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Abstract

In this paper, we model and estimate the relationship between adolescent childbearing at different ages and human capital investment. Taking advantage of a large set of potential instruments for fertility--principally state and county-level indicators of the costs of fertility and fertility control--we use instrumental variables procedures to generate unbiased estimates of the effects of early fertility at different ages on education and work. Using data from the NLSY, we find that adolescent fertility at any age substantially reduces years of formal education and early adult work experience for both black and white women. Moreover, we find that the effects of early and later teen births are essentially the same for both education and early adult work experience, and that there are no important racial differences in the effects. We also find that having a first birth prior to age 18 substantially reduces teen work experience, but that births during ages 18 and 19 have little impact on teen work experience. Our results suggest that a teen birth is a teen birth, and that public policies that reduce teenage childbearing are likely to have positive effects on the economic well being of many young mothers and their families.

Does teenage childbearing adversely affect women's social and economic outcomes? This question has given rise to a large, contentious research literature. If the answer is "yes," a second question naturally follows: do the effects vary by the mother's age at birth? Knowing whether the timing of a teenage birth matters can help us better understand the relationship between teenage childbearing and later outcomes and may provide useful information in designing policy interventions. This paper builds on our earlier evidence that teenage childbearing has negative effects on young mothers' human capital accumulation (Klepinger et. al. 1995a, 1997), and considers whether early and later teenage childbearing have different effects on this important outcome.

The presence of young children, with their need for care, will tend to conflict with the human capital investment activities typical of adolescence and early adulthood -- completing high school, attending college or obtaining other post-secondary education and training, and obtaining early work experience -- by raising the costs of and possibly reducing the returns to time spent in investment. Any human capital reductions that follow are likely to reduce the mother's long-run earnings capacity.

If the presence of children does lead to reductions in early human capital investments, a woman's age at the time of her teen birth may influence the extent to which early investments are affected by the presence of children. For instance, older teen mothers may be more likely to complete high school than younger teen moms because they are closer to graduation. Thus, a teen birth may cause a greater disruption in educational attainment if it occurs at an earlier age. Similarly, having children at a younger age may have a more detrimental effect on work experience because younger teen mothers will have had to devote time to caring for their children for a longer period of time. On the other hand, parents and other kin may provide greater support to younger teen moms because they are especially ill prepared to support themselves and their children. If support is related to age at birth, then younger teen moms may be as likely as older moms to complete high school and participate in the labor force. Alternatively, age at birth may only have a timing effect. Early teen mothers may leave school and the labor force at an earlier age than older teen mothers, but return to school and the labor force at a sufficient rate later to cancel these early effects.

While there is a sizable literature on the effects of teen childbearing on educational attainment, the question of the timing of teen childbearing has received little attention. To examine this issue, we present a life-cycle model of adolescent choices about fertility and human capital acquisition that underlies the empirical analysis. The model recognizes that the adolescent childbearing decision is endogenous in a model of human capital investment. We then specify instrumental variables models of the effects of adolescent fertility at different ages on human capital accumulation as measured by years of schooling, work experience as a teenager, and work experience as a young adult. State and county level indicators of abortion and family planning facilities and policies are appended to a sample of young women from the National Longitudinal Survey of Youth (NLSY) to provide a rich set of potential instruments for fertility. A conservative procedure for choosing an acceptable instrument set in the presence of a large set of potential instruments is suggested. The instrumental variables estimates indicate that early and later teenage childbearing have large and nearly identical effects on longer run human capital accumulation.

Research on the Human Capital Effects of Adolescent Fertility

Most investigators have found that early fertility has a negative effect on educational attainment, though there is considerable disagreement as to the magnitude of this effect. Early research on the effects of teenage childbearing on educational attainment provided evidence for a strong negative effect (Waite and Moore, 1978; Upchurch and McCarthy, 1990; Forste and Tienda, 1992). Much of this research treated fertility as exogenous to educational and employment decisions. This approach is now widely recognized as likely to lead to biased estimates, since differences in such outcomes may be due to pre-existing differences between women who parent early and those who delay childbearing, rather than a causal relationship between adolescent childbearing and adverse adult outcomes (Hofferth and Hayes, 1987; Geronimus and Korenman, 1992).

More recent studies follow one of three improved methodological paths. One approach estimates the relationship between fertility and schooling using an instrumental variables approach. Some studies employing instrumental variables find no significant effect (Rindfuss, Bumpass, and St. John ,1980; Olsen and Farkas, 1989; Ribar, 1994ab), while others find a significant impact that is much smaller than that reported in the earlier studies (Marini, 1984; Moore et al., 1993). The most recent instrumental variables studies (Klepinger, Lundberg and Plotnick, 1995a, 1997, Angrist and Evans, 1996) find that early childbearing substantially reduces schooling. In our previous studies we use a large set of instrumental variables that predict fertility well. They observe that many of the studies with insignificant results use a small number of instrumental variables (1 or 2), and suggest that weak identification of fertility may be responsible for the failure to find statistically significant effects.

A second set of studies use family fixed-effect models to account for unobserved heterogeneity. In general, these studies find smaller effects than did the early studies that treated fertility as exogenous (Ahn, 1994; Geronimus and Korenman, 1992; Hoffman, Foster and Furstenberg, 1993; Ribar, 1994b). Concern that unobserved family heterogeneity biases upward the estimated effects of early childbearing appear warranted, yet significant negative effects persist in most samples. Although family fixed-effects models are an improvement over OLS, they do have limitations. Specifically, estimates derived from family fixed-effects models are unbiased only if family heterogeneity fully captures any association between the unobservables in the risk of having a teen birth and in the relevant adult outcomes. If, however, there is unobserved individual heterogeneity that also influences both teen childbearing and adult outcomes, or endogenous relationships between fertility and other choices, family fixed-effects models are likely to yield biased estimates. Furthermore, family fixed-effects models restrict the sample to women who had a teen birth and also have a sister who was not a teen mother. This restriction severely limits the sample size, reducing the efficiency of the estimates, and may yield an unrepresentative sample.

