

How Does Adolescent Fertility Affect the Human Capital and Wages of Young Women?

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Abstract

The consequences of teen childbearing for the future well-being of young women remain controversial. In this paper, we model and estimate the relationship between early childbearing and human capital investment, and its effect on wages in early adulthood. 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 on education and work experience, and the effects of these outcomes on adult wages. For both black and white women, adolescent fertility substantially reduces years of formal education and teenage work experience. White teenage mothers also obtain less early adult work experience. We find that, through these human capital effects, teenage childbearing has a significant effect on a young woman's market wage at age 25. Our results, unlike those of recent "revisionist" studies, suggest that public policies which reduce teenage childbearing are likely to have positive effects on the economic well-being of many young mothers and their families.

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The human capital young women bring to the market is a major determinant of their earnings capacity. It seems reasonable that the presence of young children, with their need for care, will 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.

If reductions in these early investments occur, they are likely to have adverse long term consequences for the wages, earnings, and employability of the mother. Reduced earnings will have substantial negative effects on the total income and, hence, economic well-being, of young mothers and their families, both because the contribution of young married women's earnings to total family income is substantial and increasing (Dechter and Smock, 1994) and because a young mother is likely to be single for several years when her children are young. In 1994, more than three-quarters of teen births were non-marital (Child Trends, 1996), and divorce rates for very young married couples are high. Lower earnings and the need for child care also make long-term dependence upon government aid a more likely outcome for adolescent mothers.

While there is a sizable literature on how teenage childbearing affects educational attainment (see Klepinger, Lundberg and Plotnick, 1995a, and the references therein), research on how it affects experience and wages is relatively meager. Since these matters are central to the scholarly and public policy debates about adolescent childbearing, this study estimates the relationships between teenage childbearing and human capital

accumulation as measured by years of schooling, work experience as a teenager, and work experience as a young adult. It then considers the implications of these relationships for the wages that young women can expect to earn. The findings allow disaggregation of the impact of teenage fertility on wages into a direct effect and indirect effects operating through reduced human capital accumulation.

We develop 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 models of human capital investment and wage determination and suggests an identification strategy, in that factors affecting the costs of fertility control should affect human capital decisions only through realized fertility.

We then specify instrumental variables models of the effects of early fertility on education and work experience, and of the effects of these outcomes on adult wages. State and county level indicators of abortion and family planning facilities and policies are appended to our sample of young women from the National Longitudinal Survey of Youth (NLSY) to provide a rich set of potential instruments for fertility. A conservative policy for choosing an instrument set in the presence of a large set of potential instruments is suggested, and we follow a mechanical, step-wise procedure to exclude instruments that are uncorrelated with the endogenous regressor variables, or that cause the model to fail a test for overidentifying restrictions. With this new application of instrumental variables, we fail to reject the conventional wisdom that teenage childbearing has substantial effects on future labor market opportunities. These results

are different from, and usefully supplement, the largely negative results of other recent studies based on the comparison of selected subsamples.

Research on the Human Capital and Wage Effects of Adolescent Fertility

Education Early research on the effects of teenage childbearing on educational attainment provided strong evidence for the expected negative effect. Waite and Moore's (1978) path-breaking paper reports large negative effects of early childbearing on educational attainment after controlling for a variety of individual and family background factors. That work, as well as some more recent studies (Upchurch and McCarthy, 1990, Forste and Tienda, 1992) treats fertility as exogenous to educational decisions. Such an approach is now widely recognized as likely to lead to biased estimates, since differences in outcomes such as educational attainment may be due to pre-existing differences between women who parent early and those who delay childbearing, rather than any causal relationship between adolescent childbearing and adverse adult outcomes. For instance, compared to women who delay their first births, women who have early births may have low educational and earnings aspirations, more disadvantaged backgrounds or other unobserved characteristics that lead to poorer later outcomes (Hofferth, 1987; Geronimus and Korenman, 1992).

More recent studies follow one of three improved methodological paths. Some estimate the relationship between fertility and schooling using an instrumental variables approach. Rindfuss, Bumpass, and St. John (1980) find no significant effect of age of birth on educational attainment. Marini (1984) reports a significant impact much smaller than that reported in the earlier literature. Olsen and Farkas (1989) find no effect of

pregnancy on the drop-out behavior of poor black female high school students. Using a pooled sample of whites, blacks and Hispanics from the NLSY, Ribar (1994a) reports that teenage fertility does not affect the likelihood of dropping out of high school by age 20. His later NLSY study (Ribar 1994b) reports similar results and also no effect on completed years of schooling.¹ In another instrumental variables study using the NLSY, Moore *et al.* (1993) report no effect of age at first birth on highest grade completed for whites and blacks, but a significant positive relationship for Hispanics.

In contrast, the most recent instrumental variables study (Klepinger, Lundberg and Plotnick, 1995a) finds that early childbearing reduces schooling by nearly 3 years for white, black and Hispanic women. The authors use a large set of instrumental variables that predict fertility well, while many of the studies that report insignificant results use a small number of instrumental variables (1 or 2). Weak identification of fertility in those studies may be responsible for the failure to find significant effects.

