TEENAGE FERTILITY AND HIGH SCHOOL COMPLETION

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David C. Ribar. "Teenage Fertility and High School Completion," *Review of Economics and Statistics*, 76:3 (August 1994), 413-24. http://www.jstor.org/stable/2109967

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Abstract:
This paper uses 1979-85 data on women from the National Longitudinal Survey of Youth to examine the economic, sociological, and institutional antecedents of adolescent childbearing and high school completion and to analyze the effect of early childbearing on school completion. Fertility and school completion are modeled as dichotomous outcomes, and their determinants are estimated using a bivariate probit specification. The paper finds evidence that adolescent childbearing is an endogenous determinant of high school completion and that failing to account for this endogeneity leads to an over-estimate of the schooling consequences of early childbearing.

Article:

I. Introduction

Research on poverty has devoted considerable attention to issues related to teenage childbearing. Early fertility appears to be associated with a number of adverse economic outcomes such as lower earnings and family incomes, higher rates of poverty, and greater risk of welfare dependence (Hofferth, 1987). While analysts and policy-makers commonly list these outcomes as consequences of adolescent childbearing, such an identification rests on surprisingly thin evidence. Empirical research has not, in fact, established whether the outcomes associated with teen fertility are consequences or whether they, along with fertility, are co-determined by other underlying factors.

If early parenthood does affect subsequent economic status, educational attainment is thought to be an important transmission mechanism. An opportunity cost analysis suggests that a causal relationship may exist between teenage fertility and schooling. Parenthood demands substantial inputs of time and energy. For an adolescent mother, these demands may come at the expense of time required for schooling. A reduction in schooling, in turn, is likely to decrease adult earnings.

This paper uses 1979-85 data on women from the National Longitudinal Survey of Youth (NLSY) to examine the economic, demographic, and institutional antecedents of adolescent childbearing and high school completion. Teen fertility and high school completion are modeled as jointly-determined dichotomous variables, and their determinants are estimated using a bivariate probit specification. Importantly, childbearing is modeled as an endogenous determinant of schooling.

Numerous studies have examined the relationship between fertility timing and educational attainment. These studies may be classified into three broad groups. Early multivariate analyses modeled fertility as an exogenous determinant of educational attainment. These first generation studies (e.g., Moore and Waite, 1977; Mott and Marsiglio, 1985) suggested that age at first birth had a strong positive effect on schooling. The next generation of studies used instrumental variables methods to account for the possible endogeneity of fertility timing. These studies (Rindfuss et al., 1980, and Marini, 1984) reported mixed evidence of the effect of childbearing on education.[1] A final set of studies has used a variety of techniques (fixed effects, quasi-natural experiments, and survival analysis) to correct for different statistical problems and to examine timing effects more closely. The third generation studies (Bronars and Grogger, 1992, Geronimus and Korenman, 1992, Hoffman et al., 1993, Olsen and Farkas, 1989, Upchurch and McCarthy, 1990) also reported mixed evidence.[2]

This paper is methodologically related to the second generation studies, though it does make several refinements. First, relative to Rindfuss et al. (1980) and Marini (1984), the paper examines a more contemporary cohort of women.[3] Second, unlike these two earlier studies, this paper focuses exclusively on teenage decision-making. Third, the study improves upon the identification restrictions employed by Rindfuss et al. and Marini. Indeed, a key contribution of this paper is its use of proper identifying variables for the effect of fertility on high school completion.

While not entirely comparable, this study also offers some advantages relative to the third generation analyses. First, unlike the studies by Geronimus and Korenman (1992), Hoffman et al. (1993), and Upchurch and McCarthy (1990), this paper accounts for the possible endogeneity of teenage fertility. Second, relative, to Geronimus and Korenman and Hoffman et al., this study examines a substantially larger set of observations. Third, the sample selectivity problems of some earlier studies are avoided.[4]

The results of this paper strongly reject the hypothesis that teenage childbearing is an exogenous determinant of high school completion. Moreover, the results indicate that failing to account for endogeneity leads to an over-statement of the schooling consequences of early fertility. Estimation also reveals some support for economic hypotheses. In particular, Medicaid generosity appears to significantly encourage early fertility and discourage high school completion. Other types of public assistance are also estimated to have strong negative effects on schooling. Educational funding, the availability of obstetrician/gynecologists, local abortion rates, family background, race, religiousness, and physical maturity also appear to be important determinants of teenagers' decisions.

The remainder of this paper is organized as follows. Modeling considerations and previous work are discussed in section II. Section III details the variables used in the analysis. Descriptive statistics for the analysis variables are also provided in section III. Section IV presents econometric results from the bivariate models. Results from several alternative specifications of the models are also given in section IV. Concluding remarks appear in section V.

II. Theoretical Considerations

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[1] Specifically, Rindfuss et al. found that age at first birth had no effect on schooling, while Marini found that early births had significant negative effects on women's educational attainment.

