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THE EFFECTS OF A MOTHERS RETURN TO WORK DECISION ON CHILD DEVELOPMENT IN THE UK

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1. Introduction

The labour market participation of women with very young children in the UK has seen an unprecedented increase in recent decades. The proportion of women in paid work 8 to 11 months after childbirth rose from 24 per cent in 1979 to 67 per cent in 1996 (Dench et. al, 2002). It is no exaggeration, then, to say that the norm of behaviour for women with a child less than a year old has shifted from non-employment to employment in a period of less than 20 years. The question of how early maternal employment affects children's development is therefore a question of social concern as well as personal concern to many mothers. A number of US based studies have concluded that maternal employment in the first year of life is associated with poorer outcomes later in childhood, and in particular poorer cognitive outcomes. These findings often suggest that adverse effects are focused on mothers returning early after the childs birth and returning full-time, it is unclear whether their findings would apply in the UK, with its very different maternity rights, childcare system and greater use of part-time working.

In this paper we analyse data from a cohort of children born in the Avon area of the UK in the early nineties. The extremely rich nature of our data allows us to shed new light on the relationship between maternal employment and child outcomes. Firstly and on the same lines as recent US work, we attempt to identify the causal impact of early maternal employment on three outcome variables that measure aspects of child development between four and eight years of age. To do this we must remove the influence of confounding factors that are correlated with maternal labour supply and that have an independent influence on child outcomes, which otherwise might lead to our estimates being biased. The second issue we address is whether different groups are affected by maternal employment in different ways. Specifically, we explore whether the effect varies with the mother's educational attainment and the household's lone parent status. Third we explore the extent to which the observed outcome patterns can be explained by reduced parental inputs, by higher household income from the mother's earnings or by the type of replacement non-maternal childcare used.

Our results suggest that full-time employment in the first 18 months after a birth by mothers who predominantly use informal substitute care from relatives or friends leads to poorer cognitive outcomes for children. There is no evidence that part-time working or full-time working with more formal care substitution leads to any adverse outcomes. Even for the adversely affected group the magnitude of the effects are not large at around one-tenth of a standard deviation. Strikingly parental inputs in terms of caring, reading with the child, teaching and the like are not greatly affected by the mother's employment. This stems from greater paternal involvement and compensating strategies by the mother. There is also some evidence that any adverse effects are restricted to more affluent or better-educated mothers.

Section 2 outlines the conceptual issues involved in estimating the effects of maternal employment. Section 3 reviews the existing literature relating to this issue. Section 4 lays out our empirical methodology and discusses the data used in our analysis. Results are presented in Section 5 and we conclude with a discussion of the implications of our findings in Section 6.

2. Conceptual issues

In this section we review a number conceptual issues involved in estimating and interpreting the effects of early maternal employment on child outcomes.

2.1 What are the effects of early maternal employment on child outcomes?

The most basic question that is addressed by all studies of this type is whether we can identify any significant effect of early maternal employment on child outcomes. To this end, most investigations into this issue estimate an equation of the general form[1]:

$$C_{it} = \alpha + \beta_{t-j} H_{it-j} + \gamma X_i + e_{it} \qquad (1)$$

where C_{it} is an outcome measure for child *i* at time *t*, H_i is a measure of maternal employment, period *t-j* refers to the early period of the child's life that is being examined and X_i is a vector of control variables of the family's characteristics (that

[1] This presentation draws heavily on Ruhm (in press).

may include previous and subsequent maternal employment). The coefficient $\hat{\beta}_{t-j}$ gives an estimate of the impact of early maternal employment on the outcome of interest. Many investigators experiment with different measures of H_{it-j} in order to explore whether the estimated effect varies with the timing of work (for example work in the first year versus work in the second and third years) or its intensity (i.e. part time versus full time work in the first year).

2.2 Are estimates of the effect of early maternal employment biased?

The *X* vector in equation (1) is included in order to capture the effect of confounding factors that may be correlated with early employment, such as mother's age and education. There are two issues that arise here. Firstly, if there are unobservable factors that are not included in *X*, but that are correlated with both C_{it} and H_{it-j}, then the estimate of $\hat{\beta}_{t-j}$ may be biased. Secondly, as Harvey (1999) points out, variables that are *affected by* patterns of early employment and in turn affect children, e.g. childcare arrangements, should not be considered as selection factors and require a different analytical approach than the simple inclusion of controls.

The problem of unobserved heterogeneity is one that is widely recognised in the literature. To illustrate the problem we can rewrite equation (1) as

$$C_{it} = \alpha + \beta_{t-j} H_{it-j} + \gamma X_i + \delta M_i + \eta Z_i + \varepsilon_{it} \qquad (2)$$

where M_i are time-invariant unobservable maternal characteristics and Z_i are unobservable characteristics of the child such as his or her innate ability. If *M* or *Z* are correlated with *H* then $\text{cov}(H_{it-j} e_{it}) \neq 0$ in equation (1) and the estimate of $\hat{\beta}_{t-j}$ will be biased.

Intuitively, we can think of two broad groups of factors that might result in biases of opposite signs. One possibility is that market and home ability are positively correlated so that employed mothers are more able in both the labour market and child rearing settings. In this case the estimate of $\hat{\beta}_{t-j}$ will be biased upwards. We will tend

to underestimate the negative effect of maternal employment (or overestimate the positive effect) because $\hat{\beta}_{t-j}$ is picking up the effects if this unmeasured ability as well as the causal effect of maternal employment. An upward bias may also result if mothers feel more able to return to work if their children are better adjusted or better at learning.

Alternatively, it may be that market and home ability are negatively correlated, for example if employed mothers tend to have less interest or skill in child rearing than the non-employed. In this case $\hat{\beta}_{t-j}$ will be biased downwards because we are attributing the effects of this (fixed) lack of skill to the effects of maternal employment. If mothers choose to reinforce their children's endowments by devoting more time and care to the more able then this will accentuate any downward bias.

It is clear that *a priori* we can make no firm prediction as to the magnitude or even the direction of the overall bias in the estimated effect of early maternal employment. A number of different techniques have been applied to this problem, however, and the evidence is reviewed in Section 3.

The key aim when tackling the problem of unobserved heterogeneity is to evaluate the effect of working given the *fixed* characteristics of different families. The second key question following from the above discussion regards the mechanisms by which maternal employment affects children. Participation in the labour market has the effect of removing the mother from the home for a certain number of hours each week. However, it will also have other effects on the characteristics and behaviour of the household. These types of factors are not held fixed when a mother returns to work and so to control for them could lead to a very misleading picture of the effects of maternal employment. For example, suppose that the addition to income from the mother's earnings has beneficial effects on the child. If we were to control for household income we would statistically remove from the estimated employment effect the contribution of this mechanism. Such an estimate may be of interest in its own right but it no longer represents the total net effect on the child of the mother's employment. As this is the effect in which we are interested, it follows that we should not include controls for any factors that change *as a result* of the mother's labour

supply decision when trying to understand the total net effect on the child but we may wish to explore how these mechanisms may underpin the causal relationship between mothers' employment and child attainment. Besides income, other factors of this kind might include the parenting behaviours of the both the mother and the father, breastfeeding patterns and the mother's mental health, tiredness and stress levels.

3. Existing evidence

Virtually all of the recent evidence on the effects of early maternal employment on child outcomes is US-based and most studies use data from a single source – the National Longitudinal Survey of Youth (NLSY). Despite the use of this common dataset, these studies frequently provide conflicting results as to the nature of the impact of mothers' employment. It is clear that their conclusions are sensitive to methodological differences with regard to sample selection, the measures of maternal employment and child development used and the choice of control variables. Comprehensive surveys of this literature exist elsewhere (see, for example, Waldfogel et. al., 2002, and Ruhm, in press). However, because this paper explores a number of different hypotheses surrounding maternal employment and child development, it is instructive to review the evidence on each issue separately. Although much work was carried out on this topic in the early 1990s, we concentrate here on more recent studies[2]. These tend to address at least partially some of the methodological deficiencies that have been highlighted in the earlier papers (see Harvey, 1999, and Ruhm, in press, on this issue).

3.1 Is early maternal employment harmful to children's development and does its effect vary with the timing and intensity of work?

Although it is by no means universal, a substantial number of the US studies report the result that maternal employment in the first year after the birth has small negative effects on children's cognitive outcomes (relative to not working at all in the first three years). However, this may be at least partially offset by positive effects of working in the second and third years of the child's life[3]. Many studies suggest that these effects are larger for full time working than part-time or that higher intensity of

[2] For examples of this first wave of studies, see Desai et. al. (1989), Bayder and Brooks-Gunn (1991), Belsky and Eggebeen (1991), Vandell and Ramanan (1992), Parcel and Meneghan (1994), and Greenstein (1995).

working in the first year (earlier return or duration * hours) is more damaging. In general, behavioural problems in children seem to respond to maternal employment in the same directions as cognitive outcomes although the relation is weaker and estimates tend to be insignificant.

Using five measures of cognitive development[4] as the dependent variables in OLS regressions, Waldfogel et. al. (2002) find significantly poorer outcomes on all five measures for the children of mothers who worked at all in the first year of life. The effects of employment in years 2 and 3 are positive although generally smaller in absolute magnitude and less well determined than the early negative effects. They test whether working in all three years has more harmful effects than employment in years 2 and 3 alone and find that delaying employment until after the first year is associated with significant improvements in the child's performance. With regard to intensity of employment, they find that the negative effects of first year employment are driven by the effect of full time working (more than 20 hours per week). The coefficients on first year part time work, whilst generally negative, are small and insignificant.

Using a smaller sample but a very similar methodology, Han et. al. (2001) again find negative effects of first year employment and weaker positive effects of later work for white children only. In this case, they find no significant differences between part time and full time working in the first year. They also test whether the negative impact of work in the first year is greater for mothers who returned to work more quickly after the birth. They find that the negative effects of return before the child is 10 months old are stronger than for return in the last quarter of the first year.

Hill et. al. (2001) use the technique of propensity matching in order to identify the effects of early maternal employment. They find that children of mothers who worked part-time in the first year would have experienced adverse effects if their mothers had instead worked full time. They also find that children of mothers who worked full time apparently could have benefited if their mothers had not worked in the first year.

[3] See Section 5.1 for a discussion of the magnitudes of these estimates.

[4] The measures of cognitive development available in the NLSY are the Peabody Picture Vocabulary Test-R (PPVT-R) at age 3 or 4 and the Peabody Individual Achievement Tests on maths and reading recognition (PIAT-M and PIAT-R respectively) at age 5 or 6. Some studies also analyse the PIAT scores for children at later ages, most commonly for 7 or 8 year olds.

The effects of second and third year employment on performance tend to be positive but insignificant.

Ruhm (in press) analyses NLSY data for children aged 3 or 4 and 5 or 6. His inclusion in the regressions of a far more extensive set of background controls, however, leads to somewhat different results. He again finds a negative effect of the amount of employment in the first year but it is only significant for 3 to 4 year olds. In contrast with other work, he also finds significantly negative effects for second and third year employment. Ruhm also investigates whether the timing of return to work matters. He finds no significant difference between return prior to 6 months and return between 7 and 12 months, although his results suggest that children gain if mothers delay their return until after the first year. In general, Ruhm's specifications impose a linear relationship on the number of hours worked and child outcomes. He notes, however, that when he explored potential non-linearities he found some evidence the employment exceeding 20 hours per week had particularly negative effects. Baum (2003) using the NSLY in a similar vein to Ruhm, concurs that greater intensity (total hours in the first year) and early return (before 13 weeks) are associated with modest adverse effects. He suggests that full-time work in the first year is associated with reduced scores on ability tests by around 17% of a standard deviation.

