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Anna Aizer, Brown University
Paul J Devereux, University College Dublin
Kjell G Salvanes, Norwegian School of Economics

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Grandparents, Mothers, or Fathers?

Why Children of Teen Mothers do Worse in Life[1]

Anna Aizer
Brown University and NBER

Paul J. Devereux
School of Economics and Geary Institute, University College Dublin
CEPR and IZA

Kjell G. Salvanes
Norwegian School of Economics
CEPR, HCEO, and IZA

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Abstract

Women who give birth as teens have worse subsequent educational and labor market outcomes than women who have first births at older ages. However, previous research has attributed much of these effects to selection rather than a causal effect of teen childbearing. Despite this, there are still reasons to believe that children of teen mothers may do worse as their mothers may be less mature, have fewer financial resources when the child is young, and may partner with fathers of lower quality. Using Norwegian register data, we compare outcomes of children of sisters who have first births at different ages. Our evidence suggests that the causal effect of being a child of a teen mother is much smaller than that implied by the cross-sectional differences but that there are still significant long-term, adverse consequences, especially for children born to the youngest teen mothers. Unlike previous research, we have information on fathers and find that negative selection of fathers of children born to teen mothers plays an important role in producing inferior child outcomes. These effects are particularly large for mothers from higher socio-economic groups.

JEL Codes: J12, J13, I31. I32

Key words: Teen pregnancy, intergenerational mobility, family fixed effects

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It is well documented that children who are born to teenage mothers have worse outcomes including worse health, less schooling, and lower earnings in adulthood (Hofferth, 1987; Francesconi, 2008). However, less is known about whether this is a causal effect of teen childbearing or whether it is because mothers who have teen births are negatively selected so that their children will have poorer outcomes irrespective of the age of the mother at birth. Negative maternal selection is likely to be important as previous work has shown that the negative relationship between teen parenting and long-term *maternal* outcomes – educational attainment and earnings -- declines significantly and, in some studies, declines to zero with more comprehensive controls for selection into teen parenting or using natural experiments for identification.[2]

However, there may still be a negative causal impact of teen parenting on child outcomes for several reasons. First, teenagers have lower levels of psychosocial maturity than their older and more developed counterparts – they are more likely to be depressed and more likely to report greater levels of stress (Kingston, Fell, Heaman, and Chalmers, 2012; Hodgkinson, Lee Bears, Southammakosane, and Lewin, 2014), both of which have been linked to deficits in parenting behaviors (Reid and Meadows-Oliver, 2007). Second, previous work on the impact of teen parenting on maternal education and income finds small long-term effects once selection has been considered, but with the negative effects on income declining over time (Hotz McElroy, and G. Sanders, 2005). As such, teen parents may be more resource constrained during their children's earliest years, a period critical for child development (Almond and Currie, 2011, Carneiro, Lopez Garcia, Salvanes, and Tominey, 2015). Finally, teen birth may also be

[2] See Geronimus and Korenman, 1992; Holmlund, 2005; Hotz, McElroy and Sanders, 2005; Lang and Weinstein, 2015; Ashcraft and Lang, 2013; Fletcher and Wolf, 2009; Ribar, 1994; Klepinger, Lundberg and Plotnick, 1999.

associated with lower paternal quality. If so, this can also result in worse outcomes for affected children through either genetic heritance or fewer and lower quality paternal inputs.

We examine the impact of teen motherhood on child short-, medium- and long-term outcomes using sister fixed effects to control for negative selection into teen motherhood. Specifically, using Norwegian administrative data that links individuals across three generations, we compare the outcomes of children born to a teen mother with the outcomes of the children of her non-teen sister who give birth at age 24.5 on average. In this way, we allow for negative selection into teen motherhood by controlling for all family background characteristics (observed and unobserved) of teen mothers that are common across children born to the same family. Though existing work suggest that family background is likely the most important determinant of teen child bearing, there can still be within family variation in maternal background characteristics correlated with teen pregnancy and offspring outcomes. [3] As such, we also control for whether the mother started academic high school, a marker for academic achievement and aspirations at age 16.

While this sister fixed effects approach to studying the effects of teen childbearing on offspring outcomes has previously been used, our empirical work adds to the literature in several ways. First, since we have population wide data, our sample sizes are much larger than the small samples that have been previously used with sister fixed effects, allowing much more precise estimates. Second, not only do we consider the short and medium run outcomes of these children, such as birth weight and test scores among preschool and elementary school children,

[3] Previous work has shown that family background matters much more than peers, classmates or neighbors in explaining adolescent delinquency (Duncan, Boisjoly and Harris, 2001). Moreover, comparing monozygotic and dizygotic twins, the authors found that while both environmental and genetic factors affect cognitive test scores, the latter seems not to exert much influence over adolescent delinquency, underscoring the importance of controlling for family background in our estimation. Using sibling correlations in educational attainment, and decomposing into family and neighborhood factors, Solon, Page and Duncan (2000) for the USA, and Raaum, Salvanes and Sørensen (2008) for Norway, both find that most of the inequality in education can be explained by family background.

as others already have (Rosenzweig and Wolpin, 1995; Geronimus, Korenman, and Hillemeier, 1994), but we can also consider long-term outcomes such as adult IQ score (for boys), educational attainment, and earnings. Examining long run outcomes is particularly important in this context as there is a growing literature showing that conditions in early childhood can have effects in the long-run that are not observed in the short or even medium term (see Chetty *et al*., 2011; Deming, 2009). Third, because it is register-based, our measure of teen childbearing is not subject to recall bias or reporting error. Finally, while previous work has emphasized the importance of the underlying background characteristics of teen mothers, it has not been able to consider the role of fathers as information on fathers is generally unavailable for teen mothers. Because our register data records the father, we can examine what role paternal quality plays in explaining the worse outcomes of the offspring in both absolute terms and relative to factors previously considered - maternal human capital and resources.

In OLS regressions with controls for only mother's year of birth and child gender, we find a strong negative relationship between teen motherhood and offspring outcomes: offspring have lower grades in middle school, IQ scores that are one third of a standard deviation lower, are shorter in young adulthood, complete 1.3 fewer years of schooling, are 15 percentage points less likely to complete high school, have 11 percent lower earnings at age 30, and are 16 percentage points more likely to have ever used means-tested social assistance. Among female offspring, those born to teen mothers are seven percentage points more likely to have a teen birth themselves.

However, consistent with prior research on teen motherhood and maternal outcomes, much of this negative relationship can be explained by teen mothers' underlying levels of disadvantage. In our data, teen mothers are 15 percentage points more likely to come from a home in which the father has not completed high school (an important determinant of household resources). They are also 25 percentage points less likely to have started academic high school by age 16, a measure of past academic achievement and future aspirations. When we include sister fixed effects that control for observed and unobserved differences in the teen mother's family background, the estimates decline considerably, but still suggest a negative relationship between teen childbearing and child outcomes. However, within family differences between sisters remain: teen mothers are 9 percentage points less likely to start academic high school than their sisters. When we augment the fixed effects with a control for this within family difference in maternal background, the estimated relationship between teen motherhood and offspring outcomes changes little and still suggests a negative effect. With all controls included, we find that children born to teen mothers have cognitive test scores that are 13 percent of a standard deviation lower, complete half a year less of schooling, have four percent lower earnings at age 30, and are three percentage points more likely to have a teen birth themselves. These estimated effects are generated from examining all teen births (ages 15-19). We find that the estimated negative effects are much larger for the children of the youngest teenagers, mothers aged 15-17 at the time of birth. Most effects for the children of the 15-17 year-olds are between 25 and 70 percent larger than for those born to women who are 18-19 years old at the time of birth.

To assess the likelihood that these remaining estimated effects are driven by unobserved characteristics biasing our estimates, we calculate how much selection on unobservables must remain for the true effect to be zero. More specifically, we conduct an exercise in which we assume that the remaining omitted variable bias is proportional to coefficient movements scaled by the change in R-squared when controls are included (Altonji, Elder, and Taber, 2005; Oster, 2017). We find that, for reasonable assumptions about the relative importance of included and excluded variables, the estimates still indicate a negative effect of teen childbearing on child outcomes. We conclude that negative selection into teen motherhood explains much but probably not all of the worse outcomes observed for their offspring.[4]

What explains the remaining negative relationship between teen motherhood and offspring outcomes? We consider three factors: teen mother behavior (ie, smoking while pregnant), household resources in early childhood, and paternal quality. All three appear to play a role in explaining the worse child outcomes still observed after controls for maternal selection are included. Teen mothers are more likely to smoke even after including sister fixed effects. Teen mothers also have lower levels of family earnings especially when the child is young, but over time, the size of the effect declines (consistent with existing work). Finally, paternal quality is much lower for children born to teen mothers even once we control for observable and unobservable characteristics of the teen mother. The "partners" of teen mothers score significantly lower on a cognitive test at age 18, are shorter, consistent with diminished nutrition in childhood, and are less likely to have started academic high school at age 16. Once we control for the underlying characteristics of both teen mothers and their partners, the offspring of teen mothers generally fare little worse than offspring born to older parents with similar background characteristics.

