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INTERRELATIONS OF FERTILITY AND WOMEN'S LABOR FORCE PARTICIPATION, WITH PARTICULAR EMPHASIS ON THE EFFECTS OF EDUCATION

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ABSTRACT

The effect of more education for women on their fertility behavior is examined using data from the National Bureau of Economic Research--Thorndike-Hagen sample (NBER-TH) and a comparable group from the National Longitudinal Survey. The NBER-TH data are longitudinal 25-year histories of 5,083 white males and their families.

The effect of education on family size is decomposed into distinct factors: contraceptive efficiency, age at marriage, tastes toward children and desired standard of living, opportunity cost and efficiency in raising children. Investigation shows that a combination of the taste and efficiency factors has a positive, though nonlinear, relation to fertility. A cost factor has the expected negative relationship to family size. Since the cost factor has dominated other results, this raises the question of the true impact of increased women's wages on fertility.

Interrelations of Fertility and Women's Labor Force Participation with Particular Emphasis on the Effects of Education

This study concerns the effect of increasing a woman's education on her family size. More precisely, the hypothesis that the effects of more education for women are smaller families and greater labor force participation is examined. A utility maximization model is employed where education and labor force participation are viewed as affecting both costs and tastes. Data from the National Bureau of Economic Research--Thorndike-Hagen study (NBER-TH)--a longitudinal, 25-year history of 5,083 white males who participated in an Air Force testing program in 1943--and a comparable group from the National Longitudinal Survey are used. Single men are excluded from the samples used here.

1. The Model

In the model posited here individuals are assumed to be utility maximizers, where utility includes not only satisfaction derived from goods and services but also includes utility from children, status, and job satisfaction. To illustrate, in the simplest two-good sense, we can measure child services (utility derived from children) on one axis and other goods and services--a composite good--on the other axis. Any point in the quadrant represents a combination of these two types of "goods." In order to get the utility, one needs to expend resources in the form of income and time. That is, an individual or household uses its resources to produce its satisfaction. It is possible to use time to earn income (labor force participation) and thus produce goods and services in a more direct fashion, but time is also needed to derive satisfaction from goods and services and from children.

The utility model which follows is for each married couple in the sample, with one period starting on the day of their marriage and continuing over the remainder of their lifetime:

$$U = f[N, Qc, S^X, G^P, S, L, W^d, C; R, E^O, Sib, A, SES, G]$$
$$+ \lambda[P^G(G^P + NG^C) + P^E(E^P - E^O) + NE^C) - (H-L - (E^P - E^O) - T-C)P^{\ell}$$
$$- r(\delta(W^d, W^i)];$$
$$Q_c = Qc(N, E^c, E^P, G^c, T, Sp)$$
$$S = S(G^P, E^P, \delta(W^d, W^i), M, O)$$
$$O = O[E^P, A, O^f, (H-L - (E^P - E^O) - T - C), PWE]$$
$$T = (N, Sp, E^c)$$
$$P^{\ell} = (O, E^P, A)$$

where

G^P = A composite good representing a discounted flow of goods and services consumed by the parents over time from m to d, where m = marriage, d = death of the last parent.

Ch = Child utility, a discounted quality-adjusted flow of utility from one's children over time from b to d, where b = birth of child, d = death of last parent.

S = Status, a combined measure of the status of husband and wife with imperfect substitutability between the two.

L = Leisure. This comprises the leisure time of both husband and wife. While some substitution is possible, the leisure of one parent is not a perfect substitute for the leisure of the other. Thus if the wage rate of one is much higher than that of the other, having one partner continuously work full-time while the other uses most of his/her time for leisure will not maximize the combined utility from leisure.

W^d = Wealth at time of death--the bequest left to future generations. This may be $\gtrless$ the initial wealth of the couple at the time of marriage.

C = Coition, which is itself a source of satisfaction. This is particularly important in an analysis aimed at explaining demand for children since it enters into the cost of preventing conception. Other forms of sexual pleasure are included in leisure.

R = Religion.

E^O = Education at time of marriage.

M = Marital status. This can change because of death of one parent, and is broader than usual in that it includes forced separation and divorce.

Sib = Number of siblings of each of the parents and the parent's position in birth order.

A = Ability, i.e., the inherited ability or IQ.

SES = Socioeconomic status of each of the families of the couple before their marriage.

G = Other geographic characteristics, including size of community in which each grew up, urban versus rural background, and region of the country.

P^G = Price of goods and services.

G^c = Goods consumed by the children on a per child basis.

P^E = Price of education.

E^P = Total amount of education of the couple.

E^c = Education of the children, on a per child basis.

N = Number of surviving children.

H = Total time available from day of marriage until death of husband and wife.

T = Time parents spend in child care.

P = Price paid per unit of labor.

r = Rate of interest.

δ = A function discounting wealth.

W^i = Initial wealth at time of marriage.

Q^C = Qualify of children.

S^X = Sex of children.

S^P = Spacing of children.

O = Occupation.

O^f = Occupations of the couple's parents.

