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Chapter Author: James P. Smith

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JAMES P. SMITH
The Rand Corporation

Family Labor Supply over the Life Cycle

ABSTRACT: A life cycle model is derived to explain the allocation of time of family members over the life cycle. The timing of market participation is shown to depend upon the life cycle wage pattern of men and women, the rate of interest, the rate of time preference, and age-related changes in the productivity of nonmarket uses of time. ¶ The data used to test the model are from the 1967 Survey of Economic Opportunity and the 1960 and 1970 U.S. censuses. First, actual life cycle paths of working hours of married men and women are compared to paths predicted by theory, using synthetic cohort techniques to simulate life cycle patterns because of the lack of adequate panel data. At this heuristic level, support for the life cycle approach is strong. A more rigorous test of the model is provided by regressions explaining male and female household time using all three data sources. These regressions, also, are consistent with the implications of the life cycle model: increases in wage rates induce participation in the market sector for both spouses, an additional young child at home produces greater female specialization in the household sector and male specialization in the market sector, and positive interest rates give households incentives to consume more leisure when they are older. However, some anomalies exist. The most important is that the life cycle behavioral patterns of black women more closely parallel those of white men than of white women. Some suggestions are offered to explain this

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inconsistency, but the puzzle remains unsolved. ¶ In addition to its implications for age patterns of working hours, the life cycle model also implies paths for consumption, savings, and assets over the cycle. The implied consumption and saving behavior was derived formally and empirical tests were performed using the Survey of Economic Opportunity data. In the final section, the life cycle approach, rather than the usual single-period models, was used to predict and analyze the expected labor supply effects of proposed income maintenance plans. An empirical simulation of the likely impact of these programs is also provided.

INTRODUCTION

In the last two decades, economists have made major contributions toward our understanding of the labor supply decisions of individuals. The theoretical structure of the traditional labor-leisure choice model was generalized in a seminal article by Gary Becker (1965). His household production model permitted time to be entered in varying intensities in all the commodities produced by individuals.

Jacob Mincer (1962) argued persuasively that an individual's decision about the amount of hours to exchange for market dollars is often made in a family context, a view he pioneered. Hence, the hours of work of any family member depend not only on his wage and other variables specific to him, but also on similar variables of other members and on those variables common to the family unit. The household production model provides a useful theoretical framework for the analysis of family labor supply issues. In this model, the family is viewed as if it were a small firm producing its ultimate wants within the household. In order to satisfy these wants, the family (firm) combines purchased market goods and services with the time of various family members. This approach differs from the traditional treatment of the labor-leisure choice decision since the price of *any* activity now has two components—the goods price and the time price of each family member. The relative empirical importance of the two components depends, of course, on their respective shares in the cost of producing an activity.

It has been demonstrated in a number of statistical studies that many empirical regularities are consistent with an economic explanation of the allocation of time.[1] Yet, it has also been apparent that serious deficiencies remain in the theory. In the one-period framework in which the model is placed, the variables that determine the levels of market participation are long-run or permanent measures of wage rates and wealth. Since the reference period represents a full life span, the model is best suited to predicting average lifetime participation rates. However, individuals are also confronted with temporal variations in wage rates and other variables that could elicit timing responses about the long-run levels of participation desired. A complete model of labor supply should incorporate the impact of this variation on the timing of market responses. In a recent book, Ghez and Becker (1975) extended Becker's original one-period model to a lifetime context, and thus they were able to place in sharp focus the previously neglected influence of cyclical, seasonal, and life cycle movements in wage rates and other variables. In this paper, I build on their work by treating explicitly the family context in which these decisions are made. In the process I investigate two related issues: (1) how each family member's available lifetime stock of time is distributed over time between market and nonmarket activities and (2) the potential within each family unit for substituting the time of one member for that of another.

THE LIFE CYCLE MODEL

In deciding on the number of hours each member should supply, the family is actually confronted with two problems. Given the long-run or permanent values of family wealth and the wages of the individual members, the family determines the lifetime levels of market time of each of its members. In addition, since the family is faced with temporal variations in wages and other variables, a decision must be made concerning the optimal timing of hours of the individual members. At any moment in time, let the family combine market goods and time in such a way that the cost of obtaining the desired bundle of commodities is minimized. But the consuming unit also must allocate its consumption over time in a manner consistent with its taste for commodities in the future and the expected prices of the future commodities relative to present prices. Combining this intertemporal utility maximization problem with that of the least-cost combination of inputs of time and goods to use in each period yields some interesting and testable predictions concerning individual members' allocation of time to market activities over time.[2]

Assume for simplicity that the intertemporal utility function of a family that has a horizon of n periods (equal to its life span) is of the CES (constant elasticity of substitution) variety; so it can be written

$$(1) \quad U = \left(\int_0^n Z_t^{(\sigma_c - 1)/\sigma_c} e^{-\alpha t} dt \right)^{\sigma_c/(\sigma_c - 1)}$$

where U is family utility, Z_t represents the level of consumption of "commodities" in period t, α is the time preference parameter, and σ_c is the intertemporal elasticity of substitution in consumption. The Z's are produced within the household by employing as resources both purchased market goods (X_t) and the time inputs of the husband (M_t) and wife (F_t)

$$(2) \quad Z_t = B_t f(X_t, M_t, F_t)$$

where f is homogeneous of degree one, and B_t is a technical parameter that permits the efficiency of production to vary with age. The family is faced with both time and money constraints that can be written (using the price of market goods as numeraire) as

(3a) $M_t + N_{mt} = F_t + N_{ft} = T; \quad t = 1, 2, \ldots, n$

(3b) $\int_0^n X_t e^{-rt} dt = \int_0^n (W_{mt} N_{mt} + W_{ft} N_{ft}) e^{-rt} dt + A_0$

The time constraint (3a) indicates that the total amount of time (T, which is given) available to each family member in every period is absorbed either in the household production process (home time) or in hours at work (N_{mt} and N_{ft}). Equation 3b states that the discounted value of money expenditures on goods is equal to the discounted market earnings (with W representing the market wage) of the husband and wife and of initial property wealth (A_0). The two constraints combine easily into one, as follows:

(4) $R = \int_0^n \pi_t Z_t e^{-rt} dt$

where

$$R = T \int_0^n (W_{mt} + W_{ft}) e^{-rt} dt + A_0$$

is Becker's "full wealth" concept, and

$$\pi_t = (X_t + w_{mt} M_t + w_{ft} F_t)/Z_t$$

is the average or unit cost of production of Z_t. When π_t is minimized, it is independent of Z_t, and therefore is the marginal cost or shadow price of Z_t.

Equations 1, 2, and 4 constitute the complete structure of the model. It is assumed that the family desires to maximize lifetime utility (equation 1) subject to the production function (equation 2) and the wealth constraint (equation 4). This problem is easily solved with a two-stage optimization procedure. First, maximize utility (1) subject to the budget restraint (4), with prices (π_t) taken as given, to obtain the demand function (or consumption function) for the basic commodity at each age (t), as follows:

(5) $Z_t = R P^{\sigma_c - 1} \pi_t^{-\sigma_c} \{\exp[\sigma_c (r - \alpha) t]\}$

where P is the lifetime "price index" of the basic commodity.

Solving for the percent change in consumption from one period to the next, we have

(6) $\dfrac{dZ_t}{Z_t} = -\sigma_c \dfrac{d\pi_t}{\pi_t} + \sigma_c (r - \alpha)$

where α is an index of family time preference, and $\alpha > 0$ indicates preference for the present; $\alpha < 0$, the future; and $\alpha = 0$, neutral time preference.

Note that the full-wealth term (R/P) drops out when we consider changes in the levels of consumption over time. If individuals do not have unbiased expectations about future earnings, then the level of full wealth does not change. Therefore, with these assumptions, an individual's full wealth will not affect the change in consumption from one period to the next.

The second step in maximizing lifetime utility involves minimizing the price (π_t) at each age t. At cost minimization, the following holds for the inputs of the husband and wife, where σ_{ij} is the Allen (1967, pp. 503-508) partial elasticity of substitution between inputs i and j, and S measures the cost share of an input in the household production process:

$$(7) \quad \frac{dM_t}{M_t} = \frac{dZ_t}{Z_t} - (S_f\sigma_{MF} + S_X\sigma_{MX})\frac{dw_{mt}}{w_{mt}} + S_f\sigma_{MF}\frac{dw_{ft}}{w_{ft}} - \frac{dB_t}{B_t}$$

Substituting (6) and (7) and expressing the changes in commodity prices in terms of input prices, we have the respective demand equations for husbands' and wives' home time:

$$(8) \quad \frac{dM_t}{M_t} = -(S_M\sigma_c + S_f\sigma_{MF} + S_X\sigma_{MX})\frac{dw_{mt}}{w_{mt}} + S_f(\sigma_{MF} - \sigma_c)\frac{dw_{ft}}{w_{ft}} + \sigma_c(r - \alpha) + (\sigma_c - 1)\frac{dB_t}{B_t}$$

$$(9) \quad \frac{dF_t}{F_t} = -(S_f\sigma_c + S_M\sigma_{MF} + S_f\sigma_{FX})\frac{dw_{ft}}{w_{ft}} + S_m(\sigma_{MF} - \sigma_c)\frac{dw_{mt}}{w_{mt}} + \sigma_c(r - \alpha) + (\sigma_c - 1)\frac{dB_t}{B_t}$$

Equations 8 and 9 indicate that the hours of work of each family member, given the parameters of the utility and production function, are determined by variations in the price of time of both members, the rate of interest, time preference,[3] and any changes in the technology of household production in the course of the aging process.

To illustrate: as the real wage of the wife increases over the life cycle, the amount of her time spent in the household will decline for two reasons: (1) Because the price of one of the inputs is rising, the relative price of future commodities also rises. The resulting decline in future consumption will, on this "scale" effect, reduce the demand for her home time. The magnitude of this effect (represented by $S_f\sigma_c$) depends on the possibilities for intertemporal substitution (i.e., the larger σ_c, the more elastic is the demand curve for commodities) and the share of the wife's time in total costs. (2) Substitutions can also be made within the production process. As w_{ft} increases, the other two inputs will be substituted for the wife's time. This effect $(S_M\sigma_{MF} + S_X\sigma_{FX})$ will also lead to a decline in the use of her time as her real wage rises.[4] It follows that in periods when the real wage of the wife is high, the prediction of the model, ceteris paribus, will be that her hours of market work will also be high. Note that in contrast to the traditional one-period labor-leisure choice, the sign of this effect is unambiguous. Since full wealth is fixed in this analysis, there are no income effects. It is, of course, the presence of income effects in the static theory that leads to a negatively sloped supply curve of hours.

As the real wage of the husband varies over his lifetime, the effect on hours worked by his wife is again determined by the two avenues of substitution. Increases in the price of his time will also raise the prices of future commodities and induce a fall in the use of all inputs, including his wife's time. However, in the production process, the relative price of her time will be declining; hence, F_t per unit of output will increase if the two time inputs are substitutes ($\sigma_{MF} > 0$). Thus, the relationship between the behavior of hours of work of the wife and the husband's wage is ambiguous. If commodity substitution swamps substitution in production ($\sigma_c > \sigma_{MF}$) her market hours will increase as her husband's real wage rises. The roles of a positive interest rate and the degree of time preference are the standard Fisherian ones. A positive interest rate (by lowering discounted prices) and time preference for the future will increase future consumption and decrease hours of work of all family members. The interpretation of the term dB_t/B_t is an interesting one. Since this technical change is of the Hicks-neutral variety, a 1 percent improvement in efficiency will lower future prices by 1 percent and increase the amount consumed in the future. The effect on the use of inputs is ambiguous because input requirements per unit of output have also declined by 1 percent. Whether time at home increases with an improvement in the efficiency of home time depends on whether the elasticity of demand for commodities is greater than 1 ($\sigma_c - 1 > 0$).

LIFE CYCLE PATTERNS

Because the available data on the actual age patterns of market work for married men and women were limited in their detail and quality, I constructed a new set of profiles from a subsample of the 1967 Survey of Economic Opportunity (SEO). These age profiles turned out to be quite fascinating and illustrate, in a way not possible with multivariate regression tecnniques, the richness of the life cycle approach.

The subsample consisted of those black and white families with both spouses present. It was further restricted to nonfarm families in which the husband's age was between 18 and 65 inclusive. The husbands were required to have worked at least one week in 1966. At each husband's age, arithmetic means of the labor supply and wage variables were calculated. To smooth the data, three-year moving averages of the means were taken. In order to observe racial and educational differences, the total sample was stratified by race and by the level of education of the husband. The education groups were elementary (grades 1-8), high school (grades 9-12), and college (grades 13 or higher). The SEO sample is described in more detail in Appendix B.

Since these profiles are derived from cross-sectional data, we are not, as we move along any profile, following a single cohort through its life cycle experience. Each observation represents a separate cohort at one point in its life cycle path. The entire profile captures not only movements along life cycle paths but across profiles of different cohorts as well. If the between-cohort effects are important, these profiles must be adjusted in order to have a "pure" life cycle profile. The large secular increases in labor force participation rates for married women suggest that, for this group at least, the across-cohort changes are not negligible.[5] Since these rates have increased over time, an adjusted profile for those of cohort age 19 in 1967 would be above the profiles presented here. This qualification should be kept in mind in the discussion that follows. The problems associated with cohort effects are discussed below.

In Table 1, I list the average lifetime market participation levels of married men and women in different education and racial groups. Not surprisingly, market participation of married white women is well below that of married white men. This difference is reflected in all measures of market work. In an average year, over 40 percent of white women specialize exclusively in activities in the nonmarket sector. Those women who are participants work fewer weeks in any year than men and fewer hours in any week. The spread in male-female market productivity, as measured by hourly wage rates of \$3.44 and \$2.16, no doubt accounts for much of the gap in market hours per year. After the schooling period, annual market hours of whites quite clearly increase with level of education. The rise in annual hours takes place in both measures of labor supply—weeks worked and hours worked per week—a phenomenon readily explained in the one-period model by the rise in the level of male market wages as level of education rises. Within every education class, men spend approximately four times as many hours in the market sector as do women. Relative to their wives, men's lifetime market participation and hourly wage both increase with level of education.

The lifetime levels of market participation of men are lower, in all dimensions, for blacks than for whites. These lower levels are paralleled by the smaller hourly return of market activity to black men. In fact, the intrafamily wage structure differs by race. Compared to whites, relative male-female wages of black families are lower, offering market incentives to the latter to devote fewer hours of the wife's time to home work. Compared to white

TABLE 1 Average Lifetime Market Participation of Married Men and Women, Ages 19-64, by Race and Education

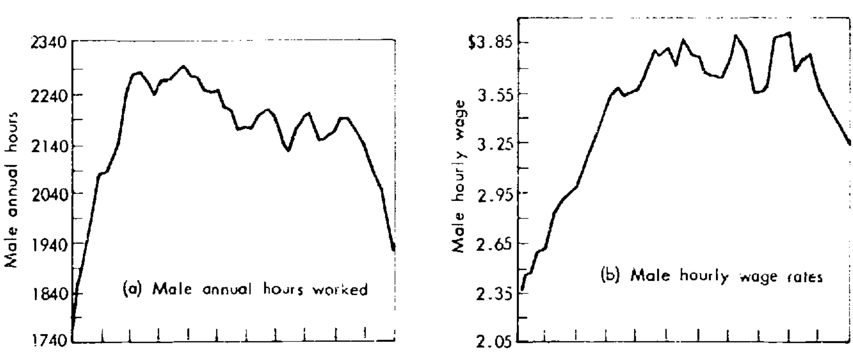
Group	Annual Hours[a]	Weekly Hours[a]	Weeks Worked[a]	Labor Force Participation Rates		Annual Hours Worked[b]	Hourly Wage Rate
				Yearly	Weekly		
White men	2,147.5	43.84	48.82	NA	NA	2,147.5	3.44
White women	1,486.0	34.46	36.58	.52	.35	563.4	2.16
Black men	1,963.7	40.69	47.71	NA	NA	1,963.7	2.37
Black women	1,385.6	33.58	35.36	.65	.52	662.6	1.68
Elementary							
White men	2,039.1	42.43	48.04	NA	NA	2,039.1	2.64
White women	1,515.4	35.91	35.33	.48	.31	511.5	1.77
High school							
White men	2,171.6	44.15	49.06	NA	NA	2,171.6	3.24
White women	1,496.2	34.62	37.14	.53	.37	594.0	2.10
College							
White men	2,189.2	44.26	49.33	NA	NA	2,189.2	4.44
White women	1,434.5	33.71	35.82	.49	.33	505.6	2.53

NA = not available.
SOURCE: Smith (1972). These are life cycle means for 1966.
[a]Averaged over labor market members only.
[b]Averaged for all individuals.

women, black women indeed perform more market work, both absolutely and relative to their husbands. Racial comparisons for women must be made carefully, for the magnitude of the differences by race depends critically on the measure of labor supply used. In many studies of female labor supply, weekly labor force participation rates are used to compare racial groups. These rates are 50 percent higher for black women, but that figure grossly overstates the true racial differences. The fraction of white women in the labor force is smaller than the fraction of black women, but white women in the labor force work more hours per year than black women. Therefore, when measures of working time include zero values for nonworkers, black women work about 100 hours a year more (almost 20 percent more hours) than white women.