While previous work has emphasized the importance of considering the underlying background characteristics of teen mothers, we conclude that when considering the outcomes of children born to teen mothers, the underlying characteristics of the fathers also play an important

[4] Unobservable characteristics would have to be more important than (and in many cases, more than twice as important as) all of the observable characteristics in explaining the negative selection into teen motherhood. Given our use of a fixed effect strategy that controls for all background characteristics of the family, combined with the fact that other work has found family background to be one of the most important predictors of delinquent behavior and educational background, it seems very unlikely that unobservables can explain all of the effect.

role in explaining their worse outcomes in both the short and long run. That is, a significant part of the reason that the children of teen mothers have worse outcomes is because their fathers have lower levels of human capital and earnings, likely resulting in fewer child investments. More precisely, our decomposition analysis indicates that the quality of the fathers explains as much of the difference in child outcomes as economic resources. This is the first work to emphasize this linkage. Our results suggest that policies that consider the role that fathers play in teenage childbearing and its consequences may be more effective than those that consider mothers only.

I. Background Literature

In developed countries, the teen birth rate ranges from a low of 4.1 per 1000 women aged 15-19 in Switzerland to 40 in the US as of 2009 (Kearney and Levine, 2012). In Norway, the setting of our study, the teen birth rate is 9.5 which is in the middle of the distribution. In the US, teen mothers are twice as likely to drop out of high school and receive public assistance than mothers who delay childbearing, with similar patterns observed in Europe.[5] However, teen mothers are more likely to come from disadvantaged families from which offspring on average accumulate less schooling and earn less in adulthood, regardless of teen childbearing. For example, using data from the 2003 PSID, Kearney and Levine (2015) report that 20% of US women give birth before the age of 20, but among those born into poverty, 49% give birth before the age of 20. The same pattern is observed in Norway: teen childbearing is twice as likely in low SES families as high SES families.[6] As a result, studies of the effect of teen child bearing on

[5] For research based in the UK see Francesconi, 2008; for patterns in Sweden see Olausson *et al.*, 2001, for Norway see Black, Devereux and Salvanes, 2008, and Mølland, 2016, and for cross-country comparisons throughout Europe see Robson and Berthoud (2003). See also Perper, Petersen, and Manlove, 2010.

[6] Teen mothers also have less educated mothers, mothers who were more likely to be teenagers themselves when they gave birth and are less likely to live with both parents (Abma, Martinez ,and Copen, 2010)

maternal outcomes have either included comprehensive controls for parent background (including family fixed effects) or exploited arguably exogenous variation in teen parenthood that derives from shocks such as miscarriages or access to family planning.[7] The evidence from this work shows that most, if not all, of the negative relationship between teen childbearing and a mother's future outcomes is attributable not to any causal impact of teen parenting on women's outcomes, but to the negative selection into teen parenting.

As with the literature on maternal outcomes, the research on child outcomes also suggests that selection into teen parenting is an important factor in explaining the worse child outcomes of those born to teen mothers. Several studies have documented that once one includes additional controls for maternal background, the estimated OLS relationship between teen motherhood and child outcomes declines (Shaw, Lawlor and Najman, 2006; Card, 1981; Jaffe, Caspi, Moffitt, Belsky, and Silva, 2001).

A small number of studies have sought ways to more comprehensively control for family background/maternal selection. These have taken one of three approaches: 1) including maternal family fixed effects, thereby comparing outcomes of children born to sisters – one of whom had a teen birth and one of whom delayed birth until at least age 20 (i.e., comparing outcomes of cousins); 2) exploiting a natural experiment that results in plausibly exogenous variation in the timing of first birth; 3) including child sibling fixed effects, thereby comparing outcomes of

[7] These include papers that use family fixed effects by Geronimus and Korenman (1992) and Holmlund (2005). Work that exploits variation in teen motherhood derived from miscarriages includes Hotz, Mullen and Sanders (1997), Hotz, McElroy and Sanders (2005), Fletcher and Wolf (2009), Ashcraft, Fernandez-Val and Lang (2013) and Lang and Weinstein (2015). Ribar (1994), using age at menarche as an instrument for teen parenthood, finds that the relationship between teen parenting and maternal educational attainment is small. Klepinger, Lundberg and Plotnick (1999) use access to family planning and abortion as an instrument for teen fertility and find that teen motherhood substantially and negatively affects labor market outcomes of mothers. Research that has used propensity score matching methods to address underlying differences between teen and non-teen mothers has produced estimates that are smaller than the cross-sectional estimates but still negative and significant (Lee, 2010 and Levine and Painter, 2005).

children born to the same mother – one born before she turned 20 and one after. This work, with one exception, is based on survey data which are rich in terms of maternal and child characteristics, but suffers from small sample sizes, attrition and measurement error, which can increase bias and decrease precision.

Geronimus, Korenman and Hillemeier (1994), Rosenzweig and Wolpin (1995) and Lopez Turley (2003) address negative selection into teen parenthood by including maternal family fixed effects and comparing outcomes of children born to sisters. All these studies use data from the NLSY or PSID to examine the role of teen motherhood (Geronimus, Korenman, and Hillemeier, 1994; Rosenzweig and Wolpin, 1995) and maternal age at birth (Lopez Turley, 2003), on child outcomes including birth weight, cognitive test scores and behavioral problems. In all three studies, the authors find that the inclusion of sister fixed effects and maternal AFQT reduces the negative association between maternal age at birth and child short and medium-term outcomes to statistical insignificance in most cases. The main limitations of these studies are the small sample sizes (roughly 130 teen mothers with sisters in the NLSY, for example) and relatively short follow-up periods for the child outcomes.

Recent work exploits the school starting age rules in Sweden that generate variation in age at first birth. Frederiksson, Huttunen and Ockert (2017) show that those born after school entry cut off (and therefore older when they start and finish school) are more likely to postpone pregnancies and thus are older when giving birth to their children. Using data on a cohort of women born in Sweden 1932-1944, the authors find no evidence that the children of those born after the school entry cutoff fare any better than those born before the school entry cutoff. However, interpretation of these results is complicated by the fact that school starting ages also affect maternal education which has been shown to affect child outcomes directly (Currie and Moretti, 2003).

Francesconi (2008) uses sibling fixed effects to compare the outcomes of children born to the same mother when she was young versus when she was older. Not surprisingly, he finds little difference in child outcomes as this analysis is complicated by the confounding of birth order as well as the generally limited spacing between births that generates little variation in the environments and resources faced by children born to the same mother.

Our work advances the current literature by using a large population-based dataset that allows us to consider long run outcomes in addition to short and medium run outcomes. There are several major advantages of these data. First, our large sample size (42,000 teen births to sister pairs) allows us to generate more precise estimates. Second, a reliance on birth records instead of survey self-reporting of teen pregnancy reduces potential bias from any misreporting of teen pregnancy. Third, our estimates are less likely to be biased by any non-random attrition which can be substantial in surveys such as the NLSY or PSID, especially for the longer run outcomes. Finally, we have information on fathers and so can examine to what extent the poorer outcomes of children of teen mothers are due to the selection of fathers.

II. Data

Our empirical approach requires information on three generations of individuals. Our sample consists of all live singleton births in the Norwegian Birth Register (1967 - 2009). Importantly, both mothers and fathers of the children are known. We restrict the sample to first-born children and keep cases where the mother is aged between 15 and 45 at the time of birth.

We further restrict the sample to mothers born between 1950 and 1980 for whom we know the identity of the maternal grandparents (this information is not widely available for mothers born before 1950). Finally, because we include maternal grandparent fixed effects (equivalent to a sister FE), we restrict the sample to mothers who have at least one full sister in the sample. Our base sample consists of 303,085 observations on first-born children for whom we observe both their parents and their maternal grandparents.[8] Of these births, 14% or 42,432, are to teen mothers. Table 1 shows means for the full sample and for the sample for whom we have information on at least two sister sibling mothers. The means for the two groups are generally quite similar, suggesting little to no non-random selection into the analysis sample.

It is important to consider the circumstances of the time period (1967-2009) when interpreting the results. Two factors are particularly relevant. First, abortion was legalized in Norway in 1972, before most of the births in our sample occurred. As a result, there were likely fewer unintended births over this period compared with previous periods. Second, teen childbearing was declining over this period in Norway as it was in most developed countries. This suggests that negative selection into teen childbearing may have increased over this period. However, empirically we find no evidence of this. We discuss this further and present results with respect to time trends in teen motherhood and child outcomes in Table 7.

A. Measures of Maternal Quality

We have limited information on the economic circumstances of mothers when they were growing up. Our main measure of family background is an indicator for whether the maternal

[8] By limiting our sample to first born children, we ignore any effects of teen motherhood on other children. Since teen mothers have higher completed fertility and previous work has documented worse outcomes for higher birth order children (Black, Devereux and Salvanes, 2005), this would suggest that teen motherhood also negatively affects the outcomes of later born children.

grandfather (the mother's father) had “high” education, defined as completing high school and measured when the mother was aged 16. Our primary approach is to control for maternal quality using grandparent fixed effects, which automatically controls for all differences in family background characteristics and human capital that are shared across sisters. However, there may also be differences within sister pairs that correlate with teen motherhood and affect child outcomes. To examine this, we consider a measure of maternal quality that varies within sister pairs: whether a mother started academic high school at age 16. This is a measure of pre-existing achievement and orientation towards academic study (68% of mothers started academic high school at 16) and the decision is made prior to the vast majority of teen births – only 0.1% of births are before age 16 and only 0.7% of births occur before age 17.

