	*1.54*
Ability:		0.049	0.257	0.202
		5.41	*3.58*	*2.63*
(Age left education)*Ability:			-0.012	-0.004
			2.9	*0.78*
(Age left education)*(Ability^2)				0.001
				1.14
(Age left education)*(Ability^3)				-0.002
				3.7
Age left education:	0.036	0.033	0.038	0.028
	4.91	*4.65*	*5.06*	*3.67*
N:	2322	2322	2322	2322
R-squared:	0.21	0.23	0.24	0.25
Implied mean return to schooling:	0.036	0.033	0.038	0.029
F test on joint significance of 3 interaction terms				F=12.28 (p=0.00)

Robust t-statistics below the coefficients

Dependent variable is log hourly earnings at age 33.

Figure 1: Schooling return by observed cognitive ability

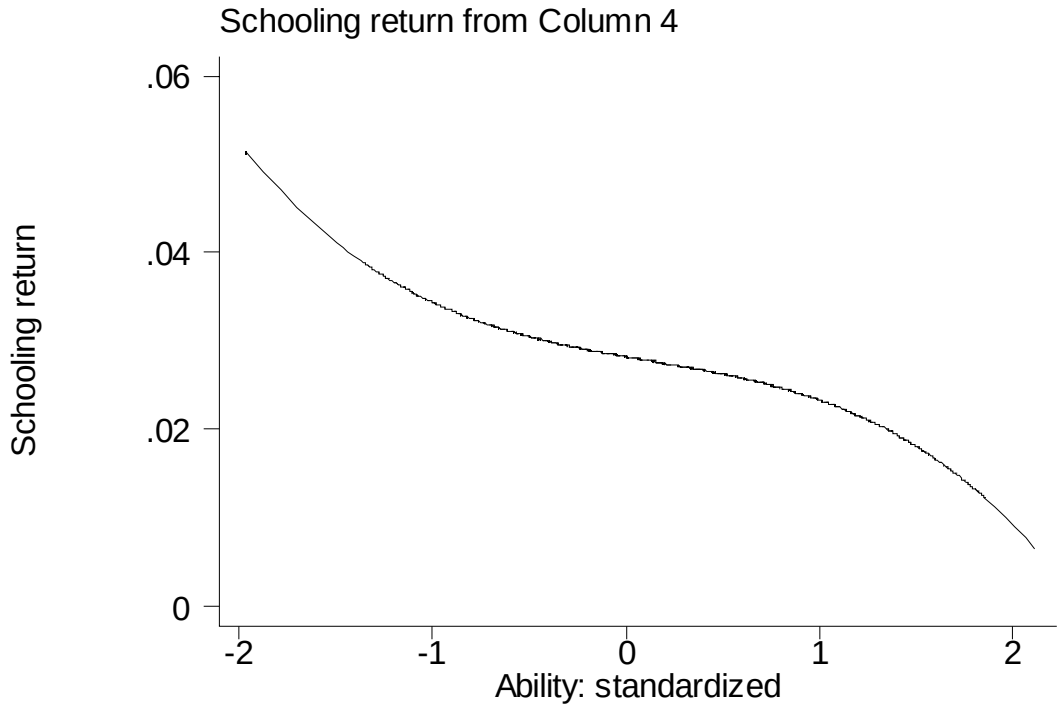
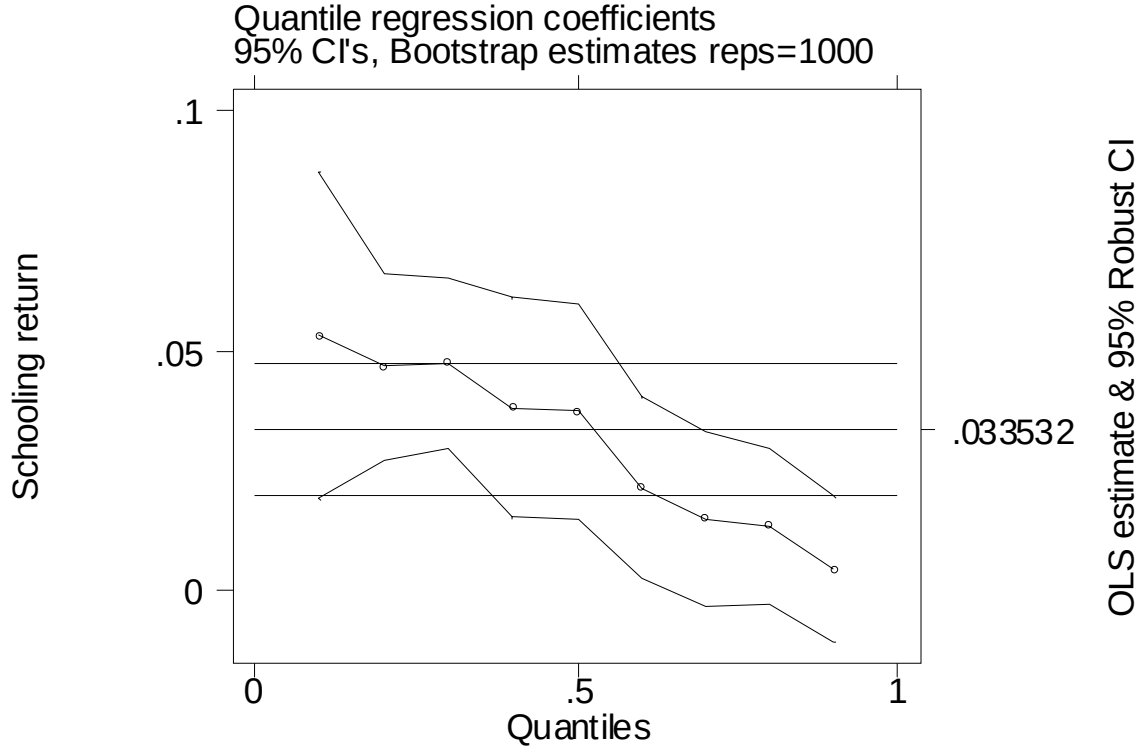


Figure 2: Schooling returns from quantile regressions



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