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ABSTRACT

This paper examines the long-term effects of low birthweight (LBW) on educational attainments, labor market outcomes, and health status using data from the National Child Development Study. The study has followed the cohort of children born in Great Britain during one week in 1958 through age 33. We pay particular attention to possible interactions between LBW and socio-economic status (SES), asking to what extent the deleterious effects of LBW are mitigated by higher SES. We find that LBW has significant long-term effects on self-reported health status, educational attainments, and labor market outcomes. However, there is little evidence of variation in the effects of LBW by SES. An important exception is that high SES women of LBW are less likely to report that they are in poor or fair health than other LBW women.

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Relative economic status shows a strong tendency to persist from one generation to the next. However, the mechanisms underlying the intergenerational transmission of status are poorly understood. Three facts suggest that health shocks offer a possible explanation for some of the persistence. First, poor health among teenagers and adults has been shown to have a negative impact on educational attainment, employment, and earnings (c.f. Currie and Madrian, 1999 for a review of this literature). Second, the poor are more likely to suffer from most forms of ill health than the rich (c.f. Wilkinson, 1996; Hertzman and Weins, 1996). Third, negative health shocks may have worse consequences for the poor than for the rich. For example, some observers have concluded that poor children suffer from double jeopardy in that they are both more likely to suffer negative shocks, and less likely to be able to recover from them (Bradley *et al.* 1994; Parker, Greer, and Zuckerman, 1988).

This paper investigates the linkages between socioeconomic status (SES) and a specific negative health shock: low birth weight (LBW). There is much evidence that children of higher socioeconomic status do better than other children on average, regardless of the outcome measure. This evidence may reflect either the effects of increased access to resources *per se* or the greater "efficiency" with which more educated (for example) mothers can use these inputs (c.f. Mayer, 1997; Rosensweig and Wolpin, 1994).

There is also a great deal of evidence linking LBW to poor health, cognitive deficits, and behavioral problems among young children (c.f. Aylward *et al.*, 1989; Brooks-Gunn, Liaw, and Klebanov, 1992; Kohen *et al.* 1997; McCormick, Gortmaker, and Sobel, 1990). Moreover, the problems tend to be most severe in the lightest infants. These observations suggest that the effects of LBW may be long lasting, but there has been little direct corroboration of this conjecture. The first goal of this study is to shed light on this issue.

The second goal is to investigate the interactive effects of SES and LBW and thus to provide a test of the "double jeopardy" hypothesis. There is a presumption in the literature that negative health shocks have more harmful effects on low-SES (LSES) children, but much of the research on this issue relies on small samples and follows children for only a limited amount of time. For example, Bradley and Casey (1992) examined 87 LBW children at 18 months and found that children with both poor home environments and medical problems had the lowest scores on a test of cognitive functioning. Hunt, Cooper, and Tooley (1988) examined 108 very low birthweight children and found that children whose parents were more educated suffered fewer cognitive effects of neonatal illness. In larger scale studies, Werner *et al.* (1971) report that severe perinatal stress did not impair the functioning of 20 month olds from high and middle SES families in the Kauai birth cohort study. In a study of approximately 800 3 year olds, Brooks-Gunn *et al.* (1992) find that children whose mothers had less than a high school education derived the most benefit from an early intervention program for LBW, preterm infants.

This study will examine the effects of LBW and the interaction between LBW and SES using data from the British National Child Development Survey (NCDS) which has followed the cohort of approximately 17,000 children born in one week in 1958 up to age 33. As measures of long-term outcomes, we examine educational attainment using transcript records collected when the children were 20. We also examine self-reported employment, wages, and health status at age 23 and at age 33.

This data set provides us with a unique opportunity to examine the long-term effects of LBW on education, earnings, employment, and adult health status. We find that LBW has significant long-term effects on self-reported health status, educational attainments, and labor market outcomes. However, there is little evidence of variation in the effects of LBW by SES. An

important exception is that high SES women of LBW are less likely to report that they are in poor or fair health than other LBW women.

I. Possible Interactions Between SES and LBW

The literature offers several hypotheses predictive of an interactive effect between SES and LBW. These hypotheses can be organized with reference to the now standard model of parental investments in children's human capital. In this model, parents care about child outcomes which they "produce" at home by combining inputs with their time. Parents maximize their own utility subject to a production function for child outcomes, a budget constraint, and a set of prices for inputs and other goods.

The first hypothesis regarding interactive effects suggests that low birthweight changes the production function for child health. For example, "Infants at biological risk may be more susceptible to adverse environmental influence than are normal babies" (Watson *et al.* 1995, page 420; see also Escalona, 1982). If LBW LSES children suffer from a higher incidence of "adverse environmental influences" than LBW, high-SES (HSES) children then this theory predicts that they will have worse outcomes.

A second closely related hypothesis focuses on differences in inputs between HSES and LSES groups. Suppose for example, a mother is unwilling to take actions necessary to improve the health of the newborn (e.g. eat nutritious food during pregnancy), and is also less likely to make costly investments after the child is born (e.g. help with homework). If the propensity to invest in children is correlated with social class (as discussions of "quality" vs. "quantity" tradeoffs would suggest), then we will observe that LBW has its most adverse effects among LSES children.

A third hypothesis focuses on the constraints facing parents. For example, Becker and Tomes (1986) develop a model in which the poor face credit constraints which prevent them from making worthwhile investments in the human capital of their children. Even if the optimal level of investment was lower for a LBW child than for one of normal birthweight, HSES parents might be more able to undertake these investments than LSES parents.[1]

All three hypotheses predict that LBW will have a more negative effect on LSES children than HSES children. However, if we allow that HSES and LSES children may have different ability levels on average (independent of birthweight), then it is possible for LBW to have either a greater or lesser effect on HSES children. Suppose that on average HSES children have higher ability than LSES children. Becker and Tomes call this the endowment effect. Then we can think of a LBW shock as placing both the HSES child and the LSES child on a lower ability profile than they might otherwise have had. But whether the impact of this shock is bigger or smaller for the LSES child will depend on the exact shapes of the outcome production functions associated with different ability levels.

Previous work with these data has shown that there is a striking SES gradient in math and reading test scores at ages 7, 11, and 16, that is that average endowments do seem to increase with SES (Currie and Thomas, 1998). Since SES appears to affect endowments as well as input choices and budget constraints, the sign and importance of the interaction between SES and LBW must be determined empirically.

II. The Data

The National Child Development Study (NCDS) is a continuing longitudinal study of all of the approximately 17,000 children born in Great Britain between March 3 and March 9, 1958.[2] The

study began with the Perinatal Mortality Survey which was aimed at uncovering the determinants of stillbirth and infant death. Subjects have been contacted 5 times since, including interviews at ages 23 and 33 (waves 4 and 5). In addition, schools were contacted in 1978 and asked for information about performance on public examinations.

The response rates for the age 23, age 33, and exam surveys were 76%, 72% and 85% respectively. Thus, overall response rates have remained high, considering the length of the panel. However, individuals disappear and reappear in this data, a fact which is not surprising given that with sufficient resources it is possible to trace members of the cohort whether or not they have appeared in earlier followups. Restricting the sample to those who appear in every wave would result in a significant reduction in sample size. Instead, we will use the available sample for each outcome measure, as well as limiting the sample to individuals who have appeared in consecutive waves in some of our analyses.[3]

Our measure of socioeconomic status is the father's social class. The NCDS used the 1958 maternal responses to open-ended questions about paternal occupation to assign fathers to one of seven social classes using a system devised by the British Registrar General. These classes are: Professional, supervisory, skilled non-manual, skilled manual, semi-skilled non-manual, semi-skilled manual, and unskilled. In what follows, we will call those with fathers in professional, supervisory, or skilled non-manual jobs HSES, and those with fathers in semi-skilled manual and unskilled jobs LSES. Persons without a father present at the time of their birth are assigned to either the SES corresponding to their mother's occupation, or to the LSES group if the mother was not employed.

We examine the effects of LBW on performance on the O-level examinations, and on wages and employment at ages 23 and 33. O-level tests are normally written at about age 16, and

the results determine whether or not one can continue with an academic education. Students would usually take 5 or 6 O-levels. We focus on whether the person passed any O-levels, the number of O-levels passed, and on whether they passed O-levels in the academic subjects of English and Mathematics.[4]

Means of the data are shown in Table 1, by SES and gender. We examine males and females separately because both mean outcomes and the incidence of LBW differ considerably by gender—girls are more likely than boys to suffer LBW across the SES distribution. This observation suggests that the production functions for child outcomes may differ for boys and girls. The incidence of LBW also shows the expected gradient by SES, since LBW is more common in LSES than in HSES families.

Turning to measures of long-term outcomes, Table 1 shows that girls are somewhat more likely than boys to have passed any O-levels, and that they write a larger number of O-levels. In particular, girls are more likely to have passed English, though they are less likely to have passed Mathematics. These relationships hold across the SES distribution. Note that only about half of all children passed any O-levels. O-levels are not compulsory and many of those who did not pass an O-level may have chosen not to write them because they had no plans to continue with their educations.

Table 1 also shows the fraction who were employed full-time at age 23 and age 33. At 23 there is a large SES gradient in employment rates among women, but little evidence of any gradient among men. By age 33, the gap between HSES and LSES women has narrowed, while a gap has started to open up for men. We tried using "any employment" rather than full-time employment as an outcome and obtained much the same results as those reported below.

These lower probabilities of employment among LSES individuals may be related to their higher probability of reporting themselves to be in fair or poor health. As Currie and Madrian (1999) discuss, measures of self-reported health status are subject to a number of biases but they do seem to be good predictors of morbidity and mortality and are generally highly correlated with labor force status. The survey at age 33 includes a number of self-reports about more specific conditions. We focus here on reports of high blood pressure, both because it is a relatively common condition and because of work linking LBW to heart conditions in later life (c.f. Barker *et al.*, 1989). Table 1 shows that LSES individuals are more likely than HSES individuals to suffer from high blood pressure.

Finally, Table 1 reports mean wages.[5] Table 1 shows that low-SES people earned virtually the same wages as high-SES people at age 23, even though on average they had characteristics that one would expect to be less generously remunerated.[6] However, the wage gap between high and low-SES individuals widens dramatically between ages 23 and 33, suggesting that the high-SES individuals have steeper wage profiles.

There is a significant gender gap in earnings at age 23, which widens considerably by age 33. This pattern is observed for each SES group, and remains if we restrict the sample to those with wage observations at both points in time. Moreover, although they are not shown, the means are very similar to those discussed above when the sample is restricted to include only those who have wage and employment observations at both 23 and 33.

