Session Number: 8D
Session Title: *Poverty and the Well-Being of Children*
Session Chair: Stephan Klasen, University of Göttingen

Paper Prepared for the 29th General Conference of
The International Association for Research in Income and Wealth

Joensuu, Finland, August 20 – 26, 2006

DO HOUSEHOLD INCOME-RELATED CHANGE AFFECT EDUCATIONAL AND BEHAVIOUR OUTCOMES IN CHILDHOOD AND ADULTHOOD?

IAN PLEWIS (PROJECT DIRECTOR)
CONSTANTINOS KALLIS (RESEARCH OFFICER)

For additional information please contact:

Author Name(s) : Ian Plewis
Author E-Mail(s) : i.plewis@ioe.ac.uk

Author Name(s) : Constantinos Kallis
Author E-Mail(s) : c.kallis@ioe.ac.uk

DO HOUSEHOLD INCOME-RELATED CHANGES AFFECT EDUCATIONAL AND BEHAVIOUR OUTCOMES IN CHILDHOOD AND ADULTHOOD?

JULY 2006.

IAN PLEWIS (PROJECT DIRECTOR)
CONSTANTINOS KALLIS (RESEARCH OFFICER)

Introduction

The context for our study is provided by:

(i) The short, medium and long-term UK government targets first to reduce and ultimately to eliminate child poverty by 2020.
(ii) UK policies to increase lone parent employment and to reduce the number of children brought up in workless households.

Our study focuses on the potential to relate changes in income-related variables experienced during childhood to outcomes at the end of childhood and beyond in such a way as to be able to come to causal conclusions about:

(i) the relation between poverty and children's outcomes, both intermediate outcomes such as educational qualifications and behaviour problems,
(ii) final outcomes in adulthood such having no educational qualifications.

In other words, the study is assessing whether, and to what extent, it is possible to go beyond the well-established association between poverty in all its forms on the one hand and poor outcomes on the other.

This association – usually based on cross-sectional data - can be explained in a number of ways, only some of which can be regarded as causal. It is important for policy makers to know what kind of social benefits, for example less crime and less unemployment, can be expected if family incomes were to rise or the level of parental employment to increase. Although easily stated, the question is a challenging one to answer, both in terms of the kinds of data needed and the statistical techniques to be applied. This study is guided by the view that a dynamic approach based on longitudinal data is the most useful way to tackle the fundamental question stated above.

Review of Previous Research

This review draws heavily upon the work by Plewis and Hawkes (2005) and is tightly focused on papers and reports that relate changes in socio-economic circumstances in childhood, to childhood and adult outcomes. The literature on relations estimated from longitudinal data is much less extensive but much more useful than the literature based on cross-sectional data. This section is divided into three sub-sections according to the research approach adopted: (i) evaluations of policy interventions; (ii) sibling comparisons; (iii) controlling for confounding variables in analysis.

Evaluations of policy interventions

In the US, policy evaluation studies in this area are often based on random assignments to welfare experiments. In the UK, however, such random assignments are rarely undertaken and therefore matching methods are required. The experimental method, encapsulated by random assignment, is a very powerful device for estimating causal relationships. The more common quasi-experiments for which selection into intervention and comparison groups is not under the control of the investigator can also be informative about the effect of a policy initiative, although the validity of any causal conclusions is open to more doubt in the absence of randomisation. However, evaluations can often be difficult to generalise beyond the policy itself. For example, the findings from the UK Education Maintenance Allowance (EMA) evaluation (see below) might not generalise to increases in household income as the EMA was received by the child and not by the family. In addition, for this method to be applicable to British cohort studies such as the UK National Child Development Study (NCDS) it would be necessary for some of the cohort to have experienced the change and others not. It is, however, much more likely that all cohort members will have experienced the change in policy at the same time. For example, all NCDS cohort members in England would have experienced the effect of raising the school leaving age to 16 at the same time.

We have found three relevant evaluation studies. The first – the longitudinal evaluation of the EMA pilot alluded to above (Ashworth et al., 2002) – estimates that the up to £30-40 weekly allowance increased the post-16 education participation of 16 to 19-year-olds from lower-income families by 5.9 percentage points. The strength of the study comes from the propensity score matching that eliminates many of the problems caused by the failure to randomise. Nevertheless, the validity of the findings depends on the quality of the match made between those students in pilot intervention areas and those in comparison areas. The EMA is paid directly to the student, so the observed differences could reflect the differential effects of a young person's own income on their participation decisions, compared to the effects of household income on participation.

