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Economic Analysis of Fertility in Israel

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I. Introduction

I view, in this paper, cross-section evidence on fertility in Israel through a very simple hypothesis based on the links among education, the cost of time of women, and the full price of children. The hypothesis is useful in explaining some aspects of behavior, but important facets of the variation in fertility remain unexplained.

In recent years there have been several attempts to bring the determination of family size within the scope of the economics of household behavior (see Leibenstein 1957; Becker 1960; Mincer 1963; Easterlin 1968, 1969; Schultz 1969; and others).

An economic theory of fertility starts with the postulate that households maximize some utility function in which children and other goods appear as arguments subject to resource constraints in which the prices or the costs of production of the arguments appear. The effect of a change in any variable on the number of children depends on the extent to which it lifts the general resource constraint and induces an income effect and the extent to which it changes relative prices and induces a substitution effect. Recent developments in the theory of the household (particularly by Becker [1965] and Lancaster [1966]) provide a unified framework for handling various aspects of the fertility decision. However, in choosing

This paper is part of a research project at the Falk Institute of Economic Research, Jerusalem, on the economic determinants of fertility. I acknowledge Avner Halevi's very able research assistance. I benefited much from comments by Zvi Griliches as well as conversations with Simon Kuznetz, H. Gregg Lewis, Jacob Mincer, M. Rothschild, T. Paul Schultz, T. W. Schultz, Julian Simon, and many others. Communication with several of the authors in this book was very helpful, and I owe much to Robert J. Willis in particular. The Central Bureau of Statistics supplied data, and the Demographic Center, the Prime Minister's Office, Jerusalem, partly financed this study. I wrote this paper under National Science Foundation grant GS 2762X while visiting at Harvard. None of those acknowledged probably wishes to be responsible for anything in this paper.

a particular specification within this framework, one has to deal with a number of variables that are not directly observable and on which mere speculation could lead more than one way. Alexander Gerschenkron alluded only to one of them when he commented that "in the case of a child the act of shopping has felicific aspects not fully duplicated in buying a car or a refrigerator" (1961, p. 1007).

The most difficult questions have to do with the basic motives for having children, the substance of parent-child relationships in terms of mutual responsibilities, and the associated costs and benefits (see Section VI). The economist's contribution depends on his ability to explain the phenomena in terms of changes in resources and scarcities and to go beyond statements about "taste" differences. Even when one avoids the speculative terrain, these considerations implicitly affect the choice of the dependent variable in the fertility analysis—the "quantity of children demanded." The expected number of surviving adults (or adult-years) would be appropriate according to some motives, while expected child-years or some other measure would be more appropriate under another motive. In this study the choice of fertility variables simply reflects expediency.

An economist is also faced with the (somewhat less frustrating) questions arising because the actual number of children (or any other measure of the quantity demanded) is not equal to what it would have been had people been able to achieve the exact quantity they wanted with full certainty and without extra cost (I am avoiding the distinction between desired and undesired births). Uncertainties associated with the health, virility, and fecundity of the parents, and with contraception and the risks of infant and subsequent mortality, affect the demand for children through their effects on costs and benefits in ways that depend on the risk preferences of the parents.

Much of the economic treatment of fertility has been concerned with the relation between income and fertility, largely in an attempt to discover the expected positive association behind the "mask" of the observed negative association.[1] The emphasis in this paper is on the relation with education. Education of parents is likely to be associated with every aspect of the fertility model. It may affect not only the individual parent's preferences for children and the relative importance of husband's and wife's preferences in family decision making, but also parental productivity in child rearing and in other activities; it may affect the ability to control the number of births as well as reduce the incidence of child mortality. In a dynamic context where households are faced with changes in conditions, people with more education may perceive changes earlier, be able

[1] In addition to the studies already mentioned, see Adelman (1963), Freedman (1963), and Simon (1969).

to form more realistic expectations, and therefore conceive of their "true" optimum earlier than others.

Students of fertility are all aware of the complexity and the richness of the phenomena.[2] There are evidently more aspects and relevant considerations than there are actually measurable variables. The choice of the dividing line between things expressed explicitly in the hypothesis and things relegated to the "residual" or to poststudy speculation is to a degree arbitrary.

The advantage of the simple hypothesis I am using to view evidence in this paper lies in its relative proximity to market phenomena: it minimizes assertions about unobserved relationships. The questions are how far one can go with such a simple tool, and where it fails, what one can learn from this experiment about possible improvements.

After introducing the Israeli context briefly (Section II), I present the following hypothesis in Section III: the demand for children depends on the full income of the household and the full prices of children and other goods. Child rearing, compared with other goods, is intensive in the time of the mother, and therefore the price of children relative to that for other goods moves together with the price of time of women.

Education is assumed to be related to higher cost of time of women, and therefore it is associated with a substitution effect against children. Education is also associated with higher full income; if the substitution effect dominates, one would expect a negative relation between fertility and education of women. Because of the lesser role of men in child rearing, the husband's education is expected to be associated less with such price effects and, perhaps, more with household income.

The evidence (Section IV) shows the expected negative association between fertility and the education of women and an ambiguous relation with the education of men.

A strange pattern emerges, however, in that the relation between fertility and education is steep at the very low levels of education and tends to flatten or even turn up at the top. Section V is devoted mostly to exploring the fertility-education relation as a reflection of the initial hypothesis. Examination of a more sophisticated version of this hypothesis suggested by Willis (1971) does not answer the query posed by this shape of curve. The relation among education of women, the wage rate, and labor supply indicates that at the low levels of education, where the decline in fertility is large, the differentials in labor supply are modest, while at the top educational categories, where differential fertility is modest, the differences in labor supply are large. The possibility of large elasticity of substitution in

[2] Roberto Bachi, Dov Friendlander, Judah Matras, Helmut Muhsam, Oscar Schmeltz, and other Israeli demographers have studied various aspects of these questions. See also a recent study by Peled (1969).

child raising and some doubts as to the relative time-intensity assumptions are discussed.

Thus, my impression is that the simple cost-of-time hypothesis, while consistent with some of the evidence, leaves some important aspects of the fertility-education relation unexplained. This is not a statement about the "validity" of the hypothesis, but rather one about its power or robustness —its ability to account for a particular set of facts when other hypotheses are "left out." This is a tentative statement based on limited data and imperfect analysis. Future work will try to improve the analysis of this hypothesis as well as to explore somewhat richer hypotheses (see Section V).

II. The Context

I briefly review here some of the salient characteristics of the Israel case and their implications for analysis of the cross-section data on fertility. A somewhat broader background I presented elsewhere (Ben-Porath 1970*a*) included some tentative discussion of the time series and the Arab population; the emphasis in this paper is on cross-section differences in the Jewish population.

More than half of the Jews in Israel in 1970 were foreign born. Moreover, out of 1,789,000 adult Jews (15 years of age and older), 73 percent were foreign born, and an additional 23 percent had foreign-born fathers (Central Bureau of Statistics 1971, table B/20, pp. 46–47). There is great diversity in place of origin. Slightly more than half of the foreign born in 1970 were natives of Europe and America (EA), mostly of Eastern Europe, and the rest were born in Asia and Africa (AA), mostly in the Arab countries of the Middle East and North Africa. The timing of immigration differed for the two broad groups. As of 1970, about 32 percent of the Europeans and Americans had come before 1948, and another 39 percent had arrived in the period 1948–54. Of the immigrants from Africa and Asia only 7 percent came before 1948 and about 46 percent came in 1948–54. (The period 1948–51 is known as the period of mass immigration, when about half of all the 1948–70 immigrants arrived.) The EA component of the population has thus had a longer average stay in the country.

Both place of birth and recency of arrival show up very clearly in fertility differentials (table 1). The AA women, consistent with the fertility levels of their countries of origin, have much higher levels of fertility than the rest of the Jewish population. Over time, differentials have narrowed—fertility of AA women has declined sharply, and that of the EA group and those born in Israel (IS) showed some increase (among IS, partly reflecting the change in composition by parents' place of birth).

TABLE 1

TOTAL FERTILITY OF JEWISH WOMEN IN ISRAEL BY CONTINENT OF BIRTH AND PERIOD OF IMMIGRATION: 1960–62 AND 1969

	1960–62	1969
All	*3.41*	*3.39*
Israel	*2.67*	*2.95*
Asia-Africa, all	*5.03*	*4.22*
Immigrated:		
1954 or before	4.69	4.09
1955–60	6.15	4.21
1961–64		4.88
1965 or later		4.53
Europe-America, all	*2.35*	*2.78*
Immigrated:		
1954 or before	2.35	2.79
1955–60	2.40	2.62
1961–64		2.82
1965 or later		3.79

SOURCE.—Central Bureau of Statistics 1971, table C/26, p. 82.
NOTE.—Total fertility is the sum (unweighted) of age-specific birth for women (all, not only married) aged 15–49.

The cross-section differences by period of immigration reflect both "learning," or adjustment over time, and differences between periods in the composition of immigration by specific countries of origin within each continent.

The main challenge of the Israeli situation, to which this paper can make only a slight contribution, is the understanding of the demographic transition of those coming from less-developed countries of Asia and Africa, together with the fertility behavior of Jews of European origin, who came initially from a low-fertility background and who on the whole had to make a somewhat less dramatic cultural adjustment.

III. The Wife's Cost of Time

The theory of the allocation of time (Becker 1965) suggests a framework that can accommodate a variety of problems of household behavior. Consider a simple model carved out of this framework which formalizes one of the traditional explanations for the secular decline in fertility.[3] Let:

C = services from children;
N = number of children;
$\bar{Q}$ = a constant;
S = real consumption level of parents;

[3] This is the simplest common denominator of all current microeconomic models of fertility and is a direct application of Becker (1965).