Appendix Table 1 shows means for a rich set of control variables, including indicators for twins; whether the mother and father stayed in school past the minimum school leaving age; the maternal grandfather's SES; whether the mother was a single parent at the time of the birth; family size; birth order; mother's age at the birth; and whether the mother smoked during pregnancy. Not

surprisingly, these variables are highly correlated with SES. For example, compared to HSES mothers, LSES mothers are more likely to be from LSES backgrounds, to be teen mothers, to be single at the time of the birth, to smoke, and to be having a child of higher parity. These observations suggest that some of the effect of SES is mediated through these variables, a conjecture that we will return to below.

III. Main Results

Tables 2, 3, and 4 show estimates from models of the determinants of O-levels, age 23 outcomes, and age 33 outcomes respectively. All of these models include indicators for LBW, HSES, and LSES as well as interactions between LBW and the two SES indicators. In addition, they include all of the controls described in Appendix Table 1.

Table 2 shows that SES has the expected effect on attainment on O-levels: For example, normal birthweight HSES children are 11 or 12% more likely to pass any O-levels, write more O-levels, and are 9% more likely to pass Mathematics and 12 to 15% more likely to pass English O-levels. Low birthweight has a persistently negative effect on O-level performance, as indicated by the F-statistics at the bottom of the table. The only outcome for which the coefficients on LBW are not jointly significant is female performance on the Mathematics O-level.

Interactions between LBW and SES are significant only for HSES males. These children write fewer O-levels, and are less likely to write English O-levels than other HSES males. In fact, LBW has the effect of wiping out much of the advantage associated with being HSES. For example, among the LBW children the HSES-LSES gap in terms of O-levels passed is .47 compared to a differential of 1.32 O-levels among children of normal birthweight.

Many of the other model covariates have large and statistically significant effects on O-level performance. For example indicators for twin, LSES maternal grandfather, single parenthood, maternal smoking during pregnancy, larger family size, high parity, and teen motherhood all have negative effects which are in some cases much larger than those associated with LBW. On the other hand, higher parental education and a HSES maternal grandfather are associated with better performance on O-levels.

It is much more difficult to explain wage and employment outcomes at age 23, as the R-squareds shown in Table 3 indicate. Here, HSES has a positive effect on employment and earnings among women, but little effect on men. Relative to people in the middle, LSES reduces the probability of employment among both men and women, reduces the earnings of men, and increases the probability that both men and women report themselves to be in fair or poor health. The main effect of LBW is to reduce employment among both men and women, to reduce female earnings, and to increase the probability that women report fair or poor health.

Interactions between LBW and SES are not generally statistically significant, with two exceptions. First, HSES reduces reports of ill health among LBW women. In fact, HSES neutralizes the negative effect of LBW on reported health status. Second, the negative effect of LBW on employment is reduced for both HSES and LSES women relative to women in the middle of the SES distribution, although only the interaction with LSES is statistically significant. It is possible that different mechanisms are at work in these two groups. If HSES LBW women are healthier than other LBW women then it is not surprising that they work more. It is possible that LSES LBW women also work more than middle-class women due to poorer opportunities in either the marriage market or in the market for higher education.

The other covariates included in the model generally have their strongest effects on the employment and earnings of women. For example, maternal smoking, large family size, higher birthorder, and having a teen mother are all associated with lower employment probabilities among women. Having a teen mother also has a negative effect on the earnings of women and on the reported health status of men.

Table 4 shows estimates of the effects of SES and LBW on outcomes at age 33. These models show that HSES individuals have higher earnings (6% for men and 5% for women), and are 5 or 6% less likely to report ill health than LSES people. LSES men also have slightly lower employment probabilities. Among middle class men, LBW is associated with an 8% lower probability of employment, a 7% higher probability of reporting fair or poor health, and a 5% higher probability of reporting high blood pressure. LBW has no significant effects on female outcomes measured at age 33.

Interactions between LBW and SES are significant in three cases. First, HSES LBW women are less likely to report ill health than other LBW women, which is consistent with what we saw in Table 3. However, LBW LSES men are less likely to report ill health than other LBW men. And LBW LSES males may actually be *more* likely to be employed than other LBW males, though this difference is only marginally statistically significant. Thus the interactions for men show quite different patterns than those for women.

To summarize, we find the expected effects of SES on educational attainment and labor market outcomes. LBW appears to have strong negative effects on educational attainments, on male and female employment at age 23, and on male employment at age 33. In terms of earnings, we find small significant effects of LBW only among women at age 23. Finally, we find negative effects on female health status at age 23, and on male health status and blood pressure at age 33.

The conclusion that health shocks have a greater impact on employment probabilities and self-reported health than on wages is consistent with much of the literature on health and labor supply (c.f. Currie and Madrian, 1999).

We find little evidence of an interactive effect of LBW and SES with these exceptions: Among men, LBW negates much of the positive effect of HSES on educational attainments as measured by the number of O-levels and the probability of passing the English O-level. LBW LSES men are also less likely to report ill health at age 33 than other LBW men. Thus, among men, HSES children seem to suffer greater ill effects of LBW than LSES children.

Among women, LBW individuals of HSES are less likely to report ill health than other LBW individuals at both age 23 and at age 33. At age 23, LSES LBW women are also more likely to be employed than middle-class LBW women, and there is some suggestion that this is also true for HSES LBW women. Thus, it is only for the reported health status of women that we find evidence supportive of the hypothesis that HSES mitigates the negative effects of LBW.

IV. Extensions

A. Differential Mortality by SES

A possible explanation for our results is that surviving LBW children of HSES suffer greater impairments than those of LSES, and that these greater impairments outweigh any advantages due to HSES. Suppose that many LSES LBW children die, while those of HSES have access to superior medical resources and live. Then the LSES LBW children will be systematically selected to be the healthiest LBW infants, while the opposite will be true among HSES LBW children. One way to get at this hypothesis of differential selection is to examine the bottom tail of

the birthweight distribution, to see if it is "longer" for the HSES children, i.e. whether HSES children are surviving at lower birth weights.

This distribution is shown in Figure 1 for all surviving children. The figure indicates that there are only very small differences in the probability that a LBW child belongs to either the HSES or LSES groups conditional on birthweight. Appendix Table 2 examines percentiles of the birthweight distribution for both survivors and non-survivors. The table suggests that the very lightest babies have a higher probability of survival if they are not LSES. For example, the fifth percentile of the distribution of nonsurvivors is 794 grams among HSES children and 907 grams among LSES children. However, the tenth percentile is approximately 1000 grams for all SES categories. Hence, we have also repeated our analyses excluding infants with birthweight less than 1000 grams from the analysis (see Appendix Table 3). We have also excluded children with mental handicaps from our models without appreciably altering the results (see Appendix Table 4). Finally, we estimated models using the probability of survival as the dependent variable and including LBW, SES, and interactions on the right hand side. We found that while probability of survival declined with LBW, there was little evidence that it was related to SES.

B. Changes in Specification

We have restricted the sample to those who were surveyed at both 23 and 33 and to those who were employed at both age 23 and age 33. These changes had little impact on our estimates, as shown in Appendix Table 5.

We have also experimented with the inclusion and exclusion of different sets of covariates. As discussed above, it may be the case that much of the effect of SES is mediated by intervening variables such as the propensity to smoke. (Alternatively, it may be argued that many of these

factors reflect omitted variables that persist throughout the child's life and bias the estimated effects of SES and LBW.)

Models that include only LBW, SES, and the interaction terms are shown in Appendix Table 6. A comparison of these estimates with those presented above indicates that the inclusion of our set of controls has very little effect on the estimated effects of LBW, although it often has a great effect on the estimated effects of SES. The results reported above regarding the interactions between LBW and SES are remarkably robust. The only real change is that the positive interaction between LBW and LSES in the male age 33 employment equation that appeared in Table 4 is not present in Appendix Table 6. The robustness of these estimates provides further support for the finding that the negative effects of LBW are largely invariant with respect to SES.

On the other hand, some may object that our model excludes measures of important events that take place after birth and affect child outcomes. Thus, we might be attributing too much to LBW and the effects of maternal SES measured at the time of the birth. In order to address this concern, we have included three additional classes of variables in our models.

First, we estimated models which included a measure of health care spending at the local authority level in the year of the birth.[7] The incidence of low birthweight could be affected by public health conditions, which in term might be affected by spending levels. Alternatively, these variables may capture characteristics of the child's birth neighborhood that are correlated both with poor birth outcomes and inferior outcomes in later life. Although Britain had instituted a National Health system by the time of our cohort's birth, a great deal of variation in expenditures remained—expenditures in the richest local authorities were 2.5 times greater than those of the poorest districts in 1958.

Second, we added variables that measure hardships suffered after the birth. These included indicators of poor housing conditions (overcrowding, lack of amenities such as indoor plumbing); income; and measures of financial hardship and parental unemployment. Bartley *et al.* (1994) show using the same data that LBW children were much more likely to suffer from this type of disamenity in subsequent years than children of normal birthweight.

We have also constructed variables describing characteristics of the respondent's employers at age 23 and 33, including the occupation, whether the job was covered by a union, and firm size. These variables may be important, if for example, the lingering effects of LBW are mediated by occupational choice.[8]

These two sets of additions had little effect on the estimated effects of LBW, SES, and their interactions. Estimates of these augmented models are shown in Appendix Table 7 (for employment) and in Appendix Table 8 (for wages).

Finally, we have re-estimated our models including marital status and measures of the number of children. As discussed above, the impact of adding marital status and children depends on the extent to which ill health limits opportunities in the marriage market relative to opportunities in the labor force.

When these variables are added to the model of employment at age 23, LBW women still work significantly less, but the point estimate on LBW falls substantially from -.091 to -.053. Since unmarried women are more likely than married women to work, the fact that controlling for marital status reduces the estimated effects of LBW on employment probabilities suggests that younger LBW women are in fact more likely to be married than other women. Since we do not find a similar effect at age 33, it appears that LBW women marry younger than other women. The

addition of marital status and number of children did not significantly alter the result that LBW males were less likely to be employed full-time at age 33.

LSES LBW women are an exception. In the equations including marital status, the coefficient on the LSES LBW interaction is significant, positive and larger (.078) than the coefficient on LBW. For these women, the combination of low socioeconomic status and ill health may limit their marriage prospects more than their employment prospects, and thus have the counter-intuitive effect of increasing employment for women in this group.

C. Changes in the Measure of Health Shock

We experimented with three alternative measures of health shocks: Whether the child was very low birth weight (VLBW, defined as less than 1800 grams); whether the child had a serious illness noted at the time of the birth; and a measure equal to one if the child was both LBW and had an illness noted at birth. Our efforts in this regard were hampered by small sample sizes. For example, although logically the effects of VLBW should be more serious than those of LBW, it was difficult to detect even the main effect of VLBW in many of our specifications. Moreover, when we restricted our attention to children with both LBW and illness, many of our outcome, SES, LBW cells were empty. It is sobering that even in a sample of this size, it is so difficult to detect the effects of rare conditions.