The second study (Clark-Kaufmann et al., 2003) is in fact a review of several random assignment to welfare studies in the US. They find that increasing maternal employment with additional income support of $1500-$2000 per year for two to three years increases educational attainment for those 0-5 years old by 8 percent of a standard deviation compared to those who also experienced an increase in maternal employment without the additional subsidy. There was an insignificant negative effect for those aged 6-15. A weaknesses of the study is that the findings might not generalise beyond those eligible for welfare.

The third study (Goering and Ferns, 2003) analyses data from the Moving to Opportunity programme in the US. The key findings are that moving from a poor to a wealthier neighbourhood is associated with a marked reduction in behavioural problems, and improvements in school test scores. In addition, for older children, it is also associated with a reduction in the number of arrests for violent crime. Weaknesses of the study are that the findings might not generalise beyond those eligible and willing to move from poor neighbourhoods and that it does not directly address the issue of the effects of changing household income.

Sibling comparisons

Sibling comparison studies exploit the fact that, at a specific age, siblings might experience different levels of household income and therefore differential effects of income on outcomes can be estimated. There is, of course, less within family variation in income than there is between families. Moreover, parents might try to allocate resources within the household to compensate for differences between siblings. In addition, any measurement error in the income measures will be amplified when the between sibling within family approach is used. This approach can only be used when there is more than one child in the family and there are sufficient data on two or more siblings; this restricts the generalisability of the results.

Ermisch et al. (2001, 2004) use a sibling fixed effects method to show that growing up in a workless household age 11-15 increases the chance of leaving the parental home, becoming a smoker and the likelihood of psychological distress. Growing up in a workless household age 6-10 increases the chances of early child bearing. Growing up in a workless household age 0-5 reduces the chances of achieving A-levels while increasing the chances of economic inactivity, early childbearing and smoking.

Levy and Duncan (2001), using data from the US Panel Study of Income Dynamics (PSID) and also using the sibling fixed effects method, show that a 2.7 fold increase in parental income when the child is 0-4 years old leads to an increase of about half a year of schooling. Income increases during adolescence also have a positive effect but these are less robust.

Controlling for confounding variables

The third and perhaps the most widely used approach attempts to control for confounding variables in the analysis. Subject to the availability of the data on these potential confounders and access to longitudinal data, the relationship between income change and child outcome change can be estimated. Most of the studies found in this category are from the US although Blanden and Gregg (2004) apply this method to the NCDS and BCS70 in the UK. The method is suitable if the potential omitted variables can be controlled for.

Blanden and Gregg's work, based on data from BCS70 as well as from NCDS and BHPS, suggests that there is a causal link between family income and educational attainment in the UK. A lower bound estimate suggests that a reduction in family income by £140 a week (£7000 a year) reduces the chances of securing a degree by around 4 percentage points. Similar effects are found for obtaining no GCSE A-C grades and staying on at school. For BCS70 and NCDS, they control for ability using early ability measures to eliminate child ability bias. In addition, for BCS70, they control for permanent income using repeated measures of household income at child ages 10 and 16. For BHPS, direct controls for permanent income using average post-school income are employed along with the sibling fixed effects method.

Plug and Vijverberg (2001) use the Wisconsin Longitudinal Survey and focus on the children of the cohort members to obtain a positive relationship between family income and school success that they consider to be causally important. They control for permanent income by using two measures of family income and for ability by using parents' IQ results, and they apply the sibling method. They use adopted children to break the genetic link in ability as a form of natural experiment. Their models are estimated using random effects but only for those in two parent families.

Blau (1999) use random and fixed effects models on the matched mother-child data from the US National Longitudinal Survey of Youth and finds a small effect of current income on the child's cognitive, social and emotional development. The effect of permanent income is substantially larger although not as large as those ascribed to family background characteristics. One weakness of this study is that mothers' ability was assessed between the ages of 15 and 23. Therefore, their ability score might be influenced by their educational experience.

Shea (2000) draws on PSID data to consider the impact of parents' income by focusing on income variation due to union status, industry and job loss which are associated with 'luck'. Changes in family income due to these measures of luck are found to have a negligible impact on children's human capital although it is more important for those with less educated fathers. Shea uses Ordinary Least Squares (OLS) and Two Stage Least Squares (2SLS) (instruments used: industry, union status and job loss) to estimate an effect of an exogenous change in income. But, in common with many studies that use instrumental variables, there is a question mark over the validity of the instruments used – for example, if job losses are more likely for those with less educated fathers than the instrument would be invalid.