Harvey (1999) provides a further challenge to the finding of damaging effects of early employment offset by later positive effects in the NLSY. Harvey explores the effects of a variety of measures of maternal employment such as age of the child in weeks at return and dummies for any employment in the first year or in the first three years. Relative to not working in the first three years, she finds no evidence of any adverse of effects of early employment. However, amongst women who do work in the first three years, Harvey finds that working more hours is associated with a small but significant decrease in test scores.

Turning to studies based on data other than the NLSY, Brooks-Gunn et. al. (2002) analyse data from the richly detailed NICHD Study of Early Childcare. Unlike the NLSY, data are only available on the cognitive outcomes of infants (aged 15, 24 and 36 months). Brooks-Gunn et. al. find that the children of mothers who are employed by the ninth month score significantly lower on the assessment at age 3, compared to

the children of mothers who do not return before that date. When they explore whether this effect varies with the intensity of employment, they find that the adverse effect of full time work in the first nine months is double the effect of part time work. However, they find no evidence of negative effects on children's scores at younger ages.

UK Evidencee

Return to work patterns in the UK differ markedly from those in the US. Berger and Walfogel (in press) report that in the NLSY some 40% of new mothers are back in work within 3 months and 15% back by 6 weeks. Among mothers in work prior to the birth some 63% were back by 3 months and 25% by 6 weeks. In contrast in the UK only 8% are back by 3 months and tiny numbers return by 6 weeks. Furthermore far more UK workers return part-time with 70% of those returning within 6 months working part-time compared with only 40% in the US (Berger, Hill and Waldfogel, 2004). So whilst around a half of new UK mothers are back at work within a year, a similar figure as in US, return dates are usually later and at shorter hours of work.

These differences stem form the fact that the UK has had since 1979 an extensive set of maternity leave rights, whereby until 2003, a new mother can return to her previous employer after a 29 week leave period, the first 18 weeks being supported financially, subject to meeting certain employment history requirements (see Gregg et al. 2003, for a history of leave rights and patterns of early maternal employment).[5] These leave periods produce large spikes in the distribution of return to work times for new mothers at dates coincident with the ending of the paid leave period (at around 16 weeks) and the unpaid leave period (at 26 weeks). Burgess et al. (2002b) show that these spikes form both from people who would otherwise return to work very early, postponing return until leave is exhausted and those who would not return in the first 7 months doing so in order to hold on to their previous job (which is normally better paid than any later replacement). The dominant effect is to induce more returns in the 4th and 7th months from among those who would otherwise stay out beyond a year.

There is relatively little UK-based evidence on the effects of parental employment on child outcomes. Joshi and Verropoulou (2000) analyse two UK birth cohort studies, the children of the 1958 NCDS cohort and the 1970 BCS70 cohort members. They find some evidence of small negative effects of maternal employment in the first year of life on reading scores when the chld is aged 5 to 17 but not for maths or behavioural adjustment scores at the same age. In common with the US studies they also report small positive effects of maternal employment begun after the first year. With regard to outcomes in adulthood, they find a small negative association between maternal employment in the first five years and the child's eventual qualifications. However, no association was found with either the incidence of youth unemployment or of teen motherhood. Overall they conclude that whilst maternal employment may have some small effects on child outcomes, their magnitude is swamped by the contribution of other factors such as poor economic circumstances in the home and the mother's own academic ability and attainments.

Another UK-based study is Ermisch and Francesconi (2000). This study uses retrospective information from the British Household Panel Survey and, in common with Joshi and Verropoulou, finds a negative relation between maternal employment in the first five years and the child's eventual qualifications. They find that increasing the amount of full time maternal employment before age 5 by one year reduces the probability of achieving at least an A-level by 7 to 9 percentage points. A similar increase in part time work lowers the probability but by a smaller amount – 3 to 6 percentage points. These results rely on their use of a sibling difference estimator, as their cross-sectional logit estimates do not identify any significant effects of early maternal employment on later achievement.

Joshi and Verropoulou (2000) use data on children born between 1974 and 1986 (in the NCDS) and children born in 1970 (in the BSC70). The BHPS data used by Ermisch and Francesconi (2000) relates to children born between 1970 and 1981. These births then occurred before or just after the introduction of maternity leave rights legislation and certainly before the huge expansion of returning to work within

[5] Since 2003 these leave periods have been extended to a year with 6 months financial

the first year of the childs life. Given that there have been substantial changes in the last 20 to 30 years in the employment patterns of mothers of young children, in the structure of maternity rights legislation and in the provision of early childcare, it is of interest whether the results of previous studies will be replicated for children born in the 1990s.

3.2 Is there any evidence of bias due to heterogeneity in the basic estimates and if so in which direction does it work?

As discussed in Section 2.2, heterogeneity between working and non-working mothers may result in biased estimates of the effects of employment on children. In addition, it is not clear in which direction this bias will operate. Several techniques have been used to address this problem but no consensus has been reached regarding the magnitude and sign of the bias due to unobservable factors.

One method is to include as comprehensive a set of explanatory variables as possible, in order to 'mop up' as much of differences in ability in child rearing between the two groups as possible. Ruhm (in press) includes controls relating to the mother's family background and the degree of stimulation in her childhood home; her attitudes and experiences; the health of the mother and the child, and previous and subsequent maternal employment characteristics. He argues that these characteristics may directly influence the quality of home investments as well as proxying unobserved determinants of them. The inclusion of previous and subsequent maternal employment is important because these variables are correlated with labour supply in the post-birth period but can have no causal effect on the child's assessment score. The effect of these variables, then, must capture the effect of unobserved characteristics that are correlated with labour supply.

The addition of these supplementary controls to Ruhm's basic specification generally results in more negative (less positive) estimates of the effect of early maternal employment. This result favours the argument that there are complementarities between market and home abilities. Ruhm concludes that studies which fail to control adequately for heterogeneity will tend to underestimate the negative influence of early

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support.

maternal employment. Early-returning mothers tend to have other characteristics that are positively associated with their children's cognitive development.

Brooks-Gunn et. al. (2002) are able to utilise information on maternal sensitivity in parenting and the quality of the child's home environment that is unavailable in other datasets such as the NLSY. They find no evidence that mothers who return to work early after a birth are relatively more sensitive in their parenting or provide a more beneficial home environment. In fact, they find that controlling for maternal sensitivity and home environment at 6 months slightly reduces the negative effects of maternal employment prior to 9 months. This result suggests that, if anything, working mothers are relatively low quality, rather than superior, along these dimensions.

The 'mopping up' approach assumes all the important unobserved characteristics of the mother that are associated with both labour supply and child development can be captured, either directly or indirectly, by an extensive set of observed characteristics. A different technique that avoids this problem is to estimate a family fixed effects (FFE) model. This method essentially compares outcomes between siblings whose mother worked in the early years of one child's life but not in the other's early years. FFE models controls for any characteristics of the family, observed or unobserved, that are fixed over time. Any bias due, for example, to a correlation between the mother's labour market ability and innate skills in child rearing will be eliminated. However, FFE estimates are subject to bias in themselves if there are other influences on child development that are not fixed across the two siblings. For example, the mother's labour supply decision may be affected by the child's degree of development. FFE estimates will understate the negative effect of early employment if mothers are happier to place more developed, better adjusted children in childcare, whilst they will overstate the negative effect if mothers work to get away from 'problem' children. Further, the decision to work may be affected by another factor that also influences child development. If, say, a mother chose to work when one child was young (but not the other) because of a sharp drop in other income sources at that time, FFE estimates will overstate the negative effect of employment.

The evidence from the FFE method on the magnitude and sign of the bias is again mixed. Waldfogel et. al. (2002) find that estimates of the effects of first year maternal employment become less negative and lose significance when an FFE model is used. The differences between the OLS and FFE results are significant for test scores at early ages but not for tests at age 7 or 8. Ruhm (in press) also finds that FFE estimates of the effect of maternal employment in the first three years are less negative and less significant than the corresponding OLS coefficients. This evidence is consistent with the hypothesis that the unobservable fixed characteristics of mothers who return to work early are *negatively* associated with their children's cognitive development. For example, these mothers may have less interest and ability in child rearing than those who choose not to work. Ermisch and Francesconi (2000), however, reach the opposite conclusion. Their FFE estimates are more negative than the cross-sectional estimates, indicating the presence of a positive bias. Given the potential error associated with FFE estimates in general, these results do little to resolve the questions of whether and in what way basic estimates of the effect of early maternal employment are biased.

3.3 Sub-group analysis

Many of the studies referred to above investigate whether certain sub-groups experience greater harm from early maternal employment than others. The hypotheses explored, however, vary across studies. Here we draw together the available evidence on two of the key issues:

Mothers Education

One hypothesis is that mothers with higher ability provide greater cognitive stimulation to their children and so their absence due to employment will have a greater adverse effect. Han et. al. (2001) interact first year maternal employment with the mother's AFQT score[6]. They conclude that first year maternal employment has significantly negative effects for moderate to highly skilled mothers but find no evidence of any negative effects among the lowest skilled quartile. Ruhm (in press) interacts employment in the first three years with indicators of the mother's wage in

[6] The Armed Forces Qualification Test (AFQT) is a measure of cognitive ability that consists of the sum of scores on four subtests: word knowledge, numeric operations, paragraph comprehension and arithmetic reasoning.

the quarter prior to pregnancy. The results are not robust across alternative measures of child attainment.

Lone Parents

The evidence of this issue is remarkably consistent across a number of studies – early employment has no negative effects for the children of single mothers and may actually be beneficial. The studies of Hill et. al. (2001), Ruhm (in press), Brooks-Gunn et. al. (2002), Harvey (1999) and Han et. al. (2001) all find that the negative effects of early maternal employment are concentrated in the children of two-parent families. This may suggest that the earnings of single mothers are particularly beneficial, that they have access to higher quality subsidised childcare or perhaps that the quality of their investments in the child is lower than for mothers in couples.

3.4 Mechanisms

Research into the mechanisms by which early maternal employment affects child outcomes has been hampered by lack of appropriate data. In particular, the role of the father in child rearing has received little attention. Nevertheless, the following details the available evidence on the issues examined in this paper.

Paternal Inputs

A number of studies have analysed the effects of paternal employment on child outcomes. However, as Ruhm (in press) notes, paternal labour supply is not likely to be a good proxy for their investments in young children. Non-employment rates amongst fathers of young children are not high (O'Brien and Shemilt, 2003, give a figure of 9 per cent in 2001 for fathers in couples with a child under the age of 3) and non-employment is likely to reflect other factors that are generally related to employment instability. Given the unusual nature of non-working fathers, it is not surprising that greater paternal employment is often associated with improved outcomes for children. However, when Ruhm (in press) and Ermisch and Francesconi (2000) control for this heterogeneity they find that the estimated effect of early paternal employment on child outcomes is negative, although smaller than for maternal employment. The fact that maternal and paternal employment seem to work in the same directions suggests that the time investments of mothers and fathers may have qualitatively similar effects on children. These results do not address the issue of variations in the nature of parental inputs or of whether paternal inputs into child rearing are substituted for maternal ones in households where mothers work.