D. Additional Estimates Using Test Scores as Outcomes

As discussed above, many previous studies have found evidence of a negative effect of LBW on the cognitive test scores of young children. The fact that we find insignificant effects of LBW for some long-term outcomes suggests that the effects of LBW may gradually fade out over

time or be dominated by other factors. While we cannot directly examine this hypothesis by following the same outcome measure from early childhood into adulthood, it is interesting to look at the standardized math test scores of this cohort of children at ages 7, 11, and 16.[9]

In models similar to those of Tables 2, 3, and 4 (see Appendix Table 9), we found that between age 7 and age 16 the estimated effect of LBW declined with age for males (from -.21 to -.10 standard deviations) but not for females. This result suggests that the negative cognitive effects of LBW may fade out more rapidly for males than for females. This may in part reflect the fact that males are likely to be heavier conditional on being LBW. Thus, the negative estimated effects of LBW on the employment and health status of males at 33 may reflect health consequences that begin to crop up as people age rather than the effects of initial cognitive deficits. It is also interesting to observe that at age 11 and 16, there was a negative interaction between LBW and HSES for males but not for females, a result that echos what is shown for O-levels in Table 2.

V. Conclusions

The most striking conclusion of this study is that the effects of LBW can be very long term. The effects are greatest for educational attainments, followed by self-reported health status and employment. The effects are smallest for wages which is consistent with much of the literature on the relationship between health and labor markets.

Second, LBW has long term effects on both HSES and LSES children. In fact, there is evidence that HSES boys may actually suffer more from LBW than their less advantaged peers in terms of educational attainments. HSES does mitigate the effects of LBW in one important dimension: LBW women of HSES are less likely to report themselves in fair or poor health than other LBW women.

The evidence presented in this paper suggests that poor children do suffer from double jeopardy in the sense that they are more likely to suffer both from the effects of poverty and from LBW. Thus, these health shocks can be viewed as one of the mechanisms underlying the intergenerational transmission of inequality. However, we find little evidence of "double jeopardy" in the conventional sense of a negative feedback between LBW and SES.

On the whole the results suggest either that environments were not more "adverse" for LBW LSES children than for LBW HSES (at least in the relevant dimensions); that credit constraints were not binding when it came to the relevant compensating investments; or that the types of investments necessary to compensate for LBW were not generally more available to HSES LBW children than to LSES LBW children. The results highlight the importance both of preventing LBW and of finding effective interventions for combating its effects in all sectors of the population.

An important caveat is that these estimates of the long-term effects of LBW refer to the effects of health shocks suffered 40 years ago. Much has changed in the treatment of LBW children, and children of lower and lower birthweights are being saved. To the extent that the patterns we find continue to hold in future, it is likely to be the children of lowest birthweights who will suffer the longest-lasting ill effects. Finally, we have examined only one type of health shock. It is possible that the interaction between health shocks and SES is more pronounced for other kinds of shocks.

References

Aylward, G. P.; Pfeiffer, S. I.; Wright, A. and Verhulst, A. J. "Outcome Studies of Low Birthweight Infants Published in the Last Decade: A Metaanalysis". Journal of Pediatrics. 1989, 115, pp. 515-520.

Barker, David; Osmond, C.; Winter, P. *et al.* "Weight in Infancy and Death from Ischaemic Heart Disease." The Lancet. Sept 9, 1989, 577.

Bradley, Robert H. and Casey, Patrick H.. "Family, Environment and Behavioral Development of Low-birthweight Children". Developmental Medicine and Child Neurology. 1992, 34, pp. 822-832.

Bradley, Robert H.; Whiteside, Leanne; Mundfrom, Daniel J.; Casey, Patrick H. *et al.* "Early Indications of Resilience and their Relation to Experiences in the Home Environments of Low Birthweight, Premature Children Living in Poverty". Child Development, 1994, 65 pp. 346-360.

Bartley, M; Power, Christopher; Blane, D.; Smith, G. Davey. "Birthweight and Later Socioeconomic Disadvantages: Evidence from the 1958 British Cohort Study". British Medical Journal. December 3, 1994, 309, pp. 1475-1478.

Becker, Gary S. and Tomes, Nigel. "Human Capital and the Rise and Fall of Families". Journal of Political Economy. 1986, 4(3, part 2), pp. 1-39.

Brooks-Gunn, Jeanne; Gross, Ruth and Kraemer, Helena *et al.* "Enhancing the Cognitive Outcomes of Low Birth Weight, Premature Infants: For Whom is the Intervention Most Effective?" Pediatrics. June 1992, 89(6), pp. 1209-1215.

Brooks-Gunn, Jeanne; Liaw, Fong-ruey and Klebanov, Pamela K. "Effects of Early Intervention on cognitive Function of Low Birth Weight Preterm Infants". The Journal of Pediatrics. March, 1992, 120(3), pp. 350-359.

Card, David. "Earnings, Schooling, and Ability Revisited." Solomon Polachek, ed., Research in Labor Economics. 1995, pp. 23-48.

Connolly, Sara; Micklewright, John, and Nickell, Stephen. "The Occupational Success of Young Men who Left School at Sixteen." Oxford Economic Papers, 1992, 44, pp. 460-479.

Currie, Janet and Madrian, Brigitte. "Health, Health Insurance, and the Labor Market." in Orley Ashenfelter and David Card, eds., Handbook of Labor Economics. Amsterdam: North Holland, forthcoming, 1999.

Currie, Janet and Thomas, Duncan. "Early Test Scores, Socioeconomic Status, and Future Outcomes." xerox, Dept. of Economics, University of California at Los Angeles, 1998.

Escalona, Sibylle K. "Babies at Double Hazard: Early Development of Infants at Biologic and Social Risk". Pediatrics. November, 1982, 70(5), pp. 670-676.

Fogelman, Ken. Britain's Sixteen-Year-Olds. London: National Children's Bureau, 1976.

Fogelman, Ken. Growing Up in Great Britain: Papers from the National Child Development Study. London: MacMillan, 1983.

Grogger, Jeff and Eric Eide. "Changes in College Skills and the Rise in the College Wage Premium". Journal of Human Resources. 1995, 30(2), pp. 280-310.

Hertzman, Clyde and Wiens, M. "Child Development and Long-Term Outcomes: A Population Health Perspective and Summary of Successful Interventions". Social Science and Medicine. 1996, 43(7), pp. 1083-1095.

Hunt, Jane; Cooper, Bruce and Tooley, William. "Very Low Birth Weight Infants at 8 and 11 Years of Age: Role of Neonatal Illness and Family Status." Pediatrics. October, 1988, 82(4), pp. 596-603.

Kohen, Dafna E.; Brooks-Gunn, Jeanne; McCormick, Marie; Graber, Julia A. "Concordance of Maternal and Teacher Ratings of School and Behavior Problems in Children of Varying Birth Weights". Developmental and Behavioral Pediatrics. October, 1997, 18(5), 295-303.

Mayer, Susan E. What Money Can't Buy: Family Income and Children's Life Chances. Cambridge MA: Harvard University Press, 1997.

Meghir, Costas and Whitehouse, Edward. "The Evolution of Wages in the United Kingdom: Evidence from Micro Data." Journal of Labor Economics. January, 1996, 14(1), pp. 1-25.

Murnane, Richard; Willett, John B. and Levy, Frank. "The Growing Importance of Cognitive Skills in Wage Determination". The Review of Economics and Statistics. 1995, pp. 251-266.

National Children's Bureau. National Child Development Study Summary, Prepared: December, 1991. Essex University: Essex Survey Research Center Data Archive, 1991.

Parker, S; Greer, S. and Zuckerman, B. "Double Jeopardy: The Impact of Poverty on Early Child Development". Pediatric Clinics of North America. 1988, 35 pp. 1227-1240.

Rosenzweig, Mark R. and Wolpin, Kenneth, I. "Are There Increasing Returns to the Intergenerational Production of Human Capital?" The Journal of Human Resources. Spring, 1994, 29(2) pp. 670-693.

Watson, Janine E.; Kirby, Russell S.; Kelleher, Kelly J. and Bradley, Robert H. "Effects of Poverty on Home Environment: An Analysis of Three-Year Outcome Data for Low Birth Weight Premature Infants". Journal of Pediatric Psychology. 1996, 21(3), pp. 419-431.

Wilkinson, Richard G. Unhealthy Societies: The Afflictions of Inequality. New York: Routledge, 1996.

Werner, Emmy; Bierman, Jessie and French, Fern. The Children of Kauai: A Longitudinal Study from the Prenatal Period to Age Ten. Honolulu: University of Hawaii Press, 1971.

Table 1

Sample Means, Low Birthweight and Outcome Variables in the NCDS

	Males			Females		
	High SES	Middle SES	Low SES	High SES	Middle SES	Low SES
Health Shock						
low birthweight	.045 (.0047) 1930	.053 (.0037) 3606	.051 (.0055) 1571	.058 (.0055) 1827	.068 (.0043) 3373	.088 (.0072) 1529
Outcomes						
1. Examinations						
passed any O-levels	.69 (.012) 1602	.43 (.0090) 3014	.29 (.012) 1316	.76 (.011) 1547	.50 (.0094) 2848	.35 (.013) 1283
number O-levels passed	3.77 (.087) 1602	1.74 (.049) 3014	1.01 (.058) 1316	4.10 (.085) 1547	1.93 (.051) 2848	1.17 (.060) 1283
passed math O-level	.56 (.014) 1303	.34 (.011) 1991	.24 (.016) 680	.49 (.014) 1202	.27 (.010) 1744	.21 (.016) 614
passed English O-level	.61 (.013) 1361	.33 (.010) 2203	.25 (.015) 774	.70 (.012) 1404	.44 (.010) 2251	.35 (.016) 874
2. Age 23						
employed full-time	.82 (.010) 1465	.83 (.0073) 2605	.78 (.012) 1107	.68 (.012) 1441	.56 (.0097) 2620	.48 (.015) 1120
hourly wage	1.86 (.016) 1000	1.94 (.012) 1902	1.84 (.018) 747	1.69 (.015) 957	1.58 (.011) 1504	1.52 566 (.017)
fair/poor health	.068 (.0065) 1473	.082 (.0054) 2620	.11 1105 (.0094)	.078 (.0070) 1447	.11 (.0060) 2630	.14 (.010) 1129
3. Age 33						
employed full-time	.92 (.0071) 1368	.90 (.0062) 2378	.85 (.012) 927	.41 (.013) 1337	.34 (.0096) 2439	.30 (.014) 1038
hourly wage	6.31 (.12) 1003	5.27 (.069) 1764	4.80 (.11) 654	4.56 (.081) 928	3.86 (.042) 1727	3.44 (.054) 706
fair/poor health	.090 (.0077) 1361	.14 (.0071) 2371	.18 (.012) 922	.081 (.0075) 1327	.15 (.0072) 2425	.18 (.012) 1029
high blood pressure	.036 (.0051) 1370	.052 (.0046) 2378	.053 (.0074) 926	.060 (.0065) 1335	.057 (.0047) 2439	.078 (.0083) 1038

Note: The first number in the column is the mean and the sample size is in the second row. Standard errors are in parentheses.