Dearing et al. (2001) show that a change in income-to-needs does not matter for those in a non-poor family but does for those in poverty. An increase in the income-to-needs for children from poor families at least 1 SD above the mean change for poor families results in outcomes similar to their non-poor peers. They use two level hierarchical linear (random effects) models on data from the National Institute of Child Health and Human Development Study of Early Child Care. However, data collection does not continue long enough to see if these effects continue past the age of three; they consider not a 'pure' income effect but income to needs, which will mean larger families are represented differently from other studies.

The edited volume from Duncan and Brooks-Gunn (1997), based on PSID data, suggests that only parental income for child ages 0-5 is significantly associated with completed schooling although there is a concern that the estimated effect of income may be spurious due to unmeasured confounders.

Burgess et al. (2004) use ALSPAC data to show that children from poor households have poorer health. The magnitude of the direct income effect is, however, small. A larger effect is found for the mother's own health and events in her early life. They control directly for child and mother fixed characteristics and estimate using ordered probit. They focus on financial hardship questions as a measure of low income rather than the actual income data reported although income data are used to confirm the results found. Also, rather than directly considering changes in financial hardship, they appear to consider the number of times and amount of time in financial hardship. It is possible that changes in child health are endogeneous, i.e. that they affect as well as being affected by income changes.

Dahl and Lochner (2005) use the US National Longitudinal Survey of Youth and apply a fixed effect instrumental variables strategy to estimate the causal effect of income on children's mathematics and reading achievement. Identification comes from the large non-linear change in the Earned Income Tax Credit (EITC) over the last two decades. The baseline estimates indicate that a $1000 increase in income raises mathematics test scores by 2.1% and reading test scores by 3.6% of a standard deviation.

Phipps and Lethbridge (2006) investigate the relationship between income and child well-being for a broad range of outcomes (cognitive, physical health, behavioral, social/emotional). Using the Statistics Canada National Survey of Children and Youth (NLSCY), they find that higher income is almost always associated with better outcomes for children. Other findings include the dependence of the size and the functional form of the association between income and child outcomes on the developmental domain and that the time-period average income has the largest associations with child outcomes. Another important conclusion of this study is that for children age 8-15, changes in family income appear to be less important for child outcomes than levels of family incomes and that income changes are more important for younger children (ages 4-7).

Research questions

We investigate the effects of income-related changes during childhood on late childhood outcomes and outcomes in adulthood. More specifically, we examine the effect of changes in the receipt of means-tested benefit between ages 10 and

16 on educational and behaviour outcomes at age 16. The educational outcomes at age 16 cover mathematics, vocabulary and two spelling tests. The behaviour outcomes cover indicators for emotional, conduct and attention problems. If there is a causal effect of income on outcomes then we would expect to find that:

(i) Children who experience a move out of poverty (in terms of their families being on benefits) would have higher test scores and fewer behaviour problems at age 16 than those who move into poverty.
(ii) Children in poverty at both occasions will have the worst outcomes and most problems and those not in poverty at all will have the best outcomes and fewest problems.

We also estimate the effect of benefit status change between ages 10 and 16 on the probability of having no educational qualifications at age 34 with the expectation that there will only be a distal effect of this kind if there are also more proximal effects on educational test scores and behaviour problems as hypothesized above.

Sample and variables

For our analysis, we use the British Cohort Study (BCS70), a longitudinal study of all GB births (originally about 17K) in a week in April 1970. The full sample was followed up at ages 5, 10, 16, 26, 30 and 34.

Our analysis sample consists of all BCS70 cohort members who participated in sweeps in 1980 (age 10) and 1986 (age 16). The sample sizes at ages 10 and 16 are respectively 14875 and 11615. There are 4017 cohort members who participated only in the 1980 sweep and 757 who were present only in the sweep in 1986 and these cases have been removed from further analysis. Henceforth, 10858 cohort members are included in the analysis of changes between the ages of 10 and 16.

(i) Outcomes at age 16

The outcome variables at age 16 are four measures of educational attainment: mathematics, vocabulary, spelling A (taken at school) and spelling B (taken at home). Out of 10858 cohort members, the corresponding valid scores for the tests mentioned above are 3414, 5389, 5268 and 5157. The quartiles for all these tests are shown in the Appendix.

Behaviour is measured by the Rutter A scale (Rutter et al. 1970) and subsets of the items are to used to create behaviour subscales related to emotional behaviour adjustment, conduct problems and attention problems (hyperactivity). Emotional behaviour adjustment of the cohort member includes the following items: tears/unhappy, worries, fearful and sleep. Conduct problems include the items destroys, fights, disobeys, steals, lies and bullies and attention problems include the items fidgets, poor concentration and restless.