A second set of studies use family fixed-effect models to account for unobserved heterogeneity. Geronimus and Korenman (1992) use three major data sets to compare the experiences of sisters who timed their births at different ages. Hoffman, Foster and Furstenberg (1993) and Ribar (1994b) replicate this study on different samples. With all five samples, cross-section regressions show that early childbearing reduces the probability both of completing high school and of obtaining post-secondary schooling. The fixed-effect approach finds an insignificant relationship in three of these ten cases and substantially reduces the magnitude of the significant effect in several others. Ribar

¹ His disaggregated estimates show negative effects for whites and Hispanics, but positive effects for blacks.

finds a similar pattern with years of schooling as the dependent variable. Concern that unobserved family heterogeneity biases upward the estimated effects of early childbearing appears warranted, yet significant negative effects persist in most samples.²

Despite their appeal, family fixed-effect models have limitations. Estimates derived from such models are unbiased only if unobserved family heterogeneity is the only factor that affects both the risk of having a teen birth and 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-effect models are likely to yield biased estimates. Family fixed-effect models restrict the sample to women who had a teen birth and also had a sister who was a non-teen mother. This restriction limits the sample size, reduces the efficiency of the estimates, and may introduce sample selection bias.

The third approach relies on natural experiments to provide reduced form estimates of the impacts of adolescent fertility. Grogger and Bronars (1993) use Census data to compare outcomes of teenage women experiencing twin first births to those of teenage women experiencing single first births. They report insignificant effects of teenage childbearing on years of schooling and the likelihood of high school graduation for whites, but significant negative effects for blacks.³ Although the birth of twins can be viewed as a random event, use of twin births as a natural experiment will not yield

² Because of the small sample sizes typically obtained in sibling analyses of qualitative outcomes, no study disaggregates by race when analyzing the two probabilities. With years of schooling as the dependent variable Ribar can disaggregate by race and finds similar patterns. In a similar vein, Ahn (1994) finds that controlling for individual-specific heterogeneity reduces the estimated impact of a teen birth on high school completion, but the effect of a birth is still negative and statistically significant.

³ Bronars and Grogger (1994) report similar results in an analysis of the consequences of unwed motherhood. In this study unwed mothers can be of any age.

unbiased estimates of the effects of a teen birth unless the effect of a twin birth is exactly twice that of a single birth.

Hotz, McElroy and Sanders (1995) suggest an interesting “control group” with which to compare teenage mothers. They argue that since miscarriages are largely random events, women who miscarry as teenagers are a random sample of women who become pregnant as teenagers and, thus, comparing outcomes of teenagers who miscarry to those who have births is an appropriate natural experiment.⁴ Their analysis of the NLSY finds that teen mothers are less likely to complete high school and more likely to get a GED than teens who miscarry. Although Hotz *et al.* attempt to control for certain non-random aspects of spontaneous abortions, the assumptions they impose are inherently difficult to test. The underreporting of teenage abortions in the NLSY (Jones and Forrest, 1992) and the possible misreporting of miscarriages also raise concerns about the randomness of this control group.

Work Experience, Wages and Earnings The literatures on determinants of women's labor supply and wages are enormous.⁵ There are many estimates of the effect of fertility on wages, and some recent studies have accounted for the endogeneity of fertility, education, and experience (Korenman and Neumark, 1992; Neumark and Korenman, 1994; Blackburn and Neumark, 1995). Little research, though, specifically addresses how adolescent childbearing affects work experience or later wages. We review the most relevant studies.

⁴ Although Hotz *et al.* actually use spontaneous abortions to identify an IV estimation method, they do so to account for certain non-random aspects of spontaneous abortions. That is, they use the IV approach to create a "better" comparison group for their natural experiment.

No consensus emerges from recent estimates of the effects of adolescent childbearing on current employment or labor force participation. Geronimus and Korenman (1992) find no effect on current employment. Ribar (1994b) generally finds negative effects on 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. These studies focus on labor force activity when the respondents are in their mid-twenties or older, rather than teenage employment.

Moore et al. (1993) and Blackburn, Bloom, and Neumark (1993) provide the two most comprehensive studies of the labor market effects of early childbearing. Moore et al. (1993) examine accumulated work experience by age 26 and real earnings at age 27 and address the possibility that wages may be jointly determined with fertility, schooling and experience. Age at first birth has no impact on work experience for whites, blacks or Hispanics, and affects education only for Hispanics. Since the model allows age at first birth to affect earnings only indirectly through its effects on education or experience, we infer it has an indirect effect only for Hispanics.

Blackburn, Bloom, and Neumark (1993) report that early childbearing reduces schooling, experience, tenure and wages for white women. Lower investments in schooling, experience and job tenure due to early childbearing account for most of the wage effect. Fertility timing appears to have a small direct effect on wages even after controlling for its impact on human capital accumulation. The analysis assumes

⁵ For a recent set of papers on women's labor supply and wages, see the spring 1994 issue of the Journal of Human Resources.

education is exogenous with respect to wages. It does test for whether fertility and experience are endogenous to wages and concludes the latter is, but the former is not.

Hotz *et al.* (1995) report that becoming a teen mother is associated with short term declines in the likelihood of working, hours of work, and earnings, but that these effects dwindle over time and eventually reverse direction. The study does not examine whether the effects of teen motherhood on work and schooling account for the effect on earnings.

The existing literature suggests that the effect of early childbearing on wages or earnings is mostly indirect.⁶ Women who become young mothers earn less because they obtain less formal education and work experience. This relationship appears both in studies that ignore the possibility that wages may be jointly determined with fertility, schooling and experience and those that consider it.