Table 2

Examination Results and Low Birthweight (< 2500 g)

	Passed O-levels		Number of O's passed		Mathematics O-level		English O-level	
	males	females	males	females	males	females	males	females
low birthweight	-.037 (.038)	-.15 (.034)*	-.33 (.22)	-.64 (.20)*	-.13 (.049)*	-.12 (.049)*	-.039 (.046)	-.11 (.043)*
high SES	.12 (.016)*	.11 (.016)*	.96 (.092)*	1.0 (.094)*	.094 (.019)*	.093 (.019)*	.15 (.018)*	.12 (.018)*
low SES	-.071 (.016)*	-.091 (.016)*	-.36 (.091)*	-.42 (.092)*	-.054 (.021)*	-.028 (.022)	-.039 (.020)*	-.047 (.019)*
low birthweight, high SES	-.074 (.066)	.076 (.058)	-.96 (.38)*	-.086 (.34)	-.10 (.081)	.076 (.076)	-.18 (.074)*	.046 (.067)
low birthweight, low SES	-.080 (.067)	.057 (.055)	-.11 (.39)	.26 (.32)	.047 (.098)	.095 (.082)	-.046 (.091)	.018 (.070)
twin	-.077 (.040)**	-.092 (.041)*	-.37 (.24)	-.63 (.23)*	-.040 (.051)	-.12 (.053)*	-.10 (.047)*	-.12 (.047)*
mother > min schooling	.18 (.015)*	.14 (.015)*	1.2 (.088)*	1.2 (.088)*	.15 (.018)*	.16 (.018)*	.15 (.017)*	.17 (.017)*
father > min schooling	.16 (.016)*	.13 (.017)*	1.2 (.096)*	1.1 (.097)*	.14 (.019)*	.13 (.020)*	.14 (.018)*	.12 (.019)*
mother's father high SES	.026 (.018)	.026 (.018)	.49 (.10)*	.25 (.10)*	.053 (.021)*	-.016 (.022)	.076 (.020)*	.021 (.020)
mother's father low SES	-.038 (.015)*	-.068 (.016)*	-.25 (.088)*	-.29 (.090)*	-.068 (.019)*	-.031 (.020)	-.042 (.018)*	-.043 (.018)*
single mother at birth	-.070 (.033)*	.0051 (.034)	-.35 (.19)**	-.042 (.20)	-.049 (.046)	.038 (.046)	-.0093 (.042)	.0046 (.040)
mother smoked	-.063 (.012)*	-.060 (.012)*	-.34 (.070)*	-.42 (.071)*	-.030 (.015)*	-.056 (.016)*	-.025 (.014)**	-.033 (.014)*
family size	-.016 (.0043)*	-.011 (.0044)*	-.053 (.025)*	-.050 (.025)*	-.0075 (.0058)	-.0010 (.0061)	-.019 (.0054)*	-.0043 (.0054)
birth order								
first born	.078 (.015)*	.098 (.015)*	.59 (.087)*	.39 (.088)*	.056 (.018)*	.037 (.018)*	.077* (.017)	.064 (.017)*
third or fourth child	-.12 (.016)*	-.11 (.017)*	-.56 (.096)*	-.70 (.097)*	-.052 (.021)*	-.079 (.021)*	-.065 (.020)*	-.089 (.020)*
fifth or higher	-.27 (.025)*	-.28 (.026)*	-1.4 (.15)*	-1.5 (.15)*	-.18 (.038)*	-.12 (.038)*	-.22 (.035)*	-.24 (.032)*
mother's age at birth of child:								
under 20	-.22 (.031)*	-.18 (.031)*	-1.3 (.18)*	-1.1 (.18)*	-.17 (.041)*	-.12 (.040)*	-.16 (.038)*	-.16 (.036)*
20-23	-.11 (.019)*	-.13 (.020)*	-.68 (.11)*	-.85 (.11)*	-.082 (.024)*	-.12 (.024)*	-.071 (.022)*	-.078 (.022)*
24-26	-.036 (.019)**	-.055 (.019)*	-.17 (.11)	-.35 (.11)*	-.033 (.023)	-.039 (.024)**	-.026 (.021)	-.012 (.022)
30-34	-.0045 (.019)	.053 (.019)*	.054 (.11)	.35 (.11)*	-.0059 (.023)	.020 (.023)	.0035 (.022)	.084 (.021)*
35-39	.030 (.023)	.099 (.024)*	.34 (.14)*	.59 (.14)*	.052 (.029)**	.054 (.030)**	.048 (.027)**	.13 (.028)*
40 or over	.045 (.041)	.13 (.041)*	.33 (.24)	.69 (.24)*	.011 (.052)	.11 (.051)*	.12 (.051)*	.12 (.047)*
N	5932	5677	5932	5677	3974	3560	4338	4528
adj. R^2	.19	.19	.24	.26	.13	.12	.16	.15
F-tests (p-value) for joint significance of the effect of:								
Low birthweight	2.93 (.032)	8.17 (.00)	6.53 (.00)	6.20 (.00)	6.73 (.00)	1.98 (.11)	4.85 (.00)	3.46 (.016)
High SES	26.78 (.00)	25.34 (.00)	54.58 (.00)	62.49 (.00)	12.81 (.00)	13.90 (.00)	36.48 (.00)	25.46 (.00)
Low SES	12.79 (.00)	16.31 (.00)	8.38 (.00)	10.24 (.00)	3.30 (.037)	1.19 (.30)	2.43 (.088)	3.07 (.047)

Notes: Standard errors are in parentheses. Other covariates include regional controls and indicators for missing mother's age, parental education, grandfather's SES, family size, and smoking. A * denotes significant coefficients at the 5% level; ** indicates significance at the 10% level. The F-statistics are for a test of the null hypothesis that the main effect and interactions are jointly equal to zero.

Table 3
Age 23 Outcomes and Low Birthweight (< 2500 g)

	Employed Full Time		Log Hourly Earnings		Fair/Poor Health Status	
	males	females	males	females	males	females
low birthweight	-.045 (.035)	-.091 (.039)*	-.017 (.029)	-.035 (.029)	-.0070 (.024)	.060 (.025)*
high SES	-.0061 (.015)	.054 (.018)*	-.024 (.012)*	.013 (.012)	-.00022 (.010)	-.0086 (.012)
low SES	-.049 (.015)*	-.049 (.018)*	-.036 (.012)*	-.016 (.013)	.018 (.010)**	.031 (.012)*
low birthweight, high SES	-.046 (.061)	.10 (.067)	-.024 (.051)	-.014 (.045)	.033 (.042)	-.086 (.043)*
low birthweight, low SES	-.072 (.064)	.13 (.064)*	-.025 (.056)	-.047 (.045)	.0048 (.045)	-.038 (.041)
twin	.016 (.039)	-.0098 (.046)	-.0057 (.031)	-.012 (.032)	-.0087 (.027)	.025 (.029)
mother > min schooling	-.019 (.014)	.023 (.017)	-.021 (.012)**	.040 (.011)*	-.0098 (.0099)	-.021 (.011)**
father > min schooling	-.018 (.016)	.013 (.019)	.00032 (.012)	.046 (.012)*	-.0081 (.011)	-.016 (.012)
mother's father high SES	-.025 (.017)	.00083 (.021)	.0026 (.014)	.017 (.014)	-.0061 (.012)	-.011 (.013)
mother's father low SES	-.015 (.015)	-.010 (.018)	-.0084 (.012)	-.014 (.012)	.015 (.010)	.0065 (.011)
single mother at birth	-.021 (.033)	-.048 (.040)	.0020 (.027)	-.056 (.029)*	.0031 (.023)	-.0049 (.025)
mother smoked	-.014 (.012)	-.040 (.014)*	-.0075 (.0094)	-.015 (.0095)	.010 (.0080)	.0079 (.0089)
family size	-.0048 (.0042)	-.020 (.0051)*	.0024 (.0034)	.00010 (.0037)	.00058 (.0028)	.0046 (.0032)
birth order						
first born	.0051 (.014)	.059 (.017)*	.0066 (.011)	.016 (.011)	-.015 (.0098)	-.016 (.011)
third or fourth child	-.030 (.016)**	-.080 (.019)*	-.0096 (.013)	-.034 (.013)*	.032 (.011)*	.0089 (.012)
fifth or higher	-.026 (.024)	-.19 (.029)*	-.069 (.020)*	-.074 (.021)*	.026 (.017)*	.040 (.018)*
mother's age at birth:						
under 20	-.059 (.031)**	-.20 (.035)*	-.018 (.025)	-.054 (.026)*	.058 (.021)*	.0040 (.022)
20-23	-.000020 (.018)	-.11 (.022)*	-.0094 (.015)	-.027 (.015)**	.016 (.012)	-.0055 (.014)
24-26	-.012 (.018)	-.048 (.022)*	.0072 (.014)	.0011 (.014)	-.00071 (.012)	-.0058 (.014)
30-34	.0086 (.018)	.018 (.022)	-.010 (.014)	.0062 (.014)	.012 (.012)	.0015 (.014)
35-39	.016 (.022)	.057 (.028)*	.025 (.018)	.033 (.018)**	.0034 (.015)	-.0090 (.018)
40 or over	-.012 (.041)	.050 (.046)	.032 (.034)	.022 (.031)	.020 (.028)	.0072 (.030)
N	4815	5079	3649	3026	5181	5186
adj. R^2	.012	.055	.013	.073	.0094	.011
F-tests (p-value) for joint significance of the effect of:						
Low birthweight	3.01 (.03)	2.05 (.10)	.65 (.58)	2.74 (.04)	.22 (.88)	2.26 (.08)
High SES	.44 (.64)	6.72 (.00)	2.52 (.08)	.62 (.54)	.32 (.72)	2.73 (.06)
Low SES	7.01 (.00)	4.36 (.01)	5.01 (.01)	1.76 (.17)	1.56 (.21)	3.60 (.03)

Notes: Standard errors are in parentheses. Other covariates include regional controls and indicators for missing mother's age, parental education, grandfather's SES, family size, and smoking. A * denotes significant coefficients at the 5% level; ** indicates significance at the 10% level. The F-statistics are for a test of the null hypothesis that the main effect and interactions are jointly equal to zero.