Out of 10858 cohort members, 2850 have missing values for the emotional subscale, 2849 missing values for the conduct subscale and 2776 missing values for the attention subscale at age 16. We have used the value closest to the upper third cut-off point of the sample distribution for each of the subscales mentioned above to define the population with the corresponding behaviour problem. Thus, at age 16 we have created three binary indicators for each of the behaviour problem types. The distributions of the behaviour indicators are shown below.

Table 1: Emotional behaviour adjustment problems at age 16

Emotional at age 16	Number of cohort members	Percentage
Yes	5853	73
No	2155	27
Total	8008	100

Table 2: Conduct problems at age 16

Conduct at age 16	Number of cohort members	Percentage
Yes	5112	64
No	2897	36
Total	8009	100

Table 3: Attention problems at age 16

Attention at age 16	Number of cohort members	Percentage
Yes	5520	68
No	2562	32
Total	8082	100

(ii) Outcome at age 34

We use a binary variable indicating whether the cohort member has any educational qualifications at age 34. The sample we have used in our analysis to investigate the link between benefit change between ages 10 and 16 and having no qualifications at age 34 includes data from ages 5, 10, 16 and 34. The sample size is 7341 and there are 29 cohort members in the analysis sample with educational qualifications at age 34 missing. The distribution of the variable denoting the lack of qualifications at age 34 is the following:

Table 4: No qualifications at age 34

No quals at age 34	Number of cohort members	Percentage
Yes	6715	92
No	597	8
Total	7312	100

(iii) Income related measures

Our research is focused on the effect of family benefit status change between ages 10 and 16 on the outcomes at ages 16 and 34 mentioned above. The family of the cohort member received income related benefits at ages 10 and 16 when at least one of the three conditions was true:

1. Family received family income supplement.
2. Family received supplementary benefit.
3. Family received unemployment benefit.

Out of 10858 cohort members, 2483 have benefit status at age 10 missing and further 1339 have the corresponding benefit status at age 16 not known. A further 192 entries initially indicating no receipt of income related benefits at age 16 have been changed to missing as there was no response given about the source of income at the same age. As receipt of free school meals indicates receipt of income related benefits, we have replaced 1895 missing benefit status entries at age 10 and 118 at age 16 using free school meals status at the corresponding age. Finally, 299 observations at age 10 and 143 observations at age 16 have been changed from "not receiving benefits" to "receiving benefits" because they reported that they had been receiving free school meals.

The distributions of benefit status for ages 10 and 16 and change in benefit status are given in Tables 5 to 7.

Table 5: Benefit status at age 10

Receiving benefits at age 10	Number of cohort members	Percentage
Yes	1562	15
No	8708	85
Total	10270	100

Table 6: Benefit status at age 16

Receiving benefits at age 16	Number of cohort members	Percentage
Yes	1899	21
No	7079	79
Total	8978	100

Table 7: Benefit status change between ages 10 and 16

Receiving benefits at ages 10 & 16	Number of cohort members	Percentage
10: No, 16: No	6208	73
10: Yes, 16: No	566	7
10: No, 16:Yes	1076	13
10: Yes, 16: Yes	697	8
Total	8547	100

We can see that the percentage receiving benefits increased between the ages 10 and 16 from 15% to 21%, which is in accordance with the increase in the unemployment rate during the same period.

(iv) Other explanatory variables

In our analysis, we include a number of possible confounders. We control for earlier measures of educational attainment and behaviour. At age 10, two tests of educational attainment are available: mathematics and reading. Out of 10858 cohort members, 8664 have results for the mathematics test and 8674 have results for the reading test. And at age 5, we have the English Picture Vocabulary Test (EPVT) and Copy Designs test with 7514 and 9145 cohort members taking these tests. The quartiles for all these tests are shown in the Appendix.

In addition, there are variables derived from the Rutter A scale at ages 5 and 10. At ages 10 and 5, we have created z-scores for each of the behaviour subscales at the corresponding age. There are missing values for each of the subscales at ages 10 and 5 as follows: 880 for the emotional at age 10 and 150 for the corresponding subscale at age 5, 856 for conduct at age 10 and 131 for conduct at age 5 and 834 and 131 for attention problems at ages 10 and 5 respectively. The distributions of the behaviour subscales can be seen in the Appendix.

Other control variables include confounders related to the cohort member's parents. The educational qualification level of the parents at age 10 has been recoded to correspond to the National Vocational Qualifications (NVQs). There are 9210 cohort members with father's NVQ level recorded at age 10 and 9574 cohort members with mother's NVQ level at the same age.

The distributions of parental educational levels are given in Tables 8 and 9 (see Appendix for more details about the levels).

