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Does Mothers' Employment Conflict with Child Development? Multilevel Analysis of British Mothers born in 1958

Running Title: Mothers' Employment and Child Development

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Abstract

Does maternal employment, while children are very young, affect their development? We link cognitive and behavioural scores of school-aged children to mothers' employment during pre-school years using virtually unique data for two generations in the 1958 British Birth cohort. Our multivariate, multi-level model controls for mothers' own cognitive and behavioural scores in childhood. Results are mixed and minor, confirming other British studies at mid-childhood. Reading is, significantly, slightly poorer where less educated mothers work in the child's first year of life. We found few other interactions with employment, but did detect intergenerational transmission of behavioural as well as cognitive characteristics.

JEL codes: J13, J22, J24

Keywords: child development, maternal employment, intergenerational transmission

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1 Introduction

A major feature of the rise in female labour force participation in the last quarter of the Twentieth century in Britain has been a shortening of the break in employment after childbearing which characterized women's employment profiles in the earlier post–war era (Martin and Roberts 1984, Kempeneers and Lelievre 1991). Mothers tend to increasingly return to paid work soon after the birth of their children. Around half the mothers of children born in the National Child Development Study (NCDS) of the 1958 cohort (52%) had not taken any paid work before the interview when the child was aged seven, in 1965 (Davie et al. 1972). In the next national birth cohort study of children born in 1970 (British Birth Cohort Study, BCS70), half the mothers had taken paid work by the time the child reached five, in 1975 (Joshi and Verropoulou 2000). In the study of a cohort born in and around Bristol in 1991-2 (Avon Longitudinal Study of Parents and Children, ALSPAC) two thirds of the mothers had been in some kind of paid work two months before the child's third birthday and just over 40% (41.5%) before the child reached 9 months (Gregg and Washbrook 2003). For births at the start of the new Millennium, the trend had continued. Around half the mothers (49%) were in employment by the time the child reached 9 months (Dex et al. 2005), although the speed of return to work in Britain had still not reached the levels reported for the US in the 1990s, where one third of mothers did so within 3 months (Berger et al. 2005). In Britain, over the second half of the

century, paid work for mothers in their children's early years, albeit often part-time, changed from being the exception to a majority experience.

Many people wonder what this has meant for children, and for public policy towards families. Should care for young children be provided by their own parents, on leave from the labour market, or by the state or the market while mothers as well as fathers pursue paid work? Should several options be available?

At the beginning of the post-war period, it was received wisdom in Britain that child development and mental health were jeopardized by separation from the mother (Bowlby 1951). This reinforced a general expectation that mothers had the prime responsibility for the care of preschool children, and the specific assumption of New Home Economics that the allocation of maternal time to the labour market comes at the expense of time invested directly in child rearing (Becker 1985, Ermisch and Francesconi 2002). Furthermore, direct investment of maternal time is assumed to be more productive of child 'quality' than the alternative resources that might be purchased if the mother earned. Breastfeeding is one reason why this would apply particularly in the child's first year. A trade-off between maternal time and cash resources might also change if the cost of alternative care falls as the child approaches school age. Women with higher qualifications may be better able to compensate for their absence, unless they are also even better at 'home production'.

The role conflict hypothesis chimes with social pressures creating guilt and anxiety about combining the roles of a mother and a worker, but other hypotheses point in the opposite direction. Children may not thrive if their mother is depressed through the social isolation

that may accompany full-time domesticity or if they fail to develop initiative and independence because of an 'omnipresent mother' (Davie et al. 1972). The 'working mother' may offer a good role model (Kiernan 1996), and early exposure to other children, at least in good quality day care settings, may promote a child's social and educational development.

It has thus become important to consider the impact of mothers' employment on their children's wellbeing, as more and more children are 'exposed', and to assess the factors that may accentuate or mitigate any such impact. These include: the age of the child when the mother's employment starts, whether this is full-time or part-time, her own level of education, the cash generated by the mothers' earnings, and the age at which the child outcome is assessed. There should also, ideally, be evidence on whether maternal employment deprives the child of attention. What is the amount and quality of time children spend with mothers with and without jobs? How does it compare with the time spent with other people, particularly fathers, other family and friends, and paid carers? It is also necessary to guard against spurious association, or lack thereof, being misinterpreted as causal. Estimated coefficients may be biased because of the omission of confounding variables correlated with both child outcomes and maternal employment, such as maternal competence (see Gregg et al. 2005). They may also be biased if causality runs from child development to parental behaviour rather than the reverse – a child's competence or disability could affect both test scores and the mother's employment decision.

This paper uses data from two generations of the British birth cohort of 1958 (NCDS), to look for evidence that maternal employment when a child is under age 5 may affect children's later cognitive and behavioural development. The four outcomes analyzed are

the child's maths and reading scores as well as aggressive and anxious behaviour, measured once the child is over school age. A strength of the NCDS is that it allows us to control for the mother's own childhood test scores on behavioural adjustment as well as cognitive development, which can be thought of as measures of maternal competence and whose unavailability in other data sets may lead to omitted variable bias. We compare our results to the analyses of child cognitive development in ALSPAC by Gregg et al. (2005). The latter study includes, as explanatory variables, cognitive scores on tests administered to mothers as adults. In contrast to the present study it does not include cognitive scores measured in the mother's childhood nor any assessment of her behaviour as a teenager. We also investigate whether effects are differentiated according to mother's education, sex of child, family structure and age of child at assessment. Child age can be investigated insofar as the study includes a cross-section of children of all ages from 4 to 17; however, there is no longitudinal evidence on individual children. Although we can also allow for some other relevant circumstances and unobserved heterogeneity at the level of the child and the family, a limitation of this study is that we have little information on alternative childcare arrangements or the way parents (of either sex) interacted with the children in their early years.

1.1 A Brief review of the Literature

Quantitative empirical literature on the issue of the impact of mother's employment on children is largely confined to English speaking countries, which reflects a cultural concern about effects on children of working mothers, a relative paucity of day care and early education facilities and the availability of longitudinal data. We consider first research on the medium term effects on children of primary school age and, then on the longer term, impact on older children and young adults.

1.1.1 Mid-childhood effects of mother's preschool employment

There are a number of US studies which focus on cognitive and behavioural development in mid-childhood, in relation to mother's employment during early years. Among those finding evidence for an impact are Han et al. (2001), Hill et al. (2001), Waldfogel et al. (2002) and Brooks Gunn et al. (2002) who find significant negative coefficients ('effects') if the mother had been in employment when the child was under 1, particularly if she works full-time. Ruhm (2004) is less optimistic about negative effects being confined to employment in the early years of life. Ruhm (2005) pursues the investigation of maternal employment and a range of child outcomes in the NLSY when children are aged 10-11, old enough to show whether the impact of early experiences had 'worn off'. Ruhm finds a negative 'effect' on vocabulary, maths and reading, and on body weight among children of more advantaged families, but little significant association with two behavioural indicators. He also provides evidence for the advantaged mothers having higher quality home time. Belsky et al. (2007) find modest associations of non-maternal care on externalising behaviour problems through the first six years of school, but also document positive cognitive progress in vocabulary for children having attended high quality day care settings in their preschool years.

In Britain, the relationship between maternal employment and outcomes in mid-childhood was initially explored in the 1960s with an analysis of the original cohort of NCDS (Davie et al. 1972). Before age 5, 9 percent of the mothers had ever had a full-time job and 20 percent had only worked part-time. When the children's cognitive and behavioural development was assessed at age 7, it was found that children of employed mothers fared better than those whose mothers had stayed at home. When social class, and other

covariates were controlled for, there was a significant negative association, for reading only, with mother's full-time employment before the child had reached age 5, lowering reading age by a factor of about three months.

Children born in 1958 went on in turn to become parents, and children of the second generation, who were old enough, were assessed in 1991. Joshi and Verropoulou (2000) looked at these children, born mainly in the early 1980s (1974-1987), finding that maternal employment in the first year of a child's life had some negative (and positive) associations with cognitive and behavioural outcomes, but only for reading was the negative relationship statistically significant. When full-time and part-time employment were considered separately (to the extent that they can be identified in these data), it was the full-time employment when the child was under 1 that had the most significant negative effect. On the other hand, employment when the child was aged 1-2 or 3-4 showed small positive associations, particularly with freedom from anxiety.