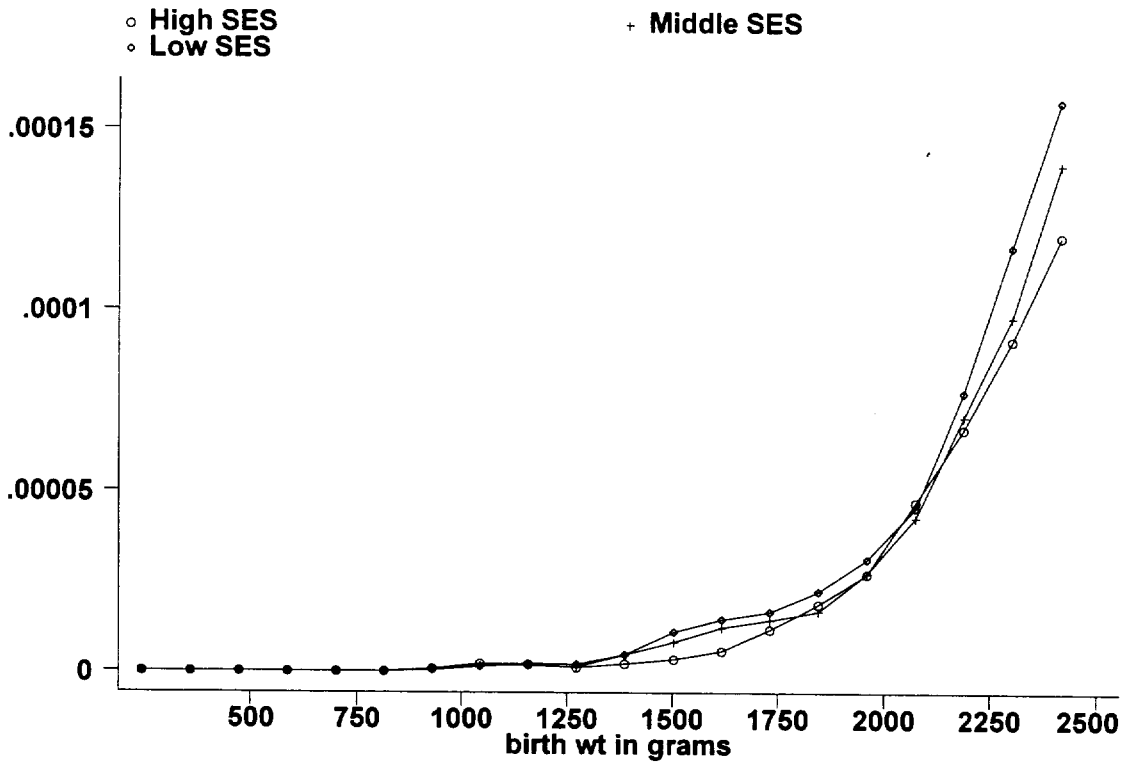
Table 4
Age 33 Outcomes and Low Birthweight (< 2500 g)

	Employed Full-Time		Hourly Earnings		Fair/Poor Health Status		High Blood Pressure	
	males	females	males	females	males	females	males	females
low birthweight	-.082 (.034)*	-.0095 (.040)	-.021 (.045)	.034 (.039)	.068 (.032)*	.045 (.028)	.050 (.020)*	.010 (.020)
high SES	.014 (.014)	.017 (.019)	.068 (.018)*	.047 (.019)*	-.018 (.013)	-.034 (.013)*	-.0039 (.0082)	.011 (.0095)
low SES	-.037 (.014)*	-.028 (.019)	-.064 (.019)*	-.061 (.019)*	.032 (.014)*	.027 (.013)*	-.0020 (.0086)	.013 (.0095)
low birthweight, high SES	-.054 (.057)	.049 (.069)	-.083 (.075)	-.11 (.070)**	.065 (.055)	-.10 (.049)*	-.051 (.034)	.023 (.034)
low birthweight, low SES	.11 (.064)**	.0065 (.068)	-.0032 (.086)	-.017 (.067)	-.19 (.061)*	-.068 (.049)	-.038 (.038)	.025 (.034)
twin	-.030 (.035)	-.072 (.052)	-.083 (.048)**	-.024 (.052)	.034 (.034)	-.059 (.036)**	-.028 (.022)	.050 (.026)*
mother > min schooling	.0061 (.013)	.046 (.018)*	.11 (.017)*	.11 (.018)*	-.033 (.012)*	-.022 (.012)**	-.0040 (.0080)	-.0016 (.0089)
father > min schooling	.011 (.014)	.031 (.020)	.075 (.019)*	.11 (.020)*	-.021 (.014)	-.019 (.014)	-.014 (.0086)**	-.0016 (.0097)
mother's father high SES	-.0016 (.016)	.031 (.022)	.022 (.021)	.049 (.022)*	-.028 (.015)**	.0032 (.015)	-.0017 (.0095)	-.0076 (.011)
mother's father low SES	-.032 (.014)*	-.044 (.018)*	-.025 (.018)	-.012 (.018)	-.0042 (.013)	.0087 (.013)	-.000058 (.0083)	-.0016 (.0091)
single mother at birth	-.046 (.032)	-.0039 (.041)	-.091 (.044)*	.0076 (.042)	.034 (.031)	-.012 (.029)	.017 (.020)	.019 (.021)
mother smoked	-.0099 (.011)	-.022 (.015)	.0031 (.014)	-.029 (.014)*	.024 (.010)*	.014 (.010)	.010 (.0065)	.018 (.0072)*
family size	-.0073 (.0038)**	.0028 (.0053)	-.0083 (.0051)**	-.0091 (.0052)**	-.0030 (.0037)	.0040 (.0038)	-.0014 (.0023)	.0055 (.0027)*
birth order								
first born	.036 (.013)*	-.0052 (.018)	.023 (.017)	.051 (.018)*	-.022 (.012)**	-.052 (.012)*	.010 (.0079)	-.0070 (.0089)
third or fourth child	.0056 (.015)	-.046 (.020)*	-.053 (.020)*	-.048 (.020)*	.043 (.014)*	.0015 (.014)	.016 (.0089)**	.0010 (.010)
fifth or higher	-.057 (.023)*	-.087 (.030)*	-.15 (.031)*	-.11 (.031)*	.065 (.022)*	.070 (.022)*	.015 (.014)	.034 (.015)*
mother's age at birth:								
under 20	-.081 (.028)*	-.025 (.036)	-.10 (.037)*	-.14 (.036)*	.052 (.026)*	.061 (.026)*	.0031 (.017)	.049 (.018)*
20-23	-.024 (.017)	-.060 (.023)*	-.032 (.022)	-.082 (.023)*	.042 (.016)*	.045 (.016)*	-.0076 (.010)	.014 (.012)
24-26	-.011 (.016)	-.050 (.023)*	-.012 (.022)	-.040 (.023)**	.036 (.016)*	.0095 (.016)	-.0089 (.010)	.013 (.011)
30-34	-.0044 (.017)	.028 (.022)	-.023 (.022)	.027 (.022)	-.010 (.016)	-.0016 (.016)	-.022 (.010)*	.012 (.011)
35-39	-.012 (.020)	.033 (.029)	.016 (.027)	.044 (.029)	.0017 (.019)	-.019 (.020)	-.026 (.012)*	.010 (.014)
40 or over	-.061 (.036)**	.053 (.047)	.025 (.050)	-.034 (.046)	.052 (.035)	.045 (.033)	-.017 (.022)	-.0053 (.024)
N	3890	4472	3421	3360	4641	4762	4661	4793
adj. R^2	.023	.020	.11	.10	.022	.022	.0056	.0032
F-tests (p-value) for joint significance of the effect of:								
Low birthweight	4.67 (.00)	.18 (.91)	1.00 (.39)	.91 (.43)	6.15 (.00)	1.69 (.17)	2.11 (.097)	1.07 (.36)
High SES	.79 (.45)	.84 (.43)	7.15 (.00)	3.69 (.02)	1.38 (.25)	7.01 (.00)	1.43 (.24)	1.13 (.32)
Low SES	4.13 (.02)	1.09 (.34)	5.92 (.00)	5.77 (.00)	6.42 (.00)	2.45 (.086)	.60 (.55)	1.63 (.20)

Notes: Standard errors are in parentheses. Other covariates include regional controls and indicators for missing mother's age, parental education, grandfather's SES, family size, and smoking. A * denotes significant coefficients at the 5% level; ** indicates significance at the 10% level. The F-statistics are for a test of the null hypothesis that the main effect and interactions are jointly equal to zero.