The third approach relies on natural experiments to provide reduced form estimates of the impacts of adolescent fertility. Studies of this type typically find either non-significant effects or small effects (Grogger and Bronars, 1993; Hotz, McElroy and Sanders, 1997). Although these studies have a certain appeal, they suffer from weaknesses. For instance, Grogger and Bronars (1993) use the occurrence of a twin birth as an exogenous event, and compare the outcomes of women who have twin births to women who have a single birth. However, in estimating the impact of a teen birth their analysis inherently imposes the assumption that the effect of a twin birth is exactly equal to twice that of a single birth. Similarly, Hotz et al. (1997) use spontaneous abortions as exogenous events, and compare teens that had a spontaneous abortion to teens who gave birth. However, they must impose assumptions that are inherently difficult to test in an attempt to control for certain non-random aspects of spontaneous abortions, and the underreporting of teenage abortions in the NLSY (Jones and Forrest, 1992) and the misreporting of miscarriages raise concerns about the unbiasedness of their estimates.

Little research specifically addresses how adolescent childbearing affects work experience and what there is produces no consensus. [1] Geronimus and Korenman (1992) find no effect on current employment. Ribar (1994b) generally finds negative effects on

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[1] The literature on determinants of women's labor supply is enormous. For a recent set of papers on women's labor supply and wages, see the spring 1994 issue of the Journal of Human Resources.

both participation and hours of work. Grogger and Bronars (1993) find no effect on participation of whites but a large negative effect for blacks, while Trussell and Abowd (1980) find a positive effect for whites but no effect for blacks. However, because early childbearing is likely to affect work choices over many years, and because the positive effect of experience on wages is well established, studies that examine only current employment may well miss an important long run impact of adolescent childbearing.

Among papers that examine impacts on work experience, Moore et al. (1993) find that a teen birth has no impact on work experience for whites, blacks or Hispanics, and affects education only for Hispanics. Blackburn, et al. (1993) report that early childbearing reduces schooling, experience and tenure for white women. Hotz et al. (1997) report that becoming a teen mother is associated with short term declines in the likelihood of working and hours of work, but that these effects dwindle over time and eventually reverse direction. These studies focus on labor force activity when the respondents are in their mid-twenties or older, rather than teenage employment.

The few studies that examine fertility timing and human capital investments yield conflicting results. Upchurch and McCarthy (1990) find that earlier childbearing reduces the likelihood of completing high school, at least among dropouts. Ahn's (1994) results suggest that much of the age difference is due to unmeasured heterogeneity. Using an instrumental variables approach, Moore et al (1993) find little effect of age at first birth on either completed education or work experience, except for Hispanics. Most of these studies examine the timing issue by considering births at all ages, not just teen births. Consequently, findings of timing effects in these studies could be due to large teen birth effects, rather than evidence that there is a smooth monotonic effect of age at first birth. Hotz et al. (1997) examine the timing of all births using dummy variables for age at first birth, and find that earlier teen births have a greater detrimental impact on high school completion than a later teen birth, but they find that the timing of a teen birth has little impact on hours of work.

Our study contributes to this literature in several ways. We link the empirical estimates to a behavioral model of adolescent childbearing and its impact on both adolescent and adult human capital. We consider the effect of early childbearing on teenage work experience as well as education and later experience. We employ a large set of theoretically plausible instruments to identify the model, and implement a systematic method for selecting acceptable instruments from this set.

A Model of Adolescent Fertility and Human Capital Investment

In this section, we outline a simple model of a young woman's decisions to become a mother and to invest in human capital through formal education and work experience that guides the specification and identification of our empirical models.[2] Though the model is designed to contrast the optimal human capital investment decisions of a teen mother with those of a childless teenager, it illustrates how the effects of early childbearing might vary with the age of the mother. A lifetime consists of two periods -- adolescence and adulthood -- with investment in human capital occurring in only the first period. Each young woman maximizes a utility function of the form:

(1) $$U = U_1(C_1, L_1, KQ; K) + \rho U_2(C_2, L_2; K),$$

where period 1 is adolescence and period 2, adulthood. Future utility is discounted at rate ρ. Utility in each period depends upon consumption of goods and services, C_i, and leisure, L_i. Early childbearing is represented by a dummy variable, K, equal to one if the adolescent bears and keeps a child, and equal to zero otherwise. If $K = 1$, the utility of the adolescent mother will also be a function of child quality, Q, which depends upon inputs of time and goods to childrearing. Adult utility is also conditional upon adolescent fertility, since the child is likely to remain in the household.

Consumption and leisure are constrained by limits on time and resources in each period. Each adolescent has a fixed amount of time, which can be devoted to leisure, market work, school attendance, or childcare, although childcare can be provided or paid for by others. Consumption in period 1 depends upon the teenager's own earnings, financial or in-kind support from relatives or a spouse, and the presence of a child with whom resources must be shared. The availability of support will depend upon the adolescent's decisions regarding marriage and fertility, as well as exogenous factors such as parental resources. In general, actual support received is endogenous, and choices of fertility, marital status and living arrangements by adolescent mothers will depend upon the availability of such support, and the perceived costs of receiving it. Young adolescent mothers can be expected to receive more kin support, both because the willingness to provide support for those closer to dependent childhood will be greater, and because alternative support regimes, such as marriage or self-support, will be less feasible.

