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Does education have an impact on mothers' educational attitudes and behaviours?

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Centre for Research
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DOES EDUCATION HAVE AN IMPACT ON MOTHERS' EDUCATIONAL ATTITUDES AND BEHAVIOURS?

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Executive Summary

Introduction and background

The importance of parents' educational attitudes and behaviours on children's educational attainment has been well documented, especially in the developmental psychology literature. In such research different elements of parents' educational attitudes and behaviours, such as the provision of a cognitively stimulating home environment, parental involvement in children's activities, and parental beliefs and aspirations, have been identified as having a significant effect on children's levels of educational achievement.

It therefore seems likely that some of the intergenerational effects of education may be transmitted through parents' educational attitudes and behaviours. The empirical research, however, has not been robust enough to test whether there is indeed a causal effect of education on such attitudes and behaviours. This report fills this gap by providing a rigorous estimate of this educational effect.

Key findings

While initial analysis shows an association between the age at which mothers left full time education and her subsequent educational attitudes and behaviours, the use of a more robust instrumental variable (IV) methodology showed that this link was not the result of causal effects of post-compulsory education. Rather it was due to underlying related differences between those who stayed on in education and those who did not.

An interesting implication of these results is the emphasis they place on the positional importance of education – as educational levels for those with lower educational aspirations increase, individuals with positional ambition increased their education further in order to maintain their relative advantage.

It is likely that the significant association shown by the use of the less robust ordinary least squares (OLS) regression method is the result of selection bias –that is, that individuals in the sample elect to stay on in full-time education as the result of underlying factors which the data do not measure and which are therefore not taken into account. This highlights the need to interpret the results of such studies with caution and to consider alternative approaches, particularly where data allows few control variables to be used.

Other research shows a robust link between parental education and child attainment which this study does not dispute. It shows only that duration of parental education in and of itself did not subsequently affect their educational attitudes and behaviours and that influencing the *duration* of individuals' education is not necessarily a means of influencing their subsequent parenting. It does not imply that changes in the *quality* or *nature* of education would have no effect, as it does not test these hypotheses.

Methodology

We use data from the National Child Development Survey (NCDS), a representative sample of the cohort of individuals born in the UK in 1958. We utilised information

reported mainly by the mother in 1965, when the cohort members were 7 years old. We focussed exclusively on mothers' educational attitudes and behaviours as mothers were, even more than now, primary carers, and because more information was available on mothers than fathers.

The NCDS contains a number of measurements, including reading behaviours, parental expectations of their child's education and teacher ratings of parents' interest in their child's schooling, that we used to generate a measurement of mothers' educational attitudes and behaviours.

Mothers' education was measured as the age at which they left full-time education. In terms of our data, mothers who were 25 years or older in 1958 would have been subject to a minimum school leaving age of 14 years, whereas mothers younger than 25 would have been in compulsory schooling until the age of 15.

We use two approaches to assess the effects of mothers' post-compulsory education on their educational attitudes and behaviours. First, we employed Ordinary Least Squares (OLS) regression, a commonly used statistical technique. In this we controlled for a number of extraneous factors which may otherwise confound the result, including socio-economic status, fathers' schooling, and child gender and behavioural characteristics. However, we recognised that there may be other, unobservable factors which are not taken into account which bias the estimation. To correct for this we used instrumental variable (IV) methods, akin to a quasi-experiment. This relies on the use of a measure which is related to the explanatory variable (in this case duration of education, which we hypothesise explains mothers' educational attitudes and behaviours) and is independent of other factors which may affect the result. In this case we used the change in minimum school leaving age in 1947 to assess the effects of the duration of full time education (essentially the effects of post-compulsory education) on mothers' educational attitudes and behaviour. The fact that the minimum school leaving age was strongly associated with the duration of schooling gave us greater confidence that the change in the school leaving age was an appropriate instrumental variable.

We also performed a number of tests for the reliability and sensitivity of the measures used.

Findings

While initial analysis seemed to suggest that there was an association between the duration of mothers' full time education and her educational attitudes and behaviours, the use of a more robust instrumental variable (IV) methodology showed that this link was not the result of causal effects of post-compulsory education. Rather it was due to underlying related differences between those who stayed on in education and those who did not.

Results from our initial OLS regression showed that an additional year of post-compulsory schooling for mothers was significantly associated with the index of educational attitudes and behaviours i.e. mothers who stay in full time education beyond the minimum school leaving age are more likely to demonstrate positive educational attitudes and behaviours such as reading to their children. Controlling for

the effects of socio-economic background factors marginally reduced the impact of post-compulsory full time education while adding measures for the child's behavioural characteristics and innate ability reduced the effect still further. Taken together, controlling for all these additional factors reduced the apparent association between the duration of mothers' schooling and educational attitudes and behaviour by 32%, but still showed a statistically significant result.

However, results from the IV estimates, which allowed us to strip out confounding factors from the model, showed that the average effect of an additional year of (post-compulsory) full time education on mothers' educational attitudes and behaviours was reduced to zero. While it is possible that this disguises some variation between educational stages (e.g. between 'A' level and degree), the fact that there is an absence of effect overall suggests that the variation is unlikely to be substantive.

Conclusions

The effect of an extra year of education on mothers' educational attitudes and behaviour was mainly a selection effect – that is, it can be explained by who stayed on in full time education rather than being the educational effect of the post compulsory education itself.

The results also suggest that education is treated as a positional good – that is, it is used by some to as a means of maintaining and marking out their socio-economic status. Individuals from low socio-economic background in 1947 tended to leave the educational system at the first opportunity – age 14. When the minimum school leaving age was raised from 14 to 15, those from low socio-economic backgrounds still tended to leave education at the first opportunity, but this was now age 15. However, individuals with positional ambition, who had previously stayed on an extra year or years to 15 or older, also increased their education in order to maintain their relative advantage, continuing to stay on beyond the (higher) minimum leaving age. These women also tended to have higher subsequent scores on the index of educational attitudes and behaviours used in this study. Thus, while educational attitudes and behaviours are not influenced by staying on at school, resulting rather from underlying values and aspirations, nevertheless both education and educational attitudes and behaviours are very important elements of the inter-generational transmission of social and economic advantage.

We also emphasise the relatively narrow focus of this current study, which relates to post-compulsory participation in education for women in the UK in the period after the Second World War. In the intervening years there have been substantial changes to pedagogy, curricula, assessment, pupil motivations, the structures of the education system, the factors underlying the decision to stay on in education and teacher training. Some or all of these may have changed the effects of post compulsory schooling on subsequent educational attitudes and behaviours. Moreover, the education measure used here relates only to the *duration* of full time education, finding that additional years of post-compulsory education in and of themselves have no effect. This is not to say that no aspect of learning can affect the educational attitudes and behaviour of parents. We say nothing about the *quality* or *nature* of the learning which took place. We may speculate that cognitive development, resilience, self-efficacy, social inclusion, engagement and belief in the value of schooling are

important influences on subsequent educational attitudes and behaviours and support for children's learning and that an individual's experience of education may affect all of these. But if this is so, it will be the quality and nature of the education on offer which matters, not the duration. Thus, the results do not suggest that education cannot generate causal effects, rather that simply increasing its duration does not do so.

However, this is not a trivial finding because, as our own OLS results also show, many regression analyses have shown strong correlations of the duration of parents' education with subsequent elements of their educational attitudes and behaviours. These results indicate the strong possibility that these apparent relationships shown by OLS may be spurious as indicators of a causal relationship. This should be taken into account when drawing inferences from OLS studies, particularly those with few control variables. If policy reform causes individuals to self-select within the system, then educational interventions based on observed links between education and outcomes may not generate the expected results.

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1. Introduction

Several important theoretical models have been developed to explain the complex pathways by which parents can have a significantly beneficial effect on their children's educational attainment and behavioural adjustment (Bronfenbrenner, 1979 and 1986; Eccles, 1993). Parents can, for example, transfer their beliefs and values to their children and provide warmth and affection as well as discipline and guidance. They also can engage in educational activities with their children and utilise resources to create a cognitively stimulating home environment. For this reason, the family has been identified as an important dynamic environment where parent-child interactions can have a significant impact on child development from infancy to adolescence (Bronfenbrenner, 1986).

Within the family environment, the role of parents' educational attitudes and behaviours on children's educational attainment has been well documented, especially in the developmental psychology literature (Eccles et al., 1997; Brook-Gunn, Klebanov and Duncan, 1996; Brook-Gunn and Duncan, 1997; Hoff, 2003; Eccles, 2005). In this research different elements of parents' educational attitudes and behaviours, such as the provision of a cognitively stimulating home, parental involvement in children's activities and parental beliefs and aspirations, have been identified as having a significant effect on children's levels of educational achievement (Wigfield and Asher, 1984; Alexander and Entwisle, 1988; Schneider and Coleman, 1993).

