

The University of Sheffield



**Systematic review of the long term outcomes
associated with teenage pregnancy within the UK
Draft report**

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DEFINITION OF TERMS

Binary variable	A variable which can only take the value 0 or 1. This may represent two categories such as male and female.
Confidence intervals	An estimated range of values which is likely to include an unknown population parameter
Control variable	An explanatory variable which controls for differences between the treatment and control group but whose effect is not the main focus.
Endogenous variable	A variable within a regression which is correlated with unobservable variables which are also correlated with the outcome of interest (the dependent variable).
Observational data set	A data set which is collected without a specified treatment and control group, often due to a randomised controlled trial being infeasible or unethical.
Regression analysis	A mathematical equation specifying a relationship between a dependent variable and one or more independent variables.
Unobservable variables	These may be variables which cannot be observed from an observational data set (a) because they have not been collected, or (b) because it is not possible to collect them (for example, people's personality).
Variable	A value which may be varied within a mathematical equation and represents some information such as age of a person

EXECUTIVE SUMMARY

This report aims to review the literature which assesses the long term consequences of a teenage birth within the UK by controlling for observable and unobservable characteristics which might predispose a young woman to teenage motherhood. Studies were identified by an initial systematic literature search followed by citation searching, author searching, reference searching and an unstructured search in Google to identify any additional working papers which had not yet been published. Five studies were identified which assess the long term socioeconomic outcomes of teenage mothers and one study was identified which assesses the outcomes of the child of a teenage birth. No relevant studies were identified considering the father's outcomes following a teenage birth.

All of the studies identified by the review suggest that if both observable and unobservable characteristics are controlled for, a teenage birth is associated with smaller long term negative outcomes than previous literature has suggested which does not control for these factors. However, the extent of any negative long term socioeconomic outcomes associated with a teenage birth is highly uncertain. This is due to the difficulty with creating a suitable control group from an observational data set to compare with teenage mothers. Three of the identified studies suggest that there is no significant impact of a teenage birth upon long term socioeconomic outcomes, whilst three of the studies (two of the mother and one of the child) suggest that there are small negative long term socioeconomic outcomes associated with a teenage birth. No relevant studies consider the long term health-related outcomes associated with a teenage birth.

The implications of this review are that even if a teenage birth leads to some negative long term outcomes, it certainly does not account for all of the negative long term socioeconomic outcomes experienced by people who are born with socioeconomic disadvantage. Therefore, even if all teenage pregnancies could be prevented, this would not eradicate the poorer long term outcomes often experienced by this group of people. It is thus important that future research should focus upon reducing initial disadvantage in addition to implementing interventions to prevent teenage pregnancy.

1 INTRODUCTION

1.1 Purpose of this report

This report aims to review the literature around the long term consequences of a teenage birth upon the mother, father and child within the UK. This will facilitate assessments of effectiveness, and hence cost-effectiveness, of interventions to encourage young people to use contraceptives and contraceptive services. The accompanying three reviews of the effectiveness of interventions to encourage young people to use contraceptives and contraceptive services consider only the short term effectiveness of the interventions, including the impact upon the number of pregnancies and contraceptive use (Blank *et al.*, 2010a, b, c). The underlying assumption of the literature presented in these reviews is that teenage pregnancy is associated with negative outcomes; hence it is beneficial to prevent teenage pregnancy. In the sense that a greater proportion of teenage pregnancies result in abortion, there are undoubtedly negative consequences associated with teenage pregnancy. However, whilst many studies have been undertaken which show the negative consequences associated with teenage motherhood, the majority of these studies fail to control for unobservable characteristics which may influence selection into teenage motherhood. This report aims to systematically review the literature which estimates the long term outcomes associated with a teenage birth within the UK by adjusting for observable and unobservable characteristics which might predispose a woman to teenage motherhood.

1.2 Background

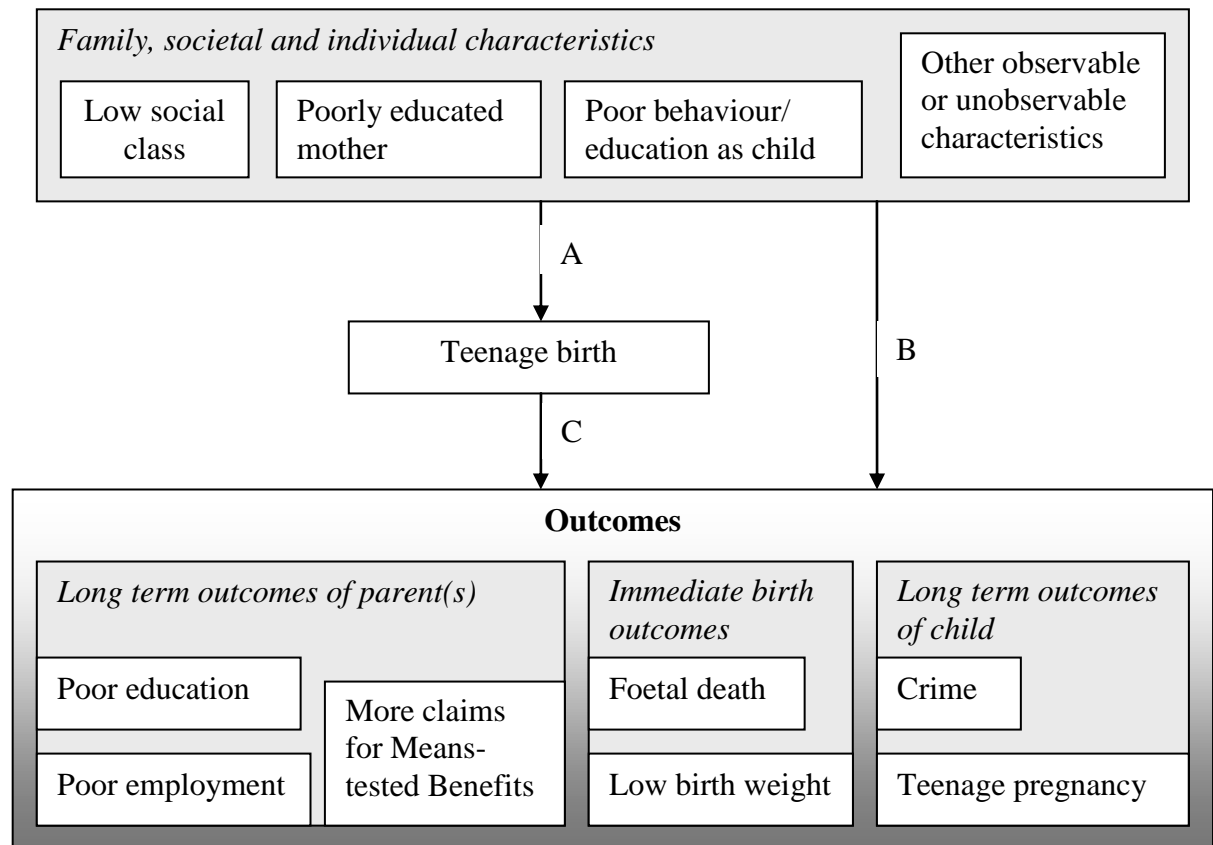
There are numerous negative outcomes typically associated with a teenage pregnancy. Firstly, young age of pregnancy is associated with a greater likelihood of abortion. Secondly, if the pregnancy is continued, there might be an increased risk of foetal death and a greater risk of having a low birth weight baby. Finally, there may be longer term negative outcomes for the mother, the father and the child typically associated with teenage parenthood, including lower education, poorer employment status, an increased risk of a female

child becoming a teenage mother herself, and an increased risk of the children committing crime as they become older. There may also be an increase in claims of means-tested Benefits. This review focuses upon these long term outcomes of a teenage birth.