B. Measures of Paternal Quality

The birth certificate register contains information on the father of the child. Due to strictly enforced rules of paternal child support, 97-98 percent of the fathers are reported in the birth register, enabling us to link them with additional information available in other registers. We utilize three measures of paternal quality. The first is a measure of his father’s education (i.e., the paternal grandfather’s education). This serves as a proxy for his family background. The second is whether the father started academic high school, measured at age 16. The third set of measures derive from Norwegian military records and include the height, weight, and IQ score of the father. These are measured when the father is between the ages of 18 and 20. In Norway, military service is compulsory for every able young man and, before entering the service, their medical and psychological suitability is assessed. The IQ score is reported in stanine (Standard Nine) units, a method of standardizing raw scores into a nine point standard scale that has a discrete approximation to a normal distribution, a mean of 5, and a standard deviation of 2.[9] This information is available from 1969 to 2010, covering men born between about 1950 and 1991. As a result of this cohort restriction, this information is missing for 18% of the sample. We also examine the relationship between teen birth and paternal age.[10]

C. Resources and Investments in the Child

We use information on the birth year of the child and on household income of the mother to construct family income when the child is aged 1, 5, 10, and 15. Information on spouses (needed to construct family income) is available from 1970 through 2015 so we have information on family income when the child is aged 3 or older for our full sample.

To explore whether and how teen motherhood might influence behavior that affects their children, we estimate whether teen mothers are more likely to smoke during pregnancy. Smoking during pregnancy has been shown to be extremely harmful to the fetus (Rubin *et al.*, 1986, Bernstein *et al.*, 2005). We have information on smoking from the Birth Register for mothers who give birth between 1999 and 2009. Women report smoking status to doctors at a free, recommended consultation around gestational week 8-12.[11] The response rate in our data for this smoking question is 83%, with about 15% reporting smoking during pregnancy.

[9] The IQ measure is the mean score from three IQ tests -- arithmetic, word similarities, and figures (see Sundet, Barlaug, and Torjussen, 2004 for details). The arithmetic test is quite similar to the arithmetic test in the Wechsler Adult Intelligence Scale (WAIS) (Sundet, Barlaug, and Torjussen, 2004; Cronbach 1964), the word test is similar to the vocabulary test in WAIS, and the figures test is similar to the Raven Progressive Matrix test (Cronbach 1964). The correlation between this IQ measure and the WAIS IQ score has been found to be 0.73 (Sundet, Barlaug, and Torjussen, 2004).

[10] We also have information on completed education of fathers but do not use it in our main specifications as it may be partly determined by the teenage birth.

[11] Some women report it slightly later because their first consultation is after week 12.

D. Child Outcomes

An advantage of our register data is that we can examine short, medium and long-run child outcomes for large samples of children.

Short run outcomes:

We study the birth weight of the child. This is available in birth registers from 1967 to 2009. Birth weight is the most widely used measure of health at birth and low birth weight has been linked to poorer outcomes in adulthood (Black, Devereaux and Salvanes, 2007).

Medium run outcomes:

We have two measures of achievement and cognitive abilities during the teenage years. The first is the grade point average (GPA) from middle school (which is completed by most Norwegians around age 16). This information covers years 2002 to 2015 and, hence, cohorts 1986-1999. The GPA ranges from 0 to 6 and has a mean of 4.07 and standard deviation of 0.82. This is a good measure of achievement during core schooling.[12] The second measure is cognitive test scores from military tests at ages 18-20 for all men. Additionally, we have information on male height at 18-20 as measured by the military.

Long run outcomes:

[12] After middle school, students choose between two different tracks for high school; the academic track and the vocational track. The academic track is a preparation for university and other higher educational studies.

Our long-run offspring outcomes include completed education by 2014. This requires restricting the sample to persons aged at least 25 in our data, which corresponds to birth cohorts 1967-1989. To have educational information for a larger range of cohorts, we also construct an indicator for whether the person has completed high school (either vocational or academic). We can measure this for persons aged at least 20 by 2014, which corresponds to birth cohorts 1967 to 1994.

Our principal measure of economic welfare is earnings at age 30 (calculated using available data on earnings up to 2015).[13] This outcome is available for cohorts born between 1967 and 1985. We also have access to information on whether someone used social assistance between 1992 and 2010. Social assistance is means-tested support for people who do not have an adequate source of income but have not accumulated the right to unemployment benefits or other support earned through the labor market. It is widely used by young people of both genders and is a useful measure of difficulty obtaining stable employment in the labor market. We use these data to generate a measure of whether someone ever used social assistance during this period and limit our sample to birth cohorts 1967-1990. The mean for this variable is about 19%.

Finally, we use the birth records to calculate whether each of the female children in our sample subsequently had a teenage birth herself. This information is available for the 1967-1990 cohorts (as we have birth information up to 2009) and the mean is about 6%.

III. Empirical Strategy and Results

Our analysis proceeds in several steps. First, we examine selection into teen motherhood. We do so by establishing how teen childbearing is correlated with the mother's family

[13] We deflate earnings and other monetary amounts to 2010 NOK (Norwegian Krone).

background factors as well as her own maternal characteristics. Evidence of strong negative selection into teen motherhood would imply strong potential bias in OLS estimates of the impact of teen motherhood on child outcomes. Second, we demonstrate that fathers of children born to teen mothers are systematically different from other fathers. Third, we estimate cross-sectional and sister fixed effects models of the effect of teen childbearing on child outcomes, controlling for underlying characteristics of teen mothers. We argue that the fixed effects estimates, while smaller than cross sectional estimates, represent an upper bound of the true causal estimates if negative selection on unobservables still remains. We then assess the likelihood that the lower bound of the causal effect includes zero. To do so, we calculate how much selection on unobservables must remain for the true effect to be zero. Finally, we consider the mechanisms behind any estimated effects of teen motherhood on child outcomes and contrast the importance of father characteristics to that of household financial resources.

To maintain comparability between OLS and specifications with sister fixed effects, we restrict the sample in each regression to observations where there are at least two sisters for whom the dependent variable is non-missing. In all specifications we include an indicator variable for teenage first birth with the omitted category defined as first births at all other ages.[14]

A. Selection into Teen Motherhood

We consider how the pre-determined characteristics of mothers relate to whether they have a teen birth by individually regressing multiple maternal background characteristics on an indicator for teen birth. Each regression includes, at a minimum, year-of-birth FE for the mother. The background characteristics include 1) maternal family background as proxied by whether her

[14] We later show estimates where we disaggregate teen births further by exact age of the mother.

father completed high school, 2) whether the mother started academic high school at age 16, a good measure of the pre-existing orientation of the mother towards academic study, and 3) the birth order of the mother.[15]

The results, reported in Table 2, confirm negative selection into teen motherhood. Mothers who have a teen birth are disproportionately drawn from families in which the father has less education. Among non-teen mothers, 31 percent have a father with at least a high school education. Among teen mothers, that declines by 15 percentage points (Table 2, column 1). For this outcome we cannot include a family fixed effect as the maternal grandfather is common to sibling mothers.

We also consider negative selection within sister pairs by regressing whether the mother started academic high school on teen birth. We find that, when this is the dependent variable, the coefficient on teen birth is -0.25 (Table 2, column 2) relative to a mean of 0.70; when we add sister fixed effects, the coefficient falls to -0.09. This is consistent with previous findings that while much of the selection into teen childbearing is shared by siblings, there is also selection within-families in terms of who has a teen birth (Holmlund, 2005). In column 3 of Table 2, we find that teen mothers are 3 percentage points less likely to be first-borns. This falls to 1.5 percentage points when we include sister fixed effects.

We conclude that while sister fixed effects and controls for individual academic achievement at age 16 do serve to reduce bias from negative selection into teen motherhood, there is still some negative selection that occurs within family that likely biases our estimates of the impact of teen motherhood on child outcomes. In a later section we explore how likely it is that omitted variables explain all the remaining negative effects by conducting exercises as

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[15] There is an extensive literature indicating that there is a first birth advantage across many outcomes. See, for instance, Black, Devereux and Salvanes (2005).

detailed by Altonji, Elder and Taber(2005) and most recently Oster (2017). These exercises require assumptions about the degree of negative selection explained and unexplained by our controls.

B. Selection of Fathers

To our knowledge, this is the first paper to consider the quality of the fathers of children born to teen mothers and the role this plays in explaining offspring outcomes. To do so, we regress multiple measures of paternal quality on an indicator for teen birth. The basic controls included in all regressions are indicator variables for the year of birth and gender of the child, we then include sister fixed effects, thereby limiting our comparison to the fathers of children born to sisters, and then the sister-specific maternal control. Our first dependent variable is whether the paternal grandfather (the father of the father of the child) has finished high school education (Table 3) which yields an estimated coefficient on teen birth of -0.067 showing that fathers of children born to teen mothers are negatively selected on family background. When we include sister fixed effects, the teen birth coefficient falls to -0.007, indicating that most of the paternal selection on this particular measure is common across sisters and not unique to teen mothers.