More intriguing than the levels are the fluctuations between different stages of the life cycle. Life cycle variations in market work of married white men are illustrated in Figure 1a. The inverted **U** shape in the overall pattern of annual working hours conforms quite well to implications derived from the life cycle model.[6] When the age profile of wage rates is combined with a positive interest rate, both the inverted **U** shape and the age scheduling of peaks in the graphs of hours worked become intelligible. Since wages are relatively low for the younger cohorts, the latter have an incentive to concentrate their time in nonmarket pursuits. A positive interest rate is consistent with the decline in hours during the older ages and the peaking of hours before wage rates.[7] The resulting lower discounted prices of future consumption increase the derived demand for home time at older ages. A positive interest rate also implies that discounted commodity prices will decline before real wage rates and that peaks in annual working hours will lead peaks in wages.[8] Since hours peak before hourly wages, earnings will necessarily decline before hourly wage rates.[9] Wages begin to fall in the late fifties (Figure 1b), while earnings profiles are known to peak in the late forties or early fifties. Although the existing literature

FIGURE 1 Annual Market or Home Hours and Hourly Wage Rates of All White Married Men and Women



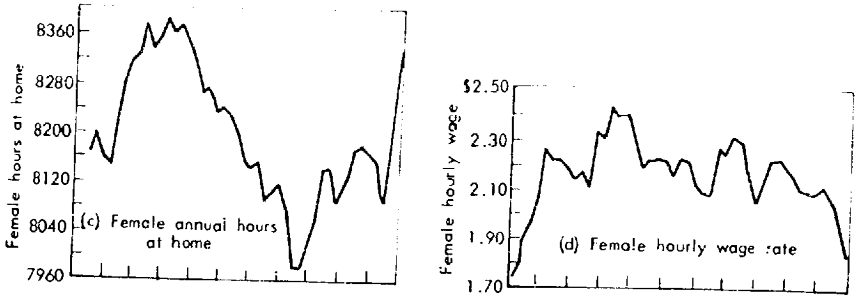
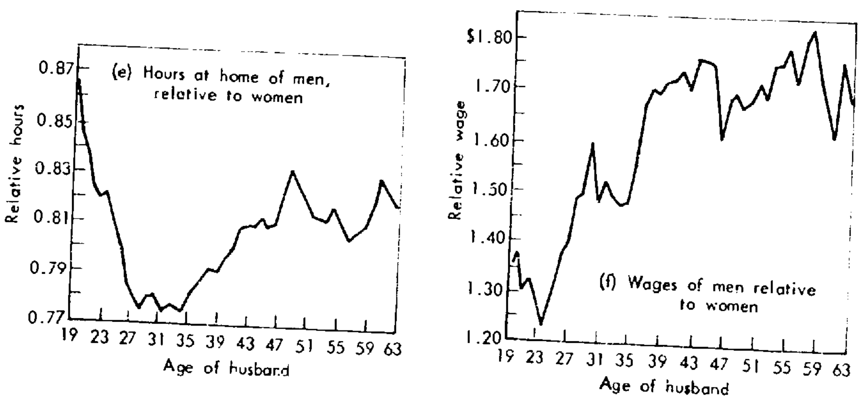


FIGURE 1 (continued)

has emphasized such factors as human physical depreciation with age, i.e., deterioration in health or disinvestments in human capital, apparently a substantial fraction of the decline in earnings for older people may be due to individuals optimally allocating their time to home activities.[10]

The profiles generated for black men add additional support to the life cycle model. Their annual hours profile (Figure 6a, below) also has the inverted U form—the expected shape in view of the age variation in their hourly wages and positive interest rates. Hours worked peak at a younger age than for whites, reflecting in our model the earlier maximum value of black hourly wages (Figure 6b). The latter observation implies that extreme values of commodity prices are reached at a younger age for black men than for whites, which in turn leads to the confirmed prediction on the earlier peaking of their market time. Both the working time and wage profiles are somewhat flatter for black men than for whites. In the life cycle model, the degree of curvature in the hours profile is directly related to the amount of curvature in the wage profile.

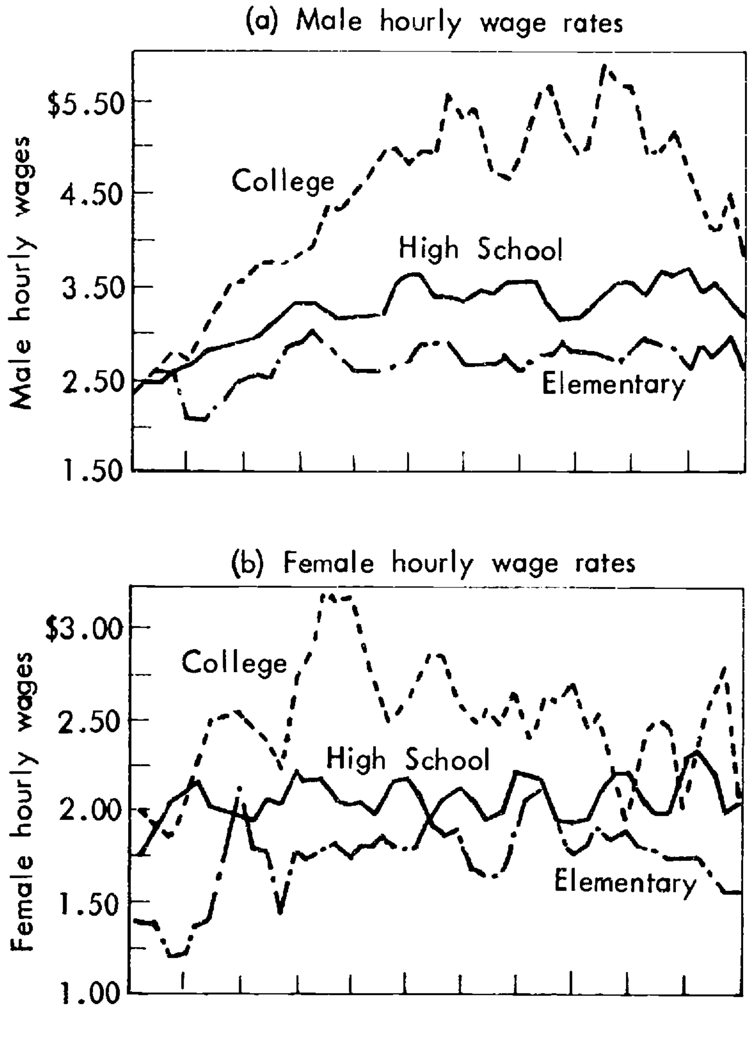
FIGURE 1 (concluded)



SOURCE: Data for all figures are from the 1967 SEO survey.

Interpretation of the differences among white men classified by education groups is difficult because of fluctuations evidently caused by the smaller cell sizes of these groups.[11] Still, the age pattern of male annual hours within each education class (Figure 2c) is on the whole similar to that of the complete white sample, although the validity of the initial period of rising hours in the elementary profile is questionable. Because the cell sizes are small, the data for the under-thirty section of the elementary profile are erratic, with the result that no clear trend can be discerned. The tendency for the annual hours pro-

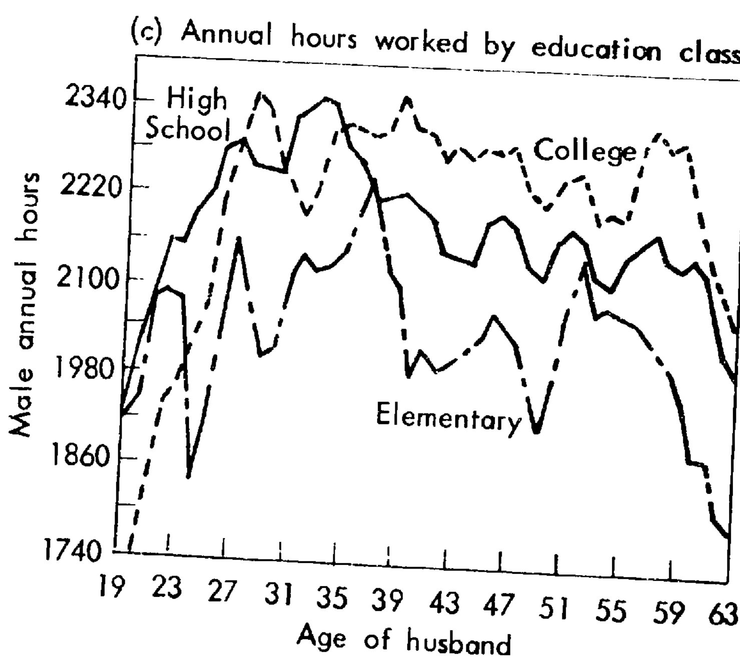
FIGURE 2 Hourly Wage Rates, All White Married Men and Women, By Educational Level of Husband



files to flatten out for the less educated groups is consistent with the flattening of the wage profiles. Because wages peak later for the more educated (Figure 2a), the empirical finding that the more educated the group, the later the age at which annual market hours peak is a further confirmation of one implication of the life cycle model.

Economists have used a number of operational definitions of women's labor supply—weeks worked, weekly or annual working hours, and weekly labor force participation rates. In recent papers, Gronau (1973), Lewis (1969), and Hanoch (1976) have argued that, from a theoretical perspective, these supply definitions should not be viewed as alternative empirical measures of an identical theoretical concept. The hours profiles of married white women are a strong empirical confirmation of the Gronau-Lewis argument. It is clear from Figure 3 that any single definition, if considered in isolation from the others, would yield a misleading description of the life cycle pattern of the labor supply of women. The best single descriptive statistic combines a measure of labor force participation with annual working hours of working wives. Average time at home (Figure 1c) at any age is defined as a weighted average of time spent at home by working and nonworking women, with the weights being the fraction of women working and not working.[12] At the beginning of the cycle, average market hours of all married white women (Figure 1c) are relatively high,

FIGURE 2 (concluded)



with a substantial fraction of women working at some time during the year (Figure 3d) but on an irregular and short-term basis, as indicated by the low number of weeks worked (Figure 3a). Then, time at home increases continuously into the middle thirties as many white women leave the labor force completely. This increase in home time is mainly a consequence of declining weekly and yearly labor force participation rates. The small increase in hours worked of working women could be either a true increase in the work year of the remaining labor force members or merely a compositional effect resulting from the withdrawal of women from the labor market whose working time had been well below the average. Following the home-time peak in the thirties, women spend an increasing amount of their time in the market sector until age fifty. This expansion in market activity appears in all four supply definitions of Figure 3. Although average market work at age fifty is almost identical to the level of the peak at age nineteen, the two peaks are quite different. At age fifty the fraction of yearly labor force participants is well below the fraction at age nineteen, but the older participants have a much longer work year. Indeed, as we proceed through the cycle, we find a dramatic tendency for women to increase the length of time they spend in the market once they commit themselves to entering it. This decline in labor force turnover among women is reflected in both the increasing levels of weeks worked and the steady decline in the absolute difference between the yearly and weekly participation rates. After age fifty, the profiles are characterized by a decline in annual market time as women once again leave the market. Those who remain continue to increase their participation within the year.

To illustrate the distinction between the cross-sectional and time series profiles for women, I have linked together the annual Current Population Survey (CPS) cross sections of labor force participation rates by age, 1947-1974, for married women living with their husbands. This allows us to follow the labor force experience of the cohorts of 1894 to 1943 for twenty-seven consecutive ages. The section of the life cycle covered obviously varies with the cohort. From Figure 4, it appears that the historical experience can be described reasonably accurately as one in which the life cycle profile of each successive cohort lies wholly above the one preceding. The principal difference between the cross-sectional and time series profiles is that the double peak characteristic of the cross section is not present in the time series. What appears in the cross section as a sharp decline in the labor force participation rates of women during the childbearing ages is actually a temporary leveling out of these rates in the time series. Following the childbearing period, both the cross-sectional and time series profiles show a sharp increase in participation rates into the midfifties, although the level of the peak is considerably higher in the time series. Finally, the decline in participation after age fifty seems to be identical in both graphs. Clearly, for the empirical work described below, some assumptions were necessary before the cross-sectional data could be employed.

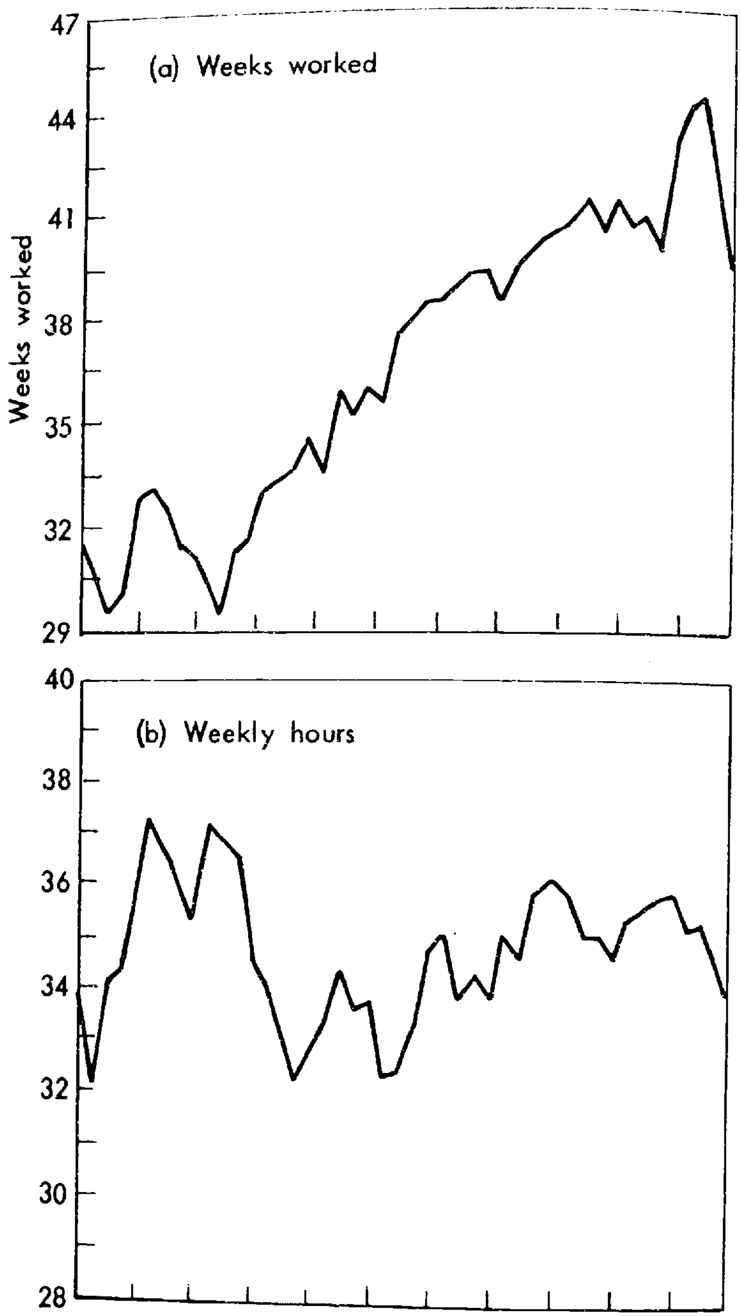


FIGURE 3 Weeks Worked, Weekly Hours, and Yearly and Weekly Participation Rates of All White Married Women

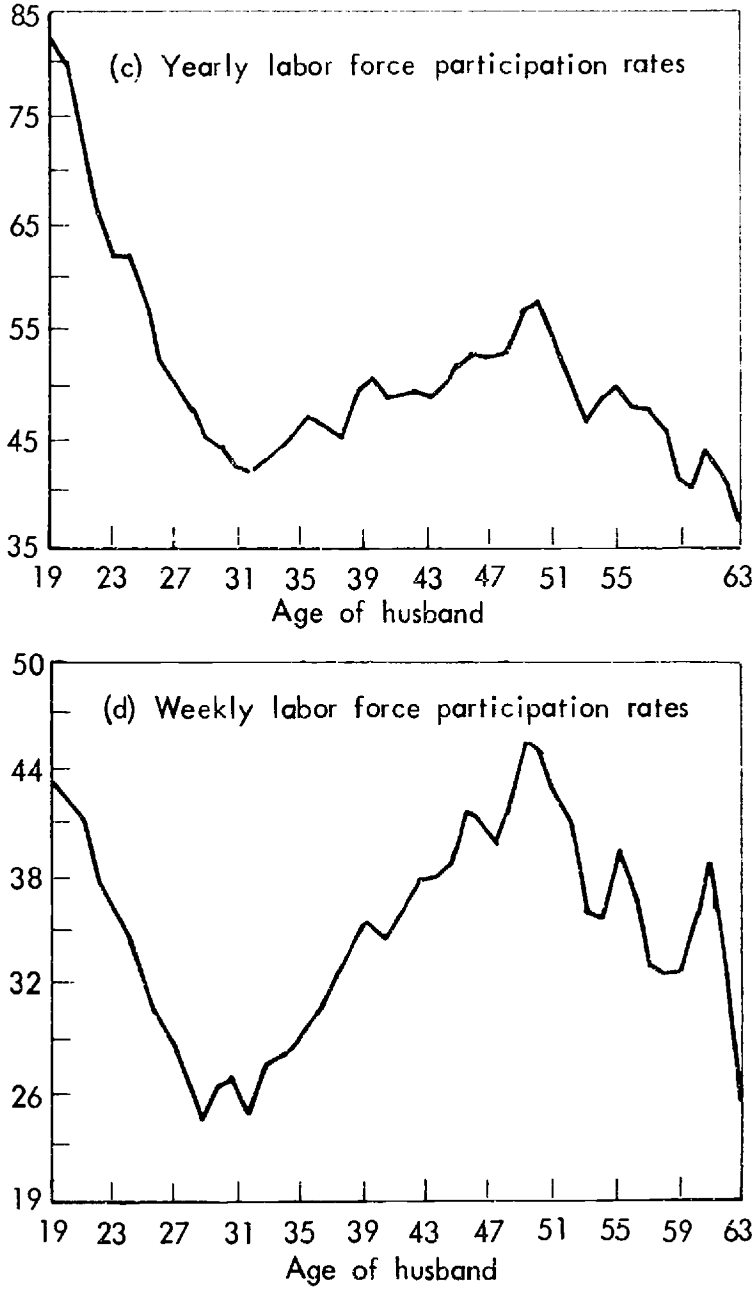


FIGURE 3 (concluded)

A sequence of events occurring during the life cycle can be postulated to explain these profiles for married women. At the youngest ages, wives are substituting their market time for their husbands' as he completes his schooling investments. The complex process of family formation with its changing demands on women's time is a major factor during the remaining stages. The values for mean number of children under seven at ages 24, 34, and 43 of the husband are 0.51, 0.91, and 0.15, while famiy size itself, defined as the number of children living at home, stabilizes around age thirty-four. The decline in market work into the midthirties is therefore paralleled by an increase in the number of preschool children. As these children grow up and begin their formal education, the wife is released from some of her home duties, and her market activity increases. The profiles after age 53 might be capturing the period when children are leaving home to attend college or to marry.