In contrast to studies from developmental psychology, economic models have focused more on the impact of parental education on children's educational attainments, rather than on the parent-child relationship itself. These models concentrate upon investments made by parents to influence their children's educational outcomes (Becker, 1981; Becker and Tomes, 1986). Parents can choose to spend resources of time and money on those activities that produce attainment. The limit to this investment is the limit of time and money available and the ability of the attainment production process to produce attainment (see Black, Devereux and Salvanes, 2003; Chevalier, 2004; Oreopolus, Page and Stevens, 2003 for recent empirical studies).

If we accept that parents' educational attitudes and behaviours are important influences on children's educational attainments and that parental education impacts on children's educational outcomes, it seems likely that some of the intergenerational effects of education may be transmitted through educational attitudes and behaviours. The main problem, however, with current empirical evidence on the relationship between parental education and their subsequent educational attitudes and behaviours is a difficulty in establishing causality, since numerous observed and unobserved characteristics have been shown to predict parents' educational attainments and the outcome of interest. The aim of this report is to deal with this gap in the empirical literature by providing an estimate of the effects of parental education on their subsequent educational attitudes and behaviours using the technique of instrumental variables (IV).

In particular, we investigate the effects of maternal participation in post-compulsory education on subsequent attitudes and behaviours that have been consistently associated with children's development, such as reading to the child, taking the child

for outdoor activities, being interested in the child's progress at school and having expectations of the child's future educational achievements (Baker et al., 1994). Our empirical model uses data from the National Child Development Study (NCDS), a cohort of children born in 1958 in the UK. Parents of members of the 1958 cohort faced a policy change to the educational system in 1947 when the minimum school leaving age was raised from age 14 to 15. This exogenous variation to the educational system allows the identification of educational effects. IV estimation techniques are used to estimate the effect of mothers' education on their subsequent educational attitudes and behaviours. The use of these instruments is not novel (see Chavalier, 2004; Oreopolus et al., 2003; Meghir and Palme 2000; and Harmon and Walker, 1995). However, as it will be shown, the application of these instruments to this context raises new and relevant questions.

This report is organised as follows: in Section 2 we describe the theoretical framework utilised to address the intergenerational transmission of advantage from parents to children and the roles of parental education and educational attitudes and behaviours in this setting. Section 3 describes the estimation method, the data used in this analysis, and the main variables of interest. Section 4 provides an interpretation of the empirical results and sensitivity analysis. Section 5 discusses the policy and research implications.

2. Theoretical framework

What does education provide to parents that can lead to their having better interactions in terms of their educational attitudes and behaviours with their children? The impact of parental education on parents' educational attitudes and behaviours has been emphasised particularly by Bronfenbrenner (1979, 1986) and recently by Davis-Kean (2003, 2005), Eccles (2005), Burton, Phipps and Curtis (2004), and Feinstein, Duckworth and Sabates (2004).

For Bronfenbrenner, education may provide parents with important cognitive resources that enable them better to support and facilitate their children's learning. Based on a review of studies, Davis-Kean explains that parental education facilitates parents' ability and willingness to seek out expert advice about rearing their children. Furthermore, education increases parents' ability to synthesise information, leading to better decision-making and greater efficiency in meeting goals. Education is also associated with the accuracy of parents in rating their children's school performance and in forming expectations that are more related to children's actual performance. Finally, Davis-Kean mentions that low levels of education are linked to anxiety, hostility and depression, which in turn affect parents' attitudes towards their children.

Burton, Phipps and Curtis' (2004) model of the effects of parenting style on child conduct incorporates a feedback effect from child behaviour to parents' attitudes, beliefs, aspirations and skills; a reciprocal influence of children's behaviour on parenting practices. Feinstein, Duckworth and Sabates (2004) discuss how in the neo-classical "Becker" economic model, parental education may increase the effectiveness of the household production or it may change the weight given to children's educational attainments when decisions about investments are being made. These are thought of as productive and allocative efficiency effects of education, respectively (see also Foster, 2002).

The empirical research has shown evidence of an association between education and some elements of parents' educational attitudes and behaviours. The Effective Provision of Pre-school Education (EPPE) project in the UK tested the relationship between parents' education and parents' educational behaviours. Sammons et al. (2002) found that mothers' educational qualifications are significantly associated with the Home Learning Environment index, and that this association was larger than for parental SES. They also found that parents with higher levels of education engaged with their children in more complex and higher quality verbal interactions than parents with low levels of education. Based on an experimental design study, Magnuson (2003) showed that the increase in the participation of mothers in educational activities induced by the National Evaluation of Welfare to Work Strategies Child Outcome Study was linked to the provision of more stimulating home environments.

In the US, data from the National Household Education Survey and the Federal Interagency on Child and Family Statistics have shown that mothers' education has been consistently related to whether children are read to by a family member (Child Trends, 2002). Young children were more likely to be read to if their mothers have completed higher levels of education. Diaz, Neal and Vachio, (1991) found that maternal education was significantly related to maternal teaching strategies during

problem-solving interactions with their children. Harris, Terrel and Allen (1999) showed that parents with higher levels of educational attainments had teaching styles that promoted children's development. Hoff (2003) found that parents with more education both talk to, and use more complex and varied language with, their children.

Education may also affect parental expectations. Davis-Kean, Eccles, and Schnable (2002) found that higher levels of education were significantly related to parents having higher expectations of child achievement ($\rho = 0.41$). Using structural equation analyses, the authors found that parents' education levels had the strongest impact on parental expectations of the family demographic variables assessed (income, employment status and ethnicity). The authors claim that parental education impacts directly on parental expectations of their children's achievement as well as highlighting the mediating effect of parental beliefs and behaviours on explanations of children's outcomes. A complementary study by Alexander, Entwisle and Bedinger (1994) found that parental education also impacted on the accuracy of parents' predictions of children's academic performance. The authors suggest that the importance of accurate information lies in the ability of parents to introduce corrective measurements adequately.

The studies shown above find evidence of association between education and different educational attitudes and behaviours: reading to the child, providing a cognitive stimulating home environment, having high and accurate expectations and adopting appropriate teaching styles. However, it is difficult to test the level of causality in the relationship between parental education and educational attitudes and behaviours, since numerous observed and unobserved characteristics have been shown to predict both: i) the policy variable; parents' educational attainments; and ii) the dependent variable; their educational attitudes and behaviours. We proceed to describe the methodology utilised to deal with this issue empirically.

3. Methodology

In this section we first describe the data and variables used for the empirical estimation of the effects of participation in post-compulsory education on educational attitudes and behaviours. We then provide details on the econometric model and a description of the estimation methods and post-estimation techniques. Finally, we explain five sensitivity analyses performed in areas of concern that may affect our estimates.

3.1 Data, variables and the 1947 school leaving age reform

3.1.1 Data and sample

The dataset utilised in this part of the report is the NCDS. The data comprise all births in a single week in Britain in 1958. The NCDS starts with a survey of perinatal mortality and is followed up by subsequent further follow-ups at various ages (7, 11, 16, 23, 33 and 42). We utilise information on elements of mothers' educational attitudes and behaviours on cohort members at age 7, which was collected in 1965.

There are three main reasons why we focus exclusively on mothers' educational attitudes and behaviours. First, the measurements utilised were collected in 1965, when the relative engagement of mothers and fathers in caring for children was even more unequally distributed than is the case today. Secondly, most NCDS questionnaires were completed by the mother, so we expect the information reported about mother-child relation or mothers' educational behaviours to contain less measurement error. Thirdly, the data contain more background information for mothers than for fathers, making the set of possible control variables for mothers richer.

3.1.2 Outcome variable: mothers' educational attitudes and behaviours

A standard measure of parenting quality, which includes measures of educational attitudes and behaviours, is the HOME Inventory (Caldwell and Bradley, 1984). This inventory assesses parental quality in terms of emotional support, for example measures of warmth and discipline, as well as cognitive stimulation such as reading materials and the physical appearance of the home. The individual items that are used in the HOME inventory to assess cognitive stimulation are not available in the NCDS since this scale was introduced in the 1980s. However, the NCDS contains other measurements that can be used to generate a measurement of parents' educational attitudes and behaviours.

The following elements of mother's educational attitudes and behaviours are available: (i) a measurement of the intensity of the mother's or of the father's reading to the child or taking the child out, reported, in most cases, by the mother; (ii) an indicator of parents' own educational attitudes, measured by parents being able to spare time to read, reported, in most cases, by the mother; (iii) parental interest in the child's education reported by the headmaster or headmistress and by the teacher; and (iv) parental expectations on child's educational attainment reported by the mother.

Table 1 shows the distribution of the different elements of mothers' educational attitudes and behaviours using data when the cohort member was 7 years old. Nearly half of the mothers of children aged 7 in 1965 read to their children on a weekly basis. About 85% of the mothers take the child out of the house every week. This variable does not necessarily represent taking the child to places that may enhance their emotional or intellectual development.

The other available proxy is parental own educational behaviours. Parents who read are, in general, more likely to read to their children. Also parents who read may be more able to facilitate their children's learning. The NCDS discriminates between reading newspapers or magazines and reading technical books or journals. The percentage of mothers and fathers reading technical books is lower than reading newspapers. Nearly 44% of the mothers reported never reading technical books or journals.

