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The Impact of Early Motherhood on Future Living Standards

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Abstract

In recent years the government has focused particular attention on reducing teenage pregnancies. Early motherhood is associated with lower future socio-economic outcomes, due to loss in investment of human capital due to child rearing. This paper seeks to identify the impact of early motherhood on wages at 33, using miscarriage as an instrumental variable. Data is taken from the 5th sweep of the National Child Development Study. The Treatment model was used and it was estimated that having a teen birth decreases wages at 33 by up to 25%.

The Impact of Early Motherhood on Future Living Standards

1. Introduction

Reducing teenage pregnancies has become a government agenda in recent years, as statistics show that the UK has the highest rate of teenage births in Europe. They are seen to be detrimental to society as many believe early motherhood to be related to lower future socio-economic outcomes, such as lower future earnings, lone parenthood and a cycle of early motherhood. The SEU (1999) put the high conception rates down to low future job expectations, along with mixed messages from advertising and media about sex, and ignorance.

Figure 1

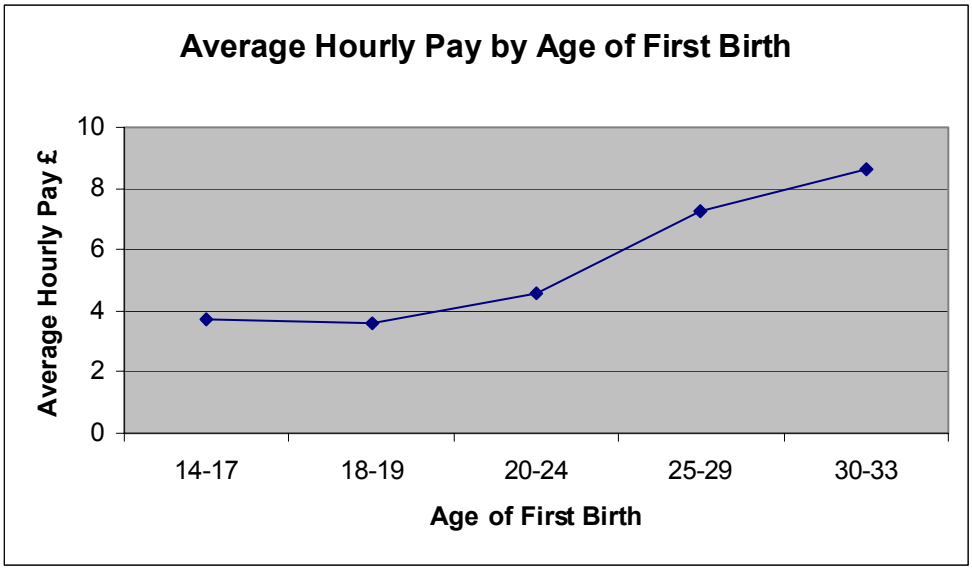


Figure 1 shows gross average hourly wage for women who were working at age 33, split up by age of first birth. The data was taken from the National Child

Development Study. It is clear that average earnings increase the more childbearing is delayed, with average hourly wage more than doubling over the ages. However, the interesting question is how much is actually attributed to early motherhood, and how much to unobserved characteristics?

Most would agree that a teen birth would conflict with human capital investment, due to rising opportunity costs for young mothers. They will be faced with a choice of forgoing future earnings by investing in education, working to provide for their family, or becoming a full time mother. If a teenage mother does not have high future job expectations, they are unlikely to invest in education. Furthermore, if their expected average wage barely covers childcare costs, most are likely to opt out of labour force participation.

The British government is spending up to £70million in 2004/2005 to get conception rates down 50% by 2010, and to reduce the risk of long-term social exclusion by increasing the rate of participation in education, training or work (Teenage Pregnancy Unit). The government justifies its policies on the grounds that rates in the UK are the highest in Europe. However, some say the comparisons with Europe are inappropriate. For instance Sweden, which has one of the lowest birth rates, also has abortion rates that have been up to 3 times higher than the UK per 1000 births (Arai, 2003 cites Kane & Wellings, 1999). Teenage conception rates have also decreased over the last decade (Office of National Statistics).

This paper seeks to investigate the true impact of early motherhood on future living standards, by looking at wages at 33. Whilst most UK studies have found that there is a negative effect on wages, some American studies have found a positive effect.

As it is now generally believed that teenage girls who become pregnant would probably not have been high wage earners, it is unfair to compare teen mums against all other women. If, by allowing for endogeneity, the impact of a teenage birth is lower than previously expected, it is debatable as to whether the government should be focusing so much time and money to a phenomenon that may have an insignificant impact to future living standards. Furthermore, the government's policies to reduce early motherhood will have little effect and the perceived adverse outcomes may still arise. Therefore, it is important to understand the true consequence of early motherhood when designing policies.

Past literature on the impact of early motherhood on future living standards is discussed in the next section. Section 3 looks at the model development and Section 4 at the data source. The results are contained in Section 5 and there is further discussion in Section 6. Section 7 concludes the project. A complete description of the data can be found in the Appendix.

2. Literature review

My research has focused on papers that look at the impact on future earnings for teen mothers, whilst using a variety of models to account for endogeneity.

There is extensive literature indicating that teen births reduce schooling, adult work experience and wages. However, in the past most studies overestimated the impact, as endogeneity was not accounted for. In the US many authors have revisited papers to adjust the estimates, but few studies have been conducted in the UK. It is still unclear as to what extent these perceived adverse outcomes are due to the birth, and to what extent due to unobserved heterogeneity.

There are a variety of approaches to attempt to tackle endogeneity, however each approach has its limitations. Instrumental variables (IV) are a popular approach to overcome any possible bias posed by OLS estimates. The instrumental variable must be uncorrelated with the error term in the initial regression, and correlated to the endogenous explanatory variable.

Chevalier and Viitanen (2003) and Klepinger et al (1999) choose to use age of menarche as an instrument in the IV approach. The former paper concludes that teen births affect wages by up to 12% at 33, whilst the latter only finds insignificant negative effects at 25. Klepinger et al (1999) also concede that where data for wage was missing at 25, it was replaced by the observation at 26. This clearly biases the results.