One should recognize, however, that many aspects of women's profiles are also consistent with life cycle variations in the relative wages of their husbands. Compared to their husbands, white women's hourly wages are relatively age-invariant (Figure 1d) and, also, peak at an earlier age. One prediction of human capital theory is that the greater the amount workers invest in themselves, the more rapidly their wage profiles will rise and the later the profiles will peak.[13] Women who expect to spend a smaller fraction of their future time in the market than men will have correspondingly less incentive to invest in market forms of human capital. The profile of the wage of husbands relative to wives (Figure 1f) has a concave shape, with the largest increases occurring at the youngest ages.[14] Relative to his wife, both a husband's wage and his market time are lowest at the youngest ages. The most rapid increases in his relative market time (Figure 1e) before his midthirties occur simultaneously with the sharpest increases in his relative wages. Therefore, these profiles are not in conflict with a model allowing interfamily substitution of time as the value of the time of one of the members changes. Of course, the movement in relative wages and the family formation process jointly contribute to the observed allocation of time between the two sectors.

If white wives are classified by their husbands' educational level (Figure 5), the principal differences are the following: (1) before age thirty, wives' nonmarket hours are negatively related to their husbands' educational attainment; (2) between ages thirty and fifty, women in the college group engage in home activities to a much greater extent than those in either of the other two groups; (3) after age thirty, the difference in levels between the college group and the other two is much larger than the difference between high school and elementary groups; (4) the more educated the group the later the peak level of home time occurs; and (5) the tendency for women's hours profiles, particu-

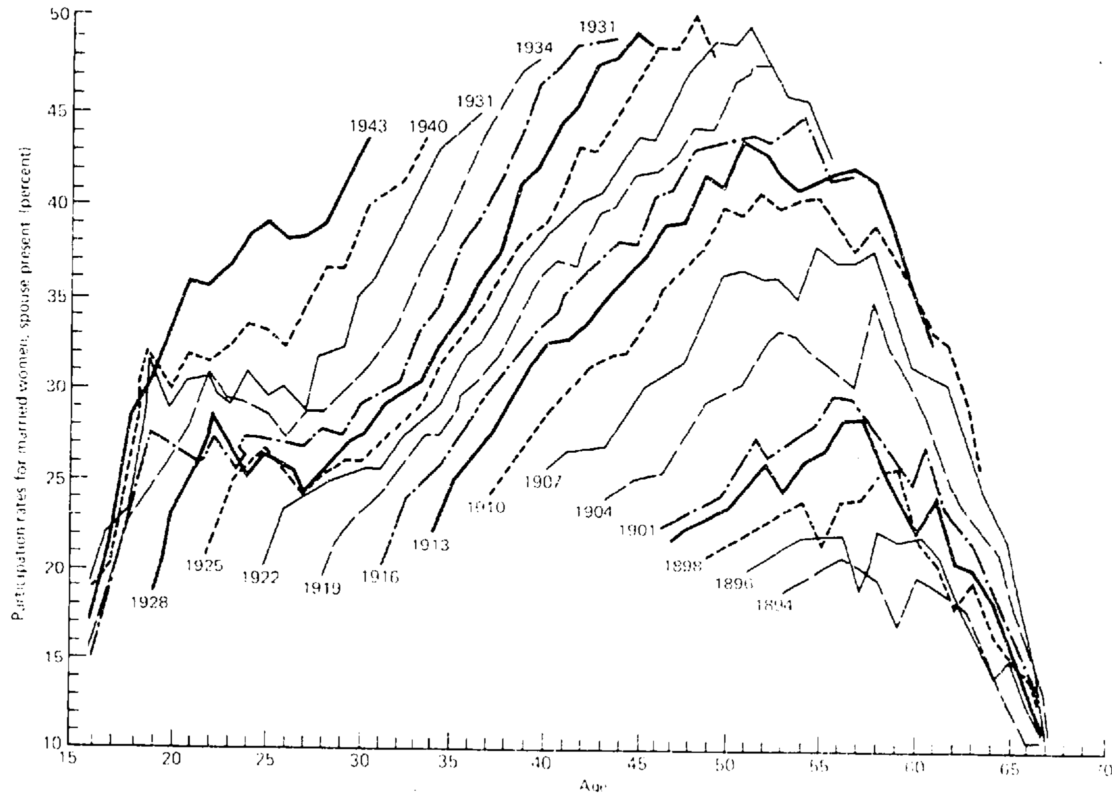
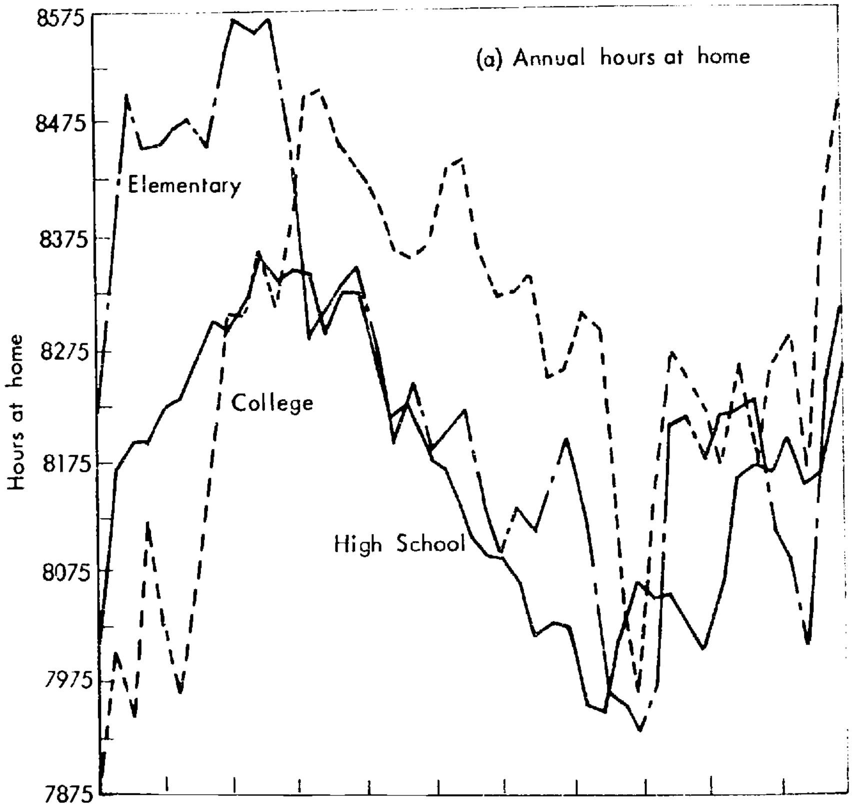


FIGURE 4 **Labor Force Participation Rates of Selected Cohorts of Married Women; Husband Present in the Household**

larly in relative terms (Figure 5b), to flatten out is greater, the lower the educational level of the husband.

All five dissimilarities are consistent with differences among education groups in age-related variations within family units in market and nonmarket productivities. The positive correlation at the youngest ages between women's market participation and husbands' educational attainment presumably results from the higher expected levels of future relative male wages of the more educated. Wives of more educated men have incentives to concentrate their market activity during the years when the husband's comparative advantage in market activities is low. The more rapid withdrawal of those women from the market sector as their husbands reach their midthirties coincides with a steeply rising relative male wage.[15] Between ages thirty and fifty, relative male wages and market hours increase with educational level, and the largest differences in

FIGURE 5 Annual Home Time of All White Married Women, by Educational Level of Husband

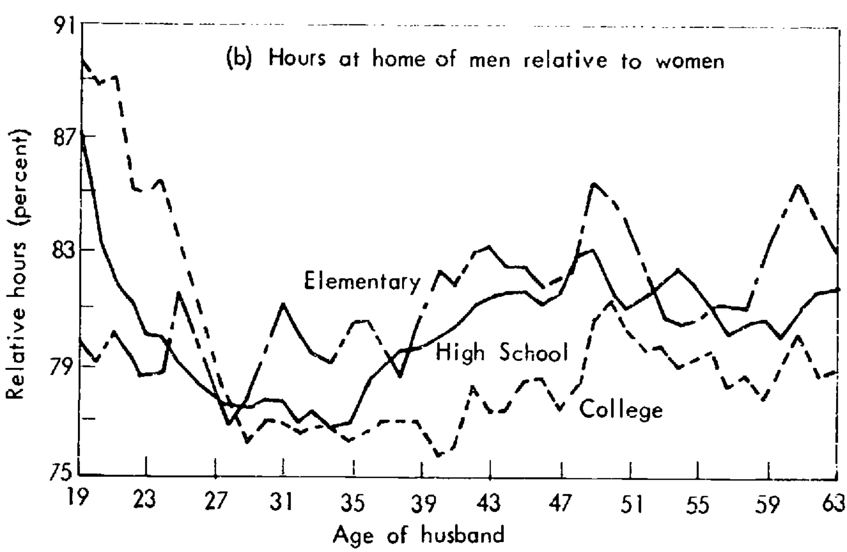


both relative hours and relative wages are between the high school and college groups. The more educated the group, the later the age at which the peak levels of both female relative home time and male relative wage are achieved.[16] Finally, as predicted by the model, corresponding to less curvature in the relative wage profiles for the less educated is the decline in the curvature of the relative hours profiles.

Note that for all whites and for every education subsample, variations in relative market productivities of spouses become less important as the family unit grows older. The profiles of relative husband-wife market time begin increasingly to mirror life cycle movements in the relative nonmarket productivities of spouses. The decline in relative male market time between ages thirty and fifty is caused by changes in female nonmarket productivity as the fraction of women with young children at home falls. After age fifty, this variation in nonmarket productivity is also less important as children leave home. The lack of variation in either relative market or nonmarket productivity is matched by a generally constant relative hours profile during this period.

The profiles for black married women (Figure 6c) are more similar to the observed profiles of black men than they are to those of white women.[17] The market hours profiles of black married men and women have an inverted **U** shape. This translates into a very erratic black husband-wife relative hours profile (Figure 6f) with no clearly discernible trend. The sharpest contrast between the hours behavior of black and white married women occurs before age

FIGURE 5 (concluded)



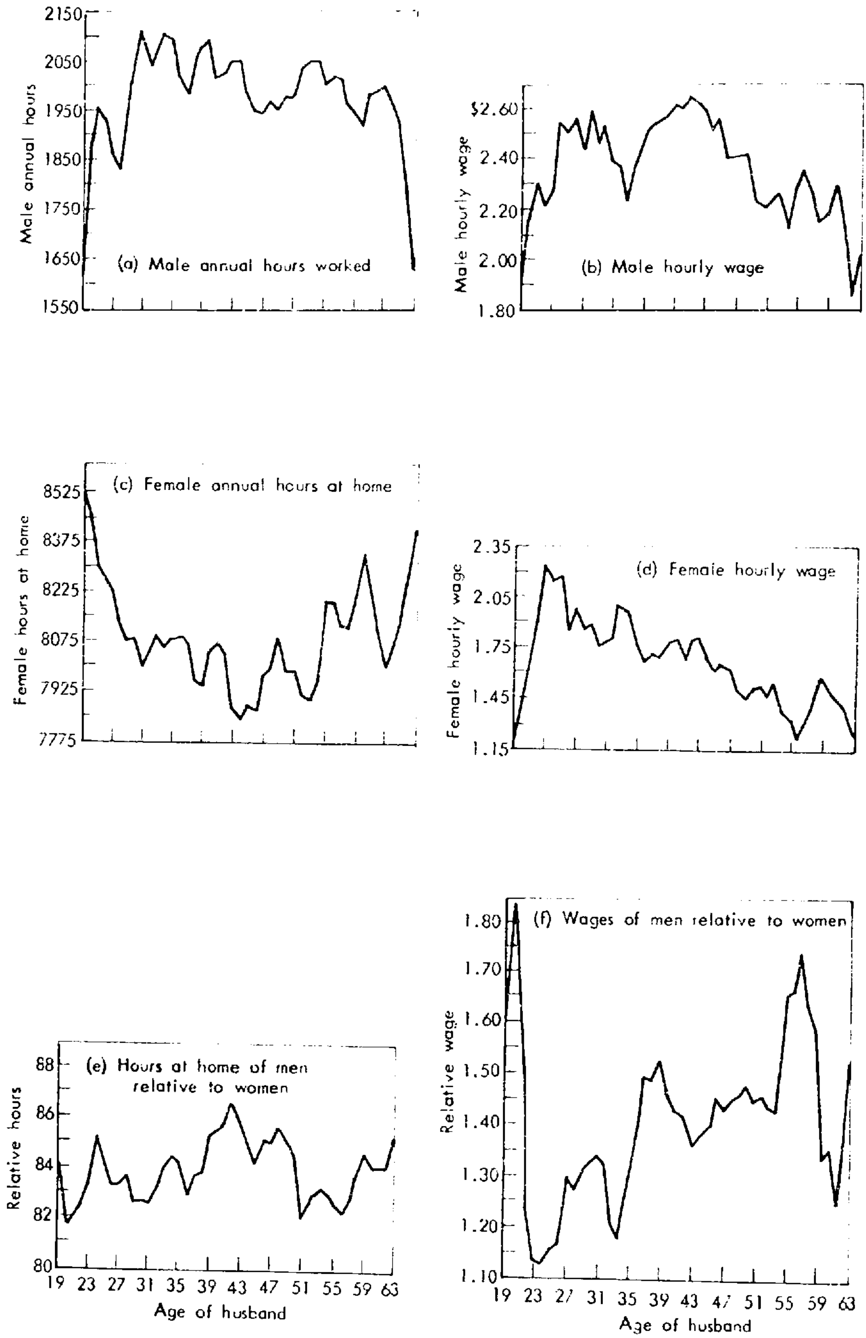


FIGURE 6 Annual Market or Home Hours and Hourly Wage Rates of All Black Married Men and Women

thirty-five. During this period, black women are specializing more in market pursuits while their white female counterparts are approaching their peak level of home participation.

A number of factors could account for this striking difference between black and white married women. The relative male-female wage structure for blacks exhibits less variation over the cycle (Figure 6f) than that of whites. This would imply that the relative hours variation for blacks should also be smaller. The patterns of child spacing and timing also offer a partial explanation for the hours behavior of black women. The latter do not generally concentrate their childbearing within a relatively short time interval. Because of this, they have less incentive to respond to the presence of young children by lowering their market participation. Another factor is the higher rates of marital instability they face. This increases the cost of complete home specialization for blacks. Finally, the black wage profiles might be dominated by secular increases in black wage levels. The observed decline in black female wages with age (Figure 6f) is surely not a life cycle phenomenon but an indication of the improving status of the younger cohorts. In the empirical sections that follow, the evidence on these hypotheses is investigated.