Gregg et al. (2005), looking at ALSPAC children born in 1991-2 in Avon, UK, examine the impact of maternal employment before the study child reached 34 months old on three outcome measures (school entry assessment at 4-5, an ALSPAC literacy test at age 7, and the official school attainment test, Key Stage 1 at age 6 or 7). They find that full-time maternal employment, started in the first 18 months of a child's life, has some negative association with later child outcomes, significant only for literacy at age 7. This seems to apply mainly to the children of women with middling levels of education, to those who had been lone mothers when the child was aged 21 months and to those who used unpaid childcare from relatives. Part-time employment before 18 months and any employment that began later do not seem to have any adverse effects. Inclusion of additional controls

does not provide any evidence of a positive relationship between mother's market and childrearing abilities which might have biased the unadjusted estimates. Gregg et al. (2005) also note that the magnitude of any effect in the Avon Study is relatively small. This is also true of the first generation study of NCDS (Davie et al. 1972), and the existing analysis of the Second Generation Study (Joshi and Verropoulou 2000), and the findings form the US NICSH Early Child Care Research Network (Belsky et al. 2007). These three British studies also have in common the finding that it is the child's reading or literacy that seems most sensitive to the mother's employment record.

1.1.2 Long term effects of mother's early employment

Among US Studies of long-term outcomes for children is Haveman and Wolfe's (1995) analysis of the resources invested in children's human capital in the Panel Study of Income Dynamics. This concludes that maternal employment makes very little difference to the child outcomes, with, if any, positive effects, resulting from cash resources and a positive role model. In an analysis of 18 year olds in a New Zealand birth cohort, Horwood and Fergusson (1999) found that an initially positive association between academic attainment and mother's employment was accounted for by confounders - socio-economic status, maternal education, child IQ and early mother-child interaction. However, including these terms did not uncover any negative long-term effect in late adolescence.

There is UK evidence of a negative association between early parental employment and the attainment of young adults. Ermisch and Francesconi (2001, 2002) using BHPS data (on children mainly born between 1970 and 1981) find that maternal employment when the child was under 6, particularly full-time, significantly reduces the chances of that child

obtaining an 'A' Level later on - by a factor of 7 percentage points per year of full-time employment (this level of qualification would be a pre-requisite for proceeding to tertiary education). This result emerges once the data are transformed into differences between sibling pairs, controlling thus for unobserved differences between mothers. A similar result was found in another longitudinal British survey, the 1970 birth cohort (Joshi and Verropoulou 2000). Educational qualifications by age 26 were adversely associated with the employment of mothers when the child was under 5. Other outcomes (maths and reading scores at 10, teenage motherhood, unemployment by 26) were not. Neither of these studies, however, was able to report how early the employment had to be to produce the negative association, nor what childcare arrangements were associated with the subsequent 'underachievement'. The fragmentary evidence available suggests childcare was mainly informal (Hansen et al. 2006). These findings from the BHPS and BCS70 can be given a worrying interpretation as a delayed, cumulative or 'sleeper' effect on child development which is not fully revealed until the child reaches adolescence, applying generally, including those cohorts currently in infancy. On the other hand, they could reflect a historically transient situation with respect to childcare and parental employment arrangements in the 1970s and 1980s.

1.2.4 Behavioural or non-cognitive development in the formation of human capital

While economic literature on the long term consequences beyond childhood has tended to focus on the development of skills based upon cognitive attainments, a more holistic approach recognizes the necessity, for success in adult life, of non-cognitive skills which might be described as emotional intelligence, or 'soft skills' such as motivation, persistence, trustworthiness etc (Heckman and Rubinstein 2001, Carneiro and Heckman 2003). Such attributes are not widely measured, but multi-disciplinary longitudinal

datasets do include some psychometric instruments on behavioural development. Carneiro and Heckman (2003) report the analysis of an Anti-Social Score on children of the NLSY and Ruhm (2005) looks at a Behaviour Problems Index in the same source which has strong similarities to the items asked (with NLSY comparison in mind) of mothers in the NCDS Second Generation. Carneiro and Heckman (2003) do not link the behavioural scores directly to maternal employment, but do show that they are strongly related to family background in terms of income, race, maternal education and maternal ability.

1.3 Plan of the Paper

One objective of this paper is to elaborate the existing analysis of the NCDS Second Generation data to compare results with those found in the ALSPAC study, in a context where opinions are strong but evidence, at least in Britain, is weak. Secondly, it investigates whether any apparent effects of preschool maternal employment diminish as children grow older or conversely, lie dormant until the later years of development. Thirdly, it observes the role of behaviour in the development of two generations and the intergenerational transmission of hard and soft skills. In these latter two aspects it exploits the strengths of the little known NCDS Second Generation Study. Section 2 describes the data, section 3 sets out the multivariate multi-level method employed, section 4 reports results and section 5 discusses conclusions.

2 Data and Methods

2.1 The Data Source

The National Child Development Study (NCDS) is a study of over 17,000 people in Britain, born in one week in 1958 (see Ferri 1993, Ferri et al. 2003). Follow-up sweeps took place in 1965, 1969, 1974, 1981, 1991, 2000 and 2004. In 1991, when cohort

members were aged 33, supplementary information was obtained on the children so far born to 1 in 3 cohort members. A total of 3,782 persons were traced of whom 2,590 had natural or adopted children and responded to the child survey. Moreover, in 1991 information was collected on all cohort members' employment history. That information allows us to relate women's employment history to their children's test scores at school. Children whose father was the cohort member (of whom rather fewer were old enough for assessment) are omitted from this analysis, as there is very little information on their mothers' employment. This leaves 2,550 children of 1,516 female cohort members. The target sample is reduced further as only children aged 4 or more had a behavioural assessment while only children aged 5 or more took the cognitive tests. The NCDS second generation sample includes 1,985 children aged 4 or more, of 1,284 mothers. The requirement for complete data on at least two out of the four assessment scores reduces sample size further. Hence, we are left with 1,714 children of 1,129 mothers. 60% of these 1,129 mothers have only one child in the sample while 30% have two children, and 10% have three or more. Of the children in the sample, 61% have a sibling old enough to be in it; in fact, one third of those have two siblings or more in the sample.

Table 1 Comparison of the NCDS Second Generation Sample with the full NCDS sample and the Mothers of the Avon Cohort

	NCDS 1991	NCDS 2nd Generation, 1/3 sample		ALSPAC	
	All women: Age 33	Mothers aged 33 of children born 1974-87		Mothers of children born 1991-2	
	Full cohort	All	Analysis sample	Post birth sample	Analysis sample
Sample size	5,766	1,516	1,129	12,923	6,704
		Percent in each category			
Highest Qualifications					
Low (None/CSE)	29	26	32	18	11
Mid ('O' level + Equivalent)	37	36	41	42	43
High: 'A' Levels +	34	36	27	33	44
missing		2	-	7	2
Employment by age of youngest child					
When child under 12 months		na	33		
Under 18 months				58	60
When child 12-35 months but not also under 12		na	14		
18 -34 months		-	-	9	9
Any employment under 36/34 months			46	70	69
Age of children at assessment		**0-17**	**4-17**	**fixed: 4-5, 6-7, 7**	

ALSPAC Analysis sample has data on Literacy score at 7 and non-missing employment
ALSPAC classifies all vocational qualifications with O level. NCDS includes lowest level NVQ1 in Low.
Note: In NCDS Sample size and percentages by educational qualifications are mother-based. Percentages of mothers in employment are Child-based and reconstructed from non-missing data. No difference between mother and child base in ALSPAC. Employment rates for all mothers in the one third sample are not shown as some still have oldest child under 3.
Source: NCDS: Ferri ed (2003) Table 2.1a, Authors' analysis of NCDS, ALSPAC : Gregg et al Table A1 (2005)

The children in our analysis do not constitute a random sample of the child population, as they are selected on mother's age. All mothers were 33 at data collection, and the child had to be at least 4, so that no child born to a mother over 29 is covered in this study. Because early childbearing is not randomly spread across the social spectrum, the profile of the families analysed here is not representative of British families in general. This is illustrated in Table 1 which compares the mothers in this Second Generation sample with all the 33 year-old women in the cohort from which they were drawn and with the mothers in the Avon Study, who had given birth in 1991-2 at the full range of ages. The young mothers in the one third sample are distinctly less well educated than either of the other two groups, 32% having no or minimal qualifications, compared with 29% in the whole 1958 cohort of women and 16% in the ALSPAC sample. The higher level of educational attainment in the ALSPAC sample may reflect the fact that it not only covers mothers at all ages but also, that they include later cohorts with more schooling, and that response bias in the analysis sample weights towards the educated. The different geographical coverage could be another but minor reason for the difference. Employment after childbearing is more prevalent among the ALSPAC sample; 7 out of 10 of the children in that study had mothers in paid work before they were 34 months, compared with 46% of the children in the NCDS by 36 months. The increased employment is as expected: the ALSPAC sample is better educated, and births occurred at least five years later when maternity leave provision had already improved. Although the Second Generation children do not provide a representative cross-section of the wider population in tabulation, we contend that the evidence they carry, particularly of intergenerational links, can be used in the modelling of relationships, given the allowances we can make for their observed and unobserved peculiarities.

