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THE VALUE AND ALLOCATION OF TIME IN HIGH INCOME COUNTRIES: IMPLICATIONS FOR FERTILITY

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Abstract

The household demand framework assigns importance to the parent-specific time requirements of having (and enjoying) children and the distinct price effects of the opportunity value of women's and men's time in market and nonmarket production. The framework implies that if child care duties can be transferred to the market without loss of parental satisfaction, then the link between the opportunity value of the parents' time and the shadow price of children would be partially broken. The family may use increasingly the market for specialized preschool child care and extended adolescent schooling. But this development is not likely to prevent the opportunity cost of children from continuing to rise, though it may dampen the rate of increase. Fertility may not, therefore, rebound substantially and permanently from its current trough, though it may become less sensitive to women's wages for reasons indicated. Intermittent periods of fertility increase, however, can be expected, as the timing of fertility becomes subject to perfected methods of control.

This paper restates the simple static economic theory that underlies this framework, reviews the evidence from modern industrial societies in recent decades, and considers the wage, price, and labor market conditions that would, according to the theory, help forecast future levels of fertility.

THE VALUE AND ALLOCATION OF TIME IN HIGH INCOME COUNTRIES: IMPLICATIONS FOR FERTILITY*

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1. INTRODUCTION

Several economic hypotheses have been proposed to account for the long run decline in fertility in modern industrial societies. This paper restates one of these theories, reviews some evidence bearing on its predictions, and considers the conditions that would, according to the theory, help forecast future levels of fertility in countries such as the United States. The theory links the decline in fertility to the increase in real wages, and to the increase in wages of women relative to men.

Let me at the outset indicate, therefore, which issues I will consider and which I will set aside here. The issues I have selected for emphasis embody, I think, important constraints that affect long run trends in aggregate fertility levels in high income countries. Showing how these constraints may affect fertility levels is my first task; the second is to suggest the developments that have modified these constraints in the past and are likely to continue to influence them in the future.

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This paper will not attempt to separate the exogenous biological supply and endogenous behavioral demand factors in fertility determination; rather, my working assumption is that changes in the determinants of desired fertility dominate today the overall level of fertility, and, moreover, that this dominance of demand factors will become progressively greater in the future as birth control technology improves and becomes more widely available (Westoff, 1981; Pratt and Horn, 1985; Rosenzweig and Schultz, 1985a, 1985b). Thus the neglect here of supply.

Another neglected aspect of fertility is the timing of births and implicitly the timing of marriage and remarriage. Although this dynamic dimension of fertility is beginning to be studied by economists (Wolpin, 1984; Newman, 1985; Heckman, Hotz, and Walker, 1985), it is not a central objective of this paper. More research is needed to discover whether the onset of childbearing and resumption of childbearing upon remarriage is responsive to lifecycle liquidity constraints or other economic conditions.

The juxtaposition of parent choices of the quantity of children and the human capital resource intensity (or quality) of children focuses attention on two central, and undoubtedly related, changes in human behavior that change with modern economic growth (Becker, 1960; T.W. Schultz, 1984). But despite our fascination with this empirical regularity across households between fertility and the resources parents provide each of their children (proxied generally by schooling), such parallel changes in family choices may arise for many reasons. Quantity and quality may interact in the budget constraint in the sense that the marginal cost of increasing quality (quantity) depends on quantity (quality) as in Becker and Lewis (1974). But this specification is generally indistinguishable from conventional explanations that interpret the correlation between quantity and quality as evidence that the goods are substitutes in the usual sense. Economists (e.g. Schultz, 1983) and

anthropologists (Caldwell, 1982) have yet to demonstrate a satisfactory causal explanation that arises from outside of the household economy and is responsible for these two aspects of parents' investment strategy in children.

Two developments will be ascribed a role in increasing the relative price of children and hence in decreasing the number of children parents desire or demand in this paper. The first hypothesis is of two parts: (1) if children are more time intensive than the average consumption commodity, and (2) the real value of human time increases, the price of children will increase relative to other goods, and some of these other cheaper goods will partially substitute for children in the budget constraint of parents that is defined to include both time and goods.[1/] The second hypothesis is also founded on a feature of production technology and a trend in prices: (1) if child care is more intensive in the mother's time than in the father's time, and (2) the value of women's time increases relative to the value of men's time, children will be more expensive and fewer children will be sought. These secular trends in the relative prices of child inputs should induce households to also conserve on the increasingly costly inputs and rely more heavily on the progressively cheaper inputs (Mincer, 1963; Becker, 1965).

This paper is organized in the following manner. Section 2 develops the household demand model to define more precisely how the opportunity cost of time of men and women may affect fertility. Section 3 estimates the U. S. relationship between fertility in the cross-section and the wage opportunities of husband and wife. Section 4 reviews recent trends in education, wages, and labor force participation of men and women in several high income countries. A framework is then proposed in Section 5 to account for the changing relative educational attainment of women and men. As these fragmentary relationships are assembled into a consistent story, a clearer understanding should emerge of the causal dynamics underlying modern economic and demographic development.

2. THE HOUSEHOLD DEMAND FRAMEWORK

To structure the empirical analysis and make the assumptions underlying my two hypotheses explicit, it is convenient to start with the standard household demand framework. A couple is assumed to decide how many children to have over their lifetime based on their physical assets at marriage (A), a vector of prices (P), wages (W), and asset returns (R). The utility of parents (U) depends on the enjoyment of two commodities: number of children (C) and other goods (G), the latter including investments in child "quality." Parents produce both commodities with known household technologies using their own time (T_w, T_h) and market goods (X), where the subscripts w refer to the wife and h to the husband:

$$U = U(C,G)$$

$$C = C(T_{wc}, T_{hc}, X_c)$$

$$G = G(T_{wg}, T_{hg}, X_g)$$

The economic opportunities available to the parents are summarized in a full income (F) budget constraint:

$$F = W_wT + W_hT + V = Y + W_w(T - T_{wm}) + W_h(T - T_{hm})$$

where V = RA is the return on the physical assets, Y is market income, and T is the total time available to each parent, which is the sum of time producing C and G and that supplied to the market labor force T_{jm}. Thus,

$$T = T_{jc} + T_{jg} + T_{jm} \qquad \text{for } j = w \text{ and } h.$$

The full income constraint can also be stated in terms of the sum of the commodities produced and consumed by the parents valued in terms of the

opportunity cost of the time and market good inputs used in their production (shadow prices π), if the household technology is assumed to be subject to constant returns to scale and there is no jointness between the production of C and G.

$$F = \pi_c C + \pi_g G$$

These last two technological assumptions of Becker's (1965) framework are needed if the shadow prices are to be treated as exogenous and consequently invariant across households in which parents vary in their output/consumption decision (Pollak and Wachter, 1975).