Our study contributes to this literature in several ways. Unlike most work (except Blackburn *et al.*, 1993), we link the empirical estimates to an explicit behavioral model of adolescent childbearing and its impact on both adolescent and adult human capital and labor market outcomes. We also consider the effect of early childbearing on teenage work experience as well as education and later experience. Since early childbearing is likely to affect work choices over many years, and 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. Last, in pursuing the instrumental

⁶ Two important early studies which do not consider possible endogeneity of fertility also support this conclusion. Hofferth and Moore (1979) show that delaying the first birth raises earnings at age 27. This effect arises largely because delaying a birth reduces family size, which in turn increases earnings. Among women who had a first birth at 18 or younger, the earnings impact is largely due to another indirect effect: delaying a birth increases education. Trussell and Abowd (1980) find that after controlling for education and experience, age at first birth has no effect on wages of married mothers age 25-44.

variables estimation approach, we implement a systematic method for selecting acceptable instruments from a large set of conceptually plausible potential instruments.

A Model of Adolescent Fertility and Human Capital Investment

We present 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. The model does not provide a fully general description of adolescent behavior as it relates to childbearing and investment in human capital, but is designed to contrast the optimal human capital investment decisions of a teen mother with those of a childless teenager. We use the theoretical results to help specify and identify empirical models of the determinants of education, work experience, and adult wages in a manner consistent with a theory of individual decision-making.

For simplicity, we represent a lifetime as 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:

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

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, but we do not consider explicitly the determinants of adult childbearing or its effects on adult time allocation.

Consumption and leisure are constrained by limits on time and resources in each period. Each adolescent has a fixed amount of time, \bar{T}_1 , which can be devoted to leisure (L_1), market work (H_1), school attendance (S), or childcare (D_1), so that

$$(2) \quad \bar{T}_1 = L_1 + H_1 + S + D_1$$

The budget constraint is assumed to be binding in each period, so that adolescents are not permitted to borrow against their adult earnings. 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, so that

$$(3) \quad C_1 = \{w_1 H_1 + Y_1\} / N_1 ,$$

where w_1 is the market wage of a teenager, $N_1 = N(K)$ is a consumption deflator, and Y_1 is the value of support received from parents, spouse, or other kin. 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.

The adolescent mother chooses child quality through endogenous inputs of time and money to childraising. If household public goods, such as shelter, are important determinants of child quality, it seems reasonable to tie money inputs to children to the

mother's own consumption level. Childcare time can be provided by the mother (D_1), or donated by others (DO_1), so that $Q = Q(C_1, D_1, DO_1)$.

Time and budget constraints in the second period are:

$$(4a) \quad \bar{T}_2 = L_2 + H_2, \text{ and}$$

$$(4b) \quad C_2 = \{w_2 H_2 + Y_2\} / N_2,$$

where the variables are analogous to those defined above. The market wage in adulthood depends upon work experience and schooling undertaken in adolescence, so that $\ln w_2 = \ln w_1 + r_S S + r_H H_1$ where r_S and r_H are the rates of return to schooling and work experience, respectively. In general the parameters of the adult budget constraint, specifically the wage rate, potential husband's income and the consumption deflator, will be functions of the fertility decisions made in period 1.

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, 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. These decisions are made by an individual 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.

To examine the effects of fertility on human capital investments, given that fertility is endogenous, we consider the young woman's decision process in reverse order.

First, we maximize her utility conditional on $K = 0$ (U^0), and derive the conditional demands for schooling and work experience by non-childbearers. Then, we maximize utility conditional on $K = 1$ (U^1) and derive the corresponding conditional demands for human capital investment for an adolescent mother. Finally, the maximal levels of utility conditional on K enter into the young woman's decision to employ costly pregnancy avoidance and pregnancy resolution strategies. Combining the costs of avoiding or terminating a pregnancy with the utility consequences of fertility enables us to derive an equation for observed fertility.

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

$$(5) \quad E(U) = p(c)[\max(U^0 - a, U^1) - \mu(c)] + (1 - p(c))[U^0 - \mu(c)]$$

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 $K = i$, will yield a set of demands for adolescent human capital investment of the form:

$$(6a) \quad S_1^i = s^i(w_1, r_S, r_H, \rho, N_1^i, Y_1^i, DO_1^i, N_2^i, Y_2^i)$$

$$(6b) \quad H_1^i = h^i(w_1, r_S, r_H, \rho, N_1^i, Y_1^i, DO_1^i, N_2^i, Y_2^i)$$

where Y_1^i , DO_1^i and Y_2^i are the endogenous amounts of support received, given the young woman's optimal choice of a support regime when $K = i$.

In general, this human capital model predicts that completed years of schooling will be a positive function of income and child care support received during adolescence, which reduces the marginal cost of time spent in school, and a negative function of the income support expected during adulthood, which reduces the marginal benefit to school by encouraging a fall in future labor supply. An increase in the rate of return to formal education will increase schooling, as will an increase in the relative value of adult versus adolescent consumption (ρ).

Adolescent fertility has both positive and negative effects on schooling, though the net effect is expected to be negative. The direct negative effect of early childbearing will act through the effect of child care time on the marginal cost of school time.

However, the effect on adult labor supply, and thus the return to schooling, is uncertain, since the presence of a child will increase both consumption demands and available financial support in adulthood.

Work experience is usually analyzed with a standard labor supply model, in which the level of schooling and fertility decisions are taken as given. This model shows that early work experience must be recognized as an alternative to formal education in terms of both sacrificed leisure and in the opportunity to transfer resources into the future by investing in skills, and so implies that adolescent work experience is a function of the same variables determining formal schooling.