PWE = Premarital working experience; this can include experience gained on the job or in the military.

The couple is assumed to choose among the alternatives available so as to maximize satisfaction derived from their total consumption. The satisfaction which can be derived from any possible combination of commodities is contained in this utility function. Generally, a particular level of satisfaction can be derived from different combinations of commodities; the loss of one unit of goods and services can usually be compensated for by an increase in other commodities. All the combinations which yield the same amount of satisfaction form an indifference curve. The shape reflects the tradeoffs the couple would be willing to make that would yield them a given amount of satisfaction. The rate of substitution at any point on a given curve measures the amount of one good, say child services, that must be given

to the couple if one unit of another good (such as the composite good) is taken away, in order for the couple to be as well off.

The couple is limited by their time, wealth, and income in the purchase of commodities. This restraint is contained in the Lagrangian multiplier λ above. It says that the total amount of money spent over the couple's lifetime cannot exceed their wage and other income, including changes in wealth, and that the amount earned is limited by available time (i.e., time not spent in leisure--including sleep, education, child care, and coition), and by the wage rate, which is affected by occupation, education, ability, and experience.

The utility framework is used to derive the couple's demand for a commodity such as child services. In general, under the assumption that the second order conditions are satisfied, one solves the first order conditions in order to obtain demand functions. The demand functions therefore depend upon the properties of the couple's utility map. For normal goods the demand curves are negatively sloped so that as price decreases more is demanded.

My analysis is directed at explaining how education affects the indifference map with regard both to children and to goods and services, and how costs--particularly opportunity costs--affect the demand for children. More specifically it tests the hypothesis that more education for women has a negative effect on their demand for children.

Tastes in a utility model are reflected in indifference curves. Basically, differences in behavior are observed. Individuals are assumed to behave rationally, at least at the margin, and thus purchase those commodities which provide them with the greatest amount of satisfaction, or in the case of children, to have the number and quality desired.[1] The point of maximization is where the individuals' budget line just touches, i.e., is

tangent to, the highest indifference curve that can be achieved, given their income and prices. Once opportunities are the same for individuals (the budget lines are the same), persisting differences in behavior represent differences in tastes. An attempt is made here to control the budget lines by including available income and cost variables in the regression equation.

Education in the Model

Additional education can be viewed as having five possible effects on fertility:

(1) increasing contraceptive efficiency and thereby reducing the costs of contraception;

(2) raising the age at marriage and thus reducing exposure to conception (at least within marriage);

(3) influencing tastes toward children and desired standard of living;

(4) increasing the market wage rate and so increasing the opportunity cost of time spent in child care; and

(5) increasing productivity in child care, thereby reducing the costs of a given "quality" child.

Another possible effect is assortive mating: a highly educated woman is likely to marry a similarly well-educated man with a high income, and this income may have a positive effect on fertility.

In the decision whether or not to have an additional child, costs of preventing an additional birth are weighted in. If these costs are lower through better knowledge about contraception, the cost of preventing a birth will be lower. Therefore, this effect is predicted to decrease fertility of the better educated.[2]

By exposing individuals to new ideas and possibilities, education may affect tastes. The process of taste formation suggested here is that individuals

form or change their tastes through their experiences--their environment.[3] Sociologists tend to emphasize group norms as helping to determine an individual's actions. The strength of coercion applied affects the observance of these norms. Thus it is necessary to look at the groups with which one identifies in order to understand behavior.

More specifically, education can affect tastes in the following ways. First, it can increase exposure to the attitudes of others toward contraception and thereby reduce or change the psychic costs associated with it. This is likely to reach a saturation point early in post-high school education.[4]

Second, education may broaden interests, which in turn may either decrease or increase the number of desired children. Education may increase the demand for children by increasing interest in child development and related topics. Conversely, it may decrease the demand by creating other interests, such as travel, cultural activities, reading, etc. which require competing time and resources.

Third, and related to the second factor, education may change one's perspective on the desired standard of living. Relative income effect falls into this category. When an individual becomes aware of others' standards of living, she may revise her own standards--either upwards or downwards. If her desired standards rise, her demand for children might decrease, while if they should decrease, the demand for children might increase. An example of this is the smaller family size of those in the NBER-TH sample whose standards were set in college but did not complete their degrees, which will generally result in lower incomes. In order to achieve these standards they might forego additional children who would take up time and income.

Still a fourth way is that the group norms for family size of an adult may differ from those of one's earlier environment, and these new norms may change desired family size.

Viewed as a cost, more education generally increases the opportunity costs of women. Women with more education tend to earn higher wages in the labor force. Their nonparticipation thus involves foregoing more income than is true for less educated women. Having children generally involves spending a certain amount of time with them which might otherwise be used in labor force participation. A traditional measure of this cost takes the form of hours spent out of the labor force times an appropriate wage rate.[5] An increase in the wage rate means higher opportunity costs of children. If children are more time-intensive than goods and services, as has generally been true in the U.S., the opportunity costs will increase by more than goods and services if wages increase. Thus there should be a substitution away from children and towards goods and services. In addition to this, there is an income effect. Higher wage rates shift the income constraint out, making it possible to move to higher levels of satisfaction, i.e., the income effect allows the consumption of more of all goods. This is true both in terms of the short run, when more income can be earned in the same amount of time such as through part-time work, and also in terms of greater future income.