Our measure of adolescent fertility, K, requires that a pregnancy occurs and is carried to term, and depends upon the young woman's decisions regarding sexual activity,

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[2] This model is developed in more detail in Klepinger, Lundberg, and Plotnick (1997).

contraception, and abortion. Adolescent women face a two-stage decision process. In the first stage, a young woman makes decisions regarding sexual activity, contraception, and abortion that determine whether she becomes a teenage mother or remains childless. An individual makes these decisions cognizant of their second-stage implications. In the second stage, she decides how to allocate her time and resources, conditional on the presence or absence of a child. The second stage of the young woman's utility maximization problem yields her demands for education and work experience conditional on bearing and keeping a child or on remaining childless during adolescence.

For each young woman, the probability of becoming pregnant, p, will be influenced by her choice of costly pregnancy-avoidance measures, c, including contraceptive use and delay of sexual activity. The cost vector, $\mu(c)$, will depend upon the availability of contraceptive information and services, as well as individual characteristics. Conditional on a pregnancy occurring, she may choose to terminate it via abortion, incurring costs which will vary over individuals (psychic costs) and location (time and money costs, and possibly socially induced personal costs). We assume that the utility of a young woman who decides to have an abortion is equal to maximum no-child utility minus a, which represents the disutility of abortion itself. Abortion disutility (or abortion cost) will depend on personal characteristics, the social context within which fertility decisions are made, and variables measuring the availability of abortion services. The parameters affecting the fertility decision will change as the adolescent matures, with greater exposure to sexual opportunities increasing the probability of pregnancy, while the availability of contraceptives is likely to increase.

The first stage decision consists of choosing c so as to maximize expected utility, where:

$$(2) \qquad E(U) = p(c)[\max(U^0 - a, U^1) - \mu(c)] + (1 - p(c))[U^0 - \mu(c)].$$

The fertility outcome we observe, K, will be a function of abortion costs, a, and of the pregnancy-avoidance cost vector μ, as well as all variables entering the young woman's budget constraint, either with or without children. These costs, however, do not affect schooling and work experience except through their effect on observed fertility, and hence provide a way to statistically identify the effects of fertility on human capital investment decisions.

Maximization of lifetime utility, conditional on adolescent fertility, will yield a set of demands for schooling and work experience that depend upon the opportunity set facing the adolescent, including the expected rates of return to these investments. To introduce some empirical content, we recognize that the arguments of these investment functions vary over individuals. Family background variables, x_B, affect adolescent market wages, the cost of schooling, and possibly the rate of time preference, as well as available parental and other kin support. Age may affect the rates of return to schooling and experience: the return to high school completion is higher than the return to college, and the work experience of young teenagers tends to have less effect on future wages than later experience.[3] Community variables, x_C, include measures of local educational services, local social characteristics and housing market conditions. Variations in adolescent wages and employment opportunities are reflected in local labor market variables, x_{L1}. The reduced form investment equations for schooling and work experience are of the form:

(3a) $S = s(x_B, x_C, x_{L1}, K)$

(3b) $H_1 = h(x_B, x_C, x_{L1}, K)$

where the remaining endogenous variable is adolescent fertility. Childbearing necessarily depends upon all determinants of human capital investment and also upon the vector of contraception and abortion costs, $z = (a, \mu)$, so

(4) $K = k(x_B, x_C, x_{L1}, z)$

We use this relationship to identify the schooling and experience models in (3a) and (3b).

This model of adolescent human capital investment leads to reduced form empirical functions for adolescent fertility and demands for schooling and early work experience. Since work experience is an alternative to formal schooling for teenagers, the model implies that the same variables should be included in both functions. The effect of adolescent fertility on the investment functions is identified by the exclusion of contraceptive and abortion costs, which should affect adolescent time allocation only through realized fertility.

The dependence of adolescent fertility on abortion and contraception costs, and the likelihood that these parameters vary with age, suggest that the determinants of early and late adolescent childbearing be estimated separately. The model also suggests that the effect of adolescent childbearing on schooling and work experience will depend upon age, but does not generate a firm prediction as to the direction of that effect. An earlier teen birth may more severely interrupt schooling and have greater long-term effects on earnings,

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[3] For a recent survey of research on the effects of high school employment on future school performance, work, and earnings, see Ruhm (1997).

but greater kin support for younger adolescent mothers may mitigate the effect of fertility on schooling.

Estimation Methods

To test whether teenage childbearing affects educational attainment and work experience, we include dummy variables for adolescent fertility before age 18 and at ages 18-19 in regression models of these outcomes. The primary issue raised by this procedure is the potential endogeneity of fertility. Through abstinence and the use of contraception, adolescents can control the likelihood that they will become pregnant, and through abortion determine whether to carry a pregnancy to term. Consequently, if adolescents perceive that childbearing will affect their schooling and work opportunities, fertility will be determined jointly with those outcomes. To control for this potential source of bias, we estimate the effects of teenage fertility at different ages using an instrumental variables (IV) approach. [4] We report Hausman endogeneity tests and, for comparison purposes, results from OLS models.

