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The Effects of Early Maternal Employment on Child Development in the UK

Preliminary results under project: Understanding the Impact of Poverty on Children of the 90's

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Abstract

This paper uses data from the ALSPAC cohort of 12000 births to explore the effects of early maternal employment on child cognitive and behavioural outcomes. The results indicate that full time maternal employment begun in the 18 months after childbirth has small negative effects on later child outcomes. Part-time work and work begun later than 18 months, however, do not seem to have any adverse consequences. We explore the issue of whether our results are biased by unobserved heterogeneity but find no evidence that our results are sensitive to the inclusion of controls for a wide range of background factors. We conduct sub-group analyses to investigate whether certain groups may be more vulnerable to the effects of early full time maternal employment than others. This paper also explores the mechanisms linking maternal employment to children's development. The mechanisms examined relate to the parenting behaviours of the mother and father, breastfeeding behaviour, maternal tiredness and stress, household income and the use of non-maternal childcare. We find that a number of factors work to minimise the effect of mothers' labour market participation on their children. Fathers are significantly more involved in child rearing in households where mothers return to work early and this more equal division of parenting has strongly beneficial effects on later child outcomes. Negative employment effects are concentrated in those families where mothers work full time and also rely on unpaid care by a friend or relative. The use of paid childcare protects children from these negative effects and attendance at a centre-based provider may actually lead to better cognitive outcomes than if the child were at home with a non-working mother.

Keywords: Maternal employment, child development
JEL Classification: J22 I20

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Summary

This paper uses data from the ALSPAC cohort to explore the effects of early maternal employment on child cognitive and behavioural outcomes. The results indicate that full time maternal employment begun in the 18 months after childbirth has small negative effects on later child outcomes. Part-time work and work begun later than 18 months, however, do not seem to have any adverse consequences. We explore the issue of whether our results are biased by unobserved heterogeneity but find no evidence that our results are sensitive to the inclusion of controls for a wide range of background factors. There is some indication that certain groups may be more vulnerable to the effects of early full time maternal employment than others. The children of the least educated mothers, of lone mothers and those in the poorest households appear overall to benefit when their mothers work, leaving the negative effects concentrated amongst the children of the more advantaged. Our results also provide some tentative support for the hypothesis that boys are more adversely affected than girls by early maternal employment.

This paper also explores the mechanisms linking maternal employment to children's development. We find that a number of factors work to minimise the effect of mothers' labour market participation on their children. Overall, the children of working mothers receive no less active parental interaction that the children of non-working mothers because fathers are significantly more involved in child rearing in households where mothers return to work early. Our results suggest that this more equal division of parenting has strongly beneficial effects on later child outcomes. The additional income generated by the mother's earnings is a second factor that helps to offset any negative effects associated with maternal employment. With regard to the negative effects of early maternal employment, shorter duration of breastfeeding makes a minor contribution to the overall negative effect. We find no evidence that maternal tiredness and stress (which is positively associated with early full time employment) leads to less stimulating caregiving or adverse effects on children.

The type of childcare used by the family is a crucial determinant of the impact of maternal employment. It is only the children of mothers who work full time before 18 months *and* whose non-parental care consists solely of care by a friend, relative or neighbour who experience significant detrimental effects of maternal employment. The use of paid childcare protects children from these negative effects and attendance at a centre-based provider may actually lead to better cognitive outcomes than if the child were at home with a non-working mother.

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. Although research has looked into the impact of maternal employment on children (mostly using data from the US), little consensus has been reached. A number of 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. Why this should be the case, however, is seldom addressed directly, let alone explained.

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 allow us not only to investigate whether the findings of US studies are replicated in the UK, but also what the mechanisms are that link maternal employment to child outcomes. In fact we investigate three separate but related questions in this paper. Firstly, we attempt to identify the causal impact of early maternal employment on five outcome variables that measure aspects of child development between two and eight years of age. To do this we must remove from our estimates the influence of confounding factors, i.e. characteristics that are correlated with maternal labour supply and that have an independent influence on child outcomes. The second issue we address is whether certain groups are more vulnerable to the effects of early maternal employment than others. Specifically, we explore whether the effect varies with the mother's educational attainment, the child's gender, lone parent status and the household's financial resources.

Once we have identified the overall effects of maternal employment on child outcomes we explore the third question of the routes through which labour market participation impacts on children's development. Different hypotheses emphasise ways in which maternal employment may be either beneficial or detrimental to children. We develop a framework that encompasses these conflicting hypotheses and allows us to test the validity of each one. The mechanisms we explore relate to the parenting behaviour of the mother and the partner, breastfeeding, maternal tiredness and stress, household income and the use of non-parental childcare. We investigate how early maternal employment affects each of these mediating

factors and then the way in which each factor impacts on child outcomes. This analysis gives an insight into what is happening in households where mothers work and what accounts for any observed relationship between employment and child outcomes.

Section 2 outlines the conceptual issues involved in estimating the effects of maternal employment and develops a framework for thinking about the various hypotheses regarding mediating factors. Section 3 reviews the existing literature relating to each of our three questions. 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 of child outcomes.

2.1 What are the effects of early maternal employme nt 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]:

$$C_{it} = a + b_{t-j} H_{it-j} + gX_i + e_{it} \qquad (1)$$

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 may include previous and subsequent maternal employment). The coefficient $\hat{b}_{t-j}$ 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 $\hat{b}_{t-j}$ may be biased. Secondly, as Harvey (1999) points out, variables that are *affected by* patterns of early employment and in turn affect children should not be considered sele ction factors and require a different analytical approach than the simple inclusion of controls. We address the first point here, the second is discussed in Section 2.4.

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

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

$$C_{it} = a + b_{t-j} H_{it-j} + gX_i + dM_i + hZ_i + e_{it} \qquad (2)$$

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 $\hat{b}_{t-j}$ will be biased.

For example, suppose that market and home ability are positively correlated so that employed mothers are more able in child rearing than non-employed mothers. Then $\text{cov}(H_{it-j} M_i) > 0$ and the estimate of $\hat{b}_{t-j}$ will be biased upwards. We will tend to underestimate the negative effect of maternal employment (or overestimate the positive effect) because $\hat{b}_{t-j}$ is picking up the effects if this ability as well as the causal effect of maternal employment. Alternatively, if employed mothers tend to have less interest or skill in child rearing then $\text{cov}(H_{it-j} M_i) < 0$ and $\hat{b}_{t-j}$ will be biased downwards. Similarly, if mothers feel more able to return to work if their children are better adjusted or better at learning then $\text{cov}(H_{it-j} Z_i) > 0$, leading to an upward bias in $\hat{b}_{t-j}$. On the other hand, mothers may choose to reinforce their children's endowments by devoting more time and care to the more able so that $\text{cov}(H_{it-j} Z_i) < 0$ and $\hat{b}_{t-j}$ is biased down.

It is clear that *a priori* we can make no firm prediction as to the magnitude or even the direction of the 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 3.2.

2.3 Are some children more vulnerable to the effects of early maternal employment than others?

The effects of early maternal employment may differ across different types of family. The estimation of a single average effect, therefore, may disguise the fact that certain children could be particularly adversely affected when their mothers work. A number of potential risk

factors have been explored in the literature – in this paper we focus on four of the most widely tested hypotheses.

If the effects of early maternal employment are due to the loss of the unique form of care provided by the mother then we might expect the effect for individual children to vary with the mother's level of skill. Specifically, if it is the case that more cognitively skilled mothers provide greater stimulation for their children, the children of the more able may experience greater negative effects because they have more to lose when their mothers divert time to paid work. Alternatively, the more skilled may be better able to compensate for the hours that they are away with higher quality interactions when they *are* there. We examine this issue by investigating whether the effect of maternal employment varies with the educational attainment of the mother.

A number of studies have also explored whether the impact of maternal employment varies with the income level of the household. Again, however, it is unclear what pattern we would expect to observe. On the one hand, children in high-income families, like the children of the more skilled, may have more to lose from their mother's absence. On the other hand, it has also been suggested (Han et. al., 2001) that mothers in low-income families experience greater financial strain and hardship than those in better-off families. If this stress is more pronounced when mothers work then children in low-income families may experience greater negative effects from mothers' employment. An important mechanism through which household income impacts on young children relates to the quality of purchased childcare. Better-off families may be able to offset the negative effects of maternal employment by providing alternative care of a high standard. In fact, some research suggests that it may be children in middle-income families who experience the poorest quality of childcare as higher-income families are better able to obtain and purchase good childcare, while low-income mothers are often eligible for high-quality subsidised care and early intervention programmes (Waldfogel, 2002). Of course, maternal earnings are potentially an important component of total household income. The measure of income or poverty used when investigating this issue, therefore, should ideally be measured prior to the birth in order to avoid the endogeneity problem. In this paper, we investigate whether families classed as experiencing material deprivation in the pre-birth period are more or less affected by early maternal employment.

Another sub-group that we investigate are children in lone parent versus two-parent households. In lone parent families there is no possibility that paternal time investments in children may increase in order to offset lower maternal time investments. In addition, as lone mothers tend to be poor they will be less able to afford high quality alternative childcare. For

these reasons we might expect the children of lone parents to be particularly adversely affected by maternal employment. However, there are other arguments to suggest that the employment of lone mothers will have negligible, or even positive, effects of their children's outcomes. Perhaps most importantly, the mother's earnings may be of greater value to the child when income from other sources is low. And again the 'more to lose' (or in this case 'less to lose') argument may apply if the quality of single mothers' parenting is lower than that of mothers who have a partner (for example because of greater stress).

The fourth hypothesis that we examine relates to whether male or female children suffer greater negative effects from the their mother's employment. We investigate the suggestion that different causal mechanisms may operate for boys and girls (see, for example, Waldfogel et. al., 2002).

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

Sub-group analysis and techniques for dealing with unobserved heterogeneity are essentially concerned with the same issue – that of constructing a counterfactual. They help us to answer the question 'How would the children of non-employed (employed) mothers have fared if their mothers had (had not) worked?' The key aim here is to evaluate the effect of working given the *fixed* characteristics of different families. A separate question 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, not least of which may be the addition to income from the mother's earnings. In our analysis of the routes through which maternal employment affects children's development we are essentially asking two questions: how does the child's environment change when the mother returns to work and what impact do these changes have on the child's development?

The labour supply of the mother is only one variable that is determined jointly with others in a model of household decision-making. Even without specifying a full structural model, we can infer some of the implications of a joint decision-making process of this kind. We can think of a simple model in which parents maximise a household utility function subject to a set of constraints and production technologies. Parents derive utility from their own consumption, their individual leisures and the development of their child:

$$U_t = U(L_{Mt}, L_{Ft}, E_t, C_t) \quad (3)$$

where U_t is household utility at time t, L_M and L_F are the leisure times of the mother and father respectively, E is parental consumption of goods and services and C is an outcome measure of the development of their (only) child. Parents face the time constraint

$$H_{it} + L_{it} + K_{it} = T, \qquad i = M, F \quad (4)$$

so that total time available (T) is divided between work (H), childcare (K) and leisure (L). They also face a 'production function' for child development which relates inputs into the child rearing process to outputs in terms of the child's welfare and development:

$$C_t = C[\ \mathbf{q_M K_{Mt}}, \mathbf{q_F K_{Ft}}, \mathbf{q_X K_{Xt}}, \mathbf{I}_t, Z\ ] \quad (5)$$

Child outcomes at time t are a function of the time inputs of the mother, father and non-parental sources (subscripted X), consumption of child-related goods and services (I) and the child's innate ability or endowment (Z). Outcomes will depend not only on the time that the child is cared for by each source but also on the quality if that care. $q_i K_{it}$ is therefore a quality-adjusted measure of the investment in the child by source i, what we may term the *input* from each source into the child outcome. For correctness the terms $\mathbf{q_M K_{Mt}}$, $\mathbf{q_F K_{Ft}}$, $\mathbf{q_X K_{Xt}}$, and $\mathbf{I}_t$ are vectors of current and lagged values (e.g. $\mathbf{I}_t = \{I_t, I_{t-1}, \ldots, I_0\}$ where t=0 represents the child's birth). However, our concern here is with variables in the period t-j only (the child's early years) and so in what follows we treat values in other periods as fixed.

It is clear from the model presented in equations (3) to (5) that maternal labour supply, H_{Mt-j}, will be determined jointly along with paternal labour supply, the leisure times of both parents, household consumption and the time inputs into childcare. In other words, we would expect differences in maternal labour market participation to be associated with differences in each of the variable inputs into child rearing in equation (5). It is clear that estimates such as $\hat{b}_{t-j}$ in equation (1) give us the net effect of early maternal employment on outcomes. According to equation (5), however, this net effect is the sum of four components:

$$b_{t-j} \equiv \frac{dC_t}{dH_{Mt-j}} \quad (6)$$

$$\equiv \frac{\partial C_t}{\partial q_M K_{Mt-j}} \frac{\partial q_M K_{Mt-j}}{\partial H_{Mt-j}} + \frac{\partial C_t}{\partial q_F K_{Ft-j}} \frac{\partial q_F K_{Ft-j}}{\partial H_{Mt-j}} + \frac{\partial C_t}{\partial q_X K_{Xt-j}} \frac{\partial q_X K_{Xt-j}}{\partial H_{Mt-j}} + \frac{\partial C_t}{\partial I_{t-j}} \frac{\partial I_{t-j}}{\partial H_{Mt-j}}$$

The first three terms show the influence of maternal employment on child outcomes through its effect on the inputs of the mother, the father and non-parental sources respectively. In each case, this is the product of the effect of maternal employment on the amount of the input used ($\partial q_i K_i / \partial H_M$) and the effect of the amount of the input used on the child's outcomes ($\partial C / \partial q_i K_i$). The last term shows the effect of maternal employment on outcomes through its influence on child-related consumption. This framework is useful because it allows us to categorise the numerous theories regarding the effects of maternal employment according to their predictions as to the sign and magnitude of the various derivatives.