Education may also affect opportunity costs of time in terms of the value of time spent in raising children. An increase in efficiency in child care will reduce the costs, and this may have a positive effect on fertility.

2. The Data

This study primarily uses the NBER-TH sample, a data base with information on approximately 5,000 white males and their immediate families over a 25-year

period, plus background information on the husband's and wife's parents. In addition to providing longitudinal data, this sample is a relatively homogeneous group in education and age: the white male respondents have a minimum level of education equivalent to high school completion and ranged in age from about 44-54 in 1969. These men are among the 500,000 who volunteered for pilot, navigator, and bombadeer tests during World War II. As part of this program, they took the Aviation Cadet Qualifying Test, filled in background information and took additional tests to measure other abilities. In 1955 Thorndike and Hagen resampled 9,700 of these men to analyze the usefulness of aptitude tests in predicting future occupational success. The NBER obtained this information and recontacted 5,089 of this group in 1969. Two follow-ups were later conducted.[6]

The information collected includes actual number of children in 1969; religion, age, and education of respondent and wife; 1969 marital status; 1955 and 1969 actual income; earnings of other family members and other income in 1958 and 1968; wife's work history since marriage in five-year intervals; occupation of respondent and his father; education of respondents' and wife's parents; and desired education of the children.

The percentage distributions of households by number of children for the NBER-TH sample and a comparative group of white women aged 40-49 in 1967 in the U.S. are presented in Table 1. The mean number of children for the NBER-TH sample is 2.82, very close to the U.S. mean figure for children ever born to white women ever married, age 40-44 years in 1967. An F-test performed between the two distributions

Table 1

Percentage Distribution of Households by Number of Children: NBER-TH Sample and U.S. Population

	NBER-TH	U.S. Population (Number of Children Ever Born to White Women Ever Married, 1967)	
		40 to 44 Years	45 to 49 Years
Total	100.0	100.0	100.0
0	3.4	8.4	11.3
1	10.9	12.9	16.6
2	30.6	26.5	26.9
3	27.0	22.4	20.9
4	14.9	13.3	10.5
5	6.6	11.5	9.2
6	6.3		
7+		4.9	4.6
Mean	2.82	2.84	2.58

Source: U.S. Department of Commerce, Current Population Reports Population Characteristics, Series P-20, No. 211 (January 26, 1971), Table 7.

Note: Variable is defined differently in these two distributions. For the NBER-TH it is children in 1969, but for the U.S. population, it is children ever born. One would expect the U.S. figure to be larger, since it is not decreased by infant and child mortality.

Table 2

Percentage Distribution of Households by Religion

	NBER-TH	United States Population (White Males, 19 years and older, 1957)
Protestant	63.6%	63.0%
Catholic	23.1	28.1
Jewish	5.2	3.6
Other	3.0	1.6
None	4.3	4.0
N	4899	51,315,000

found no significant difference between the NBER-TH distribution and the comparison populations. The percentage distributions of this sample and that of white males in the U.S. population by religion, given in Table 2, are quite alike.

The education of the respondents, with a minimum level equivalent to high school graduation, is considerably higher than that of the general U.S. white male population. This discrepancy is a limitation in applying any of the results to the total population, but given the rising trend in level of education among cohorts in the U.S. population, it can be considered to be moving toward the educational distribution of the NBER-TH sample. The occupational distribution shows a heavy concentration in the occupations with high status scale rankings, such as managers, proprietors, and salaried professionals. Not surprisingly, the income distribution is also higher than the white income distribution of the U.S. population.

The education distribution of the wives in the NBER-TH sample shows them, too, to be better educated than a comparable group of white women in the U.S., but they are more similar to the U.S. population than their husbands. While the medians differ by just half a year of education, only 6 percent of the NBER-TH women have fewer than twelve years of education compared to 32 percent of U.S. white women aged 34-44.

Table 3 cross-tabulates the level of education of the respondent with that of his wife. This shows a tendency toward assortive mating: the higher the level of education of the wife, the higher, in general, is the level of education of her husband.