EMPIRICAL TESTS

Methodology

The ideal data for a test of life cycle theory would be observations on the same individuals over a number of years. Since extensive panel data covering large parts of the life cycle are lacking, the more available cross-sectional surveys were used instead to simulate the preferred data set. Fortunately, Ghez has developed techniques that, under appropriate assumptions, make cross-sectional information usable. First, the sample is stratified by the age of the husband. Mean values of all variables within each age group are calculated. In the absence of secular growth, the observed variation between these age cells will correspond to the expected life cycle variation for any cohort if its expectations are unbiased on average.[18] Using equations 8 and 9 and aggregating over all families at each age (t) of husbands, we have the following, neglecting changes in home productivity and consideration of all the familiar aggregation problems:

$$\frac{d\bar{M}_t}{\bar{M}_t} = a_1 \frac{d\bar{W}_{mt}}{\bar{W}_{mt}} + a_2 \frac{d\bar{W}_{ft}}{\bar{W}_{ft}} + a_3$$

$$\frac{dF_t}{F_t} = b_1 \frac{d\bar{W}_{ft}}{\bar{W}_{ft}} + b_2 \frac{d\bar{W}_{mt}}{\bar{W}_{mt}} + b_3$$

Upon integrating, we obtain

$$(10)\quad \log \bar{M}_t = c_0 + c_1 \log \bar{W}_{mt} + c_2 \log \bar{W}_{ft} + c_3 t$$

$$(11)\quad \log \bar{F}_t = d_0 + d_1 \log \bar{W}_{ft} + d_2 \log \bar{W}_{mt} + d_3 t$$

Equations 10 and 11 are the demand equations for male and female home time as estimated by the respondents. From the theory, we expect that c_1 and d_1 will be negative, since increasing the price of a factor induces two substitution effects, each lowering the amount of time at home. The signs of c_2 and d_2 cannot be predicted a priori because altering the wage of one spouse produces conflicting incentives for the use of time by the other. c_3 and d_3 are age coefficients and capture the interplay of interest rates and time preference. If families have neutral time preferences and face positive interest rates, c_3 and d_3 will be positive.

In this empirical strategy, it is implicitly assumed that in i years families of age j in 1967 will be in a situation identical to families of age $i + j$ in 1967. Yet we know that real wages have grown over time; consequently, younger cohorts have a higher expected real wealth. As long as real wages grow at a constant secular rate, the estimated wage coefficient will be unbiased, but the age coefficient will be a biased estimate of the interest rate effect.[19] Intuitively, we understand that if real wealth grows at a constant rate over time, wealth becomes perfectly negatively correlated with age and all wealth effects are picked up in the age variable.

The main empirical results are based on the 1967 SEO subsample described above. Although all the variables used are listed and defined in Table 2, a few deserve additional comment. Hours spent in home production is a difficult variable to measure precisely. One simple solution for husbands is to treat all nonworking hours as time spent at home, i.e., CHR1M, which is simply the difference between total number of hours per year (8,760) and the number of working hours. This method has several shortcomings, since many nonworking hours are spent neither in producing nor consuming but in investing in human capital both on the job or through formal schooling, in job search, and in poor health. Moreover, we know that the number of hours engaged in these activities varies considerably with age (i.e., investments generally occur at the youngest ages while sick days are more numerous for the elderly). To reduce the biases caused by time spent at school, regressions were run that included persons in each schooling class who were at least several years older than those typically completing that class. Thus the college sample was run over the age intervals 26-64; and the elementary sample, over ages 18-64. The SEO allowed me to obtain a measure of the time spent looking for work and a crude measure of annual hours in sickness.[20] In the second definition of male home time, CHR2M, time spent working, looking for work, and in illness were subtracted from total yearly hours.

TABLE 2 Definition of Variables in SEO Regressions

Variable Name[a]	Definition
HRS	Hours worked in SEO survey week
WKSWK	Weeks worked in 1966
WKSWK2	Weeks worked and looking for work in 1966
WKSWK3F	Weeks worked in 1966 for women who worked in 1966 and during SEO survey week
WKSWK4F	Weeks worked in 1966 for women who worked in 1966 and did not work in SEO survey week
HRYR	Annual hours worked [= (HRS)(WKSWK)]
CHR1M	Male annual home hours (= 8,760 − HRYRM)
LFPWK	Fraction of women working in SEO survey week
LFPYR	Fraction of women working in 1966
CHR1F	Female hours at home {= (1 − LFPYR) 8,760 + LFPWK (8,760 − HRYRF) + (LFPYR − LFPWK) [8,760 − (WKSWK4F) (HRSF) (WKSWK4F/WKSWK3F)]}
HEALTH	Annual hours ill
CHR2M	Male annual home hours {= 8,760 − [(WKSWK2M)(HRSM) + HEALTHM]}
CHR2F	CHR1F − (HEALTH + female time looking for work)
WKWG	Wages before deductions in SEO survey week
HRWG	Hourly wage = WKWG/HRS
WKY	Workmen's compensation for injuries (including sick pay and unemployment compensation and public welfare payments)
OADI	Social Security payments and government, private, and veterans pensions
WTHY	Interest, dividends, rent, annuities, and royalties
AGE	Age of men
KUSV	Number of children under seven years old

[a]In the regression tables, some variable names include a suffix letter M, for male, or F, for female. A prefix letter L denotes log values.

Defining home time for married women is even more difficult. It would be misleading to consider only the behavior of participating women, for this ignores completely the home specialization of nonworkers. Therefore, all women were divided into three categories: (1) women who did not work at all; (2) women who worked both in the survey week and the previous year; and (3) women who worked during the previous year but not in the survey week. Average home time for women (CHR1F) was then defined as a weighted average of the home time of women in each category, with the weights being the proportion of women in each category.[21] In the second definition of female home time (CHR2F) time working, looking for work, and in illness were excluded from home time.

TABLE 3 Male Time at Home[a]
(figures in parentheses are *t* ratios)

Dependent Variable	Independent Variables								Constant	R^2
	LHRWGM	LHRWGF	AGE	KUSV	LWKWGM	LWTHY	LWKY	LUADI		
All White, Ages 22-64										
LCHR1M	−.1040 (6.88)	.0202 (0.82)	.00014 (0.67)	−.0178 (4.60)					8.92 (52.45)	.75
LCHR1M		.0283 (1.71)	.00007 (0.49)	−0.158 (5.92)	−.1065 (11.71)				9.31 (241.6)	.88
LCHR1M	−.0667 (2.86)	−.007 (0.26)	.0004 (1.36)	−.0222 (5.45)		−.0105 (1.79)	.0103 (2.12)	−.0014 (0.45)	8.91 (281.0)	.80
LCHR2M		.0160 (0.82)	−.0006 (3.46)	−.0185 (5.83)	−.0796 (7.45)				9.19 (203.1)	.76
All Black, Ages 22-64										
LCHR1M	−.0643 (2.16)	.0455 (1.71)	.00001 (0.031)	−.0107 (1.35)					8.86 (255.6)	.22
LCHR1M		.0480 (2.21)	−.00002 (0.061)	−.0070 (1.07)	−.0937 (4.50)				9.23 (96.2)	.43
LCHR1M	−.0816 (2.50)	.0609 (2.07)	.0000 (0.01)	−.011 (1.1)		−.0043 (1.30)	.0011 (0.20)	.0047 (1.27)	8.87 (221.6)	.27
LCHR2M		.0589 (2.11)	−.0005 (1.06)	.0149 (1.75)	−.0701 (2.62)				9.12 (73.89)	.25

College White, Ages 26-64						
LCHR1M	.0454	−.00002	−.0180	−.0872	9.21	.48
	(3.29)	(0.07)	(2.81)	(5.60)	(15.8)	
LCHR2M	.0466	−.0001	−.0161	−.0805	9.17	.46
	(3.37)	(0.32)	(2.51)	(5.16)	(115.3)	
High School White, Ages 22-64						
LCHR1M	.0413	−.00008	−.0160	−.1092	9.31	.76
	(2.24)	(0.37)	(4.15)	(7.31)	(133.8)	
LCHR2M	.0546	−.0001	−.0145	−.1032	9.26	.55
	(2.20)	(0.41)	(2.81)	(5.20)	(100.1)	
Elementary School White, Ages 19-64						
LCHR1M	.0242	.0010	.0095	−.1309	9.38	.51
	(1.13)	(3.20)	(1.54)	(4.78)	(77.8)	
LCHR2M	.0025	−.0002	−.003	−.0575	9.06	.16
	(0.11)	(0.68)	(0.42)	(1.95)	(69.9)	

[a]The variables are identified in Table 2.

To reduce the effect of measurement error, three-year moving averages of all variables were calculated. Since the number of observations in an age cell varied with age, heteroscedasticity in the error term was expected. The conventional remedy was applied of weighting each observation (age cell) by its cell size.[22] Each of the variables is discussed separately because each one captures an important aspect of the life cycle process and reveals important lessons concerning the modeling of labor supply.

Behavior of the Variables

Life Cycle Wages For both the white and black male samples, the own-wage elasticity (male hourly wages) has the predicted negative sign. The persistence of this finding is encouraging, for this wage coefficient is likely to be strongly biased toward positive values. Hourly wages are computed by dividing weekly wages by hours worked in the preceding week. Thus, any positive errors present in hours will reappear as negative ones in hourly wages, introducing a spurious positive correlation between home time and hourly wage rates. Secondly, true wage rates are underestimated at the younger ages because of self-financing of on-the-job training. Time spent in job training activities is expected to decline with age; hence this source of bias will be a declining function of age. Therefore, the observed wage variation with age exceeds the true one, biasing the wage elasticities in Table 3 toward zero values. Using the male weekly wage from the survey in place of male hourly wages provides some control over the measurement error biases, since weekly wages and home time are separate questions in the SEO survey. As expected, the coefficient on the male weekly wage variable is more negative than the one for male hourly wages. The extent of the bias in the computed hourly wage should be negatively related to the average number of observations in each age cell. Apparently this was the case, for the difference in magnitude of the weekly and hourly wage coefficients was largest in the samples with the smallest cell sizes—the black and education-specific white samples. In all five samples of Table 3, the size of the male weekly wage coefficients was similar and all had the predicted negative sign.

An additional test of the error problem in variables was performed. A second weekly wage measure could be computed from the SEO data by dividing the previous year's earnings by the previous year's weeks worked. The weekly wage variable used in the text was constructed independently of the (dependent) hours variable. This is not true of the weekly wage measure just given. Hence, regressions using the latter still contain the spurious negative correlation between market time and wages. If the coefficients of the two weekly wage variables are compared, it would be expected, because of the error problem in variables, that the coefficient on the second weekly wage is less negative than the coefficients reported in the text. Also, the difference between the two wages should be negatively related to average cell size. Both propositions were supported when the second weekly wage concept was used.

I anticipated difficulty in estimating an independent effect for female wages. First, the true life cycle variation in women's wages is small compared to that of men's; so it should play a smaller role in explaining the timing of market participation of family members. Secondly, during any week, approximately 60 percent of married women are not working. Therefore, each mean female wage is based on fewer observations than the mean male wage, and on this account, the former is probably less reliable than the latter as a descriptive statistic of the true wage of *working* individuals. The third problem is that the value of time (shadow home wage) of nonworking women is not necessarily equal to the observed wage of workers. Gronau (1974) has pointed out that for population subgroups in which a large fraction is not working, the observed wage distribution represents only one section of the total wage offer distribution. The unobserved section has been rejected by job seekers as unacceptable. As Gronau also demonstrates, the observed wage may change without any alterations in the wages offered by firms, owing to what he calls a selectivity bias. For example, in years when there are young children present in the home, the implicit home wage increases and many women will leave the labor force. Indeed, it is only the women receiving the highest wage offers in the distribution who will remain in the labor force. Only part of the observed life cycle variation in female wages reflects a real change in their market opportunities. In spite of these considerations, the female own-wage effect in the female equations (Table 4) is consistent with the model. When female weekly wages are used, the coefficient is negative and significant in all but the high school sample. As expected, a less significant and smaller negative effect is obtained for female hourly wages. Thus, the negative sign of the own-wage coefficient in both the male and female regressions supports the predictions of the model. Nevertheless, because of the biases mentioned above, a little skepticism is in order for the female wage even though the estimated sign is "correct."

As long as the time inputs of spouses are sufficiently strong substitutes,[23] the sign of the cross-substitution wage term will be positive. In almost every male sample, an increase in the female wage increases the amount of male home time, although this effect is not always significant. Also, the male wage has a positive sign in the all-white, high school white, and college white regressions for female home time. The only troublesome results are the negative signs for male wages in the regressions for elementary school whites and, especially, all blacks. Some idea of the extent of substitution between inputs can be obtained if we subtract the demand equations for wives from that of husbands. If we then add the two wage coefficients, we have $S_X(\sigma_{MX} - \sigma_{FX})$. When this number is positive, market goods are a better substitute for men's time than for women's. For the total white sample, this appears to be the case. In the education-specific samples, goods are a better substitute for men's home time

TABLE 4 Female Time at Home[a]
(figures in parentheses are t ratios)

Dependent Variable	LHRWGF	LHRWGM	AGE	KUSV	LWKWGF	LWTHY	LWKY	LOADI	Constant	R^2
	Independent Variables									
All White, Ages 22-64										
LCHR1F	−.0396 (1.50)	.0444 (2.74)	.00057 (2.54)	.0359 (8.68)					8.95 (491.7)	.82
LCHR1F		.0246 (2.78)	.0007 (4.02)	.0364 (11.2)	−.0852 (4.20)				9.31 (121.3)	.88
LCHR1F		.0564 (4.37)	.0013 (6.0)	.0298 (9.39)	−.0967 (6.36)	−.0178 (3.88)	.001 (0.36)	−.001 (0.48)	9.40 (125.2)	.92
LCHR2F		.0358 (3.04)	.00001 (0.08)	.035 (9.37)	−.0856 (4.31)				9.30 (106.2)	.92
All Black, Ages 22-64										
LCHR1F	−.039 (1.27)	−.1367 (4.0)	−.0004 (0.78)	.0048 (0.53)					9.14 (229.5)	.44
LCHR1F		−.1127 (4.11)	−.0011 (2.4)	.0034 (0.46)	−.0695 (4.54)				9.40 (138.6)	.62
LCHR2F		−.096 (3.70)	−.0016 (3.70)	.0018 (0.254)					9.38 (146.2)	.61

College White, Ages 26-64						
LCHR1F	.0416	.0006	.032	−.0547	9.17	.54
	(1.36)	(1.16)	(3.60)	(2.52)	(91.9)	
LCHR2F	.0421	.0003	.0329	−.0394	9.10	.61
	(2.16)	(0.51)	(3.46)	(1.69)	(85.3)	
High School White, Ages 22-64						
LCHR1F	.0188	.00075	.038	−.0115	8.99	.84
	(1.11)	(2.96)	(8.40)	(0.68)	(120.1)	
LCHR2F	.0297	−.00007	.0335	−.0024	8.95	.88
	(1.56)	(0.25)	(6.58)	(0.12)	(106.0)	
Elementary School White, Ages 19-64						
LCHR1F	−.0407	.00057	.029	−.040	9.18	.62
	(1.24)	(1.49)	(4.12)	(2.12)	(121.4)	
LCHR2F	−.046	.0001	.0349		9.19	.74
	(1.23)	(0.26)	(4.14)		(104.9)	

[a] The variables are identified in Table 2.

than for women's only in the college and high school samples. In the all-black and elementary white samples, this relation switches and goods appear to be a better substitute for women's time than men's.

One test of consistency suggested by consumer demand theory is that the slopes of these cross-substitution terms should be equal, that is, $\partial M_t/\partial W_{ft} = \partial F_t/\partial W_{mt}$. However, in terms of both elasticities and absolute slopes, an increase in the male wage has a larger effect on female home time than an increase in the female wage on male home time. However, it is probably inappropriate to impose this restriction on consumer behavior. Much of the adjustment for women takes the form of rather large changes from no work to thirty-plus hours per week; hence, it is not surprising that $\partial F_t/\partial W_{mt} > \partial M_t/\partial W_{ft}$.

Table 3 also contains regressions for alternative definitions of home time. In addition to working time, time spent looking for work is not counted as available for home production in constructing LCHR2. Theoretically, one cannot predict the effect on home-time wage elasticity of excluding time spent looking for work. On the one hand, that elasticity evaluated at any wage will be greater (in absolute value), since mean home hours will be lower. On the other hand, the slope component of the elasticity expression ($\partial M/\partial W$) should decline. Hence, the net impact of excluding search time depends on the comparative strength of the two effects.[24] Although the results did not differ substantially from those obtained with the first definition of home time,[25] there was a tendency for the own-wage elasticity to decline for all male groups, suggesting that the slopes of the demand curve had decreased sufficiently to offset the lower number of mean home hours.[26] In the other definition of home time, LCHR2, hours spent working, looking for work, and in illness were subtracted from total yearly true annual hours. The additional exclusion of ill time generally had the effect of reducing the observed wage elasticities, with the result that any negative relation between wages and ill time was not strong enough to offset the reduction in mean home hours.

Interest Rates and Time Preferences The age variable gave the least satisfactory results. If a family faced a positive interest rate, home time of both men and women was predicted to be positively correlated with age. When home time was taken to include all nonworking hours, the only male sample in which age had a significant positive sign was the elementary one. The age variable was positive in most of the white female samples. The negative correlation between age and working time implied by the life cycle argument could be negated in cross sections if intercohort changes are important. Measured age difference captures movement both along the path of life cycle hours and across the profiles of different cohorts. The rising levels of male and female wages throughout the twentieth century will affect desired working time through the familiar substitution and wealth effects.[27] For men, the time series evidence indicated that the income effect outweighs the substitution effect. Therefore, the cohort effect conflicts with the life cycle expectation. The substantial increases in recent decades in the labor force participation rates of married women suggests that the secular effect should strengthen the negative relation of age and working time implied by the life cycle model. Another factor confounding the interpretation of age in these regressions was the strong positive correlation of sick time with age.[28] When sick time and time spent searching for work were excluded from home time (definition CHR2), the positive age effect was eliminated from the elementary male and white female samples. In fact, a significant negative sign was obtained in the all-white male and all-black female samples.