Chevalier and Viitanen (2003) acknowledge in a footnote that age of menarche is mostly determined by nutrition, thus differences in diet between rich and poor children could lead to a correlation between age of menarche and schooling attainment.

Other studies have contributed to this belief that children who are obese tend to enter puberty earlier, and low socioeconomic status groups in developed countries are at higher risk of obesity, particularly adolescents aged 12-17 (Wang, 2001). The authors may have underestimated the endogeneity of age of menarche, and perhaps a more suitable instrument could have been used.

Hotz et al (1997) use miscarriage as their instrument. They adapted the results from Horowitz and Manski (1995) on identification within data from a contaminated sample, to construct bounds on the casual effect of a teen birth on future wages. Miscarriage is regarded as a ‘contaminated’ variable because studies have shown that it can be random or non-random. Non-random miscarriages occur from heavy drinking, smoking and physical abuse (Klein et al, 1989), which are characteristics that could be correlated with wages. Therefore, miscarriage is an appropriate instrument for the random miscarriages only.

Hotz et al (1997) use the Horowitz and Manski bounds (1995) to calculate that a teenage birth before 18 increases wages by $4565-$6043 per year. Using OLS, the effect is negative, but not significant. Instrumental variables compute a positive

effect of $4147 per year, which is below the bounds. They conclude the instrumental variables are quite robust and OLS is simply not effective. The results indicate that having a teenage pregnancy actually increases women's earnings later in life, perhaps because they are more motivated to work.

Hotz et al (1999) conduct a similar experiment, again using miscarriages. Using OLS, early motherhood significantly reduces wages by $2.28, although by using the IV approach, wages are significantly increased by $4.22. The latter result is again outside of the bounds found in Hotz et al (1997). It is also a slightly larger increase. This may be because the wages were calculated a year later, at 28, in the most recent paper.

Ermisch and Pevalin (2003) also adapted the Horowitz and Manski (1995) bounds using miscarriages on the British Cohort Survey. They found there to be an insignificant effect at age 30 on wages, which may illustrate the success of recent government policies to return young mothers into education. They also calculated a confidence interval for the impact to be between –0.17 and 0.34 for the instrument. This is highly inconclusive, as it indicates an early birth can either increase or decrease wages at 30.

Natural experiments are also used to account for family background heterogeneity. However, they are usually based on rare occurrences, which can severely restrict the sample size.

Bronars and Grogger (1994) use the twins-first approach, by comparing mothers who had twins and mothers who had singletons. They find a significant decrease in family earnings for black women only who give birth before 18. However, the experiment is restricted to comparing two children to one, and is only appropriate if the socioeconomic outcomes of having twins are exactly twice the impact of having one birth. If there are economies of scale the experiment cannot be extended to estimate the marginal impact of one birth to no births.

Geronimus and Korenman (1992) used three data sets: NLSYW[1], PSID[2] and NLSY[3], to compare sisters who started parenthood at different ages. Results varied depending on the data set. The PSID results showed no evidence of family background heterogeneity. The NLSYW found an insignificant negative effect, but the authors concluded that the sample may have been non-representative, as women who left home were not included. The NLSY found a significant negative effect of 27%. The authors were unable to conclude why the PSID and NLSY differed significantly. This suggests that it is difficult to compare data sets even within the same country, and so for conclusive results tests should be carried out on more than one data set.

[1] National Longitudinal Survey of Labour Market Experience, Young Women's Cohort
[2] National Longitudinal Survey of Labour Market Experience of Youth
[3] Panel Study of Income Dynamics

Siblings can also vary in endowments. For instance, parents tend to get richer as they get older and younger siblings may have a higher standard of living. In addition, parents may redistribute their resources in an attempt to equalise their children's endowments or to set an example to younger siblings. Siblings' endowments may also differ in academic potential, and so the results may still be biased upwards.

There is conflicting literature on actual impact of early motherhood on living standards, partly due to the different approaches adopted and the complexities of endogeneity. Natural experiments tend to only find suggestive results, as unobserved heterogeneity is never completely accounted for. However, studies that use instrumental variables have found positive and negative effects, and so are also inconclusive. If a suitable instrumental variable can be found, IV experiments seem to be more robust. I will attempt to find the real impact of teenage births on future wages, using miscarriages as an instrumental variable.

3. Model Development

It is assumed that a young woman will decide on whether to continue with a pregnancy by weighing up the costs and benefits. If the expected utility of having a child and social transfers associated with motherhood, such as happiness, outweigh

the associated costs of a child and the earnings forgone by having a child, they will choose to continue their pregnancy.

The model for teenage motherhood will be estimated using a Probit model based on personal, background and economic characteristics (X_i). I will use miscarriage as an instrumental variable (Z_i) in estimating whether a woman experiences early motherhood (T) or delays motherhood. A miscarriage is expected to delay the chance of giving birth during the teen years and is a fairly random occurrence. The error term (ε_i) estimates the unobservable characteristics.

$$T_i = \beta X_i + \gamma Z_i + \varepsilon_i \quad (1)$$

The observed outcome- a teen pregnancy or not can be modelled by

$T_i = 1$ if $T^* > 0$

$T_i = 0$ if $T^* < 0$

We can then estimate the effect on wages by running a wage equation. Y_i are the set of characteristics affecting wages such as background, region, job sector, labour market experience and education and u_i is the error term.

$$W_i = \beta Y_i + \delta T_i + u_i \quad (2)$$

We only observe wages for those who choose to join the labour force; when the net returns to working are above some threshold W*:

$$W_i = \beta Y_i + T_i + u_i \quad \text{if} \quad W^* > 0 \quad \text{and} \quad (3)$$

$W_i = 0$ if $W^* < 0$

Ideally we would like to calculate the difference between wages at 33 if the female experienced early motherhood and if they had postponed motherhood. This is widely known as the effect of the treatment on the treated. The treatment is entering motherhood early. The following equation shows the expected wages at 33 of a woman who postponed childbearing (W_0) subtracted from a woman who had a teen birth (W_1).

$$E(W_1 - W_0 \mid T=1) = E(W_1 \mid T=1) - E(W_0 \mid T=1) \quad (4)$$

Unfortunately we are unable to observe what the wages would have been had they postponed birth. We cannot use other women's observations because those who became pregnant in the first case may have particular characteristics, such as not being career orientated.