Table 3

Cross-Tabulation of Wife's Education by Husband's Education:
NBER-TH (Nonsingle) Sample

Wife's Education (in years)	Husband's Education						
	High School	Some College	B.A.	Some Graduate	M.A.	Professional Degree	Total
0-7	37.93	31.03	20.69	3.45	3.45	3.45	100.00
	.91	.72	.43	.40	.23	.27	.59
8-11	48.87	30.83	11.28	3.01	3.38	2.63	100.00
	10.73	6.60	2.15	3.16	2.10	1.90	5.43
12	36.34	27.89	22.76	3.84	5.34	3.84	100.00
	69.61	52.09	37.85	35.18	28.97	24.12	47.36
13-15	12.89	28.18	34.93	6.13	8.80	9.07	100.00
	11.97	25.52	28.15	27.27	23.13	27.64	22.96
16	7.65	17.64	40.81	7.23	14.45	12.22	100.00
	5.95	13.37	27.51	26.88	31.78	31.17	19.21
>16	4.59	9.63	25.23	8.26	27.06	25.23	100.00
	.83	1.69	3.94	7.11	13.79	14.91	4.45
TOTAL	24.72	25.35	28.50	5.16	8.74	7.53	100.00

N = 4899

Note: Upper row of each panel gives husband's educational distribution (in percent) for wives of that education level. Reading down each column, lower number in each panel gives wife's educational distribution (in percent).

Sixty-two percent of the women in the sample worked since marriage; approximately 7 percent of the sample worked full time 5-10 years or 10-15 years since marriage, although these two groups overlap only slightly. The average age of the women in the sample is 46 (as of 1971) and the average length of marriage is 23 years, hence the average age at marriage was 23. The average age of the first child in 1971 was 17.4, the average space between children was 2.3 years, while the average expected years of education to be completed by the couple's children was 15.5 years. The simple correlation between wife working since marriage and the log of 1969 income was .06, and between wife working and total family income in 1968 it was -.03.

3. Results

Cross-Tabulations

As a first step in testing the model and in order to facilitate comparisons with other studies, a cross-tabulation of number of children by woman's education is presented in Table 4. The education levels are grouped into six categories: less than 8, 9-11, 12, 13-15, 16, 17 plus. The mean number of children for each group, in addition to the percentage distribution of education by number of children, is presented. The means show small differences: women with more than 16 years of education have a mean of 2.58 compared to an overall mean of 2.83. Those with some high school (8-11) have the highest mean at 2.99. This pattern is somewhat unusual but not strikingly so. The distributions show that the women who completed high school or some college--the

Table 4

Cross-Tabulation of Wife's Education
By Number of Children: NBER-TH (Nonsingle) Sample

	Years of Wife's Education						
Number of Children	0-7	8-11	12	13-16	16	16+	TOTAL
0	.55	5.46	45.36	18.03	20.77	9.84	100.00
	3.45	3.76	3.58	2.93	4.04	8.26	3.74
1	1.12	6.74	51.31	22.10	15.17	3.56	100.00
	20.69	13.53	11.81	10.49	8.61	8.72	10.90
2	.47	4.73	48.53	22.73	18.13	5.40	100.00
	24.14	26.69	31.38	30.31	28.91	37.16	30.62
3	.45	4.69	44.33	25.11	21.86	3.56	100.00
	20.69	23.31	25.26	29.51	30.71	21.56	26.99
4	.55	6.31	47.46	21.54	19.48	4.66	100.00
	13.79	17.29	14.91	13.96	15.09	15.60	14.88
5	.93	6.50	45.51	26.93	17.34	2.79	100.00
	10.34	7.89	6.34	7.73	5.95	4.13	6.59
6 or more	.65	6.49	50.65	18.51	20.45	3.25	100.00
	6.90	7.52	6.72	5.07	6.70	4.59	6.29
Mean	2.79	2.99	2.83	2.90	2.89	2.58	2.83
TOTAL	.59	5.43	47.36	22.96	19.21	4.45	100.00

Note: Upper row of each panel gives percentage of women with each family size having the given level of education. Reading down each column, lower number in each panel gives percentage of women with each education level having the given family size.

largest groups--tended to have the average percentage distribution of children. Approximately 15 percent had 0 to 1 child, 70 percent had 2-4 children, and 13 percent had 5 or more children. The women who did not complete high school comprised a slightly greater percentage with large families, 5 or more children, while the group with under eight years of education had a much larger percentage of five-child families. Women with graduate education had more childless families and more two-child families.

To test whether or not all the distributions of number of children by level of education are from the same overall population, the non-parametric Kolmogorov-Smirnoff test is used. This is based on the maximum difference between two cumulative functions. If the maximum difference is greater than the Kolmogorov-Smirnoff statistic at the 5 percent level of significance for that number of observations, the null hypothesis stating that both are from the same parent population is rejected.

Compared to the overall distribution, the null hypothesis could not be rejected for any individual level of education. The highest level of education was quite close to this level, however. Comparing the distribution for the group with 16 years of education to that for the women with 17 or more years of education, the maximum difference exceeds the 5 percent level of significance of .106. Thus, these distributions are statistically different. These groups with the highest levels of education may differ, i.e., have fewer children, because of higher opportunity costs and different tastes, but in a simple cross-tabulation, such possibilities cannot readily be sorted out.

Single Equations

Next, wife's education is included in dummy variable form in multiple regressions. Years married and wife's age are included to test the effect of education through postponement of marriage; husband's income is included to test its effect on fertility. There is evidence that contraceptive knowledge should be high and similar for the entire sample, based on the level of education of the women and their husbands,[7] so this differential should have little effect on fertility. Therefore, the education variables are presumably capturing the combined effects of taste, opportunity cost and efficiency in the home.