Table 1: Measures of educational attitudes and behaviours (cohort member aged 7, NCDS-1)

Variable	Every week (%)	Occasionally (%)	Never (%)
Parents reading to the CM			
Mother	48.5	35.0	16.0
Father	34.5	34.1	27.4
Parents take the CM out			
Mother	85.2	13.1	1.5
Father	68.3	22.5	5.8
Parental reading behaviours			
Mother: newspapers or magazines	72.1	17.8	9.9
Father: newspapers or magazines	81.8	10.0	4.8
Mother: technical books	34.0	21.4	43.6
Father: technical books	48.7	19.5	27.9
	Yes	**No**	
Parental expectations on CM education	82.0	18.0	
Headmaster's response: parents initiative to discuss CM's school progress	56.8	43.2	
	Very interested	**Some interest**	**No interest or over concerned**
Teacher rating of mother's interest on CM schooling	36.5	39.8	23.7

Source: NCDS, sweep 1.
Notes: Total number of cohort members (CM) 14,176.

Finally, Table 1 shows the percentage of parents who expect that their children will stay on post compulsory education (82%) and the headmaster's report of whether the parents have taken the initiative to discuss the child's progress (57% of parents did). With respect to parental interest on the child schooling, teachers rated the mother interest on the cohort member schooling. Teachers rated over concerned as a different category, which we merge with no interest since both extremes may have negative, although different, consequences for child development. More than one-third of mothers appeared to be very interested in the child's schooling progress and 23.7% were not interested or over concerned.

Constructing an index for mothers' educational attitudes and behaviours

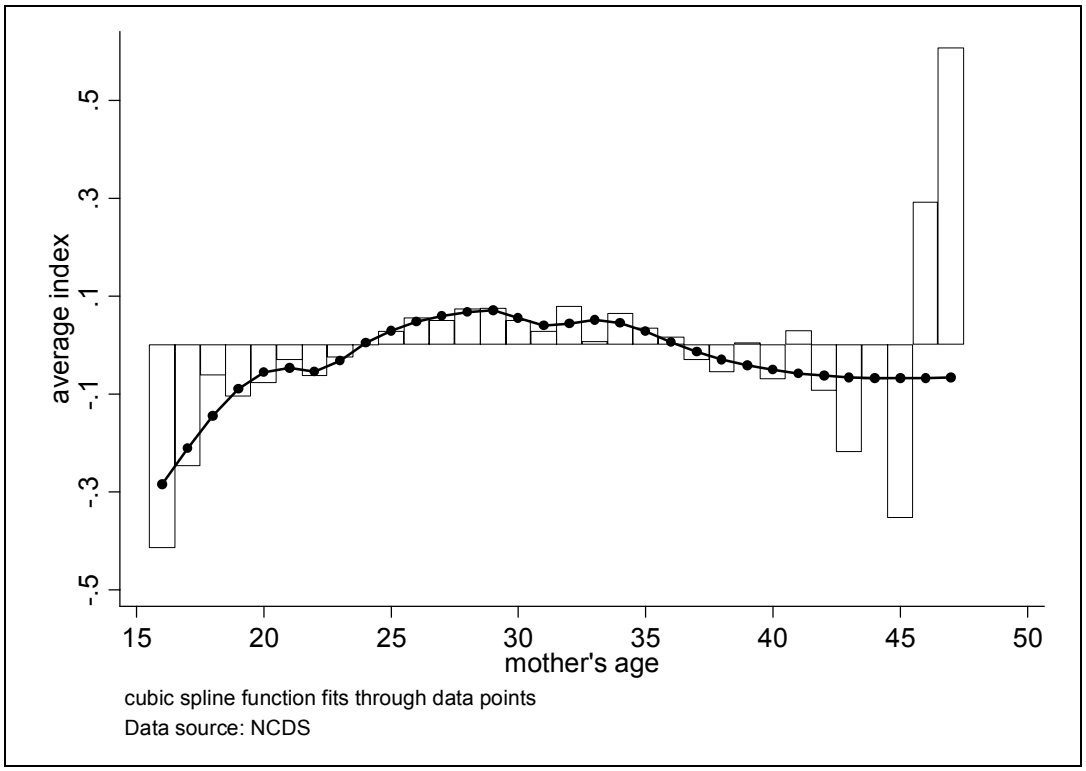
To generate a single measure of mothers' educational attitudes and behaviours we use all the proxy measures available from Table 1. These measures are whether mother reads to the child, whether the mother takes the child out, her educational behaviours, her expectations on her child's schooling and her interest on her child's schooling progress. These elements may represent parental resources which influence children's educational activities. But equally, they may be thought of as the allocation of resources. They include behaviours and cognitions and also refer both to mother activity, child competences, and to parent-child interactions. We will discuss the implications of this measurement in the conclusions.

Factor analysis is used to generate an index of educational attitudes and behaviours that ranges from low (-2.9) to high (1.1) educational attitudes and behaviours. We undertake validity analysis to ensure that this measure correlates as expected with mothers' age and with measures such as children's maths and reading scores, children's behavioural problems and children's ability as rated by the teacher.

Figure 1 shows an inverted-U relationship between mothers' educational attitudes and behaviours and age. The index increases with age, reaches a maximum for mothers between the ages of 25 to 35 and then decreases for older mothers. A cubic spline function in age to educational attitudes and behaviours is fitted to the data points. It indicates that the introduction of a quadratic function in age should be enough to control for age effects.

The relationship between educational attitudes and behaviours and age is also very volatile at extreme values since we do not have a large enough number of teenage mothers or mothers giving birth in their forties (Figure 1). In order to investigate whether the inclusion of these extreme cases affects the results, we will estimate our empirical model with and without mothers aged 16 and 17 and those older than 40 years.

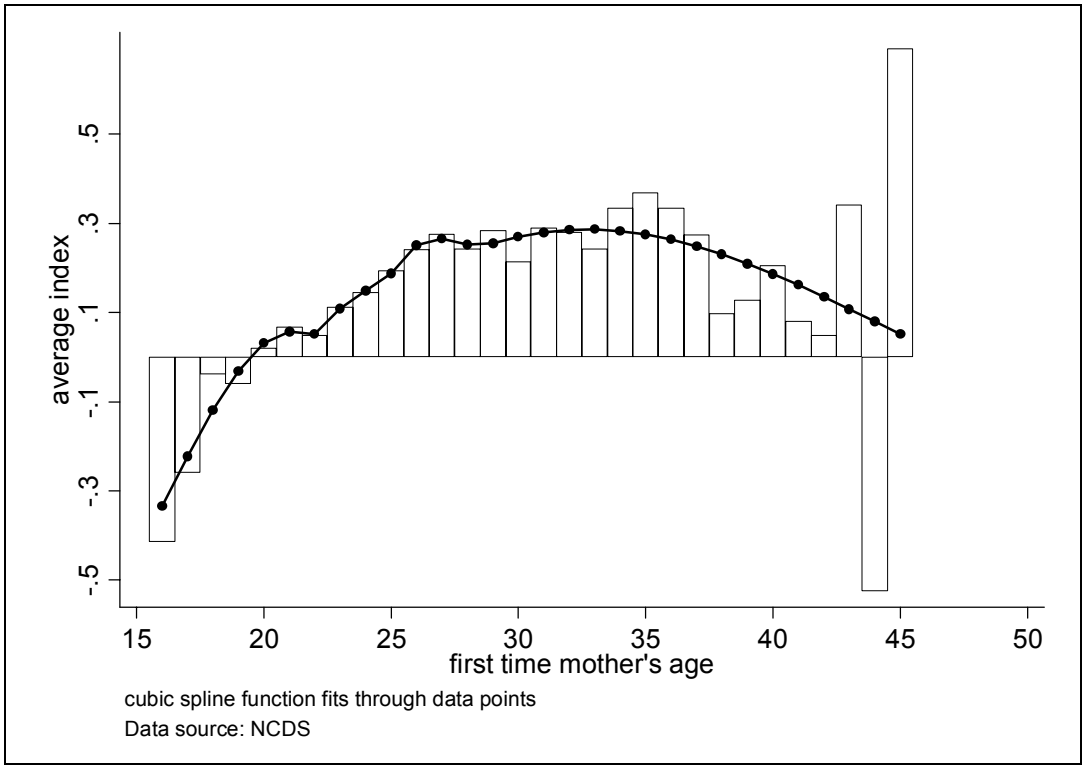
Figure 1: Educational attitudes and behaviours by age of the mother (NCDS-1)



Not all the mothers in our analysis are first time mothers. This introduces two further complications in the analysis. Firstly, it is possible that mothers with several children have time constraints that may affect their educational attitudes and behaviours to the particular child they are referring to here, i.e. the cohort member. For example, mothers with several children may have less spare time to read or to discuss the cohort member's school progress with the teacher. Secondly, age of the mother refers to the time when they gave birth to the cohort member and not necessarily when they gave birth to their first child. This issue distorts the well-established association between age of the mother and school attainments as well as age of the mother and educational attitudes and behaviours.