The low values of the Durbin-Watson statistics indicated that positive serial correlation existed in these regressions. Since each observation was a three-year moving average, errors tended to perpetuate themselves, and autocorrelated residuals were expected.[29] In this situation, ordinary least squares will not generate biased coefficients, but the calculated standard errors are generally too low. In evaluating the statistics, a degree of caution is in order.

The serial correlation that plagued the male regressions was present in the female ones as well. The use of three-year moving averages was not sufficient to explain all the autocorrelation. Female home time was overestimated between ages 22-28 and 45-52 and underestimated in the other age intervals. Such a long, persistent pattern of positive or negative residuals does not result from a three-year moving average but is caused by other factors related to the age ordering of the observations. Some possibilities are examined in the section below on children.

Family Size and Composition Within a family unit and across different families, the demand for home time is related to a variety of family characteristics that affect the incentives provided by the market sector. To obtain a proxy for these factors, I followed the conventional approach of economists by including as an independent variable the number of children younger than age seven (KUSV).[30] The effect of young children in reducing the market participation of women has been well documented by others. But my work shows that it is also a factor in the supply functions of white men: it has the opposite effect of increasing their working hours. One hypothesis consistent with this evidence is that children and those commodities complementary to children are less husband-time intensive than a vector of all other home-produced goods. When young children are present, the structure of household consumption is altered in favor of the former set of commodities, enabling husbands to work additional hours. Another plausible rationale is that units of time typically may be used to produce many household commodities jointly. As the wife leaves the market to care for children, her time will simultaneously be employed in other home activities as well, thus freeing some of her husband's time for market work.

In every white sample, female home time increased when young children were present. Since the absolute size of the coefficient of KUSV was greater for wives than husbands, both the percent and absolute number of female hours withdrawn from the market exceeded the percent and absolute increase in market hours of their husbands. Evaluated at mean levels, the addition to the household of one child younger than seven would lead to a net reduction of approximately $263 in family earnings.[31] The number of young children had no significant effect on the working time of black wives or husbands. Indeed, this lack of response to the presence of children was a major behavioral difference between the two racial groups. High priority should be given to a complete study of the causes of this dissimilarity. On the basis of my work here, I offer two explanations based on black-white differences in the patterns of child spacing and timing and on the higher rates of marital instability among blacks. In the tabulation below, which shows the percent of families with children younger than six, the fraction of the life cycle during which young children are present is longer for blacks than for whites:

	Age of Husband					
	19	24	29	34	39	41
White	28	68	76	64	37	29
Black	68	83	74	58	39	37

Because the childbearing period is less concentrated for blacks, there is less incentive for black women to limit their market participation to those years when young children are not present. Since the expected probability of dissolution of the marriage is higher for blacks than for whites, it is rational for each black spouse to avoid becoming too specialized in either the market or nonmarket sectors. The costs, in terms of lost job seniority and depreciation in market skills, of leaving the market sector for even a short period decrease with the expected duration of marriage. Racial differences in female hours behavior were especially evident in labor force participation rates. During the childbearing period, there was a substantial decline in the participation rates of white women, but the rates for black women remained remarkably constant for most of the life cycle, suggesting that black women were reluctant completely to leave the market sector.

Although the Survey of Economic Opportunity is the principal data source used in the analysis, the SEO estimates were checked by running similar regressions with 1960 and 1970 Census data. The SEO and Census estimates are compared in Table 5. There is a strong degree of conformity among the three samples. In particular, the Census results parallel quite closely the male and female wage coefficients estimated with the SEO data. This conformity extends to the disturbing negative male wage coefficient in the home time regression for black women. For the other variables, the Census regressions in fact are more consistent with theory. In each sex and race group in both Census years, a positive age coefficient is found. The absence of a positive effect in the SEO male equations is disturbing. The regression based on the 1970 Census reproduces the positive impact of children on the labor supply of white men. However, in the 1960 Census regression, KUSV was insignificant in the male equation. The general similarity in estimates among these three data sets is encouraging.

The relationship between the residuals in the male and female regressions also conveys information about the nature of factors omitted from these regressions. The simple correlations between these residuals for the 1960 and 1970 Census regressions are as follows:

	Whites		Blacks	
Age Group	**1970**	**1960**	**1970**	**1960**
18-65	.18	.05	.41	.38
18-41	.07	−.04	.35	.27
42-65	.36	.16	.49	.47

If the omitted variables operate similarly on both spouses, the correlation in residuals will be positive. Wealth would be included among such variables and, perhaps, generalized, market-oriented ability, which may be positively correlated between spouses. For the complete sample, except 1960 whites, the significant positive correlation between the male and female residuals indicates that important variables are missing from these equations.

In a second step, each sample was divided into two age groups (18-41 and 42-65) to determine if there was a life cycle element to any model misspecification. In all four samples, the size of the positive correlation in residuals increased over the life cycle. In fact, for the white samples, there was no evidence of any relation between residuals for the younger half of the sample; the missing variables probably reflect factors related to childbearing and spacing that operate in opposite directions on the allocation of time of men and women. A more efficient method of estimation would be to use this correlation in residuals between male and female regressions to estimate both equations jointly, but this strategy was not pursued.

A simple count of the number of young children at home cannot be expected to measure many changes during the course of the life cycle in those characteristics of family structure that determine a woman's labor market behavior. Indeed, the pattern of residuals in the white female labor supply regressions did indicate a misspecification in the empirical model. Female market

TABLE 5 Regressions for Comparing the 1970 and 1960 U.S. Census with 1967 DEO Data (figures in parentheses are *t* ratios)

	Independent Variables[a]				
	LHRWGM	LHRWGF	AGE	KUSV	Constant
Log of male home hours					
Whites					
1970 Census	−.0851	.0087	.0004	−.0049	8.94
	(20.9)	(0.65)	(4.72)	(2.21)	(193.8)
1967 SEO	−.1040	.020	.00014	−.0178	8.92
	(6.88)	(0.82)	(0.67)	(4.60)	(52.45)
1960 Census	−.0707	.0207	.0008	−.0007	8.83
	(19.8)	(2.28)	(11.1)	(0.54)	(16.68)
Blacks					
1970 Census	−.0748	.0270	.0053	−.009	8.81
	(3.10)	(0.62)	(2.67)	(1.65)	(991.5)
1967 SEO	−.0643	.0455	.00001	−.0107	8.86
	(2.16)	(1.71)	(0.031)	(1.35)	(255.6)
1960 Census	−.0481	.0198	.0010	.0104	8.81
	(5.39)	(1.64)	(6.54)	(3.20)	(999.5)
Log of female home hours					
Whites					
1970 Census	.0444	−.0841	.0014	.0478	8.95
	(5.49)	(3.11)	(7.36)	(10.89)	(358.9)
1967 SEO	.0444	−.0396	.00057	.0359	8.95
	(2.74)	(1.50)	(2.54)	(8.68)	(491.7)
1960 Census	.0233	−.0314	.0015	.0388	8.95
	(2.47)	(1.35)	(7.90)	(11.5)	(657.7)
Blacks					
1970 Census	−.0401	−.0605	.0006	.0184	9.02
	(1.72)	(2.56)	(3.36)	(3.53)	(509.0)
1967 SEO	−.1367	−.0395	−.0004	.0048	9.14
	(4.0)	(1.27)	(0.70)	(0.53)	(229.5)
1960 Census	−.0917	.0102	.0017	.0436	8.96
	(7.53)	(0.62)	(6.22)	(9.87)	(795.8)

[a]The variables are identified in Table 2

hours were overestimated in the age intervals 28-41 and 55-65, while positive residuals were present in the supply equations during the other ages. The extent of the labor market response of married women could depend on their children's ages and sex and on their aspirations for educating their children

TABLE 6 Effect of Children's Age on Working Time of Their Mothers

	Groupings of Children by Age (years)						
	Under 6	13 or Under	Under 6 or Over 13	All Ages	6-13	Over 13	Over 6
All whites	–	–	?	?	+	+	–
All blacks	?	?	+	?	+	?	?
College whites	–	–	?	?	?	+	–
High school whites	–	–	–	–	?	+	?
Elementary school whites	?	–	?	–	+	?	?

\+ Indicates effect is to increase hours of work.
– Indicates effect is to decrease hours of work.
? Indicates t value less than 1.0.

(child quality). Also, the interaction of these characteristics among siblings, including the spacing of children, might be important. To separate some of these factors, I defined a group of variables measuring the labor force participation of women grouped according to the ages of their children, using a set of mutually exclusive child-age categories.

From Table 6, in which the results obtained with these variables are summarized, it is evident that the allocation of a woman's time varies considerably with the ages of her children. Since preschool children are notoriously high demanders of their mother's time, it is not surprising that in almost all samples[32] an increase in the fraction of families with only preschool children reduces the working hours of wives. An interesting interaction occurs when the preschool children have siblings who are all over thirteen. The amount of market work performed by mothers in such families either differs little from the annual hours worked of childless wives or, as is the case for black wives, the mothers actually work more. It appears that the tendency to reduce market hours when young children are present is offset to some degree by substituting the time of older children in some child-care activities.

But the most interesting finding is the positive effect on female market time of children six to thirteen or children older than thirteen. The common denominator of most economic models of fertility is that children are assumed to be relatively wife-time-intensive commodities. Yet, labor supply evidence here indicates that the factor intensity of children might well switch as a child grows up. Parents with preschool children consume a relatively (wife-) time-intensive commodity. However, as these children grow older they become less time-intensive to their parents, with the result that there are stages in the life cycle when the presence of an older child makes household consumption more goods-intensive than in childless families. There is some additional evidence in support of this notion of factor reversals during the cycle. In every sample except elementary school whites, the presence of children over thirteen induces more additional female market time than the presence of children six to thirteen. Some of the older children are attending college—a quite goods-intensive commodity from a parent's point of view. Because a larger fraction of college-educated whites have children attending college, it is also consistent with this hypothesis that in white families, the additional hours of work of wives with children over thirteen increases with educational level.

The lesson for economists in their modeling of family behavior is that children should not be treated as a homogenous commodity. A variety of children's characteristics determines the relative input intensities of home production and the ability of women to substitute market time for household time. Many characteristics (school attendance, age) are by their nature intimately associated with specific stages of the cycle.

Nonlabor Income, Assets, and Savings To measure the rate at which hours are withdrawn from the market due to a "pure" income change, economists generally use an aggregate of all current-period nonearnings income. This measure often contains components that do not correspond to the theoretical construct. For example, eligibility for unemployment compensation, disability insurance, and pension income is usually contingent upon the recipient's nonparticipation in the market. If these receipts are included in the income measure, a spurious negative correlation between work and income is introduced. Because of this, I divided all current-period nonearnings income into three categories; the first (WKY) consisted of income received because of unemployment (i.e., unemployment insurance, workmen's compensation); the second (OADI) included income from various private and public pension plans and was also directly related to the amount of an individual's market work; the final category was wealth income (WTHY), which included interest and dividends. The last category was intended to be independent of the work-leisure choice and, hence, the appropriate one to use in estimating an income effect.

The necessity of separating income in the manner described receives empirical backing in tables 3 and 4. In the all-white male sample, WKY has the expected negative impact on working hours.[33] Because this income is received only by those who are not working, the result is at best a confirmation that the data are reasonably well reported. The retirement variable, OADI, had no detectable influence on working hours. If WTHY is viewed as the appropriate nonlabor wealth statistic, its sign should be positive as long as this income had not been previously capitalized.[34] But nonmarket time and WTHY tend to be negatively related, raising the real possibility that even these income flows are the consequence of present and past labor supply choices of the family. Since this income is largely the return on the accumulated savings of the family unit, and their magnitude is determined by *current, past*, and *future* expected levels of market work, the positive correlation between WTHY and market time is understandable: individuals with large past and current levels of market work have generated the assets that produce this income.

One advantage of placing the labor supply decision in a life cycle context is that a unified theory of asset accumulation, savings, and labor supply can be developed.[35] The life cycle approach clearly demonstrates that any observed relation between assets (or nonlabor income) and working hours should not be interpreted as evidence of a causal sequence from assets to market work, reflecting a wealth effect. Both are simultaneously determined by similar economic forces, and the observed relation may reflect only an individual's position in the life cycle.

To illustrate, define savings in the conventional manner as the difference between current income and current market goods consumption:

$$(12)\quad S_t = w_{mt}N_{mt} + w_{ft}N_{ft} - X_t + rA_t$$

where A_t, net assets at any age t, is given by

$$(13)\quad A_t = A_0 + \int_0^t S_t dt$$

Using the time paths of hours and consumption, the change in savings with age can be expressed as

$$(14)\quad dS_t = \frac{dw_{mt}}{w_{mt}}(w_{mt}N_{mt} + \sigma_c w_{mt}M_t) + \frac{dw_{ft}}{w_{ft}}(w_{ft}N_{ft} + \sigma_c w_{ft}F_t)$$
$$- \pi_t Z_t \{\sigma_c(r - \alpha) - \lambda[s_{xt} + (s_{mt} + s_{ft})\sigma_c]\} + rdA_t$$

The first two terms in equation 14 capture the effect of life cycle variation in male and female wages respectively. We have seen that an increasing wage over the life cycle produces rising paths of working hours and earnings. A sufficient condition (and one that is supported by empirical evidence below) for family earnings to rise is that the time of the member whose wage has risen is a substitute for market goods.[36] If intertemporal commodity substitution outweighs production substitution, the age profile of market goods consumption will have a negative slope. Because rising wages increase family earnings and either decrease market goods consumption (or increase consumption by less than family earnings), the life cycle model predicts a positive wage coefficient in the savings equation.

The age term in the savings equation captures both life cycle patterns and any cohort differentiation. The life cycle component $[-\pi_t Z_t \sigma_c (r - \alpha)]$ depends on the relative size of the interest rate and rate of time preference. If in-

TABLE 7 Family Savings Regressions (figures in parentheses are *t* ratios)

Equation No.[a]	WKWGM	HRWGM	HRWGF	AGE	KUSV	Constant	R^2
1	2,976[c]		−879.1	−73.09	−743.5	−23,090	.13
	(2.00)		(.32)	(2.02)	(1.40)	(2.07)	
2		2,998[c]	739.4[c]	−47.63	−366.7	−236.7	.10
		(1.53)	(.29)	(1.55)	(0.77)	(1.40)	
3	3,216[c]		−2,016.0[c]	−65.25	−483.6	−247.0	.22
	(2.87)		(.93)	(2.40)	(1.21)	(28.9)	
4	4.553		793.0	−55.91	−296.5	−344.4	.21
	(2.74)		(.82)	(2.19)	(0.80)	(0.27)	
5		4,664[c]	−2,255.0	−62.07	−377.4	−1,724	.20
		(2.42)	(.68)	(2.42)	(0.70)	(0.95)	
6		1,573	617.1	−37.96	−315.6	−902.5	.15
		(2.17)	(.61)	(1.63)	(0.08)	(0.58)	

Independent Variables[b]: WKWGM, HRWGM, HRWGF, AGE, KUSV

[a]Three-year moving averages are used in the first two equations and four-year moving averages in the other four.
[b]Variables are identified in Table 2.
[c]Variable was entered in log form.

terest rates exceed time preferences, market goods consumption will grow with age and market earnings will decline, resulting in a negative age term in the savings regression.

Because the model is tested using simulated cohorts derived from cross sections, the measured age difference also becomes in part a cohort index. Secular increases in real wealth bias the age term in our regression toward positive values $[s_{ct} + (s_{mt} + s_{ft})\sigma_c$ is necessarily positive$]$ by making younger cohorts wealthier than their predecessors.[37] If this bias offsets the life cycle effect, the age coefficient in a savings function need not be negative.[38]

To test the implications of the life cycle approach on the implied savings behavior of families, additional regressions were run on savings, using wage rates of family members, husband's age, and number of children younger than seven. Direct measures of savings do not exist in the SEO; so they were constructed by taking first differences of family net worth.[39] Because the asset data contained considerable measurement error, I smoothed the asset series by taking three- and four-year moving averages and then taking first differences in the moving averages. Hence, to compute savings, we are essentially taking linear approximations three or four years apart in the asset age profile.[40] Because assets will reappear in the savings computation three or four years later, some negative serial correlation is present; hence standard errors must be treated with more than the usual skepticism. The residuals were heteroscedastic because the savings measures were computed from assets and the error in assets appears to be proportional to the level of assets.[41] Because of this, all observations were weighted by the inverse of assets.[42] The savings regressions are reported in Table 7.