2.4.1 The mechanism of maternal inputs

Most theories focus on the first term in equation (6), the effect of maternal employment on outcomes via the input of the mother. In making the link between a particular mechanism and the overall effect of maternal employment, therefore, these theories implicitly assume that the sum of the other three terms do not offset the impact of the first term.

It is commonly argued that maternal employment lowers the mother's input into child rearing (i.e. $\partial q_M K_M / \partial H_M < 0$) but different authors emphasise different reasons for this effect. The most straightforward hypothesis is that mothers' work reduces their input by lowering K_M, the amount of time that they actually spend with the child. Although the evidence suggests that this is correct, it also suggests that we may overestimate the magnitude of the effect, particularly if we focus on K_M, time investments alone, rather than $q_M K_M$, total maternal investments. Bianchi (2000) presents persuasive evidence against the notion that each hour of market work results in an hour-for-hour reduction in time with children. Time diary estimates suggest that the reduction is surprisingly small. For example, one study reports that children with employed mothers spend 86% as many hours with their mothers as do children with non-employed mothers (US data for 1997, children under 13). The argument that non-employed mothers may spend a substantial part of their day in activities other than childcare perhaps applies more to mothers with older children than with infants. However, there are other reasons for the modest differential in time inputs between employed and non-employed mothers. Bianchi argues that working mothers may 'shed load' in other areas, reallocating their time away from other activities such as housework, leisure and sleep towards time with their children. They also appear to organise their working lives in ways that protect time with their children. Shift working, part time working and the foregoing of career developments

help to explain the small employment-related gap in maternal childcare as well as the 'wage penalty' associated with motherhood (Waldfogel, 1998).

When we take the quality of time inputs into account as well as the quantity, the differences between the childcare provided by employed and non-employed mothers potentially become even smaller. Nock and Kingston (1988) analyse parental time with children in the late 1970s and early 1980s. They find that non-employed mothers spent more than twice as much time per day with their preschoolers (nine hours, compared with a little over four hours for employed mothers). However, the difference in 'quality' time – time spent in direct childcare and play/education – was less than one hour. As Bianchi (2000) notes, 'the large difference between employed and non-employed mothers lies in the time when mothers are available but not directly engaged in activities with their children'. The extent to which just 'being there' is valuable to children, then, may play a large role in determining the extent to which effective maternal inputs are reduced by employment.

The quality of the mother's input, however, may capture more than simply the allocation of time to different activities. Becker's theory of the family (see, for example, Becker, 1985) focuses on the gains from the sexual division of labour. Parents specialise in their acquisition of market or home human capital according to their comparative advantage. He asserts that women have a comparative advantage in home production and child rearing but does not specify the source of this advantage. According to Becker's theory, the quality of a mother's time investment, q_M, will be lowered when she does paid work because her acquisition of human capital is split between the different types of capital. Han et. al. (2001) raise the possibility that combining employment with motherhood in the child's early years may lead to greater tiredness and stress and therefore less nurturing and stimulating care giving. Another hypothesis regarding q_M is that working mothers are less likely to breastfeed and that formula feeding has detrimental effects on children. Noble (1999) reviews the literature on the effects of employment on breastfeeding and concludes that post-partum employment has little effect on initiation but that it is significantly associated with a shorter duration of breastfeeding. Anderson et. al. (1999) provide evidence that breastfeeding is linked to improved cognitive development and also that the benefits of breastfeeding increase with duration. A breastfeeding explanation for negative effects of early maternal employment is therefore certainly plausible.

It seems likely from the evidence presented above that the effect of maternal employment on outcomes via the input of the mother will in general be negative. We would expect that holding everything else equal, employment will reduce a mother's interactions with the child

to some extent and that this decrease will have some negative impact. However, it is difficult to predict the magnitude of this effect as it depends on the ways in which mothers' behaviour responds to the demands of work on their time, and also on the extent to which other factors such as breastfeeding or tiredness affect the quality of parenting. It is possible that the magnitude of this effect is negligible and, even if it were not, it may still be outweighed by other positive effects associated with employment.

2.4.2 The mechanism of paternal inputs

If fathers derive utility from their children, it is certainly possible that they will increase their input into child rearing in response to a fall in the mother's input (i.e. $\partial q_F K_F / \partial H_M > 0$). Yet the role of the father has received scant attention in the literature on the effects of early maternal employment. Where negative effects are found it is not clear, for example, whether fathers' behaviour does not respond to the market work of the mother or, if it does, whether paternal inputs are simply of an inferior quality to maternal inputs.

Mounting evidence suggests that the amount of time that married fathers spend with the children has increased significantly over the last decades (see Bianchi, 2000). However, we cannot infer from this that fathers increase their involvement with their children in response to the labour market participation of the mother. O'Brien and Shemilt (2003) provide direct evidence that this is in fact the case (at least for the UK). Interestingly, although they report findings that father involvement is greater in families where mothers work full time, they question how this should be interpreted. Our framework implies that it arises from the desire to maintain the level of parental time inputs into child rearing when the mother's input is reduced. An alternative interpretation is that mothers' earnings, by increasing the share of household income over which they have control, strengthen their bargaining power within the family with the result of a more equal sharing of roles. In either case, paternal inputs rise to offset the effect of the mother's absence due to employment. A final point to note here is that O'Brien and Shemilt also provide evidence that father involvement at an early age is associated with later positive educational and emotional outcomes. If there are diminishing returns to parental inputs into child rearing and if fathers generally invest less time than mothers, then the impact of an increase in paternal involvement may be quantitatively greater than for an equivalent decrease in maternal involvement.

2.4.3 The mechanism of non-parental childcare

Unless the responsibility for childcare is undertaken fully by the father during the mother's work hours, families where mothers work must seek some form of non-parental childcare, particularly when children are very young. The type and quality of that care is therefore likely to be crucial in determining the impact of mothers' employment. We can think of the quality of childcare in absolute and relative terms. If a particular form of childcare is harmful to children *in itself* (i.e. if $\partial C_t / \partial q_X \; K_X < 0$) then clearly the use of this care will reinforce the negative effects of reduced maternal inputs. If however childcare is beneficial to children then its use will offset to some degree the loss of the mother's investments. The question is whether it offsets the negative effects completely (so that the overall impact of maternal employment is zero or even positive) or only partially.

A substantial body of evidence exists on the effects of early childcare on child outcomes. In reviewing this work, Waldfogel (2002) concludes that the effects depend on the nature of the care and the characteristics of the child and the family. Early intervention programmes, such as Head Start in the US, have been shown to have significant positive effects on the cognitive and emotional development of (usually disadvantaged) children. Studies of more conventional types of childcare also find that high quality care is associated with improved outcomes. The issue here is whether mothers who return to work early will tend to place their children in high or low quality care. Brooks-Gunn et. al. (2002) suggest that the children of working mothers may be in relatively low quality care, perhaps because they are constrained in their choice of arrangements or have less time to search for an appropriate provider or perhaps because they value factors such as convenience and location more highly than quality. Of course, it is also possible that the contribution of mothers' earnings to household income enables families to purchase better quality provision. This seems even more likely if we take into account bargaining explanations in which the greater the mother's share of household income the more control she has over household expenditure patterns. Lundberg et. al. (1997) show that when mother's share of income rises (holding constant total household income) households spend relatively more on child-related goods and services. Given these different hypotheses then, the effect of maternal employment via childcare provision is an empirical matter.

2.4.4 The mechanism of income

The income earned by employed mothers is clearly of benefit to households but the key issue here is to what extent this income gain translates into improved child outcomes. Using data on British children from the NCDS, McCulloch and Joshi (2002) find evidence that lower

income is associated with poorer cognitive functioning in children aged 6 to 17. Ruhm (2001), however, finds that the direct effect of income of child outcomes is very small for young children in the US. In general, we might expect the impact of mothers' earnings to depend on the level of household income in the absence of their work. Small increases in income may have large effects when starting from a situation of poverty, whereas the increment has less effect in wealthier households. We should also consider whether household income from other sources would fall (for example through the withdrawal of transfer payments or lower partner's earnings) when a mother's earnings rise. Overall, we would expect the effect of maternal employment via household income to be positive but its relative magnitude is unclear.

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 number of the US studies report the result that maternal employment in the first year after the birth, and particularly full time working, 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]. In general, behavioural problems in children seem to respond to maternal employment in the same directions as cognitive outcomes although here the relation is weak 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

[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).

[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.

and less well determined than the early negative effects. These results apply only to non-Hispanic white children – they were unable to identify any effects of maternal employment on African-American or Hispanic children although this may be in part due to small sample sizes. 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.

Rather than using regression analysis like the other work on the NLSY, Hill et. al. (2001) use the technique of propensity matching in order to identify the effects of early maternal employment. This technique is discussed further below but we note here that Hill et. al. 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. The effects of second and third year employment on performance tend to be positive but insignificant

Ruhm (in press) again 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. This throws doubt on the claim that continuous employment during the first three years allows children to 'catch up' after damaging effects in the first months. 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.

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 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.

The sole available UK-based study of the effects of parental employment on child outcomes is Ermisch and Francesconi (2000)[5]. This study uses retrospective information from the British Household Panel Survey and, as a result, the measures of employment and child development are a good deal cruder than those employed in the US studies. Ermisch and Francesconi analyse the effect of maternal employment in the first *five* years of life on the probability of achieving at least an A-level as a young adult. 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

[5] Joshi and Verropoulu (2000) analysed data from the British NCDS and BCS70 but unfortunately this study is out of print and unavailable to the authors. A contemporary press release reports findings that first year maternal employment may lead to slightly poorer achievement in reading amongst school age children but that employment between years 1 and 4 is associated with a small improvement in emotional well-being. In common with Ermisch and Francesconi (2000) it also reports that the children of mothers who are employed in the pre-school years are slightly less likely to get good qualifications in later life.

of a sibling difference estimator, as their cross-sectional logit estimates do not identify any significant effects of early maternal employment on later achievement.

The results of Ermisch and Francesconi raise the question of how early measures of attainment are related to later measures. Were the data available, should we expect to find large negative effects in young children in the BHPS? Currie and Thomas (1999) show that test scores at age 7 have significant effects on future test scores, educational attainments and labour market outcomes. This suggests that the adverse effects of maternal employment will be apparent at younger ages. However, there is also the possibility of 'sleeper effects' in which minor negative effects observed in younger children spiral into larger problems in later life. We are not able to address this question in this paper, as data on the ALSPAC children are not currently available beyond the age of eight.

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. A number of techniques have been used to address this problem.

Ruhm (in press) follows the method of including an unusually comprehensive set of explanatory variables in order to 'mop up' as much of differences in ability in child rearing between the two groups as possible. These relate 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 suggests that there are complementarities between market and home abilities. Studies which fail to control adequately for heterogeneity will tend to underestimate the negative

influence of early maternal employment because these mothers tend to have other characteristics that are positively associated with their children's cognitive development.

Some more evidence on this issue is supplied by Brooks-Gunn et. al. (2002). They 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. However, it is not clear to what extent these measures capture innate differences between working and non-working mothers and to what extent they reflect the effects of maternal employment on household behaviour. 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, suggesting that the children of working mothers are relatively disadvantaged along these dimensions. They also find that full time maternal employment before 9 months is associated with significantly lower maternal sensitivity when the child is age 3 (although no difference in the quality of the home environment) even after a range of other factors are controlled for. Overall, 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. It is not possible to tell, however, whether this would be the case if these mothers chose not return to work.

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 again overstate the negative effect of employment.

Although FFE models have their limitations it is still interesting to compare the results of these models with OLS estimates. 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. One interpretation is that unobserved heterogeneity serves to bias downwards the OLS estimates of the maternal employment effect. Contrasting with Ruhm's conclusion about the direction of the bias, this suggests 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 the non-workers. Controlling for this reduces the magnitude of the negative effect of working. Of course, these results may also reflect feedback from the child to the mother's labour supply or reflect other factors that are not fixed between siblings but are correlated with the mother's work decision.

Ermisch and Francesconi (2000)'s FFE estimates point to opposite conclusions to those of the US studies. Their FFE results show much larger negative effects of early maternal employment than their OLS estimates. This is consistent with Ruhm's conclusion that market and parenting ability are positively correlated. Ermisch and Francesconi present several pieces of evidence in support of the assumption that parents are unable to judge their children's abilities at very young ages. It follows that they are therefore not able to systematically adapt their behaviour in response to the strengths or weaknesses of the child. Even if this were the case, however, changes in other factors may still be correlated with the decision to work.

It can be seen that there is considerable disagreement regarding the magnitude and direction of the bias due to unobservable factors. Two other techniques are worth mentioning here although they do little to resolve the issue. The standard method when dealing with unobserved heterogeneity is to find some source of exogenous variation in the explanatory variable in question (here early maternal labour supply) and use an instrumental variables (IV) approach. It seems to be an almost impossible task, however, to find something that determines labour supply but has no influence on the child's development. Blau and Grossberg (1992) instrument maternal labour supply with the pre-birth predicted wage and are unable to reject the null hypothesis of equality between the OLS and IV coefficients, i.e. of homogeneity. However, the weakness of their instrument prevents us from drawing any firm conclusions.