Table 8: Paternal educational level at age 10

Father's NVQ level at age 10	Number of cohort members	Percentage
1	3437	37
2	3328	36
3	894	10
4	1551	17
Total	9210	100

Table 9: Maternal educational level at age 10

Mother's NVQ level at age 10	Number of cohort members	Percentage
1	4938	52
2	3345	35
3	396	4
4	895	9
Total	9574	100

Home ownership at age 10 is an indicator derived from the information available for the cohort members' family accommodation. There are 733 cohort members with home ownership status unknown. From the remaining families, 64% of the families in the analysis sample are owners of the house they live in.

Analysis

The statistical analysis links benefit status change between ages 10 and 16 to educational attainment tests and behaviour scores at age 16, controlling for attainment at age 10 and behaviour at age 10 respectively and other variables.

Our regression model for educational attainment is the following:

$$y_j = b_{0j} + \sum_k b_{kj} x_k + \sum_l c_{lj} z_l + e_j, \qquad j = 1,2,3,4$$

y_j are the response variables: mathematics, vocabulary, spelling A and spelling B tests at age 16. x_k are the variables of interest (benefit status change), z_l denote control variables: house ownership, gender, mathematics and reading tests at age 10, EPVT and Copy Design tests at age 5 and also father's and mother's educational level at age 10. Additionally, we fit a multivariate response model using the package *MLwiN* (Rasbash et al. 2004) allowing for correlation of the error terms e_j.

The effects of benefit status change between ages 10 and 16 on the educational outcomes at age 16 are given in Table 10.

Table 10: Benefit status change on educational attainment at age 16

	Maths 16		Vocab 16		Spell A 16		Spell B 16	
	Coeff.	S.E.	Coeff	S.E	Coeff	S.E.	Coeff	S.E.
Benefit change 10:n, 16:n (refer.)	0	n.a.	0	n.a.	0	n.a.	0	n.a.
10:y, 16:n	0.02	0.11	0.06	0.09	0.12	0.10	0.14	0.10
10:n, 16:y	0.03	0.07	0.00	0.07	0.00	0.07	-0.03	0.06
10:y, 16:y	-0.12	0.12	-0.05	0.11	-0.01	0.11	-0.02	0.11
House owner at age 10 No (refer.)	0	n.a.	0	n.a.	0	n.a.	0	n.a.
Yes	0.09	0.06	0.02	0.05	-0.06	0.05	-0.01	0.05
Sex Boy (refer.)	0	n.a.	0	n.a.	0	n.a.	0	n.a.
Girl	0.02	0.05	0.07	0.04	0.27	0.04	0.28	0.04
Maths10 zscore	0.43	0.04	0.15	0.03	0.13	0.03	0.13	0.03
Read10 zscore	0.19	0.04	0.35	0.03	0.31	0.03	0.27	0.03
EPVT5 zscore	0.05	0.03	0.10	0.02	-0.01	0.02	0.02	0.02
CDes5 zscore	0.08	0.03	0.03	0.02	0.04	0.02	0.03	0.02
Father's NVQ 1 (refer.)	0	n.a.	0	n.a.	0	n.a.	0	n.a.
2	0.08	0.06	0.02	0.05	0.00	0.05	0.02	0.05
3	0.09	0.08	0.16	0.07	-0.01	0.07	-0.01	0.07
4	0.14	0.07	0.16	0.07	0.11	0.07	0.04	0.07
Mother's NVQ 1 (refer.)	0	n.a.	0	n.a.	0	n.a.	0	n.a.
2	-0.02	0.05	0.10	0.05	0.08	0.05	0.12	0.05
3	0.10	0.11	0.23	0.10	-0.01	0.10	-0.03	0.10
4	0.09	0.09	0.18	0.08	0.11	0.08	0.09	0.08

We can see from Table 10 that apart from the mathematics test at age 16, the effects of benefit change on educational progress are in the expected direction: children whose parents start to claim benefits between ages 10 and 16 tend to make less progress than those children whose parents stop claiming benefits. Children whose parents were claiming benefits at both ages tend to make the least progress in all subjects. The effects are not, however, statistically significant. Using a joint significance test, we find that there is no significant difference between the effect of moving out of benefits (10:y, 16:n) and moving into benefits (10:n, 16:y) ($\chi^2 = 3.14$ on 4 df, $p > 0.1$). A joint overall Wald test shows that benefit status change has no significant effect on the educational attainment outcomes at age 16 ($\chi^2 = 4.77$ on 12 df, $p > 0.1$). We have also tested for interactions but we have found that they are not significant.

The regression model for behaviour indicators contains the following binary responses: emotional, conduct and attention problems at age 16. The variable of interest is benefit status change. The following control variables are included in all equations: house ownership, gender and father's and mother's educational level at age 10. Additional control variables for each of the behaviour indicators are the corresponding behaviour scores at ages 10 and 5.