Figure 2 shows the relationship between educational attitudes and behaviours and age for first time mothers only. It also indicates an inverted-U, but with higher values of educational attitudes and behaviours for first time mothers at ages 25 to 35 than previously shown in Figure 1.

Figure 2: Educational attitudes and behaviours by age of the mother (first time mothers only, NCDS-1)



Testing the reliability of the index for mothers' educational attitudes and behaviours

To establish the reliability of our index we test how well it predicts children's educational and emotional and behavioural outcomes.

Table 2 contains multivariate linear regression estimates of the relationship between our index of educational attitudes and behaviours and different measurements of children's developmental outcomes at age 7. All regressions in this table control for risk factors that are also associated with children's poor performance at school or the development of emotional and behavioural disorders. Among the risk factors, we include low parental education and socio-economic status, young mother, absence of the father or of the mother, living in overcrowding conditions or in a household facing financial, health or physical difficulties.

As expected, our index is statistically associated with high achievement in maths, reading and drawing a man tests scores. It is also positively associated with teachers' general assessments of the child's school progress (Table 2). The teacher's assessment is a rating of the child in relation to all children her age in terms of her oral ability, levels of awareness, reading, creativity and working with numbers. A high rating indicates a high assessment of the child's ability and attainment.

Table 2: OLS estimation of educational attitudes and behaviours on children's developmental outcomes

	Educational				Behavioural and emotional	
	Maths	**Reading**	**Drawing**	**Teacher's assessment**	**Teacher BSAG**	**Rutter parent scale**
Index	0.114 (0.013)**	0.168 (0.013)**	0.111 (0.014)**	0.162 (0.012)**	-1.045 (0.122)**	-0.018 (0.002)**
# obs.	11,985	12,000	11,801	12,067	11,978	12,068
R^2	0.072	0.153	0.052	0.152	0.057	0.052

Source: NCDS. Notes: All estimations control for gender, parental education, parental socio-economic status, age of the mother, single parenthood, overcrowding ratio and index of family difficulties. Standard errors in parenthesis. Asterisks (*, **) indicates significance at 5 and 1% level, respectively.

In terms of behavioural and emotional outcomes we test the reliability of the index against the Bristol Social Adjustment Guide (BSAG) and the Rutter parent scale. Information for the BSAG is supplied by the teacher and contains information on the child's attitude towards the teacher, school work, other children and when playing games. It also contains information on the child's personal attributes and health. A high score indicates low levels of social adjustment for the child. The Rutter parent scale is an instrument designed to discriminate between different types of behavioural or emotional disorders as well as discriminate between children who show disorders and those who do not (Rutter, Tizard, and Whitmore, 1970). A high score in the Rutter scale indicates more behavioural or emotional disorders.

Table 2 shows a negative association between BSAG and educational attitudes and behaviours. This means that children who are more socially well-adjusted have mothers with better educational attitudes and behaviours. Our index is associated with a low Rutter parent scale. This indicates that the children of parents who have high educational attitudes and behaviours scores have fewer emotional and behavioural problems. These two associations are in accordance with studies from developmental psychology literature and we judge our index to be a reliable measure.

3.1.3 Main explanatory variable: mothers' participation in post-compulsory education

Mothers' education is measured as the age at which they left full-time education. In terms of our data, mothers who were 25 years or older in 1958 would have been subject to a minimum school leaving age of 14 years, whereas mothers younger than 25 would have been in compulsory schooling until the age of 15 (the 1944 Education Act changed the compulsory minimum school leaving age).
Before the reform took place, 75% of cohort members' mothers left school at the minimum school leaving age (SLA). After the reform, this percentage increased to

83% (Table 3). However, the pre- and post-reform differences can reflect not just changes in legislation, but the age of the mother. Those mothers facing the higher school leaving age are in the younger age groups. Younger mothers are more likely to have a large family size, less likely to have a cohort member as their first child and perhaps more likely to leave schooling at the first opportunity.

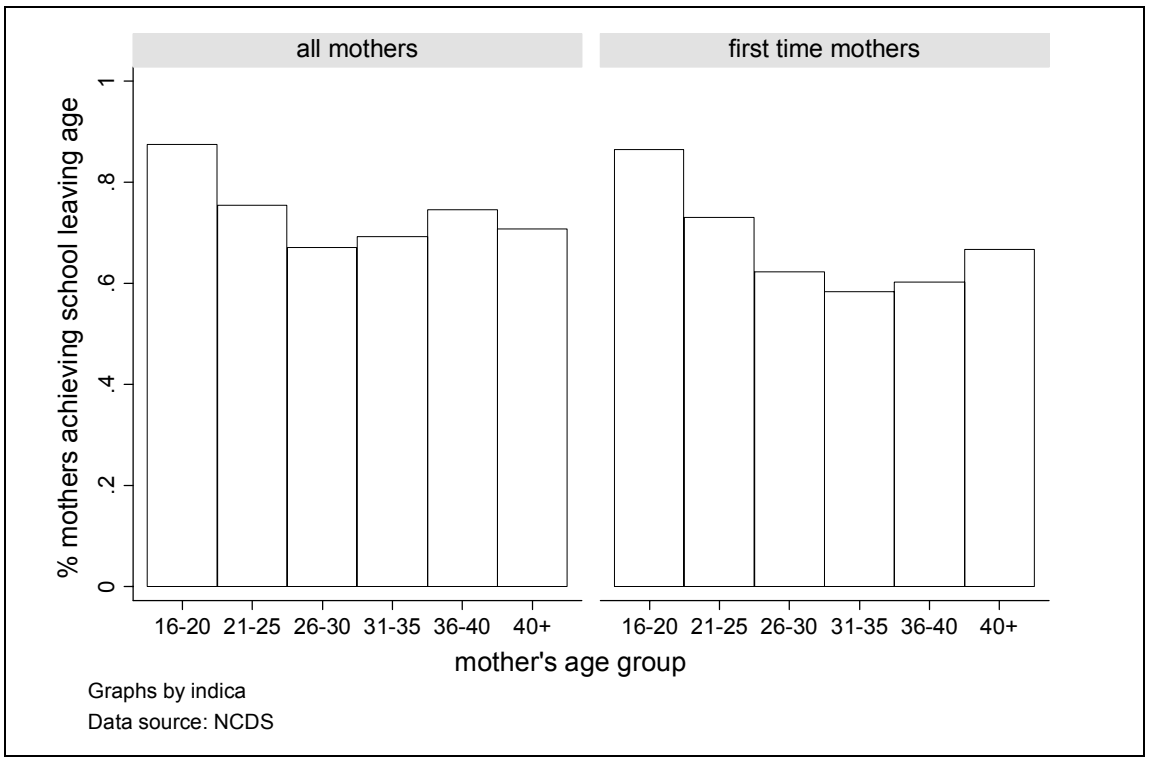
Table 3: Mothers' participation in education, by SLA legislation

	Mothers	
Years of schooling	**Pre-1947 reform**	**Post-1947 reform**
14	75.2	-
15	11.1	83.4
16	6.5	12.2
17	3.0	2.1
18	1.4	1.4
19-21	1.1	0.4
22+	1.7	0.4
# observations	*9,205*	*4,544*

Source: NCDS-1.

Figure 3 shows the percentage of mothers leaving education after completing schooling by age groups. Young mothers are more likely to leave schooling at the first opportunity, regardless of whether they are first time mothers or not. But there is a high probability that young mothers are first time mothers. For this reason, the percentage of younger mothers (aged 16 to 20) leaving schooling at the first opportunity is very similar for all mothers and for first time mothers, 87.5 and 86.4%, respectively. The difference between all mothers and first time mothers achieving only school leaving age increases with age. First time mothers, aged 31 to 35, are more than 10 percentage points less likely to leave schooling at the first opportunity than all mothers (58.2% versus 69.2%).