π_j = the shadow price of commodity j;
P = price of market goods;
V = nonlabor income;
I = full income;
t_{ij} = time input of individual i into one unit of commodity j;
T_{ij} = total time input of individual i into commodity j;
T_{iL} = total time of individual i in the labor market;
T_i = total time of individual i;
x_j = market goods input into one unit of commodity j;
X_j = market goods input into commodity j;
E_i = education of individual i;
W_i = wage rate of individual i;
α_{ij} = $(t_{ij}W_i)/\pi_j$, the share of the value of i's time in the full price of commodity j;
i = f,m, female, male;
j = N,S.

Parents are postulated to maximize a utility function:

$$U^*(C,S) = U^*(\bar{Q}N,S) = U(N,S). \tag{1}$$

This maximization is subject to the following constraints—production function for children and the consumption commodity:

$$N = f^N(T_{fN}, T_{mN}, X_N), \tag{2}$$

$$S = f^S(T_{fS}, T_{mS}, X_S). \tag{3}$$

Resource constraints are:

$$T_{iN} + T_{iS} + T_{iL} = T_i, \qquad i = f,m; \tag{4}$$

$$V + T_{mL}W_m + T_{fL}W_f = P(X_N + X_S). \tag{5}$$

Let the production functions exhibit constant returns to scale; thus average and marginal input coefficients are equal. For internal solutions of resource allocations (4) and (5), combine into

$$(t_{fN}W_f + t_{mN}W_m + px_N)N + (t_{fS}W_f + t_{mS}W_m + pX_S)S \tag{6}$$
$$= \pi_N N + \pi_S S = W_f T_f + W_m T_m + V = I.$$

Maximization of utility (eq. [1]) involves equating rates of substitution in consumption to ratio of full prices (7) and adhering to the budget constraint (6).

$$\frac{U_N}{U_S} = \frac{\pi_N}{\pi_S}. \tag{7}$$

Let us now assume that the market wage is a function of education (8):

$$W_i = g_i(E_i) \qquad \frac{\partial W_i}{\partial E_i} > 0, \qquad i = f, m. \tag{8}$$

Education affects the number of children here through its effects on full prices and on full income:

$$\frac{\partial \pi_j}{\partial E_i} = \frac{\partial W_i}{\partial E_i} t_{ij}, \qquad \frac{\partial I}{\partial E_i} = \frac{\partial W_i}{\partial E_i} T_i, \qquad i = f, m; \qquad j = N, S. \tag{9}$$

So the effect of a change in the education of $i = f,m$ is given by (10),

$$\begin{aligned} \frac{\partial N}{\partial E_i} &= \frac{\partial W_i}{\partial E_i}\left(\frac{\partial N}{\partial \pi_N} t_{iN} + \frac{\partial N}{\partial \pi_S} t_{iS} + \frac{\partial N}{\partial I} T_i\right) \\ &= \frac{\partial W_i}{\partial E_i}\left[\frac{\partial N^*}{\partial \pi_N} t_{iN} + \frac{\partial N^*}{\partial \pi_S} t_{iS} + \frac{\partial N}{\partial I}\left(T_i - N t_{iN} - S t_{iS}\right)\right], \end{aligned} \tag{10}$$

where the starred derivatives are the compensated price effects. In elasticity terms,

$$\eta_{NE_i} = \eta_{W_i E_i}\left[\eta^*_{N\pi_N}(\alpha_{iN} - \alpha_{iS}) + \frac{T_{iL} W_i}{I} \eta_{NI}\right], \qquad i = f, m. \tag{11}$$

Consider first the effect of women's education (E_f). If children are more intensive in the value of the mother's time than the consumption good (i.e., $\alpha_{fN} - \alpha_{fS} > 0$) and if the income elasticity of the number of children (η_{NI}) is small, then a negative relation between the number of children and education can be expected.

When men are considered, it is probably reasonable to assume that the α_{mj} are smaller than the α_{fj} and one cannot say much about the difference between them. On the other hand, men contribute relatively more to full income through their earnings $(W_m T_{mL})/I$ so that if the income elasticity η_{NI} is positive, there is greater ambiguity as to the sign of the relation between the number of children and the education of the father.

Mincer's study (1963) of cross-section association between fertility and the wage of women (directly rather than through education) was, to my knowledge, the first exposition and test of essentially this hypothesis, followed by an unpublished paper by Cain and Weininger (1967).

IV. Evidence

I first summarize briefly some of the evidence presented elsewhere (Ben-Porath 1970*a*, 1970*b*) relating to the cross-section association between fertility and education in aggregate data (that do not permit analysis of the relation with income).

The theoretical model presented above leads one to expect a larger nega-

tive association between the education of wives and fertility than between fertility and education of husbands. A two-way classification of wives by their education and the education of their husbands bears this out. Holding husband's education constant, one gets a clear negative relation between number of children-ever-born and the education of a wife, but when the latter is held constant, no clear relation emerges between fertility and education of the husband.

Also, in cross-section regressions where the observations are mean values for cities, towns, and villages, the median schooling of women has a larger negative coefficient than that of men (the dependent variable is an age-adjusted birth rate). See table 2.

A particularly interesting, albeit inconclusive, result emerges in the regression for kibbutzim. In such a communal social organization, where there is no private budget constraint, where many of the child-raising activities are centralized, and where allocation of women to work is not tied strongly to their education, one would expect the economic mechanism outlined earlier to be much weaker than in the usual case (of course, couples who contemplate leaving the kibbutz will take future conditions into account). In fact, the regression for the kibbutzim was the only one where the coefficient of education of women turned out to be positive, but not significantly so. The very small range of variations in the median years of schooling of women among the kibbutzim is responsible for the inconclusiveness. This can be resolved by studying differences in fertility among individuals in kibbutzim.

Household Data

Introduction

Household data allow a more detailed evaluation of hypotheses and, in the Israeli case, the inclusion of income in the analysis. A cross-section analysis of a problem like ours certainly has many limitations. Individual differences in tastes and abilities may generate the differences in fertility, education, and income, so that the postulated dependence of the first on the latter two cannot be reliably estimated, given the scarcity of truly exogenous instruments to identify the system. (See Nerlove and Schultz [1970] for a brave attempt which illustrates the difficulties involved.)

The single cross-section is particularly inadequate in view of the long span of time involved in the family-formation process. The focus here is on explaining completed family size. Decisions are in fact made on individual children as part of a broader family plan, where the joint decision on an actual child and tentative plans for future children are shaped by presently observed values of the determining variables and expectations about their future levels over the life cycle. Subsequent children are de-

TABLE 2

MULTIPLE REGRESSION OF COMMUNITIES IN ISRAEL, 1961: DEPENDENT VARIABLE, AGE-ADJUSTED BIRTHS

	CONSTANT TERM (1)	MEDIAN YEARS OF SCHOOLING		PERCENTAGE OF POPULATION			R^2 (7)
		Men (2)	Women (3)	Born in Europe and America (4)	Moslems (5)	Christians (6)	
Jewish communities except kibbutzim (429):							
1:							
b	2.572	—0.049	—0.132	...	...	...	0.533
t	(26.0)	(2.6)	(10.5)	...	...	...	...
2:							
b	2.599	—0.054	—0.083	—0.010	...	...	0.569
t	(27.2)	(3.0)	(5.7)	(5.9)	...	...	...
Jewish towns* (60):							
3:							
b	1.951	0.079	—0.203	...	...	...	0.603
t	(5.2)	(1.0)	(4.9)	...	...	...	...
4:							
b	1.883	0.096	—0.167	—0.010	...	...	0.646
t	(5.2)	(1.3)	(4.0)	(2.6)	...	...	...
Moshavim,† pre-1948 (112):							
5:							
b	2.124	—0.047	—0.086	...	...	...	0.295
t	(7.6)	(1.0)	(2.8)	...	...	...	...
6:							
b	2.112	—0.043	—0.060	—0.006	...	...	0.314
t	(7.6)	(0.9)	(1.8)	(1.7)	...	...	...

TABLE 2 (*Continued*)

	Constant Term (1)	Median Years of Schooling: Men (2)	Median Years of Schooling: Women (3)	Percentage of Population: Born in Europe and America (4)	Percentage of Population: Moslems (5)	Percentage of Population: Christians (6)	R^2 (7)
Moshavim,† 1948 and later (257):							
7:							
b	2.632	−0.50	−0.137	...	...	...	0.505
t	(21.9)	(2.2)	(8.6)	...	...	...	....
8:							
b	2.668	−0.058	−0.082	−0.011	...	...	0.551
t	(23.2)	(2.7)	(4.4)	(5.1)	...	...	...
Non-Jewish communities‡ (133):							
9:							
b	1.102	0.022	−0.089	...	...	...	0.120
t	(22.2)	(1.8)	(4.2)	...	...	...	...
10:							
b	0.710	0.033	−0.068	...	0.004	0.003	0.159
t	(4.0)	(2.5)	(3.0)	...	(2.3)	(1.7)	...
Kibbutzim (167):							
11:							
b	0.303	0.009	0.046	...	...	...	0.017
t	(0.9)	(0.4)	(1.5)	...	...	...	...
12:							
b	0.652	0.003	0.040	−0.006	...	...	0.051
t	(1.8)	(0.1)	(1.3)	(2.5)	...	...	...