To introduce some empirical content, we recognize that the arguments of the 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. 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} . Substitution into the above equations gives us reduced form investment equations of the form:

$$(7a) \quad S = s(x_B, x_C, x_{L1}, K)$$

$$(7b) \quad H_1 = h(x_B, x_C, x_{L1}, K)$$

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

$$(8) \quad K = k(x_B, x_C, x_{L1}, z)$$

We use this relationship to identify the schooling and experience models in (7a) and (7b).

Adult wages will be affected by adolescent fertility indirectly through the influence of childrearing responsibilities on realized education and early work experience, and possibly directly if such responsibilities affect the rates of return to human capital investments. We can therefore write the adult wage equation as:

$$(9) \quad w_2 = w(S, H_1, K, x_{L2}),$$

where x_{L2} is a vector of variables affecting adult labor markets. The wage equation omits x_B, x_C and x_{L1} as discussed below, to identify the wage model.

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. Finally, this model yields an equation for adult wages in which the effects of adolescent fertility can be disaggregated into a direct effect, and indirect effects through schooling and work experience.

Estimation Methods

To test whether teenage childbearing affects educational attainment, work experience and wages, we include dummy variables for early fertility in a regression model of each of these outcomes. The primary estimation 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 impacts of teenage childbearing in (7a) and (7b) using an instrumental variables (IV) approach.⁷ Fertility is also endogenous in a model of wage determination because it is likely to be related to the expected costs of and returns to investing in education, work experience as a teenager, and work experience as an adult. Education and experience, moreover, are likely to be correlated with the error in the wage equation because, in a life-cycle decision making context, adolescent investments in human capital will be related to expected future market returns.⁸ We estimate the effects of these variables and teenage fertility on wages in (9) also using an IV approach. 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

⁷ We use a linear probability model to estimate (5). The 2SLS estimator is consistent when the stochastic regressor is dichotomous (see Heckman, 1978 for a discussion).

⁸ Heckman (1980) and Mroz (1987) present evidence that labor market experience is not exogenous with respect to market wages, though Mroz finds no evidence to suggest that schooling is not exogenous.

outcomes only via its effect on fertility, and indicators of the social context within which childbearing decisions occur provide further instruments. To identify the wage equation, we allow family background characteristics to enter the schooling and experience equations, but not to directly affect wages. In addition we allow local social conditions, local educational services, and labor, housing and marriage market conditions during adolescence (x_C) as well as family background characteristics (x_B) to influence schooling and work experience, but not to directly affect wages, conditional on labor market conditions during adulthood.⁹

Proper implementation of instrumental variables methods requires acceptable instruments. Acceptable instruments must meet two criteria. First, they must be valid: uncorrelated with the error term in the estimating equation. Second, they must be relevant: they should explain a significant amount of the variance of the endogenous regressor (Nelson and Startz, 1990a, 1990b; Bound, Jaeger, and Baker, 1995; Shea, 1993; Staiger and Stock, 1994). Otherwise, the IV estimator may be severely biased.

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, experience and wage 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

⁹ Exclusion of family background characteristics (x_B) from wage equations is a standard approach for identifying wage equations with endogenous schooling and labor market experience (Griliches, 1977,

are good, they are not so compelling as to preclude testing for validity and relevance.¹⁰

We face the problem of choosing sets of instruments when the universe of potential instruments is large, and the current econometrics literature offers little guidance in designing an optimal method of doing so. Our object, then, is more modest. We wish to devise an instrument choice methodology which is conservative (i.e. unlikely to include invalid 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) discussed in Godfrey (1988).¹¹ 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. For example, we initially estimate (7a) using IV with all the potential instruments included 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.

Second, we use a goodness-of-fit test to determine whether a set of potential valid instruments is relevant to the endogenous regressor (e.g. adolescent fertility in (7a)) and significantly improve model fit in the first-stage estimation. Since we have a large

1979). Recently, Neumark and Korenman (1994) test whether this approach is econometrically appropriate and conclude that it is.

¹⁰ We would argue, in fact, that a priori arguments are unlikely to be sufficiently compelling in the absence of a true experiment.

¹¹ We use Godfrey's 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).

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 regression and significant at the 10 percent level in a regression predicting fertility. We follow analogous procedures to instrument each endogenous variable in (7b).¹² In another paper (Klempinger, Lundberg, and Plotnick, 1995b) we compare estimates of the education equation derived using this, and alternative, instrument choice algorithms. We find that the substantive results are relatively insensitive to the choice of instruments from the full set, but differ substantially from the results of a just-identified model.

The wage equation contains several endogenous regressors: teenage fertility, schooling and work experience. To select acceptable instruments in this situation, we alter the procedure slightly. The potential instruments for each endogenous regressor are a large set of family background characteristics and measures of local social conditions, local educational services, abortion and contraception costs, and local labor, housing and marriage market conditions during adolescence. We use identical sets of characteristics

¹² As a sensitivity check we experimented with using 20 percent significance levels to select instruments and found it made virtually no difference in the results. We also 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.

and measures for all endogenous regressors. We first estimate (9) with the full set of instruments. We conduct the OIR test and delete instruments that achieve a 10 percent significance level in the initial regression. Using the remaining set, we run separate goodness-of-fit tests to determine which subset of potentially valid instruments is relevant to each endogenous regressor. We again require relevant instruments to be significant at the 10 percent level in the first-stage regression. We take the union of the subsets as the tentative set of acceptable instruments and rerun the OIR test. If necessary, we delete any instruments that now achieve a 10 percent significance level. The instruments that survive these screens are all used in the first-stage regressions for fertility, education and experience.¹³

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 who 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

¹³ The wage equation also includes a standard selectivity correction. Standard errors are corrected for inclusion of the selection term.

dependent variable being analyzed and range between 1378 and 1768 for whites, and 714 and 1035 for blacks, with the smaller number applying to the wage equations.¹⁴

Adolescent fertility is represented by a dummy variable that indicates whether the respondent had a birth prior to her 20th birthday. Among whites, 16 percent were teenage mothers; among blacks, 38 percent. 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 due to 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 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. Given the sample, schooling at 25 is measured during the 1984-1990 period. 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.