Studies exploring the long term consequences of teenage motherhood rely on observational data since controlled social experiments are often not feasible. The estimated negative effects are often based on analyses that compare the outcomes of an older mother with the outcomes of a teenage mother. However, this evidence needs to be carefully interpreted as in most cases it only measures an association between the outcomes of interest and teenage pregnancy rather than a true causal effect. Establishing causation using observational data is complicated due to the incidence of confounding factors which are not present when the data are generated in a controlled environment (i.e. within a randomised controlled trial). Older mothers are more often highly educated and are more likely to have pursued their career before starting a family (Ermisch, 2003a). Teenage mothers are more frequently from a lower socioeconomic background and arguably have less to lose from becoming pregnant at a young age and hence would be more likely to have a baby as a teenager (see accompanying views review). Comparing the outcomes of these two very different populations will not provide an estimate of the consequences of a teenage birth, since many of the poorer outcomes associated with those people who have had a teenage birth would have occurred to some extent anyway.

Figure 1 shows some of the possible causes and consequences associated with a teenage birth. This figure shows that there are some family, societal and individual characteristics which may predispose a person to a teenage birth (arrow A). Some of the negative outcomes which occur in people who have a teenage birth are independent of the age at birth and can be explained by their initial family, societal and individual characteristics (arrow B). However, there may also be some negative consequences associated with the age at first birth itself (arrow C).

Figure 1: Possible causes and consequences of a teenage birth



It is very difficult to estimate how much of these outcomes age at first birth accounts for (i.e. to estimate arrow C). The outcomes must be adjusted to account for the poorer initial family, societal and individual characteristics to provide a true estimate of any negative consequences of teenage pregnancy.

1.3 Methods for identifying an estimate of the consequences of a teenage birth

All methods for assessing the long term impact of a teenage birth involve some form of regression analysis. The aim is to find the relationship between the outcome of interest, known as the dependent variable (for example, annual earnings, educational attainment, etc.) and the variable(s) which we believe to be associated with the outcome of interest, known as the independent variable(s). The independent variables include variables whose effect we are interested in (teenage pregnancy) and other individual and family socioeconomic characteristics, also called control variables, such as

examination test scores at a younger age, parental education, financial situation and social class. The relationship is estimated using one of the currently available observational datasets allowing for individual random variation. This individual random variation is called an error term. It is assumed to be zero on average and independent across individuals. It represents the difference in the outcome variable between an individual and the average of all the individuals with the same observable characteristics. This means that two individuals with the same observable characteristics might differ slightly in the value of the outcome variable due to unobservable characteristics such as personal tastes. However, these differences are assumed to be random departures from what we are able to explain.

Identifying the key parameter of interest, the true causal effect of teenage pregnancy on the outcome variables is not easily estimated with observational data sets. Estimation problems arise that unless dealt with appropriately can mask its true magnitude. Since there are differences in the underlying characteristics of the treatment (teenage mothers) and control (older mothers) groups, a causal relationship cannot be inferred by a direct comparison of the two groups. Even if a large number of observable characteristics are controlled for, unobserved differences influencing self-selection into the treatment and control groups still remains. Addressing these unobserved differences (also known as unobserved heterogeneity) is essential to obtain an accurate estimate of the true effect of teenage motherhood. There are a number of well established methods in the general microeconometrics literature to deal with this issue. The two key methods that have been used in the empirical literature discussed in this review are:

- 1) Family fixed effects models;
- 2) Instrumental variables.

These methods will be described below.

1) Family fixed effects models

This analysis involves comparing the outcomes of siblings or twins, where one has given birth as a teen and one has not. This estimation method assumes that all unobserved heterogeneity varies only at the family level and thus any

remaining difference between siblings could be attributed to teen motherhood. This assumption is also the key weakness of this method, since there may be within family differences in terms of circumstances or in terms of personality. This means that unobservable factors which may lead to both teenage motherhood and the outcome of interest may not be controlled for and consequently, the estimated effect of teenage motherhood might overestimate the true effect. In addition, sample sizes are inevitably relatively small.

2) Instrumental variables

Instrumental variables can be used to adjust for what is termed the endogeneity of teenage motherhood. The problem arises when the unobservable characteristics lead to a teenage birth but also influence the outcome of interest. Unless the unobservable heterogeneity is dealt with, the estimated outcome will include not only the effect of teenage pregnancy (the parameter of interest for policy purposes) but will also include the effect of the unobservable(s). The usual approach to deal with this problem is to use instrumental variable estimation. An instrumental variable or instrument is a variable which:

- a) is correlated with the 'endogenous' explanatory variable(s), conditional on the other covariates i.e. is correlated with whether or not the person has experienced a teenage birth; and
- b) is not correlated with the dependent variable in the regression, i.e. it is uncorrelated with the outcome of interest.

Intuitively, since the instrument changes the outcome variable only through its effect on the endogenous variable (teenage motherhood) and has no effect on the unobservables, it helps to disentangle the effects of teenage motherhood on its own from the effect of the unobservables.

Instrumental variable estimation gives consistent estimates of the true effect of teenage pregnancy as long as a valid instrument is used. However, the method leads to a loss of precision because the instrument will add noise to the estimation. The loss of precision will tend to increase the range of the confidence interval. Problems arise if the instrument is only weakly correlated

with the endogenous variable. Therefore, it is important in any empirical analysis to assess the validity of the instrumental variables used. It is difficult to find an appropriate, measurable instrumental variable in this context, and all the variables that have been used as instruments for this analysis to date have their limitations. These limitations will be discussed for each specific study within the review.

Propensity score matching

Propensity score matching has also been used in the empirical literature discussed in this review. This method is not able to control for unobservable characteristics influencing selection into motherhood, although is used in addition to the methods described above in some of the studies. Propensity score matching is therefore also described here.

Matching is a technique used to select individuals to form a control group (non teenage mothers) with similar pre-teenage pregnancy observable characteristics to those of the treatment group (teenage mothers). Any differences between the treatment and this selected control group can then be attributed to teenage motherhood. Propensity score matching matches individuals based on the probability of teenage motherhood given all the observed characteristics. The key weakness of this method is that whilst it may adjust for observable characteristics influencing selection into motherhood, it cannot control for unobservable characteristics. This is termed the Conditional Independence Assumption. Unlike regression estimation, propensity score matching does not require the researcher to specify any particular functional form for the relationship between early motherhood and later life outcomes, and hence it is more flexible in this respect. It does require, however, a choice of model and variables to estimate the propensity score and specification of the propensity score bandwidth when using Kernel Matching. The bandwidth choice is a compromise between efficiency and bias reduction. Large bandwidths lead to gains in efficiency but could mask important features leading to biased estimates. It is usual in the empirical literature to use two or more different bandwidths as a robustness check of the results.