The technique of propensity matching does not address the issue of unobserved heterogeneity because, like OLS, it relies on the assumption that all relevant differences between workers and non-workers can be captured by observable factors. It does, however, require fewer parametric assumptions that OLS (such as regarding functional form) and it allows for asymmetries in treatment group comparisons. To illustrate, Hill et. al. (2001) find that the children of first year full time workers would fare significantly better if their mothers were to delay employment beyond 3 years. However, they find no evidence that the children of mothers who do not work in the first three years would do worse if their mothers switched to full time work in the first year. This is because the composition of the two groups differs and propensity matching allows them to report an average effect of a change in maternal labour supply over the population in question. OLS regression requires the estimation of one causal effect that is supposed to apply to every individual in the sample.

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 each issue:

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

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 the quarter prior to pregnancy. The results are not consistent in that for some measures of development the children of more highly paid mothers are worst affected while for other measures the children of the lower paid experience the greatest negative effect. Hill et. al. do not address the issue of differential effects by mothers' ability directly but some evidence can be inferred from their finding of asymmetric treatment effects.

[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.

Mothers working full time in the first year tend to be better educated and have higher AFQT scores than mothers who do not work at all in the first three years of life. The children of these mothers would do better if their mothers were to postpone work or work fewer hours – in other words the effect of early full time employment for this group is negative. However, the less skilled mothers who do not work in the first three years would not experience any negative effects of switching to first year full time employment. This suggests that the adverse effects of employment may be dependent on the skill level of the mother.

3.3.2 Are boys more or less vulnerable to the effects of early maternal employment than girls?

Blau and Grossberg (1992), Harvey (1999) and Han et. al. (2001) all report no significant difference in the effects of early maternal employment on boys and girls. Although not statistically significant, the results of Hill et. al. (2001) do suggest differential effects of early employment by gender. The pattern of their results suggests that negative effects for girls peak at ages 5 and 6 while the effects for boys seem longer lasting.

Brooks-Gunn et. al. (2002) find far larger negative effects of employment prior to 9 months for boys than for girls. For full time work the associated decrease in the 36 month assessment score is three times larger for boys than for girls. In contrast, Waldfogel et. al. (2002) find that the detrimental impact on cognitive outcomes of first year full time employment is larger for girls than for boys. They also show, however, that full time work in the first year appears to lead to more behavioural problems for boys at age 4 but has no effect on the behaviour of girls.

3.3.3 Are children in 'traditional' two-parent families more or less vulnerable to the effects to early maternal employment than the children of 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. As discussed in Section 2.3, this suggests that the earnings of single mothers are particularly beneficial, that they have access to high quality subsidised childcare or perhaps that the quality of their investments in the child is lower than for mothers in couples.

3.3.4 Are children from better-off families more or less vulnerable to the effects of early maternal employment than those from poorer families?

A number of studies have addressed the issue of whether the effect of early maternal employment varies with household income but it has yet to be resolved. Han et. al. (2001) and Waldfogel et. al. (2002) find the greatest negative effects for families in the lowest income groups. Hill et. al. (2001) and Blau and Grossberg (1992), however, find the opposite result in that those in higher income groups seem to be the most adversely affected. Although Harvey (1999) finds little evidence of differential effects she does report that maternal employment seems to lead to more behavioural problems for children in high-income families only.

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.

3.4.1 The mechanism of 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. Harvey (1999) reports results that suggest the impact of paternal employment, like that of mothers, may differ for certain sub-groups. She finds that greater paternal employment is associated with improved outcomes in African-American and low income families but with inferior outcomes in high income families. 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, however, of whether paternal inputs into child rearing are substituted for maternal ones in households where mothers work.

3.4.2 The mechanism of non-parental 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, then, 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 and to the extent that type is correlated with quality the results are of some interest. 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. For example, they find that centre-based care is associated with the smallest negative effect on the maths score at age 5 or 6 but with the greatest negative effect on the reading score at the same age. Again using NLSY data, Ruhm (in press) finds no significant differences in the effects of early maternal employment according to the type of childcare used.

The one study that is able to investigate the issue of quality of childcare is Brooks-Gunn et. al. (2002) as this data is 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 reduction of the mother's input.

3.4.3 The mechanism of 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 (2001) reports that controlling for household income in the first years of the child's life makes almost no difference to the estimated effects. He suggests that this may be because household income is not a significant determinant of children's cognitive development or perhaps because the net increase in household income from early maternal employment is not large. Harvey (1999), however, reports 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.

4. Methodology and data

4.1 Identifying the effects of early maternal employment on child outcomes

In common with many previous studies 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 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 our additional controls sequentially. This allows us to observe the way in which our estimates of the effects of early maternal employment change as a greater proportion of the heterogeneity is controlled for. We also 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. By grouping our additional control variables and introducing each group sequentially we can infer the nature of the underlying heterogeneity.

To illustrate, recall from Section 2.2 that if $\text{cov}(H_{it-j} M_i) > 0$ then the estimate of the effect of maternal employment, $\hat{b}_{t-j}$, will be biased upwards. Using this logic in reverse, if the estimate of $\hat{b}_{t-j}$ falls after we control for a factor M_i it must be that M_i is positively correlated

with maternal labour supply. Conversely, if the estimate rises then the correlation must be negative. Our strategy allows us to see how sensitive our initial estimates are to the inclusion of additional controls. Since most other studies are not able to control for these variables, our results will give an indication of the extent to which they may suffer from omitted variables bias and also of the sources of this bias. Although by its nature our analysis can only control for observable factors it is hoped that they are also proxies for unobservable factors along each dimension. If the coefficients on early maternal employment are little affected by the inclusion of a particular group of controls then it suggests that heterogeneity along this dimension, whether observed or unobserved, is relatively unimportant. Large changes in the coefficients, however, would undermine our confidence in the accuracy of the estimates.

The four groups of factors that we investigate relate to the mother's mental health and personality, her social network, her physical health and health-related behaviours and her childhood and family background. Details of the measures used are given in Section 4.4.4. As Harvey (1999) points out, the inclusion of variables that are not correlated with child outcomes cannot remove error and will on average increase the standard errors of the estimates. Having conducted our investigation into the four 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 can then go on to explore the composition of this average net effect.

4.2 Sub-group analysis

The effects of early maternal employment on child outcomes may differ for different sub-groups of the population. To investigate this, in separate specifications we interact our maternal employment variables with maternal educational attainment, child's gender, lone parent status and an indicator of financial deprivation during pregnancy. We are then able to test whether there are significant differences in the impact of maternal employment on the different sub-groups and to compare the relative magnitude of the effects.

4.3 Mechanisms through which maternal employment affects child outcomes

Our strategy for exploring the mechanisms associated with maternal employment is, like our investigation of heterogeneity, to include different sets of controls and then to observe their effect on the maternal employment coefficients. The interpretation of these results, however,

is *not* the same as for the inclusion of background controls. In that instance, the resulting estimates give the net effect of maternal employment, purged of the effects of confounding factors. The inclusion of controls for a particular mechanism, however, removes the component of the net effect that is attributable to that factor from the estimate. To illustrate, suppose that the positive effect on child outcomes of the additional income from the mother's employment exactly offsets the negative effects from other mechanisms. The overall net effect of maternal employment will thus be zero. If we then control for household income in the regression, the positive influence of the mother's earnings will be removed from the estimate of the effect of maternal employment, leaving a negative coefficient. A comparison of this estimate, therefore, with the original net estimate of zero, allows us separate out the effects of mothers' earnings from the effects of other changes due to their employment. It is important to note that the negative estimate does not represent any effect of maternal employment that would be observed in reality, as we have statistically removed one of the positive benefits of working. Rather it is a device that allows us to explore the impact of individual mechanisms associated with maternal employment.

In this paper, the mechanisms that we explore relate to parenting behaviour, breastfeeding, maternal tiredness and stress, income and non-maternal childcare. In each case we compare our overall net estimate with an estimate that removes the influence of that mechanism. A note of caution is needed here. Whilst it is simple in a theoretical model to distinguish between heterogeneity and causal mechanisms, empirically the distinction is far less clear cut. An observed association between maternal employment and certain patterns of behaviour could indicate a causal mechanism but equally both employment and behaviour patterns may be driven by a third unobserved factor. For each of the mechanisms we investigate we have sound theoretical reasons for believing that maternal employment has a causal role. However, this does not mean that all observed differences in behaviour between working and non-working mothers are attributable to the effect of employment. Our results may be consistent with a causal interpretation but, in the final analysis, we can never be certain what the characteristics of the family would have been had the mother's employment decisions been different.

4.4 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. Mothers complete up to three survey 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 (and from a younger age for a selected sub-sample) in which they are able to directly assess various aspects of the children's development. Records from other agencies 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.

4.4.1 Measures of child outcomes

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

The infant communication score is derived from responses to the 24-month child-based questionnaire completed by the mother[8]. It is composed of four subscores that each capture a slightly different aspect of the child's language development such as vocabulary or grammar. We present results for this score as it is the most useful measure of child outcomes available prior to age 4 to 5. However, the mother-reported nature of the data causes us to have concerns as to its validity and there is some evidence that it may be subject to a reporting bias (see Burgess et. al., 2002a). The results of regressions using this dependent variable, therefore, should be treated with caution.

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 fourth assessment of cognitive ability was administered by the ALSPAC team to children at the age of 7. This ALSPAC literacy score is again composed of a number of subscores, in this case capturing skills in reading, spelling and the manipulation words.

Our measure of behavioural problems is again derived from mother-reported data, this time at age 4. The measure contains five components – scores relating to hyperactivity, emotional

[7] The mother's partner also received annual questionnaires but the response here is patchy.
[8] Questions were adapted from the MacArthur Infant Communication Questionnaire (Fenson, Dale, Reznic et. al., 1991).

symptoms, conduct problems, peer problems and a prosocial score (reversed). The behavioural problems measure is the opposite sign to the cognitive measures as higher scores indicate more behavioural problems.

In order 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 five 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 five measures. 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.

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 measures. 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 five measures as this would have resulted in the loss of large quantities of data (from 9323 to 3843 observations in the case of the infant communication score, for example). 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.

4.4.2 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 studies. We divide this 0 to 34 month 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 if 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 3 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.

4.4.3 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 gender, ethnicity, birthweight and whether the child was admitted to a special care unit immediately after the birth.

Controls related to the mother are her age at birth, her highest level of educational attainment, and her occupational grouping (defined according to her last job prior to the birth). We also

[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.

include variables capturing her previous and subsequent employment status as these help to control for unobserved heterogeneity (see Section 3.2). Specifically, these variables are whether she worked in pregnancy, her hours of work in her last pre-birth job and whether she was employed at 47 months.

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. Our basic set of controls includes variables relating to 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).

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. Our second measure is a subjective measure of financial difficulties in pregnancy. Mothers were asked to rate how difficult they found it to afford five items (such as food, rent or mortgage and clothes) on a scale from 0 to 3. Mothers with a composite score of 8 or above – about 10 per cent of the sample – were then classed as experiencing moderate to severe financial difficulties. We do not include a post-birth measure of household income in our basic controls as this is endogenous with regard to maternal labour supply. Rather, we analyse income as a potential mechanism through which maternal employment may influence child outcomes.

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 very 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 some evidence that maternal 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 birthweight 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.

4.4.4 Additional background controls

We explore the extent of any bias in our basic estimates by sequentially introducing four groups of additional controls (all derived from questionnaire data given prior to the birth)[10]. The first group consists of three variables relating to the mother's mental health and personality. The Crown-Crisp Experiential Index (CCEI) is derived from the responses to 23 questions relating to free-floating 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. 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.

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

The second group of controls relates to the extent and depth of the mother's social support networks. 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 third group of controls relates to the mother's long term physical health and health-related behaviours. These variables include 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 include controls for her consumption of alcohol, tobacco and hard drugs in pregnancy.

The final group of variables concern the mother's childhood and family background. We control for whether the mother's father and mother had any educational qualifications, the parenting behaviour of the mother's mother and whether she was present in the home throughout the mother's childhood. We also include controls for 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.

As noted in Section 4.1, 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 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.

4.4.5 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.

The means of the parental interaction scores for each category of early maternal employment are given in Panel C of Table 2. Maternal interaction shows little variation according to employment status but the partner's score is somewhat higher in households where the mother is in work before 18 months. We cannot tell from the raw figures, however, whether this pattern reflects the influence of other factors such as the partner's education or employment status.

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 8 different places such as the local shops, the library and friends and family. Responses were scored from 0 to 4 and summed to give an overall score with a maximum of 32.

4.4.6 Measures of breastfeeding

The ALSPAC survey provides extremely detailed information on the breastfeeding behaviour of mothers. We define two variables – a dummy to indicate whether a mother ever initiated breastfeeding and the duration in months of breastfeeding, given that breastfeeding was started (this latter variable is censored at 15 months). Panel C of Table 2 gives some descriptive statistics on breastfeeding patterns according to the mother's early employment status. Somewhat surprisingly, we see that the likelihood of initiating breastfeeding is strongly *positively* associated with early maternal employment. 84 per cent of mothers who return full time before 18 months breastfeed at some point compared with only 73 per cent of mothers who remain at home until at least 34 months. It seems likely that this association reflects the differing composition of the groups in terms of age and education, for example, rather than any causal effect. Panel C also shows, however, that the median duration of breastfeeding is higher for women who delay their return to work.

4.4.7 Measures of maternal tiredness and stress

Another advantage of the ALSPAC dataset is that it includes numerous self-reported measures of the mother's mental health and feelings. Unlike other studies, therefore, we can explore directly the links between maternal employment and stress. To do this we use two indicators. The first is the mother's CCEI score measured at 21 months, which is assessed in an identical way to the pre-birth CCEI (see Section 4.4.4). We also take the mother's response to the question, "Do you feel tired or exhausted: very often, often, not very often or never?' The data in Panel C of Table 2 show that stress, as measured by the CCEI, is actually slightly negatively correlated with early maternal labour supply. These raw figures, however, may be picking up long term mental health, a factor we control for in our regressions with the inclusion of the pre-birth CCEI.