For numbers of children to be parent time-intensive means that the share of the opportunity cost of children due to parents' time inputs (s_{jc}) exceeds the parents' time input value share in other goods (s_{jg}), namely:

$$(T_{wc} W_w + T_{hc} W_h)/(\pi_c C) = (s_{wc} + s_{hc}) > (s_{wg} + s_{hg}) = (T_{wg} W_w + T_{hg} W_h)/(\pi_g G)$$

Analogously, for children to be more female time-intensive than male time intensive means that the female time intensity of children relative to that of the other consumption commodity exceeds the male time intensity of children relative to the other commodity:

$$(s_{wc} - s_{wg}) > (s_{hc} - s_{hg}).$$

The utility maximizing demand of parents for numbers of children depends on the underlying exogenous variables in the model: wages, prices, endowments, and preferences. Preferences are generally set aside by economists because they are not objectively observed and are conventionally assumed to be uncorrelated with other exogenous variables:

$$(1) \quad C = D_c(W_w, W_h, V, P_g, P_c),$$

where P_g and P_c are the exogenous prices of the market inputs to the two basic commodities. While it is common to assume that market prices do not

vary substantially in the cross section, it is important to distinguish between variation in market determined prices of children which is exogenous, and variation in the resource intensity of parent investments or consumption expenditures on children, which reflect parent choice and is therefore another endogenous variable.

The derivative of numbers of children demanded by parents with respect to wage rates and nonearned income can be expressed as a weighted combination of compensated price and income effects:

$$(2) \qquad dC/dW_w = (C/W_w)(\eta^{*}_{c\pi_c}(s_{wc} - s_{wg}) + \eta_{cy}(W_w T_{wm}/Y))$$

$$(3) \qquad dC/dW_h = (C/W_h)(\eta^{*}_{c\pi_c}(s_{hc} - s_{hg}) + \eta_{cy}(W_h T_{hm}/Y)$$

$$(4) \qquad dC/dV = \eta_{cy}(C/Y)$$

where $\eta^{*}_{c\pi_c}$ is the income compensated demand elasticity with respect to the full opportunity price of children, and η_{cy} is the market income elasticity of demand for children. Demand theory implies that the compensated own-price elasticity is negative. Some economists suspect that the income elasticity of demand for children is positive if appropriately defined (Becker and Lewis, 1974), but there is nothing in economic theory that precludes wealthier parents demanding to have fewer children and to invest more resources per child.

The empirical demand estimation equation for fertility is initially assumed to be linear, or, more specifically, semi-logarithmic in the wage parameters.

$$(5) \qquad C_i = \beta_o + \beta_1 \ln W_{wi} + \beta_2 \ln W_{hi} + \beta_3 V_i + e_i,$$

where the i indexes individual couples in the sample of observations on fertility, their permanent wages, nonearned income, and e is a residual error due to many minor omitted factors and misspecifications of functional form, which is assumed independently distributed with respect to the other explanatory variables and symmetrically distributed.

The income elasticity of children is readily obtained from a regression of the form (5), $\eta_{cy} = \beta_3(Y/C)$. If the price of time effects on the price of children are suitably captured by the husband and wife's wage variables, then nonearned income will reflect merely an expansion of the parents' opportunities and possibly exert a small positive effect on fertility. The compensated price components of the wife's wage (w^*) and the husband's wage (h^*) can be constructed from the estimates of (5) and the sample mean values of fertility and market labor supply.

$$w^* = \eta^*_{c\pi_c}(s_{wc} - s_{wg}) = \beta_1/C - \beta_3 T_{wm}$$

$$h^* = \eta^*_{c\pi_c}(s_{hc} - s_{hg}) = \beta_2/C - \beta_3 T_{hm}$$

Our two hypotheses regarding time intensity of children may be now empirically evaluated. For the time intensity of children to exceed that of other goods, $w^* + h^* < 0$. This condition would hold if the sum of the uncompensated wage effects per child $(\beta_1 + \beta_2)/C)$ is negative, and the income elasticity is either positive, or if negative, it is smaller than the sum of the previous wage effects. Empirical studies of fertility that have sought to estimate the distinctive effects of the wage opportunities for men and women generally find β_1 is negative while β_2 tends to be negative in high income urban populations and frequently positive in low income agricultural populations (Schultz, 1981). Regardless of the sign of β_2, the absolute magnitude of β_1 generally exceeds that of β_2 and the fertility effect of nonearned income β_3, is positive.

The second hypothesis that children are female relative to male time intensive implies that $w^* - h^* < 0$. This is a more difficult condition to satisfy if the income elasticity is positive. The difference in the uncompensated wage price effects per child (i.e. $(\beta_1 - \beta_2)/C$) must in this case be larger (negative) than the time weighted difference in income effects (i.e. $\beta_3(T_{hm} - T_{wm})$). Thus, confirmation of the female relative to male time intensity hypothesis requires more than the standard finding that the wife's uncompensated wage coefficient is more negative than that for the husband's uncompensated wage coefficient. In other words, wages of men and women may increase by the same percentage contributing to a reduction in fertility if $\beta_1 < \beta_2$, but this empirical regularity need not imply that children are more female than male time-intensive.

It would be useful in addition to have measures of market prices of basic child inputs, P_c, holding in some sense the quality or resource intensity of children constant (Lindert, 1980). But I know of no satisfactory proxies for such prices over time or across regions. Studies have attempted to calculate the cost of a child, but these investigations do not recognize that expenditures on children and the number of children parents have are to some degree jointly and simultaneously determined. Thus, when these studies hold constant for fertility and the wife's work behavior to calculate the expenditures on children (Espenshade, 1984), it is not clear how the estimates are to be interpreted. Existing measures of market expenditures on child rearing are not solely determined by market prices, but by parents choosing their expenditure level to satisfy their own preferences. Exercises using demand systems to estimate compensating variations in income that appear to offset precisely the consumption "requirements" of an added child are merely more sophisticated ways of treating fertility and family composition as if they were exogenous (Deaton, 1982; Lazear and Michael, 1982). These studies

do not permit us to infer expenditure "effects" of an added child, since they yield inconsistent estimates if parents influence their own fertility and the distribution of children thereby becomes correlated with the tastes of the consumer that are impounded in all of the errors in the demand system.[2/]

3. FERTILITY ESTIMATES: UNITED STATES 1967

To describe how fertility varies with respect to wage opportunities of women and men in the United States, the reduced-form fertility equation (5) is estimated as suggested by the household demand framework. The data are from the 1967 Survey of Economic Opportunity (SEO), an augmented version of the Current Population Survey (CPS). Fertility regressions are reported in Table 1 for the 14,631 husband-wife families, stratified by age and race groups. Age is introduced as a linear control for differences in both the experiences of specific birth cohorts and variation in stage of their lifecycle. Nonemployment income is the realized income flow from wealth and excludes work conditioned public and private transfers such as unemployment, social security, pension, and welfare payments. These work conditioned payments may be endogenous, since they may be administratively linked to family size or fertility, as well as to past and current labor force behavior.