[2] Bronars and Grogger used data from Public Use Micro- data Samples of the 1970 and 1980 Censuses to compare the socioeconomic outcomes of teenage mothers of twins and singletons. Although the overall effect of early births on high school graduation was insignificant in both samples, Bronars and Grogger did find marginally significant negative effects for whites in the 1970 Census and highly significant negative effects for blacks in the 1980 Census. Geronimus and Koren- man used data from the NLSY, the National Longitudinal Survey of Labor Market Experience, Young Womens Cohort (NLSYW), and the Panel Study of Income Dynamics (PSID) to compare the socioeconomic outcomes of sisters who differed in their fertility timing. Geronimus and Korenman found that teenage childbearing had no significant effect on graduation in the NLSYW but significant negative effects in the NLSY and PSID. Their PSID results were replicated by Hoffman et al. Olsen and Farkas used experimental data to estimate survival models of the effect of childbearing on time to secondary school exit. Their analysis, which accounted for the possible endogeneity of fertility timing, found that age at first birth had no significant effect on schooling. Upchurch and McCarthy estimated survival models using NLSY data. They found that fertility had no significant effect on women's decisions to leave school but significant negative effects on drop-outs' decisions to return to school.

[3] Rindfuss et al. examined data from the 1970 National Fertility Study and the 1973 National Survey of Family Growth: Marini studied women who were high school students in 1957-58.

[4] Geronimus and Korenman examined mothers who had at least one other (sampled) sibling who was also a mother. Hoffman et al. also restricted their analysis to female siblings. Bronars and Grogger examined first-time mothers. Olsen and Farkas examined black underclass women.

Economic models of individual decision-making rely on rational choice. Individuals are assumed to make choices which maximize expected benefits and minimize expected costs. In the case of educational attainment, the primary benefit is a premium on subsequent wages. Tuition and the cost of books and supplies make up the direct costs of schooling. The indirect cost of school attendance is assumed to be the value of the individual's time in its next best alternative use. Thus, the prevailing wage or the individual's valuation of leisure represents the indirect, or opportunity, cost of schooling.

An examination of the determinants of adolescent fertility is more complicated. A birth results from a sequence of actions (e.g., the initiation of sexual activity, contraception decisions, the decision to continue the pregnancy to term) and probabilistic events (fecundity, contraceptive efficacy, etc.). Factors may have different effects on each action or event. For example, religiousness may discourage both sexual activity and abortion with an ambiguous net effect on fertility. To keep the analysis tractable, this paper focuses only on birth outcomes and, thus, reduces the teenager's decision to whether or not to become a parent.[5]

In an economic model, the benefit of parenthood is assumed to be the child itself (more precisely, the utility derived from having a child). Direct costs of adolescent fertility include prenatal health care costs, delivery costs, subsequent child care costs, physical discomfort associated with pregnancy and delivery, and any stigma attached to teenage childbearing. The opportunity costs of early childbearing are the additional schooling and labor income that might have been obtained in the absence of fertility. This implies costs in the current period, and to the extent that education and work experience increase adult wages, costs in subsequent periods.

As this discussion suggests, fertility and schooling decisions may be related. The birth of a child increases the value of the mother's time outside of school and, thus, increases the opportunity costs of school attendance. Hence, adolescent fertility may have a direct negative effect on high school completion.[6]

As discussed in the previous section, tests of causality have had mixed success. Empirical tests of economic hypotheses have also been generally inconclusive. For example, several studies have found evidence that economic variables are significant determinants of teen fertility (Duncan and Hoffman, 1990, Lundberg and Plotnick, 1990a) and high school completion (Olsen and Farkas, 1989). However, other studies (An et al., 1990, Ribar, 1993) found that economic variables had little or no effect on these decisions.

Sociological hypotheses have also been advanced to explain fertility and schooling behavior. These hypotheses emphasize the roles of family background, neighborhood characteristics, race, and ethnicity. Sociologists have noted that the children of teenage mothers and high school drop-outs are at greater risk of becoming teen parents and not completing school respectively than children from other families (Kahn and Anderson, 1992). Family structure may also play a role (Haveman et al., 1991, Manski et al., 1992, McLanahan, 1985, Wojtkiewicz, 1991). Diminished attitudes and resources in impoverished neighborhoods also appear to contribute to higher rates of adolescent fertility (Hogan and Kitagawa, 1985) and lower rates of high school completion. Cultural differences in the acceptance of teen childbearing and attitudes toward education may explain variations in fertility and schooling patterns between racial and ethnic groups (Sandefur and McLanahan, 1990).

This paper develops a simple empirical model to analyze the determinants of high school completion and adolescent childbearing. Let E_i^* represent the difference between the benefits and costs of high school completion for individual i conditional on teenage fertility and other demographic and sociological factors. In particular, assume that F_t is a linear function of teen parenthood, F, and other observed and unobserved economic, sociological, and institutional variables such that

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[5] Examples of studies with sequential choices are Lundberg and Plotnick (1990a, 1990b).