We overcome this by using miscarriage as an instrumental variable. An instrumental variable essentially breaks the correlation between teenage birth and the error term. We use the treatment model to compute the predicted probabilities of becoming a teen mother and are then able to input these into the wage equation.

The treatment model is estimated in two stages. First, it estimates using a Probit model the reduced form equation for a teenage birth.

$$T_i = \beta X_i + \gamma Z_i + \varepsilon_i \quad (1)$$

Then the predicted values are substituted into equation (2), the wage equation.

$$W_i = \beta X_i + \gamma \hat{T}_i + u_i \quad (5)$$

where: $\varepsilon_i \sim N(0, sigma)$

$u_i \sim N(0, 1)$

$corr(\varepsilon_i, u_i) = \rho$

From this we are able to interpret the effect of a teen birth on wages at 33, by looking at δ the coefficient of a teen birth.

Miscarriage as an instrument

There are several limitations to using miscarriages as an instrument. Firstly, they are greatly under-reported. The woman may not even know she experienced one. There is also an incentive for young women to conceal a miscarriage. If there is a lot of misreporting, the sample may not be representative. For instance, if misreporting is highest among those where the pregnancy was an unfortunate error and the woman went on to do very well, then the sample that acknowledged the pregnancy would be more disadvantaged than the rest of the general female population.

Miscarriages are random and non-random events, as discussed in the literature review. Although it is classed as a contaminated instrument, it is still effective for random miscarriages.

4. Data analysis

The National Child Development Study (NCDS) is a continuing, multi-disciplinary longitudinal study which follows the lives of all those living in Great Britain by age 16 who were born between 3rd and 9th March 1958. To date, there have been 6 sweeps since they were born at ages 7, 11, 16, 23, 33, and 41. I have used data mainly from the fifth sweep at age 33, although some variables have been extracted from earlier sweeps.

In the fifth sweep there were 11,407 cohort members. In order to assess the representation of cohort members, the distribution in terms of a range of characteristics was compared to earlier surveys (Ferrai, 1993). It was found there was only a marked difference for the ethnic minority groups. However, they also suggest an under representation for low-achievement groups (for example, low test scores at 11); those with low aspirations (for example those who did not intend to stay on at school), and those with origins in the lower social classes. It is therefore possible that our data set may be slightly affected by attrition.

A complete list of variable definitions can be found in the Appendix. Most variables were extracted straight from the data set, although several were adjusted. Teen pregnancies were only counted for ages 13-19. All observations that suggested the year of first birth being before 1969 were dropped. 27 observations for a birth were re-coded as missing because the year of birth was not identified. Two observations where hourly pay exceeded £1000 were dropped, as were those which were

calculated to be between £0 and £1 an hour (27 observations). Log wage was calculated for all women who were working, so as to ease interpretation of the results.

Within the study, there are 5,766 women who have provided information on their fertility history, of which 4,340 became mothers. In this sample, 749 women became pregnant before 20, 6.2% became pregnant before 18 and 11% became pregnant at ages 18-19.

Table 1 shows the outcomes of their first pregnancy. The percentages are within each age group.

Table 1: Outcomes of their first pregnancy

	Age First Pregnancy: 13-17	**Age First Pregnancy: 18-19**	**Age First Pregnancy: 20-33**
Birth	**202**	**411**	**3,192**
	68.9%	83.7%	85.3%
Abortion	**76**	**33**	**174**
	25.9%	6.7%	4.6%
Miscarriage	**15**	**47**	**383**
	5.1%	9.6%	10.2%
Total	**293**	**491**	**3,750**

It illustrates clearly expected patterns in the data. As women grow older, they are more likely to continue a pregnancy. Abortion rates decrease by more than 82% from the youngest childbearing group to the oldest. The rate of miscarriages double between the youngest and oldest groups.

Table 2 shows the percentages of women that smoked during their first pregnancy.

Table 2: Smoking during first pregnancy

	Age First Pregnancy: 13-17	**Age First Pregnancy: 18-19**	**Age First Pregnancy: 20-33**
Smoked during 1st pregnancy	**141**	**274**	**1,305**
	61.0%	60.5%	36.5%
Total	**231**	**451**	**3,575**

Although smoking is known to have a positive affect with miscarriages, simple comparisons show a negative effect. This is probably due to smoking being offset by the rate of miscarriage increasing with age, and the relatively small sample size. This simple analysis suggests that our results may not be greatly affected by non-random miscarriages, although it is impossible to say for certain.

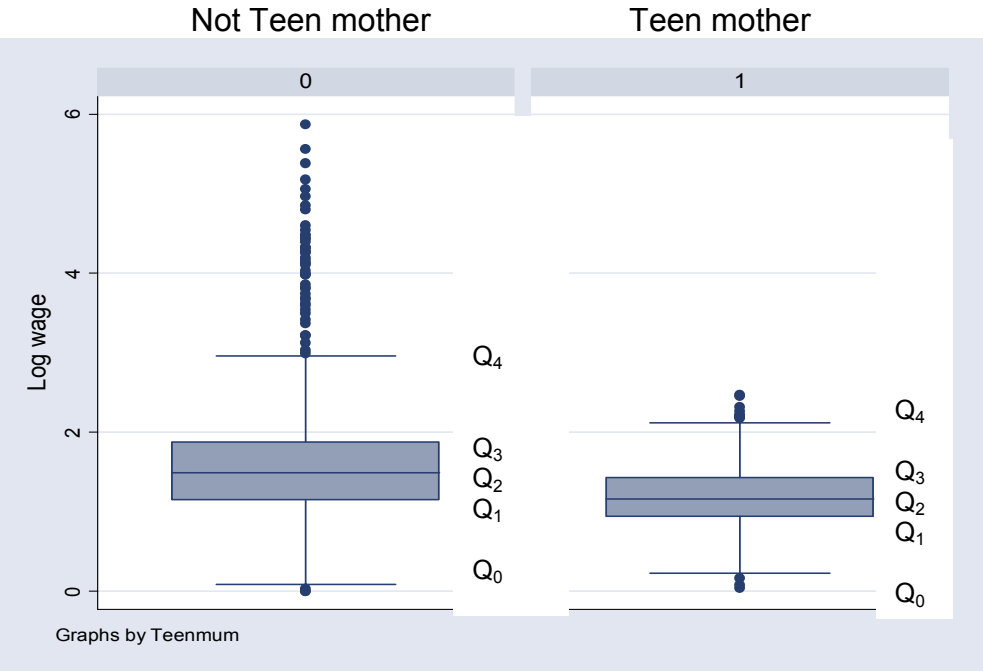
Our sample is reduced from 5,666 mothers who provided information on their fertility history, to 1,293 mothers (9% being teenage mothers), who also provided complete information on their family and earnings history.