We identify the effect of teenage childbearing on education and work experience by excluding from the education and experience equations a set of variables included in the childbearing equation. As suggested by the theoretical framework, external influences on fertility control costs, such as state policy variables that influence contraception and abortion costs, provide instruments for teenage childbearing. Age of menarche, an individual characteristic that affects fertility but is likely to affect other outcomes only via its effect on fertility, and indicators of the social context within which childbearing decisions occur provide further instruments.

Proper implementation of IV methods requires acceptable instruments. Acceptable instruments must be valid: uncorrelated with the error term in the estimating equation. They must also be relevant: they should explain a significant amount of the variance of the endogenous regressor. Otherwise, the IV estimator has poor small-sample properties and is likely to be inconsistent (Nelson and Startz, 1990a, 1990b; Bound, Jaeger, and Baker, 1995; Shea, 1993; Staiger and Stock, 1994).

The data file we have developed appends many measures of community characteristics, local economic conditions and the policy environment to individual records. These measures provide a rich set of theoretically plausible potential instruments that far exceed the minimum number needed to exactly identify the education and experience

[4] We use a linear probability model to estimate (4). The 2SLS estimator is consistent when the stochastic regressor is dichotomous (see Heckman, 1978 for a discussion).

equations. We would expect the inclusion of additional instruments to generate more efficient estimates and increase the power of tests of the substantive hypothesis. However, though the *a priori* arguments for the acceptability of the available instruments are good, they are not so compelling as to preclude testing for validity and relevance.[5] We face the problem of choosing sets of instruments when the universe of potential instruments is large.

The current econometrics literature offers little guidance in designing an optimal method of selecting instruments. Our object, then, is more modest. We wish to devise an instrument choice methodology which is conservative (i.e. unlikely to include unacceptable instruments), and which is sufficiently mechanical to avoid unintended investigator bias.

To this end, we first choose a set of valid instruments from the full set using a test of over-identifying restrictions (OIR).[6] The initial IV estimate of (3a) includes all the potential instruments in the first stage regression. If the χ^2 based on the full set of theoretically plausible instruments fails the over-identifying restrictions test, we exclude each instrument that achieves a 10 percent significance level in the OIR regression. To exactly identify the model, we maintain age of menarche, an individual characteristic likely to affect childbearing but not educational attainment or work experience, as an acceptable instrument throughout the analysis.

We then use a goodness-of-fit test to determine whether a set of potential valid instruments is relevant to the endogenous regressor and significantly improves model fit in the first-stage estimation. Since we have a large number of instruments, we can not test all possible combinations. We adopt a mechanical testing procedure that allows systematic consideration of a large number of possible predictive models and eliminates unintended investigator bias in selecting the instruments for the final model. We apply backward stepwise regression until each instrument remaining in the model achieves a 10 percent level of significance in the first-stage equation. We then rerun the OIR test on the remaining instruments and drop any that now achieve a 10 percent significance level. Thus, each instrument we ultimately use is insignificant at the 10 percent level in the OIR

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[5] We would argue, in fact, that a priori arguments are unlikely to be sufficiently compelling in the absence of a true experiment.

[6] We use Godfrey's (1988) test since it is straightforward, but other tests to determine the validity of potential instruments are also available (Hausman, 1978; Hausman and Taylor, 1981; MacKinnon, 1992; Ruud, 1984; White, 1982). For a full discussion of the approach, see Klepinger, Lundberg and Plotnick (1995b).

regression and significant at the 10 percent level in a regression predicting fertility. We follow analogous procedures to instrument each endogenous variable in (3b).[7]

Data, Samples, and Variables

The data are from the National Longitudinal Survey of Youth (NLSY), the Alan Guttmacher Institute (AGI), and other public sources. In 1979 the NLSY interviewed 12,686 male and female youths that were between ages 14 and 21 on January 1, 1979. Blacks, Hispanics and economically disadvantaged whites were oversampled. Re-interviews were conducted in succeeding years through 1991 in the file available at the start of this study. The sample for this analysis includes all women aged 14 to 20 in 1979, excluding those in the military subsample and the oversample of economically disadvantaged whites. All analyses are conducted separately for non-Hispanic whites, and non-Hispanic blacks (hereafter "whites" or "blacks") because results are likely to vary substantially by race. Sample sizes after exclusion for missing values depend on the dependent variable being analyzed.[8]

Adolescent fertility is represented by two dummy variables that indicate whether the respondent had a first birth prior to her 18th birthday and whether a respondent had a first birth during ages 18-19.[9] Among whites, 6.5 percent were mothers before age 18 and 9.3 percent had a first birth during ages 18-19; among blacks, 21.2 percent had a birth prior to age 18 and 17.1 percent had a first birth during ages 18-19. We measure educational attainment as completed years of schooling at the time of interview in the year the respondent turned 25. Reductions in human capital investments during the teenage years because of the demands of parenting may be partially replaced by later investments. By examining education levels at age 25, when most people will have completed their formal

[7] To examine the robustness of the estimates, we experimented with other significance levels to select instruments, selectively eliminated a few of the final instruments and repeated the entire process to see whether the results were being driven by specific instruments. Point estimates were robust to varying the set of potential and final instruments, but differ substantially from the results of an exactly identified model.

[8] We examined Hispanics also. The relatively small sample led to unstable results which we do not report.