We test further for paternal selection using more direct measures of paternal human capital -- whether the father started academic high school, cognitive test scores and height of the father from military enlistment exams at ages 18-19, as well as the father's age at first birth (of his child.) Using these measures of paternal quality, we find much stronger evidence that the fathers of children born to teen mothers are negatively selected, even within sister pairs. Fathers of children born to teen mothers are five percentage points less likely to have started academic high school, they have IQ scores that are 25 percent of a standard deviation lower, are shorter at age 18, and are themselves 2.5 years younger when the child is born. Our results imply that fathers of teen mothers are negatively selected. In a later section we show that this negative selection on paternal quality explains a significant share of the negative relationship between teen childbearing and offspring outcomes. We also explore whether this finding reflects worse decision making/lower quality of the mothers or more of a direct causal impact of paternal quality on child outcomes.

C. Impact of Teen Motherhood on Child Outcomes

We begin by characterizing the relationship between teen motherhood and child outcomes including only our "basic" controls: year-of-birth indicators for the child and a gender dummy for the child.[16] We report estimates for child short, medium and long run outcomes: birth weight, middle school GPA, IQ score and height at age 18 (for boys), completed years of education, child earnings at age 30, whether the child used welfare, and whether the child had a teen birth herself (for girls). In each regression, (including OLS regressions) we restrict the sample to cases where there are at least two sisters with non-missing values of the dependent variable.

In column (1) of Table 4, we show estimates for child birth weight. Without fixed effects (and therefore comparing children of teen mothers to all other children), the estimate on teen birth is -35, indicating that children of teen mothers weigh about 35 grams less on average, a modest effect. Once the fixed effects are included, this becomes a very small and statistically insignificant effect of 4 grams. The small negative effect of teen motherhood on birth weight in

[16] An alternative would be to include year-of-birth indicators for the mother. Given there can be cohort effects in the outcome variables, it is preferable to control for year-of-birth of the child. Essentially, we are leveraging the different birth years of the sister (mothers) to allow a comparison of the outcomes of cousins born in the same year but to mothers of different ages.

the cross section appears to be due entirely to selection rather than reflect a causal effect, consistent with previous findings (Rosenzweig and Wolpin, 1995).

In column (2), the dependent variable is middle school GPA, a variable that is between 0 and 6 and has a standard deviation of 0.82. The cross-sectional effect of -0.52 is therefore very large. Once the fixed effects and the control for mother high school track are added, the coefficient falls to -0.14 or about 17% of a standard deviation. Likewise, in column (3) we see that teen birth is associated with boys scoring 0.67 less on average in the IQ test at age 18-20. The standard deviation is about 1.75 so, once again, this is a sizeable effect. With controls, it falls to 0.23 (13% of a standard deviation). For height of boys, adding the controls reduces the negative effect of teen birth from 1.2 cm (mean of 180 cm) to 0.61 cm.

When we study educational outcomes, we see a similar pattern. Children born to teen mothers have, on average, 1.3 fewer years of completed schooling (mean of 13.12) and are 15 percentage points less likely to finish high school (compared to a mean of 0.80). However, adding the FE and maternal controls reduces these effects by about 60%, yielding an effect size of about half a year for years of schooling, and six percentage points for high school completion.

Children of teen mothers earn about 11% less at age 30 but this falls to only 4% when controls are added. Social assistance usage is much higher for children of teen mothers (16 percentage points, compared to a mean usage of 0.16) and this effect is halved after adding controls. Finally, daughters of teen mothers are 7 percentage points more likely to have a teen birth themselves, but this falls to 3 percentage points when controls are included.

Overall, without controlling for differences in maternal background, we estimate a large negative relationship between teen birth and child outcomes. When we include sister FE to compare the outcomes of children of sisters where one sister had her first birth as a teenager and the other did not, the estimated effects fall considerably but, except for birth weight, do not disappear and in many cases remain economically meaningful. Adding an indicator variable for whether the sister began academic high school at age 16 as a proxy for both previous academic achievement and future expectations or aspirations leads to little further change in the estimated effects, suggesting that within-sister heterogeneity may have limited effects on our estimates.

Assessing Omitted Variable Bias

While we have controlled for important confounders related to family background of the mother, there are likely other unobservables for which we cannot control. Therefore, the above estimates can only be considered an upper bound.[17] To assess the likelihood that selection on unobservables is responsible for the entirety of the estimated effects, we use the methodology of Altonji, Elder and Taber (2005) and the recent contribution of Oster (2017). Defining some notation, let $\dot{\beta}$ be the estimate from the baseline regression with only cohort and gender controls and $\tilde{\beta}$ be the estimate when we include the sibling fixed effects and the maternal control. Equivalently, let $\dot{R}$ be the R^2 from the baseline regression and $\tilde{R}$ be the R^2 from the regression with the sibling fixed effects and maternal control (the total R^2 not the within R^2).

Oster emphasises two different parameter choices: δ and R^{max}. δ is the relative importance of selection on unobservables to selection on observables. She argues that 1 is probably an upper bound as researchers are likely to control for the most relevant variables.[18]

[17] If there are spillover effects of teen pregnancy on younger siblings, then our sister fixed effects estimates may be downward biased. We have re-estimated after excluding all teen births that are not to the youngest sister to minimize the role of these spillovers. The estimates (in Appendix Table 1) are similar to those from the full sample.

[18] Duncan, Boisjoly and Harris (2001) show that family background matters more than peers, classmates or neighbors in explaining adolescent delinquency, suggesting that family background is likely a very important (if not the most important) factor in predicting teen childbearing.

R^{max} is our determination of what the R-squared would be if we could include all relevant variables (it may not be 1 due to measurement error in the dependent variable or variation in the dependent variable due to factors subsequent to the birth). Oster suggests using $R^{max} = 1.3\tilde{R}$ as a reasonable choice. We assume this value for R^{max} and use the formulas in Oster (2017) to estimate how large δ (selection on unobservables relative to observables) would need to be for our estimates to be consistent with a true coefficient value of zero. These are also reported in Table 4 and indicate that δ would need to be over 1 for 7 of our 8 child outcomes for the true effect to be zero (and over 2 for 4 of the 8). In other words, if unobservable characteristics of the mothers are driving the effects we estimate, selection on unobservables would have to be greater than selection on observables which include, in this case, all family background characteristics, observable and unobservable, that are common across sisters and a mother-specific measure of human capital at age 16. We think that very unlikely. While not definitive, our interpretation is that there is a small, but non-negligible, negative effect of teen childbearing on child outcomes. The only exception is birth weight where, consistent with previous work (Rosenzweig and Wolpin, 1995), there is no evidence of any adverse effect.

More Detailed Age Categories

We have thus far treated all teen births as equivalent. Here, we break down teen births into two categories: age 15-17 (3% of first births) and age 18-19 (11% of first births). We expect that the negative effects of teen motherhood are likely greater for those born to the youngest mothers who are the least mature and for whom the disruption of child birth is likely to have a greater impact on their own maternal human capital accumulation and future earnings.

We present the estimated effects on child outcomes using only the basic controls (Appendix Table 2, top panel) and the full set of sister FE and the maternal control in the bottom panel. When we include the full set of controls, we find that children born to the youngest teens fare between 15 and 74% worse than those born to older teens, depending on the outcome. For example, overall, the children of teen mothers have an IQ score that is 0.23 points lower (11 % of a standard deviation), but if they were born to a mother aged 15-17, it is 0.35 points lower (18 % of a standard deviation), and if they born to a mother aged 18-19 it is 0.19 points lower (9 % of a standard deviation).

Could the larger estimated effects for the children of young teens simply reflect greater negative selection into pregnancy at younger ages? Examining how the estimates change when we control for maternal characteristics provides some insight into this. If the estimated effects decline further for the youngest teens than for oldest teens when we control for maternal characteristics, this would be consistent with greater negative selection into teen pregnancy at early ages generating greater bias. Comparing the estimates in the top and bottom panels of Appendix Table 2 does not support this. When we include controls for maternal characteristics, the estimated effects decline at roughly similar rates for the 15-17 year-olds as for the 18-19 year-olds. More formally, at the bottom of the table we present the estimates of δ for the two age groups. No clear pattern emerges: the magnitudes of the δs are not consistently larger (or smaller) for the youngest mothers, suggesting greater selection on unobservables is not likely to be driving the greater effects observed for them.