SOURCE.—Actual births by community: unpublished Central Bureau of Statistics data. Independent variables: Central Bureau of Statistics (1963, pt. 2, table 1, and pt. 3, table 2, for cols. 4–6; 1966*b*, tables 13 and 14, for cols. 2, 3).

NOTE.—The dependent variable is the ratio between (*a*) number of births (average 1961–62) of the community (e.g., town or village) and (*b*) the number of births predicted on the basis of women's ages. The predicted number was calculated by multiplying the number of women aged 15–44 (5- and 10-year intervals) by the age-specific birth rate of Jewish women, for all Jewish communities, and of non-Jewish women for all non-Jewish communities. The number of observations is given in parentheses in the stub.

* Includes Jewish population of mixed towns.

† Cooperative rural settlement (all Jewish). The date refers to foundation of settlement.

‡ Includes non-Jewish urban population.

cided upon on the basis of more information, with actual income substituting for part of the previously expected values, while the rest of the expectations are also revised. Cross-section data can give information on completed family size of relatively older couples, but the corresponding earnings or wage data are contemporaneous, realized values that may deviate from the past expected values on the basis of which decisions were made, and which were partly determined by them (e.g., women who decided simultaneously to have children and forego schooling and the learning experience in the labor market).

On the other hand, analysis of the cross section of couples at the prime childbearing ages suffers from lack of information on completed fertility, and issues of spacing are confounded with issues of completed family size (data on expected number of children have not been widely analyzed by economists). Longitudinal data could solve some of the problems and would of course require a more sophisticated analysis.

Data

There is to my knowledge only one source of data that allows analysis of fertility by education and income on an individual household basis in Israel. This is the Family Expenditure Survey 1963/64 (Central Bureau of Statistics 1966*a*) in which urban wage earners (in communities of 10,000 and over) were sampled, and women were asked, in addition to the usual questions on consumption and income, about the total number children born to them.

The set of observations that I work with has certain defects[4] which I shall ignore in the subsequent analysis. Table 3 presents some of the sample characteristics.

Origin and Immigration Period

The importance of the place of birth and period of immigration has already been stressed. These group differentials may be simply differences in levels of fertility. More likely, they are differences in the coefficients of the independent variables. Even if people were responding identically to these "true" variables, it is plausible that the relation between measured variables and the true variable which they approximate varies among groups.

This affects the analysis in several ways:

a) The sample is divided by place of marriage—those married in Israel

[4] The original material was on cards when we got it and was not entirely complete. Also, the tape prepared for us did not include the weights of the individual observations, so the analysis gives equal weight to all individual observations. The survey is described by the Central Bureau of Statistics (1966*a*).

TABLE 3

MEANS AND STANDARD DEVIATIONS OF VARIABLES USED IN REGRESSIONS—FAMILY EXPENDITURE SURVEY 1963/64

	ALL COUPLES	MARRIED ABROAD		MARRIED IN ISRAEL (MIS)	
		11+ Years*	15+ Years*	11+ Years*	15+ Years*
No. of households	1,217	455	437	354	201
No. of live births	2.55	3.28	3.29	2.70	2.75
SD	(2.17)	(2.74)	(2.77)	(1.77)	(1.95)
Age of wife	38.1	45.7	46.2	40.3	44.9
SD	(11.5)	(9.9)	(9.8)	(8.8)	(7.8)
Years of marriage	16.4	24.5	25.0	18.1	22.2
SD	(10.5)	(9.3)	(9.1)	(6.8)	(6.4)
Distribution by place of birth and period of immigration:					
ISIS	0.03	...	...	0.06	0.07
ISAA	0.03	...	...	0.03	0.03
ISEA	0.05	...	...	0.04	0.04
AA (1947 or before)	0.05	0.01	0.02	0.08	0.09
AA (1948–54)	0.21	0.22	0.22	0.11	0.00
AA (1955 or later)	0.06	0.11	0.10	0.00	0.00
EA (1947 or before)	0.23	0.08	0.09	0.51	0.70
EA (1948–54)	0.25	0.37	0.37	0.17	0.07
EA (1955 or later)	0.09	0.21	0.20	0.00	0.00
Total	1.00	1.00	1.00	1.00	1.00
Husband's monthly earnings (IL)	494.7	420.2	421.1	584.3	627.0
SD	(274.2)	(272.6)	(281.0)	(282.4)	(305.1)
Distribution by years of schooling of husband:					
0	0.06	0.10	0.10	0.02	0.01
1–4	0.08	0.12	0.12	0.06	0.03
5–8	0.33	0.35	0.34	0.31	0.26
9–12	0.34	0.28	0.29	0.39	0.40
13+	0.19	0.15	0.15	0.22	0.30
Total	1.00	1.00	1.00	1.00	1.00
Distribution by years of schooling of wife:					
0	0.12	0.18	0.18	0.08	0.07
1–4	0.08	0.10	0.10	0.08	0.04
5–8	0.35	0.37	0.37	0.32	0.29
9–12	0.33	0.30	0.30	0.37	0.42
13+	0.12	0.05	0.05	0.15	0.18
Total	1.00	1.00	1.00	1.00	1.00

NOTE.—The notation for place of birth is: IS = Israel, AA = Asia and Africa, and EA = Europe and America. For those born in Israel, the second two letters indicate place of birth of fathers. Information in parentheses following place of birth of the foreign-born indicates years of immigration to Israel.

* Length of marriage.

(MIS) and those married abroad (MAB). Those married abroad could have had some of their children born abroad, responding to different conditions.[5] Persons married in Israel presumably have had a more common environment for family decision making. In comparing the two groups, MIS and MAB, the following differences should be noted (table 3): Proportionately more members of the MIS sample are of European origin, with only a small fraction of the women born in Asia. They have also immigrated earlier. They have lower fertility and are somewhat younger, the husbands earn more, and both husbands and wives are better educated.

b) Within these place-of-marriage groups dummy variables are used to allow for differences in fertility levels by place of birth and period of immigration. Table 4 shows the following (the benchmark for the dummy variables here is the European- and American-born who immigrated from 1948 to 1954):

Place of birth and period of immigration account for a large proportion of the variance among both MAB and MIS, but more among MAB than MIS. The AA group, particularly the recent immigrants (1955 and later), has much higher fertility than the EA group. Differences are somewhat narrower among MIS. The EA group shows small differentials by period of immigration and has somewhat higher fertility than the Israeli-born.

c) The sample is broken into two groups by origin—European and oriental. The first group includes European-born (EA) and Israeli-born with European-born fathers (ISEA), while oriental origin includes those born in Asia and Africa (AA) and Israelis born to AA fathers (ISAA). The few third-generation Israelis in the sample are left out here.

Years since Marriage and Age

The treatment of the marriage variables is somewhat problematic. Any reasonable theory of marriage will have to state that the decision to marry is at least partly derived from the demand for children. If this is true, then the marriage variable (both as a criterion for dividing the sample and as a variable in the regression) should not be used; if it is used, its estimated coefficients are likely to be biased. In the Israeli population a large fraction of those born abroad went through the world war, migrated, and endured various experiences that might have postponed marriage independently of the demand for children. Thus for some groups the age and length of marriage may indeed be an exogenous variable relevant to the determination of the number of children. (Bumpass [1969] discusses this issue differently.)

Most of the analysis was performed on subsamples of couples who were married 11 or 15 years or more, with age and length of marriage as vari-

[5] In future work I hope to be able to follow a suggestion by H. Gregg Lewis to break the sample into those educated in Israel and abroad.

TABLE 4

REGRESSIONS OF NUMBERS OF CHILDREN-EVER-BORN TO COUPLES MARRIED 11+ YEARS, BY PLACE OF MARRIAGE

	ALL (MIS + MAB)			MARRIED IN ISRAEL (MIS)			MARRIED ABROAD (MAB)		
	b	t	R_i^{*2}	b	t	R_i^{*2}	b	t	R_i^{*2}
Constant term	2.69	6.59	...	2.55	5.01	...	2.69	4.15	...
Age of wife	−0.05	4.84	.07	−0.05	3.41	.08	−0.05	3.10	.06
Years married	0.06	5.63		0.07	4.04		0.06	3.61	
Continent of birth and period of immigration:									
ISIS	0.98	2.52	.3	0.99	2.61	.14	...	...	.36
ISAA	0.80	1.47		0.78	1.55		...	...	
ISEA	1.00	2.07		0.97	2.14		...	...	
AA (1947 or before)	1.92	5.84		1.75	4.88		2.42	3.03	
AA (1948–54)	1.62	7.27		1.20	3.65		1.81	5.70	
AA (1954 or later)	3.44	11.11		...	...		3.57	9.32	
EA (1947 or before)	0.23	1.33		0.23	0.91		0.00	0.00	
EA (1955 or later)	−0.13	0.6		...	...		−0.09	−0.35	
Husband's years of schooling:									
0	0.07	0.36	.0	1.13	2.00	.02	− .29	0.67	.0
1–4	0.21	1.29		0.02	0.96		− .31	0.83	
5–8	−0.23	0.87		0.39	1.86		0.04	0.16	
13+	0.02	0.06		0.25	1.08		− .18	0.56	
Wife's years of schooling:									
0	2.07	7.42	.09	1.75	4.77	.10	2.14	5.10	.09
1–4	0.69	2.50		0.73	2.01		0.63	1.55	
5–8	0.40	2.34		0.23	1.08		0.48	1.98	
13+	0.36	1.51		0.36	0.17		0.31	0.69	
Husband's earnings	−3.10	1.21	...	−5.70	1.8	...	−1.28	0.32	...
$\bar{R}^2$	.47	...	...	.34	...	...	.50	...	...
SEE	1.74	...	...	1.44	...	...	1.93	...	...
No. of observations	809	...	...	354	...	...	455	...	...