The realized wage of a woman is clearly a function of her past accumulation of labor market experience, and consequently it tends to be inversely related to her fertility and directly related to her lifecycle investments in labor market skills. The realized hourly wage rate is, therefore, endogenous to the couple's reproductive choice or plans, or in other words, the unexplained error in the fertility equation (5) is likely to be correlated with the wife's past, current, and anticipated labor market and human capital investments behavior. Exogenous instrumental variables are therefore used to predict a wage for each wife (and husband) based on an

Table 1

Fertility Estimates for U.S. Married Women in 1967, by Race and Wife's Age[a/]

Sample Composition	Explanatory Variables: Log of Predicted Wage (dollars per hour) wife	husband	Nonearned Income ($1000 per year)	Wife's Age (Years)	Intercept	F-Statistic (sample size)	Dependent Variable Children Ever Born (standard deviation)
White:							
Wife's Age:							
18-24	-1.80 (13.4)	.417 (3.06)	-.0814 (-1.23)	.313 (17.7)	-5.42 (14.2)	87.8 (1209)	1.13 (1.06)
25-34	-2.10 (11.4)	.402 (2.46)	.0232 (.51)	.144 (13.7)	-1.05 (3.07)	85.8 (2199)	2.58 (1.58)
35-44	-.888 (3.42)	-.371 (2.30)	-.0108 (.32)	-.0243 (1.99)	4.92 (9.78)	20.4 (2980)	3.04 (1.92
45-54	-1.37 (5.66)	-.270 (2.40)	-.00318 (.19)	-.0373 (2.71)	5.45 (7.84)	28.5 (2651)	2.62 (2.05)
55-64	-1.50 (7.58)	-.623 (4.52)	-.0227 (.83)	.0047 (.25)	3.46 (3.05)	56.8 (1689)	2.54 (2.28)
Black:							
Wife's Age:							
18-24	-2.34 (6.47)	1.13 (3.31)	1.89 (.59)	.277 (8.62)	-4.57 (6.29)	26.7 (433)	1.91 (1.37)
25-34	-1.33 (4.33)	-.370 (.99)	-4.60 (1.59)	.171 (4.33)	-.842 (1.02)	31.8 (807)	3.55 (2.39
35-44	-1.76 (5.40)	-.631 (1.77)	-2.64 (1.04)	-.101 (3.44)	8.74 (7.43)	48.7 (1161)	3.92 (3.05)
45-54	-1.10 (2.95)	-.942 (2.53)	1.72 (1.03)	-.121 (3.55)	9.78 (5.83)	25.7 (937)	3.09 (3.12)
55-64	-1.85 (3.69)	-.273 (.61)	1.47 (.71)	-.0042 (1.03)	5.37 (2.14)	14.2 (565)	2.67 (2.92

[a/] Beneath regression coefficients are shown in parentheses the absolute value of the t statistics.

estimated semi-logarithmic hourly wage function that does not include as explanatory variables endogenous fertility, family composition, or labor market experience. It includes schooling, a quadratic in postschooling age, functional health disabilities, and local labor market characteristics in the residential region. (See Schultz, 1975 for more detail.) These predicted wage variables may, however, be subject to selection bias, but experimentation with standard probit corrections (Heckman, 1979) for this source of bias in the wage and fertility equations did not indicate that the bias was statistically significant.[3/]

In every age and race regression the wife's predicted wage is negatively associated with fertility. The coefficient on the husband's predicted wage changes sign over the life cycle (or across birth cohorts), adding to the number of children ever born for younger wives, age 18 to 34 for whites and age 18 to 24 for blacks, but contributing to lower fertility among older wives. If this pattern in the age cross-section were to persist for a cohort over time, higher wages for husbands encourage earlier childbearing, but the earlier onset of childbearing is counterbalanced by a much lower rate of childbearing at later ages. For white wives over age 35 and for black wives age 35 to 54, a higher predicted husband's wage is significantly associated with lower completed fertility. The elasticities of fertility with respect to the wage rates of wives and husbands are of similar magnitude for blacks and whites, though the level of black fertility is higher and wage levels lower.

In no regression is the estimated effect of nonearned income on fertility statistically significantly different from zero at the 5 percent confidence level. Alternative net worth (stock) measures of potential nonearned income were substituted for the flow of nonearned income, but the explanatory power of the relationship was not improved. These estimates do not confirm that the

timing of cumulative fertility or the completed number of children among currently married couples is affected substantially by nonearned or wealth income. This evidence supports the view that η_{cy} is essentially zero.

These estimates give credence to the hypothesis that children are time intensive. In all age and race regressions the sum of the coefficients on the wife's and husband's wage rate are negative and increase generally for the older age groups. The hypothesis is most appropriately tested for these later age groups, since the model describes completed fertility and not the timing of childbearing. The adjustment for the income elasticity is small and more often than not negative. The hypothesis that children are more female than male time intensive is also consistent with these estimates. The value of w*-h* is always negative, but smaller for older white age groups and not particularly stable for older black age groups.

In sum, cross-sectional linearized reduced-form fertility regressions from the late 1960s suggest that in the U.S. the standard technology assumptions advanced by the household demand model are reasonable. Although women's wages did not increase relative to men's during the 1950s, 1960s, and early 1970s (O'Neill, 1985), equiproportional growth in real wages for both men and women could have been responsible for substantial declines in fertility at all ages. Increases in both spouses real wage rates by 50 percent, as occurred from 1960 to 1980, is associated with an average reduction in fertility in these regressions of .6 to 1.2 children ever born. This large reduction in fertility would have been anticipated on the basis of the reported regression estimates and the actual U.S. trends in male and female real wage levels. But if, as some economists forecast (Smith and Ward, 1985), female wages relative to male wages are likely to increase in the U.S. for the rest of this century, will U.S. fertility continue to fall?

4. WAGES AND LABOR FORCE BEHAVIOR OF WOMEN AND MEN

The fertility consequences of change in real wages of women and men depend on a couple's allocation of their time among child care, housework (proxied by G), and market labor force participation, as summarized in equation (2) and (3). Data for high income countries are currently insufficient to measure directly the difference in male and female time intensities of children and other household commodities, or in our notation, $s_{wg} - s_{wg}$ and $s_{hc} - s_{hg}$. But impressionistic evidence suggests a gradual convergence in the time allocation patterns of men and women may be occurring. If this continues, one should anticipate that the fertility effects of male and female wages will also become more similar. The increasing value of women's time relative to men's should contribute to changing the relative household production roles of husbands and wives, and to a substitution of child care activities from the family to the marketplace. These adjustments in factor proportions within household production and the locus of production contain the seeds of change that should dampen the responsiveness of fertility to future increases in women's relative wage.