As perceived adverse outcomes are consequences of teenage births, the sample was divided into two groups - women who gave birth before they were 20 (118 women) and those who delayed there motherhood until at least 20 (1,175 women).

This gives us a teenage birth rate of 91 births per 1000 women; almost 3 times the national average for 15-19 year olds in 1976, when the women would have been 18 (National Office of Statistics). Our sample is over representative because the teenage birth rate is calculated against mothers, whereas the national data is for all women.

Figure 2 is a box plot that clearly illustrates the range of wages for all women. Not only do teenage mothers have a lower average hourly wage, but also the range of wages is a lot smaller for those who experienced early motherhood. The box plot indicates that experiencing early motherhood potentially inhibits very high wages at 33.

Figure 2: a box plot of log wage against whether the woman experienced early motherhood or not. The box on the left represents women who delayed childbearing past their teenage years, and the box on the right represents those who did not.



Key

Q_4 : Q_3 +1.5(Inter-quartile range)

Q_3 : Upper bound of the Inter-quartile range

Q_2 : Median

Q_1 : Lower bound of the Inter-quartile range

Q_0 : Q_1 - 1.5(Inter-quartile range)

The dots are the more extreme values out of the bounds set by (**Q_0 Q_4**).

Table 3 reports certain outcomes as percentages within the age group. It is clear that early childbearing increases the chances of working at 33. The lower percentage for the mothers aged 20-33 could reflect the later childbearing age and many mothers staying at home to look after young children. However, it is interesting that for those working at 33, women who delay childbearing are only slightly more likely to be working full time.

Delaying childbearing to 18-19 increases wages by almost 12% and delaying childbearing from under 18 to over 20 increases average hourly wage by 64%. Labour market experience is highest for those who give birth the earliest. It is generally believed that most teenage mothers come from low-income backgrounds and so may have to enter the job market earlier in life.

The maths and reading test scores at 11 indicate that those who gave birth aged 18-19 generally performed worse at their early tests than those who experienced very early childbearing. However, due to the relatively small sample size, the evidence is not conclusive. These results do follow through to highest qualification at 33.

Very young mothers are more likely to go on to achieve a high vocational course or degree than those in the middle group. Those who give birth under 18, as oppose to 18-19, are actually 5 times more likely to achieve a high vocational course by 33.

Table 3: Summaries

	Age First Birth: up to 18	Age First Birth: 18-19	Age First Birth: 20-33
Work			
Working at 33	83.8%	84.0%	76.9%
Working full time	91.9%	91.1%	94.8%
Average hourly wage at 33	£3.54	£3.96	£5.82
15 or more years labour market experience	94.6%	92.6%	83.1%
Education			
Maths Test: scored above average	40.5%	29.6%	56.6%
Reading Test: scored above average	51.4%	43.2%	64.4%
Highest qualification at 33:			
Degree level or higher	2.7%	1.2%	12.0%
Vocational High	13.5%	2.5%	9.5%
Vocational Medium	18.9%	29.6%	41.7%
A Levels	0.0%	1.2%	4.9%
CSE/O level	64.9%	66.7%	33.7%
Firm Size			
Size of firm: 0-25 employees	43.3%	40.7%	38.7%

Size of firm: 26-99 employees	24.3%	23.5%	21.6%
Size of firm: 100-499 employees	21.6%	28.4%	20.2%
Size of firm: 500+ employees	10.8%	7.4%	19.5%
General			
Lived with parents at 16	97%	97.30%	98.10%
Ever been a lone parent by 33	56.8%	45.0%	17.8%

However, those who do experience motherhood before 20 are twice as likely to only achieve CSE/O level by 33. Women who experience early motherhood are less likely to be working in very large firms at 33.

Almost all teenagers in the sample lived with both parents at 16. Divorce rates were much lower in 1976 than currently (Office of National Statistics) and using a more recent data set could show different trends. The data clearly indicates that lone parenthood is more common the younger a woman begins motherhood. However, a younger childbearing age increases the potential time a mother could be exposed to lone motherhood, as oppose to a woman giving birth at 30.

Simple comparisons suggest that women who delay childbearing past 20 are more likely to gain better qualifications and receive higher wages. Although young mothers have higher labour market experience, this is offset by their lower qualifications. However, these results do not account for the unobserved

heterogeneity between the individuals. Women who experience early motherhood achieved lower results in their tests at 11 and so it is possible that even without a child, they would still not achieve the wages of the oldest group.

Testing the validity of miscarriage

For miscarriage to be a valid instrument it should be omitted from and exogenous to the wage equation, but it must have some partial correlation with whether or not a woman becomes a teenage mother. Two conditions must also be fulfilled regarding the instrument relevance and exogeneity. Although we cannot test that miscarriage is uncorrelated with the errors in the wage equation, we are able to test the relevance of the instrument.

Firstly, by regressing teenage birth on miscarriage and other background variables, we can measure the information content contained the instrument by computing the F statistic. The null hypothesis is that the coefficient on miscarriage is zero. The F-statistic is 91.17, indicating that miscarriage is a strong instrument. The results are shown in table 4.