Income

There is little direct evidence on the extent to which the additional income from mothers' earnings moderates the negative effect of maternal employment. Ruhm (in press) reports that controlling for household income in the first years of the child's life makes almost no difference to the estimated effects. Baum (2003) suggests that controlling for income results in somewhat larger estimates of the detrimental effect of mothers' employment and argues that increased income works to partly offset reduced maternal contact. Harvey (1999) concurs, reporting the results of a pathway analysis that explicitly investigates the links between maternal employment and household income and between household income and child outcomes. She finds significant positive effects at both stages and concludes that her overall finding of no significant effects of early maternal employment reflects the fact that positive income effects are offset by negative effects from elsewhere.

Childcare

Data on childcare in the NLSY is restricted to a broad categorisation of the types of care in which the child was placed. Studies which use this data are not able to investigate directly the relationships between maternal employment, the quality of non-maternal childcare and children's outcomes. Several studies do investigate the effects of different types of childcare, Waldfogel et. al. (2002) find that controlling for childcare type in the first year slightly reduces the negative estimate of the effect of first year full time maternal employment. This suggests that the childcare arrangements of working mothers contribute in part to the overall negative impact of their employment. Han et. al. (2001) use a similar methodology but reach the opposite conclusion. Their estimates of the effect of first year maternal employment become more negative when childcare is controlled for and so imply that the childcare arrangements of working mothers help to offset other negative effects. Waldfogel et. al. also interact childcare with first year full time work in order to see if the effects of employment vary with the type of childcare used. They find that the effects of first year full time maternal employment are negative regardless of the form of childcare used but there is no consistent pattern in their estimates to suggest whether any one type of care is better than another.

The one study that is able to investigate the issue of quality of childcare is Brooks-Gunn et. al. (2002) using data collected in the NICHD. They find that, for the children

of mothers who were in work by the ninth month, the quality of childcare at age 3 is no lower than for mothers who did not return by 9 months, and for those who worked part time the quality is actually higher. Controlling for the care history of the child up to age 3 they find that the estimate of the negative effect of early full time work is slightly increased. In common with Han et. al., therefore, they find that the characteristics of the childcare used by mothers who return to work early are relatively beneficial for children's development and help to compensate for the any drawbacks associated the mother's absence whilst at work.

4. Methodology and data

4.1 Identifying the effects of early maternal employment on child outcomes

Our basic estimation strategy is to run OLS regressions of a number of measures of child development on early maternal employment variables and various sets of additional controls. Our initial specification corresponds to equation (1) and serves to identify the overall net effects of early maternal employment.

Next we investigate the issue of bias in the basic estimates. The ALSPAC dataset is a survey of a single cohort of children and so we do not have the necessary data on siblings to construct a family fixed effects estimator. The difficulty of finding a valid instrument for maternal labour supply also rules out the use of an IV strategy. The strength of the ALSPAC survey, however, is that is collects an unusually extensive amount of background information on the characteristics of members of the household prior to the birth. This includes not only sociodemographic data but also information on such factors as childhood experiences, attitudes and psychological characteristics. Our strategy is similar to that of Ruhm (in press) in that we include a wide variety of background characteristics in our regressions in an attempt to 'drive out' as much residual heterogeneity as possible. The variables we use are restricted to those measured prior to the child's birth so we can be reasonably confident that they are exogenous with regard to post-birth maternal labour supply.

Like Ruhm, we introduce groups of additional controls sequentially. This allows us to explore whether different dimensions of heterogeneity affect the estimates in different

ways. Ruhm simultaneously introduces controls that capture aspects of the mother's family background, her physical health and her beliefs and attitudes. It may be that mothers who return to work early have relatively positive characteristics along some dimensions but relatively negative characteristics along others. For example, they may be more 'able' in terms of certain skills but have less interest or motivation in interacting with their children. By grouping our additional control variables and introducing each group sequentially we can infer the nature of the underlying heterogeneity.

We group factors into two domains, which relate broadly to the mother's ability in the labour market and her attitudes towards parenting. The first group contains variables that we might expect to be positively correlated with both maternal labour supply and child outcomes. These variables, such as the mother's previous employment experience and occupation and social networks, are designed to capture something about her unobserved 'ability'. We explore the hypothesis that controlling for these positive confounding factors lowers our estimates of the effects of early maternal employment.

The second group of controls is designed to capture something about the mother's attitudes. It includes, for example, several measures of the mother's personality and her consumption of alcohol, tobacco and drugs during pregnancy. If mothers who return to work early tend to be less interested in child rearing then we might expect the inclusion of this second group to raise our estimates of the effects of maternal employment.

Details of the measures used are given in below. Having conducted our investigation into the different potential sources of heterogeneity, we then retain only those additional controls that have explanatory power for at least one measure of child development (thus ensuring that we maintain a common specification across all the measures). We take the results from these regressions as the most unbiased estimates possible of the overall net impact of early maternal employment. We then go on to explore variations in these effects across mother's education and lone parent status. The final and perhaps key contribution of the paper is to investigate the importance of a number of mechanisms through which maternal employment might be expected to

impact on children. Our data is unusually rich in detailing the nature of the parenting activities undertaken, childcare arrangements and indicators of the mothers mental and physical health. We use these to explore what we can learning about why any observed adverse effects come about and what if any compensating strategies parents might apply.

4.2 The data

The Avon Longitudinal Study of Parents and Children (ALSPAC) is a cohort study of around 12 000 children born in the Avon area of the UK in 1991 and 1992. Hence the survey is after the major expansion of early return by mothers that occurred in the mid-late 1980s (see Gregg et al. 2003), although this expansion has continued more recently. Mothers complete up to three surveys a year, one relating to the characteristics of herself and the household in general and two relating to the child[7]. In addition, mothers answered four questionnaires during their pregnancies. The ALSPAC survey also contains data from sources other than self-completion questionnaires. The ALSPAC team have run a number of clinics for children from the age of seven in which they are able to directly assess various aspects of the children's development. Records from schools can also be matched to the individual children so data is available on school-based assessments at ages 4 to 5 and again for ages 7 to 8.

Measures of child outcomes

We analyse the effects of early maternal employment on three different measures of child cognitive development. The following is a brief description of the measures. For a more detailed treatment that includes a summary of the technique of factor analysis see Burgess et. al. (2002a).

The two school-based measures of cognitive development available in ALSPAC are the entry assessment test taken at age 4 or 5 and the Key Stage 1 assessment which is administered in Year 2 at age 7 or 8. Each test is composed of four subscores that capture ability in reading, writing, mathematics and language skills (entry assessment only) or spelling (Key Stage 1 only). Our third assessment of cognitive ability was administered by the ALSPAC team to children at the age of 7. This ALSPAC literacy

[7] The mother's partner also received annual questionnaires but the response here is patchy.

score is again composed of a number of subscores, in this case capturing skills in reading, spelling and the manipulation words. To combine the subscores for each measure into one overall score we used the technique of factor analysis. This method allows the data to dictate the relative weights attached to each component and so to distil the maximum possible information into a single measure. Each of the three resulting scores were then normalised to have a mean of 100 and a standard deviation of 10. The magnitudes of our regression estimates, therefore, are directly comparable across all four measures. [8]

As is inevitable in a survey of the scale of ALSPAC, attrition results in smaller sample sizes for the later assessments of child development. In addition to this problem, parents were required to give written permission for the release of the school-based test results. The sample sizes for the entry assessment and Key Stage 1 scores are therefore substantially smaller than for the other measure. Table 1 shows the pairwise correlations between each score and also the sample sizes used in our regressions. We chose not to restrict our analysis to a common sample across all measures as this would have resulted in the loss of large quantities of data (from 6964 observations in any of the three measures to 4310 observations in all three). Our results, therefore, cannot be considered strictly longitudinal. The differing sample sizes raise the question of whether there is major variation in the characteristics of each population. We investigated this issue for a range of characteristics such as household income, mother's age and educational attainment, etc and concluded that there is little variation in the composition of each sample.

Measures of maternal employment

Our measure of early maternal employment is based on the age of the child in months when the mother returned to work. Our analysis focuses on maternal employment prior to 34 months because our data on return times is censored at this point and also because this cut-off corresponds well to the three-year break used in many previous

[8] As a guide to interpreting the size of our estimates, assuming a normal distribution an increment of 1 point (i.e. a tenth of a standard deviation) results in a shift from the median to the 54th percentile, while an increment of 5 points (or half a standard deviation) results in a shift from the median to the 69th percentile.

studies. We divide this 0 to 34 month period into sub-periods and create dummies to indicate whether the mother returned to work in each one. Throughout most of our analysis we distinguish between return prior to 18 months and return in the 19 to 34 month period. (The effects of varying this cut-off point are discussed more in Section 5.1.)

Ideally, we would like to allow our results to vary with the number of hours that the mother worked in a typical week in the first three years of the child's life. Unfortunately, data on the mother's hours of work are only available at the discrete points of 21 and 33 months. We therefore use this information to assign mothers to either a part time category (less than 30 hours per week) of a full time category (30 or more hours per week), giving priority to the 21 month data.

The proportions of mothers falling into each employment category are shown in Panel A of Table 2. Because the sample sizes for each measure of child development are different, the descriptive results in Table 2 relate to our working sample as a whole. The figures for each sub-sample may vary but, as noted, these differences are only minor. Some 57 per cent of mothers have returned to work by 18 months, 14 per cent full time and 43 per cent part time[9]. We do not distinguish between part and full time work for mothers who returned between 19 and 34 months because so few of these mothers fall into the full time category (only 0.9 per cent of the total sample). For some regressions this leads to cell sizes that are simply too small to be of analytical value. Panel A also shows that the dates of return for mothers who go back part time are spread fairly evenly over the 18 month window, whilst full time return in concentrated in the first eight, and particularly the first four months when maternity rights legislation will apply.

Basic controls

A list of the basic controls that we include in all regressions is given in Appendix Table 1. Here we discuss them briefly in broad groupings. Child-related controls are the child's age in months at the time of the assessment, gender, ethnicity, birth weight

[9] Mothers for whom hours of work are not available are assumed to be split into part time and full time in the same proportions as those for whom hours data are available. In our regression analysis, these mothers are captured by a separate dummy variable.

and admission to a special care unit immediately after the birth. We also include controls for the mother's age at the child's birth and her highest level of educational attainment, whether the mother has a partner with whom she lives at 21 months, whether the partner is employed at 21 months and the partner's educational attainment and occupational group (both defined from pre-birth questionnaire data).[10]

We also include a number of variables relating to the household as a whole. Household composition is captured by the number of older siblings and whether the study child has a younger sibling by 42 months. We use two measures to control for the long run economic situation of the household, the first of which is housing tenure at 21 months., whilst the second measure is a subjective measure of financial difficulties in pregnancy. We do not include a post-birth measure of household income in our basic controls but explore how it might act as mechanism by which mothers labour supply impacts on child attainment later.

Panel B in Table 2 shows the breakdown of selected characteristics for each early maternal employment category. It shows that the types of women in each category vary substantially. Mothers who return to work by 18 months tend to be older than those who return later – 83 per cent of early full time workers were aged over 25 at the birth, compared with 74 per cent of mothers who had not returned to work by 34 months. Despite this, mothers who were in work by 18 months are more likely to have just had their first child than those returning later, and this is particularly true for women working full time. Panel B also shows that early maternal employment is associated with higher educational attainment of both the mother and, to a lesser extent, her partner. The main difference between mothers who return to full instead of part-time work is education. Almost twice as many mothers working full-time before the child is 18 months old hold a degree as those working part-time. Interestingly, the proportion of mothers of non-white children is greater amongst women who return full time by 18 months than those who work fewer hours or return later. Mothers who are in work by 18 months are less likely to be lone parents at 21 months and were less likely to experience financial difficulties during the pregnancy. Finally, we provide

[10] In the ALSPAC survey the identity of the 'partner' is defined by the mother. Although we use the terms 'father' and 'partner' interchangeably in this paper it is important to note that the mother-defined partner may not be the biological father of the child.

some evidence that maternal labour supply is influenced by the health characteristics of the child. Mothers who remain at home until at least 34 months are more likely to have had a low birth weight baby than those who have gone back to work.

