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Executive Summary

In his influential report on basic skills issues, Moser (DfEE, 1999) suggested that approximately 20 per cent of adults in England had severe literacy difficulties at that time, whilst around 40 per cent had some numeracy problems. Having poor literacy and/ or numeracy is potentially a great impediment to one's personal well-being. Having low skills may also have economic implications. One way to explore this issue is to consider the economic value of basic skills, such as lower level numeracy and literacy, in the labour market.

Research, using data from the early 1990s, suggested that the value of basic skills in the labour market is particularly high in the UK, implying a relative scarcity of individuals with good basic skills (Dearden *et al*. 2002) and McIntosh and Vignoles 2001). In this paper we update the evidence base on this issue, drawing on new data from the British Cohort Study (BCS) collected in 2004, which enables us to consider the importance of basic skills in the current UK labour market, for a relatively young cohort born in 1970. We make comparisons with previous work in this field to ascertain whether the value of basic skills has changed over time, for workers in mid career.

In addition to being asked about their home life and economic activity, respondents were also assessed in terms of their literacy and numeracy. This survey was commissioned under the *Skills for Life Initiative* and part funded by the National Research and Development Centre for Adult Literacy and Numeracy (NRDC). A preliminary but comprehensive account of the literacy and numeracy profiles of this cohort and the details of the survey is given in Bynner and Parsons (2005).

In this paper we focus specifically on the link between basic skills and earnings for the BCS cohort in the 2004 labour market, estimating the wage return to both literacy and numeracy. Estimates of the return to education may suffer from ability bias if measures of ability are not included in the model (Blundell et al. 2000). Likewise with estimates of the return to basic skills it may be that some of the apparent role of basic skills in determining earnings is actually due to the fact that more able individuals (who would earn more anyway) also have better basic skills. We address this by using rich data that enables us to control for prior ability, as well as numerous other factors that may influence earnings.

We also seek to estimate the causal impact of basic skills on individuals' earnings. Presenting simple correlations is not sufficient to do this. We have a number of different estimation strategies. Firstly, we use the richness of the BCS data to control for the widest range of observable characteristics possible, thereby limiting the likelihood of omitted variable bias. We also attempt to make use of the panel element of the data to overcome potential endogeneity bias. Lastly we use the method of instrumental variables. Our preferred instruments are early ability, as measured by

age 5 test scores, and variables measuring the extent of reading that the child was exposed to at age 5.

The paper finds the following results:

- The best predictor of how skilled an adult will be is his or her skill level in primary school. Cognitive test scores obtained in primary school are important determinants of adult basic skills.
- It is not only early ability that matters for future literacy and numeracy. Rather it is the combination of family factors, early schooling and inherent individual characteristics that is a more important determinant of how literate and numerate a person is in adulthood.
- Problems with basic skills emerge early; early interventions may be effective. However, this evidence does not preclude the need for adult intervention.
- Literacy and numeracy continue to be valued in the labour market. Our analysis suggests that the raw wage premium from having level 1 numeracy is actually greater in the 2004 labour market, as compared to the premium in 1991. One might infer from this that the increase in supply of numeracy skills that has occurred in recent years has been met by an even greater increase in the demand for such skills.
- Literacy and numeracy have a strong and similar association with individual's earnings. Specifically, even in models that control for an individual's ability and family background, an additional standard deviation in literacy results in approximately 14 per cent higher earnings, whilst an additional standard deviation in numeracy results in 12 per cent higher earnings. Just under 10 per cent of the variation in earnings for this cohort can be explained by differences in literacy and numeracy skills.
- Instrumental Variable results (that are more likely to establish causality) confirm the strong and statistically significant relationship between adult literacy and numeracy and age 34 earnings.
- The IV results suggest a higher range of possible effects from literacy and numeracy on earnings. For example, the effect of an additional standard deviation in literacy ranges from 29 per cent to 37 per cent; the effect of an additional standard deviation in numeracy ranges from 29 per cent to 32 per cent.

The estimates in this paper focus only on wage impacts from basic skills. All our estimates are therefore from a sample that is in work. Of course many people, particularly those with poor basic skills, are not in employment and the next phase of the research will investigate the relationship between basic skill levels and employability.

1. Introduction

The UK has a poor record in terms of the basic skills of its work force. In his influential report, Sir Claus Moser (DfEE, 1999[4]) suggested that approximately 20% of adults in England had severe literacy difficulties at that time, whilst around 40% had some numeracy problems[5]. The UK also compares poorly to other countries, in terms of the supply of basic skills, coming as it does in the bottom half of the OECD distribution, in terms of the proportion of adults having very low levels[6] of literacy or numeracy (Leitch 2006). This lack of basic skills is confirmed by evidence that the labour market value of basic skills is also higher in the UK labour market than in many of our competitor countries (Denny et al. 2003; Hansen and Vignoles 2005). Such a high price for basic skills suggests a deficiency in supply. In recent years however, there have been concerted policy efforts to improve the supply of basic skills, such as the *Skills for Life* initiative, and this may have reduced the price paid for such skills. In this paper we use new data from the British Cohort Study[7] to determine the labour market value of basic skills in the current (2004) UK labour market for a cohort of adults in their thirties. We also compare this to the value of basic skills for an older cohort (from the National Child Development Study, 1958 cohort) in the mid 1990s.

This paper contributes to the literature[8] in a number of ways. Firstly, the existing evidence on the labour market value of basic skills is based on data from the UK labour market in the 1990s[9]. Given that the supply of basic skills may have changed somewhat since then, it is important to assess the value of skills in today's labour market as we do here. Also, unlike previous work that was largely based on surveys with very small sample sizes[10], the 2004 British Cohort Study survey provides basic skill assessments for the entire BCS cohort, resulting in substantially larger sample sizes. Lastly, we are also able to make comparisons

[4] The Moser report drew on a small but influential body of research in this area, including Basic Skills Agency (1997); Bynner and Parsons (1997a, 1997b); Carey et al. (1997) and Parsons and Bynner (1998).
[5] Full details and a table showing the equivalencies of the different UK literacy/numeracy levels are given at Appendix A.
[6] Level 1 or below.
[7] This study follows a cohort born in 1970.
[8] Most of which is summarised in Leitch (2006).
[9] For example much of the evidence is derived from analyses using the National Child Development Study that follows a cohort born in 1958.
[10] Most previous UK work on this issue used the same surveys as used in this paper (BCS and NCDS) but only had data on the literacy and numeracy skills of a 10% sub sample of each cohort.

over time, i.e. to determine whether (for individuals in their mid thirties) the value of basic skills has increased between 1995 and 2004.

The paper is set out as follows. The next section provides a brief overview of the literature which has examined the relationship between basic skills and labour market outcomes. Section 3 then discusses data and method. Section 4 presents results on the wage effects of literacy and numeracy and the relationship between basic skills and employment. Section 5 concludes.

2. Literature

A useful summary of the current literature is given by Grinyer (2005)[11]. Here we highlight key results that pertain to the UK (also see Leitch 2005 for a summary). Dearden *et al*. (2002) and McIntosh and Vignoles (2001) showed that basic numeracy and literacy skills have important positive effects on individuals' labour market outcomes. The results from these papers were derived from two data sources. The first is a data set that contains information on a cohort of individuals born in 1958 (the National Child Development Study). Individuals in this data set were assessed in terms of their literacy and numeracy in 1995[12]. The second source is the International Adult Literacy Survey, which surveyed a cross section of individuals aged 16-64 in 1996.