The record is much clearer when it comes to documenting the increasing share of women's time that is allocated to labor market activities (Mincer, 1962; Cain, 1966; Evenson, 1983). This change is particularly notable among married women and, most recently, among married women with preschool aged children. Since male participation rates have tended to drift downward slowly with secular increases in real wage levels, the ratio of female to male participation has often risen markedly, averaging an increase of about 60 percent from 1960 to 1980. Table 2 shows these tendencies in labor force participation rates for prime aged men and women after age 25, when schooling is generally completed, and before age 55, when retirement becomes evident for both men and women. There are still, needless to say, differences across

Table 2

Male and Female Market Labor Force Participation Rates

Between Age 25 and 54: 1960 and 1980

Country:	Labor Force Participation Rates for Ages 25 to 54 (%)				Ratio of Female To Male Participation Rates	
	Males		Females			
	1960	1980	1960	1980	1960	1980
Australia	97.9[a]	93.7[b]	26.7[a]	54.9[b]	.273[a]	.586[b]
Belgium	94.1[c]	n.a.	25.1[a]	n.a.	.266[a]	n.a.
Canada	96.3	94.8	30.6	60.1	.318	.634
Finland	95.7	88.5	56.8	77.6	.593	.877
France	96.3	96.4	45.1	63.0	.468	.654
German Fed. Rep.	96.7	93.5	45.1	53.9	.466	.576
Greece	92.9[ad]	89.6[d]	35.6[ad]	36.7[d]	.384[ad]	.410[d]
Ireland	97.3[a]	95.1	23.4[a]	28.4	.240[a]	.300
Italy	95.2	93.1	32.4	39.9	.340	.429
Japan	96.0	97.0	57.6	56.7	.600	.585
Netherlands	98.0	94.5[c]	17.2	42.5[c]	.175	.454[c]
New Zealand	98.2[a]	95.7[b]	24.9[a]	45.3[b]	.254[a]	.473[b]
Norway	96.9	95.0[c]	22.2	72.0[c]	.230	.758[c]
Portugal	96.5	94.6[b]	15.9	56.2[b]	.165	.594[b]
Spain	97.1	94.4[b]	16.2	32.7[c]	.167	.346[c]
Sweden	96.1	95.4	56.0	82.9	.583	.879
Switzerland	98.4	97.7	32.9	51.8	.334	.530
United Kingdom	98.1	96.9	40.4	63.6	.412	.656
United States	95.7	94.0	42.8	63.8	.447	.678

[a]1961
[b]1981
[c]1982
[d]age 25 to 64
n.a.: not available
Sources: U.S. Bureau of the Census Statistical Abstract of the United States 1982-83, (103rd ed.) Washington, D.C., 1982, Table 1534, p. 872; International Labour Office Yearbook of Labour Statistics 1982, Geneva, 1983, Table 1; United Nations, Demographic Yearbook 1964, New York, 1965, Table 8; Labour Force Statistics 1963-1983, OECD, Paris, 1985.

countries and time periods that have influenced the level and rate of increase in women's labor force participation rates (Stafford, 1980; Davis and Van de Oever, 1982; Evenson, 1983). In some countries, such as Japan, this reallocation of women's time to the market is entirely concealed in overall labor force statistics, because married women were frequently enumerated in previous periods as economically active in family businesses, such as small farms, and were therefore counted as unpaid family workers or self-employed. Thus, in countries such as Japan, the traditional family segment of the female labor force has contracted while wage and salary employment for women has expanded, leaving total participation rates temporarily unchanged (Hill, 1983).[4/]

Women over the course of the first half of the 20th century have tended to get married earlier in more developed countries. And since married women have historically participated less in the market labor force than single women, this secular change in marital status composition helps to explain why participation rates for married women can increase, while overall female participation rates remain more stable (Layard and Mincer, 1985). The shift of married women into market employment has occurred in some countries through acceptance of part-time jobs, the United Kingdom being an example. In the United States, on the other hand, the share of the female labor force in part-time jobs has been relatively stable for two decades.[5/] The increase in hours that women have supplied to the labor market is not frequently reported, and it need not, thus, follow precisely the path of participation rates.

The overall trends toward increasing female participation in market labor force activity do not necessarily imply that female workers are accumulating labor market experience at a more rapid rate than are male workers. On the contrary, Smith and Ward (1985) and O'Neill (1985) document that one reason

for the postwar stability of female wages relative to males in the United States was the tendency during the early postwar years for the accumulated work experience of working women to decline relative to that of working men. The market wage opportunities available to the average women in the population may have been increasing, as more women worked in the labor force force for part of their lives. But a change in the experience composition of the women who worked concealed this fact. In the next decade this short-run compositional shift in experience of working women will have run its course, and the average experience of working women should begin to increase relative to that of working men, with implications for women's wages relative to men's.

The educational attainment of women in most societies is lower than that of men. The United States is an exception in this regard. White women born from 1856 to 1921 attained more schooling than did white men in their birth cohort (Smith, 1984). This pattern reversed for men and women born between 1925 to 1954, among whom men attained slightly more schooling than did women. Though the differences in schooling of men and women were small in the U.S., changes in the average schooling of those women who decided to work in the labor force were more substantial. Here too, the educational level of women who worked during the 1950s and 1960s declined relative to that of all women, contributing to a compositional decline in the schooling of female workers relative to male workers (O'Neill, 1985; Smith and Ward, 1985). As the participation rate of women increases, changes in the educational composition of female workers relative to that of the female population are likely to diminish in importance.

Across a national labor market, wages of both men and women are strongly associated with their educational attainment, particularly when age or postschooling experience is held constant. Therefore, the tendency for educational attainment of women to increase relative to men is a crucial

factor in raising the market wage opportunities of women relative to men. Moreover, the process is self-reinforcing through its impact on female labor supply behavior illustrated in the estimates of Table 3 for U.S. married women based on the same SEO sample used for the previous fertility estimates. Increasing market wage opportunities for women contributes to more women entering the labor force and working more hours (Smith, 1980). This outcome permits women to accumulate more labor market experience and thereby increase further their market wage opportunities (Mincer and Polachek, 1973). This tendency for male and female wages to converge relatively in the long run is likely to continue, but the speed of convergence remains uncertain, not only because of the cross-currents in compositional change noted earlier, but also because technologically determined derived demand for male and female labor may differ from country to country and over time as the composition of output changes during modern economic growth (Schultz, 1985b).