2 METHODS OF LITERATURE REVIEW

2.1 Search methods

An initial systematic search was undertaken in four databases: Medline, Cochrane, EconLit and Web of Science. The search strategy was developed by the ScHARR information specialist and aimed to be sensitive to any literature relating to outcomes of teenage pregnancy. Full details of the search strategy (search terms used) can be found in Appendix 1.

The search strategy included terms relating to pregnancy and its consequences. The only restrictions that were applied to this search were in terms of date (limited to 1990-2009), limiting the search to humans (to avoid animal studies) and to English language. No restrictions were placed in terms of study type or place of publication; however at the data extraction stage studies were excluded if they had not been undertaken using a UK dataset. This was a decision which was made following title and abstract sifting due to the differences in the UK education, work and benefits system compared with other countries such as the US.

Additional methods to identify evidence were undertaken as follows:

- Searching the reference list of included papers;
- Searching for the authors of included papers;
- Cited reference searches on all of the included studies in Google Scholar and Web of Science Cited Reference Search. No date, study type or language restrictions were placed on these searches;
- Search of references of formal government documents such as the Teenage Pregnancy Research Programme research briefing, number 8 (2007);
- Informal searches using Google.

2.2 Inclusion and exclusion criteria

All of the retrieved literature was screened at title and abstract level and those that were relevant were taken through to full paper appraisal.

Studies were included if they:

- Considered any long term outcomes of a teenage birth using a population dataset
- Attempted to control for unobserved characteristics as well as observed characteristics influencing selection into teenage parenthood.

Working papers were included where the analysis had not been published as a journal article.

2.3 Data extraction strategy

Data relating to study design, outcomes, and quality were extracted by one reviewer (HP) and each extraction was independently checked for accuracy by a second reviewer (MH). Disagreements were resolved by consensus and consulting a third reviewer where necessary. The data extraction tables are presented in Appendix 2.

2.4 Quality assessment criteria

Table 1 shows the quality assessment criteria applied for each of the studies. The quality criteria used here differ from the NICE quality criteria, and was devised for this report as there is no NICE tool for measuring the quality of econometric studies.

Table 1: Quality assessment criteria

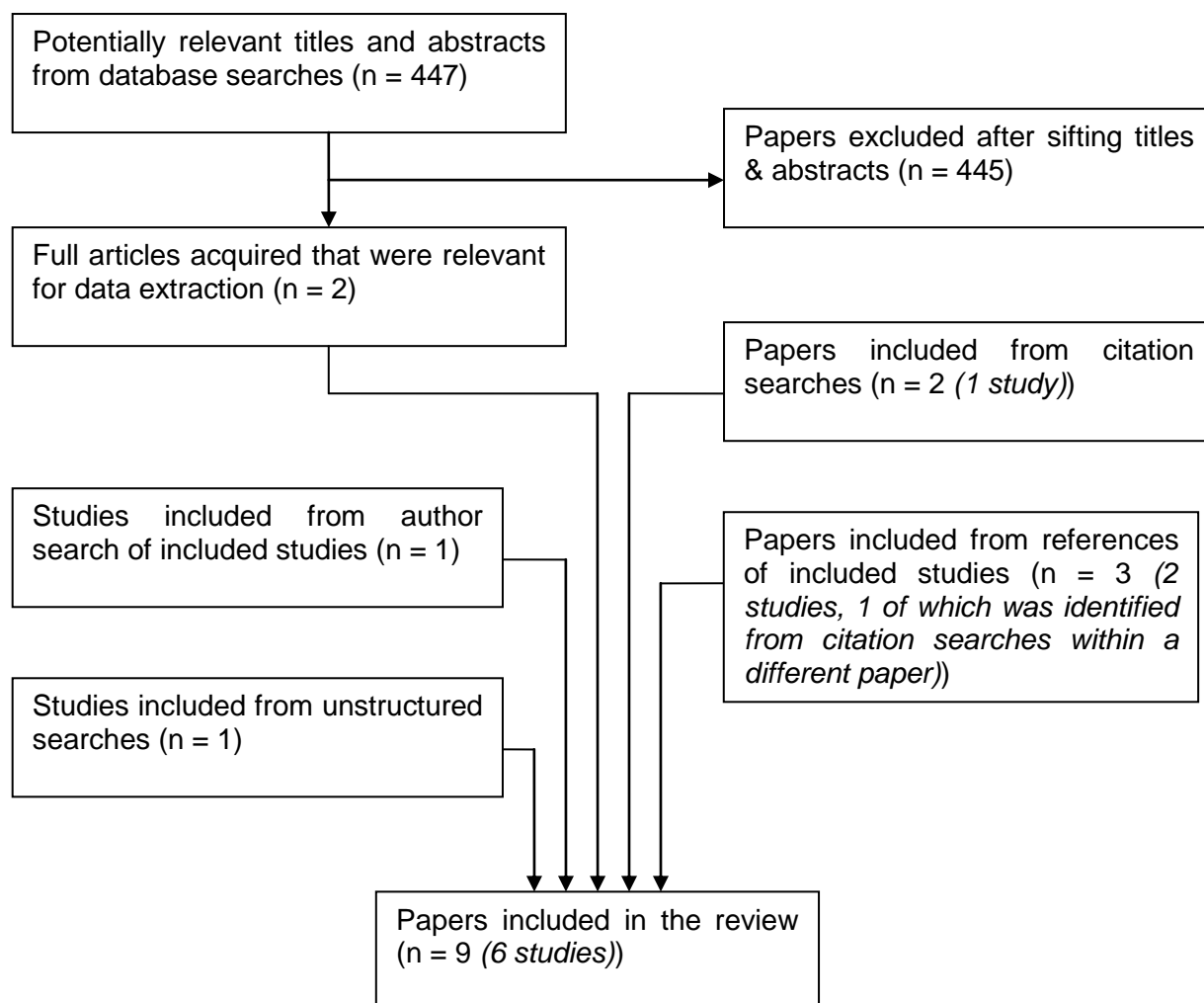
Quality assessment criteria	Quality rating
<ul style="list-style-type: none"> • Study data set is from 1970 or later; and • Methodology of assessing outcomes is high quality; and • Sample size is sufficient. 	***
<ul style="list-style-type: none"> • Study data set is from 1970 or later; and • Methodology of assessing outcomes is of reasonable quality, although may contain some weaknesses. 	**
<ul style="list-style-type: none"> • Outcomes of study data set are probably no longer applicable (i.e. 1958 data set); or • Methodology is poor; or • Sample size is insufficient to be able to draw conclusions. 	*

3 RESULTS OF THE REVIEW

3.1 Quantity of the evidence available

Eight studies were identified which met the inclusion criteria. Figure 2 shows the QUOROM diagram for the search.

Figure 2: QUOROM diagram



Five studies (8 papers) were identified which assessed the consequences of teenage motherhood in terms of the mother's outcomes, controlling for unobservable characteristics. No studies controlling for unobservable characteristics considered the impact of teenage birth in terms of the father's long term outcomes. Finally one study considered the impact of teenage motherhood upon the child's (socioeconomic) outcomes controlling for unobservable characteristics.