The results in Dearden et al. (2000) suggested that there is a large positive effect on earnings and employment rates from having better *numeracy* skills, specifically from achieving at least Level 1 skills[13], although there was also evidence of a large premium from acquiring just Entry Level numeracy skills. Not taking into account other factors that influence earnings, individuals with Level 1 numeracy skills earn around 15-19% more than those with skills below this level. Even after allowing for an independent effect from the worker's education/qualification level, and after controlling for family background, workers with Level 1 numeracy skills earn around 6-7% more than their less skilled peers. The same studies

[11] See also Ananiadou et al. 2004.
[12] Only 10% of the sample undertook literacy and numeracy assessments so sample sizes are small.
[13] The UK has a complex classification of literacy and numeracy, shown in Appendix A. Broadly Level 1 is the level expected of an eleven year old, Entry level is the level expected of a 7 year old.

found a positive relationship between *literacy* and economic outcomes, although the results vary according to the data set used and the effects tend to be smaller and/or insignificant. With no controls, Level 1 literacy is associated with having 15% higher earnings (similar to the numeracy effect). Once other variables are added to the model the effect from Level 1 literacy is reduced to 1-3% for individuals born in 1958 but is still a sizeable 11% when using cross section data from IALS[14].

McIntosh and Vignoles (2001) also found that better numeracy is associated with higher employment rates. Specifically, individuals with Level 1 numeracy skills are around five percentage points more likely to be employed (not taking into account other factors) than those below Level 1. Even in the full model, which conditions for a person's education level, Level 1 numeracy skills are still associated with having a 2-3-percentage point higher probability of being in employment. Again, the literacy results differ according to the data set used. With no controls in the model, having Level 1 literacy skills is associated with a 5-percentage point higher probability of employment in the NCDS, and 13-percentage point higher probability in IALS. Once all the controls are added, including education level, there is no effect from Level 1 literacy in NCDS but a 10-percentage point higher probability of employment from IALS.

A potential criticism of this work is that in fact it is individuals' attitudes and their so-called 'soft skills' that primarily determine their earnings, and, that such characteristics may also be correlated with numeracy and literacy. This could largely explain the positive relationship observed between basic skills and labour market outcomes. Dearden et al. (2001) test this argument and find that the inclusion of the 'soft skill' variables[15] and also the individual's qualification levels into the *employment* models generally rendered any positive relationship between adult basic skills and employment insignificant. However, inclusion of the 'soft skill' variables did *not* eliminate the relationships found between adult numeracy and literacy and individuals' earnings.

Dearden *et al.* (2001) also analysed the impact of *improvements* in adult literacy and numeracy skills, as opposed to just identifying the effect of having a particular level of skill.

[14] This data set has little information on family background and no information on early ability, and therefore this estimate should be viewed with caution.
[15] See also work on this issue by Carneiro, Crawford and Goodman (2006)

They tested a number of different measures of skill improvement, including whether respondents had taken a basic literacy or numeracy course, whether respondents believed that their skills had improved and whether there had been real changes in respondents' literacy and numeracy test scores between the ages of 16[16] and 37. They found that individuals who *reported* that their skills had *improved*, generally earned more than those who did not believe that their skill levels had improved. Most of the other skill improvement measures were insignificant in the model. Males who improved their literacy skills between the age of 16 and 37 (particularly those who started with higher level literacy skills) did earn more subsequently, whilst those who improved their numeracy skills had a greater probability of being employed.

Bynner et al. 2001 and Parsons and Bynner (2005)[17] include estimates of the impact of basic skills on earnings and employment using data on a 10% sub-sample of the British Cohort Study surveyed in 1991. This work confirms the basic findings above, namely that those with better basic skills earn more and are more likely to be employed.

In addition to UK evidence there has been a substantial amount of international research on this issue. Tyler (2002) provides an excellent brief review of the literature in this area. He also finds substantial value for basic cognitive skills for young people who have dropped out of high school and who are early on in their careers. We do not review the international evidence here since it is unlikely that evidence pertaining to a different labour market is necessarily relevant to the UK context. However, it is worth noting that studies that have undertaken international comparisons of the economic value of basic skills have generally suggested that the return to basic skills is considerably higher in the UK labour market (Denny et al. 2003; Hansen and Vignoles 2005)[18]. This would appear to reflect the relatively low supply of such skills in the UK as compared to demand.

The evidence cited above is derived from estimates of the economic value of basic skills in the labour market in the 1990s[19]. Since that time there has been an expansion of the education

[16] The tests administered at age 16 to the NCDS were not designed specifically to assess literacy and numeracy however.
[17] This paper explores some interesting relationships between basic skills and a range of outcomes, including employment, well-being and social and psychological measures.
[18] Both studies use IALS data from 1996.
[19] More precisely in 1991 for studies relying on BCS70 data; 1995 for studies relying on NCDS data and 1996

system, as well as a concerted effort to tackle the problem of basic skills. The UK government claims some success in this regard. For example, the Department for Education and Skills report that the proportion of adults aged 16-65 who have literacy skills below the minimum target of Level 1 fell from 7 million in 1997 to around 5.2 million adults now. The proportion with numeracy skills below the minimum target of Entry Level 3 (the standard expected of 9-11 year olds) has also apparently been reduced from the 7 million estimated in 1997 to 6.8 million adults now. Such significant changes may have affected the supply of basic skills in the labour market and there is therefore a clear need to update the evidence base and obtain more current estimates of the economic value of basic skills.

Some robust work on this issue has already been completed. For example, Grinyer (2005) uses data from the *Skills for Life* Survey to examine the relationship between basic skills and a range of outcomes, particularly employment. He finds strong positive effects on employment from having higher basic skills. He also examines the link between skills and earnings. He uses a somewhat different measure of earnings to that used in the analysis below, i.e. total annual income rather than actual wages. Thus it is less clear that he is measuring the productivity effect of having better basic skills. Given the cross sectional nature of his data, he is also unable to control for the full range of family background and early ability measures that we use in our analysis below. His results confirm a significant relationship between both literacy and numeracy and individuals' earnings.

3. Data and Methods

Data and descriptive statistics

For much of the analysis below, we use a face to face survey of the British Cohort Study (1970 cohort) that was carried out in 2004. In addition to being asked about their home life and economic activity, all respondents were also assessed in terms of their literacy and numeracy[20]. A preliminary but comprehensive account of the literacy and numeracy profiles of this cohort and details of the survey are given in Bynner and Parsons (2005). In addition,

for studies relying on IALS data.

[20] See Appendix B for a brief discussion of these data.

we make comparisons over time using the 1995 survey of the National Child Development Study (1958 cohort) which provides basic skill assessments for 10% of the cohort. Full details of this survey can be found in McIntosh and Vignoles (2001).

Table 1: Literacy and numeracy levels amongst thirty year olds

		BCS (1970) cohort surveyed in 2004		NCDS (1958) cohort surveyed in 1995	
Level	**Average age expected to achieve level**	**Literacy (% of sample)**	**Numeracy (% of sample)**	**Literacy (% of sample)**	**Numeracy (% of sample)**
Entry Level 2 or below		4	14	6	23
Entry Level 3 or below *(minimum target level for numeracy*)	Age 7	4	25	13	25
Level 1 (*minimum target level for literacy*)	Age 11	30	34	38	24
Level 2 or above	Age 16	62	27	43	27

Source: BCS data comes from Bynner and Parsons (2005), Figures 3.5a and 3.6a. NCDS data comes from McIntosh and Vignoles (2001).

The tests used by the BCS cohort are similar to those taken by the NCDS cohort in 1995 (as described in Appendix B), we can therefore examine changes over time in levels of literacy and numeracy in these cohorts (Table 1). The first two columns show the profile of basic skills for the BCS cohort, based on the assessment taken in 2004. Thus in literacy 8% of individuals still have skills below the minimum target of Level 1, whilst in numeracy 14% of the sample fall below the government target of Entry level 3 skills[21]. The final two columns of Table 1 provide similar information from the NCDS cohort born in 1958. Thus the NCDS data in the final two columns of Table 1 provides a basic skills profile of a cohort age 37 in the 1990s. This can be contrasted with the BCS data, which provides information on a cohort aged 34 in 2004.

[21] This is broadly consistent with the results from the Skills for Life Survey cited extensively by the Leitch review (2006).