[6] Given that additional schooling might also increase the mother's potential wage and thereby increase her opportunity costs of fertility, causality between these decisions may actually be reciprocal. Because of the econometric difficulties involved, an analysis of the effect of educational attainment on early fertility is left to future research.

$$E_i^* = \beta_f F_i + \beta_x' X_i + \epsilon_i \qquad (1a)$$

where X_i is a vector of observed determinants and ε_i represents unobserved variation. The school completion decision, E_i, for individual i is then assumed to follow

$$E_i = \begin{cases} 1 \text{ (finishes high school)} & \text{if } E_i^* \geq 0 \\ 0 \text{ (does not finish high school)} & \text{otherwise.} \end{cases} \qquad (1b)$$

Similarly, let F_i^* denote the difference of the benefits and costs of adolescent fertility for i. Assume that F_i^* is a linear function of economic and sociological determinants; specifically, let

$$F_i^* = \delta_z' Z_i + \eta_i \qquad (2a)$$

where Z_i is a vector of observed variables and η_i is an error term.[7] Observed fertility is a dichotomous outcome which is given by

$$F_i = \begin{cases} 1 \text{ (teenage birth)} & \text{if } F_i^* \geq 0 \\ 0 \text{ (no teenage birth)} & \text{otherwise.} \end{cases} \qquad (2b)$$

The error terms ε_i and η_i are assumed to be distributed

$$\begin{bmatrix} \epsilon_i \\ \eta_i \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\epsilon^2 & \rho\sigma_\epsilon\sigma_\eta \\ & \sigma_\eta^2 \end{bmatrix} \right). \qquad (3)$$

Thus, from equations (1) and (2) and the distributional assumption (3), high school completion is specified as a probit with teen fertility as an endogenous dummy determinant.

Maximum likelihood estimation of this specification is straightforward, although there are some identification issues. First, the coefficients and error variances in equations (la) and (2a) are only identified up to their proportions, $\frac{\beta_f}{\sigma_\epsilon}, \frac{\beta_x}{\sigma_\epsilon}, and\ \frac{\delta_z}{\sigma_\eta}$. The paper applies the standard normalization $\sigma_\varepsilon = \sigma_\eta = 1$. Second, the effect of teenage fertility on high school completion is only identified subject to exclusion or covariance restrictions. This paper imposes exclusion restrictions on the vector X_i.

The variables which are excluded from Xi should be theoretically and statistically related to fertility but theoretically unrelated to high school completion. This paper considers three such variables—age at menarche, availability of obstetrician/gynecologists (Ob-Gyn), and the local abortion rate. Similar to Presser (1978), the paper assumes that age at menarche is an indicator of the timing of fecundity and socio-sexual behavior. Thus, an earlier age at menarche is assumed to affect adolescent childbearing by increasing the length of exposure to fertility.[8] Ob-Gyn availability seems likely to decrease the costs of contraceptive and abortion services but also decrease the costs of childbearing. These offsetting effects lead to no clear prediction. The local abortion rate is

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[7] The determinants of E_i^* and F_i^* are not treated symmetrically (F_i^* does not include i as an explanatory variable). Unfortunately, the likelihood function for the symmetric specification does not, in general, integrate to one (Maddala, 1983).

[8] Rindfuss et al. (1980) and Marini (1984) also used controls for fecundity as identifying variables. Rindfuss et al. used an indicator for a previous miscarriage; Marini used parity (did the woman have fewer than two children) interacted with desires (did the woman want more children). Marini's measure, which was constructed using the endogenous fertility variable, appears to be inappropriate.

taken to be a proxy for abortion availability and attitudes and hypothesized to be negatively associated with fertility. None of these three variables is assumed to affect educational attainment directly.[9]

III. Data

The econometric analysis uses data on women drawn from the 1979-85 panels of the NLSY. The NLSY is a national sample of individuals who were 14 to 21 years old in 1979. The individuals have been reinterviewed annually. Economic, demographic and other behavioral data are available for each individual in all years. Retention through 1985 was roughly 90%.

The two decision variables are high school completion and adolescent fertility. The school completion variable reports whether the woman finished 12 or more years of education before age 20. No distinction is made between graduation and completion of a General Equivalency Degree (GED).[10] Three measures of adolescent fertility are incorporated into the analysis. A standard early fertility measure—whether the woman experienced a birth before age 20—is used for comparability with previous research. However, because this variable includes births to women who had already completed high school, the paper also includes indicators for becoming a teen parent before completing high school and becoming a parent before age 18 and before completing high school.

The independent economic variables are calculated using external data. To account for the costs and benefits of high school completion, repeated cross-section data on women's education, age, annual wage and salary income, ethnicity, and state of residence are collected from the 1979-81 releases of the Current Population Survey (CPS).[11] Using these data, log annual earnings are regressed on nine variables—work experience (age minus years of schooling minus six), experience squared, a flag for high school completion, interactions of the high school flag and the two experience variables, flags for African and Hispanic ethnicity, and year dummies. Separate regressions are performed for each state and the District of Columbia.