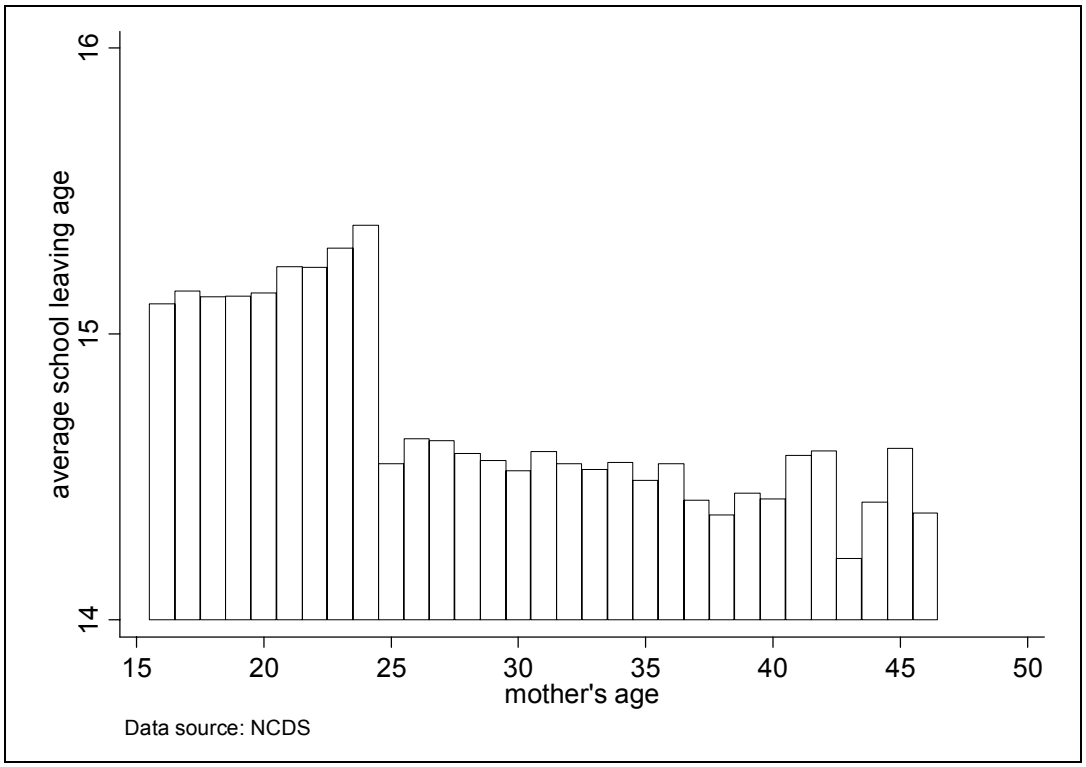
Figure 3: Mothers' participation in education by age group (all mothers and first time mothers, NDCS-1)



The relationship between age of the mother and the school leaving age reform is shown in Figure 4. It is clear how the change in SLA legislation increased the average age at which mothers left schooling for mothers younger than 24.[1] This discontinuity on schooling induced by the policy reform allows us to measure an exogenous variation in participation in post-compulsory education.

[1] Similar discontinuity is shown for first time mothers.

Figure 4: Discontinuity due to change in compulsory education (all mothers)



3.1.4 Other control variables

If they are to remove confounding bias, other variables introduced in the analysis should influence both participation in post-compulsory education and subsequent educational attitudes and behaviours, and they should not be part of the mechanism by which education may impact on educational attitudes and behaviours. Therefore, these covariates should be measured prior to, or at the time of, the decision to stay in schooling. Covariates prior to education that are available in the data are the mother's age, the mother's father's socio-economic status, the mother's family size and her birth order. The mother's father's socio-economic status is obtained using the Registrar General's Social Classification (RGSC) of information from the main employment of the mother's father when the mother left full-time education.

Information on the father (or partner) may be important in that maternal educational attitudes and behaviours may be affected by their partners' educational and socio-economic backgrounds (Kiernan, 1997). We introduce father's education, measured as the number of years of post-compulsory education, and father's socio-economic background, measured as the father's father's socio-economic status, also obtained by the RGSC, when the father left full-time education. We also control for the presence of the father at home.

Burton, Phipps and Curtis' (2004) empirical result shows that children's behaviour has an influence on reported parenting measures. For instance a disobedient child may not be read to by the mother; not because of the mother's educational behaviours but because of the child's behaviours. Therefore, it is important to control for child characteristics in our estimation. Covariates introduced in the analysis for children's characteristics include: gender and birth order; whether the child is obedient at home

at age seven; whether the child fights with other children at age seven; whether the child had been separated from the mother for more than one month from birth to age seven; whether the child used to wet the bed at night when she was five; and the child's ability measured by human figure drawing test. Caution must be taken in interpreting the associations between our measure of educational attitudes and behaviours and these characteristics of children as these may be an outcome of educational attitudes and behaviours and not exogenous influences.

3.2 Econometric model and estimation method

We propose to estimate the effect of a mother's participation in post-compulsory schooling (S_m) on her subsequent educational attitudes and behaviours (Y) by the following linear model:

$$Y_i = X1^{'} \alpha_1 + X2_i^{'} \alpha_2 + \beta_m S_m + \beta_f S_f + e_i \qquad (1)$$

where educational attitudes and behaviours (Y) of the mother of child i is a function of the observable characteristics of the mother that predict her educational attitudes and behaviours and their values do not depend on the choice of schooling (denoted by the matrix **X1**) and also of the children's own characteristics that may determine the ways in which mothers interact with their children (denoted by the matrix **X2**). Variables included in matrices **X1** and **X2** are required to be exogenous in the sense that their values do not depend on schooling or do not change over time, for example time-constant factors and pre-schooling choice characteristics.

We explicitly model the effects of mother's schooling (S_m) and control for father's schooling (S_f). We do this because of marital choice, where individuals with similar levels of education get together to improve household efficiency (Becker, Landes and Michael, 1977). In this set-up, β_m represents the effect of schooling on educational attitudes and behaviours, which we assume to be the same across children, that is β_m is not a function of i. In this equation e_i is the error term, which is assumed to be uncorrelated to the explanatory variables in the analysis, independent across children (i), and normally distributed with mean at zero and standard error equals σ_e.

We employ Ordinary Least Squares (OLS) to estimate the parameters of the model described in equation (1). For each of the OLS estimations we perform *step-wise* analysis. This process works by estimating the effects of mother's schooling on educational attitudes and behaviours by including first mother's age and age squared, father's schooling, and the descriptive aspects that characterise the environment. We then include the full set of variables that may predict parental education and educational attitudes and behaviours, **X1**, followed by the inclusion of characteristics of the children, **X2**. For each step, the main emphasis is on the gains made from accurately estimating the effects of mother's schooling.

Estimation of the effects of mother's schooling on her subsequent educational attitudes and behaviours may suffer from bias due to a misspecification of the effect of observable variables. This bias may be introduced if the true model contains higher order terms of **X1** or interactions between the various factors in **X1**. Another condition for unbiased estimation of β_m in equation (1) by OLS is that mother's

education should be an exogenous variable. This means that schooling is uncorrelated with all the unobservable information that is captured by the error term. This is unlikely to be the case. As for estimation of the wage return, education may be correlated with unobservable characteristics of the mothers, such as motivations and aspirations, which predict their educational attainments and their outcome: here the ways in which mothers interact with their children. The resulting estimate of β_m by OLS is likely to be biased.

The Instrumental Variable (IV) estimator, under the assumption of homogeneity in the effects of maternal education on educational attitudes and behaviours, is a useful methodology to deal with the bias in the parameter for mother's education induced by the correlation between education and unobservable information. In an IV setting, the relationship between mother's schooling and her educational attitudes and behaviours can be described by the following system of equations:

$$\begin{aligned} Y_i &= X1^{'}\alpha_1 + X2_i^{'}\alpha_2 + \beta_m S_m + \beta_f S_f + e_i \\ S_m &= Z_m^{'}\delta_m + X1_m^{'}\alpha_3 + e_m \end{aligned} \qquad (2)$$

where Z_m is a 0/1 instrumental variable for the schooling of the mother; e_m is the error terms in the equation for schooling; and the rest of the variables have been described in equation (1). We rely on the policy reform in the United Kingdom, which raised the minimum school leaving age from 14 to 15 years in 1947, to provide an instrument for schooling. This instrument should provide as much identification to the model as possible, meaning that it should explain as much variation in the schooling equation and it should condition out as much of the relationship between age and educational attitudes and behaviours.

Identification of the schooling effect is based on regression discontinuity (Card, 1999). There are two conditions for identification. Firstly, the policy reform should induce a sharp increase on the levels of education for those mothers affected by the policy. Secondly, the rest of the relationships are smooth and unaffected by the policy. The last point is important. We are particularly concerned with the possibility that educational effects may be confounded with age effects. This is because this reform affected certain cohorts of women, i.e. those aged 14 or younger in 1947. Therefore, it is younger mothers who are affected by the policy but younger mothers also tend to achieve lower levels of schooling and have lower levels of educational attitudes and behaviours.

Estimates using these instruments are biased towards the group more affected by the policy and as such are interpreted as Local Average Treatment Effect. Chevalier (2004) proposes one possible group affected by the policy. This group comprises pupils who wanted to leave school at the first opportunity, i.e. at age 14, and with the reform are induced to stay on for an extra year. This is the main target group for policy. However, we suggest that a second group is also affected by the change in school leaving age. This group encompasses the first one plus those that stay in schooling for extra years to maintain their relative position in the educational scale. In other words, the reform may induce pupils who would have left schooling at ages 15 or above to stay on in education for an extra year. It is unlikely, however, that pupils who would have achieved a university degree before the reform were affected.