Table 1 shows some very significant differences between the two cohorts. The proportion of the most recent 1970 cohort with poor basic skills (i.e. below level 1) is much smaller than in the earlier 1958 cohort. This could potentially be due to policies aimed at improving the basic skills of adults during this period, such as *Skills for Life*. However, it may also be due to the fact that school leavers have been improving over time in terms of their qualification levels, and therefore by implication, they may have also been improving in terms of their basic skills. Certainly the more recent cohort acquired more education than the 1958 cohort and we would therefore anticipate a reduction in the proportion with poor skills. For example, by their mid thirties, 30% of the NCDS cohort had acquired a degree level qualification or above. By contrast, nearly 40% of the 1970 recent cohort had acquired a degree level qualification or above by their mid thirties. However, it is worth noting that TIMSS[22] data suggests that the average mathematical literacy of English 14 year olds has been quite constant since the early 1990s.

Of course another possibility is that the basic skill tests used in the 1995 survey of the NCDS cohort were somewhat different to the tests used for the 2004 survey of the BCS cohort. Bynner and Parsons (2005) highlight the differences between the assessment methods used for the NCDS age 37 survey and the BCS 2004 survey. The assessments used for the NCDS were based on the Wordpower and Numberpower standards of the time. These assessment methods were somewhat different from those needed to identify the levels individuals achieve in basic skills, according to the new *Skills for Life* standards (Bynner and Parsons, 2005). The 2004 BCS survey therefore combined elements of the earlier assessments, with new literacy and numeracy assessments specifically designed for the age 34 BCS survey, as set out by Brooks et al. (2005). This ensures a high degree of comparability (Bynner and Parsons, 2005).

In addition to issues of comparability across cohorts, there is also the related issue of how one should measure and model basic skills. In previous work the emphasis has been on using the levels of literacy presented above, which were adopted by various government reports, including Moser (DfEE, 1999) and Leitch (2005). However, the basic skills assessment administered to the BCS cohort provides continuous measures of the individual's basic skill

[22] Trends in international mathematics and science study.

level. Specifically it provides measures running from zero to twenty seven for literacy and zero to twenty three for numeracy. We make use of these continuous measures so as not to lose information unnecessarily.

Methodology

In this paper we focus specifically on the link between basic skills and labour market outcomes, namely earnings and employment, for the BCS cohort in the 2004 labour market and, for comparisons over time, the NCDS cohort in the 1995 labour market. For the wage analyses, we use the following adaptation of the basic Mincer (1974) earnings model:

$$\ln Y_i = \alpha + \beta X_i + \delta Z_i + \mu_i$$

Where Y is an individual's gross hourly earnings, X is a vector of individual characteristics and Z is a vector of variables describing the individual's literacy and numeracy levels. We include a range of individual characteristics (X)[23] from these very rich cohort data, including gender and ethnicity, as well as a number of family background variables such as parental social class when the children were age 5, whether the individual lived in financial hardship during their childhood, whether they were eligible for free school meals[24] at age 10 and their parents' education level and interest in the cohort member's education at age 16. It is of course rare to find such rich information in cross section and/ or administrative data sets, for example. Such family background variables are important since other evidence does suggest that they affect an individual's education level and hence their basic skills, as well potentially having a direct impact on subsequent earnings.

It is well known that estimates of the return to education may suffer from ability bias (Griliches 1977). Estimates of the return to education will be upward biased if measures of ability are not included in the model (Blundell et al. 2000). Likewise with estimates of the return to basic skills it may be that some of the apparent role of basic skills in determining

[23] Appendix C contains means of all the variables used in the analysis for the sample for our preferred specification.
[24] In the UK children whose parents are on low income or unemployed are eligible for free meals at school. This indicator is widely used as a proxy for socio-economic disadvantage in UK education research.

earnings is actually due to the fact that more able individuals (who would earn more anyway) also have better basic skills. The data set used in this analysis has the additional advantage of containing a range of proxy indicators of the individual's ability, and the model therefore also controls for an individual's ability, as measured by test scores from cognitive skill tests undertaken at age 5 and 10.

In some specifications of the model, variables describing the individual's current situation are included. These include whether the individual is disabled, whether they have children, their education level and variables describing their labour market history. These variables may of course be endogenous and we therefore include them only for illustration. It is also worth noting that where we include the individual's highest education level, the specification measures the marginal impact of having better basic skills conditional on a given level of education achieved. We recognise that one of the major routes by which having poor basic skills impacts on an individual's subsequent labour market success is by ensuring poor educational achievement. In models that control for educational achievement, we are limiting the effect of having poor basic skills to an additional effect over and above any impact poor basic skills may have on a person's education level. This is made clear in the discussion of results.

Causality

Ideally of course one wants to estimate the causal impact of basic skills on individuals' earnings. Presenting simple correlations is not sufficient to do this. We have a twofold estimation strategy. Firstly, we use the richness of the BCS data to control for the widest range of observable characteristics possible, thereby limiting the likelihood of omitted variable bias. The specifications we use are extremely rich and can arguably be said to allow for ability bias. Furthermore, we are able to include a range of individual and family characteristics that have been found to significantly affect educational achievement, and may well also be proxy measures for unobserved factors that influence both basic skill achievement and subsequent earnings. For instance, by controlling for parental attitudes towards education, we attempt to allow for what are normally unobservable characteristics of parents that influence children's educational achievement, and which may well also eventually influence their earnings.

Whilst including a rich range of family background controls does go some way to reassuring us that we are uncovering causal relationships, such an approach does not take care of unobservable factors. Another potential problem we face is that our OLS estimates may also be biased by measurement error in the literacy and numeracy tests, which is an issue that has been recognised as a particular problem in this literature (Tyler, 2004). Classical measurement error will produce downward bias in OLS estimates. An IV approach can be used to both address the issue of causality and the problem of measurement bias (see for example Dearden, 1999). We therefore undertake a series of robustness checks to attempt to take account of both endogeneity and measurement error bias. Firstly, we include lagged measures of both wages and basic skills in the models. This is an attempt to control for constant unobserved factors that determine both current and previous basic skills and wages. We also adopt the use of the method of instrumental variables. We have a number of potential instruments, arising from the rich data collected throughout these individuals' lifetimes, and particularly during their childhood. We used some variables measured early in the individual's childhood to avoid capturing the effect of their education. Specifically, we considered a number of potential instruments, namely:

- Indicators of the extent to which the cohort member was read to as a young child (age 5);
- Whether or not the mother was the one doing most of the reading to the child at the age of 5;
- Whether the mother smoked during pregnancy.

The above instruments potentially identify individuals' basic skill levels but arguably do not directly impact on their wages. We also consider a set of instruments to deal with measurement error. The BCS data include indicator of the individual's early childhood ability, as measured by three tests undertaken at age 5 (a human figure drawing test, a copying designs test and an English picture vocabulary test) as well as later measures such as the mathematics tests at age 10. Using these measures as instruments for adult basic skills can test the extent to which measurement error may be an issue in these data.

Employment outcomes

For the analysis of the relationship between basic skills and employment, we rely on simple probit models in which the outcome measure takes a value of one if the person spent more months in employment than in any other state (i.e. unemployment, inactivity, long-term sickness, working in the home, full-time education) between the ages of 33 and 34, and a value of zero otherwise. The proportion of the cohort in employment at any one time is high so variation is limited using this measure. We are also interested in the relationship between basic skills and different types of employment. As there is evidence that part time jobs are disproportionately low quality, we also consider the effect of basic skills on full time employment specifically. We use a binary variable which takes the value of one if the person spent more months in full time employment during the last year than in any other state. Again our estimation strategy is to rely on the richness of the data to enable us to fully control for a number of observable characteristics that might be correlated with basic skills and also influence employment. We were unsuccessful in estimating IV probit models and therefore we acknowledge that in the case of the employment analysis, we are not as confident that we have established causality.