[9] We also estimated models with additional dummies for births after age 19. For whites, none of these are statistically significant at even the .10 level, and adding them has little effect on the qualitative results. For blacks, the added dummies are rarely statistically significant (in some models a birth at ages 20-21 is positive and statistically significant), and the results are not robust to relatively minor changes in model specification. The inclusion of additional dummies for non-teen births yields much larger standard errors for the teen birth dummies, suggesting that their inclusion creates multicolinearity among the instrumented variables. Moreover, relatively few instruments have predictive power for the non-teen birth dummies . Consequently, we only report results for the models that do not include dummies for non-teen births. Results for models that included non-teen births are available on request.

schooling, or at least will have begun college if they intend to do so, we capture most delayed (as opposed to permanently foregone) investment in schooling. If the measure is missing for the interview year in which a respondent turned age 25, we substitute the value recorded at the time of interview in the year she turned 26.

There is some evidence to suggest that much teen work experience may have little career relevance and a correspondingly low payoff (Klepinger et. al., 1997; Ruhm, 1997). Consequently, the returns to teen and early 20s experience as well as their empirical determinants may differ. For this reason, we estimate separate equations for teenage and early adult experience. We measure full-time, full-year equivalent years of work experience during ages 16 through 19, and adult experience is measured for ages 20 through 24.[10] Table 1 lists the dependent variables and their means.

[Table 1 about here]

The education and experience equations include the same exogenous variables (also listed with means in Table 1). Personal and family background variables include highest grade completed by mother and father, a set of variables for different living arrangements experienced as a child, number of siblings and of older siblings, whether there was an adult female working for pay in the household when the respondent was age 14, whether the respondent or her parents were born outside the US, whether the respondent was born in the South, whether the respondent lived in the South or an urban area at age 14, whether a non-English language was spoken at home when the respondent was age 14, whether her household subscribed to magazines or newspapers, whether anyone in her household had a library card, the respondent's religious affiliation, and frequency of attendance at religious services. [11] We measure employment opportunities open to adolescents by the percentage of workers employed in services and in wholesale and retail trade for the state where the respondent lived at age 14. We also include county level variables, which measure aspects of the distribution of income, local economy, religious and social environment, and educational climate and school enrollment in the county in which the respondent resided in 1979. These additional controls capture potential geographical variation in the costs and returns to education and teen employment.

[10] Full-time, full-year equivalent years of work experience are calculated by dividing total hours worked by 2,000 per year. If a respondent has missing data for one or two years, we substitute the mean observed yearly experience for the missing value(s) and add it to the observed values to obtain the relevant measure of experience. If three or more years are missing, we drop the respondent from the analysis.

[11] Early regressions also included the ratio of family income to the poverty line. Since it was insignificant for all groups and since many cases lack income data, we exclude it in results reported here.

The bottom panel of Table 1 lists the full set of potential instruments for teenage fertility used in the analysis. As noted earlier, age at menarche is maintained to be an acceptable instrument throughout the analysis. State policy variables likely to affect childbearing include the maximum AFDC payment for a family of two, the presence of restrictive abortion provisions, the ages at which parental consent is no longer needed for a young woman to have an abortion or use contraception, and similar variables indicative of state policies on abortion and family planning funding and services. We measure the state-level instruments for the state in which the respondent resided at age 14, when residential location can be regarded as exogenous. We also include indicators of the availability of abortion and family planning services and of the social context within which fertility decisions are made. A substantial body of research (e.g. Billy and Moore, 1992; DeGraff, Bilsborrow and Guilkey, 1990; Grady, Klepinger and Billy, 1993; Lundberg and Plotnick, 1995; Rosenzweig and Schultz, 1985; Tsui, 1985) shows that such variables exert important influences on fertility. We measure these instruments for the county in which the respondent was living at the time of interview in 1979 (or in 1980 if data are not available for 1979).[12] Potential county-level instruments are the abortion rate, whether there is an abortion clinic performing more than 400 abortions, whether there are any Planned Parenthood clinics, the proportion of women aged 15-19 using family planning services, marital and non-marital fertility rates for women aged 15-19, and similar variables listed in the table. The final sets of acceptable instruments for schooling and the two types of work experience were selected using the procedures described in preceding section.[13]

Results

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[12] We would prefer to measure these variables at uniform early age, as we did for the state-level ones, but county of residence prior to 1979 is not available in the NLSY.

[13] Our empirical procedure does not require that the sets of acceptable instruments for the education and two experience models to be identical and, while there is overlap, they do differ. For whites, the instrument set for a birth before age 18 in the education and the two experience equations includes age of menarche and the variables indicating ages of consent for abortion and contraceptive use. In addition, the education and adult work experience equations include family planning clinics per 1000 women. The instrument set for a first birth at ages 18-19 in the education and the two experience equations includes age at menrache, hospitals per capita, and the sex ratio. In addition, the early work experience model includes the fertility rate of unmarried white women age 15-19. For blacks, the instrument set for a birth prior to age 18 in the education and two experience equations includes age of menarche, the variables indicating ages of consent for abortion and contraceptive use, the abortion rate, and family planning clinics per 1000 women. In addition, the adult work experience model includes whether there is a restriction for eligibility under Title XX. For a first birth during ages 18-19, the instruments are the same as those described above for a birth prior to age 18, but also includes the sex ratio and nurses per capita.