In this equation (Table 5, column 1) wife's graduate education shows a negative relationship to fertility. There is little difference among the other education groups in the dummy variable form.

Once a variable that attempts to control for wife's opportunity cost[8] (see Table 6) is entered there is no longer any negative relationship for wife-graduate, but instead a positive effect for wife's education at the B.A. level and higher. At the same time there is instead a negative relation between family size and wife's potential market wage. Thus, it appears that it is the market wage rate or opportunity cost, rather than higher education, that has the negative effect. Since women with more education, particularly graduate training, generally have higher market wage rates, this is not surprising. Education exhibits this relation when market wage is not controlled, but it is market opportunity cost that actually seems to have the stronger inverse relationship to family size.[9]

Table 5

OLS Regressions on Wife's Education and Opportunity Cost

	Number of Children as Dependent Variable				
	(1) Education, Income, Age, and Years Married	(2) (1) With Market Wage	(3) (2) Without Wife's Educ. Variables	(4) (2) With Work History and Fuller Model	(5) (4) With Children Only
Wife-no high school	.14 (.98)	.12 (.86)		.07 (.51)	.11 (.79)
Wife-some college	-.04 (.76)	-.02 (.46)		.02 (.43)	.02 (.47)
Wife-B.A.	.00 (.02)	.16 (2.74)		.17 (2.74)	.19 (3.25)
Wife-some grad. work	-.29 (2.85)	.23 (1.95)		.10 (.74)	.20 (1.50)
Respondent-some college	-.01 (.11)	-.08 (1.45)	-.07 (1.17)	-.00 (.06)	-.02 (.45)
Respondent-B.A.	.07 (1.17)	-.10 (1.57)	-.05 (.81)	-.01 (.10)	-.01 (.10)
Respondent-some grad. work	-.03 (-.30)	-.04 (.45)	-.01 (.12)	.09 (.92)	.12 (1.32)
Respondent-M.A.	.10 (1.16)	-.13 (1.53)	-.05 (.63)	.08 (.96)	.11 (1.24)
Respondent-prof. degree	.22 (2.42)	.08 (.88)	.15 (1.70)	.20 (2.24)	.15 (1.76)
Income 1955/000	.07 (1.18)	.12 (2.04)	.11 (1.92)	.09 (1.66)	.07 (1.33)
Income 1969/000	.01 (3.38)	.01 (4.66)	.01 (4.49)	.01 (2.81)	.005 (2.65)
Wife's age	.04 (5.10)	.20 (4.81)	.20 (4.83)	.17 (4.13)	.13 (3.23)
(Wife's age)^2	-.003 (6.41)	-.003(6.17)	-.003(6.17)	-.002(5.51)	-.002 (4.41)
Years married	.02 (5.18)	.02 (4.46)	.02 (4.35)	.02 (5.46)	.01 (3.15)
Proxy-wife market wage		-1.81(9.57)	-1.55 (9.46)	-.85 (2.42)	-.89 (2.64)
Divorced-widowed				-.74 (5.65)	-.64 (4.94)
Protestant				-.05 (.74)	-.13 (1.84)
Catholic				.74 (9.26)	.69 (8.93)
Jewish				-.23 (1.99)	-.33 (2.99)
Wife-public high school				-.09 (1.54)	-.15 (2.59)

Table 5 (continued)

	Number of Children as Dependent Variable				
	(1) Education, Income, Age, and Years Married	(2) (1) With Market Wage	(3) (2) Without Wife's Educ. Variables	(4) (2) With Work History and Fuller Model	(5) (4) With Children Only
More than 5 siblings				.10 (1.77)	.13 (2.57)
Own room				-.09 (2.00)	-.08 (2.03)
Father in-law farm				.21 (2.86)	.21 (3.05)
I.Q.-2nd fifth				.05 (.81)	.00 (.08)
I.Q.-3rd fifth				.13 (2.11)	.08 (1.47)
I.Q.-4th fifth				.16 (2.66)	.11 (1.94)
I.Q.-5th fifth				.23 (3.75)	.17 (2.80)
Proprietor				.19 (3.26)	.17 (3.10)
Technical				-.25 (2.86)	-.22 (2.78)
Mountain				.42 (4.74)	.33 (3.91)
North Central				.25 (6.05)	.25 (6.21)
Wife-work f.t. 5-10				-.62 (5.38)	-.43 (3.80)
Wife-work f.t. 10-15				-.36 (4.64)	-.27 (3.55)
Constant	-.26	6.05	5.18	3.36	4.61
Adj. R^2	.03	.05	.05	.15	.14
N	4899	4899	4899	4899	4716

Note: Numbers in parentheses are t-statistics.