4. Results

The impact of literacy and numeracy on Earnings in 2004

Column 1 of table 2 shows the relationship between continuous measures of literacy and numeracy and earnings in 2004 for the BCS cohort, with no other controls in the model. Variation in adult literacy and numeracy explains around 10% of the variation in log gross hourly earnings in this specification. Both literacy and numeracy are highly significant in the model. Better literacy and numeracy skills are positively related to earnings and the relationship is non linear, suggesting higher skill levels are associated with higher earnings at an increasing rate. An additional standard deviation of literacy skill yields on average 20%[25] higher earnings, whilst an additional standard deviation of numeracy skill yields just over

[25] Note that this is calculated including the effect of the non linear term.

Table 2: The relationship between age 34 basic skills and earnings: men and women

	Regression 1		Regression 2		Regression 3		Regression 4	
Variables	**Coeff.**	**Std.**	**Coeff.**	**Std.**	**Coeff.**	**Std.**	**Coeff.**	**Std.**
Standardised age 34 literacy score	0.164***	(0.016)	0.134***	(0.018)	0.114***	(0.018)	0.091***	(0.017)
Standardised age 34 literacy score squared	0.032***	(0.008)	0.030***	(0.010)	0.026***	(0.010)	0.022**	(0.010)
Standardised age 34 numeracy score	0.138***	(0.012)	0.094***	(0.015)	0.084***	(0.015)	0.064***	(0.015)
Standardised age 34 numeracy score squared	0.038***	(0.010)	0.033***	(0.008)	0.025***	(0.008)	0.025***	(0.009)
Controls:								
Gender	X		X		X		X	
Age 10 ability test scores			X		X		X	
Family background variables					X		X	
Labour market variables							X	
Highest education level at age 34							X	
Sample size	6255		4664		4664		4662	
R-Squared	0.10		0.11		0.15		0.19	
Adj R-Squared	0.10		0.10		0.15		0.18	

Data source: 1970 BCS Age 34 survey. Dependent variable is log gross hourly earnings at age 34.

Results are for men and women combined. Both literacy and numeracy measures are included in the same model.

*** significant at 1%, ** significant at 5%, * significant at 10%.

17% higher earnings. Given that our measures are normalised this implies that an individuals who moves from the median of the literacy (numeracy) distribution to the 84th percentile will increase her hourly wage by 20% (and 17%).

Column 2 then adds in some early ability measures, i.e. test scores at age 10. We know that early test scores are an important determinant of literacy and numeracy skills at age 34, and other evidence suggests that ability also has a direct impact on earnings. This model therefore tests whether the estimates of the impact of literacy and numeracy are attenuated once we attempt to allow for ability bias. The age 10 mathematics score and the general ability test score are significant but the age 10 literacy score is not. However, the inclusion of the early ability scores does reduce the magnitude of the effect from literacy and numeracy on current earnings. Nonetheless literacy and numeracy remain highly significant in the model and show the same non linear relationship with earnings. An additional standard deviation on the literacy test score is associated with 16% higher earnings, whilst an additional standard deviation on the numeracy score is associated with approximately 13% higher earnings.

Column 3 of Table 2 includes the full range of family background variables discussed earlier and is our preferred model[26]. Literacy and numeracy continue to be significant. The inclusion of the family background variables does appreciably reduce the wage premium associated with having better literacy and numeracy skills. An additional standard deviation in literacy results in approximately 14% higher earnings, whilst an additional standard deviation in numeracy results in 11% higher earnings.

For completeness, column 4 then includes a range of additional variables describing the individual's current situation. These variables include the person's highest education level, whether or not the person is registered disabled, months of total unemployment to 2004, months out of the labour market to 2004 and whether or not the individual has a child. Including these variables is forcing the model to include potential outcomes from having poor literacy or numeracy, thereby reducing the potential effect from literacy and numeracy on earnings and we do not stress these results but note that inclusion of these variables reduces the coefficients on literacy and numeracy as expected but the impact of literacy and numeracy on earnings remains significant. Given that we control for highest education level, the model

[26] Full specifications are in Appendix D.

in column 4 essentially measures the effect of basic skills on earnings within a given level of education. Thus basic skills still have a significant relationship with earnings, even for individuals with similar levels of education.

Men and women have very different patterns of work in the labour market, particularly in their early thirties when a significant proportion of the women have (temporarily) withdrawn from the labour market. We therefore estimate wage equations separately for men and women. We do not estimate sample selection models for women and therefore these results apply only to women who choose to participate in the labour market in their early thirties, who may not be representative of all women.

Table 3: The relationship between age 34 basic skills and earnings: males

	Regression 1		**Regression 2**		**Regression 3**		**Regression 4**	
Variables	**Coeff.**	**Std.**	**Coeff.**	**Std.**	**Coeff.**	**Std.**	**Coeff.**	**Std.**
Standardised age 34 literacy score	0.153***	(0.023)	0.137***	(0.025)	0.124***	(0.025)	0.103***	(0.025)
Standardised age 34 literacy score squared	0.030***	(0.009)	0.035***	(0.008)	0.033***	(0.008)	0.031***	(0.009)
Standardised age 34 numeracy score	0.140***	(0.018)	0.095***	(0.020)	0.089***	(0.020)	0.074***	(0.020)
Standardised age 34 numeracy score squared	0.031**	(0.014)	0.037***	(0.012)	0.029**	(0.012)	0.025**	(0.012)
Controls:								
Age 10 ability test scores			X		X		X	
Family background variables					X		X	
Labour market variables							X	
Highest education level at age 34							X	
Sample size	3257		2396		2396		2394	
R-Squared	0.10		0.11		0.14		0.16	
Adj R-Squared	0.10		0.10		0.13		0.15	

Data source: 1970 BCS Age 34 survey. Dependent variable is log gross hourly earnings at age 34.
Results are for men. Both literacy and numeracy measures are included in the same model.
*** significant at 1%, ** significant at 5%, * significant at 10%.

Table 3 summarises results for men, whilst Table 4 provides results for women. In the first specification from each table that has no additional controls, an extra standard deviation of literacy yields 18% higher earnings for men and just under 22% for women. An additional standard deviation of numeracy yields 17% higher earnings for males and 19% higher earnings for females. In the preferred specification that controls both for early ability and family background, an extra standard deviation of literacy yields 15% higher earnings for men and 13% women. An additional standard deviation of numeracy gives 11-12% higher earnings for men and women. In other words, although other characteristics affect male and female pay quite differently (e.g. ethnicity), men and women with better numeracy earn similar wage premiums in the labour market.

Robustness checks and inferring causality

From a policy perspective of course, we would like to know the potential effect of increasing individuals' skill levels on their wages, and by implication, their productivity. This requires us to take a causal interpretation of our results. The richness of our OLS results give us some confidence that we are controlling for a myriad of observed characteristics that may otherwise be omitted from most models, and implying we are more likely to be identifying causal effects. There is still the possibility however, that there may be unobserved characteristics of the individual that determine both their basic skill levels and their subsequent earnings in the labour market. For example, if particularly motivated individuals tend to have better basic skills and also tend to earn more in the labour market, we may be spuriously attributing the impact of being more motivated to having better basic skills. To some extent we already address this by controlling for early ability, as well as the rich range of family background variables available in the BCS data. However, it is still possible that our estimates suffer from residual endogeneity bias. Another issue we face is the problem of measurement error in the literacy and numeracy measures obtained at age 34. The tests were administered in a home environment setting, albeit with trained test administrators supervising the tests. We therefore recognise that measurement error is likely to be more of a problem than test scores obtained in a more controlled educational setting. To address these issues of endogeneity and measurement error, we undertake a number of robustness checks, including taking an IV approach.