2.2 Dependent Variables

We analyse four measures of children's cognitive and behavioural development. Cognitive development is measured by two sub-scales of the Peabody Individual Achievement Test (PIAT, Dunn and Markwardt 1970). The reading recognition sub-scale measures ability in oral reading while the mathematics score assesses ability in mathematics as taught in mainstream education. When the scores for maths and reading are expressed relatively to their maximum possible value, but before adjustment for age or division by their standard error, we find average scores close to 50 percent on each, marginally higher for reading than for maths.

To assess children's emotional adjustment, two different sets of questions were used. The 28-item BPI was asked of children under 8 years of age while the 18-item Rutter Scale A was asked of older children (Peterson and Zill 1986, Rutter et al. 1970). For each scale, the mother was asked if her child exhibited various elements of antisocial, anxious, headstrong, hyperactive or dependent behaviour. It is reassuring that mother's mental well-being at the time of the age 33 interview (malaise) correlated only very weakly (0.03) with her reports on child behaviour. The scales have been subdivided and labelled as non-aggressive (externalised) and non-anxious (internalised) behaviour, following exploratory factor analysis (McCulloch et al. 2000). Aggressive items include bullying, disobedience and restlessness. Anxiety is indicated, among other things, by reports of the child as worried or unhappy. To compute each behavioural adjustment score, the individual responses are summed up, divided by the maximum possible and subtracted from 1, so that behaviour scores increase as child well-being increases, like the two cognitive scores. Hence, we refer to 'non-aggression' and 'non-anxiety'. The average score for both

measures of behavioural adjustment is close to 70 percent, before standardization. For all these scores there is a standard deviation of around half the mean. The dependent variables in regressions are divided through by one tenth of this standard deviation to render results comparable with Gregg et al. (2005). Descriptives for these variables are presented in Table 2a. The data show that mean raw scores of cognitive tests increase substantially, as expected, for successive age groups of children; the older a child is, the higher he scores at reading and math tests. By contrast, the means of behavioural scores do not differ by age of child. Another point emerging from Table 2a is that the proportion of children over age 12 in our sample is quite small. In fact, they represent between 12.7 and 14.5 percent of the valid cases for these four outcomes.

Table 2a Outcome Variable distributions by children's age, NCDS Second Generation

Outcome Variable	Before Standardisation		After Standardisation[b]		N
	Mean	St Dev	Mean	St Dev	
PIAT Math Score					
Children aged 4-7	0.283	0.118	14.19	5.9	550
Children aged 8-12	0.562	0.131	28.16	6.6	736
Children aged 13-17	0.694	0.122	34.80	6.1	216
All ages	0.479	0.199	24.00	10.0	1,502
PIAT Reading Recognition					
Children aged 4-7	0.295	0.150	12.35	6.3	559
Children aged 8-12	0.604	0.168	25.34	7.0	737
Children aged 13-17	0.772	0.156	32.39	6.5	219
All ages	0.514	0.239	21.57	10.0	1,515
External behavioural adjustment (non-aggression) [a]					
Children aged 4-7	0.660	0.234	26.86	9.5	683
Children aged 8-12	0.694	0.252	28.26	10.3	687
Children aged 13-17	0.696	0.257	28.31	10.5	200
All ages	0.679	0.246	27.66	10.0	1,570
Internal behavioural adjustment (non-anxiety) [a]					
Children aged 4-7	0.730	0.302	26.12	10.8	683
Children aged 8-12	0.657	0.260	23.50	9.3	689
Children aged 13-17	0.677	0.248	24.22	8.9	200
All ages	0.691	0.279	24.73	10.0	1,572

[a] Mother's report on child behaviour
[b] Dependent variables divided by one tenth of standard deviation as entered in the estimates

2.3 Explanatory Variables

The data has a hierarchical structure: some information pertains to individual children, and some to all siblings of the same mother or family. Descriptives for the explanatory variables included in our analysis are presented in Table 2b.

Table 2b Explanatory Variable distributions, NCDS Second Generation

Explanatory Variables	Mean	Std Dev
Child Level Predictors		
Early maternal employment		
Mother's Employment History		
First year of child's life		
Some employment	0.271	0.444
Employment missing	0.170	0.376
Child aged 1 to 4		
Some employment	0.575	0.495
Employment missing	0.109	0.312
Other Predictors		
Child's age in months	109.07	38.145
Child's age squared (divided by 100)	14.542	15.982
Child's sex: female	0.508	0.500
Child's Birth Order	1.649	0.909
Any younger sibling	0.470	0.499
Health problem limiting attendance at school	0.055	0.229
health problem missing	0.005	0.072
Family status at interview		
Lone: mother currently alone	0.119	0.324
Step: child with a step-father	0.142	0.350
Intact: child lives with both natural parents	0.738	0.440
N (children)	**1,714**	
Family Level Predictors	**Mean**	**Std Dev**
Mother's educational attainment		
Low - Less than 'O' Level	0.324	0.468
Mid - 'O' Level	0.405	0.491
High - 'A' Levels or more	0.271	0.445
First child born at 20 or earlier	0.266	0.442
Social housing	0.242	0.428
Mother's reading score at 7	0.807	0.200
Mother's general ability at 11	0.550	0.178
Mother's non-aggression score at 16	0.925	0.111
Mother's non-anxiety score at 16	0.819	0.154
Behaviour score at 16 missing	0.222	0.416
N (mothers)	**1,129**	

2.3.1 Child Level Independent Variables

Maternal Employment: The information on the mother's employment at various past ages of each child has been inferred from the retrospective job history which cohort members completed in 1991. Since they were not explicitly asked to relate their job history to their children's ages, we have to rely on dates being reported consistently and correctly. The reports were not always precise enough to attribute an employment state (and whether or not it was full or part-time) to every month of the calendar. Thus, we use indicators of whether or not there was any employment in a period rather than counting the exact number of months in employment, along the lines adopted by Gregg et al. (2005), rather than by Ermisch and Francesconi (2001). The two periods distinguished are the child's first year and any time during the remaining pre-school ages, 1-4, after our earlier work found little difference between the period when the child was age 1 or 2 and the ages 3 and 4 (Joshi and Verropoulou 2000). No distinction is made here either between full and part-time work as this was not well recorded for the first year of the child's life, due to inconsistent reporting of maternity leave – some episodes reported as full-time could have been periods of leave from full-time jobs. For the next four years part-time work predominated, as far as we can tell. For each period there is also an indicator for the employment data being missing, so that we estimate the contrast between children who have definitely experienced maternal employment and those who definitely have not. The percentage of children whose mothers are known to have been employed rises from 33% in the first year of their life to 65% during the period between their first and fifth birthdays (excluding missing cases from the denominator).

Child's Age: The average age of children in this study is 9, ranging from 4 to 17. They are observed only once, not longitudinally as their mothers are. Children in this cross-

sectional sample are not randomly drawn from their age group. As the mothers come from a single birth cohort, the child's age in this dataset also contains information about the age of the mother at the time of the child's birth. Mothers who were very young were, and remain, underprivileged. For instance, in 1991 about 50 percent of the children aged 13 or more lived in social housing, compared to 16 percent for children aged 4 to 7. Older children perform more poorly on externally standardized scores than younger children, probably due to selection. Wiggins and Wale (1996) recommended internal standardisation, which has accordingly been followed in other studies of cognitive and behavioural development in this dataset (e.g. Joshi et al. 1999, McCulloch and Joshi 2001, 2002). Thus we included the child's age and its square in the regressions as a form of internal age standardization. We also explored the possibility that the effect of mother's early employment might either diminish or emerge (in a 'sleeper effect') as the child grows older, by including in regressions interactions of the employment indicators with either a linear term, counting the number of months which had passed since the child's fourth birthday, or a set of three dummy variables for age groups: 13-17, 8-12 and 5-7. We estimate interactions rather than separate regressions for children at different ages as the sample sizes would have been insufficient and we were reluctant to lose information on siblings of different age bands coming from the same home, embodied in the structure of our data.

Other demographic controls: The child's sex is included to allow for differences in biological nature or gendered nurture. There are almost equal numbers of girls and boys, gender having an additive (but not interactive) effect on the scores. Birth order is included as the number of older siblings may influence the attention a child receives from his/her parents and the availability of resources. Its mean is 1.65. Note that this variable does not

count younger siblings, some of whom would be too young to include in the sample, but there might also be competition for resources with them. Hence, a binary variable examining whether a child has a younger sibling is also included in the analysis. Nearly half of the children in our sample (47 percent) have a younger sibling. Gregg et al. (2005) point out that the presence of younger siblings may not be independent of mothers' employment, but their results showed no indications that its inclusion in the model changed estimates on maternal employment.