The application of these instruments is not novel. They have been used by Chevalier (2004) and before by Black et al. (2003), Oreopolus et al., 2003, Meghir and Palme (2000) and Harmon and Walker (1995). Nevertheless, we perform two standard post-estimation tests to verify the reliability of our IV estimation. First, we test whether the instrument is correlated with the index of educational attitudes and behaviours, a necessary condition for unbiased estimation (Bound, Jaeger and Baker, 1993). Secondly, we test for the endogeneity of education using the residuals from the first stage prediction of schooling and include these in an OLS model with educational attitudes and behaviours as the dependent variable. The null hypothesis that the residuals are not significantly different from zero in this equation is a test for weak exogeneity of education (Smith and Blundell, 1986). The intuition is that if unexplained aspects of the decision to stay on in education contained in the first stage residual are correlated with educational attitudes and behaviours, this provides evidence of endogeneity.

3.3 Sensitivity analyses

We perform five different sensitivity analyses to verify some possible areas of concern that may affect our estimates. Firstly, educational effects may be confounded with age effects (see Figure 1). This is because this reform affected younger women and these women have, on average, lower levels of education and more negative attitudes towards education.

Because the reform created a discontinuity between younger and older mothers, the instrument is associated with age. Correlation of the policy reform and parents' educational attitudes and behaviours through correlation of each with age would violate the second assumption of IV estimation. Therefore, it is important to ensure that we have adequately controlled for age. We emphasise that age is not our instrumental variable but rather that we take advantage of the discontinuity caused by the reform. Although we include age and age squared in our estimations, there may be more complex non-linearities that are not accounted for. We, therefore, estimate a two-stage semi-parametric model of parents' educational attitudes and behaviours and schooling to account for age effects that may not be captured by the quadratic age control (Speckman, 1988).

Another area of concern relates to the fact that not all the mothers in our analysis are first time mothers. This introduces two further complications in the analysis. First, it is possible that mothers with several children have time constraints that may affect their attitudes and behaviours towards the particular child they are referring to here, i.e. the cohort member. For example, mothers with several children may have less spare time to read to the child or to discuss the child's school progress with the teacher. Secondly, age of the mother in our data refers to the time when they gave birth to the cohort member and not necessarily when they gave birth to their first child. This issue distorts the well-established association between age of the mother and school attainments as well as age of the mother and her educational attitudes and behaviours. In order to deal with these issues we re-estimate the analysis for first time mothers only. A third area of concern led us to re-estimate the model excluding the youngest mothers, aged 16 and 17, and older mothers, over the age of 40, as the

relationship between our index and age is also very volatile at extreme values (again shown in Figure 1).

Fourthly, it is possible that educational effects are disturbed by mothers' labour market status. Mothers with relatively higher levels of education are more likely to be in full-time employment, which may impact on the amount and quality of time they have to spend with their children. Although mothers' employment has been shown to have relatively very little effect on children's attainments (Gregg and Washbrook, 2003; Joshi, 2000), we re-estimate the model for women not in the labour market. Finally, there may be some concerns about the measurement of educational attitudes and behaviours adopted here. Therefore, we generate another index using high score factor loadings only and re-estimate our model. The high score factor loadings are mother's reading to the child and her own reading behaviour. This variable is associated with general reading activities and is less problematic to interpret.

For all sensitivity analyses we utilise the estimation model with full background covariates only (**X1**) and also including child characteristics (**X1** and **X2**).

4. Results

This section presents results from regression analysis using OLS and IV estimation methods. It also shows post estimation tests for the reliability of the instruments and sensitivity analyses on five areas of concern that may affect our estimates.

4.1 Estimates using OLS

Results from the *step-wise* regression of mother's schooling on educational attitudes and behaviours, using OLS estimation, are shown in Table 4. We find that an additional year of mother's schooling is significantly associated with an increase of 0.12 in the index of educational attitudes and behaviours (base model). The inclusion of socio-economic background factors reduces the impact of mother's schooling by 20.6%, from 0.121 to 0.096. Adding measures for the child's behavioural characteristics and ability has an additional reduction of 14.5% on the estimated parameters for mother's schooling, from 0.096 to 0.082. The total attenuation is 32.2%.

Table 4: Step-wise OLS estimation of mother's education on her educational attitudes and behaviours

Variables	(Base Model)	(+background)	(+child characteristics)
Mother's schooling	0.121	0.096	0.082
	(24.63)**	(18.47)**	(15.73)**
Father's schooling	0.222	0.174	0.120
SLA+1	(6.98)**	(5.55)**	(3.71)**
Father's schooling	0.304	0.241	0.191
SLA+2	(13.97)**	(10.97)**	(8.64)**
Father's schooling	0.395	0.312	0.261
SLA+3 or more	(20.96)**	(15.69)**	(12.94)**
Mother's age	0.074	0.061	0.066
	(7.22)**	(5.96)**	(6.46)**
Mother's age^2	-0.001	-0.001	-0.001
	(6.46)**	(5.24)**	(4.26)**
Paternal grandfather		-0.097	-0.112
SES2		(2.34)*	(2.80)**
Paternal grandfather		-0.102	-0.122
SES3		(2.54)*	(3.17)**
Paternal grandfather		-0.188	-0.188
SES4		(4.43)**	(4.62)**
Paternal grandfather		-0.261	-0.254
SES5		(5.55)**	(5.59)**
Maternal grandfather		-0.035	-0.063
SES2		(1.02)	(1.84)
Maternal grandfather		-0.061	-0.085
SES3		(1.80)	(2.57)*
Maternal grandfather		-0.150	-0.151
SES4		(3.97)**	(4.08)**
Maternal grandfather		-0.223	-0.208
SES5		(5.77)**	(5.49)**
Mother's birth order		0.004	0.001
		(0.77)	(0.30)
Mother's family size		-0.033	-0.022
		(8.19)**	(5.64)**
CM birth order			-0.128
			(22.99)**
CM disobedient			-0.234
			(6.20)**
CM fights			-0.148
			(4.96)**
CM gender			-0.013
			(1.08)
CM separated from mother 1mth			-0.154
			(1.80)
Age 7 ability score			0.065
			(9.98)**
Wets bed			-0.059
			(2.67)**
Constant	-3.033	-2.060	-1.817
	(17.75)**	(10.95)**	(9.58)**
Observations	12,369	12,369	11,595

Notes: Robust t-statistics in parentheses. Asterisks indicate significant at (*) 5% and (**) 1% level.
All estimations control for regional variables and the presence of the father at home.
Categories for comparison: for father's schooling, SLA only; for paternal and maternal father's SES, SES1.

There are other interesting results from Table 4. Mothers raised in large families have, on average, lower scores on educational attitudes and behaviours. An additional member in the household where the mother was raised reduced her own educational attitudes and behaviours by 3.3%. Mothers whose fathers belonged to SES 4 or SES 5 have, on average, lower scores compared to mothers whose fathers belonged to the highest SES (SES 1). The background characteristics of the father are also associated with mother's educational attitudes and behaviours. Mothers whose partner's father belonged to the lowest SES had significantly lower scores on educational attitudes and behaviours than mothers whose partner's father belonged to the highest SES.

We further find that children's characteristics have significant associations with educational attitudes and behaviours. Child's birth order is significantly associated with lower educational attitudes and behaviours. Each position in the birth order reduces the index by 12.8%. It is interesting that the mother's own birth order is not a significant determinant of her educational attitudes and behaviours but the birth order of her child is. This raises an interesting point about the long term effects of the association between educational attitudes and behaviours and birth order. Mothers of disobedient children have -0.23 lower scores on the index of educational attitudes and behaviours than those of obedient children. Also mothers whose children fight with other children have -0.15 lower scores than those of other children. Another indicator of psychological maladjustment may be through wetting the bed at the age of 7. Mothers of these children also receive significantly lower scores on the index educational attitudes and behaviours than mothers of other children.

Finally, an ability measure, proxy by drawing a man test score, has a positive and statistically significant association with educational attitudes and behaviours. Caution must be taken in interpreting this association since improved ability may be an outcome of educational attitudes and behaviours, as shown in Table 2, and not an explanatory variable. However, high ability children may enjoy being exposed to educational enhancing activities and therefore increase the likelihood that parents will read to them and have high educational expectations on them.

4.2 Estimates using IV

Table 5 shows result using IV estimates and the minimum school leaving age as instrument for mother's schooling. The coefficient of the effect of mother's schooling on educational attitudes and behaviours by IV is reduced basically to zero. For the model that includes full background controls the estimated effect of mother's education is -0.004 and for the model that includes children's characteristics the estimated parameter is also -0.004. Neither of these parameters is statistically significant from zero.