Figure 1

Lower Tail of Birthweight Distribution by Socioeconomic Status



Appendix Table 1
Supplementary Sample Statistics

	Males			Females		
	High SES	Middle SES	Low SES	High SES	Middle SES	Low SES
Covariates						
twin	.021 (.0033)	.025 (.026)	.024 (.0038)	.026 (.0037)	.023 (.0026)	.022 (.0037)
mother > min schooling	.50 (.011)	.18 (.0064)	.13 (.0084)	.50 (.012)	.19 (.0068)	.12 (.0085)
father > min schooling	.51 (.012)	.15 (.0064)	.094 (.0081)	.54 (.012)	.16 (.0068)	.073 (.0073)
mother's father high SES	.37 (.012)	.14 (.0063)	.098 (.0085)	.35 (.012)	.13 (.0064)	.12 (.0091)
mother's father middle SES	.47 (.012)	.56 (.0091)	.48 (.014)	.52 (.013)	.56 (.0094)	.48 (.014)
mother's father low SES	.16 (.0089)	.30 (.0084)	.42 (.014)	.13 (.0084)	.31 (.0088)	.40 (.014)
single mother at birth	.012 (.0025)	.026 (.0026)	.070 (.0064)	.0071 (.0020)	.031 (.0030)	.076 (.0068)
mother smoked	.32 (.011)	.41 (.0082)	.45 (.012)	.34 (.011)	.42 (.0085)	.46 (.013)
family size	.99 (.028)	1.1 (.023)	1.4 (.044)	.98 (.028)	1.1 (.024)	1.3 (.041)
birth order:						
first born	.40 (.011)	.37 (.0080)	.31 (.012)	.38 (.011)	.39 (.0084)	.33 (.012)
second child	.35 (.011)	.32 (.0077)	.28 (.011)	.35 (.011)	.29 (.0078)	.28 (.012)
third or fourth child	.21 (.0092)	.23 (.0070)	.27 (.011)	.23 (.0098)	.23 (.0072)	.26 (.011)
fifth or higher	.044 (.0047)	.079 (.0044)	.14 (.088)	.039 (.0045)	.089 (.0049)	.13 (.0086)
mother's age at birth of child:						
under 20	.026 (.0036)	.059 (.0039)	.071 (.0065)	.024 (.0035)	.064 (.0042)	.084 (.0071)
20-23	.17 (.0084)	.25 (.0072)	.26 (.011)	.15 (.0083)	.24 (.0073)	.26 (.011)
24-26	.21 (.0093)	.20 (.0066)	.19 (.0099)	.19 (.0093)	.20 (.0068)	.18 (.0099)
27-29	.23 (.0096)	.18 (.0064)	.17 (.0095)	.24 (.010)	.18 (.0066)	.17 (.0096)
30-34	.23 (.0096)	.18 (.0065)	.18 (.0098)	.26 (.010)	.20 (.0069)	.18 (.0098)
35-39	.11 (.0072)	.11 (.0051)	.10 (.0076)	.10 (.0070)	.10 (.0052)	.099 (.0076)
40 or over	.023 (.0034)	.023 (.0025)	.029 (.0042)	.027 (.0038)	.024 (.0026)	.025 (.0040)
married at age 23	.24 (.011)	.36 (.0094)	.40 (.015)	.46 (.013)	.58 (.0096)	.60 (.015)
sep/div/widow/cohab at 23	.070 (.0067)	.069 (.0050)	.085 (.0084)	.094 (.0077)	.11 (.0061)	.12 (.0098)
married at age 33	.68 (.013)	.70 (.0096)	.66 (.016)	.72 (.012)	.74 (.0090)	.71 (.014)
sep/div/widow/cohab at 33	.080 (.0075)	.10 (.0064)	.12 (.011)	.11 (.0086)	.13 (.0070)	.16 (.012)
children at age 23:						
no children	.92 (.0068)	.84 (.0067)	.78 (.012)	.84 (.0091)	.68 (.0086)	.60 (.014)
one child	.064 (.0060)	.12 (.0059)	.15 (.010)	.11 (.0078)	.19 (.0072)	.22 (.012)
two children	.018 (.0032)	.032 (.0032)	.058 (.0066)	.038 (.0048)	.11 (.0057)	.14 (.0097)
three children	.0012 (.00085)	.0076 (.0016)	.0087 (.0026)	.010 (.0025)	.020 (.0026)	.027 (.0046)
four or more children	0 n/a	.00066 (.00047)	.00079 (.00079)	.0012 (.00088)	.0034 (.0011)	.0086 (.0026)
children at age 33:						
no children	.85 (.0088)	.85 (.0065)	.85 (.010)	.82 (.0096)	.77 (.0078)	.78 (.012)
one child	.043 (.0050)	.050 (.0040)	.046 (.0059)	.060 (.0059)	.052 (.0041)	.051 (.0061)
two children	.081 (.0067)	.076 (.0048)	.070 (.0072)	.090 (.0072)	.12 (.0059)	.10 (.0085)
three children	.023 (.0037)	.021 (.0026)	.029 (.0048)	.024 (.0038)	.048 (.0039)	.050 (.0061)
four or more children	.0036 (.0015)	.0040 (.0011)	.0079 (.0025)	.0038 (.0015)	.016 (.0023)	.016 (.0035)
Alternative health shocks:						
very low birthweight	.0016 (.00090)	.0033 (.00096)	.0038 (.0016)	.0038 (.0014)	.0065 (.0014)	.0079 (.0023)
illness at birth	.016 (.0028)	.018 (.0022)	.021 (.0037)	.013 (.0026)	.0090 (.0016)	.012 (.0028)
birthweight (g)	3447 (12)	3389 (8.9)	3370 (13)	3306 (12)	3250 (8.8)	3228 (14)
Educational Attainment						
age 7 math	.29 (.024)	.032 (.017)	-.18 (.027)	.22 (.025)	-.084 (.018)	-.22 (.027)
age 11 math	.48 (.026)	-.073 (.018)	-.38 (.026)	.44 (.025)	-.13 (.018)	-.38 (.025)
age 16 math	.59 (.029)	-.00071 (.020)	-.33 (.028)	.38 (.027)	-.22 (.018)	-.43 (.025)

Notes: Standard errors are in parentheses. The test scores are z-scores, normalized by subtracting the overall mean from the individual score and dividing by the standard deviation.

Appendix Table 2

Percentiles of the birthweight distribution, by socioeconomic status and perinatal mortality

	1st percentile	5th percentile	10th percentile	N
Non-survivors				
high SES	482	794	1006	110
middle SES	397	765	992	272
low SES	680	907	964	125
Survivors				
high SES	2069	2494	2721	3417
middle SES	2041	2495	2722	6444
low SES	1984	2438	2665	2846

Note: Non-survivors refer to stillbirths or those who survived less than 29 days.

Regressions of survival on low birthweight and socioeconomic status

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
Males						
low birthweight, SES, and interactions	-.27 (.012)*	.0018 (.0055)	.0027 (.0059)	.00085 (.022)	-.021 (.023)	6795
low birthweight, SES, interactions, and covariates in Tables 2-4	-.20 (.011)*	.00070 (.0053)	.0055 (.0052)	-.0095 (.019)	-.020 (.020)	6795
Females						
low birthweight, SES, and interactions	-.24 (.011)	.0094 (.0054)**	-.0023 (.0058)	.024 (.020)	.019 (.018)	6417
low birthweight, SES, interactions, and covariates in Tables 2-4	-.18 (.010)*	.0025 (.0053)	.00094 (.0052)	.0032 (.017)	.015 (.016)	6417

Notes: Each row corresponds to a regression of survival beyond 29 days. The family background characteristics also included in some specifications were: parents' education, mother's father's social class, age of the mother, if mother was single, if mother smoked, if the child was a twin, and the birth order of the child. Standard errors are in parentheses. A * indicates significance at 5% and ** denotes significance at 10%.

Appendix Table 3
Effects of low birthweight when restricting sample to those over 1000g at birth

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
Males						
1. Examinations passed any O-level	-.035 (.039)	.12 (.016)*	-.071 (.016)*	-.061 (.068)	-.070 (.070)	5914
number O's passed	-.30 (.23)	.96 (.092)*	-.35 (.091)*	-.83 (.39)*	-.033 (.41)	5914
Math O-level pass	-.13 (.050)*	.094 (.019)*	-.054 (.021)*	-.068 (.084)	-.058 (.10)	3964
English O-level passed	-.036 (.047)	.15 (.018)*	-.039 (.020)*	-.14 (.077)**	-.017 (.094)	4327
2. Age 23						
employed FT	-.049 (.036)	-.0057 (.015)	-.049 (.015)*	-.052 (.062)	-.11 (.068)	4797
log wages	-.023 (.030)	-.024 (.012)*	-.036 (.012)*	-.016 (.052)	-.0088 (.061)	3633
fair/poor health	-.0026 (.025)	-.00021 (.010)	.018 (.010)**	.031 (.043)	.017 (.048)	5162
3. Age 33						
employed FT	-.088 (.035)*	.013 (.014)	-.037 (.014)*	-.056 (.058)	.11 (.068)**	3873
log wages	-.067 (.047)	.067 (.018)*	-.064 (.019)*	-.053 (.077)	.060 (.093)	3405
fair/poor health	.084 (.033)*	-.018 (.013)	.032 (.014)*	.041 (.056)	-.20 (.064)*	4624
high blood pressure	.049 (.021)*	-.0040 (.0082)	-.0019 (.0086)	-.048 (.035)	-.028 (.041)	4643
Females						
1. Examinations passed any O-level	-.15 (.035)*	.11 (.016)*	-.091 (.016)*	.075 (.060)	.056 (.057)	5654
number O's passed	-.67 (.20)*	1.0 (.095)*	-.42 (092)*	.017 (.34)	.31 (.33)	5654
Math O-level pass	-.12 (.051)*	.093 (.019)*	-.028 (.022)	.094 (.078)	.11 (.086)	3548
English O-level passed	-.10 (.044)*	.12 (.018)*	-.047 (.019)*	.071 (.069)	.011 (.074)	4508
2. Age 23						
employed FT	-.11 (.040)*	.053 (.018)*	-.048 (.018)*	.12 (.069)**	.13 (.066)*	5059
log wages	-.019 (.030)	.013 (.012)	-.016 (.013)	-.016 (.046)	-.073 (.047)	3010
fair/poor health	.072 (.025)*	-.0088 (.012)	.031 (.012)*	-.10 (.044)*	-.042 (.042)	5166
3. Age 33						
employed FT	-.022 (.041)	.017 (.019)	-.027 (.019)	.057 (.070)	.017 (.070)	4458
log wages	.045 (.040)	.047 (.019)*	-.061 (.019)*	-.13 (.071)**	-.032 (.068)	3349
fair/poor health	.054 (.029)**	-.034 (.013)*	.027 (.013)*	-.11 (.050)*	-.072 (.050)	4747
high blood pressure	.0075 (.020)	.011 (.0095)	.013 (.0095)	.032 (.035)	.032 (.035)	4777

Notes: Each row corresponds with a regression of the outcome in the left hand column on the same set of covariates as used in the regressions in Tables 2-4. The results in section 1for males and females correspond with the regressions in Table 2, section 2 with Table 3 and section 3 with Table 4. A * denotes significant coefficients at the 5% level and ** indicates significance at 10%.

Appendix Table 4

Effects of low birthweight when mentally handicapped are excluded from sample

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
Males						
1. Examinations						
passed any O-level	-.034 (.039)	.12 (.016)*	-.070 (.016)*	-.071 (.068)	-.067 (.072)	5752
number O's passed	-.33 (.23)	.97 (.094)*	-.35 (.093)*	-.93 (.40)*	-.094 (.42)	5752
Math O-level pass	-.13 (.049)*	.095 (.019)*	-.054 (.021)*	-.096 (.082)	.046 (.098)	3958
English O-level pass	-.037 (.047)	.15 (.018)*	-.038 (.020)*	-.17 (.075)*	-.049 (.091)	4320
2. Age 23						
employed FT	-.036 (.035)	-.0083 (.015)	-.050 (.015)*	-.047 (.062)	.027 (.069)	4677
log wages	-.016 (.029)	-.023 (.012)*	-.032 (.012)*	-.020 (.052)	-.018 (.057)	3580
fair/poor health	.0039 (.024)	.0035 (.010)	.013 (.010)	.018 (.043)	-.012 (.048)	5038
3. Age 33						
employed FT	-.076 (.033)*	.014 (.013)	-.033 (.014)*	-.035 (.057)	.11 (.066)**	3789
log wages	-.024 (.046)	.064 (.018)*	-.059 (.019)*	-.064 (.076)	.034 (.091)	3350
fair/poor health	.080 (.032)*	-.020 (.013)	.026 (.014)**	.055 (.056)	-.18 (.063)*	4531
high blood pressure	.054 (.020)*	-.0049 (.0083)	-.0032 (.0087)	-.054 (.035)	-.031 (.041)	4550
Females						
1. Examinations						
passed any O-level	-.14 (.035)*	.11 (.016)*	-.086 (.16)*	.070 (.059)	.045 (.056)	5598
number O's passed	-.62 (.20)*	1.0 (.095)*	-.40 (.094)*	-.077 (.34)	.20 (.32)	5598
Math O-level pass	-.12 (.049)*	.093 (.019)*	-.028 (.022)	.075 (.076)	.095 (.082)	3556
English O-level pass	-.11 (.043)*	.12 (.018)*	-.048 (.019)*	.046 (.067)	.018 (.070)	4520
2. Age 23						
employed FT	-.088 (.039)*	.057 (.018)*	-.045 (.018)*	.11 (.068)**	.15 (.066)*	5013
log wages	-.036 (.029)	.012 (.012)	-.017 (.013)	-.018 (.045)	-.046 (.045)	3013
fair/poor health	.049 (.025)*	-.0089 (.012)	.028 (.012)*	-.071 (.043)**	-.042 (.042)	5120
3. Age 33						
employed FT	-.0098 (.040)	.017 (.019)	-.027 (.019)	.049 (.070)	.012 (.069)	4421
log wages	.033 (.039)	.046 (.019)*	-.063 (.019)*	-.11 (.070)**	-.0011 (.067)	3331
fair/poor health	.042 (.028)	-.034 (.013)*	.029 (.013)*	-.096 (.048)*	-.058 (.049)	4710
high blood pressure	.0076 (.020)	.0098 (.0094)	.0070 (.0094)	.028 (.034)	.039 (.034)	4741

Notes: Each row corresponds with a regression of the outcome in the left hand column on the same set of covariates as used in the regressions in Tables 2-4. The results in section 1 for males and females correspond with the regressions in Table 2, section 2 with Table 3 and section 3 with Table 4. A * denotes significant coefficients at the 5% level and ** indicates significance at 10%.