Family structure is a child level variable, because of the possibility of one of a pair of half siblings having a step-parent while the other lives with both natural parents. This variable is included as it may influence test scores directly and also indirectly - two-parent households may have more resources to allocate to their children in terms of time and finance compared to lone parents. In our sample the vast majority, 74 percent of the children, lived in an intact family at interview while 14 percent were living with a step father and 12 percent with a lone mother. Taking housing tenure as an indicator of the family's long term economic status, we note that only 19 percent of the children in intact families lived in social housing, compared to 44 percent for children living with a step father and 57 percent for those in lone mother families. Mothers of children in intact families are more educated, on average - 28 percent of them are in the most qualified group compared with 13 percent for children with a step-father and 17 percent with a single mother.

Health and disability: Health problems may impede school attendance and learning, thus lowering cognitive and behavioural test scores. We include a variable on whether a child

has physical, emotional or mental difficulties that limit his/her ability to attend school on a regular basis; about 6 percent of the children did.

Day care: In the literature, childcare settings are often stressed as an important factor that may accentuate or mitigate the effects of mother's employment when children are preschool age, on their outcomes later on. Unfortunately, such data on the second generation of the NCDS cohort are very limited (Hansen et al. 2006). We are confined to an indicator of whether a child ever attended some formal childcare settings (i.e. local authority or private nursery school or class or day nursery or playgroup) when under 5, but we cannot tell whether there was any formal childcare during infancy or indeed whether the attendance coincided with the time the mother was employed. The vast majority, 89 percent of these children did have some formal preschool childcare, while 30 percent of those who ever attended formal childcare, had mothers who were never employed throughout their preschool years. These day care settings have educational as well as custodial functions. After some inconclusive experiments we abandoned attempts to include childcare in the regression model. The reader should bear in mind that most of children whose mothers were employed in their early years would have had informal care (from fathers, grandparents, etc.) while their mothers were doing part-time jobs. We have not been able to isolate any cases where the situation may have been dramatically different.

2.3.2 Family Level Independent Variables

We start by considering indicators of the mother's educational attainment, as a variable common to other datasets, before looking at the longitudinal data uniquely available from her own childhood in this dataset.

Mother's education: We treat qualifications as a three-category variable; a finer breakdown would have been difficult to analyse in a sample of this size. Mothers in the low education category have left school with either no qualifications or a type of school leaving or a qualification lower than good passes at 'O level' (an academically oriented set of exams taken normally at 16). The mid category had passed at least one 'O level' at grade A-C or other equivalent vocational qualification. The higher educational category had at least passed two 'A levels' or their vocational equivalent, or anything higher than that. 'A levels' are a set of exams taken in usually 3 subjects at the end of secondary schooling (around age 18), qualifying students to progress to university or other tertiary education. Very few of the women with children old enough to be in this sample had tertiary qualifications. Mothers with minimal or no qualifications are known to have been employed in 18 percent of (child-based) cases before the first birthday of the child, and 44 percent in the second period, whereas the mother was known to have been employed around twice as often (39% and 71%, respectively) if she was in our top qualifications group.

Abilities and Behaviour: An association between mother's employment or qualifications and child outcomes might also arise for the spurious reason that they were both associated with a third factor. Among such factors might be the mother's competence or ability, possibly correlated with her employment, keeping the woman in the labour market and also giving her child a 'headstart'. This could give the appearance of a beneficial effect of employment when there might be an underlying relationship in the opposite direction, a bias due to omitted variables referred to above. We have therefore also included measures of the mother's childhood scores on cognitive tests and behaviour adjustment, to 'unpack'

the qualification 'effect' and in an attempt to guard against attributing to employment (or education) any gain to children from having a mother with some exceptional coping skill. Although we have not measured competence directly, we have measures of the mother's performance on cognitive tests administered 22 and 26 years earlier (ages 11 and 7) and have included their own mother's rating of their emotional and behavioural adjustment at 16. This is certainly an example of prospective data, and offers an unusual glimpse of intergenerational continuities in the soft skills underlying behavioural adjustment as well as the 'harder' skills needed to score well on cognitive tests and formal qualifications. The cognitive scores we include are a general ability test at 11 and a reading test at age 7. The scores are often treated as evidence of 'innate' ability, although they may, at least in part, reflect the return on earlier investment at home and the primary school in equipping children to do well in these tests. The means of these test scores are only slightly lower for the mothers in our sample compared to all female cohort members, despite their positive association with educational attainment.

For the 16 year old cohort members' behaviour we took the Rutter A scale (Rutter et al. 1970). The responses, usually provided by the grandmother of the children whose assessments are analysed here, have been allocated to an aggression and an anxiety component on the same formula as used above (Joshi and Verropoulou 2000), and similarly inverted so that a higher score reflects fewer problems. The scores range from 0 to 1, with a mean of 0.92 for non-aggression and of 0.82 for non-anxiety, and standard deviations of 0.11 and 0.15, respectively. Missing cases (22.2 percent) are flagged.

Socio-economic context: Apart from mother's education, her 'ability' and teenage behaviour scores, we wish to allow more fully for the resources available to the family in

which the children are growing up. Income data is incomplete for 1991, when the interviews took place. We therefore include housing tenure in 1991 as an indicator of parental resources. Social housing (renting from the local council or housing authority) is considered a good proxy for long term poverty (McCulloch and Joshi 2002). It is less likely than income at the time of employment or assessment to be the outcome of the mother's employment, whose inclusion would also bias estimates of the impact of employment on the child (Gregg et al. 2005). Again, the selectivity of early childbearing is reflected in our sample - 24 percent of our mothers live in local council or housing association rented accommodation, compared to 17 percent for the women in the cohort. Finally, in view of the growing social polarization by age at motherhood an indicator of early motherhood is introduced, identifying the 27 percent of the mothers who had their first child at or before age 20.

3 Methods

In our analysis of the NCDS Second Generation sample, we adopt a technique, multi-level modelling (random effects), that explicitly acknowledges that the data on the cohort's children are clustered within families, and that there are multiple outcomes measured per child (Wiggins and Wale 1996). We allow for the unobserved random elements of the child outcomes to be correlated across child, and for them to be correlated with unobserved elements attaching to each mother. The multi-level approach we use allows for such unobserved heterogeneity to have a structure with common elements between the different scores within a child, and, where more than one child is observed within the same family, between children. We model the cognitive and behavioural development of children within families using multivariate hierarchical linear modelling, a variant of multiple linear regression for data with a nested structure (Goldstein 1995).

Our dataset is at 3 levels: firstly families who, secondly, have children who, thirdly, have up to 4 scores each on developmental outcomes. The multi-level model accounts for clustering of children within families while the simultaneous estimation of 4 outcomes per child allows for the correlation of error terms within each child. For families with only one child, no variation is observed between children, but it is observed within the child's scores. The strategy has particular attractions for this data set. Firstly, the multi-variate approach can accommodate some missing data on dependent variables, thus avoiding the deletion of some incomplete cases. Secondly, it allows children of all ages in a family to add strength to the estimation using the maximum amount of evidence, whereas samples would become small and within family information would be lost if the sample was split up into separate child age groups. We look for interactions of selected variables by age of child within the full sample.

Consider first the model for each outcome, abstracting from interactions:

$$Y_{ijk} = \Sigma\, \alpha_i + \Sigma E_{jkt}\, \beta_{ti} + \Sigma X_{jk}\, \gamma_{i} + \Sigma Z_k\, \delta_{i} + \Sigma\, v_{ik} + \Sigma\, u_{ijk} \qquad (1)$$

where *i* indexes outcome, *j* indexes children, and *k* indexes families.

α_i is an intercept, fixed for each outcome

E_{jkt} is a vector of variables recording the child's exposure to maternal employment at time t in the preschool ages and β_{ti} is a parameter reflecting the impact of maternal employment at age *t* on outcome *i*.

X_{jk} are other predictors of the Y outcomes pertaining to child *j*, directly and independently influencing the outcome, or confounders indirectly influencing both employment as well as the outcome. γ_i is a vector of coefficients measuring the effects of each such variable on the four outcome variables.

Z_k are other contextual predictors of the Y outcomes pertaining to family *k,* directly and independently influencing the outcome or confounders indirectly influencing both employment as well as the outcome. δ_i is a vector of coefficients measuring the effects of each such variable on the four outcome variables.