Table 2 displays observed means of schooling, work experience, and hourly wages among women who became mothers before age 18, those who became mothers while they were age 18-19, and those who avoided teenage parenthood. The simple differences are large. On average, white teenage mothers who had their first birth before they turned 18 complete 2.9 years (21%) less schooling, and have 0.8 years (53%) less early work experience and 1.2 years (34%) less adult experience than women were not teen mothers. Whites who became mothers while they were age 18 or 19 complete 2.1 fewer years (15%) of schooling, have .5 years (33%) less early work experience and 1.4 years (40%) less adult work experience. White teen mothers also earn about $2.25 per hour less (33%) than women who did not experience a teen birth, regardless of their age at the time of the birth. Differences for blacks are smaller but still sizable -- 1.9 years (14%) less schooling, 0.4 years (44%) less early experience, 1.1 years (39%) less early adult experience, and earned $1.55 less per hour (27%) for those with a birth prior to age 18, and 1.3 years (10%) less schooling, .3 years (33%) less early work experience, .7 years (25%) less adult work experience, and earned $.81 less per hour (13%) for those with a first birth during ages 18-19. While there are observable differences between early and late teen mothers, the largest differences are between teen mothers and those who did not give birth prior to turning age 20.

[Table 2 about here]

Multivariate regression results in Table 3 show that the direct effects of teenage childbearing on human capital development are both statistically and substantively significant.[14] The 2SLS estimates for whites indicate that a birth before age 18 lowers completed years of schooling by 2.5 years and a birth at ages 18-19 lowers completed years of schooling by 2.9 years. For a birth prior to age 18, the estimated effect is slightly less than the unconditional mean difference shown in Table 2. For a birth during ages 18-19, the estimated effect is about three-quarters of a year larger than the unconditional mean difference shown in Table 2. A birth before age 18 is estimated to lower early work experience by 2.8 years and adult work experience by 2.0 years, while a birth during ages 18-19 is estimated to have no effect on early work experience and to lower adult work experience by almost 3 years.[15] Formal t-tests fail to reject the hypothesis that a birth

[14] For brevity Table 3 only presents coefficients on the key explanatory variables. Complete results for the first and second stage regressions are available from the first author.

[15] Although the estimate for a birth prior to age 18 is not statistically significant at conventional levels for either schooling or adult work experience, the estimates are close to statistical significance (p=.11 for

before age 18 and a birth at ages 18-19 have the same effect on schooling and adult work experience. In contrast, formal tests reject the equivalence of the effects of early and latter teen births on teen work experience.

For black women the negative effects on schooling of a birth before age 18 and for a birth during ages 18-19 are 2.8 years and 2.6 years respectively, nearly identical estimates to those found for whites. As was the case for whites, an early teen birth is associated with a reduction in early work experience of over 2 years (2.2), but a later teen birth is not. An early teen birth is associated with 2.3 years less adult work experience, while a birth during ages 18-19 is associated with about 2.0 years less adult work experience. As was the case for whites, formal t-tests fail to reject the hypothesis of equivalent effects for early and latter teen births on schooling and adult work experience, but do reject this hypothesis for teen work experience.

[Table 3 about here]

The OLS results in columns 3 and 4 of table 3 also show statistically and substantively significant effects of teenage childbearing on human capital development. However, the OLS estimates are smaller than the IV estimates.[16] Larger IV results are not the expected pattern: the usual story is that early childbearing and low educational attainment are the result of a joint optimizing process or are influenced by common unobservable characteristics, and that the OLS estimates should overstate the effect of early childbearing on education. A recent paper by Angrist and Evans (1996), however, also finds that IV estimates of the effect of fertility on schooling outcomes are greater than OLS estimates, and offer an explanation based on variability over the sample in the causal effects of fertility. Although they avoid the endogeneity bias of the OLS estimates, IV estimates reflect the marginal impact of teenage childbearing on schooling and work experience for that portion of the sample whose fertility has been affected by variation in the instruments. Since many of the acceptable instruments in these models measure access to abortion and family planning services, one explanation for the relatively large IV estimates is that teenage mothers facing high costs of fertility control who would have

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schooling and p=.19 for adult work experience), and the point estimates are very similar to that observed for a first birth at ages 18-19 which are significant at the .05 level. The lack of statistical significance for births prior to age 18 for whites is, in part, due to the rarity of early teen births among whites in this sample (6.5%). Early teen births are much more common among Blacks (21.2%), and the point estimate for an early teen birth for blacks is signficant at the .05 level and very similar to that observed for whites.

avoided early childbearing had these costs been lower experience larger human capital losses.[17] The natural experiment studies, which compare teenage mothers with a narrowly defined comparison group (such as teenagers who experienced miscarriages), suffer, more obviously, from the same limitation—they estimate causal impacts of fertility for a possibly atypical subsample of the relevant population (in the case of miscarriages, women who want to have a birth).

Though the OLS and IV estimates differ, the Hausman tests of the exogeneity of fertility should lead us to be cautious in interpreting these differences. For 3 of the 6 estimates found for the black subsample, Hausman tests indicate we can reject at the .10 level or better the hypothesis that fertility is exogenous, and in two additional cases the probabilities are less than .12. For the white sample, two probabilities are less than .05 and two others lie close to .20.[18] In instances where the exogeneity hypothesis is not rejected at conventional levels of statistical significance, it may be still imprudent to accept the OLS estimates.[19] For p-values that do not decisively reject or fail to reject the assumption of exogeneity, the IV estimates may be preferred to OLS, since they are unbiased whether or not the exogeneity assumption is true. With this ambiguity, it would be a mistake to overemphasize many of the differences between the two sets of estimates. However, the results in Table 3 do show very clearly that there are significant adverse impacts of teenage childbearing on human capital investment in both formal schooling and work experience and that these impacts do not disappear when the endogeneity of fertility is taken into account using IV methods.

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[16] Tests of the equivalence of early and late teen births based on the OLS results fail to reject this hypothesis for Blacks, but reject it for schooling and adult work experience for whites.