Estimates from these regressions are used to predict state- and race-specific earnings profiles for women who did and did not complete high school.[12] The discounted (5% annually) sums of the separate profiles over a 50-year career are assumed to represent the expected present value of lifetime earnings for graduates and nongraduates and are used as measures of the economic rewards associated with high school completion and noncompletion, respectively.[13]

Data on state welfare benefits have also been merged into the analysis sample. Welfare benefits are assumed to reduce the cost of (nonmarital) fertility and possibly reduce the rewards of schooling. Monthly state AFDC payments assuming no other income, monthly Food Stamp benefits assuming no income but AFDC, and average monthly Medicaid payments are computed for a family consisting of one adult and one child for the years 1978-81 (Committee on Agriculture, Nutrition and Forestry, 1985, Committee on Ways and Means, 1981-

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[9] There are some grounds for challenging this assumption. For example, sexual maturation may proxy other social and psychological changes which affect high school completion. Also, age at menarche itself may be affected by stress variables and family background (Belsky et al., 1991). Physician availability and abortion rates may be correlated with unmeasured community resources and attitudes which are associated with schooling.

[10] As there may be differences between the economic rewards associated with high school graduation and GED completion (Cameron and Heckman, 1993), the paper's results have been re-estimated using graduation as a measure of school completion. The reported results are robust to this respecification.

[11] Earnings data are only available up to ages 26-33 in the latest (1991) wave of the NLSY. The CPS is used because it includes observations on older adults.

[12] All of the regional data used in this analysis are merged on the basis of geographic identifiers provided in the NLSY. Identifiers reported in 1981 are used for women who were 14 years old in 1979. Identifiers from 1980 are used for women who were 15, and identifiers from 1979 are used for women who were 16 or older.

[13] These variables are similar to the opportunity cost measures used by Lundberg and Plotnick (1990a, 1990b).

82, unpublished data from the Food and Nutrition Service, the Office of Family Assistance, and the Health Care Financing Administration).[14]

Demographic variables incorporated to explain schooling and fertility include race, ethnicity, and family background. Dummy variables are used to identify women of African and Hispanic origin. Family structure at age 14 is represented by three dummy variables indicating whether the woman lived with her mother only, lived with her mother and a stepfather, or lived in some other arrangement. The omitted category represents women who resided with both parents at age 14. The number of siblings is also used to describe family structure.[15]

The socioeconomic status of the teenager's family is represented by another set of variables. Educational attainment of the teenager's mother is assumed to be positively associated with family socioeconomic status, family schooling expectations, and individual ability. Work experience of the mother is used to represent family economic circumstances, supervision, and values. The estimated models include a dummy variable for the mother's (or stepmother's) labor force participation. Other family characteristics recorded in the dataset include indicators for whether household members subscribed to a newspaper, subscribed to a magazine, or held a library card and an indicator for whether a foreign language was spoken in the home. Access to reading materials is taken to be a measure of family encouragement toward reading and schooling, the availability of information, and household resources generally. Growing up in a household in which a foreign language is spoken is used as a control for cultural differences and possible educational disadvantage.

The analysis also includes several personal attributes for each teenager. Religiousness, measured by frequency of attendance at church services, is assumed to be an indicator of individual values. Age at menarche is used as a control for physical maturity.

Lastly, the analysis incorporates controls for regional differences in institutions and economic conditions. Data from the 1991 Bureau of Health Professions Area Resource File (ARF) are used to determine the number of obstetrician/ gynecologists per 100,000 women aged 15-44 in each county.[16] The number of abortions per 1,000 women aged 15-44 in each state are obtained from Henshaw et al. (1984, table 2).[17] To control for regional differences in school quality, the paper uses 1979-81 data on per-pupil expenditures for public elementary and secondary schools (National Center for Education Statistics, 1989, table 146). Other regional variation is captured by

[14] For women who were 14-16 years old in 1979, benefits were assigned based on the state of residence as of age 16. For women who were over 16, 1978 benefits were assigned based on the state of residence as of 1979.
[15] Background measures at other ages would be useful (see Wojtkiewicz, 1991). Unfortunately, many variables in the NLSY are only recorded as of age 14.
[16] ARF county data are available for 1975 and 1985. Linear interpolation was used to assign data to counties for intermediate years. The analysis incorporates values for each woman as of age 16.
[17] Henshaw et al. reported abortion rates for 1980 and 1981. The paper has assigned the 1981 rates to women who were 14 in 1979 and the 1980 rates to everyone else.