For each outcome *i* the model contains two random effects: v_{ik} and u_{ijk}*;* each of these indicates a different source of unexplained variation. The random intercept v_{ik} indicates unexplained differences between families in the average Y-values (controlling for the effect of X_{jk} and Z_k *)*. The random residual u_{ijk}, indicates unexplained variation among the

individual children within families. The multivariate estimation of all four outcomes jointly allows for correlations of both child and family level residuals across all four outcomes: individual children who are unexpectedly strong on one score may also be strong (or particularly weak) on another. Likewise, there may be common unobserved elements associated with the cluster of children in a family. The multivariate multilevel approach is intended to avoid the biases and inefficiency that might arise if the structure of the data were ignored. The multivariate model in *MLwiN* allows us to include cases that are missing on up to two outcomes per child, and also allows the evidence from families with only one child in the analysis to contribute to estimates of the fixed coefficients and to between-family, (and within-child) variation, even though no variation between children within families is observed. The fact that the majority (60 percent) of sampled families only have one child in the analysis, means that it would not be possible to specify fixed unobserved family effects (as in for example sibling difference models), without discarding more that half the families. The random effects strategy makes the best use of the data available in this dataset. This rich dataset provides an unusual amount of evidence for the fixed element of the model as associated with observables.

By systematically introducing explanatory variables we are able to assess not only the association of child and family characteristics with the four outcomes, but also their impact on the estimated employment coefficients and the covariance structure between outcomes. All models assume constant variance at levels 2 and 3. We used *MLwiN,* to fit these models (Rasbash et al., 2000).

The contextual Z_k terms have to be included, as the omission of relevant information may bias estimates of β, in either direction. A simple positive association of maternal

employment and child outcomes may be due to spurious association with other variables such as mother's education or ability, or child health, all of which may be positively correlated both with the outcomes and with the chances of the mother being employed. On the other hand, it is also possible that omitted variables could be biasing the estimate of β downwards if they represent some factor which is negatively correlated with employment but positively with child outcomes, such as a penchant for child-rearing which reduces a woman's likelihood of being employed. Like Gregg et al. (2005) we attempt to minimize the chance of bias by including as much relevant information from our rich dataset, to allow for confounders. The allowance for cross-child and cross-family correlation of unobservables also helps to correct the estimated βs for unobserved child and family specific influences.

We have explored various interactions between regressors in these models. The age of the child at interview has been interacted with the *E*s (early employment) both linearly and as a threefold set of dummies. These alternative age interactions have also been investigated as possibly modifying coefficients on selected *Z*'s (notably education and ability). We have looked for interactions of child gender with mother's employment and mother's behaviour scores, and of family structure with the employment terms, of education with employment and of education with employment by child age. The exploration was done in single equation models before estimating the three multi-variate models reported below.

4 Results

Table 3 Baseline Model 0: Estimated effects of mother's past employment on child outcomes, controlling for child age and sex;

Outcomes	**Maths**		**Reading**		**Non-Aggression**		**Non-Anxiety**	
Predictors	**b**	**t**	**b**	**t**	**b**	**t**	**b**	**t**
constant	-5.041***	-9.01	-6.984***	-11.60	22.870***	25.48	27.950***	31.20
Age	0.276***	61.95	0.266***	55.76	0.026***	3.82	-0.041***	-6.06
age squared	-0.168***	-16.77	-0.147***	-13.74	0.013	0.82	0.092***	5.81
Girl	-0.561**	-2.12	0.717**	2.53	3.240***	6.86	-1.638***	-3.40
Mother's Past Employment								
(ref. category: no work when child 0)								
some work when child 0	0.287	0.81	-0.261	-0.69	0.177	0.28	0.339	0.54
work status at 0 missing	-0.361	-0.66	-0.336	-0.57	1.071	1.11	0.976	1.01
(ref. category: no work when child 1 to 4)								
some work when child 1-4	0.488	1.42	0.446	1.21	0.577	0.95	0.784	1.28
work status at 1-4 missing	-0.739	-1.08	-1.174	-1.59	-2.830**	-2.28	-0.314	-0.25
- 2LogLikelihood	41,273.8							

*** p<0.01, ** p<0.05, * p<0.1

Table 4 Model 1: Estimated effects of mother's past employment on child outcomes; also controlling for her childhood and current characteristics and child circumstances

Outcomes	**Maths**		**Reading**		**Non-Aggression**		**Non-Anxiety**	
Predictors	**b**	**t**	**b**	**t**	**b**	**t**	**b**	**t**
Constant	-11.710	-8.68	-14.310	-11.84	18.050	6.54	22.200	8.19
Age	0.296	61.12	0.274	54.60	0.036	4.57	-0.029	-3.62
age squared	-0.154	-15.53	-0.144	-14.38	0.015	0.98	0.094	5.94
Girl	-0.476*	-1.89	0.813***	3.07	3.379***	7.33	-1.685***	-3.52
Mother's Past Employment								
(ref. category: no work when child 0)								
some work when child 0	-0.011	-0.03	-0.717**	-2.03	-0.353	-0.58	0.677	1.07
work status at 0 missing	0.161	0.31	0.356	0.66	1.474	1.56	0.877	0.91
(ref. category: no work when child 1 to 4)								
some work when child 1-4	0.260	0.80	0.200	0.58	0.452	0.75	0.623	1.01
work status at 1-4 missing	-0.135	-0.21	-0.348	-0.51	-1.828	-1.52	-0.436	-0.35
Mother's educational attainment								
(ref. category Low - Less than 'O' Level)								
Mid - 'O' Level	0.243	0.68	1.102***	2.92	2.011***	2.97	1.040*	1.67
High - 'A' Levels or more	1.236***	2.79	1.771***	3.79	1.591*	1.93	-0.396	-0.54
Mother's characteristics in childhood								
reading score at 7	1.941**	2.32	3.496***	3.98				
general ability score at 11	5.995***	5.81	5.993***	5.51	4.964***	3.02		
Mother's behaviour rating at 16								
Rutter non-anxiety score	1.974**	2.12	1.547	1.63	-1.391	-0.78	2.790	1.55
Rutter non-aggression score	-1.631	-1.50			4.336*	1.83	0.646	0.27
behaviour score missing	-0.221	-0.68	-0.064	-0.19			1.091*	1.86
Family circumstances in 2nd Generation								
birth order			-0.693***	-4.65	-1.156***	-4.01	1.003***	3.44
any younger sibling					-0.720	-1.54	-1.046**	-2.13
health problems limiting school attendance	-1.425**	-2.55	-2.022***	-3.44	-2.167**	-2.01		
health problems missing	1.349	0.85			2.897	0.92		
(reference category: Intact family)								
Step father	-0.804**	-1.98	-0.702	-1.64	-1.304*	-1.67	-0.759	-0.97
Lone mother	-0.859**	-1.96	-1.041**	-2.24	-2.761***	-3.19	-0.918	-1.09
1st birth at 20 or before	-1.636***	-4.60						
Social housing	-1.043***	-3.06	-1.565***	-4.34	-1.721***	-2.72		
- 2LogLikelihood	40,862.3							

*** p<0.01, ** p<0.05, * p<0.1

Table 5 Model 2: Estimated effects of mother's past employment on child outcomes; also controlling for interactions of her past employment and age of child, her educational attainment and age of child