Because we analyze wages at age 25, the measure of work experience includes work time during both teenage years and ages 20-24. Because much teen experience may have little career relevance and a correspondingly low payoff, the returns to teen and early 20s experience as well as their empirical determinants may differ. Hence, we estimate separate equations for teenage and adult experience. We measure full-time, full-year equivalent years of work experience during ages 16 through 19 by dividing total hours worked during these years by 2,000. Adult experience is similarly measured during the

¹⁴ We examined Hispanics also. The relatively small sample led to unstable results which we do not report.

five years covering ages 20 through 24. 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 treat hours of work as missing.

Our measure of the wage is the natural logarithm of hourly wages (in 1990 dollars) at age 25. If wages are not available for the interview year in which a respondent turned 25, we substitute her wage in the year she turned 26. 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. 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 14.¹⁵ We also include county level variables which measure aspects of the distribution of income, local economy, religious and social environment, educational climate and school enrollment in the county in which the respondent resided in 1979.

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

¹⁵ In early regressions we included the ratio of family income to the poverty line among the family background variables. Since it was insignificant for all groups and since many cases lack income data, we exclude it in results reported here.

if data are not available for 1979).¹⁶ 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 wage equation contains instrumented values of fertility, schooling, early work experience, and adult work experience, as well as the local unemployment rate for the year the wage is measured as an indicator of local labor market conditions in adulthood, a dummy variable for residing in an urban area, a dummy variable for the presence of health limitations, and year and region dummies. Panel 3 of Table 1 lists the means of the wage equation's exogenous variables.

The final sets of acceptable instruments for schooling and the two types of work experience were selected from the measures of family background and local labor market, economic and social conditions during adolescence shown in panel 2 of Table 1, and the indicators of the policy environment, availability of abortion and family planning services and the social context within which fertility decisions are made, shown in panel 4.¹⁷

¹⁶ 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.

¹⁷ 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, each instrument set includes age of menarche and the variables indicating ages of consent for abortion and contraceptive use. The education model also includes county measures of the abortion rate, the presence of a large abortion provider, and the sex ratio. The early work experience model also includes county measures of the abortion rate, the presence of a large abortion provider and the fertility rate of unmarried white women age 15-19. The later work experience model also includes county measures of the abortion rate, the presence of a large abortion provider and the sex ratio.

For blacks, each instrument set includes age of menarche. The education model adds age of consent for abortion, and county measures of the unmarried teenage fertility rate and the sex ratio. The early work

Results

Table 2 displays observed means of schooling, experience and adult wages among women who became mothers before age 20 and those who avoided teenage parenthood. The simple differences are large. On average, white teenage mothers complete 2.4 years less schooling, and have 0.6 years (40%) less early work experience and 1.3 years (37%) less adult experience. Their mean hourly wage is \$2.09 (24%) less than for women who avoid teenage motherhood. Differences for blacks are smaller but still sizable -- 1.6 years less schooling, 0.3 years (33%) less early experience, 0.8 years (29%) less early adult experience, and wages \$1.19 (17%) lower.

[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.¹⁸ The 2SLS estimates for whites indicate that a birth before age 20 lowers completed years of schooling by 2.6 years, which is slightly more than the unconditional mean difference shown in Table 2. A birth before age 20 is estimated to lower early work experience by 1.2 years and adult work experience by 2.2 years--also very large numbers. For black women the negative effect on schooling of a birth before age 20 is 2.5 years, nearly identical to the white estimate. Significant negative effects on early work experience again appear, but the effect of teen childbearing on adult experience is not significant.

experience model includes age of consent for abortion, and county measures of the sex ratio. The later work experience model includes county measures of the unmarried teenage fertility rate and the sex ratio.

¹⁸ For brevity tables 3 and 4 only present coefficients on the key explanatory variables. Complete results for the first and second stage regressions are available from the first author.

[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, though they are smaller than the IV estimates. This is not the expected pattern: the usual story is that early childbearing and low educational attainment are the result of a joint optimizing process or influenced by common unobservable characteristics, and that the OLS estimates should overstate the effect of early childbearing on education. We know little enough, however, about the process by which young women are selected into teen motherhood, and it is not impossible that, conditional on all observed characteristics, young women with relatively high unobservables in the schooling equation would make their way down the chain of decisions that leads to a live birth.

In addition, the Hausman tests of the exogeneity of fertility should lead us to be cautious in interpreting the differences between the OLS and IV estimates. For 2 of the 3 black estimates, Hausman tests indicate we can reject at the .10 level or better the hypothesis that fertility is exogenous.¹⁹ For the white sample, the probabilities lie between .15 and .20. Even in such cases, it may be imprudent to accept the OLS estimates. 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.²⁰ For p-

¹⁹ Despite having a large number of potential instruments for fertility, they did not perform well in the black adult experience model as suggested by the large standard error and high Hausman p value.