TABLE 1.—VARIABLE MEANS

Variable	All Women Mean	All Women (Std.)	Gave Birth before Age 20 Mean	Gave Birth before Age 20 (Std.)	Completed High School Mean	Completed High School (Std.)
PDV Earnings-No High School[a]	5.88	(1.05)	5.83	(0.99)	5.87	(1.07)
PDV Earnings-High School[a]	10.44	(1.42)	10.41	(1.29)	10.41	(1.45)
State Monthly AFDC Benefit[c]	2.96	(1.16)	2.77	(1.06)	2.98	(1.20)
State Monthly Food Stamp Benefit[c]	1.05	(0.29)	1.09	(0.26)	1.05	(0.30)
State Monthly Medicaid Benefit[c]	1.12	(0.36)	1.10	(0.30)	1.12	(0.36)
Black	0.13	(0.34)	0.25	(0.38)	0.12	(0.34)
Hispanic	0.06	(0.24)	0.09	(0.25)	0.05	(0.22)
Mother Only	0.12	(0.32)	0.16	(0.33)	0.11	(0.32)
Mother & Stepfather	0.06	(0.24)	0.10	(0.27)	0.06	(0.24)
Other Family	0.06	(0.24)	0.10	(0.27)	0.05	(0.22)
Siblings	3.46	(2.20)	4.20	(2.27)	3.30	(2.13)
Foreign Language	0.12	(0.33)	0.13	(0.29)	0.11	(0.33)
Mother's Education	11.61	(2.65)	10.28	(2.27)	11.95	(2.55)
Mother in Labor Force	0.53	(0.50)	0.52	(0.44)	0.54	(0.52)
Family Received Magazines	0.66	(0.47)	0.45	(0.44)	0.71	(0.47)
Family Received Newspapers	0.83	(0.37)	0.69	(0.40)	0.86	(0.36)
Family Had Library Card	0.77	(0.42)	0.67	(0.41)	0.80	(0.41)
Religious Services Infrequently	0.36	(0.48)	0.38	(0.43)	0.36	(0.50)
Attended Religious Services Often	0.48	(0.50)	0.41	(0.43)	0.50	(0.52)
Lived in Urban Area at Age 14	0.78	(0.42)	0.76	(0.38)	0.78	(0.43)
Lived in South at Age 14	0.32	(0.47)	0.42	(0.43)	0.31	(0.48)
County Unemployment Rate	6.47	(2.09)	6.49	(1.83)	6.45	(2.16)
State Per-pupil Education Funding[b]	2.93	(0.65)	2.82	(0.56)	2.95	(0.67)
County Availability of Ob-Gyn MDs	43.01	(29.09)	41.57	(25.79)	42.94	(29.80)
State Abortion Rate	28.44	(12.25)	27.91	(10.51)	28.27	(12.25)
Age at Menarche	12.84	(1.51)	12.64	(1.33)	12.87	(1.54)
Unweighted Observations	4658		1221		3720	
Weighted Observations	4658		939		3986	

Note: Statistics use 1985 NLSY weights rescaled to match sample size. Figures in parentheses represent standard deviations.
[a] Variable divided by 10,000.
[b] Variable divided by 1,000.
[c] Variable divided by 100.

indicators for the county unemployment rate, residence in the South, and residence in a metropolitan area.

After excluding noninterviews and observations with missing information, the analysis sample contains observations for 4,658 women. Of these women, 3,720 were high school graduates, and 1,221 became parents before age 20. Applying 1985 sample weights, the rates of high school completion and teenage fertility before age 20 were 85.6% and 20.2%, respectively. Table 1 reports means for all of the explanatory variables and means conditional on the decision variables.

The relationships between early fertility, high school completion, and the three identifying variables are examined in table 2. The estimates from table 2 indicate that a negative association exists between high school completion and teen parenthood. In particular, the completion rate for women who became teen mothers was 35 percentage points lower than the rate for other women. School completion is also negatively related to the other two measures of early fertility.

Table 2 reports estimates of teen childbearing rates conditioned on each of the identifying variables. Consistent with expectations, these conditional estimates indicate that age at menarche and the local abortion rate are negatively associated with adolescent births. There also appears to be a weak negative relationship between teen childbearing and Ob-Gyn availability. Given that physician availability affects the costs of both births and birth prevention, a weak association is not surprising. The overall negative direction of the result suggests that the preventive implications of Ob-Gyn availability may be more relevant for teenagers.

Conditional high school completion rates are also reported in table 2. Simple instrumental variables estimates of the effect of fertility on schooling can be obtained by comparing the changes in the conditional completion rates with changes in

TABLE 2.—HIGH SCHOOL COMPLETION AND EARLY CHILDBEARING BY AGE AT MENARCHE, AVAILABILITY OF OBSTETRICIAN / GYNECOLOGISTS, AND ABORTION RATE

Category	Percent of All Women	Percent Who Gave Birth before Age 20	Percent Who Completed High School by Age 20
All Women	100.0	20.2	85.6
Early Childbearing Status			
No Teenage Birth	79.8	—	92.6
Teenage Birth	20.2	—	57.6
Teenage Birth before Completing High School	12.9	—	33.9
Birth before Age 18 and before Completing High School	8.8	—	41.9
Age at Menarche			
Earlier than 12	15.0	25.8	81.0
12	26.7	20.9	85.9
13	31.0	18.6	86.9
Later than 13	27.4	18.2	86.2
Number of Obstetrician/Gynecologists per 100,000 Women aged 15–44 in Woman's County of Residence			
None	7.8	29.4	82.3
Fewer than 50	51.6	18.9	86.6
More than 50	40.6	20.0	84.9
Number of Abortions per 1,000 Women aged 15–44 in Woman's State of Residence			
Fewer than 25	36.5	21.4	85.6
25 to 35	43.5	19.7	87.4
More than 35	20.0	18.8	81.6

Note: Figures based on 4,658 observations from NLSY and weighted using 1985 weights rescaled to sample size.

the conditional fertility rates.[18] The results from table 2 provide mixed evidence of the schooling consequences of teen fertility. Comparisons based on age at menarche and Ob-Gyn availability indicate that early births have strong negative schooling effects while comparisons based on local abortion rates suggest that there is little relationship between fertility and schooling.