Table 5: IV estimate of mother's schooling on her educational attitudes and behaviours

	(Full-background controls)[1]	(Full-background controls + child characteristics)[2]
Mother's schooling	-0.004	-0.004
	(0.14)	(0.14)
Father's schooling SLA+1	0.191	0.131
	(5.95)**	(4.04)**
Father's schooling SLA+2	0.274	0.212
	(11.09)**	(8.72)**
Father's schooling SLA+3 or more	0.412	0.349
	(11.27)**	(9.71)**
Mother's age	0.033	0.044
	(2.41)*	(3.29)**
Mother's age^2	-0.001	0.000
	(2.44)*	(2.08)*
Schooling equation[3]		
Mother-SLA	0.831	0.832
	(24.46)**	(24.15)**

Notes: Robust t-statistics in parentheses. Asterisks indicate significant at (*) 5% and (**) 1% level. Number of observations N=12,369 for full background model and N=11,881 for model with child characteristics.
All estimations control for regional variables, the presence of the father at home.
(1) Full background controls represents the model estimated by OLS in Table 4 column 2.
(2) Full background controls plus child characteristics represents the model estimated by OLS in Table 4 column 3.
(3) Mother's schooling equation includes controls for age, age squared, her father's SES when she left school, her family size, her birth order, her partner's schooling, her partner's father SES.

An unreliable instrument can seriously bias the estimated parameters. We show that the minimum SLA is strongly associated with schooling (schooling equation in Table 5). The increase in minimum SLA from 14 to 15 years is associated with an increase of 0.83 years of schooling. This provides evidence that the instrument is correlated with the endogenous covariate, i.e. schooling. Moreover, not including the change in SLA as an explanatory variable in the schooling equation reduces the R-squared from 0.26 to 0.22. This provides further evidence on the reliability of the instrument.

Finally, we find evidence to support the endogeneity of education. Using the models in Table 4, column 2, we reject the hypothesis that mother's schooling is exogenous in the model (t = 3.35). To do this test, we estimated mother's schooling and generated residuals, i.e. the part of the model not explained by the explanatory variables in the equation. We used residuals as covariates in the equation for educational attitudes and behaviours. These residuals were significantly different from zero. In other words, there are unobservable factors, captured in the schooling equations that significantly predict educational attitudes and behaviours.

4.3 Sensitivity analyses

Age may be an important confounder in estimating the effects of mother's education on educational attitudes and behaviours. For this reason, we estimated a two stage model with non-parametric components in age and parametric components for the rest of the variables, including the predicted value of mother's schooling obtained from the first stage. In this model age is modelled non-parametrically to allow for more flexibility and account for non-linearity. Table 6 shows the results from this estimation. Results show that the estimated effect of schooling is reduced significantly (to 0.013) and is not statistically different from zero.

Table 6: Two-stage semi-parametric model of educational attitudes and behaviours (all mothers, NCDS-1)

	Model with social background	
Variables	**Parameter**	**(t-statistic)**
Mother's schooling	0.013	(0.28)
Father's schooling SLA+1	0.191	(5.53)**
Father's schooling SLA+2	0.272	(9.54)**
Father's schooling SLA+3 or more	0.399	(7.76)**
Paternal grandfather SES2	-0.112	(-1.84)*
Paternal grandfather SES3	-0.179	(-2.39)**
Paternal grandfather SES4	-0.280	(-3.50)**
Paternal grandfather SES5	-0.348	(-4.33)**
Maternal grandfather SES2	-0.239	(-3.15)**
Maternal grandfather SES3	-0.259	(-3.31)**
Maternal grandfather SES4	-0.129	(-2.42)**
Maternal grandfather SES5	-0.163	(-2.92)**
Mother's birth order	-0.243	(-4.20)**
Mother's family size	-0.304	(-5.04)**

Notes: Robust t-statistics in parentheses. Asterisks indicate significant at (*) 5% and (**) 1% level. Number of observations N=12,369. Results are based on the model with full social background controls in Table 5.

The second sensitivity analysis is based on a sub-sample of first time mothers (Table 7). By doing the analysis for first time mothers exclusively our aim is to remove both the effect of having other children on educational attitudes and behaviours and the fact that the age of the mother does not represent the age at first birth. Information about first time mothers also clarifies the relationship between fertility and education. Our results show a significant association between mother's schooling and her educational attitudes and behaviours by OLS. However, by IV the estimated parameter is significantly reduced and loses its statistical significance.

The third sensitivity analysis is to include in the analysis only mothers aged 18 to 39. Using OLS estimation, we find significant associations between mother's schooling and educational attitudes and behaviours of 0.094 and 0.087 for the models that control for social background characteristics and social background plus child's characteristics, respectively. However, using IV methodology the statistical significance of this association disappears. As a fourth sensitivity test we re-estimated the model with first time mothers only and this time excluding mothers aged 16 and 17 and those over 40. Again, we find significant association using OLS and insignificant effects with IV.

Table 7: Sensitivity analysis using different sub-samples (NCDS-1)

	(OLS) Social background	(IV) Social background	(OLS) + Child characteristics	(IV) + Child characteristics
FIRST TIME MOTHERS ONLY				
Mother's schooling	0.084	-0.021	0.078	-0.025
	(10.16)**	(0.48)	(9.33)**	(0.58)
Observations	4409	4409	4198	4198
R-squared	0.12	0.10	0.13	0.11
MOTHERS AGED 18 TO 39 ONLY				
Mother's schooling	0.094	-0.020	0.087	-0.024
	(17.90)**	(0.63)	(16.14)**	(0.74)
Observations	11974	11974	11284	11284
R-squared	0.13	0.11	0.15	0.13
FIRST TIME MOTHERS AGED 18 TO 39 ONLY				
Mother's schooling	0.083	-0.052	0.076	-0.058
	(9.92)**	(1.16)	(9.11)**	(1.28)
Observations	4293	4293	4089	4089
R-squared	0.12	0.08	0.13	0.09
MOTHERS NOT IN THE LABOUR FORCE				
Mother's schooling	0.088	-0.010	0.081	-0.007
	(14.95)**	(0.26)	(13.39)**	(0.20)
Observations	9941	9941	9357	9357
R-squared	0.13	0.12	0.16	0.15
OUTCOME READING BEHAVIOURS FOR FIRST TIME MOTHERS ONLY				
Mother's schooling	0.074	-0.032	0.069	-0.043
	(8.94)**	(0.74)	(8.17)**	(0.99)
Observations	4409	4409	4198	4198
R-squared	0.09	0.07	0.10	0.07

Notes: Robust t-statistics in parentheses. Asterisks indicate significant at (*) 5% and (**) 1% level.
All estimations control for regional variables, the presence of the father at home.
(1) Full background controls represents the model estimated by OLS in Table 4 column 2.
(2) Full background controls plus child characteristics represents the model estimated by OLS in Table 4 column 3.

The fourth sensitivity analysis is performed to test the hypothesis that older mothers, with perhaps higher levels of education, are more likely to be in the labour market and that their educational attitudes and behaviours may be disrupted by the lack of time. Therefore, we estimate the model for mothers not in the labour market to test this hypothesis. Mothers not in the labour force are defined as those who are working full-time in care for their children or those who have been in and out of the labour market since the child was born. Using IV estimation we do not find evidence to support the effects of schooling on educational attitudes and behaviours for mothers not in the labour force. This result is compatible with evidence presented by Davie, Butler and Goldstein (1972) where they find that labour market participation for NCDS cohort members' mothers did not have negative effects to cohort members' outcomes.

Finally, the analysis is re-estimated for first time mothers only but the outcome variable is modified. Rather than using 6 different factors to generate an index of educational attitudes and behaviours, we use high score factor loadings, i.e. factors that cluster together. Using factor analysis we found high factors for mothers who read to the cohort member and for mothers who spare time to read. We construct an outcome variable that relates to mother's reading. In this last analysis we find significant effects of schooling on mother's general reading activities by OLS that are not significant using IV methods.

In summary, as a general result for all five sensitivity analyses we find significant associations between education and the index of educational attitudes and behaviours using OLS and an insignificant effect using IV. This suggests that our results are robust to sample specifications.