It is also useful to check whether the addition of the instrument to the reduced form equation improves the partial R^2. By adding miscarriage, the partial R^2 increases by 0.0627. This reinforces the result that miscarriage is indeed a valid instrument to use.

Table 4: OLS estimates for teen birth or not

Dependent variable: Teenage birth

Variable	Coefficient	Standard Error
Miscarriage	0.655	0.069**
Mum interest in schooling	-0.0611	0.023**
Dad interest in schooling	-0.0271	0.017
Dad stayed at school After Minimum Age	-0.0217	0.020
Mother was a member of a library	-0.0246	0.016
Mother was a Teen parent	0.0273	0.035
Housing: Owned	-0.00755	0.017
Housing: Free Rent	0.102	0.049*
Father: Social Class 1 or 2	-0.0328	0.022
Father: Social Class 3	0.00405	0.017
Child is eldest	-0.00552	0.016
Finance problems	0.112	0.035**
Family problems	0.0566	0.050
Above average score in reading test at 11	-0.00306	0.018
Above average score in maths test at 11	-0.0429	0.018*
Constant	0.191	0.023**

* significant at 5% level **highly significant at 1% level

Number of observations: 1293

R^2 =0.1217

Test for relevance

H_o: Coefficient of miscarriage=0

F (1, 1277) = 91.17

Prob > F = 0.0000

The coefficient on miscarriage is highly significant and positive. This is because the miscarriage variable is used to delay the age of birth. Ermisch et al (2000) defined the variable to delay the birth past the teen years and so find a negative relationship. In my sample, teenagers who experience a miscarriage are 65% more likely to have another birth before 20. Due to the definition of my variable this seems plausible, as a young woman who becomes pregnant at a young age is probably quite likely to fall pregnant again, soon after having a miscarriage, due to her particular characteristics. This is still relatively high coefficient, possibly because of a small sample.

5. Results

Log average hourly wage is calculated at age 33. The sample includes 1,293 mothers for whom we have complete information on earnings, background and fertility history. From this sample 118 experienced early childhood.

As a benchmark, least squares regression was calculated for the log hourly wage. However, OLS is only unbiased if a teen birth is completely exogenous. The main determinants are labour market experience, highest qualification at 33, the size and type of the firm and some background characteristics. Table 5 illustrates the results.

Some variables were excluded from the regression and subsequent models as they had little impact on wages. Omitted variables include region dummy variables, except for London and the south-east, and type of school. OLS estimates indicate that a teenage pregnancy has no significant effect on log hourly wage. The coefficient is negative as expected.

Labour market experience has an insignificant negative effect on wages at 33, whereas the square has a positive effect. This could be because there are two processes at work. Labour market experience tends to increase wages, however it is offset by the fact it usually means a woman has chosen to work over education. Therefore, they are likely to have lower qualifications. It may also be correlated with working at 23, which is highly significant and increases wages by 17%. If a woman is working at 23 they are more likely to have more work experience than someone who was not.

The lowest qualification-CSE/ O' level is used as the base variable for education.[4] All variables capturing qualifications are significant except for A' Levels. As expected, wages increase the higher the qualification. Having a degree increases wages by 54% compared to CSEs (allowing for log approximation). By achieving more than average on a maths test at 11, women will see their wage increase by about 12.5%.

[4] A variable for no qualification was generated, however only 2 people were in this category and so it was dropped.

Table 5: OLS results for regressing log wage

Dependent variable: log hourly wage

Variable	Coefficient	Standard Error
Teen motherhood	-0.048	0.047
Labour market experience (years)	-0.018	0.034
Labour market experience2 (years)	0.001	0.001
Degree level or higher	0.433	0.058**
Vocational: High	0.167	0.050**
Vocational: Medium	0.086	0.031**
A Levels	0.104	0.067
Private firm	-0.081	0.028**
Working at 23	0.170	0.030**
Size of firm: 0-25 employees	-0.312	0.037**
Size of firm: 26-99 employees	-0.177	0.041**
Size of firm: 100-499 employees	-0.163	0.042**
Father: Social Class 1 or 2	0.082	0.036*
Father: Social Class 3	0.005	0.029
Above average score in reading test at 11	0.042	0.031
Above average score in maths test at 11	0.125	0.031**
South East	0.118	0.035**
London	0.220	0.070**
Married	-0.147	0.034**
Separated	-0.127	0.051*
Constant	1.666	0.222**

* significant at 5% level **highly significant at 1% level

Number of observations = 1293 $R^2 = 0.2778$

Working in a public sector increases the wage by 8%; this may be due to union status for women. The size of the firm is also significant. Firms with 500 workers or more is used as the base variable. Firms of this size increase wage by about 27%, compared to firms with up to 25 workers (allowing for log approximation). This is expected, larger firms are likely to have better career prospects and so higher wages. Living in London or the south-east increases wages by about 25% and 13% respectively. This is as expected due to higher living costs.

Having a father is in Social Class 1 or 2 at 16 also increases wages. This could be linked to better schooling or higher job prospects. Finally, being married or separated decreases income by around 12%, perhaps due to women starting a family and possibly lower career prospects.

The least squared estimates are biased upwards due to selection in employment and selection as to whether to have a child as a teenager. This paper will not look into selection into the labour force, however by using the Treatment model we can account for the decision to become a teenage mum. The main determinants are schooling, background characteristics, finance and family problems and miscarriage.

The treatment model first estimates a Probit model on whether there is a teenage birth or not. Table 6 illustrates the marginal effects.

Table 6: Treatment model for Teenage birth (Marginal Effects)

Dependent variable: Teenage motherhood

Variable	Coefficient	Standard Error
Miscarriage	0.670	0.117**
Mum interest in schooling	-0.038	0.023
Dad interest in schooling	-0.028	0.015
Dad stayed at school After Minimum Age	-0.028	0.017
Mother was a member of a library	-0.023	0.015
Mother was a Teen parent	0.031	0.035
Housing: Owned	-0.008	0.016
Housing: Free Rent	0.117	0.070*
Father: Social Class 1 or 2	-0.044	0.017*
Father: Social Class 3	0.002	0.014
Child is eldest	-0.007	0.015
Finance problems	0.079	0.042*
Family problems	0.044	0.053
Above average score in reading test at 11	0.000	0.016
Above average score in maths test at 11	-0.041	0.016**

* significant at 5% level **highly significant at 1% level

Number of observations = 1293

Log likelihood = -335.87

A miscarriage is estimated to increase teenage conception by 67%, and is highly significant. If the teenager lives in a home where the rent is free at 16 or has financial problems in the home at 16, they are more likely to experience early motherhood. If their father is in the highest two social classes, they significantly less likely to give birth. It is widely believed that teenage mothers come from low-income backgrounds, and my results re-iterate this phenomenon.