IV. Results

Estimation results from two specifications of the bivariate probit model appear in table 3. The first two columns in table 3 list estimates from a model in which teenage childbearing is included as an exogenous determinant of high school completion. In this first specification, early fertility is estimated to have a significant negative effect.

Evaluating the results at the data means, the coefficient on fertility implies that a teen birth reduces the chances of completing high school by 23.4 percentage points. Thus, controlling for observed differences in the contextual variables reduces the estimated effect of fertility on schooling by a third.

The coefficients on the other explanatory variables generally conform with expectations. Teenagers who grow up in nonintact families, with more siblings, and in states with generous welfare benefits appear to be less likely to finish high school. Conversely, religiousness, education funding, mother's education, and access to reading materials are estimated to be positively associated with high school completion. With respect to adolescent childbearing, Medicaid generosity, a nonintact family, siblings, and African origin are significant positive determinants. Mother's education, the availability of reading materials, religiousness, age at menarche, and the state abortion rate have significant negative effects on teenage fertility. Although many of the economic

[18] Specifically, the conditional completion rates can be regressed on the conditional fertility rates weighting each observation by the size of the conditioning set. Using this method, teen fertility is estimated to reduce school completion by 71.1 percentage points when the results are conditioned on age at menarche and 39.8 points when the results are conditioned on Ob-Gyn availability. The regression based on the abortion variable produces an imprecise positive coefficient estimate.

coefficients are insignificant, the results for welfare generosity in the edueation equation and Medicaid generosity in the fertility equation provide modest support for economic hypotheses.

The next two eolumns in table 3 report estimates from a model in which adolescent childbearing is specified as an endogenous determinant of high school completion. In this speeification, teen births are estimated to have small positive effects on high sehool eompletion. Although the eoefficient on fertility is statistically indistinguishable from zero, it differs significantly from the estimate in the previous model. This result combined with the significant eorrelation eoefficient and large change in the log likelihood value indicates that the assumption of exogenous fertility should be rejeeted. These results are not unprecedented. The finding of signifieant endogeneity bias is consistent with results reported by Geronimus and Korenman (1992, table 3) and Hoffman et al. (1992). Insignifieant fertility effects were also reported by Olsen and Farkas (1989) and Rindfuss et al. (1980).

The other coefficients in the high school completion equation appear to be relatively stable. Most maintain their signs, magnitudes, and significance levels across specifications. There are, however, two exceptions. The coefficient on African origin ehanges sign and loses signifieanee in the second specification while the negative coeffieient on residence in the South increases in magnitude and gains significanee.

The results in table 3 have been subjected to several sensitivity and specifieation tests. To examine the sensitivity of the results to raeial and ethnic differenees, separate models have been estimated for women of Hispanic, Afriean, and non-Hispanic, non-African origins. Results from the non-Hispanie, non-African subsample are very similar to estimates reported in table 3. However, models for the Hispanic and black subsamples do not adequately predict these groups' schooling and fertility behavior; coeffieient estimates in these models are generally insignificant. Small sample sizes and diminished outcome variability may aecount for the insignificant results. Moreover, many of the geographic variables have not been conditioned on raee and, thus, may not accurately refleet the institutions, attitudes, and resources for minority women.

Tests of overidentification fail to reject the exclusion restrictions from table 3. In addition, the coeffieients on Ob-Gyn availability and local abortion rates appear to be robust to respeeifieations involving different sets of regional controls. The sensitivity of the estimated effect of teen births to alternative identification assumptions has also been examined. The first three rows in table 4 report estimates of fertility effects, correlation coefficients, and log likelihood values from some of these models. For comparison purposes, the relevant estimates from table 3 appear in the first two eolumns of table 4. The next three columns list results of models estimated using each of the identifying variables by themselves. These three specifications yield point estimates on teen births which are close to the eoefficient reported in the endogenous fertility model from table 3. In the models based on Ob-Gyn availability and the local abortion rate, the exogeneity of teen childbearing is strongly rejected. The exogeneity test based on age at menarche is ineonclusive.

The paper's use of childbearing by age 20 as its measure of early fertility might account for the results from table 3 and the top of table 4. To the extent that this variable includes births to women who were 18 or 19 and had already left school, it may be more weakly related to high sehool completion than fertility whieh oecurs before leaving school or among younger women. This supposition is supported by the estimates in table 2 and results from previous studies (e.g., Moore and Waite, 1977). Along these lines, the paper tests the sensitivity of its results to different specifieations of the early fertility variable.

The five models listed at the top of table 4 have been re-estimated using births before age 20 and before eompleting high school and births before age 18 and before completing school as alternative measures of early fertility. Estimates from these models appear in the middle and bottom rows of table 4. In the exogenous fertility specification, teen births which oceur before finishing high sehool are estimated to have much stronger effects on school completion than teen births generally. However, when endogeneity is taken into account, these births appear to have no significant effeet on school completion. In fact, there is virtually no difference between the estimated effeets in the endogenous fertility specifications reported at the top and middle of table 4.