4.4.8 Measures of household income

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[11]. The mean of net weekly household income for each of the maternal employment categories is given in Panel C of Table 3. It is striking that earlier return and longer hours are associated with substantially higher levels of average income. Of course, these raw figures reflect the influence of partners' earnings, as well as the mother's contribution, and it seems likely that the two are positively correlated.

4.4.9 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. We

[11] 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.

define a family as having used each type of care only if it was used for more than five hours a week as we would expect small amounts of non-maternal care to have little effect on the child. Our three categories are not mutually exclusive so a family may use up to three types simultaneously. Because our focus is on behaviour in the child's early years, and particularly in the first 18 months, we report 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. The use of all three types of non-maternal childcare is more common in households where mothers work, as we would expect. Nevertheless, childcare by a relative is extremely common even where mothers are not employed. Non-relative care and centre care are concentrated almost exclusively among the employed, particularly those working full time by 18 months. It is notable even for these full time mothers, centre-based care is relatively rare at 15 months.

5. Results

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

Table 3 shows our basic estimates of the effects of early maternal employment for each of the four measures of cognitive development. We can see that the raw positive correlation between early employment and child cognitive outcomes suggested by Table 2 disappears when we control for a basic set of household characteristics. 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. If anything the effects are slightly positive but very small and not significantly different from zero. With the exception of the infant communication score the estimates of the effect of returning to work full time prior to 18 months are negative but significant only for the ALSPAC literacy score (and then only at the 5 per cent level). It is tempting to interpret the pattern of these coefficients as evidence that the effect full time work early in a child's life becomes greater as the child grows older. We must be cautious here, however, as the assessment measures may differ in the competencies that they tap and also in the extent to which they contain measurement error. Although the negative effects of early full time work are generally insignificant relative to not working by 34 months, it may be that the children of mothers working full time would do significantly better if their mothers' switched to part time work of delayed their return until after 18 months. F-tests (not shown) suggest that delaying return until the 19 to 34 month period results in significantly higher Key Stage 1 and ALSPAC literacy scores while switching to part time work would raise the ALSPAC literacy score only.

We experimented with different cut-off points for our definition of early maternal employment before selecting the 18-month date. As much of the literature focuses on maternal employment in the first year, it would perhaps seem natural to investigate the effects of work in this period. However, we found that in general the 18-month cut-off was superior in that this definition maximised the magnitudes of the (negative) early return coefficients and of the (positive) 19 to 34 month return coefficients. We also investigated whether earlier return within the 0 to 18 month period was associated with greater effects on child outcomes. Table 4 breaks 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 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, in general we find that later return within the first 18 months has greater negative effects than earlier return. The pattern is less clear for part time workers but seems to suggest that the reverse is the case. It is important not to read too much into these patterns, however, as for every measure we cannot reject the hypothesis of no difference in the effect of return in each of the three sub-periods.

Returning to Table 3, it is interesting the compare the magnitude of the negative effects of full time early maternal employment with those estimated from other studies. 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 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. However, a fair description of the results in Table 3 would be that in general the effects of early maternal employment on child cognitive outcomes are very small, mostly so small as to be insignificantly different from zero. Estimates of the effect of early full time work are generally negative relative to part time work and later return, as well as to no return before 34 months. It may be the case, therefore, that early maternal employment has offsetting positive and negative effects on the child's environment. The positive effects may be slightly weaker when mothers return to work full time and early in the child's life or the negative effects may be slightly stronger. Before we explore this, however, we must address the issue of whether our basic estimates fully capture the net impact of early maternal employment.

5.2 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 2.2, 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 sequentially controlling for a rich set of background variables. For each subset of variables we can assess the extent and direction of the bias in our estimates due to their omission from the basic model. For example, let us suppose that working mothers tend to have better health than non-working mothers and that maternal health has some independent effect on child outcomes. Controlling for maternal health will then *decrease* our estimate of the effects of maternal employment because we have removed the upward bias on the coefficient from the factor. It follows that we can infer from the direction of the change in the coefficients on employment whether working mothers are relatively advantaged or disadvantaged along each dimension.

We begin by adding a set of controls that capture aspects of the mother's mental health and personality, measured prior to the birth. These controls are highly jointly significant in three out of the four regressions and tend to increase the coefficients on early maternal employment. This suggests that, contrary to what we might expect, mothers who return to work early after a birth tend to be relatively disadvantaged in terms of psychological characteristics. If there were any bias in our basic estimates from these factors (or unobservable factors that are strongly correlated with them) then it would tend to lead us to overstate the negative impact of early maternal employment.

Next we control for the extent of the mother's social networks. Again, these variables are highly jointly significant, this time in all four regressions. The effect on the coefficients suggests that part time early returners are relatively advantaged with regard to the strength of their social networks but that mothers who work full time before 18 months and those who return between 19 and 34 months have relatively poorer networks. This suggests that any bias

from factors along this dimension serves to overstate the negative effects of early full time work, and also to exaggerate the differences between part time and full time work in the first 18 months.

The third set of controls relate to the mother's long term physical health and health-related behaviours. F-tests suggest that these variables are generally uncorrelated with child outcomes when the effects of other factors are taken into account. Their inclusion has no consistent impact on the maternal employment coefficients and so suggests that even if working and non-working mothers do vary in terms of health this does not bias estimates of the effect of maternal employment.

Finally, we include a number of variables relating to the mother's family background and childhood experiences. Again, these controls have little explanatory power with respect to child outcomes. If anything their inclusion lowers the coefficients on maternal employment and so shows that working mothers may have some relative advantages along this dimension that bias our estimates upwards.

Our final estimates that correct as far as possible for all sources of background heterogeneity are given in Table 5. As noted in Section 4.1, 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.) For each measure the first column reproduces our basic estimates from Table 3 and the second shows our corrected estimates. The inclusion of the additional variables makes the estimate of the effect of early full time work less negative (more positive) for every measure of cognitive development although the differences are not large. The negative coefficient from the ALSPAC literacy score regression falls in significance from the 5 to the 10 per cent level. Estimates of the effect of returning in the 19 to 34 month period also become more positive while the effect for early part time work is mixed.

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. We find no evidence that the lack of large significant negative effects of early maternal employment is due to bias in our estimates. Indeed the estimated

relationship between full-time work in first 18 months and child outcomes generally become less negative. Hence we do not appear to have any residual upward bias from unobserved factors.

5.3 Sub-group analysis

So far then it is clear that the impact of maternal employment on child development is not substantial and any adverse effects are restricted to full-time employment. Even if we are reasonably confident there are no large significant effects of early maternal employment on average across the population, it may still be the case that certain groups of children are adversely affected. The following results explore how the effects of early full time maternal employment vary with four different sets of characteristics. 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.

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

The regressions shown in Table 6 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. The variation in the effect is not monotonic, however, and in fact, on three out of the four measures, it is the second lowest educational group that seems to suffer the greatest adverse impact.

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. Table 6 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 quality. This type of reasoning also helps to explain why the effect of early maternal employment is not monotonic in the level of the mother's education. More skilled mothers, presumably with higher wages, may be able to purchase alternative childcare that is of a high quality and so minimise the difference between

their own input and the input from other sources. The children of moderately skilled mothers fare the worst because the loss of maternal care is not compensated for to the same extent. It is also possible that the positive effect of employment for the least skilled reflects the importance of the mother's earnings to these families. If other family income is strongly correlated with maternal education then the extra resources provided by the mother's employment may outweigh any negative effects arising from the loss of her inputs into child rearing.

5.3.2 Are boys more or less vulnerable than girls to the effects of early maternal employment?

Table 7 gives the results on interactions between the child's gender and early full time maternal employment. The level effects of gender show clearly that on average girls score significantly higher on all four measures of cognitive development than boys. With regard to the effects of maternal employment, the interacted terms are significantly different in only one of the four regressions (for the ALSPAC literacy score). Nevertheless, we can see that in every case the effect of full time work is more negative (less positive) for boys than for girls. Hence our results provide some tentative evidence in favour of the hypothesis that boys are more adversely affected by early full time maternal employment than girls.

5.3.3 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 8 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 three out of the four 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. It is worth noting that the children of working lone mothers do not appear to suffer from the absence of the mechanism of increased partner involvement. Even though this mechanism may help to offset the negative effects in two-parent families, it is not sufficient to reverse the pattern of results.

5.3.4 Are children from better-off families more or less vulnerable than those from poorer families to the effects of early maternal employment?

The regressions shown in Table 9 interact our subjective measure of financial deprivation in the pre-birth period with early full time employment. On each of the three later assessments we find negative effects of employment only for those not classed as experiencing financial difficulties. The effects of early full time work for the group experiencing difficulties are positive on each of these three measures[12]. In general, these results provide evidence in support of the idea that the children of poorer mothers have less to lose when their mothers return to work. Even though better off families may be able to afford childcare of a higher quality, this is not sufficient to offset the other adverse effects of maternal employment. The balance of costs and benefits to mothers' early full time work is decidedly more in favour of the benefits for the poorest families than for the better off.

To sum up, although the differences are often not statistically significant, the pattern of our results suggests that the negative effects of early full time maternal employment are concentrated among certain groups of children. We find no evidence that the children of the least educated mothers, children in lone parent households or children in the poorest families suffer any adverse consequences when their mothers return to work full time in the first 18 months, and the net effect may even be beneficial. The type of alternative childcare they receive and the additional income generated by employment seem to outweigh any negative effects. This is not the case for the children of moderately skilled mothers, children in 'traditional' two-parent families and those who are not poor. The net impact of early full time maternal employment for these groups seems to be negative but is nevertheless small and often insignificant. We also find some weak evidence in favour of the view that boys experience greater difficulties due to maternal employment than girls.

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

The results of our sub-group analysis suggest that there are offsetting positive and negative effects associated with early full time maternal employment. We now turn to the explicit analysis of the routes by which maternal employment may influence child outcomes.

[12] The results for the 24-month communication measure are somewhat strange as they imply that children in deprived families score significantly higher on average than children who are not deprived.

5.4.1 The mechanism of parental inputs

The first step in our causal analysis is to investigate the way in which early maternal employment affects the inputs into child rearing of mothers and their partners. The first three columns of Table 10 show the effect of early maternal employment on our maternal, paternal and total parental interaction scores. As discussed in Section 4.4.5, 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 10 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. In Appendix Table 2 we give ordered probit estimates of the effect of maternal employment on each of the components of the interaction scores. Mothers who return to work full time by 18 months score significantly lower on every component. The change in partner involvement associated with maternal employment is positive in every case and the largest coefficients do not appear to be

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We have little confidence in these estimates (which show the opposite pattern to the other regressions)

concentrated in any one particular type of activity – we find significant effects, for example, for feeding the child, playing with toys with the child and taking the child for walks.

Table 10 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 9.

For each of the four child outcome measures the first column in Table 11 reproduces our heterogeneity-corrected estimates of the average effects of early maternal employment from Table 5. 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, with the exception of the 24-month communication score, this effect is not large. We would expect the inclusion of this variable to have little impact on the early full time maternal employment coefficients (because total parental involvement is no higher or lower for this group) but to reduce the coefficients on part time work (because we are statistically removing the effects of a factor positively associated with part time work).

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 proportions of parental interactions accounted for by the mother are 0.51, 0.55, 0.59 and 0.75 for each of the quartiles. We can 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.

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and suggest that the measure itself may be subject to some type of reporting bias

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 strongly beneficial influence on child outcomes – strong enough to outweigh the effects of lower maternal involvement when mothers are employed. These results would seem to suggest that the children of lone mothers should experience greater harmful effects of maternal employment as the mechanism of greater partner involvement is unavailable to them. However, we know from our sub-group analysis that the reverse is true – the overall effect of maternal employment is *less* negative in single than in two-parent families. We interpret this as evidence that the positive effects of other mechanisms outweigh the effect of the reduction in parental inputs. Even if the children of lone mothers do suffer from spending less time with a parent, this is relatively less important than the impact of the mother's earnings or the benefits these children receive from non-parental childcare.

The third column for each measure in Table 11 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 not strongly related to later outcomes (with the exception of the infant communication score). In fact, according to the Key Stage 1 and ALSPAC literacy scores, fewer outings are associated with marginally higher scores. 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 child receives cognitive stimulation from the mother's 'being there' as opposed to when she is actively involved with the child (which is measured by our parental interaction measures).

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. Comparing the estimates in columns 1 and 3, we see that the impact of early full time work would be up to 90 per cent larger (in the case of the Entry Assessment score) without the positive effects of these behaviours. 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 10 and Table 11 it seems perverse not to attribute at least some of the differences in parenting to the causal effect of mothers' market work.

5.4.2 The mechanism of breastfeeding

One area in which an equal division of parenting is not possible is breastfeeding. It has been suggested that it is this factor that accounts for the unique contribution of the mother is a child's early years and hence for the detrimental effects of early maternal employment. Table 12 investigates the relationship between maternal employment and breastfeeding. Since the decision to initiate breastfeeding may be somewhat different to the decision of how long to breastfeed for we model the two decisions separately.