²⁰ 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 (Type II

values that do not decisively reject or fail to reject the assumption of exogeneity, the IV estimates may 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 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.

These strong findings conflict with much of the recent research, which has found modest or no significant consequences of adolescent childbearing. We attribute the difference from earlier IV studies to our more extensive set of instruments and consequent ability to predict fertility. In contrast to siblings models, our IV approach allows control for a more general form of endogeneity, including individual unobserved heterogeneity that may influence both the risk of having a teen birth and labor market outcomes and which may not be captured by family effects. Both the family fixed-effect models and the “natural experiment” studies are based on small subsamples of the available data, and this may also help to explain the differences in the results.

Table 4 reports the estimates from the wage equations. The 2SLS wage equations in columns 1 and 2 show significant, strong effects of schooling on wages. The coefficients on early work experience are insignificant. Thus, the significant loss of early experience for teenage mothers shown in Table 3 does not appear to carry a long run

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. Type II errors are typically not bounded in the way Type I errors are, although Type II errors are typically somewhat lower than $(1-\alpha)$.

wage penalty. For whites, the coefficient on adult experience is significant and large, but for black women the coefficient is insignificant.

[Table 4 about here]

Column 1 of Table 4 also indicates that teenage childbearing has a negative, but insignificant direct effect on adult wages of white women once we control for its effects on human capital. The effect of early childbearing on wages is entirely indirect via its effect on human capital. For black women, even after controlling for human capital, there is a significant positive direct impact of teenage childbearing. Subsequent analyses (not shown here) indicate that this may be due to a differential rate of return to education for young black mothers: the return to schooling for teen mothers is four percentage points greater than the return to schooling for black women who did not have a teen birth.

In Table 4's OLS estimates for white women, the significant effects of schooling and adult experience are very similar to the 2SLS estimates. Early work experience is now significant, though with a much smaller return than adult experience. Controlling for human capital, an early birth is estimated to raise wages by 9 percent. For black women the significant effect of schooling and the insignificant effect of early work experience reappear, but adult work experience is now significant. Adolescent childbearing's effect on black women's wages, significantly positive in the 2SLS equation, is now entirely indirect via its effect on human capital.

The 2SLS estimates in Tables 3 and 4 imply that teenage childbearing has large indirect effects on wages which operate via its impact on human capital accumulation. The first column in Table 4 shows that a one year change in schooling is associated with a change of 0.10 in the logarithm of wages for white women. Since, from row 1, column 1

of Table 3, a teen birth lowers schooling by 2.59 years, a teen birth is predicted to change the logarithm of wages by $-2.59 \times .10 = -.259$ through its schooling effect.

Carrying out such calculations using all the 2SLS point estimates in Tables 3 and 4, whether significant or not, suggests that the direct and indirect effects of a teenage birth together lower wages 47 percent for whites and 23 percent for blacks. Calculations based on the OLS results yield smaller wage losses, respectively, of 17 and 11 percent.

Hausman tests indicate that we cannot, in general, decisively reject the hypothesis of exogeneity of the human capital variables in the wage equation. For whites, none of the 4 tests rejects the hypothesis that an explanatory variable is exogenous at even the 30 percent level. For blacks, 2 of the 4 tests reject the exogeneity hypothesis at better than the 5 percent level, but 2 fail to reject at the 20 percent level. Although the OLS results differ in some respects from the 2SLS ones and predict smaller wage effects, regardless of which estimates one uses, the main implication of Table 4 is clear: teenage childbearing leads to substantively important wage losses through reductions in formal education and young adult work experience.

Conclusion

How does adolescent fertility affect the human capital and adult wages of women? For white women our 2SLS results show that adolescent fertility substantially reduces human capital. Young white mothers earn less because they obtain less formal education and work experience. There is no direct impact of adolescent childbearing on adult wages once we control for these human capital effects. For black women early childbearing again has adverse effects on human capital accumulation and, hence, a negative indirect effect on wages, with the primary wage effect coming from the effect on

schooling. The negative wage effects are substantively important. The smallest point estimates indicate that teenage childbearing reduces white women's wages by 17 percent, and black women's wages by 11 percent; estimates that control for the endogeneity of fertility and human capital investment are generally larger.

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. The results stand in contrast to the recent "revisionist" view that the social and economic consequences of adolescent childbearing are small or insignificant. The pronounced differences in methodology between studies that have compared teenage mothers to a carefully-chosen "control group," and this study may explain the differences in the results, which certainly warrant further examination.

We estimate labor market consequences of early childbearing that will have serious negative impacts on the economic well-being of many young mothers and their families and make dependence upon public aid more likely. The relatively disadvantaged backgrounds of many teenage mothers also contribute to the adverse social and economic outcomes they tend to experience. Our results suggest, nonetheless, that public policies which reduce teenage childbearing are likely to have positive effects, though they do not address all the factors that restrict the life chances of disadvantaged young women.