We use the treatment model to control for the decision to become a teenage mother. Table 7 shows the results of the treatment model and OLS estimates. All the results are almost identical except for teenage motherhood.

Early motherhood now predicts a 24.5% decrease in wages (adjusting for log approximation) and is highly significant whereas the OLS result is not significant. The OLS provides an average result for all women, which is why it is likely to be lower. However, the IV estimate measures the marginal effect of a teen birth on those women where miscarriages are an important factor in determining whether they have a birth or not.

As we only observe women who enter the labour market, there is likely to be an upward bias in the results. Women may be more likely to enter the labour market if they have high earnings potential and so the results may be a slightly pessimistic view.

Table 7: Treatment and OLS results for log wage

Dependent variable: Log hourly wage

Variable	OLS results		Treatment Model	
	Coefficient	Standard Error	Coefficient	Standard Error
Teen motherhood	-0.048	0.047	-0.281	0.083**
Labour market experience (years)	-0.018	0.034	-0.020	0.034
Labour market experience^2 (years)	0.001	0.001	0.001	0.001
Degree level or higher	0.433	0.058**	0.427	0.058**
Vocational: High	0.167	0.050**	0.162	0.049**
Vocational: Medium	0.086	0.031**	0.081	0.031**
A Levels	0.104	0.067	0.101	0.067
Private firm	-0.081	0.028**	-0.083	0.028**
Working at 23	0.170	0.030**	0.168	0.030**
Size of firm: 0-25 employees	-0.312	0.037**	-0.315	0.037**
Size of firm: 26-99 employees	-0.177	0.041**	-0.179	0.041**
Size of firm: 100-499 employees	-0.163	0.042**	-0.164	0.042**
Father: Social Class 1 or 2	0.082	0.036*	0.067	0.037
Father: Social Class 3	0.005	0.029	0.004	0.029
Above average score in reading test at 11	0.042	0.031	0.037	0.031
Above average score in maths test at 11	0.125	0.031**	0.114	0.031**
South East	0.118	0.035**	0.124	0.035**
London	0.220	0.070**	0.218	0.070**
Married	-0.147	0.034**	-0.144	0.034**
Separated	-0.127	0.051*	-0.126	0.050*
Constant	1.666	0.222**	1.720	0.220**

* significant at 5% level **highly significant at 1% level

Number of observations (for both models) = 1293

R^2 (for OLS model) = 0.2778

Log likelihood (for Treatment model) = -1149.97

Using miscarriages as an instrument did restrict the sample size, which potentially alters the results. However, the sample size is 1,293, which is a reasonable amount of observations.

It is possible that there is also some attrition in the data for those who were forced to leave home after becoming pregnant as a teenager. If they could not be contacted at age 33, then they are lost from the data set. Unfortunately, as fertility questions were only asked at age 33, and there is not a suitable variable determining why women first left home, we are unable to estimate how many young women this may have affected. However, information from Shelter suggests that between 2% and 14% of those presenting themselves as homeless are teenage mothers. As we have focused on mothers who work, and only a proportion of this figure will be working, we can assume that our sample is not significantly biased.

Potentially, some cohort members may have an incentive to distort the truth, in relation to earnings and fertility history. This ties in with under reporting of miscarriages, especially at a young age. Women potentially could understate or overstate their wages, as they know they are part of a study. It is possible there is a Hawthorne effect, although this is less likely as the experiment is not short term, as it is running throughout their life.

As the estimate has such a large effect on wages, we shall perform sensitivity analysis on the data for different ages of teen birth. The treatment model was re-

estimated using Teen motherhood and miscarriages as variables focusing on the years up to age 18 and 18-19.

The results are shown in Table 8. Again, it is interesting to note that all coefficients are almost identical to Table 7, except for the coefficient on teenage motherhood. For pregnancies up to age 18 miscarriage was still a significant instrument but there is less precision in the estimates, and for ages 18-19 it was a highly significant instrument (not shown here). We find that have a teenage birth before 18 reduces wage at 33 by 27% and a birth at 18-19 by 22% (adjusted for log approximation). These results seem plausible, a very young birth will have substantial effects on wages at 33 because it will have interfered with schooling. However, a baby at 18-19 may come at a time when the teenager has decided to finish education, or has at least achieved several qualifications.

Table 8: Treatment results for log wage grouping age of first birth to under 18 and between 18-19

Variable	Age of mother at birth: under 18		Age of mother at birth: 18 - 19	
	Coefficient	Standard Error	Coefficient	Standard Error
Teen motherhood before 18	-0.313	0.140*	-0.252	0.094**
Labour market experience (years)	-0.018	0.034	-0.019	0.034
Labour market experience^2 (years)	0.001	0.001	0.001	0.001
Degree level or higher	0.434	0.057**	0.432	0.058**
Vocational: High	0.171	0.049**	0.165	0.050**
Vocational: Medium	0.855	0.031**	0.084	0.031**
A Levels	0.104	0.066	0.105	0.066
Private firm	-0.081	0.028**	-0.083	0.028**
Working at 23	0.171	0.03**	0.173	0.030**
Size of firm: 0-25 employees	-0.312	0.037**	-0.315	0.037**
Size of firm: 26-99 employees	-0.178	0.041**	-0.180	0.041**
Size of firm: 100-499 employees	-0.165	0.041**	-0.166	0.042**
Father: Social Class 1 or 2	0.081	0.036*	0.071	0.037
Father: Social Class 3	0.009	0.029	0.001	0.029
Above average score in reading test at 11	0.042	0.031	0.038	0.031
Above average score in maths test at 11	0.124	0.030**	0.117	0.031**
South East	0.118	0.034**	0.123	0.035**
London	0.220	0.069**	0.219	0.070**
Married	-0.147	0.034**	-0.146	0.034**
Separated	-0.129	0.050*	-0.130	0.05**
Constant	1.670	0.220**	1.700	0.22**

significant at 5% level **highly significant at 1% level

Log likelihood for under 18 = -969.24746 Log likelihood for 18-19= -1063.4943

6. Discussion

Miscarriage was an effective and valid instrument in this study. However, it is assumed that there are no long-term effects on wages. If there are effects on schooling or psychological well being and on subsequent outcomes, then the experiment may underestimate the true effects.