We saw from the descriptive data in Table 2 that early maternal employment is strongly positively correlated with the initiation of breastfeeding. It seems unlikely that this reflects a causal relationship – rather it reflects the correlation between breastfeeding and factors such as the mother's age and education. The first column in Table 12 shows the results of a probit model for the probability of ever breastfeeding that controls for these background factors. Neither part time nor full time employment prior to 18 months has any significant effect on the decision to begin breastfeeding. The second column of Table 12 presents the results from a tobit model[13] for the duration of breastfeeding in months given that the mother initiated breastfeeding. Here we see that early maternal employment significantly reduces the duration of breastfeeding – by around two weeks for part time work and by around five to six weeks for full time work. It seems likely that return to work earlier within the first 18 months will have a greater impact of breastfeeding behaviour than return after, say, a year. We investigate this in column 3 of Table 12. The results in this column show that it is only return before 6 months that has any impact on the length of time for which a mother breastfeeds. Therefore,

[13] We use a tobit model because data on the duration of breastfeeding is censored at 15 months.

this mechanism for the negative effects of maternal employment is only plausible for women returning to work within this time window.

Table 13 investigates the relationship between breastfeeding and children's cognitive development. Again, the first column for each measure reproduces our baseline estimates from Table 5. The second column then introduces controls for breastfeeding. We see that less breastfeeding has a significantly negative effect on all four child outcomes. As expected, the inclusion of these controls increases the coefficients on maternal employment prior to 18 months because we have removed one of the harmful effects of working from the estimates. This said, the upward change in the coefficients on early full time work is not large and the estimates remain negative for three out of the four measures (although not significant). Differences in breastfeeding, then, cannot wholly explain the very small negative effects that we find for early full time employment. This is unsurprising when we note that it is the lack of *initiation* of breastfeeding that has the greatest adverse effects on cognitive outcomes. It is only along the dimension of duration that working mothers differ from non-working mothers and the effects of shorter duration of breastfeeding tend to be smaller.

5.4.3 The mechanism of maternal tiredness and stress

Another hypothesis is that the attempt to combine motherhood with market work results in increased maternal stress and tiredness and hence in poorer quality parenting. We are able to test this hypothesis directly as the ALSPAC survey provides us with subjective measures of mental health (the CCEI) and of tiredness or exhaustion at 21 months. Table 14 illustrates the relationship between early maternal employment and tiredness and stress. We control for a range of other factors in these regressions including the identical CCEI measured prior to the birth. This helps to net out the effects of long term mental health from our estimates and so to identify the impact of the mother's environment in the first two years of the child's life.

The results in Table 14 show that mothers who return to work full time before 18 months report significantly higher levels of stress and of tiredness at 21 months than mothers who remain at home until after 34 months. Interestingly, the estimates for mothers who returned part time in the early period are not significantly different from zero. Tiredness and stress thus provide a potential mechanism for negative effects of early full time maternal employment, provided that these factors have a detrimental effect on children's cognitive development.

This point is investigated in Table 15. For each assessment measure column 2 shows the effects on our baseline estimates of including controls for tiredness and stress. Whilst

maternal stress at 21 months is generally negatively correlated with cognitive outcomes, the effects are small and insignificant. This may in part be due to collinearity with the pre-birth CCEI measure (not shown), as the correlation between the two CCEI scores is 0.54. Nevertheless, the lack of any evidence of strongly negative effects of maternal stress on child outcomes undermines the view that this is an important mechanism by which the effects of early maternal employment are transmitted. This conclusion is strengthened by the fact that maternal tiredness in *positively* rather than negatively correlated with child cognitive outcomes. It seems that our tiredness variable may be capturing the amount of effort expended by the mother. Mothers who exert more effort in child rearing or who attempt to combine a number of roles may experience more tiredness, perhaps because they cut back on sleep. Maternal tiredness, therefore, seems to be an outcome of behaviours that positively influence the child's development rather than a causal influence on it. The inclusion of controls for tiredness and stress lowers the coefficients on early full time employment, although only very slightly. This indicates that, if anything, working mothers are actually slightly superior to non-working mothers along the dimensions captured by these variables. In general, however, we can conclude that the greater tiredness and stress that is associated with early full time maternal employment is not leading to significantly poorer outcomes in children.

5.4.4 The mechanism of income

The effect of the additional income generated by mothers' earnings clearly provides a potential explanation for our lack of findings of large negative effects of early maternal employment. Ideally, we would like to isolate the extent to which these earnings offset the other mechanisms associated with mothers' work. As discussed in Section 4.4.8, however, data on household income and earnings in the first years of the child's life are unavailable. We cannot therefore investigate the effects of early maternal employment when contemporaneous income is held constant. It is still of interest to explore this issue with our best available measure of income, one derived from information given at age 3 and 4. The inclusion of this variable will certainly help to capture some heterogeneity in the 'permanent income' of households and it is likely to be correlated with income in the period in which we are interested. Our results can give us some indication of the importance of income, then, but are not a rigorous test of the mechanism of earnings from early maternal employment.

Table 16 shows the effect on our basic estimates of controlling for the log of average household income. With the exception of the infant communication measure, household income is significantly positively related to later child outcomes (even after controlling for

strongly correlated factors such as the education and occupation of the mother and the partner) although the magnitude of the direct income effect is not large. To illustrate, an increase in household weekly income from £200 to £300 per week (in 1995 prices) corresponds to a change of about 0.4 in the log of income, and so would raise the Key Stage 1 score by only about 0.6 points. Nevertheless, the inclusion of income in the regressions for the three later assessment scores does serve to reduce the coefficients on early full time maternal employment. These results, then, are certainly consistent with the view that the additional income generated by early maternal employment helps to compensate to some degree for the absence of the mother.

5.4.5 The mechanism of non-parental childcare

Unfortunately, the nature of the data regarding early childcare is again not as we would wish. 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.

Table 17 shows the effect on our basic estimates of controlling for the use of different forms on childcare. Recall from Section 4.4.9 that the childcare categories are not mutually exclusive as a family may employ more than one type for at least 6 hours per week. Table 17 shows the coefficients for childcare type at 15 months[14]. In general they have no significant effect on cognitive outcomes although the pattern of the coefficients suggests that centre care, and to a lesser extent non-relative care, may be beneficial to child development (as compared with maternal care). The effects of care by a relative other than the mother are not consistent but are small and insignificant. We know from the descriptive results in Table 2 that the majority of households use some form of relative care regularly for more than five hours a week, regardless of whether the mother is in employment. The use of non-relative and centre care, however, is concentrated largely in households where mothers are in work by 18 months. Given that attendance at these types of provider seems beneficial it is unsurprising

[14] The regressions also include controls for childcare type at 38 months as forms of childcare may be correlated throughout childhood.

that our estimates of the effects of early maternal employment are slightly lower when we control for their use. These results suggest that use of purchased childcare helps to offset, although not to any great degree, the negative effects of early maternal employment. Where working mothers rely on relatives as a source of alternative childcare this offsetting effect may be absent.

To investigate this further we can explore how the effect of maternal employment varies with the particular type of childcare used. The results in Table 18 are derived from regressions in which the dummy variables for employment before 18 months are interacted with the three types of non-parental care. The relevant coefficients relating to both childcare and employment are then summed to construct an estimate of the effect of working *and* using a particular form of arrangement. F-tests are used to test whether the total effect is significantly different from the outcomes of children whose mothers remained at home until 34 months and used maternal care only[15]. The first column of Table 18 details the proportion of mothers working full time by 18 months who used each of the five most common types of childcare arrangements. The next four columns then show the associated impact on their children. It is clear that the negative effects of early full time maternal employment are concentrated in children who do not attend any form of paid childcare (i.e. in 38% of the sample whose mothers returned full time by 18 months). Maternal employment has significant and relatively large negative effects when children are placed in the care of a friend or relative. In contrast, we find no significant negative effects at all 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. These 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 to the extent that the child is actually better off than if he or she were cared for only by the parents. Informal unpaid care, on the other hand, does not have these benefits and cannot compensate for the loss of parental inputs.

5.5 The effects of early maternal employment on behavioural outcomes

We now discuss the effects of maternal employment on our measure of behavioural outcomes at four years of age. The process of our analysis for this variable was identical to that for the cognitive outcomes but we keep our discussion here brief for three reasons. Firstly, we find no significant effects of early maternal employment on the behavioural score in any of our specifications, not even of full time work prior to 18 months. Secondly, as we have only one

measure of behavioural outcomes, compared to the four measures of cognitive development, our conclusions must be less robust. And thirdly, because the behavioural score is derived from mother-reported data it is difficult to know to what extent it accurately reflects the child's development rather than the mother's perceptions and state of mind.

Table 19 details our estimates of the overall net effect of maternal employment on the behavioural score. The initial basic specification (column 1) reveals that part time work before 18 months and work between 19 and 34 months are associated with very slightly fewer behavioural problems in children, while full time work before 18 months is associated with slightly more problems. None of these coefficients, however, are statistically significant. The second column explores whether the effects of maternal employment prior to 18 months vary across the three sub-periods. We find no evidence that very early return to work has greater effects on behavioural outcomes and cannot reject the hypothesis that the effects in each of the sub-periods are equal. Finally, we experimented with the addition of our four groups of additional background controls. Introducing each group sequentially revealed that, in contrast with our cognitive results, all four groups have a highly significant impact on behavioural outcomes and that in each case the basic estimates were biased upwards due to their omission. This suggests that the children of working mothers are relatively disadvantaged along all four dimensions and that the basic estimates tend to overstate the detrimental effects of maternal employment (or understate the benefits) because they are also picking up the effects of these negative confounding factors. The third column of Table 19 shows the result of controlling for these additional factors. As each group was significantly associated with behavioural outcomes all the variables were retained in this final specification. The size of the harmful effect of early full time work is less than half that of the basic estimate, while the effects of part time and later work appear slightly more beneficial. Overall, however, the conclusion must be that early maternal employment has no significant effects on children's behavioural outcomes.

The results of our sub-group analysis (not shown) find little variation in the effects of maternal employment on behaviour across different types of families. We found no significant, or even notable, differences in the effect according to mother's educational attainment, child's gender or pre-birth financial status. The exception was for the case of lone parents where we found that full time maternal employment prior to 18 months was associated with significantly more behavioural problems for the children of single mothers than of couples. Given our earlier caveats we would avoid drawing too strong a conclusion

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

from this result but it does suggest that early lone mothers' employment may not have uniformly beneficial effects on all aspects of child development.

The thrust of our analysis in this paper has been that maternal employment may have offsetting positive and negative effects on child outcomes. Table 20 shows the results of our exploration of these mechanisms for the behavioural score. Column 1 gives our estimates of the overall net impact of maternal employment from the previous table while columns 2 and 3 then show the effects of controlling for parenting behaviours. The results show that every measure of parenting at 18 months has large significant effects on behavioural outcomes at age 4. Unlike for cognitive outcomes, however, the division of the parenting between the mother and the partner has no significant influence on behavioural outcomes. Greater paternal involvement does not seem to have the beneficial effects on children's behaviour that it has on their cognitive development. Largely for this reason, the differences in parenting behaviour shown in Table 8 do not seem to mediate the effects of maternal employment greatly in either direction. Parenting neither offsets nor contributes substantially to a negative effect of maternal employment on behavioural outcomes.

Column 4 of Table 20 shows the effects of controlling for breastfeeding. The level effect of breastfeeding on behavioural outcomes is small and, where the coefficients are significant, not consistent. Breastfeeding for 7 to 12 months is inferior to breastfeeding for both 4 to 6 months and for greater than 12 months. It is thus not surprising that the shorter duration of breastfeeding associated with early full time work has little impact on the estimate of the effect of early full time maternal employment.

Column 5 of Table 20 explores the effects of controlling for maternal tiredness and stress. According to these results, both stress and tiredness are strongly positively related to behavioural problems in children. There is no suggestion here that tiredness is the result of the exertion of greater effort that positively benefits the child. It is difficult to know how to interpret these results, however, as they may reflect reverse causation from the child's behaviour to the mother's mental health. It may also be that the mother's mental health influences her perceptions of the child's behaviour rather than the behaviour itself. Nevertheless, the fact that the mother's report of stress and tiredness was recorded two years before the child's behavioural score provides support for the idea that there is a causal link. It is notable that controlling for these variables drives the coefficient on early full time work

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significant.

down virtually to zero. It follows that the (small) detrimental effect of early full time work is accounted for almost entirely by its effect via the mother's mental health.

The mechanism of income is examined in Column 6 of Table 20. Household income is significantly negatively related to behavioural problems in children and its inclusion in the regression increases the magnitude of the estimate of the harmful effect of full time work. These results are consistent with the hypothesis that the contribution of the mother's earnings works to offset the other detrimental effects of her employment.

Finally, Table 21 summarises the effects of the use of early non-parental childcare on children's behaviour. The results here are somewhat contradictory as Panel A suggests that paid childcare (non-relative and centre care) have relatively beneficial effects on behaviour, yet, from Panel B, it is the children of mothers who use these types of care when they work full time that experience the greatest detrimental effects. It is interesting that the sign of the coefficients in Panel B suggest that it is *combinations* of different types of care that help to minimise the harmful effects of early full time maternal employment, rather than the use of any one type of care alone. Overall, however, none of the coefficients, nor the calculated effects of full time employment, are significantly different from zero and we must conclude that the type of childcare used when the mother works does not substantially mediate the effects of her employment on behaviour.

6. Discussion

The results of our regression analysis combine to give a rounded picture of the way in which early maternal employment affects 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, of lone mothers and those in the poorest households appear overall to benefit when their mothers work, leaving the negative effects concentrated amongst the children of the more advantaged. Our results also provide some tentative support for the hypothesis that boys are more adversely affected than girls by early maternal employment. The strength of these results should not be overstated as frequently the differences are not statistically significant, but they do 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 small magnitude of the average effects of early full time maternal employment is due to a number of factors. Firstly, parenting behaviour in households where mothers work helps to compensate for the time they divert to the market. On average, the children of working mothers receive no less active parental interaction than the children of non-working mothers because the involvement of fathers rises to offset lower maternal involvement. This is an important result because it indicates that perhaps the most intuitive mechanism through which we might expect maternal employment to be harmful to children, i.e. a reduction in parental inputs, is simply not in evidence. In addition, it seems that the greater involvement of fathers in child rearing in households where mothers work has strongly beneficial effects on children's cognitive development (although not on their behavioural development). This result directly contradicts Becker's theory that the specialisation of each partner in one of either market or home production will result in gains to the household as a whole. While it may be the case that labour market productivity is maximised by such a strategy, our results

suggest that the specialisation by the mother in child rearing is less productive than a more equal division of labour.