D. Mechanisms and Mediation Analysis

We have suggested paternal selection as a possible reason for teen childbearing effects but a more standard explanation is that teen mothers have fewer financial resources, particularly when the child is young. In Table 5, we report the effects of having a teen first birth on the natural log of family earnings at various ages of the first child. The negative effect of teen birth is large when the child is young and persists but becomes smaller by age 15. Once we include sister fixed effects and whether the mother started academic high school as controls, the estimates decline in magnitude but remain sizeable and display the same decline over time. With all controls included, we find that family income of a child born to a teen mother is 40% lower when the child is aged 5, and 17% lower at age 15. This is consistent with previous work showing an initially large difference in earnings for teen mothers, but eventual convergence over time (Hotz et al, 2005).[19] Interestingly, we find that for the difference in family earnings at age 15, three fifths of this effect is driven by declines in the mother's own earnings and two fifths from declines in her spouse's earnings.

Not only do teen mothers have fewer resources, they are also less likely to make healthy investments, as proxied by higher smoking rates in pregnancy (Table 5, Column 5). While the effect declines when we include family fixed effects, the coefficient still suggests that a woman who has a teen birth is about 17 percentage points more likely to smoke during pregnancy than her sister who has a birth at a later age.[20]

Our estimates suggest that both paternal selection and maternal resources are plausible mechanisms for the negative effect of teenage pregnancy on child outcomes. We assess this quantitatively by examining how the coefficient on teen birth changes when we add these

[19] In Appendix Table 3, we show that teen mothers are less likely to be married when the child is growing up and that teen mothers have larger completed family sizes. These factors may also lead to a reduction in investments in the child.

[20] Teen mothers are also less likely to show up for the pre-natal visit at which smoking is measured. Indeed, accounting for controls, information on smoking is 9 percentage points less likely to be available for teen pregnancies.

variables as additional controls. In this analysis, we exclude children born after 2000 as we do not have information on family earnings at age 15 for them. In practice, this affects the sample used to study birth weight but none of the other samples.

We report our baseline estimates (the specification used in Table 3, row 3) in the first row of Table 6A. Next, we add controls for paternal characteristics. The controls we add are as follows: indicator variables for whether the father started academic high school, indicator variables for whether the paternal grandfather finished high school, indicator variables for father’s score on the cognitive test, a linear term for height, and indicator variables for father's age at birth of child (< 19, 19, 20 - 22, 23-25, 26-30, 31-35, 36+).[21] Note that all these variables are plausibly pre-determined at the time of the child’s birth. Adding these extra controls substantially reduces the absolute value of the teen birth coefficient, indicating that paternal selection is an important mechanism.

In the next row of Table 6A, we exclude the father characteristics and instead add controls for log family income at ages 5, 10, and 15. In about 5% of cases, family income is missing or reported as zero, we set log income to zero in these cases and add controls for whether the family had positive income.

Finally, we report estimates where we include both the father characteristics and the family income controls. For short run outcomes, the estimated effects are either small and positive, in the case of birth weight, or zero in the case of middle school GPA. However, for the longer run outcomes (IQ scores, schooling, earnings at age 30, welfare use and subsequent teen birth) the estimated effects decline by roughly 50% when we include controls for family resources and paternal human capital and remain significantly different from zero. In sum, we

[21] We "dummy out" missing control variables to maintain sample sizes. The estimates are similar if we drop observations with missing values.

find that maternal characteristics can explain all of the effects on short run outcomes (birth weight), and that maternal/paternal characteristics and family income can explain all of the effects on medium run outcomes (middle school GPA) and about half of the effects on long run outcomes.

Decomposition

The above analysis suggests that the adverse causal effect of teen childbearing on child outcomes can be largely accounted for by the characteristics of the child's father and by family resources during childhood. To assess the relative importance of these two factors, we perform a Gelbach decomposition that provides an accounting that is invariant to the order in which the controls are included (Gelbach, 2016). This exercise allows us to estimate the relative contribution of (1) paternal controls and (2) family resources, to reducing the estimated effect of teen motherhood.

The estimates are presented in the bottom panel of Table 6A. Paternal characteristics are most influential on height (not surprisingly given the strong genetic heritance of height) and cognitive test scores as well as completed schooling. Family resources seem to explain more of the estimated effects on offspring earnings at age 30 and welfare use.

Our finding that measures of paternal quality seem to explain much of the estimated effect of teen childbearing on child outcomes can be interpreted in two ways. The first is that paternal quality matters only because it is a signal of maternal decision-making or quality. The second is that it exerts an independent effect on child outcomes. We provide two pieces of evidence that are consistent with the latter, though this does not allow us to rule out the former.

First, we explore whether the importance of paternal characteristics increases when the father is married to the mother at age 15 (a proxy for his presence in the home). We hypothesize that paternal presence matters little for height, more for IQ and the most for outcomes like schooling, GPA, earnings and welfare use. If we find evidence in favor of this hypothesis, this would be consistent with a causal impact of paternal quality on child outcomes. To test this, we stratify the sample by whether the mother was married to the father of the child when the child was 15 years old.[22] The results of the stratified Gelbach decomposition are presented in Table 6B. The results are roughly consistent with our hypothesis: paternal characteristics explain more of the negative effect of teen childbearing on child outcomes when the father is married to the mother at age 15. The main exceptions are height, which is not surprising, but also log earnings of the child at age 30, which is. These results are inconsistent with the hypothesis that paternal quality is only a proxy for unobserved maternal ability.

As a second piece of evidence, we present the results of brother fixed effect regressions in which we estimate the relationship between multiple measures of paternal quality and child outcomes controlling for paternal background. We estimate a strong relationship between individual measures of paternal quality and child outcomes (Appendix Table 4). As with the previous findings, these results are consistent with a causal relationship between paternal quality and child outcomes, but do not rule out the possibility that paternal quality has no independent effect on child outcomes but rather proxies for maternal decision-making or quality.

[22] Teen births account for 13 percent of children in homes with a married father, and 21 percent of children in homes with an unmarried father. While differences in maternal characteristics between these two family types are minimal, fathers who are married are more likely to have started academic high school (0.55 vs. 0.48) and have higher average IQ scores (5.67 vs. 5.00). Not surprisingly, family earnings are higher in families with a married father and the differences increase as the child ages. Child outcomes, including IQ scores, schooling and earnings at age 30 are all lower for children in unmarried homes.

E. Heterogeneous Effects by Maternal Socio-Economic Status (SES)

We hypothesize that the negative effects of teen motherhood on children's outcomes will be smaller for those born to low SES mothers. This hypothesis is based on previous work showing that the black-white infant mortality differential is smaller among infants born to young mothers. Researchers have attributed this to the health of African American women deteriorating faster than that of white women, an explanation that is referred to as the "weathering hypothesis" (Geronimus, 1992). In a similar vein, we argue that because the social and economic trajectories of high and low SES women increasingly diverge as mothers age, delaying child bearing should generate greater advantage for high SES mothers.

To test this empirically, we regress child outcomes on an indicator for teen birth and the full set of controls (family FE and the maternal-specific control) and an interaction term between teen birth and an indicator for whether the maternal grandfather had a high degree of education (our proxy for maternal background SES). To control for changes over time in both educational attainment of fathers and the returns to their education that could bias estimates, we also include an interaction between teen birth and child year of birth. For all child outcomes (Table 7, Panel A), the coefficient on the interaction term, teen birth*grandfather high education, is negative and large, sometimes doubling the negative effect of teen birth, except for birth weight which is small. However, the estimates are only statistically significant for three outcomes: middle school GPA, welfare use, and IQ scores among boys. The effect of teen motherhood on IQ score, for example, is to reduce it by -0.22 (12% of a standard deviation) for those with low SES mothers, increasing to -0.42 (24% of a standard deviation) for those with high SES mothers.

Moreover, the worse outcomes observed for these children are not because their mothers were more negatively selected. We test this by regressing whether the teen mother started academic HS and whether she is a first-born child on an indicator for teen mother, family FE, and an interaction between teen motherhood with grandfather education. Within families, teen motherhood is not more negatively selected in high SES families than it is in low SES families (Table 7, panel B, columns 1 & 2). If anything, the negative selection into teen motherhood as measured by birth order is smaller for high SES families (Table 7, panel B, column 2). However, the male partners are much more negatively selected when the teen mothers come from high SES families relative to low SES families. The fathers are much more likely to come from low SES backgrounds, they are less likely to have finished academic high school, they score lower on IQ tests and are younger themselves (Table 7, Panel B, columns 3-8). The results underscore the important role that fathers play in explaining the negative outcomes of children born to teen mothers.

IV. Conclusions

We have built on the previous literature by using three generations of population data to study the effects of teenage childbearing on the outcomes of children. A major advantage of our analysis is that our administrative data likely suffer from little measurement error as they contain information from birth registers rather than self-reports of pregnancy. The large sample sizes enable us to obtain precise estimates and, by linking administrative registers, we avoid attrition bias that plagues panel data sets that have been used to study these issues. We are also able to link to a wider range of medium- and long-run child outcomes than have been studied in the past. Finally, our data also include information on paternal characteristics which is mostly absent from previous analyses based on survey data.[23]

[23] This is because survey data only capture fathers if they co-reside with the mother.