Table 4: The relationship between age 34 basic skills and earnings: females

	Regression 1		Regression 2		Regression 3		Regression 4	
Variables	**Coeff.**	**Std.**	**Coeff.**	**Std.**	**Coeff.**	**Std.**	**Coeff.**	**Std.**
Standardised age 34 literacy score	0.175***	(0.020)	0.130***	(0.026)	0.108***	(0.025)	0.080***	(0.024)
Standardised age 34 literacy score squared	0.035***	(0.013)	0.023	(0.018)	0.020	(0.018)	0.015	(0.019)
Standardised age 34 numeracy score	0.138***	(0.017)	0.094***	(0.023)	0.083***	(0.022)	0.060***	(0.023)
Standardised age 34 numeracy score squared	0.045***	(0.014)	0.035***	(0.012)	0.027**	(0.012)	0.027**	(0.013)
Controls:								
Age 10 ability test scores			X		X		X	
Family background variables					X		X	
Labour market variables							X	
Highest education level at age 34							X	
Sample size	2998		2268		2268		2268	
R-Squared	0.09		0.10		0.13		0.17	
Adj R-Squared	0.08		0.09		0.12		0.16	

Data source: 1970 BCS Age 34 survey. Dependent variable is log gross hourly earnings at age 34. Results are for women. Both literacy and numeracy measures are included in the same model.

*** significant at 1%, ** significant at 5%, * significant at 10%.

Firstly, we have prior measures of wages (from BCS surveys at age 26 and, for a 10% sub-sample, at age 21) and literacy and numeracy (from age 21 for a 10% sub-sample of the BCS). We therefore include lagged measures of both wages and basic skills in our model, to test whether we continue to get significant effects from current (2004) measures of literacy and numeracy on earnings. Inclusion of lagged measures of earnings for example, should at least control for the effect of constant unobserved characteristics of these individuals that determine previous wages. Inclusion of lagged literacy and numeracy measures provides a

rigorous check of the effect of current literacy and numeracy, conditional on a person's basic skills towards the beginning of their working life (age 21). The results of these robustness checks are presented in Table 5.

In column 1 of Table 5, the individual's prior earnings in 1996 are included. The person's previous wage in 1996 is highly significant in the model, as expected. However, the effects of age 34 literacy and numeracy on current earnings continue to be highly significant and of similar magnitude to effects reported in column 3 of Table 2, even after controlling for the 1996 wage. To the extent that the prior wage measure captures the time constant effect of unobserved characteristics on wages, this model provides a robustness check of the effect of literacy and numeracy on wages. In column 2, the person's prior wage in 1996 and 1991 is included in the model. The latter is insignificant and the model can only be estimated for the 10% sub-sample of the BCS that were interviewed in 1991. Given that the sample changes, perhaps unsurprisingly the exact magnitude of the literacy and numeracy coefficients also differs from the results in column 1. However, the literacy and numeracy coefficients remain positive and highly significant. This suggests that even controlling for two measures of an individual's prior wage and using a smaller sample, we still find literacy and numeracy to be positively and significantly related to current earnings.

In column 3 of Table 5 we include standardised measures of literacy and numeracy obtained for a 10% sub-sample of the BCS in 1991. The model therefore includes two sets of basic skill measures, one at the start of someone's working career (age 21) and one obtained at the age of 34. The age 21 measures of basic skill are positive and significant. Inclusion of these age 21 measures reduces the overall effect of the age 34 literacy measure, as expected. However, the age 34 literacy measure remains positively and significantly related to current earnings even after including lagged measures. For numeracy, once the non linear term has been taken account of, age 34 numeracy remains positively and significantly related to current earnings although the magnitude of the effect is considerably smaller once a lagged measure is included. In column 4 of Table 5, an alternative measure of lagged numeracy is included in the model, namely the person's mathematics test score taken from the age 16 survey of the BCS[27]. This age 16 measure is highly significant in the model and age 34 numeracy does not remain significant once this lagged measure is included. However, the age

[27] The BCS age 16 test scores in mathematics are not available from the ESRC data archive. We are grateful for Jon Johnson and the CLS British Cohort Study team for providing these data.

Table 5: Robustness checks: including lagged wage and literacy/numeracy measures

	Regression 1		Regression 2		Regression 3		Regression 4	
Variables	**Coeff.**	**Std.**	**Coeff.**	**Std.**	**Coeff.**	**Std.**	**Coeff.**	**Std.**
Standardised age 34 literacy score	0.132***	(0.022)	0.161***	(0.054)	0.152***	(0.050)	0.121***	(0.034)
Standardised age 34 literacy score squared	0.023	(0.017)	-0.069	(0.074)	-0.024	(0.058)	0.040***	(0.013)
Standardised age 34 numeracy score	0.072***	(0.018)	0.080**	(0.041)	0.027	(0.039)	0.022	(0.033)
Standardised age 34 numeracy score squared	0.035***	(0.013)	0.088**	(0.043)	0.047**	(0.024)	0.004	(0.016)
Controls:								
Log wage at age 26	0.135***	(0.018)	0.178***	(0.045)				
Log wage at age 21			0.073	(0.052)				
Standardised age 21 numeracy scores					0.065*	(0.036)		
Standardised age 21 literacy scores					0.103***	(0.037)		
Standardised age 16 math scores							0.083***	(0.029)
Age 10 ability test scores	X		X		X		X	
Family background variables	X		X		X		X	
Sample size	2827		343		608		1332	
R-Squared	0.165		0.349		0.172		0.165	
Adj R-Squared	0.156		0.282		0.126		0.145	

Data source: 1970 BCS Age 34 survey. Dependent variable is log gross hourly earnings at age 34.
Results are for men and women combined. Both literacy and numeracy measures are included in the same model.
*** significant at 1%, ** significant at 5%, * significant at 10%.

10, the age 16 and the age 34 numeracy measures are correlated (of the order of 0.60 in pairwise correlations). It is probably that the age 10 and age 16 measures are capturing most

of the effect of numeracy at age 34. Overall however, the results imply that conditional on early literacy and numeracy, individuals with better skills at age 34 still earn a wage premium to those skills[28].

Our IV results are presented in Tables 6 (for literacy) and 7 (for numeracy). We present only the coefficients on the instrumented literacy and numeracy variables and we present several IV estimates that vary by choice of instrument. The primary purpose of the IV estimation is to establish the extent of bias in the OLS estimates caused by measurement error and, in as much as we have plausible exogenous instruments, endogeneity.

Table 6: IV estimates of the impact of literacy on earnings at age 34

	Effect of literacy on hourly-wage at 34				
	Estimated Coeff. for literacy	**Std.**	**First stage F-stat of excl. instrument**	**Hansen's J statistic (P-value)**	**N**
	(1)	(2)	(3)	(4)	(5)
OLS	0.095***	0.018			3136
2SLS					
Instruments:					
Age 5 ability test scores	0.455***	0.131	14.84	0.778	3136
Same + Mother does most of the reading to child aged 5; Days/week reading to child aged -	0.378***	0.113	11.37	0.537	3139
Same +mother smoked during pregnancy.	0.321***	0.104	10.51	0.327	3136
LIML					
Instruments:					
Age 5 ability test scores ; Mother does most of the reading to child aged 5; Days/week reading to child aged 5; mother smoked during	0.339***	0.113	-	0.334	3136

Data source: 1970 BCS Age 34 survey. Dependent variable is log gross hourly earnings at age 34. Results are for men and women combined. *** significant at 1%, ** significant at 5%, * significant at 10%.

[28] A first difference model regressing the change in wages between 1991 and 2004 against the change in standardised literacy and numeracy scores over the same period did not yield a significant correlation, partly due to small sample sizes and very large standard errors.

Table 6 shows the return to literacy. In each case the instruments are good predictors of adult literacy scores (the F test from the first stage regression exceeds the value of around 8 or more in each cases). The estimates of the effect of literacy on earnings range from 0.32 to 0.46. This compares to an OLS coefficient of just .095 in an identical specification[29]. In the specification that only uses age 5 ability tests as instruments, the estimate of the return to literacy is particularly high at 0.46. This result implies that our OLS coefficients are underestimates of the true impact of adult literacy due to measurement error. In the specifications that include other instruments that predict literacy, such as the reading environment of the child in early childhood, the estimate of the return to literacy remains much higher than the OLS estimate. This result is consistent with the returns to education literature which has generally found higher returns to education using IV methods (Card, 1998). The IV method always generates a Local Average Treatment Effect (Card, 1998). This means that those individuals affected by the instrument, for example those individuals for whom early exposure to reading did affect their adult literacy, earn a higher return to literacy in the labour market.