Outcomes	**Maths**		**Reading**		**Non-Aggression**		**Non-Anxiety**	
Predictors	**b**	**t**	**b**	**t**	**b**	**t**	**b**	**t**
Constant	-9.911	-6.61	-12.460	-9.11	16.060	5.57	20.250	7.13
Age	0.280	37.27	0.259	35.63	0.055	5.04	-0.011	-1.01
age squared	-0.147	-14.53	-0.138	-13.50	0.011	0.70	0.090	5.63
Girl	-0.442*	-1.76	0.831***	3.15	3.363***	7.31	-1.706***	-3.57
Mother's Past Employment								
(ref. category: no work when child 0)								
some work when child 0	-0.439	-0.74			-0.643	-0.62	0.676	0.62
work status at 0 missing	0.033	0.07	0.204	0.38	1.521	1.63	0.944	0.97
(ref. category: no work when child 1 to 4)								
some work when child 1-4	-0.679	-1.17			2.573**	2.50	2.484**	2.33
work status at 1-4 missing	-0.078	-0.14	-0.044	-0.06	-1.883	-1.58	-0.462	-0.37
Interactions: age of child by mother's past employment[a]								
some work at 0 by age	0.007	0.89			0.004	0.25	-0.001	-0.08
some work at 1-4 by age	0.014*	1.90			-0.034**	-2.50	-0.030**	-2.10
Mother's educational attainment								
(ref. category Low - Less than 'O' Level)								
Mid - 'O' Level	-0.112	-0.16	-0.171	-0.22	2.074***	3.06	1.111*	1.78
High - 'A' Levels or more	0.031	0.04	0.605	0.60	1.547*	1.88	-0.418	-0.57
Interactions: mother's past employment by educational attainment								
(*ref. category: no work when child 0*)								
some work at 0 & mother low attainment			-1.146**	-2.01				
some work at 0 & mother mid attainment			-0.719	-1.55				
some work at 0 & mother high attainment			-0.223	-0.39				
(*ref. category: no work when child 1 to 4*)								
some work at 1-4 & mother low attainment			0.753	1.62				
some work at 1-4 & mother mid attainment			0.471	1.11				
some work at 1-4 & mother high attainment			-0.998	-1.63				
Interactions: age of child by mother's educational attainment[a]								
Mid by age of child	0.004	0.46	0.017**	1.99				
High by age of child	0.021*	1.94	0.031***	2.81				
Mother's characteristics in childhood								
reading score at 7	1.955**	2.34	3.408***	3.91				
general ability score at 11	5.934***	5.77	5.930***	5.50	5.002***	3.04		
Mother's behaviour rating at 16								
Rutter non-anxiety score	1.938**	2.09	1.465	1.55	-1.453	-0.81	2.726	1.52
Rutter non-aggression score	-1.465	-1.34			4.239*	1.79	0.653	0.28
behaviour score missing	-0.285	-0.88	-0.081	-0.24			1.134*	1.93
Family circumstances in 2nd Generation								
birth order			-0.735***	-4.93	-1.147***	-3.98	1.015***	3.48
any younger sibling					-0.714	-1.53	-1.041**	-2.12
health problems limiting school attendance	-1.300**	-2.33	-1.979***	-3.38	-2.218**	-2.06		
health problems missing	1.481	0.94			2.748	0.87		

Continued…

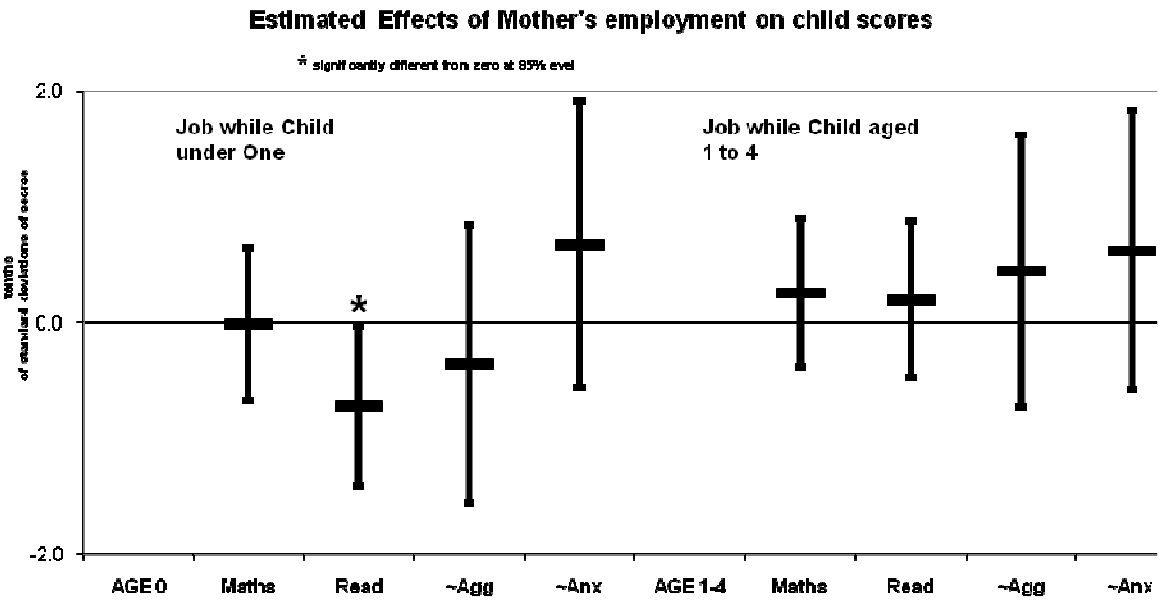
Table 5 (continued)
Model 2: Estimated effects of mother's past employment on child outcomes; also controlling for interactions of her past employment and age of child, her educational attainment and age of child

Outcomes	**Maths**		**Reading**		**Non-Aggression**		**Non-Anxiety**	
Predictors	**b**	**t**	**b**	**t**	**b**	**t**	**b**	**t**
(reference category: Intact family)								
Step father	-0.880**	-2.18	-0.667	-1.57	-1.126	-1.44	-0.606	-0.77
Lone mother	-0.830*	-1.91	-0.970**	-2.10	-2.684***	-3.11	-0.865	-1.03
1st birth at 20 or before	-1.673***	-4.70						
Social housing	-1.017***	-2.99	-1.574***	-4.40	-1.757***	-2.78		
- 2LogLikelihood	40,823.7							

*** p<0.01, ** p<0.05, * p<0.1
[a]Note that age in all interactions is the difference between the child's current age and 48 months

Tables 3-5 report three models for each of four outcomes and the respective log likelihoods. Model 0 includes only the standardising of age and gender besides maternal employment. Model 1 includes further contextual and confounding variables as main effects. Model 2 includes interactions, those which, for each outcome, emerged from our experiments as noteworthy. We report the estimated error structure of Model 0 in Table 6, and of Model 2 in Table 7, along with the numbers of non-missing cases these models are based on.

Figure 1

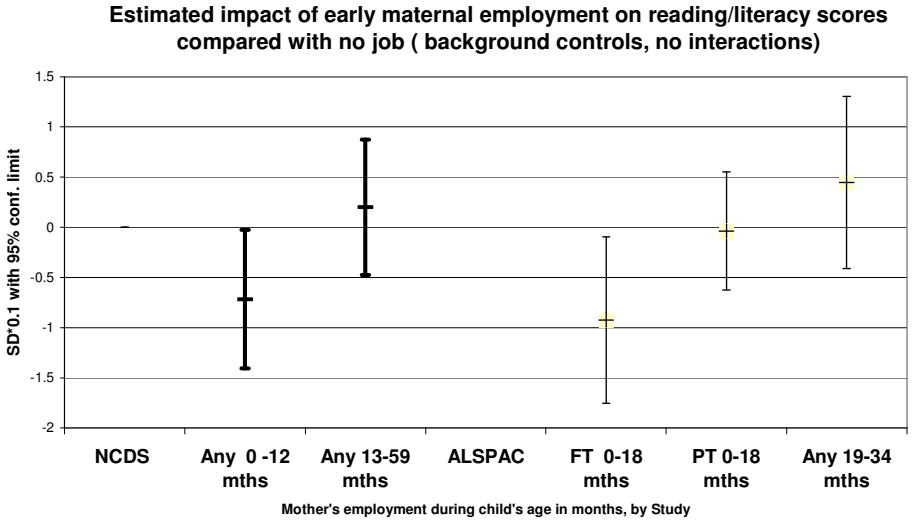


4.1 Estimates of Employment Effects

Model 0 shows no significant association between early employment and any of the outcomes, but in seven out of eight cases, the direction is positive. Reading scores and maternal employment in the first year of life is the only pair of variables which are negatively related after this basic internal standardization. Model 1 and Model 2, on the other hand, control for an array of potential confounders, which might hide an underlying negative relationship. We first concentrate on the results involving maternal employment in Model 1. Figure 1 and Table 4 indicate that mother's employment when the child is under one has only one estimate significantly different from zero at the 95% level with any of the development scores, i.e. with a confidence interval not including zero. This is a negative relationship between reading at school ages and maternal employment in the first year of life. Mother's employment when the child is 1 to 4 (which is relatively more common) has no significant terms but all are positive, as is the estimate for the association of freedom from anxiety and maternal employment.

The significant negative estimate, that reading score at school ages is reduced by 0.72 tenths of a standard deviation (or nearly 2 percentage points on the raw score) if the mother had any employment during the child's first twelve months, is of the same order of magnitude as the only significant effect found by Gregg et al. (2005) in their analysis of 3 outcomes up to age 7. Their finding was an effect on literacy at 7 if the mother had been employed full-time before the child was 18 months old - 0.92 in the same metric, just under one tenth of a standard deviation. Arguably, neither are large 'effects'. Figure 2 compares results for reading and literacy in the two studies. This figure also shows that other estimates in the two studies bear some similarity in ranging into positive as well as negative margins of error, although the groups of mothers are not identically defined. The present study looks at *any* job when the child is under 12 months, the ALSPAC study looks at any *full-time* job in the first 18 months, as permitted by a much larger sample of more frequently collected data. The ALSPAC study distinguishes mothers whose only employment in the child's first 18 months was part-time and mothers whose first employment occurred between 18 and 34 months. There is no information on later preschool employment at ages 3 and 4, which accounts for most of the employment experience recorded for NCDS mothers at children's ages 1-4.