3.2 Quality of the evidence available

Key limitations of study quality include:

- 1) All of the studies contain some weaknesses due to limitations associated with observational data sets. The analyses are limited by the frequency of collection of survey data and by the data collected from the study population. The outcomes considered within the study are dependent upon the data available within the survey data, as are the variables included within the explanatory equations. This means that it may not be possible to adjust for all factors appropriately. This is, however, inevitable since this is the only feasible way of obtaining such data.

- 2) All of the studies use either a longitudinal or cross-sectional data set in order to enable the assessment of long term outcomes. However, this means that the outcomes assessed within the analyses may not be generalisable to today's generation of teenage mothers. For example, the educational system and the Benefit's system have changed over time. Similarly, women's working lifestyles (before and after becoming a mother) and their partnerships have altered due to the changing role of women in society within the last half century.

- 3) Outcomes are only assessed at one time point in the mother's/ father's/ child's lifetime (usually at around 30 years for the mother/ father) for all of the included studies. However, it may be that any negative outcomes associated with teenage pregnancy plateau out after the follow up period of the survey, or that they become greater over time. It would be difficult to compare the parents' outcomes before age 30 due to the time taken from leaving school to partaking in higher education and beginning a career. However, the older the age of the parent during the survey the less generalisable the results to current outcomes of teenage parents. Therefore, although only considering outcomes at

one time point is a limitation of all of the studies, it is arguably most appropriate for the validity of the results in this context.

- 4) All of the methodologies used to estimate the impact of teenage motherhood upon long term outcomes have weaknesses due to the feasibility of controlling for unobservable factors which may impact upon the incidence of teenage motherhood. These are discussed in more detail in Section 1.3 and also for each specific study within Section 4.3.

3.3 Studies which assess long term outcomes of the mother

Five studies (8 papers) were identified which assess the long term outcomes of mothers who had a baby as a teenager, controlling for observable and unobservable factors which might predispose a young woman to teenage motherhood.

Chevalier and Viitanen (2003)

Chevalier and Viitanen (2003) use the National Child Development Study (NCDS) to assess the impact of teenage motherhood (defined as under 18 years at conception) upon the mother at age 33. The NCDS is a cohort study of all British people born during the first week of March 1958. The long term consequences of teenage motherhood are measured in terms of post compulsory schooling, work experience and salary. The models for these long term outcomes are first estimated using conventional estimation methods as a benchmark. Models used include linear regressions for continuous outcomes (employment experience and wages) and a probit model for the binary outcome variable (post compulsory schooling). Instrumental variables and propensity score matching (see Section 1.3 for definitions) are used afterwards to determine the causal effect of teenage motherhood on the outcomes, although not every analysis has been undertaken for each of the three outcomes considered within the study. By comparing the differences on the estimated parameters across methods, one can also assess the extent of the endogeneity problem. Chevalier and Viitanen use age at menarche as the

main instrumental variable. They report that age at menarche has been shown to be associated with teenage motherhood due to the longer duration of potential sexual activity, but at the same time it does not directly affect schooling. An additional instrument, birth order, is used together with age at menarche when estimating the model of work experience. A third instrument termed 'finance' is shown within the tables; however this is not described within the text of the paper. Propensity score matching was undertaken using a one to one match and a Kernel match (see Rosenbaum and Rubin (1983) and Heckman *et al.* (1997, 1998) for more details of these methods), both with bandwidths of 0.01 and 0.001.

Control variables differ for the three outcomes but include all or some of the following:

- Parental education;
- Location of birth;
- Number of siblings;
- Type of household;
- Use of library;
- Ability test in Maths and English at age 7;
- Type of school;
- Social class of father;
- Social class of peers' fathers;
- Dummy for financial trouble at age 16;
- Highest qualification by age 33;
- Number of children;
- Work experience as a teenager and as an adult;
- Firm size;
- Dummy for part-time work

The results of the analysis suggest that taking into account the unobserved heterogeneity, teenage motherhood is likely to have a negative effect on the long term outcomes studied here but less substantial than previously considered. Teenage motherhood reduces the chances of post-compulsory

schooling by 12 – 23% (based upon instrumental variable estimates and propensity score matching), reduces the length of employment by around 3 years at age 33 (based upon both instrumental variable estimates and propensity score matching) and reduces salary by between 5 – 10% at age 33 when correcting for sample selection or by between 14 – 22% at age 33 (based upon propensity score matching without sample selection correction).

Strengths of the study are that the analysis is based upon a relatively large sample (504) of teenage mothers. The main weakness of the study is the use of age at menarche as an instrumental variable. The use of this instrument has been criticised in the literature on theoretical grounds (Walker and Zhu, 2009) since the decision to give birth following a conception is unlikely to be dependent upon age at menarche. It has also been shown empirically to be a weak instrument in the sample of twins used by Hawkes (2004). We find evidence in the study of weak instruments. Particularly in the models for work experience which use age of menarche as well as birth order (and 'finance') as instrumental variables, the precision of the estimates decreases to the point that none of the effects of teenage motherhood appear significant at standard statistical significance levels. This is a sign of weak instruments and means that the results will not adequately control for the unobservable characteristics. Additionally, the study is based upon a cohort born in 1958 who were teenagers in the 70s, which means that it may not be generalisable to becoming a teenage parent now. The proportion and type of women undertaking post compulsory schooling, the proportion of women in employment, particularly whilst raising a child, the benefits system and the proportion of women getting married have all changed substantially over the last four decades.

Quality rating: *

Ermisch and Pevalin (2003b)

A working paper by Ermisch and Pevalin (2003b) uses the 1970 British Cohort Study of a sample of British people born 5th-11th April 1970 to assess the impact of teenage motherhood ('teenage pregnancy' is defined as under the

age of 20) upon the socioeconomic outcomes of the mother at age 30 years. Outcomes considered within the analysis include different measures of educational attainment, Income Support receipt, whether the mother is in employment and salary, and if so, whether the mother is in the top 2 social classes, whether the mother has a partner, and if so their qualifications and employment status, and whether the mother owns a house.

Two publications by Ermisch and Pevalin (2004, 2005) were also identified. These report similar analysis as described within this working paper; however they focus upon the housing outcomes associated with the teenage mother at age 30 years and the outcomes associated with the partner of the teenage mother when the mother is age 30 years respectively.

The analysis compares the outcomes of women who have had a baby as a teenager with three different control groups; (1) older mothers (2) women who conceived as teens but had an abortion or a miscarriage, and (3) women who had a miscarriage as a teen. By comparing to the first group, an estimate without correction for the individual unobservables is obtained. Comparing to the second group partly corrects for the individual unobservables since all the women in this group and the teenage motherhood group become pregnant as teenagers but only the women in the teenage motherhood group have the child. However, evidence suggests that those women who became pregnant as a teenager and had an abortion may be characteristically different from those who did not have an abortion. Those who have an abortion are more likely to be from a higher socioeconomic status and have greater professional career potential (Ermisch *et al.*, 2003a). The people that choose abortion following conception are likely to do so because they think that having a baby will lead to negative outcomes. The converse of this is that those people who choose to carry the pregnancy to term are likely to think that having a baby will lead to less negative outcomes, although this decision is also affected by other factors such as religious and moral beliefs. Ermisch and Pevalin (2003b) have therefore undertaken the third analysis, excluding women who had an abortion as a teenager and using only miscarriage as the instrumental variable.