We also run LIML estimations of the same models which are median unbiased even in the over identified case with weak instruments. We observe similar coefficients and the standard errors remain stable.

The results for numeracy in table 7 mirror those for literacy, although we also use the age 16 mathematics test score mentioned earlier as a potential instrument for age 34 numeracy. All the instruments chosen work in the first stage and the F statistics exceed 8 in each case, although the Hansen's J test statistic is less reassuring about the validity of the instruments. The IV estimates of the effect of numeracy on earnings range from 0.28 to 0.31. This compares to a somewhat lower OLS coefficient of 0.102 from the same model. Again, this can be attributable to measurement error and/or because a LATE effect is being estimated. The LIML estimates produce similar coefficients and only slightly higher standard errors. In a further check of our instruments we perform JIVE's estimations (Angrist, Imbens and Krueger, 1999a). They produce very similar coefficient estimates and standard errors (not presented).

[29] Note these estimates are linear, i.e. we include only the literacy score and not its square as in previous tables.

Table 7: IV estimates of the impact of numeracy on earnings at age 34

	Effect of numeracy on hourly-wage at 34				
	Estimated Coeff. for numeracy	**Std.**	**First stage F-stat. of excl. inst.**	**Hansen's J statistic (P-value)**	**N**
	(1)	(2)	(3)	(4)	(5)
OLS	0.102***	0.016			3129
2SLS **Instruments:**					
Age 5 ability test scores	0.310**	0.137	15.19	0.029	3132
Age 5 ability; Mother does most of the reading to child aged 5; Days/week	0.301**	0.130	9.79	0.084	3132
Same +mother smoked during	0.282**	0.126	8.65	0.098	3129
Age 16 test maths score	0.306***	0.076	160.99	-	3132
LIML					
Instruments: Age 5 ability test scores ; Mother does most of the reading to child aged 5; Days/week reading to child aged 5; mother smoked during pregnancy	0.315**	0.149	-	0.096	3129

Data source: 1970 BCS Age 34 survey. Dependent variable is log gross hourly earnings at age 34. Results are for men and women combined. *** significant at 1%, ** significant at 5%, * significant at 10%.

In summary, our IV approach suggested a positive and stronger relationship between basic skills and earnings than was the case for our standard OLS model. This is consistent with our fear that our OLS estimates suffer from attenuation bias caused by measurement error in the basic skills measures.

Changes over time

As has already been discussed, we are particularly fortunate in that we have access to two birth cohort data sets which include comparable measures of basic skill obtained at similar

ages, namely the BCS and the National Child Development Study. We are therefore able to undertake a cross cohort analysis of the relationship between literacy and numeracy and earnings and determine how it may have changed over time. In table 8 we show the relationship between literacy and numeracy levels and wages for the two cohorts in their thirties, one in 1995 (NCDS) the other in 2004 (BCS). Thus we compare the return to basic skills for a similar age sample at two points in time, to try to uncover any major change in the economic value of basic skills in the UK labour market. We adopt our preferred specification (column 3 of Table 2), and we are able to estimate virtually identical specifications using the NCDS and BCS data sets. In both data we are able to control for parental social class, whether the individual lived in financial hardship during their childhood, parents' education level and interest in the cohort member's education in childhood. In both data we are also able to control for early ability, although the early ability tests were administered at age 10 in the BCS data and age 11 in the NCDS data.

Column 1 of Table 8 suggests that for the NCDS cohort surveyed in 1995, a one standard deviation increase in literacy and numeracy was associated with a 15% increase in earnings, after controlling for early ability and family background. Column 2 of Table 8 indicates that a one standard deviation increase in literacy and numeracy in the 2004 labour market for the BCS cohort was associated with a 14%, and 11% increase in earnings respectively. Given that both cohorts are at a similar age when they were surveyed, we conclude that the return to literacy is quite similar across the two cohorts. The magnitude of the relationship between numeracy and earnings is somewhat reduced in the later cohort but the results are not significantly different from those in the earlier cohort.

On the basis of this evidence, the value of basic skills in the labour market appears to have remained remarkably stable since the 1990s, despite both a concerted effort to reduce the number of individuals with poor basic skills (approximately 200,000 fewer people now have very low numeracy skills i.e. below Entry Level 3 as compared to the late 1990s), and the massive increase in educational achievement across the two cohorts. Recall that only 30% of the NCDS cohort has a degree, for example, whilst 40% of the BCS cohort achieved a degree. Also, the basic skills tests administered to the two cohorts indicate a small rise in the skill levels across the two cohorts. All this would seem to indicate that the increase in the supply of literacy and numeracy skills since the early 1990s has been at least matched by the increased in demand for these skills, causing the return to these skills to remain stable. We

note however, that we are only considering the value of these skills for one particular age group.

Table 8: Changes over time: the relationship between basic skills and earnings for men and women (combined sample) in their thirties

	1995		2004	
Variables	**Coeff.**	**Std.**	**Coeff.**	**Std.**
Standardised age 34 literacy score	0.109	(0.025)**	0.114	(0.019)**
Standardised age 34 literacy score squared	0.038	(0.009)**	0.026	(0.007)**
Standardised age 34 numeracy score	0.150	(0.026)**	0.084	(0.015)**
Standardised age 34 numeracy score squared	0.018	(0.013)	0.025	(0.009)**
Controls:				
Gender	X		X	
Age 10/11 ability test scores	X		X	
Family background variables	X		X	
Sample size	854		4664	
R-Squared	0.33		0.15	
Adj R-Squared	0.33		0.15	

Data source: For 1995 regression, NCDS Age 31 and Age 37 surveys. For 2004 regression, 1970 BCS Age 34 survey. Dependent variable is log gross hourly earnings at age 31 for NCDS and age 34 for BCS.

Results are for men and women combined. Both literacy and numeracy measures are included in the same model.

*** significant at 1%, ** significant at 5%, * significant at 10%.

The relationship between basic skills and employment

Thus far we have focused exclusively on the relationship between basic skills and wages, with the implicit assumption being that wages are a good proxy measure of a person's productivity. From a policy perspective however, employability is at least as important as wages. In this section we therefore present the results of a probit model of employment,

which examines the determinants of being in employment at age 34. Since we know that men and women have very different labour market participation patterns at this age, we present results for men and women separately.

Table 9: The relationship between age 34 basic skills and employment: women only

Variables	Regression 1		Regression 2		Regression 3	
	Coef	Std	Coef	Std	Coef	Std
Standardised age 34 literacy score	0.040***	(0.008)	0.037***	(0.009)	0.035***	(0.010)
Standardised age 34 numeracy score	0.035***	(0.008)	0.020*	(0.009)	0.018	(0.010)
Age 10 ability test scores			X		X	
Family background					X	
Highest educational level at age 34					X	
Age 5 ability test scores					X	
Sample size	4945		3659		3659	

Data source: 1970 BCS Age 34 survey. Dependent variable takes value of 1 if the individual spent more months in employment between the age of 33 and 34 than in any other status (unemployment, inactivity, long-term sickness, working in the home, full-time education). Marginal effects are reported. Results are for women only. Both literacy and numeracy measures are included in the same model.
*** significant at 1%, ** significant at 5%, * significant at 10%.

Table 9 shows the model for women. Column 1 provides estimates of the relationship between literacy and numeracy at age 34 and employment. The dependent variable has a value of 1 if the person spent more time in employment than any other state in the previous year, i.e. age 33-34. The model in column 1 does not include any other controls. The results suggest that there is a positive and significant relationship between literacy and numeracy and being in employment. The second column includes early ability tests, in a similar manner to the wage regressions discussed above. This second model therefore identifies the relationship between basic skills and employment, conditional on the early, age 10, ability of the individual. The results still suggest a significant relationship between literacy and numeracy and employment, although the numeracy coefficient is only significant at the 10% level. The

third and final column includes a number of other family background measures (identical to those used in tables 4-6) and even earlier ability, as measured at age 5[30]. Once these measures of family background and early ability are included, we still find a positive and significant relationship between literacy and employment, for women. Specifically an additional standard deviation of literacy is associated with a 3.5 percentage point higher probability of being mostly in employment at age 33/34. The relationship between numeracy and employment becomes insignificant in this model.