References

- Billy, John and Moore, David. 1992. "A multilevel analysis of marital and nonmarital fertility in the U.S.," Social Forces 70: 977-1011.
- Blackburn, McKinley; Bloom, David and Neumark, David. 1993. "Fertility timing, wages, and human capital," Journal of Population Economics, 6: 1-30.
- Blackburn, McKinley and Neumark, David. 1995. "Are OLS estimates of the return to schooling biased downward? Another look," Review of Economics and Statistics 77(2): 217-229.
- Bound, John; Jaeger, David, and Baker, Regina. 1995. "Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak," Journal of the American Statistical Association 90: 443-450.
- Bronars, Stephen and Grogger, Jeff. 1994. "The economic consequences of unwed motherhood: Using twin births as a natural experiment," American Economic Review, 84(4): 1141-1156.
- Child Trends, 1995. "Facts at a glance." Washington DC.
- Dechter, Aimee and Smock, Pamela J. 1994. "The fading breadwinner role and the economic implications for young couples," Institute for Research on Poverty Discussion Paper 1051-94, University of Wisconsin - Madison.
- DeGraff, D. Bilsborrow, R. and Guilkey, D. 1990 "Community level determinants of fertility in the Philippines: A structural analysis," Paper presented at the annual meetings of the Population Association of America, Toronto, Canada.
- Forste, Renata and Tienda, Marta. 1992. "Race and ethnic variation in the schooling consequences of female adolescent sexual activity," Social Science Quarterly, 73: 12-30.
- Geronimus, Arline and Korenman, Sanders. 1992. "The socioeconomic consequences of teen childbearing reconsidered," Quarterly Journal of Economics 107: 1187-1214.
- Godfrey, L. 1988. Misspecification Tests in Econometrics, Cambridge MA: Cambridge University Press.
- Grady, William; Klepinger, Daniel and Billy, John. 1993. "The influence of community characteristics on the practice of effective contraception," Family Planning Perspectives 25: 67-73.
- Griliches, Zvi. 1977. "Estimating the returns to schooling: Some econometric problems," Econometrica, 45(1):1-22.
- _____.1979. "Sibling models and data in economics: Beginnings of a survey." Journal of Political Economy 87(5, Pt. II) S74-103.
- Grogger, Jeff and Bronars, Stephen. 1993. "The socioeconomic consequences of teenage childbearing: Findings from a natural experiment," Family Planning Perspectives, 25: 156-161.

- Hausman, Jerry. 1978. "Specification tests in econometrics," Econometrica, 46: 1251-1272.
- Hausman, Jerry, and Taylor, William. 1981. "Panel data and unobservable individual effects." Econometrica, 49(6):1377-98.
- Haveman, Robert; Wolfe, Barbara, and Spaulding, J. 1991. "Educational achievement and childhood events and circumstances," Demography 28 (February): 133-157.
- Heckman, James. 1978. "Dummy endogenous variables in a simultaneous equations system," Econometrica 46: 931-959.
- _____. 1980. "Sample selection bias as a specification error," in J. Smith (ed.), Female Labor Supply, Princeton, New Jersey: Princeton University Press.
- Hofferth, Sandra and Hayes, Cheryl (ed.), 1987. Risking the Future, Vol. 1, Washington DC: National Academy Press.
- Hofferth, Sandra and Moore, Kristin. 1979. "Early childbearing and later economic well-being," American Sociological Review, 44 (October): 784-815.
- Hoffman, Saul; Foster, E. Michael and Furstenberg, Frank. 1993. "Re-evaluating the costs of teenage childbearing," Demography, 30: 1-14.
- Hotz, V. Joseph, Susan McElroy and Seth Sanders. 1995. "Assessing the effects of teenage childbearing on maternal outcomes in the U.S.: Exploiting a very natural experiment," unpublished paper, Carnegie-Mellon University.
- Jones, Elise and Forrest, Jacqueline. 1992. "Underreporting of abortion in surveys of U.S women: 1976-1988," Demography 29 (February): 113-126.
- Klepinger, Daniel; Lundberg, Shelly and Plotnick, Robert. 1995a. "Adolescent fertility and the educational attainment of young women," Family Planning Perspectives, 27: 23-8.
- _____. 1995b. "Instrument selection: The case of teenage childbearing and women's educational attainment," unpublished manuscript, University of Washington.
- Korenman, Sanders and Neumark, David. 1992. "Marriage, motherhood and wages," Journal of Human Resources 27(2): 233-255.
- Lundberg, Shelly and Plotnick, Robert. 1995. "Adolescent premarital childbearing: Do economic incentives matter?" Journal of Labor Economics 13(2): 177-200.
- MacKinnon, James G. 1992. "Model specification tests and artificial regressions." Journal of Economic Literature 30(1):102-46.
- Marini, M. 1984. "Women's educational attainment and the timing of entry into parenthood," American Sociological Review, 49 (August): 491-511.
- Moore, K.; Myers, D.; Morrison, D; Nord, C; Brown, B, and Edmonston, B. 1993. "Age at first childbirth and poverty," Journal of Research on Adolescence, 3: 393-422.