NOTE.—For the units for husband's earnings, divide the coefficient by 100 to get the effect for 100 IL per month. For notation of continent of birth and period of immigration, consult table 3. R_i^{*2} is $\Sigma yx_j/\Sigma y^2$ for groups of variables indicated ($\Sigma R_i^{*2} = R^2$).

ables in the regression. Some of the analysis was also performed on subsamples selected by age of wives (40 plus) without a length-of-marriage variable. The "time" variables in the cross section capture, of course, not only the stage in the life cycle but also differences among cohorts.

Education and Earnings—Additive Regressions

The origin and "time" variables enter the discussion mostly as controls. Our main interest is in exploring the performance of parents' education and earnings as variables.

According to the model presented earlier, husband's education is expected to be associated with weaker substitution effects and stronger income effects than is wife's education (see eqq. [10], [11]). In the regression for MAB the husband's education does not seem to play any role. In the MIS sample men with no schooling report more children than the rest, while the other differentials in fertility by male education have no clear direction. When the European and oriental groups are examined separately (not shown), one can see among the oriental group a vague (low t-values) U-shaped pattern, while among the European groups the couples with a husband of little education have somewhat lower fertility than those with higher education.

Husband's current earnings are a difficult variable to interpret. We know how crude a proxy they can be for permanent income. Where education of husband is held constant, it can perhaps be argued that the remaining variation in earnings has an important transitory element that is likely to express deviations of actual earnings from the expectations that were held at the beginning of married life. If these deviations are not a matter of the given sample year but represent a persistent position, they could affect the actual number of children. The coefficients here are negative and often not distinguishable from zero (tables 4, 5). The source of the negative association is the oriental group, both MIS and MAB, while among couples of European origin there is practically no relationship.

The most interesting question has to do with the pattern of coefficients of wife's schooling. Table 5 shows the following:

a) For the whole sample and for the two subsamples, MIS and MAB, a similar pattern is observed: the "net" relation between fertility (number of children-ever-born) and education of wife is mostly negative, with a slight inflection at the top, suggesting a transpose-J shape. The sharpest decline in fertility is between women with no schooling and women with some schooling—a difference of 1.0–1.4 children.

b) Within the European group the relation between fertility and education is much steeper and more statistically significant among MAB than among MIS. Both share, however, the flattening at the top.

c) The most striking feature about the oriental group is the very sharp

TABLE 5

COEFFICIENTS OF WIFE'S EDUCATION (DEVIATION FROM 9–12 YEARS OF SCHOOLING) AND HUSBAND'S EARNINGS FROM REGRESSIONS ON COUPLES MARRIED 11+ YEARS

	I. ALL COUPLES (MIS + MAB)			II. MARRIED IN ISRAEL (MIS)			III. MARRIED ABROAD (MAB)		
	All (1)	European (EA + ISEA) (2)	Oriental (AA + ISAA) (3)	All (4)	European (EA + ISEA) (5)	Oriental (AA + ISAA) (6)	All (7)	European (EA + ISEA) (8)	Oriental (AA + ISAA) (9)
Constant term	2.70	2.77	4.67	2.56	3.07	2.01	2.69	2.61	6.83
	(6.6)	(9.4)	(4.1)	(5.2)	(7.9)	(1.0)	(4.2)	(5.8)	(4.5)
Wife's years of schooling:									
0	2.08	1.73	2.16	1.75	0.57	2.97	2.13	3.92	1.04
	(8.1)	(3.7)	(3.3)	(4.9)	(1.1)	(3.0)	(5.1)	(4.8)	(1.0)
1–4	0.70	0.65	0.81	0.73	0.27	2.47	0.63	0.91	−0.84
	(2.6)	(2.9)	(1.1)	(2.1)	(0.7)	(2.5)	(1.6)	(3.1)	(0.7)
5–8	0.40	0.23	0.75	0.23	0.00	1.49	0.48	0.42	−0.09
	(2.4)	(1.9)	(1.1)	(1.1)	(0.0)	(1.7)	(1.9)	(2.6)	(0.1)
13+	0.36	0.06	3.81	0.36	−0.01	4.54	0.31	−0.02	4.52
	(1.5)	(0.4)	(2.2)	(1.4)	(−0.1)	(2.0)	(0.7)	(0.1)	(1.7)
Husband's earnings	−3.11	1.50	−14.32	−5.70	0.26	−29.96	−1.28	0.19	−6.51
	(1.2)	(.8)	(1.6)	(1.8)	(0.1)	(1.7)	(0.3)	(0.1)	(0.6)
SEE	1.73	1.11	2.73	1.44	1.03	2.10	1.93	1.13	2.97
$\bar{R}^2$	.47	.07	.18	.34	.10	.28	.50	.10	.10
No. of observations	809	547	239	354	250	81	455	297	158

NOTE.—"All" includes, in addition to EA, ISEA, AA, and ISAA, also ISIS—second-generation Israelis. The numbers in parenthesis are t-values of the corresponding regression coefficients. Other variables in the regressions are age, years married, and education of husband. In cols. (1), (4) and (7) continent of birth and period of immigration are also included.

increase in fertility at the top schooling category (both for MIS and MAB). A clearer relation with education emerges in the MIS oriental than in the MAB oriental.

In examining the evidence, one should recognize that there are very few oriental women with thirteen or more years of schooling and European women with zero years of schooling, so that one should not place much confidence on the results for these categories.

Because of the possible biases arising from the role of the marriage variable, I have also looked at a subsample selected by the age of wife (40 plus, table 6). The number of observations is smaller and thus restricts comparability. The general pattern of sharp decline in fertility at the bottom of the education ladder and a flattening at the top shows up also in this subsample. The relation is steeper among the oriental than the European group. Contrary to the results reported in table 5, there is no sharp upturn at the top educational category within the oriental group.

How plausible is it to regard the general pattern of education coefficients as primarily a reflection of the hypothesis presented earlier?

V. Probing

The Interaction Model: Who Is on Which Margin?

The fertility model developed by Willis (1971) focuses on one aspect of the fertility decision that I have ignored so far. Willis's argument can be paraphrased in the following way: the simple model presented earlier

TABLE 6

NUMBER OF CHILDREN-EVER-BORN TO WOMEN AGE 40+: COEFFICIENTS OF WIFE'S EDUCATION (DEVIATIONS FROM 9–12 YEARS OF SCHOOL) AND HUSBAND'S EARNINGS

	ALL		MARRIED IN ISRAEL (MIS)		MARRIED ABROAD (MAB)		ORIENTAL (AA + ISAA)		EUROPEAN (EA + ISEA)	
	b	*t*	*b*	*t*	*b*	*t*	*b*	*t*	*b*	*t*
Constant term	3.39	4.76	2.84	2.32	3.71	4.04	6.74	1.74	2.88	5.53
Wife's years of schooling:										
0	2.36	5.50	1.66	2.48	2.81	4.98	2.85	1.68	0.76	1.07
1–4	1.05	2.42	3.16	3.18	0.64	1.25	1.73	0.76	0.95	3.04
5–8	0.18	0.80	—0.04	—0.12	0.34	1.17	0.10	0.06	0.18	1.18
13+	0.03	0.08	0.15	0.40	—0.14	0.27	0.19	0.04	—0.03	—0.13
Husband's earnings	—3.51	0.96	—1.60	0.31	—4.50	0.89	—2.36	—0.14	—1.95	—0.70
R^2	0.44	...	...	0.35	...	0.49	0.09	...	0.04	0.04
SEE	1.87	...	...	1.64	...	1.95	3.53	...	1.20	1.20
No. of observations	497	...	182	...	315	...	100	...	389	...

NOTE.—Other variables in the regressions are: age of women, years of schooling of husband, and origin dummies.

applies to households where the wife plans to work part of her lifetime. Only then is the market wage (or education as an indication of market productivity) a correct measure of what she is foregoing by devoting time to her children.[6] Women who do not plan to work at all presumably have a nonmarket valuation of their time higher than the market wage. Variations in the potential market wage for such women do not correspond to variations (over individuals or over time) in the marginal value of time. But higher full income of the household, by increasing the demands on women's time in all household uses, raises the shadow price of this fixed constraint and gives rise to a substitution effect away from children. Therefore, one would expect husband's higher earnings to be associated with higher probability of the wife being a permanent nonparticipant in the labor force. Empirically Willis worked with an interaction model of the form

$$N = b_1 W_f + b_2 W_m + b_3 W_f W_m, \quad b_1 < 0, b_2 ?, b_3 > 0. \tag{12}$$

This formulation implies the following derivatives:

$$\frac{\partial N}{\partial W_f} = b_1 + b_3 W_m, \quad \frac{\partial N}{\partial W_m} = b_2 + b_3 W_f. \tag{13}$$

As shown in table 7, this model, which Willis has successfully applied to U.S. data, also works quite well in the Israeli case. The coefficient of the value of wife's education (i.e., the average wage for the level of schooling) comes out negative and significant; the coefficient of husband's earnings, or alternatively husband's schooling, turns out to be negative and significant but of smaller absolute value, and a positive and significant interaction term emerges.