The use of miscarriage as an instrumental variable provides a method of accounting for unobservable factors which may impact upon both teenage motherhood and the later socioeconomic outcomes. This third analysis assumes that the same proportion of miscarrying women would have had an abortion if they had not miscarried as those who did not have a miscarriage. It also assumes that miscarriages are random events. However, it is well recognised that miscarriages are a combination of random and non-random events. A proportion of miscarriages are a result of behaviour such as smoking and drinking alcohol, which are likely to be correlated with socioeconomic outcomes and therefore might not be a valid instrument. Ermisch and Pevalin (2003b) therefore undertake an additional analysis to account for the non-random miscarriages by using an estimate of the proportion of miscarriages that are random and obtaining lower and upper bounds around the outcomes of interest.

Control variables for the instrumental variable analysis include:

- Age of the woman's mother in 1970;
- Household social class at age 10;
- Her mother's education
- A summary scale of her teacher's ratings at age 10.

The differences in the results between the three analyses show evidence of the presence of unobservable characteristics leading to an overestimate of the consequences of teenage motherhood when using methods that do not adequately correct for these unobservable characteristics. The analysis using miscarriage as an instrumental variable suggests that women having a teenage birth are more likely to partner men who suffer from unemployment (assessed when the mother is age 30 years) and are less likely to own a home at age 30 years. These results hold even after taking into account the non-randomness of miscarriages. Teenage pregnancy may also lead to a small increase in Income Support receipt. However, the study also suggests

that teenage birth per se is unlikely to affect qualifications, employment, earnings and social class of the mother at age 30 years.

Strengths of the study are that the instrumental variable 'miscarriage' provides a way of controlling for unobservable factors affecting both teenage birth and socioeconomic outcomes. The results reported in this paper assume that all miscarriages are known, which is unlikely to be the case. In a more recent publication focusing upon partner outcomes, Ermisch and Pevalin (2005) construct bounds taking also into account the underreporting of pregnancies. Even after adjusting the bounds, the results still suggest that teenage motherhood reduces the likelihood of having a working partner.

The main drawback of the study is that only 74 women within the sample had a miscarriage; hence the third analysis is based upon a relatively small number of people. The authors try to resolve this by using 95% confidence intervals around the mean estimates. Some of the outcomes of interest for this review are only presented within the working paper. These are the outcomes for which the estimated bounds, together with the uncertainty around them, are so wide that they include zero. This includes all outcomes except (1) whether or not the partner (if existent) is in employment or has no education beyond the age of 16, and (2) whether the mother is a home owner. This means that the analysis suggests that there is little difference in all other socioeconomic outcomes for teenage mothers and older mothers, once unobserved heterogeneity is controlled for.

Quality rating: **

Goodman *et al.* (2004)/ Kaplan *et al.* (2004)

A study reported by both Goodman *et al.* (2004) and Kaplan *et al.* (2004) uses the 1970 British Cohort Study of a sample of British people born 5th-11th April 1970 to assess the impact upon the mother at age 29 or 30 of teenage pregnancy (defined in two ways: less than 18 years at first birth and less than

20 years) in terms of equivalised family income¹. This outcome is broken down into component parts including number of children, weekly benefit income, whether the person is on means tested benefits, whether the person is working, weekly and hourly wage, hours worked per week, partner in household, partner's wage if existent, partner's post compulsory schooling, age at which the person left full-time education and whether the person undertook post-compulsory schooling. The analysis is undertaken using (a) simple ordinary least squares analysis, (b) miscarriage as an instrumental variable, in a similar way to Ermisch and Pevalin (2003b), and (c) using propensity score matching analogous to Chevalier and Viitanen (2003). Propensity score matching is used to compare outcomes of teenage mothers with those women who had a miscarriage as a teenager but did not give birth by matching their characteristics. This analysis cannot control for unobservable factors that influence the decision to not terminate a pregnancy and the outcome of interest (in contrast to the instrumental variable estimates). However, it is able to control for unobserved factors influencing selection into pregnancy. The model uses estimates from Epanechnikov Kernel density matching with 2 bandwidths, 0.01 and 0.001.

Control variables for both the instrumental variable analysis and the propensity score matching include:

- age mother and father left full-time education;
- maths, reading and ability test scores at age 10;
- mother's age at birth;
- father's social class;
- banded family income at age 10 and age 16;
- indicators at age 16 for whether the family had experienced financial hardship in the last year;
- whether the girl's mother thinks sex education is important, whether her daughter will do A-levels, and whether her daughter will continue in full time education past age 18;

¹ Equivalised family income comprises the real net weekly income of the mother and partner, real benefits received per week and real net weekly income from other sources, adjusted to take account of household composition and size.

- whether the teenager has had a longstanding illness or disability.

The authors explicitly exclude marriage status around the time of the birth due to the correlation between this and teenage pregnancy.

Preliminary analysis of the data compared with National Statistics data suggests that unreported pregnancies are more likely to end in abortion or miscarriage than pregnancy and that a proportion of abortions may be misreported as miscarriages. As for the study by Ermisch and Pevalin (2003b), when using miscarriage as an instrumental variable, Goodman *et al.* (2004) calculate a lower bound for their estimates to examine the implications of non-random miscarriages and misreporting of miscarriages upon the results.

The results of the analysis that do not take into account unobserved heterogeneity suggest that there are negative socioeconomic implications associated with teenage motherhood. However, the negative effect seems to be due to family size and composition rather than through the household income level and it appears that benefit income is important in compensating for the negative effects on both the teenage mother and her partners' labour market outcomes. After adjusting for unobservable factors which predispose young motherhood using miscarriage as an instrumental variable, the effects are largely reduced. However, the calculated lower bound of the instrumental variable estimator that accounts for misreporting and non-randomness of miscarriages are in line with the estimates that do not take into account unobserved heterogeneity.

Interestingly, for all methods, the results suggest that the impact of teenage motherhood is greater in the 18 – 20 years age group than in the less than 18 years age group. This could be due to the negative outcomes associated with teenage motherhood being temporary such that the negative impacts for the younger age group have tailed off, or that the younger group (<18 years) receives more support than the older group (18 – 20 years). The authors also conclude that within the UK, it appears that benefit income does a good job of

compensating for any negative effects on labour market outcomes and partners' incomes.

Within this study, the instrumental variable 'miscarriage' provides a way of controlling for unobservable factors affecting both teenage birth and socioeconomic outcomes. However, again, the miscarriage sample is small, with only 46 miscarriages reported for people less than 18 years and 77 miscarriages reported for people less than 20 years. This is especially important when using instrumental variable estimation since the finite-sample distribution of the estimator for such small sample sizes can differ greatly from the asymptotic distribution. In this case, standard significance tests of the coefficients are not reliable. The lower bound for the instrumental variable estimator is calculated under the assumption that the proportion of reported miscarriages that can be classified as having occurred non-randomly, with respect to the outcome that would occur if the woman did not give birth, is 15%. It would have been interesting to check how sensitive the calculation of the lower bound is to small changes in this assumption. Finally, this analysis is presented within two similar working papers rather than a published peer reviewed article.