A test of the validity of the life cycle approach is the consistency among the consumption, leisure, and savings equations. For example, a positive age coefficient in the consumption and leisure demand equations would be inconsistent with a positive age coefficient in the estimated savings function, since they all measure the relative size of the interest rate and rate of time preference. Life cycle consumption is estimated in the tabulation shown below. In estimate 1, consumption is defined as the difference between family income and savings, where savings are defined as net worth at age t less net worth at age $t-1$. Family income equals men's earnings plus women's earnings plus all nonlabor income flows received in the period. Estimate 2 is the same as estimate 1 but with the inclusion of the imputed income return to the net worth held in the previous period; an interest rate of 5 percent was used. In both estimates, the figures in parentheses are t ratios, and the variables are identified in Table 2; *D.W.* is the Durbin-Watson statistic:

Log of Consumption	LHRWGM	LHRWGF	AGE	KUSV	Constant	R^2	*D.W.*
Estimate 1	.7192	.0929	.0080	.0193	7.89	.68	2.18
	(2.68)	(.22)	(2.30)	(.30)	(30.7)		
Estimate 2	.7832	.0452	.0105	.0151	7.87	.78	2.10
	(3.05)	(.11)	(3.15)	(.24)	(32.05)		

The severe measurement problem encountered with savings data is evident in the low R^2 and the lack of significance of some of the variables. Still, the empirical estimates basically support the life cycle model. In the savings function, all variables have the theoretically expected sign except the female wage variable, which has an insignificant coefficient. The male wage variable has the predicted positive sign in the savings function,[43] although its absolute magnitude seems to be below what we would expect.

Age has the predicted negative sign in the savings function. A one-year increase in age reduces savings by approximately \$60. As pointed out above, secular growth in real wages biases the age term toward positive values; therefore, obtaining the negative age term is encouraging. The consumption and hours equations are consistent with the savings function. An interest rate larger than the rate of time preference leads to a positive coefficient in the consumption and home hours equations. With the possible exception of male hours, my empirical estimates support this.

The effect of children younger than seven on savings is negative, although the t values are not very high. One problem with this variable is that children are concentrated in a relatively small part of the life cycle. Notice that as we go from a three- to a four-year moving average, the children variable becomes smaller in absolute size. The smoothing process tends to dampen the variable because the age range over which we are approximating the savings function is wide enough to extend beyond the ages of concentrated childbearing.

The presence of children in the household may affect savings by altering consumption expenditures or money income. The presence of preschool children apparently (Table 4) has a depressing effect on the market participation of women, but the opposite effect of increasing male working hours (see Smith 1972). Evaluating the model at mean market hours and wages of men and women, I find an increase for men of 116 market hours and $405 in earnings and a decrease for women of 294 market hours and $636 in market earnings[44]—a net decrease of approximately $231 in family earnings and a reduction in savings because of reduced earnings.

THE SUPPLY SIDE

The supply of market hours is the mirror image of the demand for home time. Labor economists have concentrated on the former, and for comparative purposes, results using annual market hours as the dependent variable are reported in tables 8 and 9. As expected, the coefficients on annual hours for men have the opposite sign and are approximately three times larger than the coefficients on home time.[45] In cross-sectional studies, negatively sloped male supply functions have usually been found. The positive slopes I obtained in my estimates are partly due to the degree of aggregation used in this study, which presumably eliminated some of the spurious negative correlation between hours and wage rates caused by imperfect measurement. Moreover, the purpose of the type of aggregation employed was to attenuate the wealth effects, which produce the negative relation between hours and wages.

Three distinct male wage variables were tried—hourly wages, weekly wages, and annual earnings. Ghez and Becker (1975) suggested using annual earnings to obtain a less biased wage elasticity by indirect calculation. They argued that earnings have the advantage of eliminating the spurious negative correlation between computed hourly wages and annual working hours. If $\hat{b}$ is the estimated coefficient of earnings, the implied coefficient for hourly wages is $\hat{b}/(1 - \hat{b})$. However, although this transformation is algebraically correct, b will be biased upward, since hours enter on both sides of the regression.[46]

The estimates of the wage elasticities for men, using the three alternative wage variables, are compared in the following tabulation:

	All White	College	High	Elementary	Black
Direct	.3217	.1217	.2581	.0204	.2035
Indirect	.347	.313	.372	.395	.439
Weekly wage	.3293	.2583	.3283	.4443	.3371

As expected, the indirect estimates using earnings are higher than those obtained using hourly wage rates. The differences in the estimates are largest for the college and elementary groups. Any negative bias caused by measurement errors in hourly wages is most critical in these groups because they have the smallest cell sizes.

Recently, a number of people (see especially Ben-Porath 1973, Hanoch 1976, and Cogan 1976) have argued that the various definitions of labor supply that are commonly treated interchangeably in empirical work represent in fact different theoretical constructs. To test their notions, the regressions were performed over a number of definitions of labor supply. Male annual hours were separated into weeks worked and weekly hours to determine if the model would work as well in explaining the separate components.[47] In view of the similarity in signs and magnitude of the explanatory variables, the distinctions between male supply definitions do not appear to be particularly important.

When alternative measures of women's labor supply are compared, however, a different conclusion emerges.[48] Two definitions of annual market hours and weeks worked were tried—average annual hours or weeks worked of those women who were labor force members and annual hours or weeks worked of all women, including zero values for nonworkers. The estimated coefficients from these alternative specifications differ substantially. The most striking contrast is in the age variable; for all women, age tends to be negatively associated with labor supply, but has a positive effect when only labor force members are considered. The rising age trend of weeks worked of participating women simply measures the declining turnover in the female labor force over the cycle. Among older cohorts, the percent of full-time workers is higher, indicating a stronger labor market commitment. These older women in the labor force also understandably increase the return on their market-oriented human capital by working more hours in any week. The wage elasticities are also smaller when zero values are excluded from the supply functions. If adjustments are permitted to take place only through the number of hours per worker, the hours response to a wage change is surely underestimated.[49] For some purposes (a study of labor market turnover), concentrating on the hours behavior of participants alone may be useful. But this ignores an important avenue of labor market response—the possibility of leaving or entering the market. Only when the zero values are included is it permissible to interpret the age variable in the manner suggested by the life cycle model—a measure of the influence of interest rates or cohort wealth. When the zero values are included, the results for the annual hours and weeks worked regressions are similar and consistent with the implications of the model.

The decline in market hours due to the presence of young children is much smaller when the zero values are not included. Apparently, the bulk of the labor market adjustment to the presence of children is through a total market

College White Men, Ages 26-64						
LHRYRM	−.1320 (3.27)	.0001 (0.14)	.0548 (2.88)	2583 (5.67)	6.45 (27.7)	.49
High School Men, Ages 22-64						
LHRYRM	−.1246 (2.30)	−.0003 (0.48)	.0464 (4.10)	.3283 (7.49)	6.14 (30.1)	.76
Elementary School Men, Ages 19-64						
LHRYRM	−.0790 (1.12)	−.0035 (3.35)	−.0338 (1.67)	.4443 (4.91)	5.69 (14.3)	.53

[a]The variables are identified in Table 2.

TABLE 8 Male Market Time[a]
(figures in parentheses are t ratios)

Dependent Variable	Independent Variables						
	LHRWGM	LHRWCF	AGE	KUSV	LWKWGM	Constant	R^2
All White Men, Ages 22-64							
LHRYRM	.3217	−.058	−.0005	.0529		7.31	.75
	(6.90)	(0.77)	(0.78)	(4.41)		(139.5)	
LHRYRM		−.083	.0003	.0465	.3293	6.08	.87
		(1.63)	(0.66)	(5.66)	(11.8)	(51.3)	
LWKSWKM		−.036	.0002	.0116	.1515	3.15	.83
		(1.46)	(1.07)	(2.89)	(11.1)	(54.5)	
LHRSM		−.0576	−.0005	.0373	.1980	2.83	.85
		(1.27)	(1.38)	(5.10)	(7.98)	(26.9)	
All Black Men, Ages 22-64							
LHRYRM	.2305	−.1562	.0001	.0346		7.45	.20
	(2.15)	(1.63)	(0.07)	(1.21)		(59.7)	
LHRYRM		−.1654	.00001	.021	.337	6.13	.42
		(2.12)	(0.009)	(0.91)	(4.5)	(17.8)	

TABLE 9 Female Market Time[a]
(figures in parentheses are t ratios)

Dependent Variables	Independent Variables					
	LHRWGM	AGE	KUSV	LWKWGF	Constant	R^2
All white women ages (22-64)						
Logistic for yearly participation rates	−.8841 (4.77)	−.0341 (10.88)	−.7847 (13.43)	1.438 (4.62)	−0.373 (2.72)	.86
Logistic for weekly participation rates	−.0185 (0.10)	−.0245 (7.45)	−.8358 (13.51)	1.083 (3.38)	4.14 (12.94)	.88
LHRYRF	−.3036 (3.48)	.0028 (1.94)	−.085 (3.10)	0.5618 (3.82)	5.25 (8.09)	.74
LHRYRF[b]	−.3974 (2.90)	−.0121 (5.20)	−.5843 (13.5)	1.15 (4.98)	2.53 (2.49)	.91
LWKSWKF	.061 (1.07)	.0036 (3.73)	−.1163 (6.50)	0.0307 (0.32)	3.37 (8.02)	.95
LWKSWKF[b]	−.2559 (2.39)	−.0135 (7.39)	−.5361 (15.8)	0.7663 (4.2)	0.53 (0.67)	.92
LHRSF	−.2780 (4.69)	.0017 (1.71)	.0018 (0.10)	0.4299 (4.30)	2.0 (4.53)	.55

[a] The variables are identified in Table 2.
[b] Regressions were run over the set of working women only.

withdrawal (a fall in participation rates) rather than a decline in hours of work of those who remain in the labor force. In fact, the addition of a young child has no effect on the number of weekly hours. If children are a proxy for a fixed (money) cost of working, their presence should be associated with lower participation rates and higher market hours among participants. The existence of fixed money and time costs of work are undoubtedly the major cause of differences among the alternative definitions of market work. Fixed costs not only increase the wage required to induce a woman to work (the reservation wage), but they also create discontinuities in the labor supply functions with the result that the minimum number of hours worked will be positive and large. In fact, Hanoch (1976) estimates that three-fourths of the measured response in working hours to a wage change consists of the jump from zero hours to the minimum hours supplied at the reservation wage.

Theoretical and statistical distinctions must be made also between those labor supply definitions that measure variation in hours and weeks among labor force members and those that simply indicate whether an individual is a labor force participant. Labor force participation rates (LFPR) are the most common example of the latter definition (important contributors to this subject are Ben-Porath 1973, Gronau 1974, and Lewis 1969). A woman's decision to participate in the labor force involves a comparison between her potential market wage (w) and the value placed on her leisure ("home wage" = ω) at the zero work position.[50] LFPR then measures the proportion of women for whom the market wage exceeds the home wage at zero hours of work (if fixed costs are ignored).[51] When LFPR is used as the dependent variable in a supply equation, the estimated wage coefficients cannot be interpreted as measures of the underlying parameters of household production or utility functions. As we know from the theory of the firm, supply elasticities are determined by two distinct factors: the supply elasticity for each firm and the distribution around any price (wage rate) of the entry points for firms. For LFPR, the magnitude of the wage coefficients depends only on the density of the distribution of entry points for women. The more dense the distribution, the larger the estimated wage response [following the argument of footnote 51, $\partial LFPR/\partial W = f(w)$]. Clearly, wage responsiveness is partly a function of the level of participation, with the largest responses expected as we move toward the mean and the smallest at the two extremes of very low or very high participation. Unfortunately, economists have tended to equate results obtained for LFPR with those for hours and weeks worked, and also to compare groups with quite different average LFPR (men and women, for example).[52]

The statistical difficulties encountered result from the categorical nature of LFPR if it is used as the dependent variable. When the dependent variable is binary, the use of OLS is inappropriate for several reasons: (1) the error term is also constrained to take two values, with the result that the errors are necessarily heteroscedastic; (2) a simple linear regression could produce estimates that lie outside the 0-1 range; and (3) at both extreme values the relationship is surely nonlinear. The difficulties are not eliminated by grouping the individual data to form labor force rates.

To deal with these problems, several transformations have been proposed to overcome the 0-1 limitation on the dependent variable. The simplest to compute is the logit transformation, which defines the dependent variable as the natural log of the odds (P) of working. Therefore, regressions of the following form were run:[53] $\ln[P/(1 - P)] = B'X' + U$, where B' is a vector of unknown coefficients and X' is a vector of values of the explanatory variables. To correct for heteroscedastic variances, the moment matrix was weighted by $N_i P_i(1 - P_i)$, where N_i is the number of observations in a given cell (see Thiel 1975, pp. 632-636, for a proof of this weighting procedure).

The SEO survey provided labor force participation variables defined over both a weekly and yearly time interval. Although the standard labor force participation rate is defined over a weekly interval, economic theory is not of much help in specifying the appropriate interval. There may, in fact, be some reason to prefer the less frequently used yearly rate, which is presumably not as much affected by transitory elements. The yearly rate also corresponds more closely to the time unit used in the model. Results for the variables for age, number of children, and female wages are about the same, whichever definition is used, but the male wage elasticity is much lower with weekly rates. If changes from year to year in male wages are a reasonable proxy for life cycle variation, their interyear increase should reduce the fraction of women in the labor force on a yearly basis. The impact of male wages on the percent of participants in a particular week is less clear. While weekly rates measure in part the yearly variation, they also reflect some intrayear changes. The latter are a function of within-year wage variation, seasonal forces, temporary health problems, and a number of other factors not specified in these regressions. Although these labor force participation rate regressions cannot be used to retrieve the parameters of household utility or production functions, the estimates obtained from these regressions are consistent with the spirit of the life cycle perspective adopted in this essay.

AN APPLICATION OF THE LIFE CYCLE MODEL TO INCOME MAINTENANCE PLANS

In this section,[54] the life cycle model developed above and the empirical estimates obtained from the SEO are applied to an important policy issue. A large proportion of current policy research deals with the direct and indirect consequences of income transfer programs. One behavioral response that has received considerable attention both for existing government programs, i.e., social security, and for newly proposed legislation, i.e., family assistance plans (FAP) and day care centers, is the labor supply effect. Because the programs contain elements of a negative income tax, it was felt they might seriously disrupt work incentives and lead to a big reduction in the work effort of new welfare recipients.

One difficulty is that the standard model used by economists contains only one time period, but income transfer programs can generally have important interperiod or life cycle effects. The one-period model is only appropriate when the proposal being investigated operates in a way that does not alter the incentives to substitute economic activity between time periods. Because those programs alter the rate of exchange between time and market goods and increase a family's wealth, the one-period model incorporates some of the relevant economic factors at work. However, the life cycle aspect must also be included, because FAP and social security programs change the relative cost of consuming at different ages, inducing families to reallocate their consumption and working patterns over time. Finally, the incentives to invest in human capital may be altered.

The Labor Supply Model

From equation 14, the demand for home time in differential equation form is

$$(15)\quad \frac{dM_t}{M_t} = \frac{d\left(\frac{R}{P}\right)}{\left(\frac{R}{P}\right)} - \sigma_c \left(\frac{d\pi_t}{\pi_t} - \frac{dP}{P}\right) - (S_f\sigma_{Mf} + S_X\sigma_{MX})\frac{dw_{mt}}{w_{mt}} + S_f\sigma_{Mf}\frac{dw_{ft}}{w_{ft}} + \sigma_c(r - \alpha)$$

Equation 15 states that the demand for home time for any family member will be larger (and market hours lower): (1) the larger the family's real wealth (R/P); (2) the lower the cost of consumption at that age relative to the lifetime price (π_t/P); (3) the lower the wage of the family member at that age (w_{mt}); (4) the larger the wage of other family members at that age (w_{ft}); (5) the older the family member (assuming that the rate of interest exceeds the rate of time preference).

For analytical simplicity, I reduce the income maintenance programs to their two essential provisions: (1) families with zero earnings receive an income payment of S dollars per year for each year they are eligible for benefits and (2) this payment is reduced by μ cents for each dollar of earnings (E) in a year. The welfare payments a family receives in any year t are

$$(16)\quad S_t = S - \mu\,(E_{M_t} + E_{F_t})$$

A family will not receive benefits when family earnings exceed S/μ.

Although these programs are unlikely to alter interest rates or time preferences, they will affect labor supply through the other categories. As long as payments are received at any age, a family's real wealth will be increased. If a family is not eligible for a subsidy at every age, the cost of household consumption will be lowered at ages when payments are received relative to other ages. Finally, during periods of eligibility, the opportunity cost of time of men is lowered.

Wealth Effect

To evaluate the increase in lifetime wealth, it is necessary to know the ages when benefits are received and the subsidy at each age. Assume for simplicity that a family receives benefits only between periods t_1 and t_2 and is not eligible at any other age. If we let $\overline{S}$ be the constant subsidy over time periods t_1 to t_2

that is equivalent (in wealth terms) to the actual subsidy received over the same period, the increase in real wealth for participants is[55]

$$(17)\quad \Delta R = \frac{\bar{S}}{r} e^{-rt_1} (1 - e^{-rn})$$

where n is the number of periods in which benefits are received. The increase in real wealth will be larger the earlier benefits are received (the smaller t_1), the larger the number of time periods when benefits are received, and the larger the average subsidy per period.