Estimates listed in the first column (bottom three rows) of table 4 suggest that births which

TABLE 3.—HIGH SCHOOL COMPLETION AND EARLY CHILDBEARING PROBIT RESULTS

Independent Variables	Exogenous Childbearing: Completed High School	Exogenous Childbearing: Birth before Age 20	Endogenous Childbearing: Completed High School	Endogenous Childbearing: Birth before Age 20
Intercept	1.597[b]	1.416[a]	0.389	1.376[a]
	(0.697)	(0.526)	(0.699)	(0.532)
Teenage Birth	−1.029[a]	—	0.342	—
	(0.057)		(0.364)	
PDV Earnings/	−0.025	−0.027	−0.018	−0.031
No High School	(0.046)	(0.040)	(0.042)	(0.040)
PDV Earnings/	−0.034	0.044	−0.026	0.050
High School	(0.033)	(0.034)	(0.031)	(0.034)
Monthly AFDC Benefit	−0.224[b]	−0.036	−0.188[b]	−0.053
	(0.096)	(0.074)	(0.085)	(0.074)
Monthly Food Stamp	−0.883[b]	−0.166	−0.708[b]	−0.231
Benefit	(0.361)	(0.265)	(0.312)	(0.267)
Monthly Medicaid	−0.301[a]	0.221[b]	−0.331[a]	0.231[b]
Benefit	(0.111)	(0.099)	(0.099)	(0.099)
Black	0.244[a]	0.433[a]	−0.011	0.442[a]
	(0.081)	(0.069)	(0.117)	(0.069)
Hispanic	0.105	0.089	0.047	0.077
	(0.130)	(0.116)	(0.122)	(0.115)
Mother Only	−0.283[a]	0.072	−0.261[a]	0.076
	(0.080)	(0.071)	(0.075)	(0.071)
Mother and	−0.339[a]	0.305[a]	−0.420[a]	0.302[a]
Stepfather	(0.093)	(0.085)	(0.087)	(0.085)
Other Family	−0.579[a]	0.290[a]	−0.608[a]	0.287[a]
Structure	(0.096)	(0.089)	(0.093)	(0.089)
Number of Siblings	−0.029[b]	0.033[a]	−0.038[a]	0.034[a]
	(0.012)	(0.010)	(0.011)	(0.010)
Foreign Language	−0.066	−0.130	0.011	−0.107
Spoken at Home	(0.103)	(0.091)	(0.101)	(0.090)
Mother's Years	0.127[a]	−0.093[a]	0.147[a]	−0.094[a]
of Education	(0.012)	(0.011)	(0.011)	(0.011)
Mother in	0.059	0.050	0.022	0.060
Labor Force	(0.057)	(0.047)	(0.054)	(0.047)
Magazines	0.206[a]	−0.279[a]	0.293[a]	−0.277[a]
	(0.061)	(0.051)	(0.056)	(0.051)
Newspapers	0.178[a]	−0.171[a]	0.223[a]	−0.174[a]
	(0.068)	(0.059)	(0.060)	(0.059)
Library Card	0.157[b]	−0.059	0.157[a]	−0.048
	(0.064)	(0.055)	(0.059)	(0.055)
Attends Religious	0.323[a]	−0.132[b]	0.322[a]	−0.135[b]
Services Infrequently	(0.072)	(0.066)	(0.070)	(0.066)
Attends Religious	0.530[a]	−0.351[a]	0.590[a]	−0.358[a]
Services Often	(0.076)	(0.065)	(0.069)	(0.065)
Lived in an Urban	−0.127	0.0004	−0.096	0.020
Area at Age 14	(0.075)	(0.056)	(0.066)	(0.056)
Lived in the South	−0.138	0.123	−0.177[b]	0.118
at Age 14	(0.086)	(0.074)	(0.078)	(0.074)
Unemployment Rate	−0.018	0.005	−0.022	0.003
	(0.015)	(0.012)	(0.013)	(0.012)
Per-pupil Education	0.188[b]	−0.123	0.227[a]	−0.120
Funding	(0.075)	(0.065)	(0.065)	(0.064)
Age at Menarche	—	−0.052[a]	—	−0.041[a]
		(0.015)		(0.014)
Availability of	—	−0.002	—	−0.002[b]
Ob-Gyn Physicians		(0.001)		(0.001)
Abortion Rate	—	−0.006[b]	—	−0.006[a]
		(0.002)		(0.002)
ρ	—		−0.735[a]	
			(0.178)	
Log Likelihood	−3419.52		−3414.83	

Note: Estimates based on 4,658 observations from NLSY and weighted using 1985 weights rescaled to sample size. Earnings divided by 10,000; education funding divided by 1,000, and welfare benefits divided by 100. Standard errors appear in parentheses.

[a] Significant at 0.01 level.

[b] Significant at 0.05 level.