Quality rating: **

Walker and Zhu (2009)

Walker and Zhu (2009) use a sample from the UK Quarterly Labour Force Survey of women in England and Wales aged between 25 and 35 years who had their first birth by the age of 25, pooled from 1984 to 2007 to assess the impact of teenage motherhood upon 'worklessness', defined as a household where no adults are in paid employment. The consequences of teenage motherhood are assessed for two groups, those aged 19 or less and a sub group comprising all aged 17 or less. This survey provides a much larger sample of teenage mothers (>20,000 mothers who gave birth before their 20th birthday) compared with other UK cohort datasets used within the other analyses described here (several hundred teenage mothers). The study uses those whose first birth was at age 20 to 25 years as a control group.

The analysis is undertaken using two novel instrumental variables; the Raising of School Leaving Age (RoSLA) policy and the time of year of birth (spring/summer versus autumn/winter). In England and Wales, those born before September 1958 could leave school at age 15; however after this date, pupils had to remain in school until age 16. This change in legislation created a higher opportunity cost to early motherhood, and hence girls became less likely to become teen mothers. This variable is therefore correlated with teenage motherhood. The choice of the second instrumental variable is justified on the basis that the younger children within a school year will be more likely to become teenage mothers than the older children within the same school year. This is because they will be subject to peer pressure from their older peers, but at the same time are less likely to access advice, support, contraception and abortion than their older peers. Walker and Zhu (2009) undertake an analysis using the Labour Force Survey to test whether these two variables are significantly correlated with teen motherhood. Both variables are significantly associated with teen motherhood for the sample 17 and under. Only RoSLA is significantly associated with teenage motherhood in the group of all teenagers. The variables are combined within the econometric analysis to strengthen this causal relationship.

Three different estimation methods using the above instrumental variables are undertaken within the paper; (1) two stage least squares estimates, (2) the limited information maximum likelihood approach, and (3) the generalised method of moments. Each of these methods provides similar results; hence we will not discuss them in detail here (see Cameron and Trivedi (2005) for more details of these methods). Control variables for the instrumental variable analysis were age of the mother, location, year dummies and a polynomial of a continuous measure of birth cohort in months to control for smooth changes in tastes and technology over the time span considered in the analysis.

The results of the analysis suggest that, when adjusting for age, location, year and trends in tastes and technology, teenage motherhood does not have a significant impact upon worklessness. Where the instrumental variables have

the greatest correlation with teenage motherhood (<17 years), the analysis shows that the coefficient for teenage motherhood within the explanatory equation is close to zero (-0.085 with a standard error of 0.188). The authors conclude that there is no evidence of a causal effect of early motherhood on worklessness later in life, and hence the strong negative correlation between teen motherhood and worklessness within the data is largely due to unobserved heterogeneity.

Strengths of the analysis are that it uses a large data set and that it considers the impact upon worklessness of a range of ages of teenage motherhood. Out of the two instrumental variables used, only RoSLA is significant in the analysis for the group of all teenage mothers. Since there is only one endogenous variable in the model, one significant instrumental variable is enough to identify the model and therefore the lack of significance of the month of birth as an instrument is not a concern. One potential problem in the analysis is that the authors only have access to a limited number of control variables given the cross sectional nature of the dataset. Finally, this analysis is presented within a working paper rather than a published peer reviewed article.

Quality rating: **

Hawkes (2004)

Hawkes (2004) uses data taken from St Thomas' Twin Research Unit of a sample of twins who have given birth at some point in their lifetime to assess the impact of teenage motherhood ('teenage birth' is defined as giving birth between 16-19 years old) upon the socioeconomic outcomes of the mother. These socioeconomic outcomes are measured for each mother at different ages, with a mean age of 48.4 and a standard deviation of 7.5. This means that outcomes may have been measured anytime from when the mother was in her thirties to when she was in her fifties and sixties. The paper does not state exactly who makes up the sample (i.e. British, English). Outcomes assessed within the paper include household income, highest qualification,

whether the mother is employed and whether there is a partner in the household.

The study uses a family fixed effects model using twins (both identical and non-identical) to attempt to account for unobservable characteristics which may predispose teenage motherhood. These estimates also termed within-twin estimates and compare outcomes of twins controlling for the differences in their first pregnancy. In addition to these estimates, between-twin estimates (treating each twin as an individual observation in the sample) and estimates from a model used in behavioural genetics were presented. The last method is similar to the within-twin estimate but controls directly for the environment and genetics rather than using differences to eliminate them. The latter of these estimates and the within-twin estimate attempt to control for unobservables, whilst the between-twin does not. Following an initial analysis, the teenage motherhood dummy variable was replaced by a continuous variable of age at first birth. This is because the sample size of the study is relatively small and there are a smaller number of twins where one has had a baby as a teenager and one as had a baby as an older mother, than twins who have had a baby at different ages. Age at first birth was therefore used instead so that the analysis was based upon a bigger sample. This means that the results are presented in terms of the benefits of delaying motherhood rather than in terms of whether the mother was a teenager or not. An additional analysis was also undertaken, considering age of menarche as an instrumental variable as in Chevalier and Viitanen (2003), suggesting that age at menarche might be a weak instrument.

Control variables for the within-twin analysis include:

- London dummy;
- current smoker dummy;
- number of children;
- highest qualification;
- partner in household.

In addition to these controls, the behavioural genetics method includes:

- age;
- number of siblings excluding co twin;
- the twins mother's age at first birth;
- whether they grew up in a single parent family.

The results of the analysis suggest that there is a small negative impact of teenage pregnancy upon family income. The within-twin estimates which attempt to control for family background suggest that waiting an extra year before entering motherhood increases the natural logarithm of household income by 0.017, increases the highest qualification by 0.039 (on a 7 point scale ranging from 10 for basic education to 17 for degree) and increases the probability of a partner in the household and increases the probability of being employed. These estimates are much smaller than those estimated with the between-twin models and suggest that once family effects are taken into account the consequences of delaying pregnancy by one more year are small.

In comparing the outcomes of twins, the study attempts to control for both observable and unobservable factors which might predispose a woman to teenage motherhood. The paper suggests that the original intention was to include only identical twins within the analysis. This would mean that family background could be controlled for, since twins are unlikely to grow up in different circumstances, and genetic factors could be controlled for, since identical twins share the same genotype. However, the sample size of identical twins within the data set is small and hence both identical and non-identical twins were included within the analysis. This means that although the study is able to control for family background, it is not able to completely control for genetic factors which may predispose a woman to teenage motherhood because the majority of the twins within the sample are non-identical. The author also emphasizes that in this particular sample the mothers are more educated and older which could lead to underestimation of the effect of age of motherhood. In addition, the socioeconomic outcomes are observed at different times in the mothers' lifetimes. This means that, unless the impacts upon socioeconomic outcomes are constant over the mothers'

lifetimes, this will introduce bias into the results. This analysis is presented as a preliminary version and has not been published as peer reviewed article at present.

Quality rating: *

3.4 Studies which assess long term outcomes of the father

No studies were identified which assess the long term outcomes of a teenage birth upon the father by adjusting for both observable and unobservable characteristics which might predispose a person to early parenthood. One study by Berrington *et al.* (2005) does attempt to assess the socioeconomic outcomes of the father at age 30 years, but does not control for unobservable characteristics. However, the authors conclude that the age of entering fatherhood does not substantially affect socioeconomic outcomes of the father at age 30. Controlling for unobservable characteristics is therefore likely to reduce any outcome differences further.