Figure 2

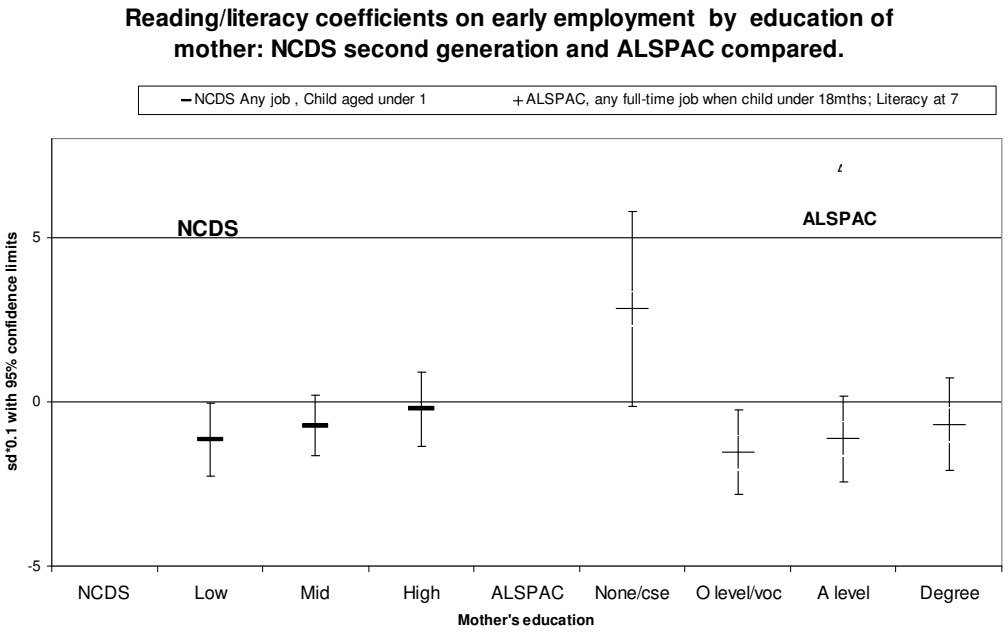


The results for Model 2 (Table 5) summarize investigations, similar to those conducted by Gregg et al. (2005) to see whether the negative effects were spread evenly among sub-groups, and to see whether other significant estimates might emerge once allowance was made for the possibility of interactions of employment with mother's education and with child's age. Although many of the estimates on the interaction terms were individually statistically insignificant, the selected set of interactions was jointly highly significant. The p value of the difference between Model 1 and Model 2 was 0.000231 in a chi-square test. We could not replicate the finding in ALSPAC that negative association with literacy was particularly strong for women in two-parent families in the early years. The employment data was not complete enough to interweave with marital history over the five relevant years, but we looked for an interaction of employment history with whether or not the family was intact at interview, which in this smaller dataset on younger and less educated mothers showed nothing passing conventional levels of significance tests.

Gregg et al. (2005) did not need to perform interactions with child's age since each of the 3 outcomes they considered was evaluated when the study children were at a constant age (as are many of the studies in the US literature). The interactions we estimated were between mother's employment and child's age at employment and assessment as well as her educational attainment and child's age at assessment. For reading scores in particular, interactions of mother's employment with her educational qualifications emerged as significant rather than with child's age. Model 2 (Table 5) reports results for the different outcomes.

The interacted estimates for reading shown in Table 5 pinpoint that the poor readers with mothers employed in the first year of life are the children of the least qualified mothers. In a further three-way interaction, not shown, that negative relationship appeared to be confined to the low qualified mothers with children currently age 8-12. The interacted coefficients on reading for employment in the first year of life are compared with interacted estimates from ALSPAC (for full-time employment in the first 18 months) in Figure 3.

Figure 3



Gregg et al. (2005) find that the least qualified group has, if anything, a positive relationship of early full-time employment with literacy at 7, and the mid-educated a significant negative term, with less of a negative relationship among the most educated. They interpreted this as consistent with better coping skills of the most educated (or better quality purchased childcare) and particularly good quality formal childcare available to the very small group of unqualified mothers in Avon in 1992. Our findings also contrast with those of Ruhm (2005) who finds negative effects on the cognitive scores of US 10-11 year olds, particularly significant for more educated mothers. Ruhm suggests that this is because these children are relatively more deprived of good quality home time, and has evidence to support this from the HOME inventory.

As far as interacted effects of employment on a child's performance in maths are concerned, Model 2 in Table 5 shows a positive relationship with increasing child's age, though significant only at the 10% level, and only for employment when the child is 1-4. Inclusion of interactions of employment and age of child in the behavioural outcomes reveals a strong positive relationship with mother's employment when the child was 1 to 4, in each case weakening somewhat for older children at assessment. We speculate that these positive associations may be related to early encounters with other children in day care or early education settings, but have been unable to establish any link due to inadequate data. The estimated effects turn negative around age 10, which might perhaps be interpreted as a 'sleeper' effect of delayed psychological harm, but these estimates were not robust to investigation with the non-linear age interaction. This interaction could mean that our results bear more similarity to those of Ruhm (2005) than appears at first sight. In his analysis of US 10-11 year olds he found no significant relationship between behaviour problems and maternal employment. One explanation could be that he did not differentiate within types of behaviour problem, but it should also be pointed out that our finding of a positive relationship applies to younger children.

4.2 Other Included Variables

We now turn to the estimates of other coefficients on variables included as controls, as often they are better predictors of child outcomes than maternal employment, and of interest in their own right. Having a well educated mother, with 'A level' or more qualifications, has a slight positive effect (at the 10% significance level) on maths scores, compared to a mother with the least qualifications. The same is true for reading, though the middle level of qualifications also raises the score of a child and is very significant. Mother's 'O Level' has also a strong positive effect on freedom from aggression but

merely a small one, significant only at the 10% level, on anxiety. For reading scores, however, the interaction terms of mother's education and child age are significant, implying that the older the child is when he took the reading test the more it helps if his mother had at least middling qualifications. Indicators of mother's cognitive abilities, however, are more important than education in predicting cognitive scores. Mother's general ability score at 11 is very significant and positive for both cognitive outcomes, more so for maths than for reading. Mother's reading at 7 is also positive and significant for these scores though more so for reading than for maths. Higher scores of mother in her general ability test are related to less aggressive children but have no impact on anxiety. The estimates for mother's non-aggression and non-anxiety scores when she was 16 indicate that children of non-anxious mothers perform better at maths (significant at the 5% level). Non-anxiety of mother seems positive for reading scores as well, though the relationship is not significant. Finally, non-anxiety and non-aggression of the mothers at 16 tend to be repeated in the behaviour of their children, but the association is not significant in the first case and only at the 10% level in the second.

The mother having her first child at or before 20 (rather than at other ages up to 29) has a negative coefficient for three out of four outcomes, but is significant only for maths scores. Lone motherhood is adversely related to cognitive development (more so for reading than for maths) and also to aggressive behaviour. Living with a step-father also has adverse associations but significant only for maths. Social housing, which proxies for long-term poverty, has a strong negative relationship with maths, reading scores and non-aggression. Non-anxiety shows little association with the mothers' human and financial resources. Its strongest association is with demographic factors such as gender and number of siblings.

The quadratic age terms fit three out of four outcome variables well. Maths and reading scores rise with child's age at a diminishing rate, anxiety (rather than its obverse) does the same. Non–aggression seems to ameliorate at perhaps an increasing rate. Girls are better at reading and show less aggressive behaviour than boys. Boys out-perform at maths and the avoidance of anxiety. Higher birth order is associated with poor reading, more aggression but less anxiety. Having a younger sibling, on the other hand, is associated with more anxiety. Health problems that limit school attendance are associated with poor cognitive scores and aggressive behaviour.