Table 6

Equation Creating Predicted Market Wage Variable,
Based on Subsample with Earnings, 1958

Variable	Equation 1	
	Coefficient	t-Statistic
Constant	3.13	(10.75)
Wife-public high school	-.095	(2.82)
Not work 5-10 years after marriage	-.24	(6.46)
Work part time 5-10 years after marriage	-.27	(6.11)
Jewish	.11	(1.32)
Protestant	-.05	(1.12)
Catholic	-.05	(.87)
Multiple marriage	.16	(1.91)
Wife's age	-.003	(.73)
Husband's earnings 1958	.02	(1.67)
Proprietor	.07	(1.66)
Blue Collar	-.07	(1.59)
Age	.01	(2.08)
Respondent-some college	-.05	(1.38)
Respondent-B.A.	-.08	(2.03)
Respondent-M.A.	-.12	(2.50)
Respondent-prof. degree	-.07	(1.17)
Wife-no high school	-.03	(.30)
Wife-some college	.003	(.07)
Wife-B.A.	.08	(2.11)
Wife-some graduate work	.26	(4.97)
adj. R^2	.10	

N=843

Additional variables which measure the wife's working history in greater detail are also included in the analysis (see Table 5, column 4). The information available includes a breakdown of women's work history 0-5 years after marriage, 5-10 years after marriage, 10-15 years after marriage, and 16 or more years after marriage. Working part time during any of these periods is not statistically significant. Working full time both 5-10 years and 10-15 years are regularly statistically significant. Presumably these variables reflect work history during the years when women frequently raise children. During the earliest years, many women work before the birth of their first child. While this provides them with concrete information about opportunity costs, and may increase such costs, it says little about its magnitude or about tastes toward working. Those who work 5-15 years after marriage presumably face a direct conflict in terms of hours spent either in child care or in the labor force. The last period, 16 years or more after marriage, contains information on a time when many of these women have their completed families. While their wage rate presumably decreases the longer they were out of the labor force, this still does not give the actual opportunity cost of foregoing labor force participation, or their attitude toward working versus having children. As expected, the coefficients for the earliest and latest time period were not generally statistically significant and so only those of the middle two time periods are included. Additional variables that are reflected in tastes toward children, such as religion, parochial or private education, wife growing up on a farm and area of the country, and respondent having six or more siblings, are included to try to isolate

the effect of educational and opportunity cost net of those other taste and cost influences. The positive relationship of women's higher education--net of age of marriage, opportunity cost, and income--remains. As can be seen in Table 5, the coefficients for these work variables are negative and significant. For the entire sample, the coefficients for wife work full time 5-10 is -.62, or close to one-half of a child, while wife work full time 10-15 has a smaller coefficient (-.36).[10] Their inclusion reduces the significance of opportunity cost (to -.85) as would be expected.

A problem may arise in interpreting these results. As indicated earlier, some of these women may work because they are unable to have children. In such a case, the negative coefficient should not be interpreted as representing opportunity cost. For this reason, regressions were run excluding childless couples (see Table 5, column 5). The coefficients are hardly changed; they remain negative and generally significant: -.89 for opportunity cost, -.43 and -.27 for wife work full time 5-10 and 10-15 respectively.

There is another aspect of considerable interest: the relationship between changing market wage rates and family size. If wages go up fertility is expected to go down, reflecting increased opportunity cost, or foregone wages. When education is used as a proxy, or market wages are estimated based on education, the relationship estimated will include other suggested effects of education. This may underestimate or overestimate the extent of the association.

If, as is the case here, the remaining effect of education, net of opportunity cost, is positive, the coefficient is somewhat biased downward.

This can be seen by comparing the regressions in Table 5, columns 2 and 3. The coefficient of wife's opportunity cost is smaller, as predicted, when wife's education is not included in the regression. (This underestimate might be one explanation of the mispredictions of fertility in the 70's.)

Two-Stage Least Squares Equations

The single equation model assumes that labor force participation is independent of the other variables included as independent variables in the equation, and that it operates exogenously rather than being affected by family size, education, etc. In a sense, then, the single equation model ignores an important problem of simultaneity. Specifically, treating labor force participation as an exogenous variable if it is endogenous leads to biased and inconsistent estimates. The magnitude of the bias depends on the extent to which endogeneity affects the disturbance term. If the effect of family size on labor force participation is small, the error is small. If not, the error is large.

Among economists the basic defense of a single equation model comes from viewing labor force participation as an income and cost factor rather than a source of utility itself. If the decisions are made independently and at different times in the life cycle, then labor force participation could be viewed as independent; i.e., as a source of income that acts as a constraint and as a cost factor affecting relative costs of children versus costs of other goods and services. If, however, the labor force decision is considered simultaneously with the decision to have another child, or if the desire for a certain

number of children enters the labor force decision, then the single equation model is not legitimate; a simultaneous model which includes labor force participation as a dependent variable is called for.

In a sense, the first stage of a reduced form version has already been discussed, i.e., the omission of the labor force participation variable. This omission did change the coefficients in a way that altered the conclusions drawn from women's education levels.