We can see from Table 11 that children whose parents start to claim benefits between ages 10 and 16 tend to have a lower risk of having behaviour problems than those children whose parents stop claiming benefits. This is not in line with our expectations. Children whose parents were claiming benefits at both ages tend to have the highest risk of having behaviour problems. Using a joint significance test, we find that there is no significant difference between the effect of moving out of benefits (10:y, 16:n) and moving into benefits (10:n, 16:y) (χ^2=2.53 on 3 df, $p > 0.1$). However, a joint overall Wald test shows that benefit status change has a significant effect on the probability of having behaviour problems at age 16 ($\chi^2 = 31.51$ on 9 df, $p < 0.001$).

Table 11: Benefit status change on behaviour at age 16

	Emotional		Conduct		Attention	
	Coeff.	S.E.	Coeff	S.E	Coeff	S.E.
Benefit change 10:n, 16:n (refer.)	0	n.a.	0	n.a.	0	n.a.
10:y, 16:n	0.25	0.14	0.47	0.13	0.15	0.13
10:n, 16:y	0.04	0.10	0.30	0.09	0.08	0.10
10:y, 16:y	0.28	0.15	0.46	0.14	0.27	0.14
House owner at age 10 No (refer.)	0	n.a.	0	n.a.	0	n.a.
Yes	0.02	0.08	-0.10	0.07	-0.03	0.07
Sex Boy (refer.)	0	n.a.	0	n.a.	0	n.a.
Girl	0.55	0.06	0.01	0.06	-0.34	0.06
Emotional10 zscore	0.62	0.03	n.a.	n.a.	n.a.	n.a.
Emotional5 zscore	0.22	0.03	n.a.	n.a.	n.a.	n.a.
Conduct10 zscore	n.a.	n.a.	0.58	0.04	n.a.	n.a.
Conduct5 zscore	n.a.	n.a.	0.39	0.04	n.a.	n.a.
Attention10 zscore	n.a.	n.a.	n.a.	n.a.	0.58	0.03
Attention5 zscore	n.a.	n.a.	n.a.	n.a.	0.29	0.03
Father's NVQ 1 (refer.)	0	n.a.	0	n.a.	0	n.a.
2	-0.01	0.08	-0.12	0.08	-0.11	0.08
3	-0.06	0.12	-0.05	0.11	-0.13	0.11
4	-0.16	0.11	-0.18	0.10	-0.28	0.11
Mother's NVQ 1 (refer.)	0	n.a.	0	n.a.	0	n.a.
2	0.19	0.08	-0.20	0.07	-0.05	0.07
3	0.26	0.16	-0.40	0.16	-0.22	0.16
4	0.08	0.13	-0.30	0.12	-0.17	0.12

In both models, the correlations between the error terms are significant (5% level) suggesting that it is advantageous jointly to model the four educational outcomes and the three behaviour problem indicators. See the appendix for the corresponding variance-correlation matrices of the error terms for the two multivariate response models.

A logistic regression model is implemented to investigate the link between benefit change between ages 10 and 16 and having no educational qualifications at age 34. Control variables included in the model are: home ownership at age 10, gender, father's and mother's educational qualification at age 10, mathematics and reading tests at age 10, EPVT and Copy Design tests at age 5 and the behaviour problem scores at ages 10 and 5. The results are shown in Table 12.

Table 12: Benefit status change on having no qualifications at age 34

	No quals, age 34	
	Coeff.	S.E.
Benefit change 10:n, 16:n (refer.)	0	n.a.
10:y, 16:n	0.03	0.34
10:n, 16:y	0.61	0.22
10:y, 16:y	0.38	0.33
House owner at age 10 No (refer.)	0	n.a.
Yes	-0.53	0.18
Sex Boy (refer.)	0	n.a.
Girl	-0.58	0.18
Maths10 zscore	-0.32	0.12
Read10 zscore	-0.37	0.13
EPVT5 zscore	-0.24	0.09
CDes5 zscore	-0.18	0.10
Emotional10 zscore	-0.09	0.09
Emotional5 zscore	0.06	0.09
Conduct10 zscore	0.21	0.09
Conduct5 zscore	-0.01	0.09
Attention10 zscore	0.27	0.08
Attention5 zscore	-0.02	0.09
Father's NVQ 1 (refer.)	0	n.a.
2	0.15	0.19
3	-0.16	0.36
4	0.07	0.35
Mother's NVQ 1 (refer.)	0	n.a.
2	-0.22	0.20
3	-0.68	0.62
4	-0.69	0.55

From Table 12, we can see that children whose parents start to claim benefits between ages 10 and 16 have a higher probability of having no educational qualifications than those children whose parents stop claiming benefits. Children whose parents were claiming benefits at both ages have a higher risk of having no qualifications at age 34 when compared with children whose parents did not claim benefits at either age. Using a joint significance test, we find that there is no significant difference between the effect of moving out of benefits (10:y, 16:n) and moving into benefits (10:n, 16:y) (χ^2=2.37 on 1 df, $p > 0.1$). An overall Wald test indicates that benefit status change has a significant effect at 5% level on the probability of having no qualifications at age 34 (χ^2=8.44 on 3 df, $p < 0.04$).