In Panel B we also present the mean scores for each of our measures of child development, according to the mother's early employment status. It is noticeable that the raw correlation between early maternal employment and child outcomes is positive. The children of mothers who return full time by 18 months score on average more than a point higher on every measure than the children of mothers who have not returned to work by 34 months. Given the differences in the characteristics of the mothers in each group, however, regression analysis is needed to disentangle the causal effects of maternal employment from the influence of other confounding factors.

Additional background controls

We explore the extent of any bias in our basic estimates by sequentially introducing two groups of additional controls (all derived from questionnaire data given prior to the birth)[11]. The first group consists of variables designed to capture the mother's 'market ability'. These variables cover her previous and subsequent employment status, or more specifically her occupational grouping (defined according to her last job prior to the birth), whether she worked in pregnancy, her hours of work in her last pre-birth job and whether she was employed at 47 months. We also include two variables that predict access to maternity leave rights – the gestation at which she stopped work and whether she had moved to the Avon area in the year before conception[12]. As leave rights will affect return times and are correlated with attachment to the labour market it may be important that we condition on having leave rights. The group also includes variables that capture the mother's long-run physical health – the mother's self-report of her health prior to the pregnancy and her body mass index, or BMI, which is her pre-pregnancy weight in kilograms divided by her height squared. We also control for the extent and depth of the mother's social support

[11] For additional information on many of measures used in our analysis, and in particular the psychological measures, see http://www.alspac.bris.ac.uk/ALSPACext/MainProtocol/Appendix%203_files/Contents.htm

[12] The ALSPAC dataset does not contain direct information on whether mothers qualified for maternity rights or not.

networks. We might expect that women who work outside the home have a wider social network than those who do not work outside the home. The social network subscore is derived from questions relating to the *number* of people on whom the mother can rely for various types of support, for example, the number of people with whom she could discuss an important decision. The social support subscore relates more to the mother's feelings about the level of emotional support she receives. The two subscores are each split into three quantiles in our analysis. The final controls in the first group are for whether the mother's father and mother had any educational qualifications.

The second group of controls is designed to capture the mother's attitudes in general and towards childrearing in particular. The Crown-Crisp Experiential Index (CCEI) is derived from the responses to 23 questions relating to anxiety, depression and somaticism. Mothers' total scores on this measure – which range from 0 to 46 – were divided into quartiles for use in our regression analysis. We also include scores from the Inter-Personal Sensitivity Measure (IPSM) which is composed of five subscores for inter-personal awareness, need for approval, separation anxiety, timidity and fragile inner self. These scores were again divided into four discrete categories in our analysis. The third measure is from a 12-point locus of control scale, which captures the extent to which the mother perceives that events in her life are a consequence of her own behaviour. This score was subdivided into three categories, which distinguish the extremes of the distribution.[13] The 'attitudinal' group of controls also includes variables relating to the mother's consumption of alcohol, tobacco and hard drugs in pregnancy and a number of measures of her childhood and family background. These capture the parenting behaviour of the mother's mother and whether she was present in the home throughout the mother's childhood; the self-reported happiness of the mother's early life; and a score relating to the number of disruptive life events that occurred before the age of 17.[14]

[13] The correlations between the CCEI score and the IPSM and locus control scores are 0.35 and 0.20 respectively, and 0.01 between the IPSM and locus of control. These correlations are relatively low and so we can be reasonably confident that they capture different aspects of the mother's psychology, each of which may influence child development in different ways.

[14] As noted earlier we do not retain all these controls in our final estimates of the net effect of early maternal employment on child outcomes. The intention here is to check for the robustness of estimated

Measures of parenting behaviour

The ALSPAC dataset is unique in that it contains a rich variety of measures of the parental inputs into child rearing. Our basic measures of parenting behaviour, which we term the maternal, paternal and total parental interaction scores, are derived from the responses to nine questions in a questionnaire at 18 months. These questions concern how frequently the mother (partner) engages in a range of activities with the child such as feeding, playing with toys, reading to the child and taking the child for walks. Responses are scored on a scale of 0 to 4 as follows: never (0), less than once a week (1), 1 to 2 times a week (2), 3 to 5 times a week (3) and almost daily (4). The scores are then summed to give a total interaction score for mothers and partners with a maximum of 36 and a total parental interaction score with a maximum of 72. In order to investigate whether the composition of total parental involvement matters for child outcomes we also create a variable that is the mother's share of the total parental interaction.

A number of further measures of parental involvement are also available but these relate to the mother's input only. Mothers were asked if they tried to teach their child a range of 10 different topics such as the alphabet, shapes, colours and songs. Each response of yes was scored as one point and summed to give an overall range of teaching score. Mothers were also asked how frequently they talked to their child whilst doing housework, with possible responses of never, rarely, sometimes, often and nearly always. Finally, an outings outside the home score was derived from information about how frequently the mother takes the child to visit 5 different places such as the library, places of interest and friends and family. Responses were scored from 0 to 4 and summed to give an overall score with a maximum of 20.

The mean parenting scores for households with different types of early maternal employment are shown in Panel C of Table 2. In general, children of working mothers seem to receive slightly more parental interactions than the children of non-working mothers, particularly along the dimension of father involvement. Again, however, we cannot tell whether this is related to employment itself or to other correlated characteristics of the mother such as her own educational attainment.

Measures of household income

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relationships to the inclusion of fuller sets of background controls. A list of the variables retained and those dropped is given in Appendix Table 1.

Despite the richness of the ALSPAC data in some areas, information on the finances of the household is quite limited. We have no measure of household income prior to 33 months and no data on individual earnings whatsoever. We cannot, therefore, directly assess the contribution of the mother's earnings to the household in the child's first three years, nor the effect that this additional income has on child outcomes. Our best available measure for capturing the financial circumstances of the household is the average of net household income at 33 and 47 months, expressed in June 1995 prices[15]. The figures in Table 2 show a clear positive raw correlation between household income and early maternal employment, as we would expect.

Measures of non-maternal childcare

Data is available on the types of non-maternal childcare used regularly at various points in the child's early life but we have no information on the quality of care given by individual providers. We distinguish three types of non-maternal care. Relative care is provision by a relative, friend or neighbour. Non-relative care is defined as any paid provision that is not centre-based, be it inside or outside the home – this covers providers such as child minders, nannies and babysitters. Finally, centre care relates to day nurseries, crèches and the like. Households may use more than one type of care simultaneously and the amount each type is used may vary substantially. For example, non-relative care covers a few hours a week with a babysitter to 40-plus hours per week with a childminder.

We organise the childcare data in a hierarchical manner. Because centre-based care is relatively rare, we first group together all families that used centre care for more than 5 hours a week, regardless of their other arrangements. Of the 341 households that use centre care at 15 months (3.3% of the total sample), 298 also used some additional type of paid or unpaid care. However the mean hours of centre care per week was 30 and more than 80% of these households placed their child in centre-based care for 20 or more hours a week.

Amongst households that did not make use of centre-based care, we distinguish between those who used 20 or more hours a week of non-relative care and those who

[15] Income data from the ALSPAC data is banded. We imputed a median value for each band using data from the Family Expenditure Survey. These values were then expressed in real terms and averaged to reach a total income figure.

used less than 20 hours. The first of these groups we term as using 'predominantly non-relative care'. Although more than 80% of this group do use some amount of relative care as well, on average their children experience 37 hours of non-relative care per week and only 19 hours of relative care. For the 'predominantly relative care' group, children receive an average of 2 hours of paid care and 36 hours of unpaid care. Essentially, then, we categorise children who have received no centre-based care into those that have been substantially exposed to paid formal childcare and those that have not.

Our focus is on behaviour in the child's early years, and particularly in the first 18 months, so we report only the results relating to childcare provision at 15 months. However, we also include controls for the type of provision at 38 months. Panel C of Table 2 contains data on the childcare arrangements of families according to the mother's early employment status. Care by a friend or relative, in addition to the mother, is extremely common in households where the mother works part time or not at all. Extensive use of non-relative care and the use of centre-based care, however, are concentrated almost exclusively among the employed, particularly those working full time by 18 months. It is notable that even for full time mothers, centre-based care is relatively rare at 15 months.

5. Results

Is early maternal employment harmful to children's development and does its effect vary with the timing and intensity of work?

As noted previously, most of our analysis relates to differences in outcomes for children whose mothers returned to work: full time before 18 months; part time before 18 months; in the period 19 to 34 months; and not at all by 34 months. This way of classifying return to work dates was not arbitrary as we chose a specification that maximised the log likelihood for a three-way catagorisation for the two test scores at age 7.

Table 3 gives some estimates of the effects of early maternal employment for each of the three measures of cognitive development. All the estimates show the effect of each type of maternal employment relative to the outcomes of children whose mothers

have not returned to work by 34 months (each regression contains the same controls for a basic set of household characteristics). The first column for each measure gives a disaggregated specification that allows the effect of early maternal employment before 18 months to vary with the timing of return. We break down the 0 to 18 month window into three periods: 0 to 4, 5 to 8 and 9 to 18 months. These intervals are of particular interest because the right to statutory maternity pay expires in the first interval and provides the first substantive group returning at ages akin to that seen in the US. The right to reinstatement in one's pre-birth job expires in the second interval. Burgess et. al. (2002b) show that large numbers of women return to work at these two expiry dates and also that the composition of those returning at the two points differs. Looking at full time workers, there is a general weak negative result for return at anytime in the first 18 months, with no greater negative effects at earlier return dates. There is no clear pattern for part time workers. However, for every measure we cannot reject the hypothesis that the model collapses to the more parsimonious specification shown in the second column. We have explored any variation in these return time patterns with or without further conditioning on maternal ability, employment patterns and attitudinal controls (as used in Table 4) and these time groupings appear robust. Note though that there are very few mothers returning directly to full-time work after 8 months.

Having established our definition of early maternal employment, we can now go on to examine the sign and magnitude of the effects. Table 4 shows how our estimates vary with the inclusion of different groups of controls. The first column essentially gives the raw correlations – the only control variable in these regressions is the age of the child in months at assessment. It is clear that if we do not control for confounding factors the observed relationship between early maternal employment and cognitive outcomes is quite strongly positive, and more so for full time work than for part time work before 18 months. This positive association disappears when we control for a basic set of household characteristics (Column 2 of Table 4). Relative to mothers who had not returned by 34 months, we find no evidence of negative effects from part-time working prior to 18 months, nor from returning to work between 19 and 34 months for any of the attainment measures. If anything the effects are slightly positive but very small and not significantly different from zero. The estimates of the effect of returning to work full time prior to 18 months are negative for both of the later

cognitive measures – at age 7 or 8 – but significant only for the ALSPAC literacy score (and then only at the 5 per cent level).

Is there any evidence of bias due to heterogeneity in the basic estimates and if so in which direction does it work?