For a two-stage least squares version, it is necessary to use the subsample with actual earnings in 1958, but an equation similar to one discussed for the entire sample to date is included for purposes of comparison. For the subsample, the coefficient on the log of wife's 1958 earnings is smaller than for the entire group, and the dummy variables for wife's education are not significant, although the coefficient on graduate work changes from negative to positive when this measure of market wage is included (see Table 7, columns 1 and 2). When wife's education is excluded, the coefficient on wife's earnings barely changes (column 3).

Columns 4 and 5 of Table 7 present two-stage least squares results. The negative effect of opportunity costs is greatly increased (and is now greater than the full-sample results). The education variables now show a positive effect for both 16 and 17 plus years, with the largest coefficient for 17 plus years. These findings suggest that as a cost factor, wife's education--as reflected by 1958 earnings--works to increase opportunity cost and thereby reduce family size. But as a taste and efficiency factor, with regard to raising children, women's higher

Table 7

Regressions for OLS and 2SLS on Subsample with Earnings in 1958

	Number of Children as Dependent Variable				
	(1) Education, Income, Age, and Years Married	(2) (1) With Wife's 1958 Earnings	(3) (2) Without Wife's Education	(4) 2SLS, Like eq. (2), Endogenous	(5) Like eq. (4) Without Wife's Education
Wife-no high school	.64 (1.59)	.56 (1.44)		.40 (.90)	
Wife-some college	.04 (.33)	.04 (.33)		.04 (.26)	
Wife-B.A.	.02 (.16)	.09 (.72)		.25 (1.63)	
Wife-graduate work	-.04 (.19)	.19 (1.03)		.68 (2.78)	
Respondent-some college	.13 (.95)	.09 (.64)	.09 (.63)	-.01 (.05)	.04 (.29)
Respondent-B.A.	.08 (.55)	-.02 (.17)	-.02 (.11)	-.25 (1.44)	-.12 (.77)
Respondent-some grad. work	.04 (.16)	.02 (.07)	.05 (.21)	-.03 (.11)	.08 (.33)
Respondent-M.A.	.09 (.50)	-.03 (.17)	.01 (.06)	-.28 (1.35)	-.06 (.34)
Respondent-prof. degree	.07 (.27)	-.00 (.01)	.06 (.26)	-.14 (.53)	.07 (.31)
Income 1955/000	-.02 (.11)	.04 (.24)	.07 (.37)	.19 (.87)	.17 (.86)
Income 1969/000	.01 (1.55)	.01 (1.99)	.01 (1.94)	.02 (2.46)	.01 (2.31)
Wife's age	.25 (2.94)	.21 (2.60)	.22 (2.69)	.14 (1.46)	.18 (2.04)
(Wife's age)^2	-.003 (3.59)	-.003 (3.27)	-.003 (3.36)	-.002 (2.04)	-.003 (2.66)
Years married	.02 (1.80)	.02 (1.60)	.02 (1.50)	.01 (.91)	.01 (1.12)
Log of wife's 1958 earnings		-.86 (7.39)	-.84 (7.38)	-2.67 (5.53)	-1.94 (5.24)
Endogenous log of wife's 1958 earnings					
Constant	-1.51 (.77)	2.14 (1.10)	1.99	9.89	6.58
Adj. R^2	.03	.09	.09		
N	827				

education appears to actually increase rather than decrease the desire for children and/or efficiency in raising children.

4. Additional Evidence And Conclusions

Because these findings may be viewed as unusual and unrepresentative, let us briefly look at supportive data from the National Longitudinal Survey (NLS) and another study. The NLS data are based on a subsample somewhat comparable to the NBER-TH sample: nonsingle older white men. The results in Table 8 show smaller families for those women with education above high school, reaching a minimum family size at some college and a maximum family size at some high school. The relationship is nonlinear. When two rough measures of opportunity cost, a Duncan rating for wife's occupation and her 1966 income, are introduced, there is an increase from some college through graduate work--a finding generally consistent with those reported here for the NBER-TH sample.

Cain and Dooley (1976) reported basically compatible findings in their study of the joint determinants of married women's labor supply, fertility and wage rates. Using 1970 Census SMSA data aggregated into age-ethnic group categories, they found that when they controlled for wife's labor supply, wife's wage, husband's wage income and nonwage income, percentage Catholic and Rural, wife's education had a consistent positive effect (Table 4, p. S193).