Our estimates suggest that cross-sectional analysis significantly over-estimates the adverse consequences of teen childbearing on the next generation. Our preferred estimates using maternal sister fixed effects suggest, however, that there are relatively small negative long-run consequences for children. Our rich administrative data allow us to study mechanisms that have not been fully explored in the previous literature. We find that paternal selection plays an important role – a major reason that children of teen mothers do worse is that their fathers are more likely to have lower education levels and cognitive scores. We also find evidence that lower family resources during childhood may play an important role. The adverse consequences of teenage childbearing are larger for mothers from higher socio-economic groups. Consistent with this, we find that adverse paternal selection is greater for higher SES moms. This underscores the importance of the role of fathers in mediating the effects of teen childbearing on child outcomes. Policies that target young, first time mothers, such as the Nurse Family Partnership program in the United States, should also consider providing services to the fathers if their objective is to improve long term offspring outcomes.

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Table 1: Summary Statistics

	Full Sample		Analysis Sample	
	N	Mean	N	Mean
Teen Birth	649133	0.13	303085	0.14
Age at birth	649133	24.96	303085	24.70
Mother year of birth	649133	1964.73	303085	1964.22
Father year of birth	649133	1961.82	303085	1961.29
Maternal grandfather high school	636805	0.31	298675	0.28
Paternal grandfather high school	609886	0.28	286222	0.26
Mother started academic HS	649133	0.70	303085	0.68
Father started academic HS	649133	0.57	303085	0.55
Mother first-born	649133	0.40	303085	0.31
Father Cognitive Score	501194	5.44	236654	5.41
Father Height	536403	179.65	253994	179.56
Father age at birth	649133	28.36	303085	28.12
First child aged 15-17	649133	0.03	302834	0.03
First child aged 18-19	649133	0.10	302834	0.11
First child aged 20-24	649133	0.37	302834	0.38
First child aged 25-29	649133	0.33	302834	0.32
First child aged 30+	649133	0.17	302834	0.16
Married when child is 1	647133	0.52	301951	0.53
Married when child is 5	644847	0.64	300900	0.65
Married when child is 10	600854	0.66	286830	0.67
Married when child is 15	522726	0.66	257463	0.67
Total number of children	463387	2.28	233378	2.33
Log family earnings child aged 1	597116	11.76	278914	11.72
Log family earnings child aged 5	613532	12.25	286262	12.22
Log family earnings child aged 10	579647	12.57	276831	12.56
Log family earnings child aged 15	506763	12.77	250162	12.79
Smoked during pregnancy	131176	0.16	48825	0.15
Child Characteristics				
Female	649133	0.49	303085	0.49
Year of birth	649133	1990.18	303085	1989.41
Birth Weight	648330	3465.00	302709	3458.81
Middle School GPA	277259	4.07	140159	4.07
Cognitive Score at 18 (boys)	154755	5.20	77821	5.14
Height at 18 (boys)	167880	180.04	84532	179.94
Years of Schooling	298094	13.12	149241	13.04
Finished High School	362844	0.80	183464	0.80
Log earnings age 30	205699	12.59	99858	12.60
Welfare use	327134	0.19	164379	0.19
Child teen birth	158267	0.06	79847	0.06

The analysis sample is restricted to cases where there are at least two sisters who are mothers in the data.

Table 2: Relationship between Maternal Characteristics and Teen Birth

	(1) Maternal grandfather high school	(2) Mother started academic HS	(3) Mother first-born
Basic Controls			
Teen Birth	-0.145***	-0.247***	-0.031***
	(0.002)	(0.003)	(0.002)
R^2	0.028	0.059	0.049
Add Sister FE			
Teen Birth		-0.092***	-0.015***
		(0.003)	(0.003)
R^2		0.611	0.540
N	298418	302834	302834

Basic controls include indicators for mother's year of birth and child gender.
Robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Relationship between Paternal Characteristics and Teen Birth

	(1) Paternal grandfather high school	(2) Father started academic HS	(3) Father Cognitive Score	(4) Father Height	(5) Father age at birth
Basic Controls					
Teen Birth	-0.065***	-0.175***	-1.014***	-1.474***	-4.257***
	(0.002)	(0.003)	(0.013)	(0.043)	(0.021)
R^2	0.046	0.048	0.041	0.013	0.296
Add Sister FE					
Teen Birth	-0.007*	-0.058***	-0.465***	-0.813***	-2.587***
	(0.003)	(0.004)	(0.017)	(0.062)	(0.033)
R^2	0.521	0.542	0.560	0.493	0.689
Add Sister FE and Maternal Control					
Teen Birth	-0.005	-0.052***	-0.449***	-0.795***	-2.587***
	(0.003)	(0.004)	(0.018)	(0.062)	(0.033)
R^2	0.521	0.546	0.563	0.493	0.689
N	275235	302834	201692	226995	302834

Basic controls include indicator variables for child year of birth and child gender and are included in all regressions.
Maternal control is an indicator for whether the mother started academic high school at age 16.
Robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Effect of Teen Birth on Child Outcomes (First-born Children)

	(1) Birth Weight	(2) Middle School GPA	(3) Cognitive Score	(4) Height	(5) Years of School	(6) Finished High School	(7) Log earnings age 30	(8) Welfare use	(9) Child teen birth
Basic Controls									
Teen Birth	-34.622***	-0.523***	-0.670***	-1.225***	-1.276***	-0.153***	-0.105***	0.163***	0.069***
	(3.198)	(0.009)	(0.024)	(0.086)	(0.018)	(0.003)	(0.007)	(0.003)	(0.004)
R^2	0.012	0.105	0.026	0.007	0.068	0.030	0.058	0.069	0.054
Add Sister FE									
Teen Birth	-4.137	-0.150***	-0.247***	-0.624***	-0.490***	-0.062***	-0.043***	0.081***	0.033***
	(4.367)	(0.013)	(0.034)	(0.118)	(0.026)	(0.004)	(0.010)	(0.004)	(0.006)
R^2	0.535	0.641	0.579	0.575	0.575	0.513	0.505	0.543	0.522
Add Sister FE and Maternal Characteristic									
Teen Birth	-3.349	-0.139***	-0.226***	-0.610***	-0.473***	-0.060***	-0.042***	0.080***	0.033***
	(4.370)	(0.013)	(0.033)	(0.118)	(0.026)	(0.004)	(0.010)	(0.004)	(0.006)
R^2	0.535	0.643	0.582	0.575	0.577	0.514	0.505	0.543	0.522
Delta ($\beta = 0$)	0.36	1.02	1.63	3.32	1.74	2.06	1.95	2.82	2.75
	(0.49)	(0.12)	(0.31)	(1.12)	(0.12)	(0.19)	(0.68)	(0.24)	(0.77)
N	302201	87059	33461	38765	114981	150589	65598	131283	35654

Basic controls include indicator variables for child year of birth and child gender and are included in all regressions.
Maternal Characteristic consists of an indicator for whether the mother started academic high school at age 16.
Robust standard errors in parentheses.
Delta ($\beta = 0$) represents the ratio of selection on unobservables to selection on observables that is consistent with a zero effect. Standard error on delta estimated by bootstrapping from sibling clusters.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Effect of Teen Birth on Resources and Investments

	(1) Log family earnings child aged 1	(2) Log family earnings child aged 5	(3) Log family earnings child aged 10	(4) Log family earnings child aged 15	(5) Smoked during pregnancy
Basic Controls					
Teen Birth	-0.977***	-0.644***	-0.480***	-0.362***	0.259***
	(0.010)	(0.008)	(0.006)	(0.006)	(0.044)
R^2	0.300	0.268	0.208	0.147	0.013
Add Sister FE					
Teen Birth	-0.676***	-0.392***	-0.267***	-0.181***	0.181***
	(0.012)	(0.010)	(0.008)	(0.007)	(0.054)
R^2	0.674	0.649	0.613	0.581	0.585
Add Sister FE and Maternal Characteristic					
Teen Birth	-0.673***	-0.389***	-0.264***	-0.177***	0.170**
	(0.012)	(0.010)	(0.008)	(0.007)	(0.053)
R^2	0.674	0.649	0.613	0.582	0.590
N	264411	275540	259802	223898	21341

Basic controls include indicator variables for child year of birth and child gender and are included in all regressions.
Maternal characteristic consists of an indicator for whether the mother started academic high school at age 16.
Robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6A: Mechanisms: Father Characteristics and Family Resources as Mediating Variables