Discussion

These early results suggest that changes in household income as measured by changes in benefit status do not affect children's educational progress during the adolescent years. The effects are in the expected direction but they are no greater than we would expect by chance. This is not entirely surprising as previous research has suggested that it is only changes in material circumstances in early childhood that affect educational progress. We should not, however, regard the absence of evidence of an effect as evidence of absence of an effect. Data limitations mean that there are a number of shortcomings in the analysis which, in combination, could affect inferences about change. For example:

1. We only have measures of the proxies of income at two occasions; we know nothing about changes in the intervening six years or anything about the timing of any change.
2. Changes in benefit status mean only that a household has crossed an income threshold; we know nothing about the size of the change represented by crossing this threshold.
3. Any changes in the eligibility for means-tested benefits could introduce error into the measure of change.
4. Errors of measurement - both in the income proxies and in the other explanatory variables in the models – can introduce bias into the estimates of interest.
5. The analyses are based on a rather small proportion of the whole cohort; again this could introduce bias.
6. The data are observational and we cannot rule out the biasing effects of self-selection into income change as an explanation for our results.

There is some evidence that *any* experience of poverty between the ages of 10 and 16 increases the risk of having behaviour problems at age 16 although no evidence to support our hypothesis that movement out of benefits will be advantageous and movement into benefits deleterious.

There is also some evidence that children who experience a move out of benefits between ages 10 and 16 are more likely to have educational qualifications than those who were not on benefits at either age (conditional on other variables). It is, however, difficult to know just how much importance to attach to this finding because the process leading to this apparent effect is difficult to identify, given that it does not operate through the test scores. It is just possible that families who move into poverty are unable to fund their children's education after age 16 and so these children end up with no qualifications (although not with lower test scores at age 16).

Appendix

Variables and their BCS70 names

Free school meals: m128 (age 10) and pe16.2 (age 16).

Benefits:

At age 10:

4. Family received family income supplement (variable c8.3)
5. Family received supplementary benefit (variable c8.4)
6. Family received unemployment benefit (variable c8.10)

At age 16:

1. Source of income - supplementary benefit (variable oe1.7)
2. Source of income - unemployment benefit (variable oe1.8)
3. Source of income – family income supplement (variable oe1.18)

National Vocational Qualifications (NVQ)

At age 10 (variables c1.1-c1.9):

Level 1: no qualifications.
Level 2: Trade apprentice, O level or equivalent.
Level 3: A level or equivalent.
Level 4: SRN (State Registered Nurse) or Registered Nurse, Certificate of Education (teachers) or equivalent, Degree or equivalent.

Gender

Child's sex (variable sex10).

Distributions of test scores at ages 5, 10 and 16

All tests have mean zero and SD = 1

Table A1: English Picture Vocabulary Test at age 5

Quartile	Value
25%	-0.54
50%	0.19
75%	0.81

Table A2: Copy Designs test at age 5

Quartile	Value
25%	-0.91
50%	0.10
75%	0.60

Table A3: Mathematics at age 10

Quartile	Value
25%	-0.63
50%	0.03
75%	0.77

Table A4: Reading at age 10

Quartile	Value
25%	-0.80
50%	0.10
75%	0.81

Table A5: Mathematics at age 16

Quartile	Value
25%	-0.68
50%	0.09
75%	0.77

Table A6: Vocabulary at age 16

Quartile	Value
25%	-0.62
50%	0.02
75%	0.65

Table A7: Spelling A at age 16

Quartile	Value
25%	-0.27
50%	0.16
75%	0.59

Table A8: Spelling B at age 16

Quartile	Value
25%	-0.31
50%	0.21
75%	0.56

Table A9: Emotional problems score at 10

Quartile	Value
25%	-0.74
50%	-0.33
75%	0.58

Table A10: Conduct problems score at 10

Quartile	Value
25%	-0.69
50%	-0.21
75%	0.28

Table A11: Attention problems score at 10

Quartile	Value
25%	-0.70
50%	-0.36
75%	0.68

Table A12: Emotional problems score at 5

Quartile	Value
25%	-1.00
50%	-0.37
75%	0.88

Table A13: Conduct problems score at 5

Quartile	Value
25%	-0.35
50%	-0.35
75%	0.47

Table A14: Attention problems score at 5

Quartile	Value
25%	-0.89
50%	0.05
75%	0.99

Variance-correlation matrices for the multivariate models

For Tables A15 and A16, the variances are highlighted; the off-diagonal terms are correlations.