[17] Angrist and Evans (1996) focus on the effects of the 1970 state abortion reforms on teen marriage and fertility, out-of-wedlock childbearing, and the schooling and labor market consequences for mothers. Changes in abortion availability are the basis of their IV estimates of the effects of fertility on schooling.

[18] The remaining two terms have higher p-values, suggesting that OLS may not be biased. However, in these two cases the IV point estimates have relatively large standard errors, indicating that the IV estimates are not very precise. As discussed in footnote 14, the high standard errors for these terms may be due to the rarity of births prior to age 18 among whites.

[19] Endogeneity tests consider the null hypothesis that the potentially endogenous regressor is exogenous. As noted by Nakamura and Walker (1994), failure to reject this null hypothesis is subject to Type II errors. That is, failure to reject the null hypothesis does not necessarily imply that acceptance of the null hypothesis is appropriate. For instance, while a .05 significance level implies that the risk of rejecting the null hypothesis when it is true (Type I error) is five percent, it does not imply that the risk of accepting a false null hypothesis

As the results in Table 3 clearly demonstrate, for both completed schooling and adult work experience, the effects of a birth prior to age 18 and those of a first birth during ages 18-19 are nearly identical. This pattern is the same for both blacks and whites. Moreover, the quantitative estimates are nearly the same for both blacks and whites; about 2.5 years for completed schooling and about 2 years for adult work experience. For both whites and blacks, we find that an early teen birth has a substantial negative impact on early work experience, but that an older teen birth has little impact. Using estimated wage equations from Klepinger ET. Al. (1997), the point estimates in Table 3 suggest that an early teen birth lowers hourly wages at age 25 by 41% for whites and 42% for Blacks, and that a later teen birth lowers adult wages by 52% for whites and 32% for Blacks.

On the basis of these results, we conclude, “a teen birth is a teen birth”. Having a teen birth is detrimental to human capital accumulation, regardless of a woman’s age when she has the birth. We find that a teen birth at any age is associated with significantly less formal schooling and less adult work experience, and that the effects are similar for whites and blacks. The loss of this human capital associated with a teen birth has a large effect on adult wages. Although we also find that an early teen birth, but not a later teen birth, is associated with significantly less teenage work experience, prior work suggests that teenage work experience generally has little impact on adult wages.

Conclusion

The results reported here support the main findings of early work on the consequences of teen childbearing, and are consistent with the conventional wisdom that adolescent childbearing has major adverse socio-economic consequences. These results conflict with much of the recent research, which has found modest or no significant consequences of adolescent childbearing. More precise estimates resulting from a much larger set of potential instruments may explain the differences between our results and those of prior IV studies. The contrast between our results, based on conventional IV methods, and those of recent family fixed-effect models and the natural experiment studies suggest that the identification of a control group in these studies may be crucial, and that

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(Type II error) is also five percent. On the contrary, the risk of a Type II error is inversely related to the risk of a Type I error.

possible variability in the causal effects of teenage childbearing requires further examination.

Does early adolescent fertility affect the human capital and adult wages of women differently than latter adolescent fertility? Our 2SLS results indicate that adolescent fertility substantially reduces the human capital investments of young women, regardless of their age at the time of the birth. This finding applies equally to both blacks and whites. Moreover, the findings show that the effects of teen births are essentially the same for blacks and whites. The public policy implications of these results are straightforward; measures that reduce teenage childbearing at any age will have positive effects on the economic prospects of young women and their families.

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Table 1

Means and Sources for Variables

Variables	*White Mean*	*Black Mean*	*Source*
1. Endogenous			
Birth before age 18	.07	.21	NLSY
First birth during ages 18-19	.09	.17	NLSY
Years of schooling at age 25	13.2	12.7	NLSY
Teenage work experience	1.4	0.7	NLSY
Early adult work experience	3.3	2.5	NLSY
2. Exogenous - Fertility, education and experience models			
Mother's education	12.0	10.7	NLSY
Mothers education missing	.04	.07	
Father's education	12.2	9.6	NLSY
Father's education missing	.07	.26	
Living arrangements at age 14			NLSY
Mother only	.08	.32	
Mother and step-father	.07	.07	
Other	.06	.13	
Both parents	.79	.48	
Years with mother only	.69	3.42	NLSY
Years with mother and step-father	.53	.73	NLSY
Years in other living arrangements	.32	.82	NLSY
Ever experienced divorce	.12	.17	NLSY
Number of siblings	3.1	4.8	NLSY
Number of older siblings	1.9	2.8	NLSY
Number of older siblings missing	.06	.06	
Mother worked	.53	.58	NLSY
Foreign born	.03	.02	NLSY
Mother foreign born	.05	.02	NLSY
Father foreign born	.04	.02	NLSY
Foreign language at home	.08	.04	NLSY
Born in South	.25	.61	NLSY
South residence at age 14	.26	.59	NLSY
Urban residence at age 14	.75	..92	NLSY
Magazines in home at age 14	.74	.40	NLSY
Newspapers in home at age 14	.88	.64	NLSY
Library card at age 14	.80	.64	NLSY
Employment in state of residence at age 14			NLSY
Percent in services	.18	.17	
Percent in wholesale/retail trade	.22	.22	
Percent in other	.60	.61	
Religion			NLSY
Baptist	.16	.61	
Catholic	.31	.06	
Other Protestant	.29	.12	
Jewish/Other	.14	.12	
None	.10	.09	