A larger sample size would also make it possible to investigate whether a miscarriage that delayed a woman's first birth longer, fared better than those where the delay was quite short.

My results differ significantly from other studies. Hotz et al (1997 and 1999) found a positive effect on wages. The obvious difference between the two studies was that it was American. However, the data set used (NLSY, 1979) is set at a time similar to mine. The difference in results could be due to country specific characteristics, which effect the data. For instance, if the welfare system is more sympathetic to young mothers in the UK, they may be more likely to spend time out of the labour force. Consequently, they build up less work experience and may not achieve as high wages.

Hotz et al (1997) calculated the effect on wages using an IV approach to be a pessimistic view compared to the Horowitz and Manski (1995) bounds calculated. Further work calculating the bounds on the NCDS data may provide more precise results, and it would be interesting to see if again, the IV provides a pessimistic view.

Ermisch and Pevalin (2003) found little effect on wages. This is likely to be due to a more recent data set. However, their paper did not produce conclusive results, possibly due to their miscarriage definition restricting their data set.

Chevalier and Viitanen (2003) use the same data set and find up to 12% decrease on wages. Our OLS results are identical which suggests that our instruments provide the variation (they used age of menarche). Miscarriage was proven to be a suitable instrument, although it did reduce the sample size. If the instruments are equally good, then the results should in theory be identical. It would be useful to compute a test for over-identification with the two instruments, to help determine which is more precise.

The other possibility for variation is that Chevalier and Viitanen (2003) also accounted for double selection into the labour market. This study only focused on self-selection by becoming a teen mother and so the results will be biased upwards. The bias will be largest if the decision to participate in the labour market is linked to higher potential earnings. In my opinion, this seems to be the cause for most of the variation. Lower qualifications may deter some mothers from working, as they will receive a low wage. Therefore, my estimates may have provided a pessimistic view of the wage gap. Further work investigating selection into the labour force may show that our results are extremely similar.

Finally, it must be noted that there are more recent studies than the NCDS that could be looked at, the most obvious being the BCS. The Labour government has introduced the New Deal, which focuses on getting young mothers back into employment. Studying women affected by this may provide different results yet again.

7. Conclusion

Using least squares we found teen motherhood to have no effect on hourly wages at 33. The Treatment model, which took into account endogeneity between teen motherhood and wages, found that early motherhood decreases wages at 33 by up to 25%. When the age of first birth is taken into consideration, the decrease drops to 22% for those who give birth aged 18-19, and increases to a total negative effect of up to 27% for those under 18.

My results conclude that teenage motherhood negatively affects wages by age 33. However, the impact is higher than estimates in other literature. The results may be biased due to selection into the labour force, and it is likely that my results overstate the actual impact.

This paper has shown that a teen birth negatively affects wages at 33 by up to 25%. Although women who give birth before 18 have a larger decrease in wages, the

difference between age groups is not great enough for the government to focus entirely on conception before 18. All young mothers will experience lower wages than they would have if they had delayed childbearing. This will in turn have inter-generational effects on their offspring. Any policies by the government that help prevent early conception will therefore increase future living standards. The estimates indicate that education and the size of the firm greatly affect wages at 33, and so policies should focus on getting young mothers back into education to achieve their potential schooling and perhaps encouraging large firms to take on mothers, as well as reducing conception rates.

Appendix

Table A1: Variable names for Wage equation

Variable	Number of total observations	Range	Definition
Pay	1293	£1-£178	Gross hourly wage (gross weekly wage divided by hours worked in a week).[5]
Log Wage	1293	£0-£6	Log (gross hourly wage) for pay>0
Teen motherhood	1293	1	If ever had a child whilst a teenager (up to 20)
		0	Otherwise
Teen motherhood before 18	1293	1	If they had a child before 18
		0	Otherwise
Teen motherhood at 18-19	1293	1	If they had a child aged 18-19
		0	Otherwise
Labour market experience (years)	1293	0-19	Labour market experience (years since first job)
Labour market experience^2 (years)	1293	0-361	Labour market experience squared

[5] Two observations were re-coded as missing as they were more than £1000. 27 observations were re-coded as missing as the hourly pay was between £0 and £1.

Education: highest qualification at 33, taken from highest qualification at 23 and qualifications taken since

Degree level or higher	1293	1	University qualification: (University/CNAA diploma/certificate, 1st degree or PG diploma, higher degree- MSC/PhD)
		0	Otherwise
Vocational: High	1293	1	Tech/Business Qualifications: (ONC/OND, HNC/HND, TEC/BEC/etc Certificate/Diploma, TEC/etc Higher Certificate, other tech/business qualification)
		0	Otherwise
Vocational: Medium	1293	1	Professional qualifications: (RSA stage 1-3, C&G-any, JIB-craft/tech, Professional (or part of) qualification, nursing qualification, Poly dip/cert)
		0	Otherwise
A Levels	1293	1	A' Level and equivalent Scottish Standard or Higher grades
		0	Otherwise
GCSE Level	1293	1	GCSE level: (CSE grade1-5, O'Level, O grade passes and GCSE

			passes)
		0	Otherwise
No Qualification	1293	1	CM has no qualifications
		0	Otherwise
Private firm	1293	1	CM was working in a private firm at 33
		0	CM was working in a public firm at 33
Working at 23	1293	1	CM was working at 23
		0	CM was not
Size of firm: 0-25 employees	1293	1	There were up to 25 employees in their current workplace (at 33)
		0	Otherwise
Size of firm: 26-99 employees	1293	1	There were between 26-99 employees in their current workplace (at 33)
		0	Otherwise
Size of firm: 100-499 employees	1293	1	There were between 100-499 employees in their current workplace (at 33)
		0	Otherwise
Size of firm: 500+ employees	1293	1	There are more than 500 workers in their current workplace