We have seen that controlling for a broad set of family characteristics eliminates the positive association between early maternal employment and child outcomes. It follows that the observable characteristics of working mothers are relatively advantageous for child development. It may be that they possess characteristics that are not controlled for in our regressions that are also relatively advantageous, so that we are underestimating the negative effects of maternal employment. Of course, as outlined in Section 2, our estimates are also potentially biased in the opposite direction so that we are underestimating the *positive* effects of working.

We investigate the extent of any bias by controlling for a rich set of background variables. We introduce two groups of variables and for each we assess the extent and direction of the bias in our estimates due to their omission from the basic model.

We begin by adding a set of controls designed to capture aspects of the mother's 'market ability'. The hypothesis we examine here is that ability in the market and in childrearing are positively correlated so that our basic estimates of the effects of maternal employment are biased upwards. Column 3 of Table 4 shows our results when this group of variables is included. If the hypothesis were correct then we should see a fall in the estimated effects. In general, we find little evidence that this is the case. There are no substantive changes in the magnitude or sign of the estimates given in Column 2.

The second group of controls that we add are designed to capture the mother's attitudes. We might expect that if working mothers are less orientated towards childrearing in general then the estimated effects of employment will be biased downwards. The inclusion of this set of controls would then have the effect of raising

the cofficients on employment. [16] Column 4 of Table 4 shows the result of adding in our 'attitudinal' controls to the specification in Column 3. Hence we retain all the 'ability' variables as well as the basic controls. Our results suggest that heterogeneity in maternal attitudes and psychology is not a cause of substantial bias in our basic estimates. Again we see little change in the coefficients when we move from Column 3 to Column 4. If anything the coefficients on early full time work become marginally lower rather than higher.

Our final estimates that correct as far as possible for all sources of background heterogeneity are given in Column 5. As noted in Section 4, we retain only those additional controls that have explanatory power in at least one regression. (Which variables are henceforth included or excluded are detailed in Appendix Table 1.) Comparing Columns 2 and 5 reveals no clear pattern in the effect of controlling for our additional factors. Hence we can find little evidence for residual heterogeneity biasing the estimates presented in column 2. By definition, we have only controlled for observable factors in our regressions. The rich nature of the ALSPAC data, however, allows us to control for a far wider variety of variables than in other studies. Optimistically, we might hope that the type of controls we have added help to proxy to some extent for truly unobservable factors such as maternal attitudes. Although we cannot hope to have 'mopped up' all the heterogeneity between mothers our results are encouraging. Our basic estimates change only slightly when a whole range of other factors are controlled for.

Although the negative effects of early full time work are insignificant relative to not working by 34 months for the Key Stage 1 tests, children of mothers working full time would do significantly better on this test if their mothers delayed their return until after 18 months. Given our positive (albeit non-significant) estimate of the effect work between 19 and 34 months, F-tests (not shown) suggest that delaying return until the 19 to 34 month period results in significantly higher Key Stage 1 scores even though the full time coefficients are not significant when compared with remaining at

[16] Note that we make no assumptions about the way in which the measures of the mother's psychology (such as the inter-personal sensitivity measure) are related to the child outcomes. All we test is whether controlling for such measures affects our estimates of the effect of maternal employment.

home until at least age 3. Similarly, the children of mothers working full time before 18 months would score significantly higher on the ALSPAC literacy score if their mothers reduced their hours or delayed return until after 18 months.

For each of our cognitive measures a coefficient of 1 corresponds to a change of one tenth of a standard deviation of the variable in question. To illustrate, the largest negative effect that we identify in Column 5 suggests that full time work prior to 18 months lowers a child's ALSPAC literacy score by slightly less than one tenth of a standard deviation compared to the children of mothers who do not work before 34 months. For ease of comparison we normalise the estimates from other studies so that again a coefficient of 1 corresponds to a change of one tenth of a standard deviation of the variable in question. Waldfogel et. al. (2002) report significant effects of first year full time maternal employment ranging from -1.9 to -2.3 on five measures of cognitive development. The effect of part time work is generally negative but smaller than for full time work and generally insignificant. The positive effects of employment between 12 and 36 months vary between 1.0 and 1.8 but are significant on only two measures. Han et. al. (2001) do not distinguish between full and part time work in the first year and report slightly larger estimates ranging from –2.6 to –4.5. Work between 12 and 36 months again has positive effects, in the region of 1.2 to 4.0. Ruhm (in press) finds significant effects ranging from -1.2 to -1.5 depending on the measure used and the period in question.

It can be seen that our coefficient of –1.0 for the effect of early full time work on the ALSPAC literacy score is not wildly out of line with some previous estimates but is at the lower end of the spectrum of US results. However, a fair description of the results in Column 5 would be that in general the effects of early maternal employment on child cognitive outcomes are very small. Our finding of some negative effects for full time work before 18 months suggests that the intensity of post-birth employment matters.

5.2 Sub-group analysis

The following results explore how the effects of early full time maternal employment vary across maternal education and lone parent status. We also experimented with interacting early part time work and return between 19 and 34 months with the

variables in question. However, we found no systematic variation in these effects and in every case the interaction terms were jointly insignificant and so were dropped from the regressions.

Are the children of more 'able' mothers more or less vulnerable to the effects of early employment?

The regressions shown in Table 5 interact early full time maternal employment with the education level of the mother. The interacted terms give the effect of returning full time before 18 months, relative to not returning by 34 months, for each of the four sub-groups. It is immediately striking that the effects for the lowest educational group are positive and quite large in magnitude. Any negative effects of early full time employment are concentrated solely among mothers who have attained a minimum of an O level or vocational qualification.

These results are consistent with the hypothesis that the children of the least skilled mothers have the 'least to lose' when their mothers are absent due to market work. Early full-time work among the least educated is quite rare, however (they account for 16 percent of the total sample but only 7 percent of the mothers who have returned full time by 18 months). Table 5 shows that the level effect of having a mother in the lowest educational group is significantly negative. When that mother works, however, this effect is offset, perhaps because the alternative care received when the mother is at work is of a higher relative quality. We also explored the whether the effect of early full time maternal employment varied with an indicator of household poverty measured prior to the birth. These results worked in the same direction as mothers' education (in that less advantaged households experienced fewer negative effects) but were less clearly identified.

Are children in 'traditional' two-parent families more or less vulnerable than the children of lone parents to the effects to early maternal employment?

Table 6 shows the differential effects of early full time maternal employment according to whether the mother lives with a partner at 21 months. We cannot reject the null hypothesis of no difference in the effect across the two sub-groups in any of the regressions. However, the pattern of the coefficients does suggest that children in two-parent families may be worse affected by early maternal employment than the

children of lone mothers. In two out of the three regressions the estimated impact of employment for lone mothers is positive and in every case it is more positive (less negative) than for two-parent families. These results suggest a similar interpretation as for the results according to the mother's educational attainment. Mother's earnings may be particularly beneficial in single parent families if other income sources are deficient or the quality of child rearing provided by lone mothers may be low relative to the alternative.

5.3 What are the mechanisms by which early maternal employment affects child outcomes?

We now turn to the explicit analysis of the routes by which maternal employment may influence child outcomes. As well as parental inputs, income and childcare, which are discussed here, we also explored potential roles for breastfeeding and maternal stress and tiredness. These dimensions were not strongly correlated with outcomes and are not reported here but can be found in Gregg and Washbrook (2003).

Parental inputs

The first step in our attempt to understand the causal routes by which employment affects child development is to investigate how early maternal employment affects the inputs into child rearing of mothers and their partners. The first three columns of Table 7 show the effect of early maternal employment on our maternal, paternal and total parental interaction scores. As discussed in Section 4, these scores give us a rough measure of how frequently the parents engage in a range of basic activities that actively involve the child. Even after we control for a wide variety of background characteristics, we find that mothers who have returned to work full time engage in significantly fewer interactions with their children at 18 months than those who have not started back at work. Interestingly, part time work seems to have no significant effect on the mother's involvement. These results are consistent with the idea that working mothers organise their time in such as way as to minimise the disruption to their children. Those who work for less than 30 hours a week are able to do this sufficiently that they do not spend less time engaged actively in childcare than non-working mothers. As the number of hours worked lengthens a reduction in child interaction becomes unavoidable.

The second column of Table 7 reports results from an identical specification relating to the partner's interaction score. It is striking that the partners of mothers who have returned to work are significantly more involved in child related activities at 18 months than the partners of non-working mothers. This is the case even where the mother works part time (although

full time maternal employment is associated with significantly greater partner involvement even than part time work). Column 3 gives estimates of the impact of maternal employment on the total amount of parental interaction a child receives. We find no evidence that the children of mothers who return to work early receive less parental involvement overall and, in fact, the children of mothers who return part time receive significantly more in total.

It is possible that the types of activities engaged in by mothers and their partners differ. The composition of total parental interactions may then be different for the children of working mothers because a greater proportion is undertaken by partners and partners may be less efficient in imparting child learning in these activities. So in what follows we explore whether partner's care can effectively substitute for mother's care. Table 7 also includes three further measures that may capture other aspects of the quality of maternal investments in the child (partners' scores on these indicators are not available). The results of these regressions suggest that early maternal employment does not have a uniform effect on the quality of mothers' investments. On average, mothers who have returned full time teach their children the same range of material as mothers who are not in work, they talk more frequently to their children during housework but take their children on fewer outings at 18 months. The way in which these differences in parenting styles affect children's development is an empirical matter that we explore in Table 8.

For each of the child outcome measures the first column in Table 8 reproduces our heterogeneity-corrected estimates of the average effects of early maternal employment from Table 4. The second column introduces controls for three quantiles of total parental involvement and also for the proportion of the total interaction score that is accounted for by the mother's input (divided into four quartiles). The first point to note is that parental involvement is positively related to cognitive outcomes but this effect is not large. The inclusion of the mother's share of parental interactions allows us to see whether the *composition* of parenting involvement matters for child outcomes, holding constant their level. It allows us to explore, for example, whether the specialisation in child rearing by the mother has beneficial effects for children. The results for the Key Stage 1 and ALSPAC literacy scores indicate that higher shares of parenting undertaken by the partner are in fact associated with significant improvements in child cognitive outcomes. The mean proportion of parental interactions accounted for by the mother even in the lowest quartile is 0.51, so we must interpret these results, then, as evidence that the more *equal* division of parenting is associated with higher outcomes. We cannot be certain what the effect would be if the partner's share were substantially greater than the mother's as the pattern is not observed sufficiently frequently.

The comparison of columns 1 and 2 shows that the inclusion of controls for the level and composition of parental involvement serves to lower the coefficients on early maternal employment. The patterns of parental involvement associated with maternal employment, therefore, are relatively advantageous. To put it another way, if parenting behaviour in households where mothers work were the same as in households where mothers do not work the negative impact of early employment would be greater. This effect seems to work largely through the mechanism of greater partner involvement which has a beneficial influence on child outcomes – strong enough to outweigh the effects of lower maternal involvement when mothers are employed.

The third column for each measure in Table 8 introduces controls for other aspects of the quality of maternal inputs. The frequency that the child is taken on outings by the mother at 18 months is positively related to later Entry Assessment scores although it has the opposite sign in the ALSPAC literacy score equation. It is possible that the amount of outings undertaken by the mother and the partner are negatively correlated and that these results again reflect the beneficial effects of more equal parenting. The mother's range of teaching score is strongly positively associated with later child outcomes even after controlling for factors such as the mother's age and education. It is of course possible that this measure captures feedback from the level of the child's development in that the teaching behaviour of the mother may be partly determined by how receptive the child is. Nevertheless, the strength of these effects up to six years later suggests that teaching does have some beneficial effect on cognitive development. The frequency with which the mother talks to the child whilst doing housework also seems to capture some behaviour that significantly influences child outcomes. For example, it may reflect the degree to which the mother is engaging in multi-tasking to provide stimulation and engage in other activities.