Increases in educational levels, and particularly in female relative to male levels of schooling, have an important long-run bearing on female relative to male labor force participation ratios, and directly and indirectly influence female to male opportunity wage ratios. The educational levels that were taken as given in the preceding section's analysis of fertility, labor force participation, and wages in a U.S. cross section must, therefore, now be reexamined. To complete my story I need an initial cause, or the forcing developmental variables that might have set into motion in industrially advanced countries the secular decline in fertility along with the increase in women's market labor force participation. These forcing variables must be shown to determine investments in schooling and ultimately differential investments in the schooling of men and women.

Table 3

Linear Probability Estimates of Wife's Labor Force Participation[a]

Explanatory Variables	White		Black	
	35-44	45-54	35-44	45-54
Wife's Market Wage[b]	.111	.168	.107	.100
	(4.01)	(6.31)	(3.14)	(2.33)
Husband's Market Wage[b]	-.0787	-.0894	-.0390	-.0872
	(5.65)	(6.44)	(1.16)	(2.04)
Nonemployment Income	-.00226	-.00142	.00851	-.00305
	(2.69)	(3.70)	(1.95)	(1.10)
Farm Residence	-.149	-.165	-.181	-.319
	(4.28)	(4.94)	(2.77)	(4.50)
Wife's Health Disability	-.149	-.196	-.264	-.249
	(5.32)	(7.86)	(6.60)	(6.40)
Constant	.406	.383	.435	.585
	(9.49)	(8.68)	(7.93)	(9.47)
R^2	.0295	.0624	.0726	.0780
F (d.f.)	17.97	34.23	17.77	14.32
	(5,2959)	(5,2570)	(5,1135)	(5,847)
SEE	.465	.467	.481	.480
Sample Size	2965	2576	1141	853
Sample Mean of Participation	.332	.366	.462	.451

[a]T-ratios reported in parentheses beneath regression coefficients for comparative purposes but they are not unbiased. See Schultz, 1975 for comparably specified logistic estimates.

[b]Wage variables are endogenous and estimated by means of instrumental variables for participating persons: schooling, region of residence, experience, experience squared, farm residence, city size, and health disability (Schultz, 1975).

5. DETERMINANTS OF SCHOOLING OF WOMEN AND MEN

Simple specifications of the technical production function relating the inputs of the education system to the output of school services can be combined with consumer demand relationships to explain the quantity of schooling that a population demands. An explicit expression is thereby obtained for the factors that determine the equilibrium level of public educational services produced in terms of the (1) income of consumers, (2) the relative prices of school inputs to the public sector, and (3) various technological and demographic constraints that might influence the unit costs or consumer benefits of these services. This production-demand framework has been employed to explain the level and distribution of national public expenditures on education, and is used here to analyze female and male enrollment rates by schooling level (Schultz, 1985a). Public expenditures on all educational levels are expressed in constant 1970 local currency prices, and converted to U.S. dollars according to prevailing average exchange rates in 1969-71, as reported by the IMF.[6/] To summarize the output of schooling services, gross enrollment ratios at all three school levels are aggregated.[7/] Between these two measures of the financial input into the educational system per child and the quantitative output of years of schooling per child there lie several intervening links that may represent qualitative dimensions of public school expenditures per child. More specifically, the quality of schooling produced and the mix of factors used in the schools may adjust to the relative price of inputs entering the educational system and the productive values of more resource-intense years of schooling as well as more years of schooling of a given quality.

The principal input to education is that teacher salaries which represents between 75 and 95 percent of the current expenses of national educational systems. The price of teachers will, therefore, be closely

correlated with educational expenditures and, as any price, it will be responsive to unexplained variations in the current demand for school services. The relative price of teachers is, therefore, treated as an endogenous variable for the purposes of understanding the long-run determinants of the demand for educational services. The price of teachers is estimated by instrumental variables, where the instruments are ten-year lagged values of GNP per adult, urbanization, and the secondary school enrollment rate. The previous production of secondary school graduates within the country provides the pool of trained personnel who could work as teachers, and, as anticipated, the size of this pool should be inversely related to current teacher salaries (Schultz, 1985a). The expenditures and enrollments of the educational system are thus regressed against real incomes per working age adult (age 15 to 65), the endogenous relative price of teachers, urbanization as a measure of population density that is expected to reduce unit costs, and the proportion of the population of school age (age 6 to 17) an indirect measure of population growth that could raise unit costs or erode benefits to providing schooling for an exceptionally large cohort of children.

Table 4 reports the estimates of the sex specific enrollment rates and the public school expenditures per school-aged child. The sample includes all countries with over a million population in 1984 for which all of the relevant variables could be obtained after 1960. The sample contained 67 countries, mostly observed in the 1970s, while several countries provided repeated observations at five and ten year intervals.

Income, not surprisingly, explains much of the international cross sectional variation in schooling expenditures; the R^2 is .95. The income elasticity of public school expenditures is 1.35; a doubling of real incomes per adult is associated with an increase of 135 percent in real expenditures on schooling per child. An increase in the relative price of teachers

Table 4

School Enrollments of Women and Men and Expenditures: Cross Country Regressions, 1960-1980[a/]

Explanatory Variables	Log of Expected Years Enrolled[b/] Female	Male	Total	Log Public Expenditures on Education per Child Age 6 to 17 (1970 $)
GNP per Adult (log of 1970 $)	.510 (5.24)	.256 (3.98)	.351 (4.79)	1.35 (21.6)
Relative Price of Teachers to Workers (log)[c/]	-.916 (5.14)	-.690 (5.85)	-.793 (5.92)	-.156 (1.36)
Proportion of Population Urban	-.835 (2.01)	-.481 (1.75)	-.624 (1.99)	-.510 (1.91)
Proportion of Population Age 6 to 17	1.46 (1.17)	.413 (.50)	.782 (.84)	-5.38 (6.75)
Intercept	-.543 (.63)	1.29 (2.26)	.631 (.97)	-3.38 (6.10)
R^2	.572	.548	.587	.942
Mean of Dependent Variable	1.71	2.02	1.89	3.89
(standard deviation)	(.726)	(.461)	(.550)	(1.44)

a/ Instrumental variable estimates with the absolute value of the asymptotic t ratio reported in parentheses below each regression coefficient. See Schultz (1985a) for description of data, derivation of model, comparison with alternative specifications and estimation methods. Sample size is 133.

b/ The expected years enrolled is defined as six times the primary and secondary school enrollment ratios and five times the higher education enrollment ratio as reported by UNESCO. These ratios are based on six, six and five year population denominators.

c/ The relative price is endogenous and probably measured with error. It is estimated by instrumental variable methods where the instruments are GNP per adult, urban proportion of the population and the secondary school enrollment ratio, all measured ten years earlier.

decreases slightly school expenditures, but not by a statistically significant amount, whereas enrollments decline markedly, and primary school teachers are used more intensively as average classroom size increases (Schultz, 1985a). With urbanization there is a small reduction in public school expenditures and enrollments, other things being equal. Rapid population growth that increases the share of the population of school age is not associated with a decline in enrollment rates, but public outlays per student in large birth cohorts do decline as classroom size increases and teacher salaries fall.

