Economics Letters 40 (1992) 229–233
North-Holland

The effect of women's schooling on fertility

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Received 15 June 1992
Accepted 29 September 1992

This study investigates the effect of women's schooling on fertility in the United States. Particular attention is given to the issue of whether women's schooling can be legitimately treated as an exogenous determinant of fertility.

1. Introduction

Numerous studies indicate that women's schooling has a negative effect on fertility. Some of the possible explanations for this effect include (1) women's schooling increasing the value of time in market work and, accordingly, the opportunity cost of allocating time to child rearing [Becker (1991)]; (2) women's schooling increasing the efficiency of fertility control [Michael (1973)]; and (3) schooling reducing preferences for children [Cleland and Wilson (1987), Easterlin (1989)].

Women's schooling could also be endogenous with fertility since children affect the cost of schooling for mothers. Mothers with children at home relative to other women are less likely to make additional investments in schooling. Perhaps more importantly, women's schooling could be correlated with unobservable traits that are jointly determined with fertility. Boulier and Rosenzweig (1984) found this to be the case in a study of women in the Philippines; they found that the negative correlation between schooling and fertility was a product of selection. In a related study, Sander (1992) found that schooling is endogenous with marital status. Thus, schooling should not be treated as an exogenous determinant of decisions that are made in the marriage market. Other studies also indicate that schooling and various types of behavior might be jointly determined [see, for example, Farrell and Fuchs (1982) and Fuchs (1982)]

By and large, most studies on fertility treat women's schooling as an exogenous determinant of fertility [see, for example, DeTray (1974) Rosenzweig and Schultz (1985), and Willis (1974)]. The study by Boulier and Rosenzweig (1984) is an exception. Further, many studies on fertility select a subset of either wives or women for analysis. For example, Willis (1974) studies the fertility of white women married once who are living with their husband. DeTray (1974) estimates children ever born

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* The author would like to thank DePaul's College of Commerce for research support. In addition, he would like to thank Tony Krautmann and an anonymous reviewer for their comments on a preliminary draft.

Table 1
Children ever born to women by age and schooling.

Age	Schooling (in years)			
	< 12	12	13–15	16 +
25–34	2.51	1.62	1.34	0.62
35–44	3.20	2.22	2.10	1.64
45–54	3.81	3.06	2.87	2.01
55–64	3.40	2.87	3.45	2.57
65 +	2.77	2.22	2.09	1.97

Source: National Opinion Research Center, 'General Social Survey: 1985–1991'.

to married women. Boulier and Rosenzweig's (1984) data are for once-married women with spouse present. The subset of women studied might further confound the relationship between schooling and fertility – particularly in rich countries where women increasingly have children outside of marriage and where women increasingly are more likely to divorce.

In this paper, the effect of women's schooling on fertility is examined. Particular attention is paid to the issue of whether women's schooling is an exogenous determinant of fertility. It is shown that women's schooling has a large negative effect on fertility regardless of whether schooling is treated as an endogenous or exogenous variable.

2. The data

The data are taken from the National Opinion Research Center's 'General Social Survey'. The survey has been undertaken annually for most years since 1972. It consists of a random sample of approximately 1,500 English-speaking persons 18 years of age or older living in non-institutional arrangements in the United States. The survey data are not longitudinal. In this study, data from the seven most recent years of the survey are used (1985 to 1991). These years are selected so that a contemporary focus is given to the study. If the data are broken down by women's schooling and age, a negative correlation is indicated between fertility and schooling (table 1). For example, women age 45 to 54 with less than twelve years of schooling have an average of 3.81 children; women in this age cohort with sixteen or more years of schooling have an average of 2.01 children.

3. The models

Children ever born to women ages 35 to 44 and 45 to 54 are estimated. Younger women are not selected because a relatively high percentage have not completed their schooling. Further, younger women have not completed their fertility. This is less the case for women in their late 30s and older. The birth rate in 1988 per 1000 women was 28 for women age 35 to 39, 5 for women age 40 to 44, and 2 for women age 45 to 49 [U.S. Department of Commerce (1991)]. Thus, women age 35 to 44 have almost completed their fertility and women age 45 to 54 have by and large completed the size of their families. Both ordinary least squares (OLS) and two-stage least squares (TSLS) are used to estimate fertility. The TSLS estimates are undertaken because one could argue that schooling is endogenous with fertility, as noted above. The variables that are used to identify the two-stage procedure include father's schooling and mother's schooling (i.e., the schooling of the respondent's parents). I would note that the dependent variable that is estimated is a count

Table 2
Summary statistics for women age 35 to 44 and 45 to 54.