TABLE 4.—HIGH SCHOOL COMPLETION AND EARLY CHILDBEARING PROBIT RESULTS—ALTERNATIVE TIMING MEASURES AND IDENTIFICATION RESTRICTIONS

	Childbearing Modeled as Exogenous	Childbearing Modeled as Endogenous, Identified by: Age at Menarche, Ob-Gyn Availability, and Abortion Rate	Age at Menarche	Ob-Gyn Availability	Abortion Rate
Teenage Birth					
Effect on High School Completion by Age 20	−1.029[a] (0.057)	0.342 (0.364)	−0.147 (0.781)	0.547 (0.426)	0.468 (0.478)
ρ	—	−0.735[a] (0.178)	−0.485 (0.408)	−0.832[a] (0.204)	−0.793[a] (0.231)
Log Likelihood	−3419.52	−3414.83	−3422.00	−3423.51	−3423.64
Teenage Birth before Completing High School					
Effect on High School Completion by Age 20	−1.691[a] (0.067)	0.323 (0.297)	−0.024 (0.666)	0.470 (0.260)	0.399 (0.329)
ρ	—	−0.898[a] (0.103)	−0.769[a] (0.255)	−0.947[a] (0.091)	−0.923[a] (0.114)
Log Likelihood	−2706.68	−2697.53	−2702.83	−2704.13	−2702.48
Birth before Age 18 and before Completing High School					
Effect on High School Completion by Age 20	−1.194[a] (0.077)	0.799[a] (0.102)	0.679[a] (0.254)	0.823[a] (0.078)	0.812[a] (0.093)
ρ	—	−0.950[a] (0.048)	−0.892[a] (0.113)	−0.961[a] (0.037)	−0.955[a] (0.044)
Log Likelihood	−2581.11	−2573.39	−2577.04	−2576.48	−2576.48

Note: Estimates based on 4,658 observations from NLSY and weighted using 1985 weights rescaled to sample size. Except as noted, models include all of the independent variables reported in table 3. Standard errors appear in parentheses.
[a] Significantly different from zero at 0.01 level.
[b] Significantly different from zero at 0.05 level.

occur before age 18 and before finishing high school also have more deleterious effects on school completion than teen births generally. The next four columns report results from different specifications of the endogenous fertility model. In each of these specifications, births before age 18 are estimated to have significant positive effects on school completion. At a minimum, the results provide strong evidence of the endogeneity of fertility. The results also suggest that after controlling for other effects, very young mothers may be more diligent in completing their schooling than other women. Clearly, caution is warranted in interpreting these results. In the sample, only one woman in eleven experienced a birth before age 18 and before finishing high school, and on average, those women who did experience such births came from very disadvantaged backgrounds.[19] The correlation coefficients, which differ significantly from zero but not from negative one, indicate that the estimation procedure has some difficulty disentangling the effects of fertility from other unobserved background factors.

V. Conclusion

This paper develops and estimates a simultaneous discrete choice model of adolescent fertility and high school completion. Through several alternative specifications of the model, the paper finds that teen childbearing is an endogenous determinant of schooling and that failing to take endogeneity into account leads to an over-estimate of the effect of fertility. The paper finds some evidence of the importance of economic variables. In particular, Medicaid generosity appears to encourage fertility; welfare generosity and high unemployment appear to discourage high school completion. Demographic and institutional characteristics such as race, family background, religiousness, and education funding appear to be significant determinants of fertility and schooling.

While the data and statistical methodology differ, these results are consistent with the findings of recent analyses which report insignificant fertility effects or significant endogeneity biases (Bronars and Grogger, 1992, Geronimus and Korenman, 1992, Hoffman et al., 1993, Olsen and Farkas, 1989, Rindfuss et al., 1980). The difference in findings between this study and the one previous analysis which controlled for and found a significant effect from endogenous fertility (Marini, 1984) may be explained by differences in the suitability of each study's identifying variables.

[19] These mothers were much more likely to be black, come from non-intact families, have poorly educated mothers, attend poorly funded schools, and live in high unemployment neighborhoods than other teen mothers.

The results of this paper may be an indication of the success of Title IX of the Education Amendments of 1972. Title IX outlawed discrimination on the basis of pregnancy and parenthood in publicly funded schools and presumably increased educational opportunities for teen mothers. In addition, schools have subsequently adopted a number of programs to discourage pregnant students from dropping out (Hofferth, 1987). Beyond this, the findings of this paper have other policy implications. Policy-makers should recognize that teenage parenthood and failure to complete high school are, in important respects, separate problems. Programs which encourage education or discourage early fertility may not be automatically reinforcing. Preventing teenage births might not by itself increase rates of high school completion.

The paper's policy implications are not entirely discouraging. Teen parenthood and school drop out appear to stem from a common set of antecedents. Programs targeted at these shared antecedents may be reinforcing. Thus, policies which keep families together or improve parental education are likely to have negative effects on adolescent childbearing and positive effects on high school completion. The intergenerational aspects of the results also suggest that programs which improve educational outcomes for today's youth are likely to reduce fertility and increase schooling among the next generation of teenagers.

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