Table 10: The relationship between age 34 basic skills and employment: men only

Variables	Regression 1		Regression 2		Regression 3	
	Coef	Std	Coef	Std	Coef	Std
Standardised age 34 literacy score	0.011**	(0.004)	0.010*	(0.005)	0.007	(0.005)
Standardised age 34 numeracy score	0.022***	(0.004)	0.023***	(0.005)	0.023***	(0.007)
Female	X		X		X	
Age 10 ability test scores			X		X	
Family background					X	
Highest educational level at age 34					X	
Age 5 ability test scores					X	
Sample size	4514		3280		3280	

Data source: 1970 BCS Age 34 survey. Dependent variable takes value of 1 if the individual spent more months in employment between the age of 33 and 34 than in any other status (unemployment, inactivity, long-term sickness, working in the home, full-time education). Marginal effects are reported. Results are for men only. Both literacy and numeracy measures are included in the same model.

*** significant at 1%, ** significant at 5%, * significant at 10%.

Table 10 shows similar specifications for men. Column 1 suggests a significant relationship between literacy and numeracy and employment for men, in a model with no other controls.

[30] In previous wage models, we used the age 5 tests as instruments. As we do not estimate IV models for employment, we also present an employment specification which includes these very early ability test scores.

Even in the third column, which includes family background and age 10 ability measures, we still see a positive and significant relationship between numeracy and employment. Specifically, an additional standard deviation of numeracy is associated with a two percentage point higher probability of being mostly employed at age 33/34.

Table 11: The relationship between age 34 basic skills and full-time employment: women only

Variables	Regression 1		Regression 2		Regression 3	
	Coef	Std	Coef	Std	Coef	Std
Standardised age 34 literacy score	0.060***	(0.025)	0.050***	(0.032)	0.047***	(0.013)
Standardised age 34 numeracy score	0.052***	(0.024)	0.029*	(0.030)	0.027*	(0.012)
Age 10 ability test scores			X		X	
Family background					X	
Highest educational level at age 34					X	
Age 5 ability test scores						
Sample size	4945		3659		2597	

Data source: 1970 BCS Age 34 survey. Dependent variable takes value of 1 if the individual spent more months in full time employment between the age of 33 and 34 than in any other status (unemployment, inactivity, long-term sickness, working in the home, full-time education). Marginal effects are reported. Results are for women only. Both literacy and numeracy measures are included in the same model.
*** significant at 1%, ** significant at 5%, * significant at 10%.

Thus far we have focused on the relationship between basic skills and being in employment, regardless of the nature of that employment. Here we also explore the extent to which basic skills are associated with full time employment specifically. Tables 11 and 12 show the relationship between basic literacy and numeracy and full time employment, where the dependent variable takes a value of one if the person has spent more time in full time employment than in any other state over the previous year (age 33-34). For women, the relationship between literacy and full time employment is stronger than the relationship between literacy and any employment.

For males, the relationship between literacy and full time employment is by and large insignificant. However, numeracy and full time employment are significantly related for males.

Table 12: The relationship between age 34 basic skills and full-time employment: men only

Variables	Regression 1		Regression 2		Regression 3	
	Coef	Std	Coef	Std	Coef	Std
Standardised age 34 literacy score	0.011*	(0.036)	0.006	(0.048)	0.003	(0.060)
Standardised age 34 numeracy score	0.028***	(0.038)	0.034***	(0.050)	0.034***	(0.063)
Age 10 ability test scores			X		X	
Family background					X	
Age 5 ability test scores					X	
Sample size	4514		3280		3280	

Data source: 1970 BCS Age 34 survey. Dependent variable takes value of 1 if the individual spent more months in full time employment between the age of 33 and 34 than in any other status (unemployment, inactivity, long-term sickness, working in the home, full-time education). Marginal effects are reported. Results are for men only. Both literacy and numeracy measures are included in the same model.
*** significant at 1%, ** significant at 5%, * significant at 10%.

In summary therefore, for both men and women, literacy is strongly associated with being in employment at age 33/34. For men, there is also a positive relationship between numeracy skills and the probability of being in employment. To the extent that we control for observed differences between individuals, we can also conclude that for women, literacy and numeracy are positive determinants of the likelihood of being in full time employment. For men only numeracy seems to be important in determining the likelihood of being in full time employment.

5. Conclusions and Discussion

This paper provides evidence on the current value of basic skills in the UK labour market, as measured by both earnings and employability.

Focusing first on the earnings effect of basic skills for a cohort born in 1970, an additional standard deviation in literacy results in approximately 14% higher earnings, whilst an additional standard deviation in numeracy results in 11% higher earnings. We also found the effects of literacy and numeracy on earnings to be non linear and to have an increasing impact on earnings. Results were quite similar for men and women. These findings are particularly strong, given that we control for the early ability of the person, as measured by age 10 cognitive test scores. In other words, we find literacy and numeracy effects on earnings that are over and above any general effect on earnings from a person being more cognitively able.

A number of robustness checks, such as including lagged measures of wage and skill, as well as an IV approach, reinforced these findings. The IV estimates were extremely large and were consistent with attenuation bias in the OLS estimates caused by measurement error in the basic skill measures. We therefore conclude that the OLS estimates cited above are very much lower bound estimates of the effect of literacy and numeracy on earnings in the 2004 UK labour market for our cohort.

We also undertook a cross cohort analysis, comparing the wage premium from having better basic skills in the 1990s labour market, as compared to the 2004 labour market, for cohorts in their thirties. This analysis suggested that the value of basic skills has remained stable during the late 1990s and early 2000s. One might infer from this that the increase in supply of skills (as the workforce has become more educated) has therefore at least been matched by increased demand in the labour market for such skills.

Another important result from this paper is that we find that having better basic skills is significantly associated with the likelihood of being in employment and full time employment at age 33/34. Specifically, for women, higher levels of literacy are associated with a higher probability of being in employment, whilst men with higher levels of numeracy have

significantly higher employment rates. Although we are more cautious about whether we have identified a causal relationship between basic skills and employment than was the case with wages, we do provide evidence that points to large potential employment benefits from having better basic skills.

Our findings imply that literacy and numeracy skills are still very much a valued form of human capital in today's UK labour market. Our evidence also confirms that the return to basic skills is particularly high in the UK, as compared to some other countries (Hansen and Vignoles, 2005). Even if there have been substantial gains in the basic skills of the UK work force, it appears this has not been sufficient to reduce the price paid for these skills by employers. This is despite a decade of effort to improve basic skills in the UK. What the evidence does suggest therefore is both that, continued efforts to improve the skills of the UK work force are needed, and also that investment in initiatives that do improve individuals' basic skills are likely to yield relatively high wage (and potentially employment) returns.

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APPENDIX A

UK Classifications of levels of literacy and numeracy

QCA National Framework of qualifications level	Basic Skills Agency standards	Equivalent vocational qualifications	Equivalent levels in schools
Below entry level	Below entry level	—	
Entry level	Entry level	—	2 (age 7)
Foundation	Level 1	NVQ level 1	4 (age 11)
Intermediate	Level 2	NVQ level 2	GCSE A*–C (age 16)

[a] Figure includes all those at level 2 or above.

Source: The Moser Report (DfEE, 1999).