A second explanation for the modest size of the effect of early full time maternal employment lies in the contribution made to household income from the mother's earnings. Although data limitations prevent us from quantifying the true impact of this mechanism, our results suggest the greater consumption made possible by the mother's earnings is beneficial to the child. One way in which household income may have a substantial impact on children's development is through 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 solely of care by a friend, relative or neighbour who experience significant detrimental effects of maternal employment. The use of paid childcare protects children from these negative effects and attendance at a centre-based provider may actually lead to better cognitive outcomes than if the child were at home with a non-working mother.

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 do not make use of any paid childcare account for only around 5 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.

We also examined two further mechanisms that we might expect to explain the negative sign of the overall effect of early maternal employment. Firstly, we found that employment before 18 months has no impact on the initiation of breastfeeding but does result in shorter durations of breastfeeding. Since it is initiation that really seems to matter for children's cognitive development, however, these shorter durations make only a minor contribution to later outcomes. Secondly, we explored whether early maternal employment affects child outcomes through the mechanism of greater maternal stress and tiredness. The first step of this hypothesis was supported by the data in that full time employment before 18 months is associated with significantly more tiredness and stress amongst mothers. However, we found little evidence of a negative causal impact of this stress on child cognitive outcomes. In fact, tiredness seems to be an indicator of the amount of effort exerted and is positively related to

cognitive outcomes. This suggests that rather than providing less stimulating care because they are tired, working mothers are tired because they maintain the quality of their inputs even with other demands on their time. This result does not hold for behavioural outcomes but it is difficult to determine the direction of causation between stress and child outcomes with this mother-reported measure.

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. The importance of the role of the father in early child rearing opens up other potential ways of influencing children's development – policies relating to paternity leave and flexible working for fathers as well as mothers could, on the basis of our results, have quite strong effects on child outcomes. Finally, we emphasise the importance of access to cheap high quality childcare, particularly for very young children. Relatively few mothers make use of formal, centre-based care before their children are two years of age but it is attendance at just such providers that appears to mitigate the effects of maternal employment to the greatest extent.

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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. The importance of the role of the father in early child rearing opens up other potential ways of influencing children's development – policies relating to paternity leave and flexible working for fathers as well as mothers could, on the basis of our results, have quite strong effects on child outcomes. Finally, we emphasise the importance of access to cheap high quality childcare, particularly for very young children. Relatively few mothers make use of formal, centre-based care before their children are two years of age but it is attendance at just such providers that appears to mitigate the effects of maternal employment to the greatest extent.

Table 1: Sample sizes and correlations between child outcome scores

	Infant communication (2 years)	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)	Behavioural problems (4 years)
Infant communication (2 years)	1.00				
Entry Assessment (4 or 5 years)	0.26	1.00			
ALSPAC literacy (7 years)	0.22	0.39	1.00		
Key Stage 1 (7 or 8 years)	0.25	0.58	0.80	1.00	
Behavioural problems (4 years)	-0.18	-0.19	-0.14	-0.19	1.00
Sample size	9323	4607	6792	5562	8766

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				
Infant communication (2 years)	100.69	100.14	99.85	99.45
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
Behavioural problems (4 years)	99.38	99.44	100.10	100.72
Panel C				
Maternal interaction score (mean)	31.4	32.4	32.4	32.3
Paternal interaction score (mean)	25.9	24.6	22.9	22.8
Total parental interaction score (mean)	56.5	56.4	53.9	53.5
Initiated breastfeeding	84.4	78.2	75.5	72.5

Median duration of breastfeeding in months (given initiation)	4	4	4	6
CCEI (stress) score at 21 months (mean)	9.8	9.4	10.4	10.2
Average household income (£ per week, mean)	399	324	281	273
Childcare at 15 months (> 5 hours per week)				
Relative care	81	84	67	60
Non-relative care	49	21	2	3
Centre care	10	4	1	1

Table 3: Basic estimates of the effect of early maternal employment of child cognitive outcomes

Maternal employment	Infant communication (2 years)	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
0 -18 months PT	**0.254** (0.294)	**0.007** (0.392)	**-0.008** (0.346)	**0.118** (0.359)
0 -18 months FT	**0.110** (0.409)	**-0.212** (0.540)	**-0.959**** (0.472)	**-0.567** (0.494)
19 – 34 months	**0.285** (0.386)	**0.427** (0.507)	**0.470** (0.458)	**0.502** (0.471)
adj R2 N	0.0890 9323	0.2419 4607	0.1144 6792	0.2046 5562

Notes

1. All 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.
2. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
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 4: Basic estimates of the effects of maternal employment on child cognitive outcomes – detailed categories

Age of child at return (months)	Infant communication (2 years)		Entry Assessment (4 or 5 years)		ALSPAC literacy (7 years)		Key Stage 1 (7 or 8 years)	
	PT	FT	PT	FT	PT	FT	PT	FT
0-4	**0.185** (0.378)	**0.675** (0.512)	**-0.151** (0.491)	**-0.061** (0.669)	**-0.274** (0.438)	**-0.645** (0.587)	**-0.021** (0.452)	**-0.526** (0.613)
5-8	**-0.066** (0.391)	**-0.334** (0.579)	**-0.116** (0.508)	**-0.289** (0.752)	**0.106** (0.450)	**-1.410**** (0.654)	**0.027** (0.462)	**-0.622** (0.693)
9-18	**0.570** (0.375)	**-1.137** (0.883)	**0.176** (0.492)	**-1.135** (1.161)	**0.050** (0.442)	**-1.365** (0.988)	**0.241** (0.458)	**-1.177** (1.061)
19-34	**0.271** (0.386)		**0.404** (0.507)		**0.447** (0.458)		**0.478** (0.472)	
Test of restrictions:	P>F = 0.1424		P>F = 0.8786		P>F = 0.7353		P>F = 0.9584	
adj R2	0.0894		0.2417		0.1150		0.2047	
N	9323		4607		6792		5562	

Notes

1. All 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.
2. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
3. Standard errors are given in brackets.
4. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
5. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.
6. 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.

Table 5: Estimates of the effect of early maternal employment of child cognitive outcomes – additional controls for background heterogeneity

Maternal employment	Infant communication (2 years)		Entry Assessment (4 or 5 years)		ALSPAC literacy (7 years)		Key Stage 1 (7 or 8 years)	
	(1) basic model	(2) + additional controls	(1) basic model	(2) + additional controls	(1) basic model	(2) + additional controls	(1) basic model	(2) + additional controls
0 -18 months PT	**0.254** (0.294)	**0.218** (0.293)	**0.007** (0.392)	**-0.021** (0.390)	**-0.008** (0.346)	**0.000** (0.345)	**0.118** (0.359)	**0.153** (0.357)
0 -18 months FT	**0.110** (0.409)	**0.186** (0.408)	**-0.212** (0.540)	**-0.196** (0.540)	**-0.959**** (0.472)	**-0.866*** (0.471)	**-0.567** (0.494)	**-0.441** (0.494)
19 – 34 months	**0.285** (0.386)	**0.367** (0.385)	**0.427** (0.507)	**0.532** (0.506)	**0.470** (0.458)	**0.563** (0.457)	**0.502** (0.471)	**0.614** (0.470)
adj R2	0.0890	0.0968	0.2419	0.2490	0.1144	0.1212	0.2046	0.2126
N	9323	9323	4607	4607	6792	6792	5562	5562

Notes

1. Basic regressions (column (1)) 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.
2. Regressions in column (2) include all the controls used in the basic regressions plus controls for 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 6: Differential effects of early full time maternal employment by the mother's educational attainment.

	Infant communication (2 years)	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
Maternal employment				
0- 18 months PT	**0.187** (0.293)	**0.001** (0.391)	**-0.005** (0.345)	**0.154** (0.357)
0- 18 months FT * cse/none	**3.303*** ** (1.231)	**1.229** (1.699)	**3.067** ** (1.525)	**2.279** (1.567)
0- 18 months FT * vocational / O level	**-0.025** (0.604)	**-1.221** (0.760)	**-1.406** ** (0.695)	**-0.813** (0.701)
0- 18 months FT * A level	**-0.025** (0.643)	**0.237** (0.819)	**-1.151** (0.711)	**-0.543** (0.757)
0- 18 months FT * degree	**-0.596** (0.686)	**0.633** (0.958)	**-0.712** (0.767)	**-0.392** (0.855)
19-34 months	**0.351** (0.385)	**0.533** (0.506)	**0.558** (0.457)	**0.613** (0.470)
Educational attainment (level effects): base = vocational/O-level				
cse/none	**-0.683** ** (0.338)	**-1.293*** ** (0.453)	**-1.729*** ** (0.424)	**-1.862*** ** (0.421)
A level	**0.360** (0.294)	**0.720*** (0.370)	**1.008*** ** (0.331)	**1.011*** ** (0.344)
degree	**0.943** ** (0.394)	**2.773*** ** (0.527)	**2.735*** ** (0.439)	**2.808*** ** (0.477)
Test of equality of interacted terms	P>F = 0.0407	P>F = 0.2436	P>F = 0.0486	P>F = 0.3196
adj R2	0.0977	0.2490	0.1217	0.2126
N	9323	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. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
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 7: Differential effects of early full time maternal employment by child's gender

	Infant communication (2 years)	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
Maternal employment				
0- 18 months PT	**0.219** (0.293)	**-0.019** (0.390)	**0.000** (0.345)	**0.153** (0.357)
0- 18 months FT * male	**0.001** (0.504)	**-0.464** (0.668)	**-1.768***** (0.583)	**-0.750** (0.615)
0- 18 months FT * female	**0.406** (0.538)	**0.103** (0.696)	**0.128** (0.605)	**-0.108** 0.633
19-34 months	**0.369** (0.385)	**0.532** (0.506)	**0.564** (0.457)	**0.616** (0.470)
Gender (level effects): base = male				
female	**4.097***** (0.209)	**3.342***** (0.274)	**2.150***** (0.245)	**3.099***** (0.253)
Test of equality of interacted terms	P>F = 0.5308	P>F = 0.4946	P>F = 0.0087	P>F = 0.4000
adj R2	0.0967	0.2489	0.1220	0.2126
N	9323	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. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
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: Differential effects of early full time maternal employment by lone parent status

	Infant communication (2 years)	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
Maternal employment				
0- 18 months PT	**0.217** (0.293)	**-0.027** (0.391)	**-0.005** (0.345)	**0.147** (0.357)
0- 18 months FT * does not live with partner	**0.590** (1.386)	**1.179** (1.796)	**-0.728** (1.645)	**0.890** (1.672)
0- 18 months FT * lives with partner	**0.164** (0.416)	**-0.279** (0.550)	**-0.890*** (0.479)	**-0.519** (0.503)
19-34 months	**0.367** (0.385)	**0.530** (0.506)	**0.563** (0.457)	**0.613** (0.470)
Lone parent status (level effects): base = lives with partner				
no partner	**-0.195** (0.582)	**-1.443*** (0.787)	**-3.788***** (0.719)	**-2.973***** (0.726)
has partner but do not live together	**0.111** (0.724)	**0.980** (1.098)	**-2.034**** (0.979)	**-1.720*** (1.004)
Test of equality of interacted terms	P>F = 0.7618	P>F = 0.4222	P>F = 0.9225	P>F = 0.4047
adj R2	0.0966	0.2489	0.1211	0.2126
N	9323	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. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
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 9: Differential effects of early full time maternal employment by subjective financial difficulties in pregnancy

	Infant communication (2 years)	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
Maternal employment				
0- 18 months PT	**0.207** (0.293)	**-0.027** (0.391)	**-0.004** 0.345	**0.145** (0.357)
0- 18 months FT * not deprived	**0.053** (0.426)	**-0.405** (0.565)	**-0.975**** 0.491	**-0.731** (0.515)
0- 18 months FT * deprived	**-0.097** (1.179)	**1.085** (1.465)	**0.007** 1.341	**1.654** (1.358)
19-34 months	**0.360** (0.385)	**0.528** (0.506)	**0.562** 0.457	**0.611** (0.470)
Financial deprivation (level effects): base = not deprived				
deprived	**1.105***** (0.357)	**-0.262** (0.465)	**-0.777*** 0.439	**-1.245***** (0.441)
Test of equality of interacted terms	P>F = 0.9006	P>F = 0.3163	P>F = 0.4702	P>F = 0.0839
adj R2	0.0969	0.2489	0.1210	0.2129
N	9323	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. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
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 10: 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	-	18.08
S.D.	3.49	6.33	9.38		1.60	-	3.19
0-18 months PT	**-0.139**	**1.118*** **	**0.943*** **		**-0.010**	**0.061***	**0.041**
	(0.103)	(0.182)	(0.223)		0.046	(0.037)	(0.094)
0-18 months FT	**-1.392*** **	**1.621*** **	**0.161**		**0.078**	**0.114****	**-0.616*** **
	(0.144)	(0.254)	(0.313)		0.064	(0.052)	(0.132)
19-34 months	**0.094**	**0.202**	**0.235**		**0.016**	**0.017**	**-0.005**
	(0.133)	(0.237)	(0.289)		0.059	(0.047)	(0.121)
adj R2	0.0670	0.1603	0.3959		0.1022		0.0681
N	9722	9156	9602		9742	9691	9725