3.5 Studies which assess long term outcomes of the child

Only one study was identified which assessed the long term outcomes of the child of a teenage birth, controlling for unobservable characteristics which may influence outcomes.

Francesconi (2008)

Francesconi (2008) uses a sample of young adults from the first nine waves of the British Household Panel Survey who were born between 1970 and 1983 (and hence aged 16 years and over at the time of the survey). These young adults were matched to at least one of their parents (biological or adoptive) and to their siblings. These data were used to assess the impact upon the child at age 16 years or greater of being the result of a pregnancy which occurred when the mother was both less than 20 years old and less than 23 years old. Outcomes considered within the study include proportion of the children completing A-levels or higher qualifications, probability of

experiencing economic inactivity², probability of being in the upper or lower decile for monthly real labour income, real hourly pay and total individual (labour and non labour) income and probability of the female children having a teenage pregnancy themselves. The study also considers the likelihood of the child smoking and of experiencing psychological distress as measured by a score of four and above in the General Health Questionnaire.

The author postulates that differences in outcomes might be the result of unobserved characteristics of the families, and therefore the study uses a sibling difference model (within family estimates), comparing siblings and half siblings, where one child was born when the mother was a teenager and one was born when the mother was older, to attempt to account for unobservable characteristics which may affect the outcomes of a child who was born to a teenage mother. Alternative parametric and nonparametric models that do not specifically account of family fixed effects are also estimated and reported. Within-family estimates were calculated in three different ways; using Chamberlain conditional logit models, using mother fixed-effects linear probability models and using mother fixed-effects logit models. Each of these methods to calculate within-family effects is reported to provide similar results; hence the authors only report the results obtained from the last model.

Control variables for the sibling difference model include sibling differences in:

- gender;
- age (sister differences are taken at the same age in the case of a teenage birth);
- age of father and mother at birth of child;
- childhood family structure and parental joblessness;
- dummy variable indicating first born.

The results of the analysis suggest that, after adjustment for family effects, children of teenage mothers have a 12.7 percentage point reduction in the probability of high educational attainment, a greater risk (5.2 percentage

² Economic inactivity is defined as not employed and not being in full time education, looking after children, or taking part in a government training programme.

points) of economic inactivity and a greater risk (2.7 percentage points) of teenage childbearing. The study also predicts that children of teenage mothers will be 2.7 percentage points less likely to be in the top decile of the income distribution and 1.2 percentage points more likely to be in the bottom decile of the income distribution. In addition, the study suggests that family structure plays a more important role on these outcomes than family poverty during childhood. Finally, the study suggests that children of mothers who give birth in their early twenties may also experience negative outcomes compared with children of older mothers.

However, siblings and half-siblings may be very different in terms of their personality and other unobservable factors which might influence outcomes such as the event of a teenage pregnancy. Siblings may also grow up in different circumstances; they may live in different households, may have a different father. Although some control variables are included, these might not be enough to take all these differences into account. The study includes siblings who are adopted which will further accentuate the potential differences between the siblings. Finally, siblings may influence each other based on the other's actions. For example, if one sibling has a teenage pregnancy, the other may endeavour to avoid this happening to her.

Quality rating: *

4 DISCUSSION

4.1 Summary of identified research

Five UK papers have been identified which assess the long term socioeconomic outcomes associated with teenage motherhood upon the mother, controlling for both observable and unobservable characteristics which might predispose a young woman to teenage motherhood. All of these studies suggest that if these characteristics are controlled for, teenage motherhood is associated with smaller long term negative outcomes than previous literature has suggested. One UK paper has been identified which assesses the long term socioeconomic impacts of teenage birth upon the child

which suggests that there may be some negative outcomes for the child of a teenage birth; however there are limitations around the methodology of this study. No studies have been identified which control for observable and unobservable characteristics which may predispose a person to early parenthood to assess the long term impacts of teenage birth upon the father.

The extent of any negative long term socioeconomic outcomes associated with a teenage birth is highly uncertain. In the case of assessing the outcomes associated with the mother, this is due to the difficulty of creating an adequate control to compare with teenage mothers to adjust for any underlying characteristics (both observable and unobservable) which may predispose the young woman to motherhood. If these factors are not adequately controlled for, the analyses are likely to overestimate the negative outcomes associated with a teenage birth. Each of the studies within the review uses different methods, each with their own strengths and weaknesses, to assess the impact of a teenage birth upon long term outcomes. None of the studies are able to provide a completely ideal control and hence the results of the analyses remain uncertain. Each of the studies also uses different controls and different outcomes to assess the long term impacts of a teenage birth, dependent upon the data available within the data sets used for the analyses.

One study using age of menarche as an instrumental variable (Chevalier and Viitanen, 2003) suggests that there remain relatively large negative long term socioeconomic outcomes associated with teenage motherhood; however this instrument is weak and the analysis is based upon an older data set and hence the outcomes of this study should be interpreted with caution. The two studies using miscarriage as an instrumental variable predict that teenage birth has no substantial impact upon the mother's long term socioeconomic outcomes; however this instrument may underestimate the long term outcomes associated with teenage motherhood due to the non-randomness of some miscarriages. One of these studies (Ermisch and Pevalin, 2003b) does suggest that women having a teenage birth are more likely to partner men who will suffer from unemployment and are less likely to own a home. Walker and Zhu (2009) use the Raising of School Leaving Age policy and the time of

year of birth (spring/summer versus autumn/winter) as instrumental variables and suggest that teenage motherhood does not have a significant impact upon worklessness. Finally, Hawkes (2004) suggests that there is a small negative impact of teenage pregnancy upon family income by comparing outcomes of twins. Using (unidentical) twins as a control is unlikely to adjust for all of the unobservable characteristics which might predispose a young woman to motherhood and hence the results of this study should be treated with caution.

All of the analyses around the mothers' outcomes are undertaken when the mothers are around 30 years old. It would be difficult to compare outcomes before this age due to the time taken from leaving school to partaking in higher education and beginning a career. Therefore, although the data sets within the analysis may seem old, it would not be possible to use data sets where the mothers were born beyond 1980. Conversely, if mothers' outcomes were assessed at older ages, the results would be less generalisable to teenage mothers today.

The only study which assesses the impact of a teenage birth upon the child's outcomes suggests that children of teenage mothers have a lower chance (by 12.7 percentage points) of high educational attainment, a greater risk of economic inactivity (by 5.2 percentage points), a greater risk of teenage childbearing (by 2.7 percentage points) and a higher probability of lower earnings (by 1 – 3 percentage points). However, this study compares the outcomes of siblings who may have very different unobservable characteristics and may also grow up in different circumstances. The results of this study should therefore be treated with caution.

It should be noted that all of the studies within this review provide an analysis of the population average, rather than individual outcomes. Individual outcomes are clearly highly variable due to different individual circumstances and personal characteristics.