APPENDIX B

British Cohort Study 1970 – 2004 sweep at age 34

The literacy and numeracy assessment tests in the age 34 survey of the BCS70 were based on the new *Skills for Life* standards, which differ somewhat from the literacy and numeracy assessments used in previous surveys of both the BCS and the NCDS. Thus an attempt was made to ensure continuity by combining elements of the tests used in previous sweeps of NCDS and BCS, as well as the new *Skills for Life* assessments. Two methods of questioning were used: Open-response (as used in previous NCDS and BCS literacy and numeracy assessments) and multiple choice (as used in the 2002 *Skills for* Life National Baseline Survey). The tests were also designed to give more information on the profile of respondents with particularly poor basic skills, with less information at the upper range of the distribution (i.e. the test scores are truncated). There were fewer items in the literacy and numeracy tests administered at age 34 in the British Cohort Study. As a result the standards of reliability are lower. For a detailed discussion of this issue see Bynner and Parsons (2005).

APPENDIX C

Means and Standard errors of the preferred BCS sample (N=3131)

	Men		Women	
	Means	**Std.**	**Means**	**Std.**
Log hourly wage	2.406	(0.612)	2.172	(0.732)
Literacy test at age 34 (min: 4, max:27)	22.561	(0.089)	22.725	(0.082)
Numeracy test at age 34 (min: 1, max:23)	18.699	(0.094)	17.608	(0.095)
Highest qualification level (min: 0, max: 5)	2.147	(0.042)	2.367	(0.040)
Non white British or Irish	0.014	(0.003)	0.021	(0.004)
Early family background:				
Social class of parents, age 5, i	0.052	(0.006)	0.062	(0.006)
Social class of parents, age 5, ii	0.181	(0.010)	0.208	(0.010)
Social class of parents, age 5, iii m				
Social class of parents, age 5, iii nm	0.107	(0.008)	0.092	(0.007)
Social class of parents ,age 5, iv	0.131	(0.009)	0.132	(0.008)
Social class of parents, age 5, v	0.043	(0.005)	0.028	(0.004)
Father has a degree, age 5	0.130	(0.009)	0.131	(0.008)
Father has A-Level, age 5	0.065	(0.006)	0.073	(0.006)
Mother has a degree, age 5	0.024	(0.004)	0.019	(0.003)
Mother has A-Level, age 5	0.036	(0.005)	0.028	(0.004)
Free school meal at age 10 (mother self qu.)	0.094	(0.007)	0.112	(0.008)
Free school meal missing	0.048	(0.005)	0.037	(0.005)
Financial hardship at age 16 (par. interv.)	0.075	(0.007)	0.084	(0.007)
Financial hardship missing	0.187	(0.010)	0.149	(0.009)
Interest of parents in child's education at age 10 (teacher's view):				
Father very interested	0.365	(0.012)	0.364	(0.012)
Father moderately interested	0.212	(0.010)	0.198	(0.010)
Father very little interested	0.029	(0.004)	0.018	(0.003)
Father uninterested	0.021	(0.004)	0.018	(0.003)
Father interest missing	0.373	(0.012)	0.402	(0.012)
Mother very interested	0.497	(0.013)	0.541	(0.012)
Mother moderately interested	0.304	(0.012)	0.287	(0.011)
Mother very little interested	0.039	(0.005)	0.026	(0.004)
Mother uninterested	0.017	(0.003)	0.011	(0.003)
Mother interest missing	0.143	(0.009)	0.134	(0.009)

Early test scores:				
Age 5 vocabulary score (min: 0, max: 51)	34.958	(0.223)	33.720	(0.228)
Age 5 copying score (min: 0, max: 8)	4.852	(0.050)	4.882	(0.047)
Age 5 Draw a man score (min: 1, max: 23)	10.046	(0.080)	10.914	(0.073)
Age 10 math score (min: 10, max: 72)	46.124	(0.289)	45.536	(0.251)
Age 10 Edinburgh reading score (min: 2, max: 64)	37.251	(0.345)	39.996	(0.310)
Age 10 British ability score (min:0, max:125)	76.583	(0.391)	76.754	(0.353)
Labour market variables (between 21 and 34):				
Months of disability	0.253	(0.011)	0.240	(0.011)
Months of unemployment	2.461	(0.344)	0.958	(0.206)
Months staid at home	0.164	(0.073)	10.346	(0.779)
% Employed	0.941	(0.237)	0.764	(0.424)
% Employed full time	0.926[31]	(0.261)	0.449	(0.498)
Number of children under age 5 in 2004	0.247	(0.014)	0.241	(0.013)
N	1528		1603	

Notes: Mean hourly wages are 11.10 (8.77) for men (women).

[31] For the employment regressions the sample size for men is 2107 and for women 2597.

APPENDIX D

Full specification for Table 2 (main text): The relationship between age 34 basic skills and earnings: men and women

	Regression 1		Regression 2		Regression 3		Regression 4	
Variables	Coeff.	Std.	Coeff.	Std.	Coeff.	Std.	Coeff.	Std.
Standardised age 34 literacy score	0.164***	(0.016)	0.134***	(0.018)	0.114***	(0.018)	0.091***	(0.017)
Standardised age 34 literacy score squared	0.032***	(0.008)	0.030***	(0.010)	0.026***	(0.010)	0.022**	(0.010)
Standardised age 34 numeracy score	0.138***	(0.012)	0.094***	(0.015)	0.084***	(0.015)	0.064***	(0.015)
Standardised age 34 numeracy score squared	0.038***	(0.010)	0.033***	(0.008)	0.025***	(0.008)	0.025***	(0.009)
Female	-0.185***	(0.016)	-0.205***	(0.019)	-0.207***	(0.019)	-0.171***	(0.019)
Age 10 mathematics test score			0.004***	(0.001)	0.003**	(0.001)	0.002	(0.001)
Age 10 English and reading test			0.002*	(0.001)	0.001	(0.001)	0.001	(0.001)
Age 10 British ability scale			0.002**	(0.001)	0.001	(0.001)	0.001	(0.001)
Non white					0.161***	(0.053)	0.150***	(0.051)
Early family background:								
Eligible for Free School Meals					-0.042	(0.032)	-0.012	(0.030)
Missing data on Free School Meal					0.012	(0.033)	0.029	(0.032)
Financial hardship at age 16					-0.105***	(0.028)	-0.069**	(0.027)
Missing data on financial hardship at age 16					-0.062***	(0.024)	-0.047**	(0.024)
Age 5 social class I					0.049	(0.049)	0.024	(0.048)
Age 5 social class II					-0.008	(0.028)	-0.023	(0.028)
Age 5 social class III non manual					0.094***	(0.035)	0.085**	(0.034)
Age 5 social class IV					-0.066**	(0.029)	-0.055**	(0.028)
Age 5 social class V					-0.133**	(0.056)	-0.095*	(0.052)
Father has degree					0.093***	(0.033)	0.000	(0.000)
Father has A level					0.064	(0.040)	0.089***	(0.033)
Mother has degree					0.115*	(0.059)	0.057	(0.040)
Mother has A level					0.010	(0.047)	0.108*	(0.058)
Interest of parents in								

child's education at age 10 (teacher's view):						
Father very interested in child's education			0.079	(0.073)	0.066	(0.069)
Father moderately interested in child's education			0.009	(0.071)	0.008	(0.067)
Father very little interest in child's education			0.013	(0.076)	0.018	(0.073)
Missing data on father interest variable			0.004	(0.070)	0.004	(0.066)
Mother very interested in child's education			0.028	(0.077)	-0.038	(0.072)
Mother moderately interested in child's education			-0.012	(0.075)	-0.067	(0.071)
Mother very little interest in child's education			-0.033	(0.074)	-0.077	(0.070)
Missing data on mother interest variable			-0.015	(0.077)	-0.076	(0.073)
Labour market variables (between 21 and 34):						
Highest qualification at age 34					0.041***	(0.006)
Disabled					-0.021	(0.020)
Total unemployment to 2004					-0.004***	(0.001)
Total months in home care to 2004					-0.004***	(0.000)
Number of children less than 5 in 2004					0.007	(0.017)
R-Squared	0.119	0.131	0.153		0.189	
R-Squared adjusted	0.118	0.129	0.148		0.183	
Sample Size	6255	4664	4664		4662	