In interpreting the findings, one should distinguish between the estimating equation and the hypothesis behind it. The estimating equation under the present conditions may be an expression of the same nonlinearities noted before. In our sample, and probably everywhere, there is a positive association between wife's education and husband's education, or earnings. The pattern depicted by the education-of-wife dummies could have been captured by a parabola:

$$N = b'_1 W_f + b'_2 W_m + b'_3 W_f^2 + \ldots. \tag{14}$$

The effect of wife's potential wage is:

$$\frac{\partial N}{\partial W_f} = b'_1 + 2b'_3 W_f, \quad b'_1 < 0, b'_3 > 0. \tag{15}$$

[6] Michael and Lazear (1971) have recently argued that market wages of married women do not correspond exactly to opportunity cost because of the foregone (net) return to investment in human capital.

TABLE 7

INTERACTION MODEL: COUPLES MARRIED IN ISRAEL

Married 11+ years (354)	b_i (t) (1)	$\frac{\partial N}{\partial w_i}\Big\vert_{\bar{w}_j}$ (2)	η_{Nw_i} (3)	$\bar{X}$ (4)
W_f	−104.70 (5.5)	−24.92	−0.335	.0363
W_m	−59.76 (5.4)	−10.17	−0.220	.0584
W_fW_m	1,366.18 (5.1)	...	...	...
$\bar{R}^2$		.323		
R^{*2}		.166		
SEE		1.458		

NOTE.—The regression is eq. (12) in the text; variables included and not reported here are: age, years since marriage, and dummies for place of birth and period of immigration. The number of observations is in parentheses. Col. 2: the derivative of fertility with respect to one variable evaluated at the mean of the other variable. Col. 3: elasticity of fertility with respect to w_i evaluated at the means (col. 4) using the partial derivatives of col. 2. The mean number of children is 2.7. W_f = an estimate of monthly full-time earnings of women by education, using the following estimates of hourly earnings by years of schooling—0: 1.28 IL; 1–4: 1.46 IL; 5–8: 1.70 IL; 9–12: 2.36 IL; 13+: 3.14 IL—and 172 monthly hours of work (units: 1/10,000 · monthly IL). W_m = earnings of husband (units: 1/10,000 monthly IL). $\bar{R}^2 = R^2$ corrected for degrees of freedom. $R^{*2} = \Sigma x_i N / \Sigma N^2$, where $x_i = w_f, w_m, w_f w_m$.

If the correlation between W_m and W_f is positive and high (but not too high), the interaction term W_mW_f may be acting as a proxy for W_f^2.

One experiment along these lines is presented in table 8. Regression 2, where W_f^2 appears, seems slightly more appealing than regression 1, with W_fW_m; in regression 3, where both appear, the former drives the latter out. No strong statement is called for, but it is not impossible that what the interaction regression is capturing is mostly a curvilinear association of fertility with the wife's education, which is independent of the (anyhow questionable) effect of husband's earnings.[7]

Given the similarity between the phenomena, the question is whether the hypothesis presented by Willis is the major quantitative determinant of the empirical relation observed.

If we could classify women by their permanent work status and identify the women who do not work in the market in the permanent sense, we would expect no association within this group between fertility and

[7] As Robert Willis and Jacob Mincer indicated, if one starts by assuming linear functions relating fertility to the relevant variables among working and nonworking women and also relating the probability of work to the relevant variables, a full quadratic results. One would assume that the resulting collinearity would make full estimation impossible, but the suggestion is that the coefficients in eqq. (12) and (14) should be interpreted as arising from an estimation where some relevant variables were left out.

TABLE 8

EXPERIMENTS CONCERNING SOURCE OF NONLINEARITY FOR WOMEN 40+ YEARS OLD (MARRIED IN ISRAEL)

	1	2	3
W_f	−47.21	−223.38	−210.21
	(1.44)	(1.96)	(1.78)
W_m	−26.77	−2.44	−12.08
	(1.38)	(0.41)	(0.55)
$W_m W_f$	547.97	...	229.65
	(1.28)		(0.45)
W_f^2	...	2,632.00	2,289.54
		(1.89)	(1.43)
$\bar{R}^2$	.306	.313	.310
SEE	1.692	1.683	1.687
$\frac{\partial N}{\partial W_f}$	−11.91	−23.66	−15.78
$\frac{\partial N}{\partial W_m}$	−4.96	−2.44	−3.28

NOTE.—Other variables in the regressions are: age, continent of birth, and period of immigration. See notation in table 7. Data include 182 observations.

women's wages (or education). On the other hand, a negative relation would be observed among those working part of the time. The actual work status in the year of the survey is affected by many random factors and also reacts differently at different times to the presence of children. Classification by present work status is thus a poor substitute on many grounds for the classification by permanent work status. Still, one would expect the group of currently working women to be dominated by those who had planned and expected to participate at least part of the time, while those who are not currently working comprise those not participating because of stage in the life cycle and random factors.

In table 9 the coefficients of wife's education for working and nonworking women are presented. The steep decline in fertility from 0 to 1–4 years of schooling is observed among both working and nonworking women. Working women now show a monotonic decline of fertility by education, while in the case of nonworking women the relation is of the transpose-J shape. The upturn in fertility at top education levels among the nonworking has also been observed among orientals and disappears when a sample of women 40 years of age and older is considered (not shown). What remains with us is the sharp decline in fertility between 0 and 1–4 years of schooling, among both working and nonworking women; this, among

TABLE 9

COEFFICIENTS OF WIFE'S EDUCATION (DEVIATIONS FROM 9–12 YEARS OF SCHOOLING) AND HUSBAND'S EARNINGS: WORKING AND NONWORKING WOMEN (COUPLES MARRIED 11+ YEARS)

	ALL (MIS + MAB)		MARRIED IN ISRAEL (MIS)		MARRIED ABROAD (MAB)	
	Working	Non-working	Working	Non-working	Working	Non-working
Constant term	3.28	2.45	3.18	2.6	4.68	2.25
	(4.9)	(4.9)	(4.8)	(4.0)	(3.5)	(3.0)
Wife's years of schooling:						
0	2.56	2.01	1.37	1.84	4.06	1.96
	(3.9)	(6.3)	(1.7)	(4.2)	(3.5)	(4.7)
1–4	0.86	0.68	0.08	0.97	1.61	0.46
	(1.7)	(2.1)	(0.1)	(2.2)	(2.0)	(1.0)
5–8	0.46	0.35	0.05	0.20	0.75	0.41
	(1.5)	(1.7)	(0.1)	(0.7)	(1.5)	(1.4)
13+	−0.14	0.61	−0.03	0.65	−0.26	0.62
	(0.4)	(1.7)	(0.1)	(1.7)	(0.4)	(1.0)
Husband's earnings ...	2.32	−3.79	6.00	−11.75	−9.32	1.28
	(0.5)	(1.3)	(1.5)	(2.0)	(0.8)	(0.3)
SEE	1.40	1.82	1.06	1.51	1.56	2.00
$\bar{R}^2$	.37	.48	.42	.35	.45	.51
No. of observations ...	183	626	99	255	84	371

NOTE.—Other variables in the regressions are: age, years married, education of husband, continent of birth, and period of immigration.

working MIS women, represents all of the variation in fertility by education.[8]

The coefficients of husband's earnings are consistent with Willis's hypothesis among MIS but not among MAB. (This is true also in regressions where husband's education is not included.)

On Labor Supply and the Demand for Domestic Help

As figure 1 shows, rough estimates of the hourly wage by education level indicate that, contrary to the response of fertility, the larger relative response of wages to schooling is at the top education level. Let us examine how labor supply is related to education.

The sample does not provide detailed information on the work status of women. Women are merely classified as "working" and "nonworking," and

[8] Regressions by Willis on U.S. data suggest also that the steep decline in fertility by education is concentrated at the bottom of the education scale, among both working and nonworking women. At the top among working women there is a big difference in fertility between women with 5 or more years of college and those with less schooling. No such difference, however, emerges for nonworking women.

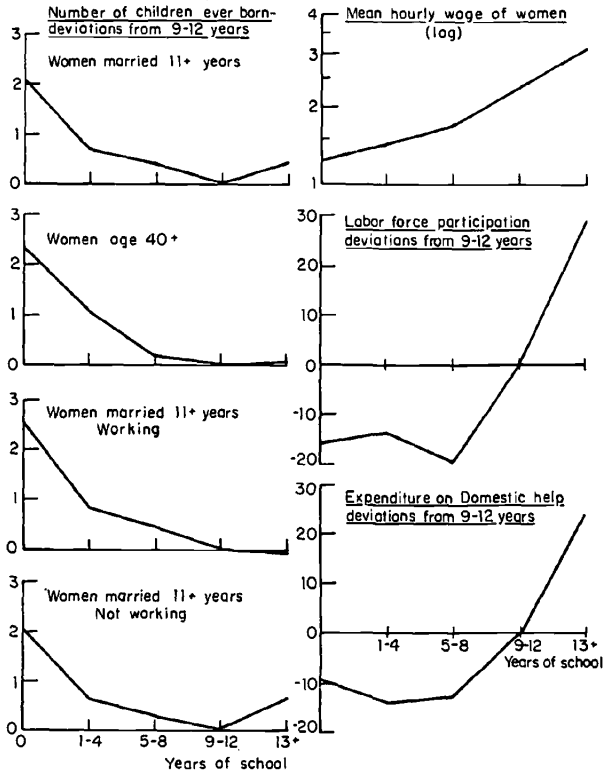

FIG. 1.—Fertility, hourly wages, labor supply, and monthly expenditures on domestic help, by education of women. (Curves on the left-hand side refer to all women married in Israel and married abroad. The coefficients are taken, going from top to bottom, from tables 4, 6, and 9. Curves on the right-hand side are based on table 7 [note], and tables 10 and 12. The last two curves refer only to women married in Israel [*MIS*].)

this binary variable is the dependent variable in the regressions in table 10.