Table A15: Educational attainments at age 16

Scores at 16	Mathematics	Vocabulary	Spelling A	Spelling B
Mathematics	**0.66**			
Vocabulary	0.53	**0.73**		
Spelling A	0.51	0.49	**0.75**	
Spelling B	0.53	0.47	0.84	**0.73**

Table A16: Behaviours at age 16

Behaviour scores at 16	Emotional	Conduct	Attention
Emotional	**1.00**		
Conduct	0.19	**1.00**	
Attention	0.22	0.20	**1.00**

References

Ashworth, K., Hardman, J., Hartfree, Y., Maguire, S., Middleton, S., Smith, D., Dearden, L., Emmerson, C., Frayne, C. and Meghir, C. (2002), "Education Maintenance Allowance: The First Two Years: A Quantitative Evaluation". London: Department for Education and Skills Research Report 352.

Blanden, J. and Gregg, P. (2004), "Family Income and Educational Attainment: A Review of Approaches and Evidence for Britain". CMPO Working paper Series No.04/101. (http://www.bris.ac.uk/Depts/CMPO/workingpapers/abstracts3.htm#04101)

Blau, D. M. (1999), "The Effect of Income on Child Development". *Review of Economics and Statistics*, 81(2), 261-276.

Burgess, S., Propper, C., Rigg, J. and the ALSPAC Study Team (2004). "The Impact of Low-Income on Child Health: Evidence from a Birth Cohort Study". CMPO Working paper Series No.04/098 (http://www.bris.ac.uk/Depts/CMPO/workingpapers/wp98.pdf)

Clark-Kauffman, E., Duncan, G. and Morris, P. (2003). "How Welfare Policies Affect Child and Adolescent Achievement". *American Economic Review*, 93, 299-303.

Dahl, G. and Lochner, L. (2005). "The Impact of Family Income on Child Achievement". NBER Working Paper No. 11279 (http://www.nber.org/papers/W11279)

Dearing, E., McCartney, K. and Taylor, B. A. (2001). "Change in Family Income-to-Needs Matters More for Children with Less". *Child Development*, 72 (6), 1779-1793.

Duncan, G. and Brooks-Gunn, J. (Eds.) (1997a). "Consequences of Growing Up Poor". New York: Russell Sage Foundation.

Ermisch, J., Francesconi, M. and Pevalin, D. (2001). "Outcomes for Children of Poverty". Department for Work and Pensions Research Report No. 158, London.

Ermisch, J., Francesconi, M. and Pevalin, D. (2004). "Parental Partnership and Joblessness in Childhood and their Influence on Young People's Outcomes". *Journal of Royal Statistical Society, A*, 167, 69-102.

Goering, J. and Ferns, J. (Eds.) (2003). "Choosing a Better Life? Evaluating the Moving to Opportunity Social Experiment". Washington DC: Urban Institute Press.

Levy, D. and Duncan, G. (2001). “Using Sibling Samples to Assess the Effect of Childhood Family Income on Completed Schooling”. Joint Centre for Poverty Research Working Paper, North Western University.

Phipps, S. and Lethbridge, L. (2006). “Income and the Outcomes of Children”. Analytical Studies Branch Research Paper Series, 11F0019 No.281, Statistics Canada.
(http://www.statcan.ca/bsolc/english/bsolc?catno=11F0019MIE2006281)

Plewis, I. and Hawkes, D. (2005). Feasibility study into the effects of low income, material deprivation and parental employment on outcomes for children both in adulthood and as children. *Department for Work and Pensions, Working Paper 20.*
(http://dwp.gov.uk/asd/asd5/wp2005.asp)

Plug, E. and Vijverberg, W. (2001). “Schooling, Family Background, and Adoption: Does Family Income Matter?” IZA DP No. 246.

Rasbash, J., Steele, F., Browne, W. and Prosser, B. (2004). “A User's Guide to *MLwiN* Version 2.0”. London: Institute of Education.

Rutter M, Tizard J, Whitmore K. Education, health and behaviour. London: Longman, 1970.

Shea, J. (2000). “Does Parent’s Money Matter?” *Journal of Public Economics*, 77, 155-184.