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 dder 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. 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 11: The effect of parenting behaviours at 18 months on children's cognitive development and the estimated impact of early maternal employment

	Infant communication (2 years)			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)	(1)	(2)	(3)
Maternal employment												
0-18 months PT	**0.218**	**0.088**	**0.148**	**-0.021**	**-0.118**	**-0.106**	**0.000**	**-0.163**	**-0.165**	**0.153**	**0.004**	**0.010**
	(0.293)	(0.290)	(0.278)	(0.390)	(0.391)	(0.390)	(0.345)	(0.345)	(0.345)	(0.357)	(0.357)	(0.357)
0-18 months FT	**0.186**	**0.141**	**-0.023**	**-0.196**	**-0.300**	**-0.367**	**-0.866***	**-1.146****	**-1.245*****	**-0.441**	**-0.668**	**-0.746**
	(0.408)	(0.407)	(0.390)	(0.540)	(0.546)	(0.544)	(0.471)	(0.474)	(0.474)	(0.494)	(0.497)	(0.497)
19-34 months	**0.367**	**0.341**	**0.323**	**0.532**	**0.507**	**0.480**	**0.563**	**0.520**	**0.490**	**0.614**	**0.557**	**0.533**
	(0.385)	(0.381)	(0.365)	(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	-	**2.257*****	**0.968*****	-	**0.658***	**0.190**	-	**0.302**	**0.096**	-	**0.555**	**0.323**
	-	(0.281)	(0.274)	-	(0.368)	(0.374)	-	(0.332)	(0.339)	-	(0.340)	(0.346)
high	-	**4.069*****	**1.626*****	-	**1.011****	**0.180**	-	**0.803****	**0.463**	-	**0.957****	**0.565**
	-	(0.328)	(0.273)	-	(0.430)	(0.366)	-	(0.385)	(0.329)	-	(0.395)	(0.340)
Mother's share of parental interaction: base = highest quartile												
lowest quartile	-	**-0.054**	**1.050*****	-	**0.727**	**1.129****	-	**1.757*****	**1.907*****	-	**1.312*****	**1.491*****
	-	(0.375)	(0.363)	-	(0.498)	(0.501)	-	(0.444)	(0.449)	-	(0.457)	(0.462)
2nd quartile	-	**-0.357**	**0.543**	-	**0.261**	**0.629**	-	**1.298*****	**1.421*****	-	**1.081****	**1.240*****
	-	(0.347)	(0.335)	-	(0.459)	(0.460)	-	(0.411)	(0.414)	-	(0.422)	(0.425)
3rd quartile	-	**-0.211**	**0.346**	-	**0.537**	**0.752**	-	**0.804****	**0.888****	-	**0.652**	**0.747***
	-	(0.329)	(0.316)	-	(0.434)	(0.433)	-	(0.390)	(0.391)	-	(0.401)	(0.402)
Outings score: base = high												
low	-	-	**-1.596*****	-	-	**-0.272**	-	-	**0.471**	-	-	**0.310**
	-	-	(0.254)	-	-	(0.351)	-	-	(0.311)	-	-	(0.323)
medium	-	-	**-0.755*****	-	-	**0.281**	-	-	**0.226**	-	-	**0.342**
	-	-	(0.230)	-	-	(0.320)	-	-	(0.280)	-	-	(0.294)
Teaching score: base = medium												
low	-	-	**-3.234*****	-	-	**-1.520*****	-	-	**-1.143*****	-	-	**-0.777****
	-	-	(0.279)	-	-	(0.389)	-	-	(0.349)	-	-	(0.360)
high	-	-	**3.863*****	-	-	**1.059*****	-	-	**0.825*****	-	-	**0.846*****
	-	-	(0.216)	-	-	(0.294)	-	-	(0.263)	-	-	(0.272)
Frequency of talking during housework: base = nearly always												
never/rarely	-	-	**-0.852**	-	-	**-2.823****	-	-	**-2.841****	-	-	**-2.260***
	-	-	(1.068)	-	-	(1.366)	-	-	(1.265)	-	-	(1.308)
sometimes	-	-	**-2.423*****	-	-	**-1.487****	-	-	**0.307**	-	-	**-0.300**
	-	-	(0.426)	-	-	(0.607)	-	-	(0.521)	-	-	(0.547)
often	-	-	**-1.289*****	-	-	**0.001**	-	-	**-0.083**	-	-	**-0.159**
	-	-	(0.209)	-	-	(0.286)	-	-	(0.257)	-	-	(0.265)
adj R2	0.0968	0.1180	0.1906	0.2490	0.2508	0.2592	0.1212	0.1266	0.1305	0.2126	0.2173	0.2196
N	9323	9323	9323	4607	4607	4607	6792	6792	6792	5562	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 12: The effects of early maternal employment on breastfeeding behaviours

	Probability of initiating breastfeeding[1]	Duration of breastfeeding (given initiation)[2]	
Mean	0.77	5.51	
S.D.	0.42	4.51	
Maternal employment			
0-18 months PT	**-0.006**	**-0.548*** **	-
	(0.044)	(0.151)	-
0-3 months	-	-	**-1.267*** **
	-	-	(0.217)
4-6 months	-	-	**-1.014*** **
	-	-	(0.203)
7-12 months	-	-	**0.088**
	-	-	(0.203)
13-18 months	-	-	**-0.076**
	-	-	(0.239)
0-18 months FT	**-0.002**	**-1.373*** **	-
	(0.065)	(0.207)	-
0-3 months	-	-	**-2.287*** **
	-	-	(0.290)
4-6 months	-	-	**-1.462*** **
	-	-	(0.274)
7-12 months	-	-	**0.085**
	-	-	(0.378)
13-18 months	-	-	**-0.816**
	-	-	(0.618)
19-34 months	**0.109***	**-0.238**	**-0.269**
	(0.057)	(0.198)	(0.198)
N	10016	7708	7708

Notes

1. Results from a probit model – dependent variable = 1 if mother ever breastfed.
2. Results from a tobit model – duration of breastfeeding right-censored at 15 months.
3. Models 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.
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 13: The effect of breastfeeding on children's cognitive development and the estimated impact of early maternal employment

	Infant communication (2 years)		Entry Assessment (4 or 5 years)		ALSPAC literacy (7 years)		Key Stage 1 (7 or 8 years)	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Maternal employment								
0-18 months PT	**0.218**	**0.249**	**-0.021**	**0.021**	**0.000**	**0.051**	**0.153**	**0.185**
	(0.293)	(0.293)	(0.390)	(0.390)	(0.345)	(0.345)	(0.357)	(0.357)
0-18 months FT	**0.186**	**0.277**	**-0.196**	**-0.090**	**-0.866***	**-0.754**	**-0.441**	**-0.365**
	(0.408)	(0.409)	(0.540)	(0.541)	(0.471)	(0.473)	(0.494)	(0.495)
19-34 months	**0.367**	**0.356**	**0.532**	**0.478**	**0.563**	**0.544**	**0.614**	**0.564**
	(0.385)	(0.385)	(0.506)	(0.506)	(0.457)	(0.457)	(0.470)	(0.469)
Breastfeeding: base = 7 to 12 months								
never	-	**-0.910*** **	-	**-1.403*** **	-	**-1.199*** **	-	**-1.689*** **
	-	(0.325)	-	(0.424)	-	(0.383)	-	(0.391)
0-3 mths	-	**-0.523***	-	**-0.743** **	-	**-0.557***	-	**-0.597***
	-	(0.288)	-	(0.372)	-	(0.325)	-	(0.340)
4-6 mths	-	**-0.200**	-	**-0.833***	-	**-1.032*** **	-	**-0.857** **
	-	(0.327)	-	(0.425)	-	(0.366)	-	(0.388)
>12 mths	-	**1.358*** **	-	**0.171**	-	**-0.003**	-	**-0.179**
	-	(0.423)	-	(0.554)	-	(0.474)	-	(0.504)
adj R2	0.0968	0.0991	0.2490	0.2507	0.1212	0.1224	0.2126	0.2149
N	9323	9323	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 14: The effects of early maternal employment on maternal tiredness and stress at 21 months

	Maternal stress score (CCEI)	Frequency of feeling tired or exhausted[1]
Mean	9.94	-
S.D.	7.21	-
Maternal employment		
0-18 months PT	**0.203**	**0.036**
	(0.182)	(0.033)
0-18 months FT	**0.711****	**0.171*****
	(0.254)	(0.046)
19-34 months	**0.400***	**-0.005**
	(0.241)	(0.044)
adj R2	0.3027	-
N	9572	9547

Notes

1. Results from an ordered probit model with categories never (1), not very often (2), often (3) and very often (4).
2. Models 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. 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 15: The effect of maternal tiredness and stress at 21 months on children's cognitive development and the estimated impact of early maternal employment

	Infant communication (2 years)		Entry Assessment (4 or 5 years)		ALSPAC literacy (7 years)		Key Stage 1 (7 or 8 years)	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Maternal employment								
0-18 months PT	**0.218**	**0.226**	**-0.021**	**-0.040**	**0.000**	**-0.022**	**0.153**	**0.123**
	(0.293)	(0.293)	(0.390)	(0.390)	(0.345)	(0.345)	(0.357)	0.357
0-18 months FT	**0.186**	**0.177**	**-0.196**	**-0.274**	**-0.866***	**-0.887***	**-0.441**	**-0.476**
	(0.408)	(0.409)	(0.540)	(0.541)	(0.471)	(0.472)	(0.494)	0.494
19-34 months	**0.367**	**0.367**	**0.532**	**0.504**	**0.563**	**0.571**	**0.614**	**0.639**
	(0.385)	(0.385)	(0.506)	(0.505)	(0.457)	(0.457)	(0.470)	0.470
Maternal stress score: base = lowest quartile								
2nd quartile	-	**-0.149**	-	**-0.064**	-	**0.114**	-	**-0.130**
	-	(0.299)	-	(0.388)	-	(0.347)	-	(0.359)
3rd quartile	-	**-0.180**	-	**-0.507**	-	**-0.334**	-	**-0.567**
	-	(0.321)	-	(0.418)	-	(0.372)	-	(0.386)
highest quartile	-	**0.012**	-	**-0.530**	-	**-0.554**	-	**-0.923****
	-	(0.369)	-	(0.483)	-	(0.434)	-	(0.452)
Frequency of feeling tired or exhausted: base = often								
never	-	**0.912***	-	**-2.392*****	-	**-1.708*****	-	**-1.189***
	-	(0.510)	-	(0.714)	-	(0.639)	-	(0.671)
not very often	-	**0.462***	-	**-1.184*****	-	**-0.620****	-	**-0.541***
	-	(0.252)	-	(0.327)	-	(0.293)	-	(0.302)
very often	-	**0.646****	-	**-0.359**	-	**-0.039**	-	**0.208**
	-	(0.328)	-	(0.431)	-	(0.384)	-	(0.400)
adj R2	0.0968	0.0970	0.2490	0.2513	0.1212	0.1221	0.2126	0.2132
N	9323	9323	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 16: The effect of average household income on children's cognitive development and the estimated impact of early maternal employment

	Infant communication (2 years)		Entry Assessment (4 or 5 years)		ALSPAC literacy (7 years)		Key Stage 1 (7 or 8 years)	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Maternal employment								
0-18 months PT	**0.218**	**0.222**	**-0.021**	**-0.036**	**0.000**	**-0.009**	**0.153**	**0.134**
	(0.293)	(0.293)	(0.390)	(0.390)	(0.345)	(0.345)	(0.357)	(0.357)
0-18 months FT	**0.186**	**0.198**	**-0.196**	**-0.502**	**-0.866***	**-1.017****	**-0.441**	**-0.732**
	(0.408)	(0.412)	(0.540)	(0.543)	(0.471)	(0.475)	(0.494)	(0.498)
19-34 months	**0.367**	**0.367**	**0.532**	**0.539**	**0.563**	**0.577**	**0.614**	**0.617**
	(0.385)	(0.385)	(0.506)	(0.505)	(0.457)	(0.457)	(0.470)	(0.469)
Log of average income	-	**-0.045**	-	**1.782*****	-	**0.850****	-	**1.542*****
		(0.290)		(0.390)		(0.347)		(0.362)
adj R2	0.0968	0.0966	0.2490	0.2523	0.1212	0.1221	0.2126	0.2150
N	9323	9323	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 17: The effect of childcare type at 15 months on children's cognitive development and the estimated impact of early maternal employment

	Infant communication (2 years)		Entry Assessment (4 or 5 years)		ALSPAC literacy (7 years)		Key Stage 1 (7 or 8 years)	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Maternal employment								
0-18 months PT	**0.218**	**0.145**	**-0.021**	**-0.087**	**0.000**	**0.059**	**0.153**	**0.138**
	(0.293)	(0.305)	(0.390)	(0.407)	(0.345)	(0.359)	(0.357)	(0.373)
0-18 months FT	**0.186**	**0.069**	**-0.196**	**-0.565**	**-0.866***	**-0.919***	**-0.441**	**-0.559**
	(0.408)	(0.433)	(0.540)	(0.571)	(0.471)	(0.499)	(0.494)	(0.521)
19-34 months	**0.367**	**0.376**	**0.532**	**0.684**	**0.563**	**0.703**	**0.614**	**0.723**
	(0.385)	(0.389)	(0.506)	(0.510)	(0.457)	(0.461)	(0.470)	(0.475)
Childcare at 15 months: base = maternal care only								
relative care (>5 hrs pwk)	-	**0.162**	-	**-0.215**	-	**-0.122**	-	**0.138**
	-	(0.246)	-	(0.324)	-	(0.286)	-	(0.299)
non-relative care (> 5 hrs pwk)	-	**0.275**	-	**0.785***	-	**0.584**	-	**0.512**
	-	(0.355)	-	(0.462)	-	(0.393)	-	(0.424)
centre care (> 5 hrs pwk)	-	**0.310**	-	**2.004****	-	**0.770**	-	**1.105**
	-	(0.568)	-	(0.803)	-	(0.640)	-	(0.706)
adj R2	0.0968	0.0961	0.2490	0.2525	0.1212	0.1221	0.2126	0.2120
N	9323	9323	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, the educational attainment of the mother's mother and childcare type at 38 months.
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 18: 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)	Infant communication (2 years)	Entry Assessment (4 or 5 years)	ALSPAC literacy (7 years)	Key Stage 1 (7 or 8 years)
Relative care only	38	**0.391**	**-1.754****	**-1.561****	**-0.920**
Non-relative care only	12	**-1.034**	**0.424**	**0.076**	**-0.070**
Centre care only	2	**-0.040**	**4.282****	**1.203**	**1.927**
Relative and non-relative care	35	**0.941**	**-0.484**	**-0.584**	**-0.048**
Relative and centre care	7	**1.936***	**3.374****	**0.543**	**1.949**
	94				
adj R2		0.0977	0.2538	0.1219	0.2120
N		9323	4607	6792	5562

Notes

1. Base is maternal care only, no employment by 34 months.
2. Types of childcare are classed as used by the household only if used more than 5 hours per week.
3. The results given are the sum of the relevant level and interaction coefficients. Significance levels relate to an F-test of whether the sum of the coefficients is equal to zero.
4. 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, the educational attainment of the mother's mother and childcare type at 38 months.
5. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
6. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
7. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.