The pattern of coefficients of wife's education is depicted in figure 1. It is quite different from what has been observed for fertility: the sharp differences in the proportion working are at the top levels of education, while there are no significant differences at the low levels (0, 1–4, 5–8 years of school).

This seems to be corroborated in a study of labor-force participation of women in Israel based on another source of data, the 1956–57 Saving Survey (Fishelsohn 1972).[9]

[9] In a regression where annual participation is the dependent variable, and age, birthplace, and various income and employment characteristics of husbands are controlled, the following pattern of dummy coefficients for women's education earnings emerges (each coefficient should read as the fraction of women who participated at any time during the year):

TABLE 10

LABOR SUPPLY OF MARRIED WOMEN (MIS)

	All b (t)	European (EA + ISEA) b (t)	Oriental (AA + ISAA) b (t)
Constant term	.53	.52	.59
Husband's earnings	−.92 (1.4)	−.48 (0.6)	−.35 (0.2)
Wife's years of schooling:			
0	−.14 (2.4)	−.22 (1.3)	−.07 (0.8)
1–4	−.14 (2.1)	−.20 (1.8)	.01 (0.1)
5–8	−.20 (5.2)	−.26 (5.2)	−.05 (0.7)
13+	.28 (5.9)	.28 (5.0)	.32 (2.6)
Has one child aged 0–5	−.14 (3.9)	−.10 (2.2)	−.26 (4.4)
Has 2+ children aged 0–5	−.29 (6.5)	−.27 (4.1)	−.34 (5.5)
Has children aged 6–13	−.07 (2.2)	−.07 (1.7)	−.11 (2.2)
$\bar{R}^2$	.17	.17	.14
SEE	.42	.44	.37
$\bar{L}$	.30	.36	.20
No. of observations	737	450	249

NOTE.—"All" includes ISIS. Dependent variable L = the binary classification, work-nonwork; $\bar{L}$ is the proportion working. The bases for the dummy variables are women with 9–12 years of schooling, and women with no children less than 14 years old in the house.

These regressions ignore the problems that arise when the dependent variable is of a binary nature (see Theil 1971, pp. 632–36). It is useful to examine also the relative change in the odds of working (number of working/number of nonworking) as education increases. When all couples in the sample are classified by the presence of children aged 0–5 (table 11, cols. 3, 4), we find that the relative increase in the odds of working with education are appreciably larger at the top of the educational ladder than at the bottom. (Husband's earnings are not held constant.)

	LFPR*
1. Did not go to school	.301
2. Elementary schooling incomplete	.328
3. Elementary schooling complete	.341
4. High school incomplete	.405
5. High school complete	.474
6. Higher education incomplete	.641
7. Attending	.656
8. Graduated	.789

* Labor force participation rate.

I thank Dr. Fishelsohn for letting me quote his as yet unpublished results.

TABLE 11

ODDS OF WOMEN WORKING (NO. WORKING ÷ NO. NONWORKING) BY EDUCATION AND THE PRESENCE OF CHILDREN AGED 0–5

	ODDS		RATIO OF SUCCESSIVE ODDS BY EDUCATION		RATIO OF ODDS BY PRESENCE OF CHILDREN (1) ÷ (2)
	Without Children Aged 0–5 (1)	With Children Aged 0–5 (2)	With Children Aged 0–5 (3)	Without Children Aged 0–5 (4)	(5)
All:					
Wife's years of schooling:					
0	0.21	0.05			4.2
			1.8	1.9	
1–4	0.37	0.08			4.1
			0.8	1.2	
5–8	0.26	0.11			2.3
			2.0	2.5	
9–12	0.52	0.28			1.8
			3.3	3.6	
13+	1.72	1.10			1.5
European (EA + ISEA) ..					
0–8	0.23	0.08			2.9
			3.0	9.2	
9+	0.69	0.74			0.9
Oriental (AA + ISAA) ...					
0–8	0.28	0.10			2.8
			3.1	1.6	
9+	0.93	0.16			5.8
MIS:					
Wife's years of schooling:					
0	0.37	0.08			4.6
			2.0	0.7	
1–4	0.72	0.06			12.0
			0.3	2.0	
5–8	0.24	0.12			2.0
			3.5	2.6	
9–12	0.88	0.29			3.0
			2.3	4.4	
13	2.00	1.27			1.6
European (EA + ISEA) ..					
0–8	0.24	0.07			3.4
			4.7	9.3	
9+	1.14	0.65			1.7
Oriental (AA + ISAA) ...					
0–8	0.67	0.11			6.1
			2.0	1.8	
	1.33	0.20			6.6

The other piece of information that seems relevant here is expenditures on hired maids in the home. Certainly, this purchased input is a close substitute for the wife's time in the household both in child raising and in other activities. Again, the pattern of the coefficients seems to indicate large differences at the top of the educational range—between 13 plus and 9–12, and between 9–12 and 5–8 years of schooling, and small differences in the lower levels (table 12).[10]

Another question that bears on the subsequent discussion is: How is the presence of children associated with work reduction by women? It is clear in this sample (as was found in other studies) that it is the presence of very young children (0–5 years old) that matters. It is important also to

[10] I have not checked here the effects of the constraint of zero expenditure, and in this sense the results are tentative and may prove wrong.

TABLE 12

EXPENDITURES ON DOMESTIC HELP

	All	European (EA + ISEA)	Oriental (AA + ISAA)
Constant	−.07	.09	−.00
Husband's earnings	4.00	4.84	1.67
	(7.3)	(6.2)	(2.4)
Wife's years of schooling:			
0	−.09	−.04	−.08
	(1.7)	(0.3)	(2.0)
1–4	−.14	−.13	−.10
	(2.7)	(1.3)	(2.7)
5–8	−.13	−.14	−.08
	(4.1)	(2.9)	(2.8)
13+	.24	.21	.05
	(6.0)	(4.1)	(0.9)
Has one child aged 0–5	.08	.13	−.00
	(2.7)	(3.1)	(0.0)
Has 2+ children aged 0–5	.05	.10	.01
	(1.4)	(1.6)	(0.5)
Has children aged 6–13	−.00	−.00	.05
	(0.1)	(1.1)	(2.0)
$\bar{R}^2$	.23	.22	.08
SEE	.34	.41	.17
$\bar{Y}$	.16	.23	.38
No. of observations	737	450	249

NOTE.—The dependent variable is the monthly expenditure on domestic help in 100 IL.

know whether the "effect" (ignoring the simultaneity aspect) of the presence of young children is larger among educated than noneducated women. In ordinary least-squares (OLS) regressions with a binary working-nonworking variable, the "effect" is larger among educated women (table 13); a similar result has been reported by others. Consider, however, figure 2. Let curve I be the density function of the shadow price of time in nonmarket activities, assuming that this curve applies to all women, irrespective of education. Let W_L be the low wage rate of the uneducated; the proportion of working women is the cumulative distribution up to W_L; W_H is the wage of the educated, and the same applies. Let the presence of young children shift the distribution of the shadow price of time to the right to the same degree for educated and uneducated women (II). The "effect" of the presence of children is the shaded area in figure 2, up to W_L for uneducated women and up to W_H for educated women. Thus, we observe a larger "effect" for educated than for uneducated women, even though we have a case of equal shift in the shadow-price-of-time curve. (Of course, if we let W_H be much farther to the right, this would not be the case.) If one wants to make inferences from partici-

TABLE 13

"EFFECT" OF THE PRESENCE OF CHILDREN ON THE PERCENTAGE OF WOMEN WORKING, BY SCHOOLING—COEFFICIENTS FROM OLS REGRESSION (WOMEN MARRIED IN ISRAEL)

	All (1)	0–8 (2)	9+ (3)
All:			
1 child aged 0–5	−.25	−.21	−.28
	(6.5)	(4.3)	(4.7)
2+ children aged 0–5	−.39	−.28	−.47
	(8.6)	(5.2)	(6.4)
Children aged 6–13	−.11	.10	−.13
	(2.8)	(2.1)	(2.6)
No. of observations	737	354	383
Oriental (AA + ISAA):			
1 child aged 0–5	−.32	−.24	−.48
	(5.3)	(3.5)	(4.0)
2+ children aged 0–5	−.41	−.30	−.65
	(6.3)	(4.1)	(4.7)
Children aged 6–13	−.07	−.07	−.13
	(1.0)	(1.0)	(0.9)
No. of observations	249	186	63
European (EA + ISEA):			
1 child aged 0–5	−.24	−.19	−.26
	(4.7)	(2.7)	(3.9)
2+ children aged 0–5	−.40	−.32	−.42
	(5.8)	(3.0)	(4.6)
Children aged 6–13	−.14	−.15	−.14
	(2.8)	(2.0)	(2.1)
No. of observations	450	149	301

NOTE.—Other variables in the regressions are: age, $(age)^2$, and total household expenditures on consumption. The bases for the dummy variables are couples with no children below 14 years of age.

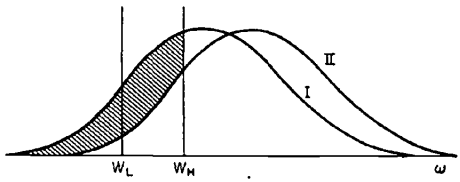

FIG. 2

pation data on differences in the effect of children on the value of time,[11] an explicit distribution has to be assumed; adopting the logic of the logit model (with the underlying logistic distribution), it is more useful to examine the *ratio* of odds-of-work status. In table 11, column 5, we see

[11] Gronau (1973) has discussed the relation between participation and the value of time.

that the *relative* effect of the presence of children aged 0–5 on the odds of working is smaller among the more educated.[12]

An interesting difference emerges, however, between women of oriental and European origin in this respect: educated oriental women let the presence of children limit their labor-market activity much more than European women. This is reflected not only in the regression coefficients of table 13, column 3, but also in the odds in table 11.