	(1) Birth Weight	(2) Middle School GPA	(3) Cognitive Score	(4) Height	(5) Schooling	(6) Finished HS	(7) Log earnings age 30	(8) Welfare use	(9) Child teen birth
Sister FE and Maternal Characteristic									
Teen Birth	-0.486	-0.140***	-0.227***	-0.616***	-0.475***	-0.061***	-0.042***	0.080***	0.033***
	(4.515)	(0.013)	(0.033)	(0.118)	(0.026)	(0.004)	(0.010)	(0.004)	(0.006)
R^2	0.534	0.643	0.582	0.575	0.577	0.514	0.505	0.543	0.522
Add Father Controls									
Teen Birth	6.776	-0.064***	-0.128***	-0.288*	-0.330***	-0.046***	-0.036**	0.066***	0.024***
	(4.826)	(0.013)	(0.035)	(0.117)	(0.027)	(0.005)	(0.011)	(0.005)	(0.006)
R^2	0.537	0.665	0.612	0.637	0.591	0.519	0.506	0.545	0.523
Add Family Resources									
Teen Birth	8.336	-0.071***	-0.179***	-0.550***	-0.358***	-0.043***	-0.024*	0.061***	0.028***
	(4.563)	(0.013)	(0.034)	(0.119)	(0.026)	(0.004)	(0.010)	(0.004)	(0.006)
R^2	0.535	0.655	0.586	0.575	0.588	0.523	0.508	0.555	0.524
Add Father Controls and Family Resources									
Teen Birth	12.695**	-0.025	-0.106**	-0.262*	-0.255***	-0.034***	-0.023*	0.052***	0.020***
	(4.850)	(0.013)	(0.035)	(0.117)	(0.027)	(0.005)	(0.011)	(0.005)	(0.006)
R^2	0.538	0.672	0.613	0.638	0.598	0.526	0.509	0.557	0.525
GELBACH Decomposition: Total Change									
	13.18	0.115	0.122	0.351	0.220	0.027	0.019	-0.028	-0.013
Contribution of Paternal Characteristics to Total Change									
	5.40	0.060	0.093	0.316	0.122	0.011	0.002	-0.010	-0.008
Contribution of Family Resources to Total Change									
	7.78	0.055	0.029	0.034	0.098	0.015	0.017	-0.018	-0.004
N	239975	87125	33475	38782	115032	150674	65623	131342	35662

All regressions include the basic controls, maternal grandparent fixed effects, and controls for maternal characteristic.
Only birth cohorts up to 2000 are included.
Robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6B: Mechanisms: Father Characteristics as Mediating Variables, Stratified by Whether Father Married to Mother at Age 15

Panel A: Cases where fathers are not married to the mothers when the child is aged 15

	(1) Birth Weight	(2) Middle School GPA	(3) Cognitive Score	(4) Height	(5) Schooling	(6) Finished HS	(7) Log earnings age 30	(8) Welfare use	(9) Child teen birth
GELBACH Decomposition: Total Change									
	14.15	0.067	0.082	0.428	0.103	0.017	0.010	-0.015	-0.014
Contribution of Paternal Characteristics to Total Change									
	7.60	0.040	0.077	0.410	0.061	0.010	0.006	-0.005	-0.011
Contribution of Family Resources to Total Change									
	6.55	0.027	0.005	0.018	0.042	0.007	0.004	-0.009	-0.003
N	55982	24326	5608	6798	20354	29808	9298	25030	6290

Panel B: Cases where fathers are married to the mothers when the child is aged 15

	(1) Birth Weight	(2) Middle School GPA	(3) Cognitive Score	(4) Height	(5) Schooling	(6) Finished HS	(7) Log earnings age 30	(8) Welfare use	(9) Child teen birth
GELBACH Decomposition: Total Change									
	4.92	0.093	0.113	0.245	0.172	0.013	0.010	-0.016	-0.014
Contribution of Paternal Characteristics to Total Change									
	3.87	0.071	0.090	0.223	0.124	0.008	0.000	-0.011	-0.012
Contribution of Family Resources to Total Change									
	1.04	0.022	0.022	0.022	0.048	0.005	0.010	-0.005	-0.003
N	103324	30283	16026	18359	56994	71214	35134	63087	16649

Table 7: Exploring Heterogeneity in the Effects of Teen Childbearing on Child Outcomes by Maternal Grandfather Education (SES)

Panel A: Teen Birth and Child Outcomes by Maternal Grandfather Education (SES)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Birth Weight	Middle School GPA	Cognitive Score	Height	Schooling	Finished High School	Log earnings age 30	Welfare use	Child teen birth
Teen Birth	14.421	-0.121	-0.219*	-0.244	-0.096	-0.013	-0.119***	0.083***	0.058***
	(10.705)	(0.086)	(0.09)	(0.311)	(0.069)	(0.011)	(0.031)	(0.012)	(0.015)
Teen Birth*Grandfather High Education	-0.741	-0.090**	-0.196*	-0.229	-0.119	-0.009	-0.022	0.031**	-0.028
	(10.979)	(0.031)	(0.092)	(0.312)	(0.074)	(0.011)	(0.033)	(0.012)	(0.015)
Teen Birth*(YOB-1966)	-1.146	0	0.001	-0.028	-0.028***	-0.003***	0.007**	0	-0.002
	(0.602)	(0.003)	(0.006)	(0.022)	(0.005)	(0.001)	(0.002)	(0.001)	(0.001)
N	297798	86112	32820	38016	112697	147767	64207	128708	35004
R^2	0.534	0.643	0.583	0.575	0.577	0.514	0.505	0.542	0.521

All regressions include the basic controls (indicator variables for child year of birth and child gender), maternal grandparent fixed effects, and controls for maternal characteristic.
YOB relates to child year-of-birth.
Robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Panel B: Selection on Maternal and Paternal Characteristics by Maternal Grandfather Education (SES)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Maternal Selection		Paternal Selection				
	Mother started academic HS	Mother first-born	Paternal grandfather high school	Father started academic HS	Father Cognitive Score	Father Height	Father age at birth
Teen Birth	-0.085***	-0.056***	0.004	-0.065***	-0.217***	-0.909***	-0.815***
	(0.007)	(0.007)	(0.008)	(0.01)	(0.05)	(0.174)	(0.078)
Teen Birth*Grandfather High Education	-0.012	0.018	-0.021*	-0.037***	-0.145**	-0.133	-0.169*
	(0.009)	(0.009)	(0.009)	(0.01)	(0.044)	(0.152)	(0.085)
Teen Birth*(MYOB-1949)	0.000	0.003***	0.000	0.001*	-0.011***	0.007	-0.107***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.009)	(0.004)
N	298418	298418	271405	298418	199578	224501	298418
R^2	0.611	0.54	0.521	0.546	0.562	0.493	0.69

All regressions include indicators for mother's year of birth and child gender and maternal grandparent fixed effects.
MYOB refers to the year of birth of the mother.
Robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix Table 1: Effect of Teen Birth on Child Outcomes (First-born Children)
Results when teen pregnancies excluded if they are not for the youngest sister

	(1) Birth Weight	(2) Middle School GPA	(3) Cognitive Score	(4) Height	(5) Years of School	(6) Finished High School	(7) Log earnings age 30	(8) Welfare use	(9) Child teen birth
Basic Controls									
Teen Birth	-39.366***	-0.551***	-0.737***	-1.253***	-1.396***	-0.169***	-0.113***	0.177***	0.078***
	(4.122)	(0.011)	(0.030)	(0.108)	(0.022)	(0.004)	(0.008)	(0.004)	(0.005)
R^2	0.012	0.100	0.026	0.006	0.067	0.030	0.054	0.067	0.058
Add Sister FE									
Teen Birth	2.491	-0.194***	-0.278***	-0.530**	-0.619***	-0.077***	-0.042**	0.088***	0.045***
	(6.320)	(0.016)	(0.047)	(0.167)	(0.036)	(0.006)	(0.014)	(0.006)	(0.008)
R^2	0.541	0.638	0.581	0.578	0.582	0.521	0.509	0.550	0.529
Add Sister FE and Maternal Characteristic									
Teen Birth	3.604	-0.179***	-0.251***	-0.515**	-0.599***	-0.075***	-0.041**	0.088***	0.044***
	(6.324)	(0.016)	(0.047)	(0.167)	(0.036)	(0.006)	(0.014)	(0.006)	(0.008)
R^2	0.541	0.641	0.585	0.578	0.585	0.522	0.509	0.550	0.529
N	269435	83115	27563	31937	95282	127277	52776	109495	29235

Basic controls include indicator variables for child year of birth and child gender and are included in all regressions.
Maternal Characteristic consists of an indicator for whether the mother started academic high school at age 16.
Robust standard errors in parentheses.
. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix Table 2: Effect of Teen Birth on Child Outcomes (First-born Children): Using More Detailed Age Categories

Basic Controls:

Age of Mother at Child Birth:	(1) Birth Weight	(2) Middle School GPA	(3) Cognitive Score	(4) Height	(5) Schooling	(6) Finished High School	(7) Log earnings age 30	(8) Welfare use	(9) Child teen birth
15-17	-47.952***	-0.622***	-0.838***	-1.459***	-1.575***	-0.195***	-0.140***	0.232***	0.127***
	(6.014)	(0.021)	(0.044)	(0.151)	(0.031)	(0.006)	(0.012)	(0.006)	(0.009)
18-19	-30.927***	-0.502***	-0.621***	-1.156***	-1.187***	-0.141***	-0.095***	0.143***	0.052***
	(3.466)	(0.010)	(0.026)	(0.094)	(0.020)	(0.003)	(0.008)	(0.003)	(0.004)
N	302201	87059	33461	38765	114981	150589	65598	131283	35654
R^2	0.012	0.105	0.027	0.007	0.069	0.031	0.058	0.071	0.058

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Sister FE with additional maternal characteristic as control:

Age of Mother at Child Birth:	(1) Birth Weight	(2) Middle School GPA	(3) Cognitive Score	(4) Height	(5) Schooling	(6) Finished High School	(7) Log earnings age 30	(8) Welfare use	(9) Child teen birth
15-17	-7.620	-0.190***	-0.353***	-0.462*	-0.560***	-0.079***	-0.048**	0.113***	0.078***
	(7.939)	(0.027)	(0.061)	(0.208)	(0.043)	(0.008)	(0.018)	(0.008)	(0.011)
18-19	-2.274	-0.129***	-0.194***	-0.649***	-0.451***	-0.056***	-0.040***	0.072***	0.022***
	(4.647)	(0.014)	(0.035)	(0.125)	(0.027)	(0.005)	(0.011)	(0.005)	(0.006)
Delta 15-17	0.62	1.23	2.31	1.52	1.62	2.12	1.53	2.77	4.77
	(0.72)	(0.22)	(0.58)	(0.91)	(0.16)	(0.28)	(0.76)	(0.30)	(1.43)
Delta 18-19	0.26	0.97	1.45	4.20	1.80	2.06	2.19	2.95	2.08
	(0.56)	(0.13)	(0.33)	(1.74)	(0.15)	(0.21)	(0.86)	(0.30)	(0.86)

N	302201	87059	33461	38765	114981	150589	65598	131283	35654
R^2	0.535	0.643	0.582	0.575	0.577	0.514	0.505	0.543	0.523

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Delta 15-17 represents the ratio of selection on unobservables to selection on observables that is consistent with a zero effect for aged 15-17. *Delta 18-19* represents the ratio of selection on unobservables to selection on observables that is consistent with a zero effect for aged 18-19 . Standard errors on delta 15-17 and delta 18-19 estimated by bootstrapping from sibling clusters.

Appendix Table 3: Effect of Teen Birth on Marital Status and Completed Family Size

Basic Controls

	(1) Married when Child is 1	(2) Married when Child is 5	(3) Married when Child is 10	(4) Married when Child is 15	(5) Completed Family Size
Teen Birth	-0.294***	-0.229***	-0.185***	-0.149***	0.232***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.007)
N	301354	299546	276030	235354	213163
R^2	0.145	0.086	0.054	0.038	0.056

Add Fixed Effects

	(1) Married when Child is 1	(2) Married when Child is 5	(3) Married when Child is 10	(4) Married when Child is 15	(5) Completed Family Size
Teen Birth	-0.168***	-0.130***	-0.103***	-0.074***	0.179***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.009)
N	301354	299546	276030	235354	213163
R^2	0.637	0.584	0.552	0.533	0.560

Add Sister FE and Maternal Characteristic

	(1) Married when Child is 1	(2) Married when Child is 5	(3) Married when Child is 10	(4) Married when Child is 15	(5) Completed Family Size
Teen Birth	-0.167***	-0.130***	-0.103***	-0.074***	0.180***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.009)
N	301354	299546	276030	235354	213163
R^2	0.637	0.584	0.552	0.533	0.560

Sample is restricted to women born by 1970 when studying completed family size.
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix Table 4: Effects of Paternal Quality on Child Outcomes Including Paternal Family Fixed Effects

	(1) Birth Weight	(2) Middle School GPA	(3) Cognitive Score	(4) Height	(5) Schooling	(6) Finished HS	(7) Log earnings age 30	(8) Welfare use	(9) Child teen birth
Teen Birth	11.509*	-0.122***	-0.194***	-0.124	-0.432***	-0.065***	-0.034**	0.079***	0.043***
	(4.818)	(0.012)	(0.036)	(0.122)	(0.028)	(0.005)	(0.012)	(0.005)	(0.006)
Female	-106.951***	0.419***			0.815***	0.065***	-0.340***	0.008**	
	(2.677)	(0.006)			(0.019)	(0.003)	(0.009)	(0.003)	
Maternal Grandfather high ed	9.532**	0.083***	0.154***	0.232*	0.192***	0.015***	-0.010	-0.007	-0.010*
	(3.207)	(0.007)	(0.032)	(0.108)	(0.026)	(0.003)	(0.012)	(0.004)	(0.005)
Mother start academic HS	27.852***	0.177***	0.399***	0.332***	0.530***	0.041***	0.026**	-0.019***	-0.010*
	(3.211)	(0.007)	(0.027)	(0.093)	(0.021)	(0.003)	(0.009)	(0.003)	(0.004)
Father start academic HS	7.905*	0.101***	0.225***	-0.001	0.372***	0.023***	0.001	-0.003	-0.014**
	(3.856)	(0.009)	(0.033)	(0.112)	(0.026)	(0.004)	(0.011)	(0.004)	(0.005)
Father IQ = 2	13.163	0.182***	0.117	-0.758	0.181	0.050*	0.062	-0.006	0.008
	(16.709)	(0.031)	(0.154)	(0.536)	(0.121)	(0.020)	(0.067)	(0.021)	(0.031)
Father IQ = 3	15.554	0.254***	0.476**	-0.979	0.375**	0.073***	0.063	-0.032	-0.008
	(15.766)	(0.029)	(0.147)	(0.503)	(0.115)	(0.019)	(0.063)	(0.019)	(0.030)
Father IQ = 4	15.044	0.357***	0.511***	-0.890	0.495***	0.109***	0.094	-0.039*	0.002

	(15.471)	(0.029)	(0.143)	(0.489)	(0.112)	(0.019)	(0.062)	(0.019)	(0.029)
Father IQ = 5	22.073	0.436***	0.637***	-0.723	0.659***	0.119***	0.109	-0.053**	-0.001
	(15.540)	(0.029)	(0.144)	(0.488)	(0.112)	(0.019)	(0.061)	(0.019)	(0.029)
Father IQ = 6	23.872	0.493***	0.894***	-0.802	0.826***	0.135***	0.122*	-0.066***	-0.004
	(15.716)	(0.029)	(0.144)	(0.491)	(0.113)	(0.019)	(0.061)	(0.019)	(0.029)
Father IQ = 7	31.374*	0.579***	1.039***	-0.751	1.008***	0.148***	0.128*	-0.068***	-0.003
	(15.977)	(0.030)	(0.147)	(0.500)	(0.115)	(0.019)	(0.062)	(0.019)	(0.030)
Father IQ = 8	24.542	0.623***	1.258***	-0.815	1.186***	0.147***	0.115	-0.079***	-0.010
	(16.525)	(0.031)	(0.152)	(0.516)	(0.119)	(0.019)	(0.064)	(0.020)	(0.030)
Father IQ = 9	26.009	0.689***	1.685***	-0.730	1.320***	0.156***	0.099	-0.074***	-0.005
	(17.683)	(0.034)	(0.162)	(0.558)	(0.127)	(0.020)	(0.068)	(0.020)	(0.030)
Father age 20-22	22.302*	0.070*	-0.093	-0.059	0.049	0.022*	-0.011	-0.038***	-0.027
	(9.643)	(0.027)	(0.072)	(0.245)	(0.055)	(0.010)	(0.024)	(0.010)	(0.014)
Father age 23-25	28.622**	0.110***	-0.096	0.162	0.123*	0.031**	0.003	-0.067***	-0.029*
	(9.891)	(0.028)	(0.074)	(0.257)	(0.057)	(0.010)	(0.025)	(0.010)	(0.014)
Father age 26-30	23.291*	0.190***	0.029	0.608*	0.334***	0.051***	0.029	-0.094***	-0.045**
	(10.318)	(0.028)	(0.079)	(0.275)	(0.061)	(0.010)	(0.027)	(0.011)	(0.015)
Father age 31-35	7.042	0.197***	-0.005	0.674*	0.424***	0.057***	0.019	-0.100***	-0.043**
	(11.212)	(0.030)	(0.091)	(0.314)	(0.071)	(0.011)	(0.033)	(0.012)	(0.016)

Father age 36+	-15.684	0.203***	0.075	0.849*	0.383***	0.066***	0.035	-0.103***	-0.031
	(12.730)	(0.033)	(0.115)	(0.413)	(0.098)	(0.014)	(0.057)	(0.015)	(0.019)
Father Height	6.902***	0.004***	0.007*	0.371***	0.007**	0.001	-0.000	-0.000	-0.000
	(0.350)	(0.001)	(0.003)	(0.011)	(0.002)	(0.000)	(0.001)	(0.000)	(0.000)
Constant	3326.505***	4.520***	4.491***	187.050***	11.683***	0.524***	12.810***	0.360**	0.129
	(133.709)	(0.053)	(0.654)	(3.578)	(0.547)	(0.092)	(0.188)	(0.115)	(0.088)
N	296475	88820	31167	36072	103197	138439	56602	118741	32548
R^2	0.460	0.650	0.582	0.593	0.581	0.508	0.503	0.535	0.505

Also included are indicator variables for child year of birth and an indicator for whether the mother started academic high school at age 16.
The sample is not restricted to cases where the mother has a sister but is restricted to cases where the father has at least one brother. Omitted categories: Father IQ = 1, Father age 19 or less. Robust standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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