4.3 Analysis of the Unexplained

Table 6 Variances and Co-variances of unexplained element in Baseline Model 0 in Table 3 (standard errors in parentheses)

	Maths	Reading	Non-Aggression	Non-Anxiety
		Mother Level		
		Variances and co-variances between families (v_{ik})		
Maths	8.48 (1.23)	7.63 (0.04)	3.41 (1.64)	-1.46 (1.59)
Reading		11.69 (0.07)	6.40 (1.80)	-0.64 (1.73)
Non-Aggression			30.79 (4.02)	20.68 (2.88)
Non-Anxiety				16.62 (3.89)
		Correlation Coefficients		
Maths	1	0.766***	0.211**	-0.123
Reading		1	0.337***	-0.046
Non-Aggression			1	0.914***
Non-Anxiety				1
Non-missing cases of mothers for each outcome	1,015	1,019	1,047	1,055
Non-missing for at least two outcomes		1,129		
		Child Level		
		Variances and co-variances between children (u_{ijk})		
Maths	19.65 (1.17)	9.69 (0.97)	5.85 (1.56)	1.98 (1.67)
Reading		21.57 (1.29)	6.92 (1.64)	0.25 (1.76)
Non-Aggression			64.19 (3.72)	-0.39 (2.84)
Non-Anxiety				78.51 (4.34)
		Correlation Coefficients		
Maths	1	0.471***	0.165***	0.050
Reading		1	0.186***	0.006
Non-Aggression			1	-0.005
Non-Anxiety				1
Non-missing cases of children for each outcome	1,506	1,520	1,570	1,579
Non-missing for at least two outcomes		1,714		

*** p<0.01, ** p<0.05, * p<0.1

Table 7 Variances and Co-variances of unexplained element in Model 2 in Table 5
(standard errors in parentheses)

	Maths	Reading	Non-Aggression	Non-Anxiety
		Mother Level		
		Variances and co-variances between families (v_{ik})		
Maths	4.95 (1.05)	3.17 (0.87)	0.46 (1.44)	-1.92 (1.46)
Reading		5.83 (1.16)	2.11 (1.52)	-1.62 (1.53)
Non-Aggression			25.24 (3.70)	19.34 (2.75)
Non-Anxiety				17.80 (3.83)
		Correlation Coefficients		
Maths	1	0.591***	0.041	-0.204
Reading		1	0.174	-0.159
Non-Aggression			1	0.912***
Non-Anxiety				1
Non-missing cases of mothers for each outcome	1,015	1,019	1,047	1,055
Non-missing for at least two outcomes		1,129		
		Child Level		
		Variances and co-variances between children (u_{ijk})		
Maths	19.17 (1.12)	9.33 (0.92)	4.87 (1.49)	2.99 (1.60)
Reading		21.03 (1.22)	5.69 (1.56)	1.72 (1.67)
Non-Aggression			62.37 (3.58)	0.86 (2.74)
Non-Anxiety				75.31 (4.19)
		Correlation Coefficients		
Maths	1	0.465***	0.141***	0.079*
Reading		1	0.157***	0.043
Non-Aggression			1	0.013
Non-Anxiety				1
Non-missing cases of children for each outcome	1,506	1,520	1,570	1,579
Non-missing for at least two outcomes		1,714		

*** p<0.01, ** p<0.05, * p<0.1

Tables 6 and 7 show variances, co-variances and correlations of the error terms at each level for the four outcomes in Model 0 and Model 2. The error structure of Model 1 is not shown as it closely resembles that of Model 2. Though inclusion of additional variables in Model 2 results in a reduction in the unexplained variance, that reduction occurs mainly at the mother rather than the child level. Table 7 shows that a large part of the variance

remains unexplained, particularly for behaviour, and particularly at the level of the child, rather than the mother.

The co-variances are strongly positive between reading and maths at both the child and the mother level. This means that individual children tend to be good at both subjects and, allowing for this, families in which children are good at maths are also likely to have children good at reading for their age. After allowing for all the variables included in Model 2, the correlation at the child level is 0.465 and at the family level 0.591 (Table 7). The associations between non-aggression and maths are 0.141 at the level of individual children and 0.041 at the family level. Between non-anxiety and reading, they are 0.043 and -0.159 for children and families, respectively. Anxiety is not significantly associated with cognitive skills at either level. Anxiety and aggression are strongly associated in families (0.912) but not in children. Families whose children are well adjusted on externalizing behaviour also tend to have well adjusted children on internalized behaviour. The smaller unexplained element for mothers compared to children may be due to our success in finding information about mothers, in terms of their early test scores and the relative scarcity of multi-child families in the dataset. The significance of most of the cross-outcome correlations in Tables 6 and 7 justifies the specification of a joint model.

5 Conclusions

5.1 Recapitulation of method

We have examined four out of several possible dimensions of child development, and allowed for them to be interrelated within children and within families. We have attempted to minimize bias from reverse causation by relating mother's employment in the preschool years to child outcomes at school ages. We have attempted to control for spurious correlation by including, among other covariates, information on the mothers' own

cognitive and behavioural scores in childhood, available in an intergenerational dataset and usually unobserved, and by estimating a multi-variate multi-level model which allows all the other sources of unobserved variation to be correlated across outcomes within children and mothers. The multivariate approach does not change the pattern of effects estimated in single models, but it did produce some better determined estimates, and it does reveal a pattern of relationships within the otherwise unexplained variation between children and mothers which should be allowed for, where possible, in future research, such as in the Second Generation Survey of the 1970 cohort, collected in 2004-5.

5.2 Does maternal employment conflict with child development?

An important consideration in a woman's decision about whether, when and how to combine motherhood with paid work, will be the outcome for her children. This will also be of interest to the rest of her family and to governments in the design of policy to facilitate or discourage such a practice. Should public policy support mothers (or fathers) staying at home or finding day care for their children, for how many hours, at what age? This paper has sought evidence for a trade-off between a mother's employment and her child's well being. In the absence of direct observation on the mechanisms that may operate, we have found some indirect evidence for some conflict between maternal employment and child development, but this is limited to employment in the child's first year and to only one of the four dimensions of child development we investigated – reading, measured at a range of ages between 5 and 17. This negative relationship is concentrated on women with low educational qualifications. It is not a big or very well determined relationship, and could be dismissed as the one coefficient in twenty, one would expect to find by chance. We have indeed done a large number of experiments and present 36 estimates of maternal employment coefficients in this paper alone (of which 2

are ‘significant’ at the 5% level). However these estimates are in the same direction as that of two other analyses of independent evidence.

Our finding of a minor negative association with reading scores of mother’s early employment among this group of children in 1991 are broadly similar to those found in the analysis of the test scores of NCDS members themselves as children in 1965 (Davie et al. 1972) and for the children in the Avon Study tested around 1999 (Gregg et al. 2005). The main point on which we agree with the Avon Study is that any effects of maternal employment are small, and that there is huge variability between children and families that does not fit into these sorts of models. Nevertheless, though the delay on cognitive development may have been small and may have been compensated, to the individual families, by other benefits from the mother’s earnings, maternal employment would in aggregate contribute to a general lowering of academic attainments over what might have been possible with more or better attention paid to the children by their mothers or some-one else. We did not however reproduce the Avon finding, for the least qualified mothers, of a positive relationship of early full-time employment with later literacy. This is likely to be because the NDCS cohort members had less access to formal childcare in the 1980s than was available in Avon in the early 1990s.

How do these findings compare those of Ermisch and Francesconi (2001, 2002), and our own analysis of BCS70 (Joshi and Verropoulou 2000) on the longer term academic prospects of children whose mothers work full-time when they are under 5? We did not find robust evidence for a long-term ‘sleeper’ effect (at least on cognitive outcomes) emerging over time, though perhaps it might take a larger or longitudinal set of data on children to detect that. The alternative explanation, that the results for cohorts born in the

1970s reflect the childcare and employment practices prevailing in that period, is also still plausible. Improvement in childcare facilities and support for working parents generally had already improved the prospects for children born in the 1990s compared to the 1970s as in BHPS and BCS70 analyses.

The other observed covariates prove to be rather better predictors of child outcomes than maternal employment. One proxy for long term poverty, social housing, is significant and negative for cognitive outcomes and for aggression. Anxiety, however, seems to be influenced mostly by family factors and is lower for boys and those with older siblings. Aggressive, or externalized behaviour problems in the Second Generation do seem to be more associated with material deprivation as well as family structure, as hypothesized by Carneiro and Heckman (2003). Externalised behaviour problems in the mothers' generation are weakly associated with such problems in the children, as well as poor mathematical attainment.

Evidence from the NCDS Second Generation as well as the BHPS, BCS70 and ALSPAC has already help to inform new policies in Britain about parental leave and the National Childcare Strategy. This addition to the body of evidence should be taken as a signal for government and parents to proceed cautiously with the widening of choices to combine employment and parenthood and balancing work and family life, especially after the child's first year. There is no evidence from this sample of relatively young mothers for a large widespread penalty in terms of child development paid for the increase in maternal employment, but there may have been some underachievement - child literacy is not completely insensitive to early maternal employment. The relatively small magnitude of the effects estimated bears witness to the heterogeneity and resilience of children, and to

the diverse adaptations parents make to maintain their time input to children, substitute for it and minimise adverse consequences. Another conclusion is that this study has demonstrated the need for new and better information about the allocation of time by parents, children and other carers in a prospective, longitudinal framework.

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