Thus, these results focus attention on the need to look at effects of costs and taste influences. Using only education, others have found a negative relationship between women's education and fertility. My findings do not contradict this, but show a trend of more education

Table 8

Regressions for National Longitudinal Sample:
Nonsingle Older White Men

	Number of Children as Dependent Variable		
Constant	2.56 (2.08)	2.28 (1.87)	2.41 (1.97)
Wife-no H.S.	.09 (.88)	.10 (1.04)	.06 (.58)
Wife-some H.S.	.66 (5.18)	.60 (4.71)	.63 (4.94)
Wife-some College	-.39 (4.67)	-.32 (3.76)	-.36 (4.36)
Wife-B.A.	-.31 (2.26)	-.18 (1.27)	-.29 (-2.11)
Wife-graduate	-.29 (1.64)	-.04 (.23)	-.16 (.91)
Wife's age	.09 (1.81)	.11 (2.19)	.10 (2.047)
(Wife's Age)^2	-.002(3.27)	-.002(3.67)	-.002 (3.51)
Resp. 1966 income/000	-.01 (2.16)	-.02 (2.56)	-.01 (2.10)
Wife's occup.-Duncan Rating		-.01(-6.35)	
Wife's 1966 income/000			-.10 (5.56)
Adj. R^2	.07	.09	.08
N = 2830			

Note: Numbers in parentheses are t-statistics.

and presumably higher wages leading to greater labor force participation, which results in fewer children for some but more children for others.[11] Other findings emphasize the dominance of the cost factors in terms of labor force participation, but this may lead to a misrepresentation of taste considerations and the opportunity costs of raising children.

The pattern of women with 16 years of education or more having the largest families--after controlling for opportunity cost, age at marriage, and income--may reflect a combination of preference for children and achievement of a certain status, and possibly greater efficiency in raising children. This combination of emphasis on the role of parenthood plus status among one's peers may reduce the demand for other goods and services and increase the demand for children. Greater efficiency may lower the relative costs of children. Thus, it is possible that among women who do not work, increased education appears related to larger families.

In summary, these findings show that the usual association of more education with smaller families should be separated into distinct factors. A taste factor and an opportunity or efficiency cost factor of raising children (i.e., home wage) show distinct positive relationships to fertility for those women who complete college and those who continue further--through graduate training. A third, a cost factor related to wage rates in the market, shows a strong negative relationship to family size. This last factor has tended to dominate the others, but if the results cited here hold more generally, then it is likely that the true impact on family size of increasing wages for women may be understated when education is used as a proxy for wages. A further implication is

that, if wages facing college educated women decline--through overcrowding for example, and these women choose not to work, then the result may be an increase in family size. Highly educated women who are not working seem either to desire more children than women with less education or to face a lower relative cost in raising them. Thus, increasing the percentage of women who complete college but not opening up more employment opportunities could well result in larger family sizes. If denied interesting, lucrative, or worthwhile jobs they may turn to motherhood and in so doing have larger families for greater satisfaction and sense of accomplishment.

FOOTNOTES

[1]Given the generally high level of education, it is assumed that households have equal information on contraception. For more detail, see Wolfe (1973).

[2]Demographers have found evidence of this effect. For example, Ryder and Westoff (1971) found an inverse relationship between education and expected and desired number of children. But the inverse relationship was stronger for expected number of children.

[3]For a similar view, see Easterlin (1969) and Folger and Nam (1967).

[4]The exception to this in the NBER-TH sample is the group which attended Catholic colleges. For them the college years may well have increased or kept high the psychic costs associated with the use of contraception. Interestingly, among Catholics there is a levelling off rather than an increase in fertility at the highest levels of respondent's education; perhaps the reduction in psychic costs occurs at graduate institutions, and this contrafertility effect works to offset the other factors which are working to increase fertility at higher levels of education (see Wolfe, 1973).

[5]This may be the wage rate expected by the individual in the labor market but it should include any reduction of future wage rates due to loss of experience (see Lindert, 1973).

[6]A more detailed history is given in Taubman and Wales (1974).

[7]According to Ryder and Westoff (1971), among fecund couples with wives aged 35-39, over 90 percent were contraceptive users if the wife had more than a high school education. Among all couples, more than

83 percent of those where both had high school education or over were past users of contraceptives.

[8]While it would clearly be desirable to have a better measure of wife's opportunity cost than a proxy for her earned income in 1958, this proxy may be a reasonable measure at a significant time in terms of the fertility-labor force tradeoff. Though it might be preferable to 'correct' this estimate of opportunity cost by the probability that the woman will work, using a procedure like Heckman's (1974), there is some evidence that this will result in little change (see Fligstein and Wolf, 1976).

[9]Results partially consistent with this can be found by recomputing a table in Ridley (1959, Table 4) which is based on GAO data. Using the groups who attended high school 1-3, 4, and college, and including the group who never worked with those who worked less than 1 year, there is a slight increase in mean expected number of children as level of education increases. This number by education for all wives is 3.44, 3.45 and 3.49 for these three education groups respectively. These means are consistent with my findings. However, the nonworking group who attended grammar school has a mean expected number of children equal to 4.73. This result may again reflect the fact that the NBER-TH sample is limited to the upper half of the education distribution.

[10]For the entire sample, the correlation coefficient or r between these variables is approximately .36.

[11]One objection to this finding is that the tastes of those who acquire more education may have been different before the education experience itself; however, several other taste factors are controlled.

Even if somewhat true, exposure to the college-educated group would tend to influence tastes toward this group. Another factor which may explain this result is that education is presumed to lead to greater efficiency in the home; thus it may reduce the cost of acquiring children of a certain quality and then lead to having more children.

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