Attendance at religious services			
Never	.17	.09	NLSY
Rare	.27	.21	
Occasional	.19	.29	
Often	.37	.41	
County level variables			
Educational spending per 1000 students	1651	1582	CCDB
Median household income in 1979	17377	15691	CCDB
Median gross rent in 1980	235	224	CCDB
Percent of population moved into county	10.0	7.8	CCDB
Proportion of county population			CCM
Catholic	.22	.17	
Conservative Protestant	.21	.31	
Jewish and other	.004	.004	
Percent of county population			CCDB
Education 12 or more years	67	61	
Education 16 or more years	16	15	CCDB
Percent of families female-headed	13	18	CCDB
Percent of labor force female	42	44	CCDB
Percent of children in poverty families	15	22	CCDB
Unemployment rate in 1980	6.8	7.2	CCDB
School enrollment rate: 5-17 year olds	.78	.78	CCDB
Proportion of 16-17 year olds in school – state	.90	.88	CENS
Proportion of 18-19 year olds in school – state	.52	.52	CENS
3. Potential instruments for teenage fertility			
Individual			
Age at menarche	12.9	12.8	NLSY
State level			
Maximum AFDC payment to 2 person family	$211	$163	HEW1
Restrictive abortion provisions	.08	.14	HEW2
Restrictive laws on the sale/advertisement of contraception	.40	.27	HEW2
Restrictions on Medicaid funding of abortion	.19	.14	HEW2
Maximum percent of state median income for eligibility under Title XX family planning services	.75	1.71	HEW2
No maximum	.02	.13	
Age of consent for abortion	16.7	16.5	HEW2
No age of consent	.64	.49	
Age of consent for contraception	16.6	16.1	HEW2
No age of consent	.68	.62	
County level			
Abortion rate per 1,000 women	26.0	46.5	AGI
Abortion provider providing more than 400 abortions	.50	.65	AGI
Presence of abortion provider	.71	.76	AGI
Proportion of women 15-19 using family planning services	.13	.16	AGI
Proportion of family planning patients aged 15-19	.35	.32	AGI
Family planning clinics per 1000 women aged 15-19	.43	.68	AGI
Number of patients per family planning clinic	1344	1361	AGI
Hospital expenditures per 1000 population	49	71	CCDB
Number of doctors per 1,000,000 population	1639	1937	CCDB
Number of nurses per 1,000,000 population	4790	4477	CCDB

County level fertility rates and sex ratio *			
Marital fertility rate women aged 15-19	368	588	AGI
Nonmarital fertility rate women aged 15-19	16	89	AGI
Sex Ratio (# of men 15-19 / # women 15-19)	.946	.929	AGI
Number of observations	2014	1280	

NLSY - Data were obtained from the National Longitudinal Survey - Youth Cohort.
AGI - Data were obtained from the Alan Guttmacher Institute.
HEW1 - Data were obtained from the United States Department of Health, Education and Welfare.
HEW2 - Data were prepared for the United States Department of Health, Education and Welfare by the Alan Guttmacher Institute.
CCDB - Data were obtained from the City-County Data Book.
CCM - Data were obtained from B. Quinn et al., Church and Church Membership in the U.S., 1982
CENS - Data were obtained from the 1980 Census of the United States.
* These are race-specific measures.

Table 2

Mean Schooling and Experience by Teenage Fertility Experience, White and Black Women

White Women

	Mother Before Age 18	Mother at ages 18-19	Not a Teenage Mother
Years of Schooling	10.7	11.5	13.6
Years of Early Work Experience	0.7	1.0	1.5
Years of Adult Work Experience	2.3	2.1	3.5
Hourly Wage ($1990)	$6.42	$6.64	$8.67

Black Women

	Mother Before Age 18	Mother at ages 18-19	Not a Teenage Mother
Years of Schooling	11.4	12.0	13.3
Years of Early Work Experience	0.5	0.6	0.9
Years of Adult Work Experience	1.7	2.1	2.8
Hourly Wage ($1990)	$5.66	$6.40	$7.21

Source: Tabulations from the NLSY.

Table 3

Impact of Teenage Childbearing on Human Capital Accumulation, for White and Black Women,
(Standard errors in parentheses)

WHITES

	Two Stage Least Squares		**Ordinary Least Squares**	
	Birth before Age 18	First birth during ages 18-19	Birth before Age 18	First birth during ages 18-19
1. Years of Schooling	-2.46 (1.62)	-2.87 (1.41)**	-1.75 (.16)**	-1.15 (.14)**
Hausman p	.68	.20		
2. Early Work Experience	-2.79 (.1.03)**	.59 (.84)	-.74 (.09)**	-.62 (.08)**
Hausman p	<.01	.03		
3. Adult Work Experience	-2.02 (1.57)	-2.93 (1.32)**	-.87 (.16)**	-1.35 (.13)**
Hausman p	.43	.22		

BLACKS

	Birth before Age 18 (2SLS)	First birth during ages 18-19 (2SLS)	Birth before Age 18 (OLS)	First birth during ages 18-19 (OLS)
1. Years of Schooling	-2.82 (1.09)**	-2.62 (1.08)**	-1.28 (.13)**	-.97 (.14)**
Hausman p	.11	.11		
2. Early Work Experience	-2.19 (.65)**	-.64 (.69)	-.24 (.06)**	-.17 (.07)**
Hausman p	<.01	.49		
3. Adult Work Experience	-2.31 (1.10)**	-1.96 (1.12)*	-.55 (.14)**	-.30 (.15)**
Hausman p	.07	.09		

The Hausman p shows the confidence level for rejecting the null hypothesis that teen childbearing is exogenous.
* = significant at 10% level
** = significant at 5% level