5. Conclusions

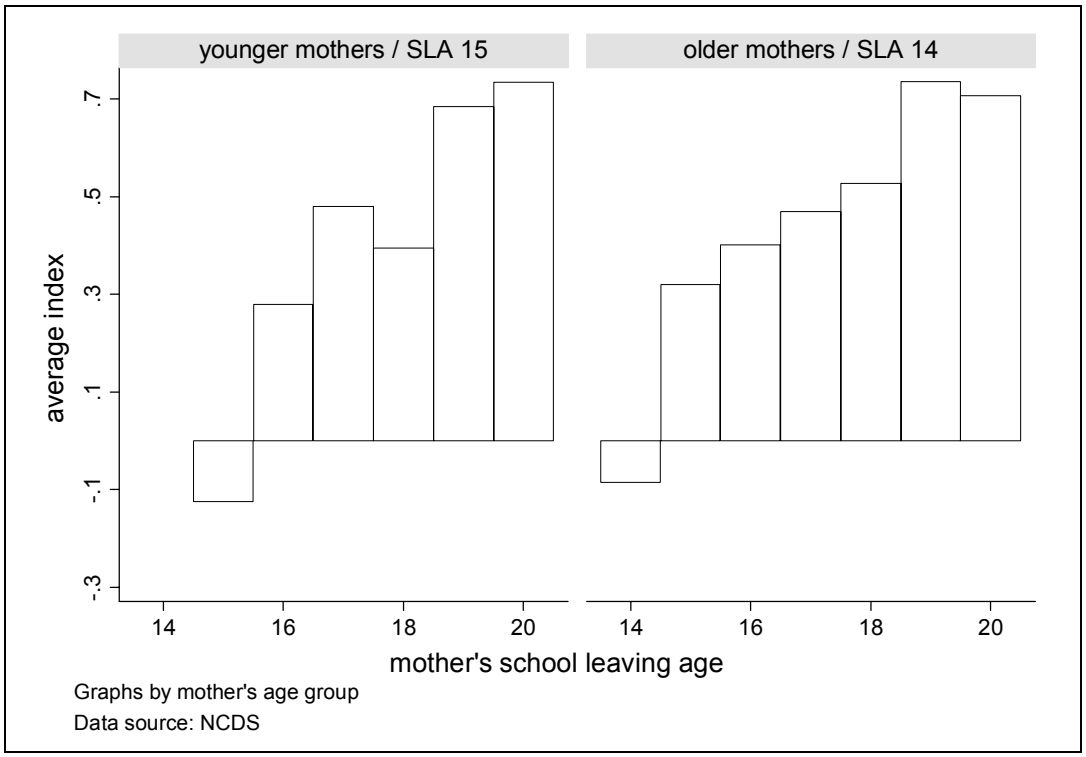
This report has focused on the effect of parental education on parents' educational attitudes and behaviours. The research we have reported first used stepwise OLS estimation to measure the extent of the bias in the estimated effect of education due to observable background factors. It then applied IV methods to estimate the causal effect of parental education on parents' educational attitudes and behaviours, using a natural experiment to address problems of unobserved confounding bias.

Using OLS we found a positive and significant association between mothers' schooling and the index of educational attitudes and behaviours. Failing to control for factors prior to schooling that are known to affect both schooling decisions and educational attitudes and behaviours would have led to a significant upwards bias in the effect of mothers' schooling. Duckworth and Sabates (2005) found an upwards bias of 73% in estimates of the effect of the mothers' staying on in education on parenting from failing to account for a full set of background characteristics, including their own ability and information on parenting they received. In the economics of education literature, Blundell et al., (2004) estimate an upwards bias of around 48% in economic returns to education for NCDS cohort members from failing to account for family background and unobserved ability. One must be cautious in comparing these results to ours. Their estimates apply to cohort members whereas ours apply to cohort members' parents. The studies of Duckworth and Sabates and Blundell et al. contain a much richer set of controls for socio-economic background and ability measures than that available here. Nevertheless the bias estimated here is substantial.

Using IV estimation techniques, we did not find educational effects on educational attitudes and behaviours. This result was robust to the different sample size and specifications utilised. Duckworth and Sabates (2005) found that in most cases the effect of staying on in education on parenting is not statistically significant when a rich set of socio-economic background, ability and psycho-social factors were introduced as controls. Our result using IV methods is compatible with their finding.

Figure 5 provides some possible explanations for these results. The effect of an extra year of education is mainly a selection effect, explained by variance in who stays on in education rather than the educational effect of an additional year of schooling. When all students can leave at 14 years, staying on in education to age 15 is a good indicator in the labour market of capabilities and productivity, and is also a good signal of status in other aspects of adult life such as partnership formation. But when everyone must stay on to 15, leaving at 15 is no longer a good signal. The figure highlights the positional aspect of education, wherein the choice to stay in post-compulsory education may reflect social-class maintenance and differentiation (Ball, 2003), and in other areas of positional status-seeking, such as the marriage market (Kiernan, 1997).

Figure 5: Average educational attitudes and behaviours by mother's schooling and SLA legislation (all mothers)



The index is a weak and unpiloted measure of a construct which we recognise is rather poorly defined. This is a constraint of the data. We have found predictive validity of the measure in terms of its association with a range of outcomes and also discriminatory validity for our central finding in that whereas the OLS estimate is significant, the IV estimate is not. However, it would be preferable if the measure had a clearer theoretical foundation. We take the view that it is a proxy for a range of educational behaviours and cognitions. The index has value in that it does not over-emphasise any one of these relatively poor proxy measures but uses information from each of the four observations to assess the underlying, latent construct. Use of any one measure would be more prone to the problem of misspecification of the dependent variable than estimation that draws on multiple sources. However, we emphasise that we find substantively identical results when we undertake the OLS and IV estimation using each of the four measures separately.

We also emphasise that the current study relates to post-compulsory participation in education for women in the UK in the period after the Second World War. In the intervening years there have been substantial changes to pedagogy, curricula, assessment, pupil motivations, the structures of the education system, the factors underlying the decision to stay on in education and teacher training. Some or all of these may have changed the effects of post-compulsory participation on subsequent educational attitudes and behaviours. Moreover, the education measure used here should not be generalised so as to be taken to refer to all aspects of learning and education. It may be that diverse outcomes of learning such as cognitive development, resilience, self-efficacy, social inclusion, engagement and belief in the value of schooling are important influences on subsequent educational attitudes and behaviours and support for children's learning. If the extra year of education observed in the

current study did not lead to gains in these domains because the extra year of education was of poor quality or focussed on other aspects of curricula then one would obtain the results obtained in this study. Thus, the results do not suggest that education cannot generate causal effects, rather that the intervention evaluated did not do so.

However, this is not a trivial finding because, as our own OLS results also show, many regression analyses have shown strong correlations of parents' education with subsequent elements of educational attitudes and behaviours. These results indicate the strong possibility that these apparent relationships shown by OLS may be the result of selection bias. This should be taken into account when drawing inferences from OLS studies, particularly those with few control variables. This is our policy remark. If the selection bias is as strong in other studies as it has proved in this one, then educational interventions based on observed gradients between education and outcomes would not generate the expected results.

Another interesting implication of these results is the way that they emphasise the positional importance of education. Individuals from low socio-economic background in 1947 tended to leave the educational system at the first opportunity. When the minimum school leaving age was raised from 14 to 15, individuals with positional ambition increased their education in order to maintain their relative advantage. These women also tended to have higher subsequent scores on the index of educational attitudes and behaviours used in this study. In other words, educational attitudes and behaviours are very important elements of the intergenerational transmission of social and economic advantage. The same is true of education and those who have the information, motivation and capability to use both of these mechanisms are best able to maintain their social and economic status. The simple correlation of educational attitudes and behaviours and education is founded on this combination of within-generation and between-generation processes.

It is also worth emphasising that other research has pointed out that there are causal effects of parental education on child attainment. Chevalier (2004) found evidence of the effects of maternal education on the education of her children using the change in minimum school leaving age from 15 to 16 that took place in Britain in 1972. Black, Devereux and Salvanes (2003) found small effects of parental education on children's educational attainments in Norway also using the change in school leaving age to instrument educational effects. Using the variation in school leaving age across US states, Oreopolus, Page and Stevens (2003) found that a one-year increase in the education of either parent reduced the probability that a child repeated a grade by between two and seven percentage points. They also found evidence that education reduced the probability of dropping out from school for children aged 15 to 16 living at home. These studies investigated the causal effects of education on child attainment using similar quasi-experimental methods to those of this report but, in contrast, found that the relationships from the OLS models persisted in the IV models. We conclude from this that the non-significance of the IV estimate is particular to the outcome considered here and is not a consequence or artefact of the method. Moreover, the results presented here suggest that educational attitudes and behaviours may not be the main channel for the intergenerational effects of education demonstrated in those other studies. Other channels such as income, health, partnership formation, neighbourhood choice, peer groups and value formation may be more influential.

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WIDER BENEFITS OF LEARNING RESEARCH REPORT NO.16

Does education have an impact on mothers' educational attitudes and behaviours?

The different elements of parents' educational attitudes and behaviours have been well documented and are identified as having a significant effect on children's levels of educational achievement.

It therefore seems likely that some of the intergenerational effects of education may be transmitted through parents' educational attitudes and behaviours. However, empirical research to date has not been robust enough to test whether there is a causal effect of education on such attitudes and behaviours. This report fills the gap by providing a rigorous estimate of the educational effect.

Whilst initial analysis shows an association between the age at which a mother leaves full-time education and her subsequent educational attitudes and behaviours, through using instrumental variable (IV) methodology we find that this link is not the result of causal effects of post-compulsory education but rather it is due to underlying related differences between mothers who stayed on in education and mothers who did not.

An interesting implication of these results is the emphasis they place on the positional importance of education – as educational levels for those with lower educational aspirations increase, individuals with positional ambition increase their education further in order to maintain their relative advantage.

The results of our research strongly indicate the possibility that the apparent relationships shown by ordinary least squares methodology (OLS) may be spurious as indicators of a causal relationship. This should be taken into account when drawing inferences from OLS studies, particularly those with few control variables. If policy reform causes individuals to self-select within the system, then educational interventions based on observed links between education and outcomes may not generate the expected results.

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