Even this simple representation illustrates some conceptual and statistical problems in the existing literature dealing with the wealth effects of these programs. In the spirit of the one-period model, researchers are acting as if benefits are received at every age, implying that $\bar{S}/r$ adequately measures the change in real wealth. But this clearly overestimates the additional wealth for families receiving benefits only for some fraction of their lives. Even if the appropriate time horizon for the statistical measures of income were known, it would still be necessary to determine which subgroups in the population differ in n or t_1.

This also suggests that the usefulness of the controlled experimental data collected to study FAP is limited. The experiments were conducted for relatively short periods of time; for example, the New Jersey-Pennsylvania experiment lasted three years. The results obtained for families in the experimental program are not applicable to families whose participation in a FAP exceeds the time span of the experiment. The number of periods of eligibility is a critical variable in determining the hours response to a FAP because it determines in part the increase in real wealth and also the strength of the substitution effect between time periods.

The Substitution Effect

By holding real wealth (R/P) constant in equation 15, we can isolate those labor supply reactions that are pure substitution effects. Two relative prices are altered by these maintenance programs: the cost of consuming in one time period relative to another, and the cost in some periods of using one input in household production relative to other inputs.

If we ignore for the moment human capital investments, the cost of consuming (π_t) in any period is lowered because the real cost of using male and female time in the household sector falls by the implicit marginal tax rate (μ).

At those ages when the family is not eligible for benefits, the wages of all family members are unaffected, but the cost of consuming at these ages relative to ages when benefits are received is increased. Using equation 15, the percent decreases in the demand for male and female home and market goods time during those ineligible ages are

$$\text{(18)} \quad \frac{dM_t}{M_t} = \frac{dF_t}{F_t} = \frac{dX_t}{X_t} = -[\sigma_c(\bar{S}_M + \bar{S}_f)\,\Omega]\mu$$

where $\bar{S}_M$ and $\bar{S}_f$ are the average lifetime shares of male and female time in household production and

$$\Omega = \int_{t=t_1}^{t_2} k_t\, dt$$

is a measure of the fraction of a family's life during which it receives program benefits.[56]

A different set of demand equations is appropriate for those ages when the family is covered. In addition to the lower cost of consuming, there is a reduction in the opportunity cost of male and female time of μ percent. The home time demand equations for eligible ages[57] are

$$\text{(19)} \quad \frac{dM_t}{M_t} = [\sigma_c(\bar{S}_M + \bar{S}_f)(1 - \Omega) + S_{X_t}\sigma_{MX}]\mu$$

These equations show the importance of distinguishing between the eligible and ineligible stages of the life cycle. On the substitution effect, market work of men and women and the demand for market goods will actually increase during the ineligible periods. With the higher cost of household consumption in those periods, the family has an incentive to reallocate some of its household production toward the eligible periods. This releases time of men and women from the household sector, and their market work will tend to increase.

However, during the eligible periods, due to the substitution effect, market hours of men and women should decline.[58] The family will attempt to produce more of its lifetime consumption in the periods of eligibility, increasing the demand for male and female time in the household sector. This effect will be stronger the larger the intertemporal demand elasticity (σ_c); the larger the combined share in household consumption of male and female time ($\bar{S}_M + \bar{S}_f$); and the fewer the number of periods of eligibility $(1 - \Omega)$. Because household production costs are lowered by approximately the same percent in all eligible periods there is no incentive to reallocate consumption between those periods. As the number of eligible periods increases, the importance of this intertemporal substitution diminishes. The second term in equation 19, $S_{X_t}\,\sigma_{MX}$, measures the incentive to substitute the time of men and women for market goods in the household production process. Because the price of each has fallen by μ percent, there is no incentive to substitute between the two time inputs. The family will attempt, however, to substitute both time inputs for market-purchased goods.

Human Capital Investment

These predictions concerning intrafamily work patterns are reinforced if we include human capital investments in the model. As a simplification assume that all human capital investment costs are forgone earnings, that is, only time enters the production of human capital. If E_t^P denotes the earnings an individual would receive if he did not invest at age t, and C_t denotes the dollar costs of investments in that time period, a person's observed earnings (E_t^*) will be $E_t^* = E_t^P - C_t$. This discrepancy between observed and potential wages is important because the latter represents the opportunity cost of time and hence governs the allocation of that time among alternative uses. But only observed wages are subject to the tax. A marginal tax rate of μ percent will lower observed earnings by the same percent, but potential earnings will fall by $\mu(1 - C_t^*)$ percent, where C_t^* is the fraction of potential earnings absorbed by human capital investments.[59] Clearly, if individuals differ in C_t^*, their labor supply reactions to income maintenance provisions will differ as well. We can use the theory of the optimal life cycle path of human capital investment to identify the distribution of C_t^* over demographic subgroups in the population.[60] Since one determinant of the probability of these investments is the expected length of future labor force participation, men have a greater incentive than women to invest in market forms of human capital. Therefore, income maintenance programs will not in general lower the true wages of men and women by the same percent. Equations 18 and 19, in which proportionate reductions in wages are assumed, are no longer appropriate. For example, if male wages fall by a constant fraction (λ) of female wages at every age in which benefits are received, the new equations for men would be[61]

$$(22) \quad \frac{dM_t}{M_t} = -[(\lambda \bar{S}_M + \bar{S}_F)\, \sigma_c \Omega]\mu$$

for the ineligible period, and

$$(23) \quad \frac{dM_t}{M_t} = [\sigma_c (1 - \Omega)(\lambda \bar{S}_M + \bar{S}_F) + S_{X_t}\, \sigma_{MX} \lambda - (1 - \lambda)\, \sigma_{MF} \bar{S}_F]\, \mu$$

for the eligible period. The qualitative predictions for the noneligible ages (equation 22) remain the same. However, in the eligible periods the family has an incentive to substitute female for male time in home production because men's wages no longer fall as much as women's. This dampens somewhat the previously predicted increased demand for men's home time and further increases the specialization of women in the household.

A well-known implication of human capital theory is that investments will decline with age. Thus even in the eligible periods, the cost of household production will not fall by an equivalent amount at each age. Rather, the largest decreases will occur at older ages when investments are less important. Consider two families that participate in a FAP—one family during ages 26-30, the other during ages 56-60. The model predicts a larger reduction in male working hours in the older family. As λ (a negative index of human capital investments) increases, the reduction in men's wages approaches that of women, and men's home time increases.[62] The principal form of male market withdrawal might well be early retirement. In the younger family, where the relative reduction in the wife's wage will be larger than the husband's, the reduction in her working time will be larger than his.[63]

The incentives to invest in human capital also are altered by programs such as FAP. Each additional dollar of potential earnings used to finance self-investment increases the subsidy received by μ cents. Moreover, if, as our theory suggests, male market hours rise during the ineligible period, the returns from any investments will increase. Because the fraction of total investment costs that are forgone earnings is probably higher for on-the-job investments than for schooling, these programs especially encourage the former.[64] We should also expect some switching to more time-intensive techniques of producing human capital and an increase in the proportion of specific job training financed by employees. If policymakers ignore these incentives to invest and use market earnings to estimate the number of potential participants in these programs, their projection for young families opting to receive benefits will be too low. Finally, encouragement of job investment is more important for men, but hours spent investing on the job are reported as working hours. This makes even more plausible the possibility that observed job hours of young married men will increase during the period when the family receives income transfers.

A Simulation of a Family Assistance Plan

The empirical estimates of the male and female life cycle home time equations can be used to predict the impact of a family assistance plan. In the tabulation below, I present again estimates of the pure life cycle home time demand functions for white married men and women (the figures in parentheses are t ratios; home time = 8,760 hours less average yearly hours worked):[65]

	Independent Variables					
Dependent Variable	Log Male Hourly Wage	Log Female Hourly Wage	Age	No. of Children Younger than Seven	Constant	R^2
Log male home time	−.1065	.0283	.00007	−.0158	9.31	.88
	(11.71)	(1.71)	(0.49)	(5.92)	(241.6)	
Log female home time	.0246	−.0852	.0007	.0364	9.31	.88
	(2.78)	(4.20)	(4.02)	(11.20)	(121.3)	

The demand equation for the pure life cycle model was shown to be

$$(24)\quad \frac{dM_t}{M_t} = -(S_M\sigma_c + S_f\sigma_{Mf} + S_x\sigma_{Mx})\frac{dw_{mt}}{w_{mt}} + S_f(\sigma_{Mf} - \sigma_c)\frac{dw_{ft}}{w_{ft}} + \sigma_c(r - \alpha)$$

and

$$(25)\quad \log M_t = a_0 + a_1 \log \bar{w}_{mt} + a_2 \log \bar{w}_{ft} + a_3\, AGE$$

which are the equations estimated in tables 3 and 4.

These life cycle estimates may be used to simulate the pure substitution component of an income transfer.[66] One difficulty is that the reactions depend also on the expected number of years a family will participate and the extent of differential investment profiles among family members. But by assuming extreme values for the duration of participation in the program and differential family investments, limits may be placed on the labor supply effects.

First consider the case of no human capital investments ($\lambda = 1$). If we add the male and female wage coefficients in the estimated life cycle equations, we have

$$(26a)\quad \frac{dM_t}{M_t} = -[(\bar{S}_M + \bar{S}_f)\,\sigma_c + S_x\sigma_{Mx}] = -0.0782$$

$$(26b)\quad \frac{dF_t}{F_t} = -[(\bar{S}_M + \bar{S}_f)\,\sigma_c + S_x\sigma_{Fx}] = -0.0606$$

These are the predicted effects of an income maintenance program for the eligible periods if the family joins for only one year ($\Omega \simeq 0$). Because the importance of the incentive to substitute between time periods diminishes as the number of periods of participation increases, the substitution effect will be strongest when a family participates for only one year. According to the first two rows of Table 10, for families in which human capital investment is not important, the maximum increases in male and female nonmarket hours for a 50 percent marginal tax rate are 3.91 and 3.03 percent. On the basis of 1966 mean levels of nonmarket time of 6,612 hours for men and 8,196 for women, the respective reductions in market hours for men and women are 259 and 248. In terms of the disruption of market activity, the reduction in market hours for men is 12 percent and for women, 44 percent. The considerably larger effect on women is dramatic, since on average 50 percent of married women do not work at all during a year. For working women, this means a reduction from 1,128 hours worked to 632 (a change of 486 hours). The minimum estimates in Table 8 are obtained by assuming that a family participates in the program throughout its life cycle, with the result that there is no interperiod substitution but only substitution between inputs in production. In this case only the $S_x\sigma_{Mx}$ and $S_x\sigma_{Fx}$ components of the total substitution effect are relevant. We can ob-

TABLE 10 Estimated Change in Market Work (Substitution Effect Only)

	Investment Assumption (value[a] of λ)	Eligible Period: % Change in Nonmarket Time		Eligible Period: Absolute Change[b] in Hours of Market Work		Ineligible Period: Maximum Increase in Hours of Market Work
		Maximum	Minimum	Maximum	Minimum	
Men	1.0	3.91	1.89	−259	−125	134
Women		3.03	1.01	−248	−83	166
Men	0.67	2.14	0.44	141	−29	111
Women		3.44	1.76	−282	−139	138
Men	0.50	1.25	−0.29	−83	+18	100
Women		3.64	2.13	−298	−175	124
Men	0.33	0.36	−1.02	−24	+67	89
Women		3.85	2.50	−316	−197	110

[a]Value of λ is inverse to the amount of human capital investment.
[b]Absolute changes evaluated at mean home hours of 6,612 for men and 8,196 for women, on the basis of the 1967 SEO survey.

tain a lower bound on these by rewriting equation 26b as $dF_t/F_t = \sigma_c + S_x(\sigma_{FX} - \sigma_c) = 0.0606$.

The positive signs of the cross-substitution effects in the life cycle equations imply that substitution in production between inputs exceeds substitution in consumption between time periods.[67] Therefore, σ_c must be smaller than 0.0606. It is also unlikely that the share of market goods in household production is less than one-third. Based on these assumptions, $S_x\sigma_{MX} \geqq 0.0378$ and $S_x\sigma_{FX} \geqq 0.0202$. These numbers were used to obtain the minimum effect of a reduction of 125 hours in the market work of men and 83 hours for women. The maximum increase in market work in the ineligible periods was calculated from equation 4 using the upper-bound assumption for σ_c and letting $\Omega \simeq 1$.[68] The predictions for the other investment assumptions were obtained using equation 10 and inserting the appropriate value of λ. For the maximum estimates it is only necessary to multiply the male coefficient by λ before summing the two wage coefficients.[69]

These results suggest what the theory itself implied: transfer programs will have a larger impact on the work behavior of married women than male heads of households. This is always true for percent withdrawal of market hours. For an investment parameter of 0.67, the maximum absolute withdrawal of female market work is twice that of men. When investments are important, the reduction in male market work becomes very small, and we cannot exclude the possibility that their market hours will actually increase.

CONCLUSION

In this paper, a model to explain the intertemporal allocation of time of family members was developed and tested. For white families, the observed cross-sectional profiles and the regression results seem consistent with the predictions of the model. At the present time, only the life cycle behavior of black married women is difficult to reconcile with the model. The empirical work suggested three possible explanations for this anomaly: (1) dominance of the cross-sectional profiles by intercohort effects, (2) patterns of child spacing, and (3) uncertainty about the duration of the family itself.

APPENDIX A: MATHEMATICAL APPENDIX

Let the family maximize lifetime utility (U),

$$(1)\quad U = \left(\int_0^N Z_t^{(\sigma_c-1)/\sigma_c} e^{-\alpha t}\, dt\right)^{\sigma_c/(\sigma_c-1)}$$

with the production function and time and money expenditure constraints described in the text:

$$(2)\quad Z_t = B_t\, f(X_t, M_t, F_t)$$

$$(3a)\quad M_t + N_{Mt} = F_t + N_{ft} = T$$

$$(3b)\quad \int_0^N X_t\, e^{-rt}\, dt = \int_0^N (W_{mt}N_{mt} + W_{ft}N_{ft})\, e^{-rt}\, dt + A_0$$

$$(4)\quad R = \int_0^N \pi_t Z_t e^{-rt}\, dt = T\int_0^N (W_{mt} + W_{ft})e^{-rt}\, dt + A_0$$

When the family maximizes utility function 1 subject to budget constraint 4, the following must hold between consumption in periods t and $t + j$:

$$(5)\quad \frac{-dZ_{t+j}}{dZ_t} = \left(\frac{Z_{t+j}}{Z_t}\right)^{1/\sigma_c} e^{\alpha j} = \frac{\pi_t}{\pi_{t+j}}\, e^{rj}$$

Therefore, consumption in any period $t + j$ can be expressed as:

$$(6)\quad Z_{t+j} = Z_t\left(e^{(r-\alpha)j}\,\frac{\pi_t}{\pi_{t+j}}\right)^{\sigma_c}$$

and since

$$(7)\quad R = \int_0^N \pi_t Z_t e^{-rt}\, dt = \int_{-t}^{N-t} \pi_{t+j}\, Z_{t+j}\, e^{-r(t+j)}\, d_j$$

we may substitute (6) into equation 7:

$$(8)\quad R = Z_t\pi_t^{\sigma_c}\,\{\exp[(\alpha - r)t\sigma_c]\}$$

$$\int_t^{N-t}\left(\{\pi_{t+j}\exp[-r(t+j)]\}^{1-\sigma_c}\,\{\exp[-\alpha\sigma_c(t+j)]\}\right) d_j$$

or

$$(9)\quad R = Z_t\pi_t^{\sigma_c}\,\{\exp[(\alpha - r)t\sigma_c]\}\int_0^N \{[\pi_t\exp(-rt)]^{1-\sigma_c}\,[\exp(-\alpha\sigma_c t)]\}\, dt$$

Define the lifetime price index (P) as follows

$$(10)\quad P = \left[\int_0^N \left(\pi_t e^{-rt}\right)^{1-\sigma_c} e^{-\alpha\sigma_c t}\, dt\right]^{1/(1-\sigma_c)}$$

Then

$$Z_t = \frac{R}{P}\left(\frac{\pi_t}{P}\right)^{-\sigma_c} e^{(r-\alpha)\sigma_c t}$$

which is equivalent to equation 5 in the text.

Since R and P are constant over the life cycle,

$$\frac{dZ_t}{Z_t} = -\sigma_c \frac{d\pi_t}{\pi_t} + \sigma_c(r - \alpha) \tag{11}$$

and

$$\frac{d\pi_t}{\pi_t} = S_m dW_{mt} + S_F dW_{ft} - \frac{dB_t}{B_t} \tag{12}$$

The demand for male home time is

$$\frac{dM_t}{M_t} = \frac{dZ_t}{Z_t} - (S_F\sigma_{MF} + S_X\sigma_{MX})\frac{dW_{mt}}{W_{mt}} + S_F\sigma_{MF}\frac{dW_{ft}}{W_{ft}} - \frac{dB_t}{B_t} \tag{13}$$

Finally, substituting equation 12 into (11) and (11) into (13), we obtain the demand function for home time described in the text:

$$\frac{dM_t}{M_t} = -(S_M\sigma_c + S_F\sigma_{MF} + S_X\sigma_{MX})\frac{dW_{mt}}{W_{mt}} + S_F(\sigma_{MF} - \sigma_c)\frac{dW_{ft}}{W_{ft}} + \sigma_c(r - \alpha) + (\sigma_c - 1)\frac{dB_t}{B_t} \tag{14}$$

APPENDIX B: THE SURVEY OF ECONOMIC OPPORTUNITY

The empirical results presented in the text are based on a Survey of Economic Opportunity (SEO) sample taken in the spring of 1967. The survey was conducted by the Bureau of the Census for the Office of Economic Opportunity to supplement information regularly collected for the Current Population Surveys (CPS) for February and March of each year. The survey covered 30,000 households (90,000 individuals) and consisted of two samples: (1) a national self-weighting sample of 18,000 households conducted in the same manner as the monthly CPS survey;[70] and (2) in an attempt to increase the reliability of information on blacks, a supplementary sample of 12,000 households taken in areas with relatively large concentrations of nonwhites.[71] For each family interviewed, information was provided on geographical location, assets, liabilities, and income other than earnings. Age, sex, race, educational attainment, and family relationship data exist for every individual in the family. Finally, adult members were additionally questioned on their work experience, earnings, previous week's salary, personal health, and marital status; and women were asked to give their childbearing history.