The inclusion of these additional parenting controls again lowers the coefficients on full time early maternal employment. Our results suggest that parenting behaviour in households where the mother is working full time helps to offset the negative effects of maternal employment substantially. We cannot say to what extent the differences in parenting are *caused* by the mother's employment. It may be that the more equal division of parenting would persist if mothers were not in work, for example if mothers with strong tastes for work tend to choose partners with greater interest in child rearing. However, given the results in Table 7 and Table 8 it seems perverse not to attribute at least some of the differences in parenting to the causal effect of mothers' market work.

Do the effects of maternal employment vary with the type of childcare used?

We would like to examine whether, on average, the quality of non-maternal childcare used in households where mothers are employed serves to reinforce or compensate for the negative effects of the mother's absence. The ALSPAC data, however, allow us only to distinguish between the types of childcare used at various points in time. As types of childcare are likely to be correlated with quality this data is still worthy of analysis but one must be careful with interpretation. The quality of childcare of a given type may differ systematically for working and non-working mothers. If this is the case we will not be able to separate out the effects of using a particular kind of childcare from the other effects of maternal employment.

We investigate how the effect of maternal full-time employment varies with the particular type of childcare used. The results in Table 10 (the most left-hand column for each dependent variable) are derived from regressions in which the dummy variable for full time employment before 18 months is interacted with the different types of childcare arrangements. All households making use of centre-based care for more than 5 hours a week are grouped together – these account for 10 per cent of the early full time returners. Of those remaining, we distinguish those who rely on care by a paid person inside or outside the home for more than 20 hours per week (predominantly non-relative care) and less than 20 hours per week (predominantly relative care)[17]. Moving down the rows in Table 10, then, is associated with decreasing amounts of paid, formalised childcare. Any families not using one of these forms of arrangement fall into the residual Other category. The coefficients presented relate to the combined effect of both childcare arrangement and full-time employment relative to the base of the average arrangements of those not working prior to 34 months[18].

The far left column of Table 10 details the proportion of mothers working full time by 18 months who used each of the combinations of childcare arrangements. The first column for each measure then shows the associated impact on their children. It is clear that the negative effects of early full time maternal employment are concentrated

[17] See Section 4

[18] Results for the differential effects of part time work are not presented as none of the effects were significant.

in children who attended little or no paid care (i.e. in 45% of the sample whose mothers returned full time by 18 months). Maternal employment has significant and relatively large negative effects when children are placed predominantly in the care of a friend or relative. In contrast, we find no significant negative effects after age 2 when the child attends a paid provider and there is some suggestion that working in conjunction with centre-based care may lead to significantly higher child outcome scores. The coefficients shown in Table 10 are the estimated effects of each combination, relative to a base of no return by 34 months. We also tested whether outcomes were significantly better for the children of mothers who returned to work early part time or after 18 months. We found, for example, that early full time work combined with predominantly relative care results in signifcantly lower Key Stage 1 outcomes when compared with both part time and delayed return, even though it is not significant against the base of no return by 34 months. In general, however, we find little difference in the effects of early full time work depending on whether they are evaluated against the alternatives of early part time work, work after 18 months or no return by 34 months.

Our results highlight the crucial importance of the childcare available to working mothers. High quality care may offset entirely any adverse effects from the mother's absence. Long hours of informal unpaid care, on the other hand, do not have these benefits and cannot compensate for the loss of parental inputs. The suspicion is that there is too little cognitive stimulation in these informal care settings.

We have now identified a particular group of children for whom early full time maternal employment may be significantly damaging – those exposed to long hours of informal care. The next question regards which families fall into this (relatively small) category. If, as we might expect, it is lack of financial resources that prevents the use of formal care then we face a contradiction. The results of our sub-group analysis tell us that it is children in the least well-off families who are the least harmed, and may in fact benefit, from early full time maternal employment. Yet we would expect that it is precisely this group that rely on informal childcare and hence should be the worst affected.

Some suggestions for the solution to this paradox are found in a more detailed examination of the employment and care arrangements of the less well-off. Mothers with the lowest education and in households that have experienced financial difficulties are very likely to rely solely on informal care. 70 percent of the mothers who are in the lowest education group and who have returned to work full time by 18 months are using predominantly unpaid care. This compares with 43 percent of the more highly educated early returners. The picture is very similar for those who experienced financial difficulties in the prebirth period – 61 percent of the worse off early returners use mostly relative care, compared with 43 percent of the better off. Interestingly, this is not the case for lone parents. Single mothers are actually less likely to rely on informal care when they work full time than mothers in couples (39 versus 46 percent). This reflects the fact that a substantial amount of relative care is done by the partner – an option potentially not available to single parents.

Although the disadvantaged groups are relatively heavy users of informal care, the absolute number of women in this category is low. This is because they are under-represented in the group of mothers returning early to full time work. Whilst the least educated account for 16 percent of the total sample of mothers, they account for only 7 percent of those back in work full time by 18 months. The gap is smaller for the financially disadvantaged who make up 11 percent of the total sample but only 8 percent of the early return group. In contrast, the proportion of early full time workers who are lone mothers is almost in line with their representation in the sample as a whole.

The net result is that although the least educated and the financially disadvantaged do tend to rely disproportionately on friends and relatives for their childcare, they still comprise only a minority of all the mothers relying predominantly on unpaid care. Of mothers who have returned to work full time by 18 months and who are not using any form of formal care, only 12 percent fall into the least educated category, 11 percent into the financially disadvantaged group and 5 percent are single parents.

It is possible, then, that the lack of paid childcare is not damaging to children in less well-off families and that our negative estimates reflect the effects of this type of care on better-off children alone. This would be consistent with the idea that the quality of

parenting provided by the poor and least educated is of a lower quality and hence that it is only the children of relatively able mothers that suffer from their absence. Alternatively, it may be that a lack of paid childcare is equally harmful to all children with working mothers, but that this effect is offset by other benefits in disadvantaged households (for example if the additional income from the mother's earnings is particularly important when income from other sources is scarce). To test this, we explore whether the effect of early full time work combined with relative care varies with the type of household. We do not interact the three indicators (least educated, financially disadvantaged, lone parent) separately as the addition of another level of interactions reduces the cell sizes drastically. Rather we define a variable that is equal to 1 if the mother falls into *any* of the three vulnerable groups. We then investigate whether the effect of relying on informal care for this group is the same as for the non-vulnerable group.

The results are shown in the second column under each measure in Table 10. It is immediately striking that the negative effects of the full time work/relative care combination are concentrated in better-off households. We find significant coefficients of around –1.5 for this group on the three outcome measures. The estimates of the effect of these arrangements on the vulnerable groups, however, are all positive. We conclude that the use of predominantly relative care is damaging only for children in the more advantaged households and that children in less advantaged households benefit from (or at least are not harmed by) early full time maternal employment. However, we are unable to say much about the reason underlying this result. It may reflect the relative quality of the parenting that would be provided were the mother not to work, the importance of the mother's earnings or, potentially, the differential quality of care provided by the friends and relatives of the two groups.

6. Discussion

The results of our regression analysis combine to give a rounded picture of the effects of early maternal employment on child outcomes. On average, it is only full time work before the child is 18 months of age that seems to have any adverse consequences for children's cognitive development and these effects are quantitatively small and often insignificant. Part time work and work after 18 months

are, if anything, slightly beneficial. These conclusions are robust to the inclusion of a wide range of background control variables and we find no evidence that our estimates are subject to a substantial omitted variables bias.

The small average negative effect of early full time maternal employment does disguise some variation in the effect across different sub-groups of the population. The children of the least educated mothers and of lone mothers appear overall not to be disadvantaged when their mothers work, leaving the negative effects concentrated amongst the children of the more advantaged. These results suggest that the balance of benefits and disadvantages associated with maternal employment differs in different families. In particular, they are consistent with the hypothesis that the mothers' earnings are particularly beneficial when income from other sources is low, and also with the hypothesis that the quality of maternal care in these families is relatively lower than the quality of the alternative care used.

The way in which the child is affected by maternal employment depends on the type of non-parental care used by the family. It is only the children of mothers who work full time before 18 months *and* whose non-parental care consists largely of care by a friend, relative or neighbour who experience significant detrimental effects of maternal employment. The use of paid childcare, including child minders, protects children from these negative effects. These results highlight the interdependence between the quality of parental care and the quality of non-parental care in determining the overall impact of maternal employment. Whether a child is disadvantaged by maternal employment depends on the quality of the care the child receives *relative* to that which would be provided by the mother. According to our analysis, it is only the children of a group of relatively unusual women that suffer significant negative effects when their mothers work. Women who are in full time work by 18 months and who use little or no paid childcare account for only around 6 per cent of all women in the sample and only around 9 per cent of the mothers who have returned to work by 34 months. In the majority of cases the difference in the child's environment caused by maternal employment is not sufficient to significantly affect their cognitive development.

Our results further suggest why the adverse effects are so muted. First, the mothers reduced input into parenting is offset by substantially greater involvement of the father to the extent that total parenting inputs are not reduced. Indeed fathers greater involvement is marginally beneficial for the childs development. Whilst we almost never see fathers doing more than half of total child rearing functions, father taking on a quarter or more seems moderately beneficial compared to where the father is not involved at all. This does not imply fathers are better for child rearing but that there may be diminishing returns to one parent providing stimulation for the child. In other words the fathers first hour of involvement is more valuable than the mothers thirtieth. In addition working mothers engage in more multi-tasking and avoiding reducing reading and teaching inputs. These responses to the mother working serve to reduce the negative effect that would have occurred in their absence. Higher family income works in the same direction.

Overall our results have a number of policy implications. Maternal employment has harmful effects on children only if certain risk factors are present and virtually all of these factors can potentially be manipulated by appropriate policy interventions. Our finding that it is only early full time work that may be problematic suggests that policies that encourage the adoption of flexible and part time working practices, and also that enable mothers to remain at home for longer after a birth, will minimise any negative effects of maternal employment. Further, we emphasise the importance of access to affordable childcare, particularly for very young children. Finally, the positive role of the father in offsetting adverse effects from the mothers absence by getting more involved could be supported by improved leave rights for fathers or more flexibility in who and how post-birth leave can be taken.

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Table 1: Sample sizes and correlations between child outcome scores

	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
Entry Assessment (4 or 5 years)	1.00		
ALSPAC literacy (7 years)	0.39	1.00	
Key Stage 1 (7 or 8 years)	0.58	0.80	1.00
Sample size	4607	6792	5562

Table 2: Descriptive statistics for the four categories of early maternal employment: selected characteristics

Figures are the proportion of observations in each category unless otherwise stated.