4.2 Implications of review and further research

The implications of this review are that even if a teenage birth leads to some negative long term outcomes, it certainly does not account for all of the negative long term outcomes experienced by this group of people. Therefore, even if all teenage pregnancies could be prevented, this would not eradicate the poorer long term outcomes experienced by these people. It is thus important that future research should focus upon reducing initial disadvantage in addition to implementing interventions to prevent teenage pregnancy.

Future econometric work within this context could include developing innovative methods for constructing the control group so that all relevant observable and unobservable variables are adequately controlled for. It would also be useful for this type of econometric analyses to be undertaken around the impact of a teenage birth upon the father and child's long term outcomes. In addition, the impact of a teenage birth upon long term health-related outcomes could be assessed within an econometric analysis. Finally, data from the Millennium Cohort Study could be used within these analyses when sufficient waves of data have been collected.

5 REFERENCES

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APPENDICES

5.1 Appendix 1: Search strategy of review

Medline – 129 records

- 1 (consequence* or outcome* or implication* or cost*).ti.
- 2 ((pregnancy or mother* or parent*) adj2 (teen* or young or adolescen*)).ti.
- 3 1 and 2
- 4 limit 3 to (english language and humans and yr="1990 - 2009")

Cochrane (All databases) – 13 records

- #1 (consequence* or outcome* or implication* or cost*):ti
- #2 ((pregnancy or mother* or parent*) NEAR/2 (teen* or young or adolescen*)):ti
- #3 (#1 AND #2)
- #4 (#3), from 1990 to 2009

EconLit – 0 records

- 1 (consequence* or outcome* or implication* or cost*).ti.
- 2 ((pregnancy or mother* or parent*) adj (teen* or young or adolescen*)).ti.
- 3 1 and 2

Web of Science – 345 records

- # 1 TI=(consequence* or outcome* or implication* or cost*) AND Language=(English)
 - # 2 TI=((pregnancy or mother* or parent*) SAME (teen* or young or adolescen*)) AND Language=(English)
 - # 3 #2 AND #1
- Databases=SCI-EXPANDED, SSCI Timespan=1990-2009

5.2 Appendix 2: Data extraction table

Author, year	Methodology	Dataset used for analysis	Control variables	Mother's age when outcomes assessed	Results of analysis	Weaknesses of method	Quality rating
Chevalier & Viitanen, 2003	(1) Age of menarche, birth order (and 'finance') instrumental variable estimate (2) Propensity score matching	1958 National Child Development Study	<ul style="list-style-type: none"> - Parental education; - Location of birth; - Number of siblings; - Type of household; - Use of library; - Ability test in Maths and - English at age 7; - Type of school; - Social class of father; - Social class of peers' fathers; - Dummy for financial trouble at age 16; - Highest qualification by age 33; - Number of children; - Work experience as a teenager & as an adult; - Firm size; - Dummy for part-time work 	33 years	<ul style="list-style-type: none"> - Reduces the chances of post-compulsory schooling by 12 – 23%; - Reduces work experience by around 3 years at age 33; - Reduces salary by between 5 – 10% at age 33. 	<ul style="list-style-type: none"> - Weak instrument - Old data set 	*
Ermisch & Pevalin, 2003	Using miscarriage as an instrumental variable.	1970 British Cohort Study	<ul style="list-style-type: none"> - Age of the woman's mother in 1970; - Household social class at age 10; - Her mother's education - A summary scale of her teacher's ratings at age 10. 	30 years	<p>No difference in terms of qualifications, employment, earnings & social class of the mother. Women having a teenage birth are:</p> <ul style="list-style-type: none"> - More likely to partner men who will suffer from unemployment; - Less likely to own a home. 	<ul style="list-style-type: none"> - Miscarriages may not be random (although additional analysis is undertaken to attempt to control for this and the under-reporting of pregnancy); - Small sample size within analysis. 	**

Author, year	Methodology	Dataset used for analysis	Control variables	Mother's age when outcomes assessed	Results of analysis	Weaknesses of method	Quality rating
Goodman et al., 2004	(1) Miscarriage as an instrumental variable estimate (2) Propensity score matching	1970 British Cohort Study	<ul style="list-style-type: none"> - Age mother and father left full-time education; - Maths, reading and ability test scores at age 10; - Mother's age at birth; - Father's social class; - Banded family income at age 10 & age 16; - Indicators at age 16 for whether the family had experienced financial hardship in the last year; - Whether the girl's mother thinks sex education is important, whether her daughter will do A-levels, and whether her daughter will continue in full time education past age 18; - Whether the teenager has had a longstanding illness or disability. 	29 or 30 years	<ul style="list-style-type: none"> - The effects of teenage pregnancy upon equivalised family income are insignificant; - The negative impact of teenage motherhood is greater in the 18 – 20 years age group than in those less than 18 years 	<ul style="list-style-type: none"> - Miscarriages may not be random (although additional analysis is undertaken to attempt to control for this); - Small sample size within analysis. 	**
Walker & Zhu, 2009	The Raising of School Leaving Age policy & the time of year of birth (spring/summer versus autumn/winter) are used as instrumental variables.	UK Quarterly Labour Force Survey	<ul style="list-style-type: none"> - Age of the mother; - Location; - Year dummies - A polynomial of a continuous measure of birth cohorts in months 	25 to 35 years	- Teenage motherhood does not have a significant impact upon worklessness	- Limited number of control variables due to data set used	**

Author, year	Methodology	Dataset used for analysis	Control variables	Mother's age when outcomes assessed	Results of analysis	Weaknesses of method	Quality rating
Hawkes, 2004	Compares outcomes of twins who had their first births at different ages	Data from St Thomas' Twin Research Unit	<ul style="list-style-type: none"> - London dummy; - Current smoker dummy; - Number of children; - Highest qualification; - Partner in household. 	Mean age of 48.4 years, standard deviation of 7.5 years	- Small negative impact of teenage pregnancy upon family income, qualifications, the existence of a partner & the probability of being employed.	<ul style="list-style-type: none"> - Not able to completely control for genetic factors since uses non-identical twins; - Within the sample data, the mothers are more educated and older than the average population; - Socioeconomic outcomes are observed at different times in the mothers' lifetimes. 	*

Author, year	Methodology	Dataset used for analysis	Control variables	Child's age when outcomes assessed	Results of analysis	Weaknesses of method	Quality rating
Francesconi, 2008	Compares outcomes of siblings, where one was born when their mother was a teenager & one was born with their mother was older	First 9 waves of the British Household Panel Survey	<ul style="list-style-type: none"> - Gender; - Age (sister differences are taken at the same age in the case of a teenage birth); - Age of father and mother at birth of child; - Childhood family structure and parental joblessness; - Dummy variable indicating first born. 	16 years or greater	<ul style="list-style-type: none"> - Children of teenage mothers have a lower chance of high educational attainment, greater risk of inactivity & teenage childbearing, a smaller probability of being in the top decile of the income distribution & a greater probability of being in the bottom decile of the earnings distribution; - Family structure plays a more important role on these outcomes than family poverty during childhood; - Children of mothers who give birth in their early twenties may also experience negative outcomes compared with children of older mothers 	<ul style="list-style-type: none"> - Siblings may be different in terms of their personality and other unobservable factors which might influence outcomes; - The different circumstances siblings may grow up in are not adequately controlled for; - Siblings may influence each other's behaviour. 	*