For the purposes of understanding the factors accounting for the increasing levels of schooling obtained by women, the estimates in Table 4 document the differential effect of income and teacher prices on female and male enrollment rates. The income elasticity of female enrollment is twice as large as that for males, .51 versus .26, and female enrollments are also more responsive to prices than are male enrollments, -.92 versus -.69. Evidence in this contemporary cross section of nations suggests that rising real incomes and decreasing relative prices for school teachers have paralleled the advance of women's educational status relative to men's.

Although the enrollment rates analyzed above are collected and published in relatively standardized form, comparable figures on educational attainment for adult populations by sex and age are not available. Years of schooling completed by age and sex can be estimated from certain national Census tabulations, but these estimates depend on attributing an estimate of years of education to many special school categories, and hence may embody considerable errors. These crude estimates are nonetheless calculated for a few industrially advanced countries and shown for illustrative purposes in Table 5. The near parity in educational attainment of men and women in the United States was already noted. This may be contrasted with the lower female to male ratio of educational attainment in more recently industrialized

Table 5

Estimated Educational Levels for Men and Women in Selected High Income Countries

Country (Year of Census)	Female to Male Aggregated Years of Enrollment 1970[a]	Female to Male Years of Education, by Age (Estimated from Censuses) 25-34	35-44	45-54	Male Years of Education Age 35-44 (Censuses)
Australia (1966)	.97	.98	.96	.96	8.90
Belgium (1970)	.96	.95	.96	.95	8.77
Canada (1976)	.96	.95	.95	.97	10.28
Finland (1970)	1.07	1.04	1.05	1.02	7.32
France (1975)	1.02	1.05	1.02	.99	7.63
Greece (1961)	.87	.86	.82	.78	6.14
Ireland (1966)	.99	1.03	1.03	1.03	6.62
Italy (1971)	.90	.84	.81	.76	6.00
Japan (1970)	.94	.92	.93	.93	10.55
Netherlands (1960)	.88	.97	.95	.96	8.22
New Zealand (1981)	.95	1.01	.98	1.00	11.46
Norway (1970)	.99	.95	.92	.92	9.71
Portugal (1970)	.90	1.01	.99	.96	6.31
Spain (1970)	.90	1.00	1.02	1.01	6.28
Sweden (1970)	.98	1.01	.95	.93	7.83
Switzerland (1960)	.96	.94	.92	.92	7.20
United States(1970)	.96	.98	.98	.99	11.62
Yugoslavia (1971)	.90	.66	.60	.60	6.35

[a] UNESCO Statistical Yearbook 1984, Paris 1984. Table 3.2. Expected years of enrollment defined as six times the sum of gross enrollment rates at the primary and secondary plus five times the enrollment rates at the third level of schooling.

*Only age group 25-44 reported in New Zealand Census.

countries, such as Yugoslavia and Italy. The higher female to male educational attainment ratios for Finland, France, and Ireland remain a puzzle that is not explained by the general cross sectional pattern illustrated in Table 4. But most educational attainment estimates confirm the expected increase in female relative to male schooling levels in the last three decades. A continuation of these trends should narrow any disadvantage women have in terms of education, and will translate, over time, into a rise in the ratio of female to male wages, as more women enter and remain more permanently attached to the labor market. Historical trends in this wage ratio are summarized in Appendix Table A-1.

6. CONCLUSIONS

The household demand framework assigns importance to the parent-specific time requirements of having (and enjoying) children and the distinct price effects of the opportunity value of women's and men's time in market and nonmarket production. The framework implies that if child care duties can be transferred to the market without loss of parental satisfaction, then the link between the opportunity value of the parents' time and the shadow price of children would be partially broken. The family may use increasingly the market for specialized preschool child care and extended adolescent schooling. But this development is not likely to prevent the opportunity cost of children from continuing to rise, though it may dampen the rate of increase. Fertility may not, therefore, rebound substantially and permanently from its current trough, though it may become less sensitive to women's wages for reasons indicated below. Intermittent periods of fertility increase, however, can be expected, as the timing of fertility becomes subject to perfected methods of control. Moreover, below replacement fertility could be a viable long run national strategy, so long as there is excess demand for immigration into high income countries, and assimilation of immigrants can be accomplished without

unacceptable social strains.

The household demand framework predicts that in traditional nuclear families, in which the wife specializes in nonmarket production activities, increases in the market wage opportunities for women relative to men will lead to downward pressure on desired fertility. But households will also attempt to substitute the male's time for the female's in some child care activities, and transfer some of these child care duties and schooling functions to lower cost providers in the market. Thus, there are two forms of household adjustment that should diminish over time the sensitivity of fertility to the upward trend in women's wages. The reallocation of women's time from nonmarket to market work is clearly proceeding apace in virtually all high income countries. It is more difficult to document, but probably also the case, that men have taken on a moderately increased share of child care activities from women, if for no other reason than that much home child care is being transferred to the marketplace. Women's gains in education relative to men are also evident in many countries and must be a factor in the growth of women's wages relative to men's. With the increased participation of women in the market labor force, women have accumulated the market experience and begun to narrow their occupational separation from men, and this development should continue to narrow relative wage differences in the remainder of this century.