Substitution in Production and Factor Intensity

Speculation about functional form is somewhat risky. The fertility-education relation, together with what we know on the education-wage relation, suggests a declining elasticity of fertility with respect to the woman's wage. Examine equation (11) (after dividing through by η_{WE}): one source of decline in the wage elasticity of children with wages is the higher weight of the income elasticity (η_{NI}) with higher wage and employment of women. What makes this argument weak is the uncertainty about the sign and the size of the income elasticity.

Alternatively one can examine the substitution effect. The assumption on which the initial model rests is a greater time intensity of mothers in child raising than in other activities. The size of the compensated elasticity of demand for children with respect to the wage rate (and therefore education) of women depends on elasticities of substitution, both in consumption and in production. The compensated elasticity of fertility with respect to the wife's wage rate is

$$\begin{aligned}\eta^*_{NW_f} &= \eta^*_{N\pi_N}(\alpha_{fN} - \alpha_{fS}) \\ &= -\sigma(1-\gamma)(\alpha_{fN} - \alpha_{fS}),\end{aligned} \tag{16}$$

where α_{fi} is the share of the value of wife's time in the full price of i, σ is the elasticity of substitution in the utility function, and γ is the share of full expenditure on children in full income $(\pi_N N)/I$. Let σ_N, σ_S be the elasticities of substitution in production of N and S between wife's time and purchased inputs. They determine the sign of the relation between the α's and W. If $\sigma = \sigma_N = \sigma_S = 1$, $\eta^*_{NW_f}$ is independent of the level of wages. .

Consider a case where $\sigma_N > 1$ and $\sigma_S = 0$; α_{fN} then declines with W, α_{fS} increases, the difference in factor intensities can narrow or even be reversed. Thus if the elasticity of substitution between wife's time and purchased inputs is high enough in child raising relative to all other

[12] This is a tentative examination of this question. Time-budget data on time devoted to children, other housework activities, and leisure, when analyzed, could show something different. In a recent paper Hill and Stafford (1971) show that U.S. women of high socioeconomic status spend more time with their children than do low-SES women. Leibowitz (1974), using both labor force and time-budget data, shows the same thing about education.

activities, the relative time intensity of children diminishes as women's cost of time rises, and factor intensity may even be reversed; correspondingly, the curve relating fertility to education can flatten or even rise. The observed relation could also be generated by other price differences correlated with education and not explicitly accounted for.

In discussing labor supply, we noted at the top education levels a sharp increase in labor supply, with a comparatively large wage differential, coexisting with a modest or even "wrong" fertility differential, and a relatively large increase in expenditure on domestic help. This all fits the story of a relatively high elasticity of substitution in child raising.

We also noted that education and the presence of children interact differently in affecting the labor supply where oriental and European couples are concerned, the former constraining labor-force participation more than the latter when small children are present. A priori speculation on the differences in the ease with which time of mothers could be substituted under these conditions could go both ways. Larger families in the oriental group provide for flexibility in this respect. On the other hand, high school–educated oriental women may regard the opportunities for substitution at a given level of quality as much more restricted.

This kind of speculation emphasizes the importance of some of the properties of the initial model. The assumption that children are relatively intensive in the time of the mother has not really been explored enough. It is certainly true immediately after birth. Beyond that we observe large variations in behavior. Many Israeli women who had worked steadily before birth stay a few months at home, draw from the social security service a large fraction of their usual pay, and then come back to their steady job which the law has guaranteed for them, entrusting their baby to the care of family or domestic help and later to a variety of child-care services, often subsidized. The American situation seems to be different. The Israeli institutional setup seems to involve less contradiction between child raising and work of women, and was created partly because of a pronatal bias.

If one considers subsequent stages in child raising, including expenditure on education, the need for more careful examination of the relative time-intensity assumption is clear. Bringing in expenditure raises, however, more than one problem and is discussed in the next section.

VI. Quality of Children and Parents—Issues for Future Work

Before concluding and summarizing, I am taking the liberty of speculating a little more about one of the issues mentioned in the introduction. It is not a direction dictated by the preceding analysis, but it is one challenging and inviting possible extension of the analysis of fertility. Discussions of the secular decline in fertility as well as of cross-section differences have

often referred to the changing characteristics of children; the rising expenditure, mainly on education; and the postponement of labor-force entry of children. Large variations in these are evident in the Israeli data (Ben-Porath 1970*a*). There is also growing evidence on a negative association in the cross section between the number of siblings and various quality dimensions. (Leibenstein [1971] has recently alerted economists to some of these findings. See also Blau and Duncan 1967.)

Becker (1960), who introduced the analogy between various characteristics of children and the quality of other goods, urged the need to recognize the voluntary element in the determination of these characteristics; and recent studies have incorporated a "quality" dimension into formal fertility models (De Tray 1972*b*; Willis 1971).

The introduction of child characteristics (I hope we can find a substitute for the word quality) as a decision variable into the utility function, as well as the corresponding expansion of the production side, makes the problem more dramatically underidentified, given the limited number of truly exogenous variables around. The theory of the household still provides a useful organizing principle, but when specific models are carved out of it by imposing enough restrictions, they need to be examined simultaneously on several aspects of behavior and compared with alternatives. Lancaster (1966) has suggested that we think of any observed good as an input into some basic commodities. Preferences can be constant in terms of the basic commodities, but the goods inputs may change. Children and their various characteristics can also be viewed as such "goods" servicing various "basic" parental needs.

One can think of several "motives" for having children, starting from various psychological needs and ending with children as a source of old-age security. Each of the motives may have a different income elasticity and is affected by different sets of substitutes and complements. Presumably the "quality" required for each of them may be different so that the nature of the qualities and their relation to numbers varies. For certain motives it is appealing to regard the number of children and some index of quality as substitutes in the provision of "child services" (as suggested by De Tray [1972*b*]). Thus, if "quality" is future earning power of children, then from the point of view of the old-age security motive,[13] quality and numbers can be substitutes—two or three well-educated children can provide the same future income that several uneducated children would. I leave to introspection the judgment of how much substitution there is between the number of children and their "quality" in serving companionship or entertainment values.

These two examples have to do with cases where both the number and characteristics of children serve what might be called egoistic motives. But it must be clear that while the decision to have children may serve

[13] An interesting study of this motive is in Caldwell (1968).

one set of motives, their characteristics may be involved with another. In particular, the characteristics of children may have to do with altruistic motives: my utility function includes the number of children, my standard of living, and what I take as a proper utility function for each of my children (that is if they would have the sense to have my preferences). While I have children for my sake, my utility depends on what I conceive to be their long-term happiness, and I decide on their standard of living while at home and on their schooling according to this consideration. What is important here is the link that this creates between the parents' own consumption level and education and those of their children. The link does not necessarily take the form of perfect complementarity (Willis 1971); there may be some sensitivity to relative prices, but one can see that there would be limits to the desired intergenerational inequalities to income and opportunities, even without assuming taste dependence on parents' education. In terms of this story, the decision between the number of children and their "quality" is inconceivable without reference to the parents' standard of living. It is evident that postulating such a link does not have to rest on arguments of social pressure (see the Becker [1960]-Duesenberry [1960]-Okun [1960] discussion and the subsequent paper by Blake [1968]) coercing the rich to spend much on their children. While such pressures may exist, they depend presumably on prevalence of a desire by most rich persons to spend much on their children.

As indicated, the weight of different motives changes as income and the relative costs of fulfilling them change. Every textbook in demography mentions social security as a substitute for old-age security. Also, the feeling of parents that they have an opportunity to affect their children's future depends not only on the supply conditions of education but also on the parents' evaluation of how the labor market works. How important, for example, is social origin versus schooling?[14] This varies between markets and among individuals, depending on their own experiences.

The other part of this question has to do with the production side. How important is the jointness in production between the "standard of living" of parents and children? To what extent can certain parents achieve certain characteristics of children "costlessly"? This is where the hereditary argument may affect family size (for a recent survey of the controversy, see Scarr-Salapatek [1971]). To what extent can parents (necessarily mothers?) with certain characteristics (IQ, schooling?) produce higher "quality" children more efficiently?[15] Is this efficiency in terms more of their time or of purchased inputs? These considerations open up many possibilities. No wonder that one can find a set of assumptions to accom-

[14] This point was made by Simon Kuznets.

[15] Michael (1969) has examined implications of education effects on household production both in general and with respect to fertility (1970). I have dealt with the effects of human capital on further production of human capital (Ben-Porath 1970*c*).

modate any facts. For example, one central set of facts is that the negative relation between fertility and education of women tends to diminish, disappear, or even reverse at the upper range of education or among groups of higher social and economic position. Elsewhere, in looking at aggregate Israeli census data by age, I have also noted a sharp decrease of fertility differentials by education of women (Ben-Porath 1970*a*). The consideration of the quality dimension can generate rationalization of these facts. The ingredients of the arguments are the following: (1) Quality, the desired "standard of living" of children while at home, and the stock of their human capital are income-elastic. (2) In producing quality, the educated and/or rich have a lower marginal cost for quality. If $\pi(Q_i)$ is the "full price" of a child of a given "quality," then

$$\frac{\pi(Q_1)}{\pi(Q_0)}\Bigg|_{\text{rich/educated}} < \frac{\pi(Q_1)}{\pi(Q_0)}\Bigg|_{\text{poor/uneducated}},$$

where $Q_1 > Q_0$.