		0	Otherwise
Father: Social Class 1 or 2	1293	1	Social class of father or male head at 16:1-2
		0	Not 1-2
Father: Social Class 3	1293	1	Social class of father or male head at 16:3
		0	Not 3
Father: Social Class 4	1293	1	Social class of father or male head at 16:4-5
		0	Not 4-5
Above average score in reading test at 11	1293	1	If the child scored more than the average mark in a comprehension test at age 11
		0	If the child scored below the average mark
Above average score in maths test at 11	1293	1	If the child scored more than the average mark in a maths test at age 11
		0	If the child scored below the average mark
South East	1293	1	CM lived in the South East at 33
		0	Otherwise
London	1293	1	CM lived in London at 33

		0	Otherwise
Married	1293	1	If they are married at 33
		0	Otherwise
Separated	1293	1	If they are separated or divorced at 33
		0	Otherwise

Table A2: Variable names for estimating early motherhood

Variable	**Number of total observations**	**Range**	**Definition**
Miscarriage	1293	1	If they had a miscarriage in their teen years
		0	Otherwise
Miscarriage before 18	1293	1	If they had a miscarriage before 18
		0	Otherwise
Miscarriage at 18-19	1293	1	If they had a miscarriage aged 18-19
		0	Otherwise
Mum interest in schooling	1293	1	If mum had any interest in child's schooling at 16
		0	If they cannot say or they have little interest

Dad interest in schooling	1293	1	If dad had any interest in child's schooling at 16
		0	If they cannot say or they have little interest
Dad stayed at school After Minimum Age	1293	1	CM's father stayed in school after the minimum age
		0	No / Don't Know
Mother was a member of a library	1293	1	CM's mum belongs to a library
		0	If she does not or replied otherwise
Mother was a Teen parent	1293	1	If their mother was younger than 20 at birth
		0	If they were 20 or over
Housing: Owned	1293	1	If they the accommodation they lived in was their own
		0	If it was not
Housing: Free Rent	1293	1	If the accommodation was rent free
		0	If it was not
Father: Social Class 1 or 2	1293	1	Social class of father or male head at 16:1-2
		0	Not 1-2
Father: Social Class 3	1293	1	Social class of father or male head at 16:3

		0	Not 3
Father: Social Class 4	1293	1	Social class of father or male head at 16:4-5
		0	Not 4-5
Child is eldest	1293	1	If the CM was the oldest child in the family at 7
		0	If the CM was not, or they did not live in a private home
Finance problems	1293	1	Financial Trouble at 16 in last year: yes
		0	No / uncertain / don't know / other replies
Family problems	1293	1	If the parents experienced some difficulties in the past year (separation/divorce) at age 16
		0	If they had not
Above average score in reading test at 11	1293	1	If the child scored more than the average mark in a comprehension test at age 11
		0	If the child scored below the average mark
Above average score in maths test at 11	1293	1	If the child scored more than the average mark in a maths test at age

			11
		0	If the child scored below the average mark

Table A3: Variable names for data analysis

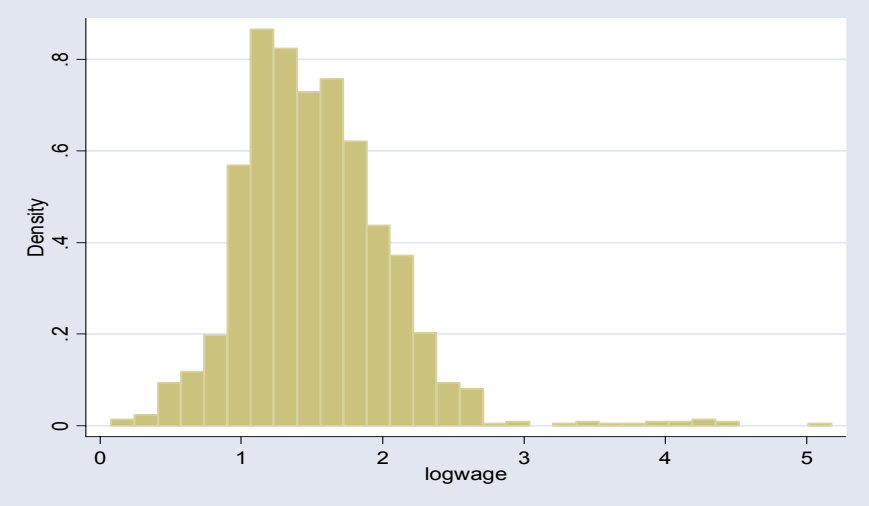
Variable	Number of total observations	Range	Definition
Birth	1293	1	If CM had at least one live child in first 3 pregnancies
		0	Otherwise
Abortion	300	1	If they had at an abortion in their first pregnancy
Smoked during 1st pregnancy	4,257	1	Smoked in 12 months prior to first birth
		0	Otherwise
Lived with parents at 16	1218	1	Lived with both parents at 16. Taken from variables concerning if the child is away from their own or adoptive mum or dad at 16.
		0	Otherwise
Working at 33	1292	1	Working at 33
		0	Otherwise

Full time	1292	1	Working full time at 33
		0	Otherwise
Ever been a lone parent by 33	954	1	They have been a lone parent for one month or more
		0	Otherwise

Table A4: Summary Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Pay	5.638	7.795	1.083	177.143
Log Wage	1.521	0.536	0.080	5.177
Labour market experience (years)	15.698	2.102	0	19
Labour market experience^2 (years)	250.831	55.391	0	361

Figure 3: Histogram showing the distribution of Log Wage



It is clear that the distribution of log wage is mostly centered on the mean, and tails at the end with a few outliers.

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