Cross sectional differences in U.S. fertility and labor force participation confirm some of these patterns in industrially advanced high income countries. Many questions, however, remain unanswered and most data on economic and demographic characteristics of these populations remain unanalyzed for what answers they would yield. A linear reduced-form fertility equation was fit to 1967 data from the U.S. Survey of Economic Opportunities for white and black married couples. Estimated coefficients on the wife's predicted wage are consistently more negative than the coefficient on the

husband's predicted wage. These estimates were shown to be consistent with the hypotheses that children are both generally time intensive and in particular female time intensive.[8/] The wife's labor force participation equation was also estimated from the same data, to illustrate the strength of market opportunity wage effects on labor force behavior. There was no evidence that nonemployment income or physical wealth increased fertility among U.S. couples circa 1967. Nonhuman wealth may influence the timing of fertility, but does not appear to be an important factor in the final size of U.S. families. A single set of cross sectional estimates of the fertility relationship such as these is only the start of the research required to confirm the usefulness of the household demand framework for interpreting fertility trends. The difference between the estimated coefficients on female and male predicted wages must now be shown to diminish in a predictable fashion as household substitutes away from mother's time in child care. This finding would lend support to the household demand framework. The next challenge would then be to account for time series changes in fertility, and on this score the record of economic research is even more sparse.[9/]

Finally, there remains the question of what has caused the secular convergence in educational investments in women and men. Section 5 provided one straightforward explanation for this fundamental development that stressed the growth in real incomes and the decline in the relative cost of teachers as affecting the level and composition of public and private expenditures on schooling. There is undoubtedly more to this trend than increasing income and lowering relative prices of schooling. Aversion to inequality within the family may increase with personal wealth, leading parents and society to demand schooling for girls and boys on a more equal basis. Certainly the increased expectation of life, the decreased share of that life needed to bear and rear children, and the capacity of household durables to reduce the time

requirements of housework, have all contributed to providing women with stronger economic incentives to invest in their market-specific training. Another source of this trend might be the change in the character of skills demanded by the modern industrial and service economy. For example, greater male than female stature may have commanded a larger wage premium in the labor market in the past than it does today, while skills in which females may have a comparative advantage are of increasing value today. But I would be cautious in assigning much weight to predisposing biological factors. Particular changes in the composition of U.S. aggregate output in this century have been implicated in the increased derived demand for educated women workers, but these connections from the composition of output to women's schooling and market labor force participation are as yet fragmentary and need to be placed on a firmer analytical foundation and tested against data from a variety of countries (Fuchs, 1968; Goldin, 1983; Schultz, 1985b; Smith and Ward, 1985). Tracking down the economic origin of the advance in women's schooling and market productivity relative to that of men should help in forecasting fertility trends. Nonetheless, it should come as no surprise that the family is an adaptable unit. The increasing value of women's time relative to men's is a relatively new development and is certain to motivate many individual and institutional accommodations; undoubtedly parent roles and household technology will adapt and new opportunities for specialization in child care between the family and market will be found. If the secular downturn in fertility in high income countries halts, or possibly reverses, it will probably be due to these largely uncharted possibilities of factor and sectoral substitution within the family, and not due to a reversal in the trends toward greater similarity in labor market participation and wage rates for women and men.

Table A-1

Wages or Earning of Female Workers Relative to Male Workers
in High Income Market Economies: Nonagriculture or Manufacturing

Year	United States	France		Germany	United Kingdom
	Year Round, Full Time, Annual Earnings of Nonagricultural Workers	Unskilled Worker Hourly (1 year)	Full Time Nonagriculture Annual Earnings	Industry Hourly	Full-Time Manual Workers Hourly
	(1)	(2)	(3)	(4)	(5)
1920		.51			(.47)
1925		.57			(.47)
1930		.59		.58[a]	(.47)
1935	-	.59		.62[a]	.47
1938-40	.58			.57[a]	
1945-47	-	.86	-	.60	.60
1950	-	.88	.65	.64	.61
1955	.64*	.89	.65	.60	.60
1960	.61	.85*	.64	.65*	.60
1965	.60	.83	.64	.68	.59
1970	.59	.87	.67	.69	.59
1975	.59	.87	.68	.72	.67
1980	.60	.87	-	.72	.70
1982	.62	.89	-	.73*	.68*

*New Series, not necessarily continuous. See sources.

Sources:

Col. (1) J. O'Neill (1985: Table 1, S94) in Layard and Mincer (1985). Current Population Survey after 1955, and dicennial census for 1939.

Col (2-3) M. Riboud (1985: Table 11, p. S199; Table 3, p. 184) in Layard and Mincer (1985). Nonagricultural hourly wage after 1965 from ILO Yearbooks of Labour Statistics.

Col (4) 1960-1980 from W. Franz (1985: Table 7, S226 in Layard and Mincer (1985). Similar to nonagricultural and manufacturing earnings per hour series in ILO Yearbooks of Labour Statistics reported before 1960.

Col (5) H. Joshi, et al. (1985: Table 6, p. S158) in Layard and Mincer. Assumed constant before 1938. Similar to ILO series for manufacturing

Table A-1 continued

Year	Australia Full Time Weekly Earnings Nonmanagerial Private Sector (6)	Sweden Manufacturing Hourly (7)	Italy Hourly (8)	Netherlands Manufacturing Hourly (9)	Japan Hourly Earnings (10)
1920					
1925					
1930		.58			
1935	-	.60	-		
1938-1940	.51	.58		.56	.34
1945-1947	.62	.69		.63	.45
1950	.67	.71		.62	.44
1955	.68	.69	-	.59	.55
1960	.72	.72	.73	.62	.46*
1965	.58*	.75	.74	.67	.52
1970	.59	.80	.74	.74	.54
1975	.76	.85	.80	.75	.56
1980	.75	.90	.83	.75	.55
1982		.90			

Sources continued:

Col (6) R.G. Gregory et al. (1985), Table 4, Col. 2, p. S300) in Layard and Mincer (1985). Manufacturing wage ratio from ILO lower at .79 after 1975. Before 1965 reported nonagricultural hourly wage rate from ILO. Unclear whether earlier series refers to minimum wages or averages by sex.

Col (7) ILO Yearbooks of Labour Statistics

Col (8) U. Colombins and B. De Stavola (1985: Table 4, p. S279) in Layard and Mincer (1985)

Col (9) ILO Yearbook of Labour Statistics

Col (10) 1960-1980 from H. Shimada and Y. Higuchi (1985: Table 5, P. S361) in Layard and Mincer (1985). ILO manufacturing series 1938-1960 show little trend around .45 in postwar period.

Table A-1 continued

	Norway Manufacturing Hourly (11)	Finland Manufacturing Hourly (12)	Denmark Manufacturing Hourly (13)	Belgium Manufacturing Hourly (14)	Ireland Manufacturing Hourly (15)	Switzerland Manufacturing Hourly (16)	Greece Manufacturing Hourly (Accident Insurance) (17)
1920							
1925							
1930			.60[a]			.57[a]	
1935	-	-	.61[a]		-	.58[a]	
1938-1940	.60	.56	.59[a]		.54	.59[a]	
1945-1948	.63	.65			.56	.67	
1950	.65	.65	-	-	.57	.68	
1955	.67	.68	.65*	.57	.56	.65	
1960	.67	.66	.67	.57	.58	.63	.65
1965	.72	.68	.72	.62	.57	.63	.62
1970	.75	.70	.74	(.69)	.56	.63	.68
1975	.78	.73	.84	.71	.60	.68	.70
1980	.82	.75	.86	.70	.69	.68	.73
1982	.83	.77	.85	.73	.69	.68	.73

( ): approximate date or less reliable estimate

- beginning or end of series

a/average of skilled and unskilled for males compared with one average wage series for females

Sources:
Col (11-17) ILO, Yearbooks on Labour Statistics, 1937-38 to 1983.