	Date of mother's return to work			
N = 10202	0 – 18 months FT	0 – 18 months PT	19 – 34 months	not by 34 months
Panel A:				
% of sample	13.5	43.7	9.2	33.6
Of which:				
Full time	-	-	0.9	-
Part time	-	-	8.3	-
Of which:				
0 – 4 months	6.8	15.9	-	-
5 – 8 months	4.9	13.9	-	-
9 – 18 months	1.8	13.9	-	-
Panel B:				
Mother's age				
<20	1.7	2.3	6.0	6.1
20-25	15.0	18.7	23.5	20.2
26-35	70.8	72.0	64.0	65.6
36+	12.6	7.0	6.4	8.1
Older siblings: none	63.0	42.6	35.9	37.1
Mother's education				
cse/none	7.6	12.5	18.2	22.5
voc/o-level	33.1	44.7	52.2	47.2
a-level	31.1	28.1	19.2	19.5
degree	28.1	14.7	10.5	10.8
Partner's qualifications				
cse/none	17.3	17.5	24.2	25.0
voc/o-level	28.9	31.9	31.2	28.3
a-level/higher	53.8	50.6	44.6	46.6
Race: nonwhite	6.5	3.5	3.7	3.9
Living with partner at 21 months	94.2	96.0	90.9	89.0
Poor prebirth: yes	8.1	9.6	13.4	13.5
Birthweight: very low (<2.5kg)	4.4	4.1	4.2	5.5
Mean child outcome scores				
Entry Assessment (4 or 5 years)	101.45	100.46	100.05	99.56
ALSPAC literacy score (7 years)	100.57	100.28	99.79	99.42
Key Stage 1 (7 or 8 years)	101.16	100.64	100.17	99.39
Panel C				
Childcare at 15 months				
Any centre care	9.7	4.1	0.9	0.8
Predominately non-relative care	38.4	9.4	1.0	1.3
Predominately relative care[1]	45.2	77.8	79.5	73.3
Parenting scores at 18 months				
Mother's interaction score	31.4	32.4	32.3	32.3
Partner's interaction score	25.9	24.6	22.9	22.8
Mother's range of teaching score	8.3	8.0	7.9	7.9
Outings score	9.7	9.8	9.4	9.4
Net weekly household income (1995£)	399	324	281	273

1. Households are classed as using predominantly relative care if they used paid care for less than 20 hours a week. Any households that used centre-based care for at least 5 hours a week fall into the separate ‘Any centre care’ category.

Table 3: Disaggregated and aggregated estimates of the effects of early maternal employment (basic controls included)

Age of child at return (months)	Entry Assessment (4 or 5 years)		ALSPAC literacy (7 years)		Key Stage 1 (7 or 8 years)	
	PT	FT	PT	FT	PT	FT
0 -18 months PT	-	**-0.044** (0.331)	-	**-0.127** (0.293)	-	**0.024** (0.304)
0 - 4 months	**-0.214** (0.430)	-	**-0.361** (0.387)	-	**-0.113** (0.399)	-
5 - 8 months	**-0.055** (0.459)	-	**0.045** (0.405)	-	**0.014** (0.417)	-
9 - 18 months	**0.181** (0.461)	-	**-0.050** (0.415)	-	**0.199** (0.430)	-
0 -18 months FT	-	**0.036** (0.481)	-	**-0.994**** (0.418)	-	**-0.507** (0.441)
0 - 4 months	**0.228** (0.619)	-	**-0.634** (0.540)	-	**-0.434** (0.567)	-
5 - 8 months	**0.092** (0.709)	-	**-1.375**** (0.614)	-	**-0.462** (0.654)	-
9 - 18 months	**-0.950** (1.143)	-	**-1.400** (0.972)	-	**-1.086** (1.047)	-
19 – 34 months	**0.359** (0.488)	**0.355** (0.488)	**0.352** (0.440)	**0.352** (0.440)	**0.462** (0.453)	**0.460** (0.453)
Test of restrictions:	P>F = 0.8294		P>F = 0.7275		P>F = 0.9446	
adj R2	0.2374	0.2378	0.1137	0.1131	0.2008	0.2008
N	4607	4607	6792	6792	5562	5562

Notes

1. All regressions include controls for: Age of child in months at assessment, child's gender, child's ethnicity, birth weight, admission to a special care unit at birth, mother's age at birth, mother's education, lone parent status at 21 months, the education and occupation of the partner and the partner's employment status at 21 months, number of older siblings, the presence of a younger sibling by 42 months, housing tenure at 21 months, an indicator of financial deprivation during pregnancy
2. The F-test of restrictions tests the hypothesis that the effects of part time work before 18 months do not vary with the date of return and that simultaneously the effects of full time work do not vary with return date.
3. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
4. Standard errors are given in brackets.
5. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
6. The measure of maternal employment refers to the age of the child in months at which she returned to work.
7. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.

Table 4: The effects of early maternal employment on children's cognitive outcomes: various specifications

Maternal employment	(1) No controls	(2) Basic controls	(3) Basic + 'ability' controls	(4) Basic + 'ability' + 'attitudinal' controls	(5) Final specification
	Entry Assessment (4 or 5 years) N = 4607				
0 -18 months PT	**1.000***** (0.342)	**-0.044** (0.331)	**-0.050** (0.395)	**-0.098** (0.396)	**-0.021** (0.390)
0 -18 months FT	**1.948***** (0.495)	**0.036** (0.481)	**-0.203** (0.544)	**-0.293** (0.545)	**-0.196** (0.540)
19 – 34 months	**0.261** (0.522)	**0.355** (0.488)	**0.486** (0.506)	**0.502** (0.507)	**0.532** (0.506)
adj R2	0.1073	0.2378	0.2462	0.2500	0.2490
	ALSPAC literacy (7 years) N = 6792				
0 -18 months PT	**0.907***** (0.298)	**-0.127** (0.293)	**-0.031** (0.348)	**-0.046** (0.348)	**0.000** (0.345)
0 -18 months FT	**1.157***** (0.420)	**-0.994**** (0.418)	**-0.908*** (0.475)	**-0.930*** (0.475)	**-0.866*** (0.471)
19 – 34 months	**0.398** (0.461)	**0.352** (0.440)	**0.551** (0.457)	**0.512** (0.457)	**0.563** (0.457)
adj R2	0.0072	0.1131	0.1210	0.1246	0.1212
	Key Stage 1 (7 or 8 years) N = 5562				
0 -18 months PT	**1.289***** (0.317)	**0.024** (0.304)	**0.161** (0.361)	**0.160** (0.361)	**0.153** (0.357)
0 -18 months FT	**1.755***** (0.456)	**-0.507** (0.441)	**-0.449** (0.497)	**-0.453** (0.498)	**-0.441** (0.494)
19 – 34 months	**0.619** (0.488)	**0.460** (0.453)	**0.592** (0.470)	**0.599** (0.470)	**0.614** (0.470)
adj R2	0.0550	0.2008	0.2098	0.2137	0.2126
Controls included:	A	A, B	A, B, C, D	A, B, C, D, E, F	A, B, C, E

Groups of controls

A. Age of child in months at assessment
B. Child's gender, child's ethnicity, birth weight, admission to a special care unit at birth, mother's age at birth, mother's education, lone parent status at 21 months, the education and occupation of the partner and the partner's employment status at 21 months, number of older siblings, the presence of a younger sibling by 42 months, housing tenure at 21 months, an indicator of financial deprivation during pregnancy
C. Mother's occupation, mother's employment status before the birth and at 47 months, the mother's pre-birth social networks and social support scores, the educational attainment of the mother's mother.
D. Gestation at which stopped work, lived in Avon less than a year at conception, pre-pregnancy physical health and body mass index, the educational attainment of the mother's father.
E. Mother's pre-birth CCEI score, inter-personal sensitivity score and locus of control score.
F. Consumption of cigarettes, alcohol and hard drugs in pregnancy, the mother's mother's maternal care score, the childhood happiness and life events in childhood scores, the presence of the mother's mother in the household during childhood.

Notes

See Notes 3-7, Table 3

Table 5: Differential effects of early full time maternal employment by the mother's educational attainment.

	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
Maternal employment			
0- 18 months PT	**0.001** (0.391)	**-0.005** (0.345)	**0.154** (0.357)
0- 18 months FT * cse/none	**1.229** (1.699)	**3.067**** (1.525)	**2.279** (1.567)
0- 18 months FT * vocational / O level	**-1.221** (0.760)	**-1.406**** (0.695)	**-0.813** (0.701)
0- 18 months FT * A level	**0.237** (0.819)	**-1.151** (0.711)	**-0.543** (0.757)
0- 18 months FT * degree	**0.633** (0.958)	**-0.712** (0.767)	**-0.392** (0.855)
19-34 months	**0.533** (0.506)	**0.558** (0.457)	**0.613** (0.470)
Educational attainment (level effects): base = vocational/O-level			
cse/none	**-1.293***** (0.453)	**-1.729***** (0.424)	**-1.862***** (0.421)
A level	**0.720*** (0.370)	**1.008***** (0.331)	**1.011***** (0.344)
degree	**2.773***** (0.527)	**2.735***** (0.439)	**2.808***** (0.477)
Test of equality of interacted terms	P>F = 0.2436	P>F = 0.0486	P>F = 0.3196
adj R2	0.2490	0.1217	0.2126
N	4607	6792	5562

Notes

1. Regressions include controls for number of older siblings, the presence of a younger sibling by 42 months, lone parent status at 21 months, gender, birthweight, special care unit at birth, ethnicity, mother's age at birth, education and occupation, mother's employment status before the birth and at 47 months, housing tenure at 21 months, an indicator of financial deprivation during pregnancy, the education and occupation of the partner and the partner's employment status at 21 months, the mother's pre-birth CCEI score, inter-personal sensitivity score and locus of control score, the mother's pre-birth social networks and social support scores and the educational attainment of the mother's mother.
2. See Notes 3-7, Table 3

Table 6: Differential effects of early full time maternal employment by lone parent status

	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
Maternal employment			
0- 18 months PT	**-0.027** (0.391)	**-0.005** (0.345)	**0.147** (0.357)
0- 18 months FT * does not live with partner	**1.179** (1.796)	**-0.728** (1.645)	**0.890** (1.672)
0- 18 months FT * lives with partner	**-0.279** (0.550)	**-0.890*** (0.479)	**-0.519** (0.503)
19-34 months	**0.530** (0.506)	**0.563** (0.457)	**0.613** (0.470)
Lone parent status (level effects): base = lives with partner			
no partner	**-1.443*** (0.787)	**-3.788***** (0.719)	**-2.973***** (0.726)
has partner but do not live together	**0.980** (1.098)	**-2.034**** (0.979)	**-1.720*** (1.004)
Test of equality of interacted terms	P>F = 0.4222	P>F = 0.9225	P>F = 0.4047
adj R2	0.2489	0.1211	0.2126
N	4607	6792	5562

Notes

See Notes 3-7, Table 3 and Note 1, Table 5

Table 7: The effect of early maternal employment on parenting behaviours at 18 months

	Mother's interaction score	Partner's interaction score	Total parental interaction score		Mother's range of teaching score	Frequency of talking during housework (mother)[1]	Outings score (mother)
Mean	32.27	24.04	55.20		8.00	-	9.64
S.D.	3.49	6.33	9.38		1.60	-	2.55
0-18 months PT	**-0.139**	**1.118*** **	**0.943*** **		**-0.010**	**0.061***	**0.109**
	(0.103)	(0.182)	(0.223)		0.046	(0.037)	(0.074)
0-18 months FT	**-1.392*** **	**1.621*** **	**0.161**		**0.078**	**0.114****	**-0.233****
	(0.144)	(0.254)	(0.313)		0.064	(0.052)	(0.104)
19-34 months	**0.094**	**0.202**	**0.235**		**0.016**	**0.017**	**-0.018**
	(0.133)	(0.237)	(0.289)		0.059	(0.047)	(0.096)
adj R2	0.0670	0.1603	0.3959		0.1022		0.1088
N	9722	9156	9602		9742	9691	9454

Notes

1. Results from an ordered probit model with categories never/rarely (1), sometimes (2), often (3) and nearly always (4).
2. Regressions include controls for number of older siblings, the presence of a younger sibling by 42 months, lone parent status at 21 months, gender, birthweight, special care unit at birth, ethnicity, mother's age at birth, education and occupation, mother's employment status before the birth and at 47 months, housing tenure at 21 months, an indicator of financial deprivation during pregnancy, log of net average household weekly income at ages 3 and 4, the education and occupation of the partner and the partner's employment status at 21 months, the mother's pre-birth CCEI score, inter-personal sensitivity score and locus of control score, the mother's pre-birth social networks and social support scores and the educational attainment of the mother's mother.
3. Standard errors are given in brackets.
4. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
5. The measure of maternal employment refers to the age of the child in months at which she returned to work.
6. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.