- Mroz, Thomas. 1987. "The sensitivity of an empirical model of married women's hours of work to economic and statistical assumptions," Econometrica, 55 (July): 765-799.
- Nakamura, Alice and James R. Walker. 1994. "Model evaluation and choice." Journal of Human Resources 29(2): 223-247.
- Nelson, Charles and Startz, Richard. 1990a. "Some further results on the exact small sample Properties of the IV estimator," Econometrica 58: 967-76.
- _____. 1990b. "The distribution of the instrumental variable estimator and its t-ratio when the instrument is a poor one," Journal of Business, 63, Part 2: S125-S140.
- Neumark, David and Korenman, Sanders. 1994. "Sources of bias in women's wage equations: Results using sibling data," Journal of Human Resources, 29: 379-405.
- Olsen, R. and Farkas, G. 1989. "Endogenous covariates in duration models and the effect of adolescent childbirth on schooling," Journal of Human Resources, 24(1): 39-53.
- Ribar, David. 1994a. "Teenage fertility and high school completion," Review of Economics and Statistics, 76(3): 413-424.
- _____. 1994b. "The socioeconomic consequences of young women's childbearing: Reconciling disparate evidence," Pennsylvania State University, Department of Economics working paper 4-94-1.
- Rindfuss, Ronald; Bumpass, Larry and St. John, Craig. 1980, "Education and fertility: Implications for the roles women occupy," American Sociological Review, 45: 431-447.
- Rosenzweig, M. and Schultz, T. P. 1985. "The demand for and supply of births: Fertility and its life cycle consequences," American Economic Review, 75: 992-1015.
- Ruud, Paul. 1984. "Tests of specification in econometrics," Econometric Reviews, 3(2): 211-42.
- Shea, J. 1993. "Instrumental relevance in linear models: A simple measure," SSRI working paper No. 9312, University of Wisconsin, Madison, WI.
- Staiger, Douglas, and Stock, James H. 1994, "Instrumental variables regression with weak instruments," unpublished paper, Harvard University.
- Trussell, J. and Abowd, J., 1980. "Teenage mothers, labor force participation , and wage rates," Canadian Studies in Population, 7: 33-48.
- Tsui, Amy. 1985. "Community effects on contraceptive use," in John B. Casterline (ed.), The Collection and Analysis of Community Data, International Statistical Institute, The Netherlands.
- Upchurch, Dawn and McCarthy, James. 1990. "The timing of a first birth and high school completion," American Sociological Review, 55: 224-234.
- Waite, Linda and Moore, Kristin. 1978. "The impact of an early first birth on young women's educational attainment," Social Forces, 56: 845-865.

White, Halbert. 1982. "Maximum likelihood estimation of misspecified models,"
Econometrica, 50(1): 1-26.

Table 1

Means and Sources for Variables

<i>Variables</i>	<i>White Mean</i>	<i>Black Mean</i>	<i>Source</i>
1. Endogenous			
Birth before age 20	.16	.38	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
Wage (in 1990 dollars)	\$8.38	\$6.80	NLSY
2. Exogenous - Fertility, education and experience models			
Mother's education	12.0	10.7	NLSY
Mother's 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. Exogenous - Wage model

Local unemployment rate at age 25	8.0	7.6	NLSY
Presence of health limitations (%)	4.6	5.5	NLSY
Urban residence (%)	77.5	83.2	NLSY

4. Potential instruments for teenage fertility

Individual

Age at menarche	12.9	12.8	NLSY
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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
<i>County level fertility rates and sex ratio *</i>			
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, Experience and Wages by Teenage Fertility Experience,
White and Black Women

	<u>White Women</u>		<u>Black Women</u>	
	Mother Before <u>Age 20</u>	Not a Teenage <u>Mother</u>	Mother Before <u>Age 20</u>	Not a Teenage <u>Mother</u>
Years of Schooling	11.2	13.6	11.7	13.3
Years of Early Work Experience	0.9	1.5	0.6	0.9
Years of Adult Work Experience	2.2	3.5	2.0	2.8
Hourly Wage (\$1990)	\$6.58	\$8.67	\$6.02	\$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)

	<u>Two Stage Least Squares</u>		<u>Ordinary Least Squares</u>	
	<u>Whites</u>	<u>Blacks</u>	<u>Whites</u>	<u>Blacks</u>
Impact of Teenage Childbearing on:				
1. Years of Schooling	-2.59** (.86)	-2.54** (.94)	-1.42** (.11)	-1.13** (.11)
Hausman p	.15	.10		
Adj. R ²	.366	.273	.411	.366
2. Early Work Experience	-1.20** (.42)	-1.79** (.66)	-.67** (.06)	-.22** (.05)
Hausman p	.20	.00		
Adj. R ²	.070	.054	.122	.138
3. Adult Work Experience	-2.24** (.80)	.27 (1.50)	-1.14** (.11)	-.62** (.15)
Hausman p	.15	.54		
Adj. R ²	.080	.148	.133	.166

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

Table 4
Impact of Teenage Childbearing, Education and Work Experience on the Logarithm of Adult Wages,
for White and Black Women
(Standard errors in parentheses)

Impact on Log Wages of:	<u>Two Stage Least Squares</u>		<u>Ordinary Least Squares</u>	
	<u>Whites</u>	<u>Blacks</u>	<u>Whites</u>	<u>Blacks</u>
1. Years of Schooling	.10**	.14**	.10**	.08**
	(.03)	(.03)	(.01)	(.01)
Hausman p	.66	.02		
2. Early Work Experience	-.03	.12	.03**	.03
	(.07)	(.08)	(.01)	(.02)
Hausman p	.39	.24		
3. Adult Work Experience	.13**	.05	.10**	.09**
	(.05)	(.04)	(.01)	(.01)
Hausman p	.48	.22		
4. Teenage Childbearing	-.12	.29**	.09**	.03
	(.22)	(.13)	(.04)	(.04)
Hausman p	.31	.03		
Selection correction	.29**	.27**	-.02	-.08**
	(.13)	(.11)	(.03)	(.04)
Adj. R ²	.131	.114	.231	.248

The Hausman p shows the confidence level for rejecting the null hypothesis that the relevant variable is exogenous.

* = significant at 10% level

** = significant at 5% level