FOOTNOTES

1/An aggregate counterpart to the increasing real value of time is the increasing share of national income received by labor. Kuznets (1959), the architect and analyst of national income statistics, has assembled the evidence from many countries to show the tendency for labor's share of national income to increase with industrialization and modern economic growth. This pattern can be "explained" by functional specification of the aggregate production function (Solow, 1958), or in terms of the changing composition of output that favors with development the expansion of labor intensive sectors, such as services, at the expense of capital intensive sectors (Johnson, 1954), or in terms of increases in the relative share of human capital in the national stock of capital (T.W. Schultz, 1961).

2/What descriptive evidence one gleans from these studies of expenditures on children suggests that outlays per child in the United States have risen rapidly in recent years as fertility has declined. But they do not clarify the extent to which parents have managed to substitute child rearing from the family to the market. Reed and McIntosh (1972) report the direct expenditures per child in 1969 dollars are estimated at $29,000 to $39,000 for urban families with low and moderate income levels. The opportunity cost of the mother's reduced time in the labor force is estimated by Reed and McIntosh as $20,000 for the first child and between $4,000 to $7,500 for subsequent children, depending on whether the children are born at two or four year intervals. The most recent calculation of direct expenditures to age 18 is by Espenshade (1984) in 1981 dollars of between $75,000 and $98,000 for low and high socioeconomic status husbands. Espenshade reports the additional cost of college education for the child at a public four year college as $15,000 and at a private four year college as $27,500 (1984, Table 5). The lack of parallel figures for the opportunity costs of the wife's time makes it difficult to even roughly compare these cost estimates over time. Has there been a substitution of market services for the wife's in the period that would have reduced the amount of time she withdrew from the labor force during her child rearing years? Has the share of income spent by parents per child

on education increased or decreased? Even simple descriptive statistics are not available on expenditures for and opportunity costs of children.

3/Almost a majority of the survey respondents report no nonearned income. Therefore, the logarithmic specification of this variable seemed inadvisable, since it then requires that one fix some arbitrary minimum value below which the variable cannot fall. The logarithmic specification with the minimum set at 1, 10 and 100 dollars per year did not yield in any race or age group a statistically significant regression coefficient for nonearned income at the five percent level. Hence, the arithmetic treatment of nonearned income is adopted here that does not require such an arbitrary choice. The wage variables were predicted in a logarithmic earnings function and are thus reasonably predicted in logarithmic form here as a function of years of schooling, completed years of postschooling experience and experience squared, functional health disability, and whether the individual resided in an SMSA of two size classes, outside of an SMSA, on a farm, or in the Southern Census region. The variables used in the wage prediction equations are described in Schultz (1975) Appendix A.

4/A similar pattern is noted by Durand (1975), where he observes female agricultural labor force participation rates vary widely across countries for no obvious reason. Much of this variation appears to be due to relatively arbitrary statistical conventions or cultural practices that lead to the enumeration or not of women as labor force participants when they work in family farming activity.

5/In the United Kingdom the proportion of women in the labor force who worked less than 30 hours per week increased from 5.2 percent in 1951 to 22.4 percent in 1981. Layard and Mincer, (1985) p. S-154.

6/GNP and public expenditures on education reported in constant local prices must be converted into common units. The conventional procedure adopted here is to use foreign exchange rates and express all monetary units in U.S. dollars as of 1970. Alternatively, purchasing power parity price deflators constructed by Summers and Heston (1984) can be employed, in which case the estimated real income elasticity of enrollments is increased by about 15 percent.

7/ See footnote b/ to Table 4 for definition of expected years of schooling enrollment rates. It is a period specific estimate of the number of years an average child could expect to be enrolled in school if current enrollment rates remained constant at today's levels. They neglect repeating and thus may not yield an approximation for the completed years of schooling reported in censuses. Data are from UNESCO Statistical Yearbook.

8/ Willis' (1974) fertility regression was estimated from the U.S. 1960 Census public-use-sample of urban white once-and-currently married women age 35 to 64. The specification estimated omitted the squared terms implied by his model, but retained the interaction between husband's predicted income at age 40 and the wife's years of education. At sample means, the elasticity of fertility with respect to husband's income is -.067, and the elasticity of fertility with respect to wife's education is -.412 (Table 3, p. 63). Converting the wife's education to a wage elasticity requires the proportionate wage effect of the wife's education. From analogous wage equations estimated for white curently married women in the 1967 SEO, this effect is about .074. Consequently, we can approximate the elasticity of fertility with respect to the wife's wage in Willis' regression as $-.53 = -.0889/(.074*2.265) = \beta/(dW/dE)(W)(C)$. The negative male income elasticity is about one-eighth the magnitude of the female wage elasticity, and both $w^* + h^* < 0$ and $w^* - h^* < 0$, confirming the general time intensity of children and the female time intensity of children, as hypothesized. Clearly, the ratio of female to male uncompensated wage effects is larger in the 1960 estimates than in the 1967 estimates, but many other features of these estimates also differ. Repeated estimates of fertility regressions are needed to confirm trends based on a common empirical specification and using both the linear and interactive approximations.

9/ Butz and Ward (1979) are virtually alone in venturing to estimate a demand equation for fertility based on aggregate U.S. time series. They regressed period fertility rates on a series for male median income and a special series representing female hourly earnings derived from a BLS occupation-specific wage series for personal services. These quasi sex-specific wage series are interacted with the wives' labor force

participation rate which is viewed as simultaneously determined with fertility. Instrumental variable estimates of the fertility equation are identified on the basis of current and one period lagged values of the wage series. A distinct rise in their occupational wage series for women relative to men's incomes after 1962 parallels the decline in fertility and the rise in the proportion of wives working. The concurrent rise in female wages and the participation of wives could be consistent with the predominance of household responses to exogenous wage developments or for that matter a change in tastes toward having a smaller family and more women working. To discount this latter possibility, women's wages must also be treated as an endogenous variable (Schultz, 1985b), which is determined in part by the past accumulation by women of market relevant experience and education, and identified by an exogenous demand factor.

In sum, any interpretation of time series must explain what factors were responsible for male wages rising more rapidly than female wages in the 1950s, if they did, and for the reverse trend developing in later years, if it did. Only then is it possible to discriminate among competing hypotheses regarding the underlying causes of fertility trends and swings about these trends. The lack of an education/experience standardized wage series for women is a serious current limitation to time series research on U.S. fertility determinants.

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