Table 8: The effect of parenting behaviours at 18 months on children's cognitive development and the estimated impact of early maternal employment

	Entry Assessment (4 or 5 years)			ALSPAC literacy (7 years)			Key Stage 1 (7 or 8 years)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Maternal employment									
0-18 months PT	**-0.021**	**-0.118**	**-0.114**	**0.000**	**-0.163**	**-0.155**	**0.153**	**0.004**	**0.001**
	(0.390)	(0.391)	(0.389)	(0.345)	(0.345)	(0.345)	(0.357)	(0.357)	(0.357)
0-18 months FT	**-0.196**	**-0.300**	**-0.336**	**-0.866***	**-1.146****	**-1.222****	**-0.441**	**-0.668**	**-0.713**
	(0.540)	(0.546)	(0.543)	(0.471)	(0.474)	(0.474)	(0.494)	(0.497)	(0.497)
19-34 months	**0.532**	**0.507**	**0.474**	**0.563**	**0.520**	**0.488**	**0.614**	**0.557**	**0.528**
	(0.506)	(0.505)	(0.503)	(0.457)	(0.455)	(0.455)	(0.470)	(0.469)	(0.468)
Total parental interaction score: base = low									
medium	-	**0.658***	**0.125**	-	**0.302**	**0.084**	-	**0.555**	**0.260**
	-	(0.368)	(0.373)	-	(0.332)	(0.338)	-	(0.340)	(0.346)
high	-	**1.011****	**0.051**	-	**0.803****	**0.456**	-	**0.957****	**0.443**
	-	(0.430)	(0.447)	-	(0.385)	(0.403)	-	(0.395)	(0.413)
Mother's share of parental interaction: base = highest quartile									
lowest quartile	-	**0.727**	**1.159****	-	**1.757*****	**1.923*****	-	**1.312*****	**1.548*****
	-	(0.498)	(0.499)	-	(0.444)	(0.447)	-	(0.457)	(0.460)
2nd quartile	-	**0.261**	**0.656**	-	**1.298*****	**1.430*****	-	**1.081****	**1.286*****
	-	(0.459)	(0.459)	-	(0.411)	(0.413)	-	(0.422)	(0.424)
3rd quartile	-	**0.537**	**0.771***	-	**0.804****	**0.898****	-	**0.652**	**0.777***
	-	(0.434)	(0.432)	-	(0.390)	(0.391)	-	(0.401)	(0.402)
Outings score: base = high									
low	-	-	**-0.963****	-	-	**0.694****	-	-	**-0.089**
	-	-	(0.387)	-	-	(0.340)	-	-	(0.356)
medium	-	-	**-0.119**	-	-	**0.682****	-	-	**0.370**
	-	-	(0.349)	-	-	(0.302)	-	-	(0.319)
Teaching score: base = medium									
low	-	-	**-1.493*****	-	-	**-1.138*****	-	-	**-0.754****
	-	-	(0.388)	-	-	(0.348)	-	-	(0.360)
high	-	-	**1.016*****	-	-	**0.832*****	-	-	**0.823*****
	-	-	(0.294)	-	-	(0.263)	-	-	(0.272)
Frequency of talking during housework: base = nearly always									
never/rarely	-	-	**-2.794****	-	-	**-2.773****	-	-	**-2.179***
	-	-	(1.365)	-	-	(1.264)	-	-	(1.308)
sometimes	-	-	**-1.464****	-	-	**0.328**	-	-	**-0.284**
	-	-	(0.606)	-	-	(0.521)	-	-	(0.546)
often	-	-	**0.003**	-	-	**-0.076**	-	-	**-0.157**
	-	-	(0.286)	-	-	(0.257)	-	-	(0.265)
adj R2	0.2490	0.2508	0.2602	0.1212	0.1266	0.1310	0.2126	0.2173	0.2199
N	4607	4607	4607	6792	6792	6792	5562	5562	5562

Notes

1. Column 1 reproduces the estimates from column 5 of Table 4.
2. Regressions include controls for number of older siblings, the presence of a younger sibling by 42 months, lone parent status at 21 months, gender, birthweight, special care unit at birth, ethnicity, mother's age at birth, education and occupation, mother's employment status before the birth and at 47 months, housing tenure at 21 months, an indicator of financial deprivation during pregnancy, the education and occupation of the partner and the partner's employment status at 21 months, the mother's pre-birth CCEI score, inter-personal sensitivity score and locus of control score, the mother's pre-birth social networks and social support scores and the educational attainment of the mother's mother.
3. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
4. Standard errors are given in brackets.
5. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
6. The measure of maternal employment refers to the age of the child in months at which she returned to work.
7. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.

Table 9: The effect of average household income on children's cognitive development and the estimated impact of early maternal employment

	Entry Assessment (4 or 5 years)		ALSPAC literacy (7 years)		Key Stage 1 (7 or 8 years)	
	(1)	(2)	(1)	(2)	(1)	(2)
Maternal employment						
0-18 months PT	**-0.021**	**-0.036**	**0.000**	**-0.009**	**0.153**	**0.134**
	(0.390)	(0.390)	(0.345)	(0.345)	(0.357)	(0.357)
0-18 months FT	**-0.196**	**-0.502**	**-0.866***	**-1.017****	**-0.441**	**-0.732**
	(0.540)	(0.543)	(0.471)	(0.475)	(0.494)	(0.498)
19-34 months	**0.532**	**0.539**	**0.563**	**0.577**	**0.614**	**0.617**
	(0.506)	(0.505)	(0.457)	(0.457)	(0.470)	(0.469)
Log of average income	-	**1.782*****	-	**0.850****	-	**1.542*****
		(0.390)		(0.347)		(0.362)
adj R2	0.2490	0.2523	0.1212	0.1221	0.2126	0.2150
N	4607	4607	6792	6792	5562	5562

Notes

1. Column 1 reproduces the estimates from column 2 of Table 3.
2. Regressions include controls for number of older siblings, the presence of a younger sibling by 42 months, lone parent status at 21 months, gender, birthweight, special care unit at birth, ethnicity, mother's age at birth, education and occupation, mother's employment status before the birth and at 47 months, housing tenure at 21 months, an indicator of financial deprivation during pregnancy, the education and occupation of the partner and the partner's employment status at 21 months, the mother's pre-birth CCEI score, inter-personal sensitivity score and locus of control score, the mother's pre-birth social networks and social support scores and the educational attainment of the mother's mother.
3. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
4. Standard errors are given in brackets.
5. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
6. The measure of maternal employment refers to the age of the child in months at which she returned to work.
7. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.

Table 10: The effects of full time maternal employment by 18 months on child cognitive outcomes, by childcare arrangements

	% of mothers using (FT return by 18 months only)	Entry Assessment (4 or 5 years) N=4607		ALSPAC literacy (7 years) N=6792		Key Stage 1 (7 or 8 years) N=5562	
0 to 18 months PT	-	**0.065** (0.398)	**0.066** (0.398)	**0.137** (0.351)	**0.133** (0.351)	**0.254** (0.365)	**0.253** (0.365)
0 to 18 months FT							
Any centre care	10	**4.085*** ** (1.532)	**4.088*** ** (1.532)	**1.006** (1.185)	**1.002** (1.184)	**2.082** (1.323)	**2.079** (1.323)
Predominately non-relative care	38	**0.194** (0.764)	**0.196** (0.763)	**-0.595** (0.659)	**-0.599** (0.659)	**-0.310** (0.706)	**-0.313** (0.706)
Predominately relative care	45	**-1.142*** (0.683)	**-**	**-1.364**** (0.608)	**-**	**-0.939** (0.627)	**-**
Vulnerable groups	*11*	**-**	***0.935*** *(1.342)*	**-**	***0.001*** *(1.206)*	**-**	***0.522*** *(1.221)*
Non-vulnerable groups	*34*	**-**	***-1.665**** *(0.742)*	**-**	***-1.705**** *(0.661)*	**-**	***-1.319**** *(0.684)*
Other	7	**-0.955** (1.602)	**-0.931** (1.602)	**0.622** (1.438)	**0.632** (1.438)	**0.861** (1.488)	**0.873** (1.488)
19 to 34 months	-	**0.700** (0.509)	**0.702** (0.509)	**0.703** (0.461)	**0.703** (0.461)	**0.716** (0.474)	**0.718** (0.474)
adj R2		0.2538	0.2542	0.1224	0.1225	0.2125	0.2127

Notes
1. See Notes 3-7, Table 3 and Note 1, Table 5
2. Regressions also include controls for childcare type used at 38 months.
3. Base is no employment by 34 months, using the average childcare arrangements for this group.

4. Households are classed as using predominantly relative care if they used paid care for less than 20 hours a week. Any households that used centre-based care for at least 5 hours a week fall into the separate ‘Any centre care’ category.

Appendix Table 1: Variables used in analysis

Figures in brackets give the number of discrete explanatory variables used in regression analysis.

Basic controls Age of child in months at assessment Child's gender (1) Child's ethnicity (1) Child's birthweight (2) Admission to special care unit/neonatal intensive care ward (1) Mother's age at birth (3) Mother's highest level of educational attainment (3) Residence of partner with mother at 21 months (2) Partner in employment at 21 months (1) Partner's highest level of educational attainment (2) Partner's occupational grouping (2) Number of older siblings (3) Presence of younger sibling by 42 months (1) Housing tenure at 21 months (3) Experienced pre-birth financial difficulties (1)	
	Variables retained in final specification
Additional controls *'Ability' group* Mother's occupational grouping (2) Mother worked in pregnancy (1) Hours worked in last pre-birth job (3) Mother in employment at 47 months (1) Gestation at which stopped work (2) Lived in Avon area less than a year at conception (1) Self-reported health prior to pregnancy (1) Pre-pregnancy body mass index (3) Mother's mother's qualifications (1) Mother's father's qualifications (1) Social networks score (2) Social support score (2) *'Attitudinal group'* CCEI score in pregnancy (3) Interpersonal sensitivity measure (3) Locus of control score (3) Alcohol consumption during pregnancy (2) Smoking during pregnancy (2) Hard drug use during pregnancy (1) Parenting score of mother's mother (1) Mother present throughout childhood (2) Childhood happiness score (2) Childhood life events score (2)	 YES YES YES YES YES YES YES YES YES YES
Parenting variables Mother's interaction score Partner's interaction score Total parental interaction score (2)[1] Mother's share of total parental interaction (3) Mother's range of teaching score (2) [1] Frequency of talking during housework (3) Outings score (2) [1] Income variable Log of average weekly net household income at 33 and 47 months (1995 prices) Childcare controls Non-maternal childcare at 15 months (4) Non-maternal childcare at 38 months (4)	

Notes

1. Variables are continuous when used as dependent variables.