Table 19: The effects of early maternal employment on child behaviour – basic estimates, detailed categories and additional controls for heterogeneity

Maternal employment	Behavioural problems (4 years)		
	(1)	(2)	(3)
0 -18 months PT	**-0.094**	-	**-0.155**
	(0.310)		(0.301)
0 - 4 months	-	**-0.062**	-
		(0.398)	
5 - 8 months	-	**-0.167**	-
		(0.410)	
9 - 18 months	-	**-0.084**	-
		(0.400)	
0 -18 months FT	**0.570**	-	**0.245**
	(0.429)		(0.418)
0 - 4 months	-	**0.915***	-
		(0.536)	
5 - 8 months	-	**-0.248**	-
		(0.604)	
9 - 18 months	-	**1.318**	-
		(0.928)	
19 – 34 months	**-0.117**	**-0.115**	**-0.366**
	(0.406)	(0.406)	(0.394)
Test of restrictions:	-	P>F = 0.4421	-
adj R2	0.0614	0.0618	0.1202
N	8766	8766	8766

Notes

1. Higher scores indicate greater behavioural problems.
2. Regressions (1) and (2) 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.
3. The regression in column (3) includes all the controls used (1) and (2) plus controls for 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, pre-pregnancy physical health and body mass index, 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 educational attainment of the mother's mother and father and the presence of the mother's mother in the household during childhood.
4. The behavioural problems measure is normalised to mean 100, standard deviation 10.
5. Standard errors are given in brackets.
6. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
7. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.
8. 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.

Table 20: Controlling for the mechanisms through which maternal employment effects child behavioural problems

	Behavioural problems (4 years)					
	(1)	(2)	(3)	(4)	(5)	(6)
Maternal employment						
0-18 months PT	**-0.155**	**-0.088**	**-0.069**	**-0.146**	**-0.186**	**-0.145**
	(0.301)	(0.301)	(0.299)	(0.302)	(0.297)	(0.301)
0-18 months FT	**0.245**	**0.219**	**0.268**	**0.255**	**0.059**	**0.460**
	(0.418)	(0.420)	(0.418)	(0.420)	(0.413)	(0.422)
19-34 months	**-0.366**	**-0.290**	**-0.287**	**-0.374**	**-0.393**	**-0.373**
	(0.394)	(0.392)	(0.390)	(0.394)	(0.388)	(0.393)
Total parental interaction score: base = low						
medium	-	**-1.205*** **	**-0.562***	-	-	-
	-	(0.291)	(0.295)	-	-	-
high	-	**-2.521*** **	**-1.351*** **	-	-	-
	-	(0.339)	(0.354)	-	-	-
Mother's share of parental interaction: base = highest quartile						
lowest quartile	-	**0.440**	**-0.149**	-	-	-
	-	(0.388)	(0.390)	-	-	-
2nd quartile	-	**0.103**	**-0.357**	-	-	-
	-	(0.359)	(0.359)	-	-	-
3rd quartile	-	**0.212**	**-0.083**	-	-	-
	-	(0.341)	(0.340)	-	-	-
Outings score: base = high						
low	-	-	**1.444*** **	-	-	-
	-	-	(0.271)	-	-	-
medium	-	-	**0.555** **	-	-	-
	-	-	(0.245)	-	-	-
Teaching score: base = medium						
low	-	-	**0.669** **	-	-	-
	-	-	(0.298)	-	-	-
high	-	-	**-0.855*** **	-	-	-
	-	-	(0.232)	-	-	-
Frequency of talking during housework: base = nearly always						
never/rarely	-	-	**2.079***	-	-	-
	-	-	(1.206)	-	-	-
sometimes	-	-	**2.472*** **	-	-	-
	-	-	(0.456)	-	-	-
often	-	-	**1.182*** **	-	-	-
	-	-	(0.224)	-	-	-
Breastfeeding: base = 7 to 12 months						
never	-	-	-	**0.171**	-	-
	-	-	-	(0.335)	-	-
0-3 mths	-	-	-	**0.277**	-	-
	-	-	-	(0.292)	-	-
4-6 mths	-	-	-	**-0.676** **	-	-
	-	-	-	(0.334)	-	-
>12 mths	-	-	-	**-0.799***	-	-
	-	-	-	(0.432)	-	-
Maternal stress score: base = lowest quartile						
2nd quartile	-	-	-	-	**1.505*** **	-
	-	-	-	-	(0.301)	-
3rd quartile	-	-	-	-	**2.304*** **	-
	-	-	-	-	(0.325)	-
highest quartile	-	-	-	-	**3.654*** **	-
	-	-	-	-	(0.375)	-
Frequency of feeling tired or exhausted: base = often						
never	-	-	-	-	**-1.832*** **	-
	-	-	-	-	(0.520)	-
not very often	-	-	-	-	**-0.895*** **	-
	-	-	-	-	(0.254)	-
very often	-	-	-	-	**1.114*** **	-
	-	-	-	-	(0.332)	-
Log of average income	-	-	-	-	-	**-1.097*** **
	-	-	-	-	-	(0.297)
adj R2	0.1202	0.1277	0.1390	0.1211	0.1447	0.1214
N	8766	8766	8766	8766	8766	8766

Notes

1. Higher scores indicate greater behavioural problems.
2. Column 1 reproduces the estimates from column 3 of Table 19.

3. All 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, pre-pregnancy physical health and body mass index, 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 educational attainment of the mother's mother and father and the presence of the mother's mother in the household during childhood.
4. The behavioural problems measure is normalised to mean 100, standard deviation 10.
5. Standard errors are given in brackets.
6. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
7. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.

Table 21: The effects of non-parental childcare on the estimated effect of early maternal employment

	Behavioural problems (4 years)		
Panel A			
Maternal employment			
0-18 months PT		**-0.155**	**-0.351**
		(0.301)	(0.313)
0-18 months FT		**0.245**	**0.081**
		(0.418)	(0.443)
19-34 months		**-0.366**	**-0.592**
		(0.394)	(0.397)
Childcare at 15 months: base = maternal care only			
relative care (>5 hrs pwk)		-	**0.098**
		-	(0.251)
non-relative care (> 5 hrs pwk)		-	**-0.290**
		-	(0.362)
centre care (> 5 hrs pwk)		-	**-0.095**
		-	(0.581)
adj R2		0.1202	0.1216
N		8766	8766
Panel B			
	% of mothers using (FT return by 18 months only)		
Relative care only	38		**-0.028**
Non-relative care only	12		**0.539**
Centre care only	2		**0.322**
Relative and non-relative care	35		**-0.486**
Relative and centre care	7		**-0.702**
	94		
adj R2			0.1228
N			8766

Notes

1. Higher scores indicate greater behavioural problems.
2. Column 2 reproduces the estimates from column 3 of Table 19.
3. Types of childcare are classed as used by the household only if used more than 5 hours per week.
4. Base for results in Panel B is maternal care only, no employment by 34 months.
5. The results given in Panel B are the sum of the relevant level and interaction coefficients. Significance levels relate to an F-test of whether the sum of the coefficients is equal to zero.
6. All 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, pre-pregnancy physical health and body mass index, 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 educational attainment of the mother's mother and father and the presence of the mother's mother in the household during childhood.
7. The behavioural problems measure is normalised to mean 100, standard deviation 10.
8. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
9. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.

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)	
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)	
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 [re-birth financial difficulties (1)	
	Variables retained in final specification[2]
Additional controls	
Mental health and personality	
CCEI score in pregnancy (3)	YES
Interpersonal sensitivity measure (3)	YES
Locus of control score (3)	YES
Social support networks	
Social networks score (2)	YES
Social support score (2)	YES
Physical health and health-related behaviours	
Self-reported health prior to pregnancy (1)	
Pre-pregnancy body mass index (3)	
Alcohol consumption during pregnancy (2)	
Smoking during pregnancy (2)	
Hard drug use during pregnancy (1)	
Childhood and family background	
Mother's mother's qualifications (1)	YES
Mother's father's qualifications (1)	
Parenting score of mother's mother (1)	
Mother present throughout childhood (2)	
Childhood happiness score (2)	
Childhood life events score (2)	
Mediating factors	
Mother's interaction score[1]	
Partner's interaction score[1]	
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 (5)	

Outings score (2)[1] Initiated breastfeeding (1) Duration of breastfeeding in months (4)[1] CCEI score at 21 months (3)[1] Frequency of feeling tired or exhausted (3) Log average net weekly household income Non-maternal childcare at 15 months (3) Non-maternal childcare at 38 months (3)	

Notes

1. Variables are continuous when used as dependent variables.
2. All additional controls are retained in the final specification of the behavioural regressions.

Appendix Table 2

	Mother's score	Partner's score	Total parental score
Frequency of bathing child			
0-18 months PT	**-0.089*** **	**0.137*** **	**0.074** **
	(0.034)	(0.033)	(-0.032)
0-18 months FT	**-0.136*** **	**0.070**	**-0.015**
	(0.048)	(0.046)	(0.044)
19-34 months	**-0.044**	**0.021**	**-0.007**
	(0.044)	(0.043)	(0.041)
Frequency of feeding child			
0-18 months PT	**-0.085***	**0.312*** **	**0.258*** **
	(0.051)	(0.033)	(0.032)
0-18 months FT	**-0.519*** **	**0.585*** **	**0.396*** **
	(0.066)	(0.047)	(0.045)
19-34 months	**-0.079**	**0.074***	**0.050**
	(0.064)	(0.043)	(0.042)
Frequency of singing to child			
0-18 months PT	**-0.068***	**0.079***	**0.029**
	(0.038)	(0.034)	(0.032)
0-18 months FT	**-0.315*** **	**0.069**	**-0.069**
	(0.052)	(0.047)	(0.045)
19-34 months	**0.069**	**0.007**	**0.025**
	(0.049)	(0.044)	(0.041)
Frequency of reading to child			
0-18 months PT	**-0.014**	**0.043**	**0.027**
	(0.040)	(0.034)	(0.033)
0-18 months FT	**-0.316*** **	**0.050**	**-0.059**
	(0.055)	(0.048)	(0.046)
19-34 months	**0.083**	**-0.014**	**0.015**
	(0.051)	(0.044)	(0.042)
Frequency of playing with toys with child			
0-18 months PT	**-0.028**	**0.130*** **	**0.106*** **
	(0.048)	(0.036)	(0.035)
0-18 months FT	**-0.297*** **	**0.203*** **	**0.086***
	(0.066)	(0.052)	(0.049)
19-34 months	**0.027**	**0.055**	**0.051**
	(0.061)	(0.046)	(0.044)
Frequency of playing imitation games			
0-18 months PT	**-0.038**	**0.086** **	**0.062***
	(0.041)	(0.034)	(0.033)
0-18 months FT	**-0.150*** **	**0.215*** **	**0.122*** **
	(0.056)	(0.049)	(0.047)
19-34 months	**-0.007**	**0.000**	**0.000**
	(0.052)	(0.044)	(0.042)
Frequency of physical play with child			
0-18 months PT	**0.027**	**0.079** **	**0.064** **
	(0.037)	(0.038)	(0.034)
0-18 months FT	**-0.148*** **	**0.084**	**-0.024**
	(0.051)	(0.054)	(0.048)
19-34 months	**0.033**	**0.048**	**0.039**
	(0.047)	(0.049)	(0.044)
Frequency of taking child for walks			
0-18 months PT	**-0.086** **	**0.171*** **	**0.086*** **
	(0.038)	(0.033)	(0.032)
0-18 months FT	**-0.789*** **	**0.386*** **	**-0.187*** **
	(0.050)	(0.046)	(0.044)
19-34 months	**0.057**	**-0.014**	**0.002**
	(0.051)	(0.043)	(0.041)

Notes

1. Results are for ordered probit models with 5 categories for the mother and partner scores and 10 categories for the total parental score.

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, interpersonal 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. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.
4. Standard errors are given in brackets.
5. Each measure of cognitive development is normalised to mean 100, standard deviation 10.
6. Part time (PT) and full time (FT) work refer to hours per week below 30 and 30 and above respectively.