Appendix Table 5a
Effects of low birthweight on any employment at ages 23 and 33

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
Males						
employed at 23	-.047 (.034)	-.0054 (.015)	-.052 (.015)*	-.036 (.060)	-.058 (.063)	4815
employed at 33	-.072 (.032)*	.012 (.013)	-.038 (.014)*	-.074 (.054)	.11 (.061)**	3890
Females						
employed at 23	-.093 (.038)*	.051 (.018)*	-.047 (.018)*	.072 (.066)	.16 (.062)*	5079
employed at 33	.00057 (.040)	.0085 (.019)	-.023 (.019)	.0059 (.070)	-.00014 (.069)	4472

Notes: Regressions are for any employment, including part-time work. Only the effects of low birthweight, SES and interactions are reported here, the other covariates are the same as in the results for full time employment in Tables 3 and 4. A * denotes significant coefficients at the 5% level and ** indicates significance at 10%.

Appendix Table 5b
Effects of low birthweight for persons in sample at both age 23 and 33

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
Males						
1. Examinations						
passed any O-level	-.0036 (.054)	.12 (.023)*	-.058 (.024)*	-.095 (.091)	-.087 (.11)	2752
number O's passed	-.52 (.33)	.97 (.14)*	-.38 (.14)*	-.88 (.55)	-.082 (.66)	2752
Math O-level pass	-.17 (.068)*	.087 (.026)*	-.083 (.031)*	-.089 (.11)	.13 (.16)	2009
English O-level pass	-.022 (.065)	.14 (.025)*	-.048 (.029)**	-.16 (.10)	-.11 (.15)	2172
2. Age 23						
employed FT	-.046 (.040)	-.016 (.017)	-.046 (.018)*	.025 (.070)	.0020 (.080)	3188
log wages	-.015 (.034)	-.018 (.014)	-.042 (.015)*	-.074 (.059)	-.050 (.067)	2519
3. Age 33						
employed FT	-.081 (.033)*	.015 (.014)	-.028 (.015)**	-.024 (.058)	.14 (.066)*	3188
log wages	-.040 (.046)	.063 (.019)*	-.065 (.021)*	-.080 (.080)	-.0071 (.093)	2830
Females						
1. Examinations						
passed any O-level	-.13 (.044)*	.095 (.021)*	-.071 (.021)*	.039 (.077)	.0069 (.076)	3332
number O's passed	-.64 (.26)*	1.1 (.12)*	-.38 (.12)*	-.43 (.45)	-.0067 (.45)	3332
Math O-level pass	-.13 (.058)*	.081 (.024)*	-.029 (.028)	.043 (.098)	.042 (.11)	2230
English O-level pass	-.12 (.054)*	.12 (.023)*	-.036 (.025)	.0046 (.088)	-.011 (.096)	2766
2. Age 23						
employed FT	-.074 (.044)**	.046 (.021)*	-.027 (.021)	.14 (.077)**	.11 (.076)	3834
log wages	-.014 (.031)	.012 (.013)	-.023 (.014)	-.034 (.049)	-.052 (.051)	2364
3. Age 33						
employed FT	-.046 (.041)	-.0026 (.020)	-.035 (.020)**	.047 (.072)	.038 (.070)	3834
log wages	.031 (.042)	.047 (.020)*	-.061 (.020)*	-.16 (.075)*	-.012 (.072)	2889

Notes: Sample required non-missing observations on full time employment at both age 23 and age 33. Each row corresponds with a regression of the outcome in the left hand column on the same set of covariates as used in the regressions in Tables 2-4. The results in section 1for males and females correspond with the regressions in Table 2, section 2 with Table 3 and section 3 with Table 4. A * denotes significant.coefficients at the 5% level and ** indicates significance at 10%.

Appendix Table 6
Gross Differences in Outcomes by Low Birthweight and Socioeconomic Status

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
Males						
1. Examinations						
Passed any O-level	-.069 (.039)**	.27 (.015)*	-.13 (.016)*	-.047 (.070)	-.083 (.071)	5932
Number O's passed	-.51 (.23)*	2.1 (.089)*	-.73 (.096)*	-.81 (.41)*	-.15 (.42)	5932
Passed Math O-level	-.14 (.049)*	.23 (.017)*	-.10 (.021)*	-.097 (.083)	.030 (.10)	3974
Passed English O-level	-.067 (.047)	.29 (.016)*	-.082 (.020)*	-.15 (.078)*	-.037 (.095)	4338
2. Age 23						
Employed FT	-.042 (.034)	-.012 (.014)	-.060 (.015)*	-.049 (.061)	-.079 (.064)	4815
Log wages	-.017 (.028)	-.022 (.011)*	-.043 (.012)*	-.032 (.051)	-.028 (.056)	3649
Fair/poor health	-.0072 (.024)	-.014 (.0092)	.027 (.010)*	.032 (.042)	.0072 (.045)	5181
3. Age 33						
Employed FT	-.088 (.033)*	.035 (.012)*	-.055 (.014)*	-.047 (.057)	.097 (.064)	3890
Log wages	-.043 (.045)	.16 (.017)*	-.098 (.019)*	-.074 (.078)	-.00068 (.089)	3421
Fair/poor health	.080 (.031)*	-.051 (.012)*	.045 (.013)*	.060 (.055)	-.19 (.061)*	4641
High blood pressure	.047 (.020)*	-.013 (.0074)**	.0024 (.0085)	-.050 (.034)	-.031 (.038)	4661
Females						
1. Examinations						
Passed any O-level	-.19 (.035)*	.26 (.015)*	-.15 (.017)*	.089 (.061)	.088 (.058)	5678
Number O's passed	-.98 (.21)*	2.2 (.091)*	-.78 (.098)*	-.049 (.36)	.47 (.34)	5678
Passed Math O-level	-.17 (.050)*	.21 (.018)*	-.060 (.022)*	.11 (.078)	.12 (.085)	3560
Passed English O-level	-.16 (.043)*	.26 (.017)*	-.092 (.020)*	.044 (.069)	.052 (.073)	4529
2. Age 23						
Employed FT	-.11 (.038)*	.11 (.017)*	-.085 (.018)*	.11 (.068)	.14 (.065)*	5079
Log wages	-.041 (.028)	.062 (.011)*	-.032 (.013)*	-.014 (.045)	-.055 (.046)	3026
Fair/poor health	.068 (.024)*	-.025 (.010)*	.038 (.012)*	-.088 (.042)*	-.043 (.041)	5187
3. Age 33						
Employed FT	-.027 (.038)	.068 (.017)*	-.045 (.019)*	.047 (.069)	.023 (.068)	4472
Log wages	.015 (.038)	.16 (.018)*	-.10 (.020)*	-.12 (.071)**	-.0068 (.068)	3360
Fair/poor health	.038 (.027)	-.059 (.012)*	.040 (.013)*	-.097 (.049)*	-.071 (.048)	4763
High blood pressure	.025 (.019)	.0024 (.0085)	.019 (.0093)*	.021 (.034)	.014 (.034)	4794

Notes: Each row corresponds to a regression of the outcome in the first column on low birthweight, socioeconomic status and interactions between high and low socioeconomic status and low birthweight. This table represents the unconditional differences in mean outcomes by low birthweight and socioeconomic status. Section 1 corresponds to Table 2, section 2 corresponds to the outcomes in Table 3 and section 3 corresponds to Table 4. Standard errors are in parentheses. A * indicates significance at 5% and ** denotes significance at 10%.

Appendix Table 7a

Effects of low birthweight additional controls are added to regressions of full time employment at age 33 for NCDS males

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
only lbw, SES and interactions	-.088 (.033)*	.035 (.012)*	-.055 (.014)*	-.047 (.057)	-.097 (.064)	3890
add twin	-.082 (.034)*	.035 (.012)*	-.055 (.014)*	-.047 (.057)	.093 (.064)	3890
add mother's age at child's birth	-.083 (.034)*	.031 (.012)*	-.054 (.014)*	-.045 (.057)	.092 (.064)	3890
add parents' education	-.078 (.034)*	.023 (.014)**	-.051 (.014)*	-.052 (.058)	.093 (.064)	3890
add mother's father's social class	-.077 (.034)*	.019 (.014)	-.048 (.014)*	-.050 (.057)	.099 (.064)	3890
add region	-.079 (.034)*	.018 (.014)	-.046 (.014)*	-.048 (.057)	.10 (.064)**	3890
add single mother indicator	-.079 (.034)*	.018 (.014)	-.045 (.014)*	-.048 (.057)	.10 (.064)**	3890
add if mom smoked	-.078 (.034)*	.017 (.014)	-.044 (.014)*	-.048 (.057)	.10 (.064)**	3890
add family size, birth order	-.082 (.034)*	.014 (.014)	-.037 (.014)*	-.054 (.057)	.11 (.064)**	3890
marital status and children at age 23	-.074 (.033)*	.014 (.013)	-.030 (.014)*	-.060 (.056)	.12 (.062)**	3890
local authority health expenditures	-.091 (.039)*	.054 (.018)*	-.049 (.018)*	.10 (.067)	.13 (.064)*	3890
other family background characteristics:						
lived in crowded household	-.089 (.039)*	.053 (.018)*	-.046 (.018)*	.10 (.067)	.13 (.064)*	3890
family lacked own bathroom and hot water	-.087 (.039)*	.052 (.018)*	-.047 (.018)*	.090 (.067)	.13 (.064)*	3890
family faced financial hardship	-.087 (.039)*	.051 (.018)*	-.045 (.018)*	.10 (.067)	.12 (.064)**	3890

Notes: Each row corresponds to a single regression. Although only the effects of low birthweight, SES and the interactions are reported, the covariates in the main specifications presented in Tables 2-4 are successively added in the first nine rows. The final five rows give the effects of low birthweight, SES and interactions when the variables listed in the left hand column are added to the specification in row 9. A * denotes significant coefficients at the 5% level and ** indicates significance at 10%.