Variable	Mean		Standard deviation	
	35–44	45–54	35–44	45–54
1. Children ever born	2.10	2.90	1.4	1.7
2. Schooling (years)	13.4	12.7	2.5	2.7
3. Age	39.1	49.1	2.9	2.8
4. Farm	10.3%	17.7%	30.4	38.2
5. Other rural	13.2%	12.8%	33.8	33.4
6. Town	31.8%	32.3%	46.6	46.8
7. Small city	17.1%	15.1%	37.7	35.8
8. West	15.8%	12.5%	36.5	33.1
9. North Central	27.9%	31.3%	44.9	46.4
10. East	22.0%	20.1%	41.5	40.1
11. Black	15.3%	15.9%	36.0	36.6
12. Catholic	26.8%	18.5%	44.3	38.9
13. Mormon	0.8%	1.6%	9.0	12.5
N	1,108	696		

Source: National Opinion Research Center, 'General Social Survey: 1985–1991'.

variable. Thus, it might be possible to improve upon least squares estimates. However, it is doubtful whether other methods would result in substantive differences from least squares.

In addition to schooling, the other variables that are used to estimate fertility are age, Black, region at age sixteen (relative to South), type of residence at age sixteen (relative to big cities of over 250,000 and their suburbs), Catholic upbringing, Mormon upbringing, and the survey year (relative to 1991). Adjustments are not made for choice variables such as marital status, current location, current religion, and so on because such variables might be endogenous with fertility. Summary statistics are provided in table 2.

4. A test for endogeneity

As noted above, schooling might not be an independent determinant of fertility. There are formal statistical tests of correlation of a regressor (e.g., schooling) and the error term in an OLS regression. One of these is suggested by Hausman (1978). The Hausman-test consists of regressing the variable in question (schooling) on a set of exogenous variables. The residual from this estimate is used to test for endogeneity.

I used this procedure to test for endogeneity between women's schooling and fertility by regressing women's schooling on all of the variables in my OLS fertility equation (apart from women's schooling) and two additional variables (father's schooling and mother's schooling) for identification. The residual from this estimate was then used in my OLS estimate of fertility. A *t*-test on the coefficient for the residual is undertaken to test for endogeneity. For both women age 35 to 44 and 45 to 54, the *t*-statistic on the residual was 1.1. The Hausman-test thus suggests that schooling is not highly endogenous with fertility.

5. The results

The results indicate that schooling has a highly significant negative effect on fertility (table 3). This is the case in both the OLS and TSLS estimates. Further, the schooling coefficients are not

Table 3
Estimates of children ever born to women age 35 to 44 and 45 to 54 (standard errors in parentheses).

	35–44		45–54	
	OLS	TSLS	OLS	TSLS
Schooling	−0.16 ***	−0.19 ***	−0.15 ***	−0.24 ***
	(0.02)	(0.04)	(0.02)	(0.06)
Age	0.06 ***	0.06 ***	0.06 ***	0.045 *
	(0.01)	(0.02)	(0.02)	(0.025)
Farm	0.26 *	0.21	0.20	0.17
	(0.15)	(0.17)	(0.21)	(0.23)
Other rural	0.27 *	0.07	0.12	0.28
	(0.14)	(0.16)	(0.22)	(0.24)
Town	0.17	0.11	0.18	0.22
	(0.11)	(0.12)	(0.17)	(0.19)
Small city	0.16	0.10	−0.23	−0.22
	(0.13)	(0.14)	(0.21)	(0.23)
West	0.05	0.04	0.68 ***	0.85 ***
	(0.13)	(0.15)	(0.22)	(0.24)
North Central	0.10	0.11	0.47 ***	0.50 ***
	(0.11)	(0.12)	(0.16)	(0.17)
East	−0.02	0.02	0.54 ***	0.56 ***
	(0.12)	(0.14)	(0.19)	(0.22)
Black	0.51 ***	0.31 **	0.55 ***	0.62 ***
	(0.12)	(0.15)	(0.18)	(0.22)
Catholic	0.12	0.14	0.17	0.28
	(0.10)	(0.11)	(0.17)	(0.19)
Mormon	1.89 ***	2.53 ***	1.55 ***	1.76 ***
	(0.46)	(0.52)	(0.53)	(0.54)
Intercept	1.63 ***	2.09 **	1.05	2.86 *
	(0.64)	(1.00)	(1.18)	(1.69)
$\bar{R}^2$	0.12		0.11	
F	9.4 ***		6.0 ***	

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

significantly different in both estimates. The schooling coefficients suggest that a ten percent increase in schooling is associated with a ten to twelve percent decline in fertility (at mean values for schooling and fertility) for women age 35 to 44. For women age 45 to 54, a ten percent increase in schooling reduces fertility by seven to ten percent.

6. Conclusions

The important lesson from this study is that women's schooling has a relatively large negative effect on fertility. Further, women's schooling is not highly endogenous with fertility. Thus, if

schooling is treated as an independent variable, this does not lead to false acceptance of socio-economic theories of fertility. Although women's schooling reduces fertility, this paper does not indicate how schooling affects decisions on children. Previous research suggests that schooling increases women's earning ability and, subsequently, the price of children. Further, schooling increases women's ability to plan family size. Other interpretations of the schooling–fertility relationship might also be possible.

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