The grounds for this may be the following: (*a*) There may be some joint production between parents' and children's standards of living, so that parents as they raise their own standard of living can raise that of their children at less cost than if they had to raise their children's standard of living alone. (*b*) As suggested earlier, educated mothers (or parents!) may be more efficient in producing human capital in their children. (*c*) The importance of parents' time in the total cost of children may be low for "high-quality" children.

These ingredients could be combined into the statement that at higher levels of income the desired quality of children is such that the cost differentials by education or income diminish or disappear. But of course equally plausible ingredients could be combined to explain some other evidence.

VII. Conclusion

I have examined cross-section evidence on differential fertility in Israel, focusing on the relation between education and fertility. The interpretation of this relation as reflecting the relation between education and the cost of women's time and the relation between cost of time and the "price" of children is helpful in understanding some of the phenomena; what is left unexplained is the large decline in fertility at the bottom of the education ladder.

This sharp decline may be dominated by informational and cultural differences concerning family planning, of the sort suggested by sociologists (see, e.g., the evidence presented by Bachi and Matras [1962], Matras and Auerbach [1962], and Peled [1969]). Several pieces of evidence are consistent with a view that most of the cross-section and time-series

variation in fertility reflects differential movement to a low level of fertility where the long-term optima do not vary much. (Thus, see the very flat curve relating fertility to education among couples of European origin married in Israel.)

Even if such a view were to be accepted, the need for explaining the mechanisms of transition remains. The possibilities of the simple cost-of-time hypothesis are far from exhausted in this paper: a more explicit treatment of the cost of time (see Gronau's paper herein), a more satisfactory treatment of husbands' lifetime or permanent income, and a fertility variable that takes timing and survival into account are some of the more immediate needs. What seems to be quite important is a simultaneous examination of several aspects of behavior.

In the specific Israeli context, I regard as the main challenge the understanding of the differentials between those born in Europe-America, Asia-Africa, and Israel and the linking of the cross section to the changes over time. The unexplained differences between these groups are partly a result of measurement problems of the economic variables. Better understanding may involve following some suggestions made by Professor Lewis and, beyond that, a study of the behavior over time of cohorts of immigrants.

In terms of further development of the hypothesis, I have suggested that an adequate analysis of fertility declines and differentials has to be more concerned than I have been here with the joint determination and interdependence between the number of children and their quality (chiefly their education) with a somewhat more explicit link with the theory of investment in humans than has hitherto been made. One additional reason why I think this is a useful direction is that it bridges the dichotomy between economic determinants and economic consequences of population change. Studying the economic corollaries of changes in fertility may turn out to be quite important in understanding the interrelations of demographic and economic transition and understanding better those cases where changes in fertility actually take place.

Comment

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Most of what I have to say in comment on Professor Ben-Porath's paper he would have said himself had he lengthened his paper by a few pages. My remarks consist mainly of conjecture.

First, I consider the question of the "power" of the budget-restraint or opportunity factors in the "new home economics" to explain fertility differences in Israel's population. It is certainly true that, in his fertility regressions across individual Jewish households, the budget-restraint factors (I include here everything except the birthplace, place of marriage, and migration-period variables) do not explain much—about 20 percent at most—of the total fertility variance. Yet mother's schooling, age, and duration of marriage together with father's schooling and earnings not only are imperfect proxies for the underlying wage, income, household-productivity, and price-of-contraception variables embedded in the budget restraint, but also the extent to which they are so differs, I conjecture, by birthplace, migration date, place of marriage, and even the parents' schooling. The consequences are biased estimates of regression coefficients and, I suspect, overestimation of the importance of the place-of-birth, place-of-marriage, and migration-date variables, and underestimation of the importance of the opportunity factors in explaining fertility differences.

But what can be done about these problems, especially without asking for unavailable data? I have a hunch that the ratio of years of schooling to the natural logarithm of wages for which schooling in one of its roles is serving as a proxy is greater: (1) for immigrants who completed their schooling before migrating to Israel than for native-born Israelis and for immigrants who completed their schooling in Israel, partly because, I think, that schooling is somewhat country-specific, especially, of course, with respect to language; (2) for more recent than for earlier immigrants; and (3) for immigrants who live in "settlements" chiefly populated by immigrants of like origin than for others, especially settlements well outside of the urban centers. These differences, furthermore, may vary by

place of origin, sex, age, and years of schooling. Checking these hunches, of course, does require wage data, though not necessarily the presently unavailable wage data by sex for individual households. In the absence of the relevant wage data, these conjectures contain only the suggestion that Ben-Porath include, in one way or another, among the independent variables in his household regressions the place of schooling and the place of settlement in Israel. Of course, even though wages are unavailable by household, if wage averages are available by years of schooling, sex, and place of residence in Israel (and perhaps other relevant characteristics), it would be useful to construct from these data an estimate of the wage by sex for each household and to include these variables in the household-fertility regressions.

Schooling quite possibly plays a significant second role in the budget restraint, namely, as a proxy for the "price of contraception"; and here, as in its wage role, its imperfections may be correlated with the amount of schooling and the other independent variables. But here, too, is there anything useful that can be done about it? I have only one suggestion. Let me assume that a person's knowledge of contraceptive technique is, say, a positively inclined linear function of both his schooling and the average schooling of the communities in which he has lived. Data on schooling by community, I assume from Ben-Porath's table 2, may be available for Israel's communities. Similarly, at least rough estimates of schooling might be available for the immigrants by country of origin. And, of course, date of immigration is known. Thus I think that it is possible to construct an estimate of the average schooling of the communities in which each parent in the household has lived, for use as independent variables.

I suspect that the errors in schooling in its third role as a proxy for household productivity may be less importantly related to the independent variables.

The power of the budget-restraint factors to explain fertility differences, of course, depends on what differences are to be explained. In particular, a little aggregation of households often helps, as Ben-Porath's regressions in table 2 tend to confirm. In the first of the regressions, which is across Jewish communities except the kibbutzim and which has only two independent variables, the median schooling of men and the median schooling of women, the coefficient of determination (R^2) is 53 percent. Furthermore, the contribution of the budget-restraint factors to explaining time-series variations in aggregate fertility of Israel's Jewish population, I conjecture, will be considerably larger than it appears to be in the household cross-section regressions. I hope that when Ben-Porath has completed his work on the latter, he will apply the results to the time-series data.

The central finding in his paper is the sharp decline in fertility with additions in schooling at low levels of schooling of the mother, and the

much more modest declines from additional schooling at higher levels. (Indeed, there is a suggestion that fertility may even be positively related to mother's schooling at high levels of schooling.) I regard this finding that fertility apparently is not linearly related to schooling of the mother as important, in part because it may help to reconcile apparently divergent findings from regressions in which wage, income, and/or schooling variables enter linearly. Furthermore, despite my earlier comments about the danger of biased coefficient estimates resulting essentially from left-out variables, I would be surprised if this result is seriously changed. More work on the data, of course, may flatten the fertility-education curve somewhat, possibly eliminate the suggestion of positive inclination at high levels of schooling, and, I would hope, reduce some of the differences between place-of-origin groups in their fertility-schooling curves. But I doubt that the sharp drop at low schooling levels will disappear, simply because it is too marked to be eliminated easily.

In his section on "Substitution in Production and Factor Intensity" and also in the following section on "Quality of Children and Parents," Ben-Porath speculates about what lies behind or explains the shape of the fertility-education or fertility-wage curve (and, related to it, the curve of labor-force participation and wage and that of domestic services expenditures and wage). He is disinclined, and so am I, to give much weight to an income-effect explanation. The sign of the relevant income elasticity is ambiguous even though the income elasticity of demand for number of children embedded in the utility function is positive. He suggests that the curve shape may be rationalized in part by factor- (time-) intensity reversals accompanying increases of the mother's potential wage if the elasticity of substitution in household production between mother's time and purchased inputs is higher in child raising than in other activities. I would add that the tendency of the elasticity of fertility with respect to the mother's wage to increase algebraically as the mother's wage increases will be accentuated if the elasticity of substitution in the utility function between number of children and parents' standard of living is less than unity. Then, as the mother's wage increases, the fraction of income allocated to the parents' standard of living $(1 - \gamma)$ will be positively correlated with the time-intensity difference $|\alpha_{fN} - \alpha_{fS}|$ in his equation (16).

Once the quality versus quantity distinction is made in the analysis of fertility behavior, and I think that it should be, our degrees of freedom to rationalize data expand rather substantially. I would put child quality (per child) in the utility function (as Willis does) along with child number and the parental "standard of living":

$$U = U(N, Q, S),$$

where Q is child quality, and I would be willing to assume, as Ben-Porath does, that in this utility function child quality has a high income elasticity

relative to those for child quantity and the parents' "standard of living." In the budget restraint I would add at least one term on the expenditure side of Ben-Porath's equation (6):

$$I = S\Pi_s + N\Pi_N + NQ\Pi,$$

where $N\Pi_N$ consists of expenditures on children that do not depend on their quality, such as contraception costs (which enter negatively) and $NQ\Pi$ are expenditures that depend on both quality and quantity. (It can, of course, be argued that there are still other expenditures on children, as long as there are any, that depend on child quality but not on number of children.) Earlier in this volume, Gary Becker and I discussed some of the implications of such a model.