Appendix Table 7b

Effects of low birthweight additional controls are added to regressions of full time employment at age 23 for NCDS females

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
only lbw, SES and interactions	-.11 (.038)*	.11 (.017)*	-.085 (.018)*	.11 (.068)	.14 (.065)*	5079
add twin	-.11 (.039)*	.11 (.017)*	-.085 (.018)*	.11 (.068)*	.14 (.065)*	5079
add mother's age at child's birth	-.10 (.039)*	.098 (.017)*	-.080 (.018)*	.11 (.068)	.13 (.065)*	5079
add parents' education	-.098 (.039)*	.074 (.018)*	-.074 (.018)*	.11 (.068)**	.13 (.065)*	5079
add mother's father's social class	-.097 (.039)*	.070 (.018)*	-.073 (.018)*	.11 (.068)	.12 (.065)*	5079
add region	-.091 (.039)*	.067 (.018)*	-.073 (.018)*	.11 (.068)	.12 (.065)**	5079
add single mother indicator	-.090 (.039)*	.066 (.018)*	-.072 (.018)*	.11 (.068)	.12 (.065)**	5079
add if mom smoked	-.084 (.039)*	.063 (.018)*	-.070 (.018)*	.10 (.068)	.12 (.065)**	5079
add family size, birth order	-.091 (.039)*	.054 (.018)*	-.049 (.018)*	.10 (.067)	.13 (.064)*	5079
marital status and children at age 23	-.053 (.028)**	-.014 (.013)	-.0094 (.013)	.089 (.048)**	.078 (.046)**	5079
local authority health expenditures	-.082 (.034)*	.014 (.014)	-.038 (.014)*	-.053 (.057)	.11 (.064)**	5079
other family background characteristics:						
lived in crowded household	-.079 (.034)*	.012 (.014)	-.036 (.014)*	-.056 (.056)	.11 (.063)**	5079
family lacked own bathroom and hot water	-.079 (.034)*	.013 (.014)	-.037 (.014)*	-.053 (.057)	.11 (.064)**	5079
family faced financial hardship	-.077 (.034)*	.012 (.014)	-.034 (.014)*	-.052 (.056)	.11 (.063)**	5079

Notes: Each row corresponds to a single regression. Although only the effects of low birthweight, SES and the interactions are reported, the covariates in the main specifications presented in Tables 2-4 are successively added in the first nine rows. The final five rows give the effects of low birthweight, SES and interactions when the variables listed in the left hand column are added to the specification in row 9. A * denotes significant coefficients at the 5% level and ** indicates significance at 10%.

Appendix Table 8
Effects of low birthweight on log earnings at ages 23 and 33 when job characteristics are included

	low birthweight	high SES	low SES	high SES, low birthweight	low SES, low birthweight	sample size
Males						
1. Age 23 log wages additional covariates:						
works part time	-.016 (.028)	-.024 (.012)*	-.036 (.012)*	-.029 (.049)	-.032 (.056)	3649
in union	-.0067 (.028)	-.012 (.012)	-.032 (.012)*	-.045 (.048)	-.047 (.054)	3649
private employer	-.0048 (.028)	-.013 (.012)	-.031 (.012)*	-.030 (.048)	-.048 (.054)	3649
firm size	-.0049 (.027)	-.011 (.011)	-.027 (.012)*	-.038 (.047)	-.042 (.053)	3649
2. Age 33 log wages additional covariates:						
works part time	-.020 (.045)	.068 (.018)*	-.064 (.019)*	-.085 (.075)	-.0050 (.086)	3421
in union	-.017 (.045)	.072 (.018)*	-.062 (.019)*	-.090 (.075)	-.020 (.086)	3421
private employer	-.017 (.045)	.072 (.018)*	-.062 (.019)*	-.090 (.075)	-.020 (.086)	3421
firm size	-.026 (.044)	.076 (.017)*	-.050 (.018)*	-.088 (.073)	-.057 (.084)	3421
Females						
1. Age 23 log wages additional covariates:						
works part time	-.038 (.028)	.015 (.012)	-.015 (.013)	-.0080 (.044)	-.049 (.045)	3026
in union	-.025 (.027)	.022 (.011)*	-.014 (.012)	-.026 (.042)	-.068 (.043)	3026
private employer	-.024 (.027)	.019 (.011)**	-.015 (.012)	-.029 (.042)	-.063 (.042)	3026
firm size	-.034 (.027)	.020 (.011)**	-.014 (.012)	-.014 (.042)	-.057 (.042)	3026
2. Age 33 log wages additional covariates:						
works part time	.034 (.039)	.047 (.019)*	-.062 (.019)*	-.11 (.070)**	-.017 (.067)	3360
in union	.039 (.036)	.040 (.018)*	-.057 (.018)*	-.096 (.066)	-.020 (.063)	3360
private employer	.041 (.036)	.036 (.018)*	-.057 (.018)*	-.096 (.065)	-.028 (.063)	3360
firm size	.027 (.036)	.041 (.017)*	-.048 (.018)*	-.091 (.064)	-.022 (.062)	3360

Notes: Each row corresponds to a regression of log earnings at either age 23 or 33. The job characteristics were added successively in each row; that is, the regression of firm size also includes controls for part time work, union, and private employer. Although only the effects of low birthweight, SES and the interactions are reported, the regressions also contained the same covariates as the specifications in Tables 3 and 4, in addition to indicator variables for missing job characteristics. The results for males and females in section 1 can be compared to Table 3 and in section 2, to Table 4. Standard errors are in parentheses. A * indicates significance at 5% and ** denotes significance at 10%.

Appendix Table 9
Test Scores and Low Birthweight (< 2500 g)

	Age 7 math		Age 11 math		Age 16 math	
	males	**females**	**males**	**females**	**males**	**females**
low birthweight	-.21 (.081)*	-.21 (.075)*	-.17 (.080)*	-.32 (.069)*	-.097 (.084)	-.27 (.071)*
low birthweight, high SES	-.00010 (.14)	-.12 (.13)	-.30 (.14)*	.0038 (.12)	-.36 (.15)*	.083 (.12)
low birthweight, low SES	.050 (.15)	-.11 (.12)	-.025 (.15)	.046 (.11)	-.060 (.16)	.0097 (.12)
high SES	.078 (.033)*	.14 (.034)*	.24 (.032)*	.28 (.032)*	.25 (.035)*	.28 (.034)*
low SES	-.16 (.033)*	-.078 (.034)*	-.20 (.032)*	-.14 (.032)*	-.20 (.036)*	-.10 (.034)*
twin	-.30 (.085)*	-.24 (.086)*	-.19 (.084)*	-.19 (.083)*	-.21 (.088)*	-.075 (.088)
mother > min schooling	.28 (.032)*	.19 (.032)*	.34 (.031)*	.32 (.030)*	.36 (.034)*	.36 (.031)*
father > min schooling	.18 (.034)*	.17 (.035)*	.38 (.033)*	.29 (.033)*	.40 (.036)*	.28 (.034)*
mother's father high SES	.043 (.038)	.065 (.039)**	.064 (.037)**	.0014 (.036)	.099 (.040)*	.0071 (.038)
mother's father low SES	-.052 (.032)**	-.056 (.033)**	-.12 (.031)*	-.10 (.031)*	-.13 (.040)*	-.059 (.032)**
single mother at birth	-.18 (.078)*	.074 (.079)	-.20 (.074)*	-.033 (.071)	-.081 (.084)	-.090 (.077)
mother smoked	-.046 (.026)**	-.029 (.026)	-.17 (.025)*	-.13 (.025)*	-.16 (.027)*	-.15 (.026)*
family size	-.0047 (.0090)	-.015 (.0096)	.0013 (.0088)	-.025 (.0089)*	-.00061 (.0096)	-.0073 (.0094)
birth order						
first born	.018 (.031)	-.034 (.032)	.17 (.031)*	.092 (.030)*	.19 (.033)*	.14 (.031)*
third or fourth child	-.054 (.035)	-.14 (.036)*	-.19 (.034)*	-.25 (.034)*	-.22 (.037)*	-.22 (.035)*
fifth or higher	-.18 (.053)**	-.16 (.055)*	-.55 (.052)*	-.48 (.051)*	-.55 (.058)*	-.49 (.054)*
mother's age at birth of child:						
under 20	-.18 (.065)*	-.091 (.065)	-.31 (.063)*	-.41 (.062)*	-.33 (.070)*	-.38 (.065)*
20-23	-.072 (.040)**	-.11 (.042)*	-.18 (.039)*	-.26 (.039)*	-.20 (.043)*	-.25 (.040)*
24-26	.0044 (.039)	-.022 (.041)	-.059 (.039)	-.082 (.038)*	-.085 (.042)*	-.075 (.040)**
30-34	.057 (.040)	.056 (.040)	.071 (.039)**	.062 (.038)	.065 (.043)	.12 (.039)*
35-39	-.024 (.049)	.016 (.052)	.10 (.048)*	.16 (.048)*	.065 (.053)	.22 (.051)*
40 or over	-.040 (.085)	.12 (.087)	.17 (.086)*	.18 (.080)*	.18 (.096)**	.28 (.085)*
N	6245	5927	5841	5552	4829	4598
adj. R^2	.066	.061	.20	.19	.22	.22

Notes: Standard errors are in parentheses. Other covariates include regional controls and indicators for missing mother's age, parental education, grandfather's SES, family size, and smoking. A * denotes significant coefficients at the 5% level; ** indicates significance at the 10% level.

[1] Card (1995) highlights an interesting implication of this model, which is that the marginal return to investments in LSES children can be higher than the return on investments in HSES children. This will be true if 1) the outcome production function is concave; 2) the high and LSES children have similar native ability levels; and 3) the LSES children receive fewer investments due to credit constraints.

[2] Further information about this study is available in National Children's Bureau (1991).

[3] Attriters are more likely than non-attriters to be from disadvantaged backgrounds, although observable differences between the two groups are quite small (Fogelman, 1976, 1983; Robertson and Symons, 1996; Connolly, Micklewright and Nickell, 1992). Connolly et al. (1992) find that controlling for sample selection in various ways makes little difference to their results.

[4] The NCDS reports the