Since the life cycle model I sought to test is set in a family context, I created a new tape by matching individuals by their marital status. The new tape, consisting of 17,874 families in which both spouses were present in the household, has on one record the asset, debt, and income levels of the family unit; personal and labor force characteristics of both the husband and wife; and some limited information on any children present. A number of additional restrictions were imposed in selecting families included in the final aggregations. The final sample was limited to nonfarm[72] black and white families in which the husband's age was between 18 and 65 inclusive and in which he had worked in 1966. I excluded families in which one member worked in the survey week, but did not work at all during the previous year.[73] Finally, those families in which the husband was under 25 years old and in the military were excluded.[74] The remaining families were divided into thirty-six cells; two race cells (black and white) each subdivided into three education cells (1-8, 9-12, and more than 12 grades of husband's schooling completed) and finally further subdivided into six labor force cells (one division determined by whether the husband worked in the survey week and three possible labor force categories for wives: no work at all, worked in previous year, and worked in previous year and survey week). For each cell, arithmetic means of variables were calculated by aggregating over the age of the husband. Since the probability of being included in the original tape was not identical across families, these means were constructed using the probability of sample inclusion as the weight for the family. Instead of recording the actual number of weeks worked, the SEO coded an individual in a class interval. Since these intervals were not of equal size, it was necessary to recode by giving an individual the midpoint of his class. Selection of the midpoint was arbitrary but a more precise estimate would have required knowledge about the shape of the distribution in each class.[75] By SEO definitions, only civilians were considered to be working; so I assumed that men over age 25 who were in the armed forces worked fifty-one weeks. I have resisted the temptation to refer to LFPWK and LFPYR as labor force participation rates. Unlike my measure, the official definition of LFPR includes as participants individuals who were not gainfully employed.[76] The means and standard deviations for the variables used in this study are reported in Table B-1.

Male Home Specialization

For this study, the final sample was limited to households in which the husbands performed some market work in 1966. For a number of reasons, this restriction was not expected seriously to impair the reliability of the results presented. First, the overwhelming majority of married men were in the sample, since only a relatively minor fraction of husbands are not members of the labor force. Moreover, if nonworkers had been included, we would have again encountered the problem (as we did for women) of not having the necessary wage data for that group. A second consideration is the hypothesis that complete male home specialization is due primarily to factors such as ill health and

TABLE B-1 Means[a] of Variables Used in the Study (figures in parentheses are standard deviations)

	Subsamples by Level of Education[b]				
Variables	All Whites (1)	Elementary Whites (2)	High School Whites (3)	College Whites (4)	All Blacks (5)
Hours variables for men					
CHR1M	6612.5	6720.9	6588.4	6570.8	6796.3
	(113.6)	(96.41)	(109.17)	(184.6)	(108.48)
HRYR1M	2147.5	2039.1	2171.6	2189.2	1963.7
	(113.60)	(96.41)	(109.17)	(184.6)	(108.48)
HRYR2M	2179.5	2109.2	2202.2	2201.7	2013.4
	(99.22)	(99.60)	(92.33)	(180.56)	(113.76)
WKSWK1M	48.82	48.04	49.06	49.33	47.71
	(1.63)	(1.28)	(1.84)	(1.49)	(1.54)
HRSM	43.84	42.43	44.15	44.26	40.69
	(1.34)	(1.93)	(1.30)	(2.83)	(1.63)
Hours variables for women					
CHRF1	8196.6	8248.5	8166.0	8254.4	8097.4
	(108.5)	(166.4)	(113.84)	(148.23)	(152.5)
HRYR1F[c]	1486.0	1515.4	1496.2	1434.5	1385.6
	(118.9)	(198.1)	(112.51)	(211.6)	(187.4)

HRYR2F[c]	1508.0	1563.2	1522.5	1440.1	1457.7
	(113.7)	(193.66)	(106.1)	(218.1)	(164.1)
WKSWK1F[c]	36.57	35.33	37.14	35.82	35.36
	(4.34)	(6.85)	(4.42)	(4.45)	(5.94)
WKSWK2F[c]	37.64	37.02	38.27	36.32	38.65
	(4.37)	(6.81)	(4.45)	(3.24)	(5.56)
WKSWK3F[c]	42.00	41.29	42.27	41.13	40.24
	(2.81)	(6.91)	(2.85)	(3.66)	(5.13)
WKSWK4F[c]	17.50	16.18	18.19	15.90	16.80
	(3.67)	(5.47)	(4.52)	(3.99)	(3.23)
HRSF[c]	34.36	35.91	34.62	33.71	33.58
	(1.46)	(2.87)	(1.19)	(3.25)	(3.21)
LFPWK	.351	.307	.366	.337	.435
	(.057)	(.103)	(.059)	(.106)	(.074)
LFPYR	.516	.481	.530	.493	.647
	(.093)	(.073)	(.086)	(.145)	(.091)
Earnings variables for men					
EARNM	7474.6	5372.3	7172.4	9718.3	4736.4
	(1332.3)	(724.09)	(1127.0)	(2705.3)	(578.3)
WKWG2M	155.30	113.38	148.35	201.8	99.42
	(25.66)	(15.00)	(21.25)	(54.29)	(10.15)
HRWG2M	3.82	2.91	3.59	4.98	2.67
	(.606)	(.406)	(.503)	(1.33)	(.207)

TABLE B-1 (continued)

Variables	Subsamples by Level of Education[b]				
	All Whites (1)	Elementary Whites (2)	High School Whites (3)	College Whites (4)	All Blacks (5)
Earnings variables for women					
EARNF	1304.1	1049.3	1343.3	1350.4	1296.6
	(208.97)	(335.5)	(231.1)	(337.3)	(379.5)
WKWG2F	68.05	57.01	66.94	77.69	54.30
	(5.04)	(10.02)	(6.36)	(12.19)	(11.23)
HRWG2F	2.16	1.77	2.10	2.53	1.68
	(.146)	(.208)	(.122)	(.331)	(.262)
Nonlabor income					
WKY	44.29	79.20	42.84	18.64	60.63
	(9.24)	(30.39)	(15.61)	(12.63)	(26.63)
OAD1	121.69	74.49	133.7	147.65	79.65
	(80.64)	(63.25)	(97.35)	(136.9)	(73.43)
WTHY	271.55	92.82	189.38	600.3	83.13
	(160.03)	(79.54)	(119.97)	(401.1)	(63.06)
Health					
HLTWKM	.0577	.0767	.0614	.0286	.057
	(.041)	(.059)	(.043)	(.020)	(.045)
HLTWKF	.093	.131	.098	.054	.135
	(.060)	(.076)	(.064)	(.041)	(.088)

Other variables					
KUSV	.592	.689	.574	.579	.765
	(.552)	(.627)	(.558)	(.55)	(.565)
EDM	11.54	6.90	11.24	15.44	9.04
	(.66)	(.257)	(.140)	(.506)	(1.46)
EDF	11.34	9.06	11.22	13.20	9.95
	(.461)	(.372)	(.20)	(.363)	(1.15)
NUM	169.15	34.07	90.02	45.14	64.09
	(51.2)	(13.28)	(30.07)	(19.40)	(20.08)

SOURCE: 1967 Survey of Economic Opportunity.
[a]Means are calculated for ages 19-64 inclusive and are averages over the three-year moving averages.
[b]The classification of the subsamples is according to the education level of the husband.
[c]Means are for female market participants only.

TABLE B-2 Reason Not Working in 1966, White Married Men, Ages 18-70

Age Group	Reason Given[a]							Total No. of Observations by Row
	Could Not Find Work	Ill or Disabled	Caring for Home or Family	Going to School	In Military	Retired	Other	
18-20	0	0	0	1.0	0	0	0	1
20-24	.053	0	0	.421	.368	.158	0	19
25-29	.167	.167	0	.167	.250	0	.25	12
30-34	.059	.471	0	.118	.177	.177	0	17
35-39	0	.50	0	0	0	.350	0	20
40-44	.038	.615	0	.0309	.155	.077	.077	26
45-49	.033	.700	0	.067	.033	.100	.067	30
50-54	.039	.706	0	0	0	.236	.020	51
55-59	.0140	.622	0	0	0	.324	.041	74
60-64	.028	.563	0	0	0	.394	.014	142
65-70	.017	.220	.004	0	0	.753	.007	287
Total no. of observations by column	18	282	1	18	18	326	18	679

[a]The figures are the fractions of nonworking men in each age group who gave the reason listed for not working.

TABLE B-3 Reason Not Working in 1966, Black Married Men, Ages 18-70

Age Group	Reason Given[a]							Total No. of Observations by Row
	Could Not Find Work	Ill or Disabled	Caring for Home or Family	Going to School	In Military	Retired	Other	
18-20	0	0	0	0	0	0	0	0
20-24	0	.125	0	.375	.50	0	0	8
25-29	.083	.250	0	.083	.167	.333	.083	12
30-34	.125	.625	0	.250	0	0	0	8
35-39	.053	.632	0	.053	0	.210	.053	19
40-44	.056	.833	0	0	0	0	.056	18
45-49	.040	.840	0	0	0	.12	0	25
50-54	0	.893	0	0	0	.071	.036	28
55-59	.072	.833	0	0	0	.096	0	42
60-64	.042	.746	0	0	0	.169	.042	71
65-70	.018	.483	0	0	0	.50	0	114
Total no. of observations by column	13	225	0	7	7	86	7	345

[a]The figures are the fractions of nonworking men in each age group who gave the reason listed for not working.

participation in schooling and military activities. In particular, it is not generally the consequence of the family relative wage structure. Hence, eliminating the nonparticipants made it possible to concentrate on those families to which the "economic" model is most applicable. To check these suppositions a pass was made through the SEO tape not only to count the number of married men not working in 1966 but also to find the reasons given by them for their nonparticipation. In tables B-2 and B-3, the results of that run are summarized for white and black men, respectively. If these men had been included, the sample size of approximately 18,000 would have been increased by only about 600 observations. More important, only 18 white and 13 black men were not working because of an inability to find work. For both groups approximately 90 percent of the male workers gave retirement or poor health as the reason they did not work. It seems clear then that very little was lost because of the decision to exclude those families from this study.

NOTES

1. The number of such studies has increased so rapidly as to preclude listing them all.
2. The following model was developed in Smith (1972). It relies on the work of Ghez and Becker.
3. It is assumed that equations 8 and 9 have an interior solution.
4. We know that $S_f\sigma_{ff} + S_M\sigma_{Mf} + S_X\sigma_{fX} = 0$ and that σ_{ff} is necessarily less than zero. Hence, $S_M\sigma_{Mf} + S_X\sigma_{fX}$ is positive. For a proof of these statements, see Allen (1967, pp. 503-508).
5. For men, this is not a major problem. Profiles for men may be derived by linking cross sections of different years. These are essentially identical to those obtained with any cross section.
6. The changes at both tails of the profile are a consequence of variation in both weeks worked and weekly hours. However, the decline in annual hours during the middle years reflects primarily a fall in hours worked per week, as yearly weeks are somewhat stable throughout this period of life. This stability is partly due to the SEO definitions of weeks worked, for it includes paid vacations. The duration and frequency of vacations surely increase with age; hence, a corrected weeks worked measure (vacations excluded) may also exhibit a decline.
7. More precisely, the crucial factor is the difference between the rate of interest and the rate of time preference $(r - \alpha)$.
8. For simplicity, assume neutral time preference and no life cycle variation in women's wage rates. Using equation 8,

$$\frac{dM_t}{M_t} = -\eta_{mm}\frac{dw_{mt}}{W_{mt}} + \sigma_c r$$

Consumption time will be at a minimum when $\eta_{mm}(dw_{mt}/W_{mt}) = \sigma_c r$. Therefore, wages will still be rising, $(dW_{mt}/W_{mt}) > 0$, when annual working hours are at a maximum.
9. Earnings (E) are the product of wage rates (w) and annual hours worked (h); $E = wh$. Therefore, $dE/E = (dw/w) + (dh/h)(dE/E) = 0$ when $dw/w = -dh/h$. Since hours decline first $[(dh/h) < 0]$, wages must still be rising when the percent change in earnings is zero.
10. Observed wages are the net earning capacity of individuals. If human capital depreciates observed wages will peak later than gross earning capacity. Our model predicts that market

time will peak before gross wages and therefore before net or observed wages.

11. The average cell sizes for the college, high school, and elementary groups are 45, 90, and 34, respectively.
12. For example, let the yearly labor force participation rate be 0.60. If the average work year for those women who did participate at some time during the year is 1,000 hours, average market time for all women would be 600 hours and nonmarket time, 8,160.
13. For the original treatment, see Becker (1975).
14. Because of individually financed investments in human capital, observed wages will be below the true opportunity cost of time. Since the frequency of these investments declines with age and is, in all cases, greater for men than for women, the wages of women relative to men will be overestimated at the early ages.
15. Jacob Mincer and Arleen Leibowitz have offered an alternative hypothesis to explain this phenomenon. They interpret the more rapid decline in market work of college-educated women as a differential response across education groups to the presence of young, especially preschool-age, children. In their hypothesis, college women have a comparative advantage in investing in the human capital of their children.
16. College-educated men are usually older than those in the lower schooling groups when they start their families, and this timing is also reflected in the dating of the peak in female home time of the college group.
17. Because of the small cell sizes, the profiles of black women contain considerable measurement error. This is especially true at older ages and is a concomitant of the high rates of marital instability among blacks.
18. That is, individual members of a cohort are permitted to under- or overestimate their future wage levels. If the average expectation of the cohort is unbiased, the wealth effects flowing from any individual mistakes will be eliminated in the aggregation.
19. If male and female wages grow at λ percent per year over time, the demand equation for male home time is

$$\frac{dM_t}{M_t} = S_m(\sigma_{mm} - \sigma_c)\frac{dW_{mt}}{W_{mt}} + S_f(\sigma_{mf} - \sigma_c)\frac{dW_{ft}}{W_{ft}} + \sigma_c(r - \sigma) + (1 - \sigma_c)(S_m + S_f)\lambda - \lambda$$

20. Each respondent was asked the length of his latest illness. The intervals for this question were 0, 1-3 months, 4-6 months, 7-12 months, and then in number of years. The intervals in months were given the class midpoints. I then calculated the average number of years that persons in any age cell were ill. Finally, this was converted to a yearly hours equivalent.
21. No direct information exists on the number of weekly hours worked by women who worked only in the year before the survey. It was therefore assumed that their weekly hours were in the same proportion to those of women in category 2 as their weeks worked were to weeks worked of women in that category, i.e., (WKSWK4F/WKSWK3F).
22. The motivation behind such a weighting procedure is straightforward. To achieve the most efficient estimate, a lower weight should be assigned to the least reliable observations, i.e., those that have the highest variance. However, a cost is incurred in this weighting procedure. The observations that receive the smallest weight occur in the youngest and oldest age groups; yet these are the observations that possess the largest relative variation in hours and wages.
23. The sign is positive when σ_{Mf} exceeds σ_c.
24. The wage elasticity of home time is $(\partial M/\partial W)(W/M)$. It is reasonable to assume that the lower the wage, the more hours will be spent searching for work. Other things the same, a demand curve for home time excluding search time would have a steeper (negative) slope than one including search time. It should be noted that the measured elasticity of the supply curve of market hours will fall if search is counted as part of total market hours because the

latter is then larger, and the increase in market hours per dollar increase in wages will be relatively less.

25. In many recent studies it has been asserted that the correct labor supply function should include search time. None of these has confronted the conceptual problems involved. For example, if unemployment is partly a seasonal phenomenon, seasonal workers may be compensated for their low hours by higher wages. At their current wage rates, it would be inappropriate to add this "unemployment" to their working time.

26. The following table lists the mean values of time spent looking for work or in illness.

	All White	Elementary	High	College	All Black
Men:					
Looking for work	32.0	70.1	30.6	12.4	49.7
Ill time	74.6	105.8	82.2	41.8	71.4
Women:					
Looking for work	34.2	48.0	26.3	5.6	82.1
Ill time	85.0	106.1	92.1	44.6	85.7

27. If real wages of husbands and wives increase at λ percent over time, the age coefficient is $\sigma_c(r - \alpha) + \eta(1 - s_m) - S_m\sigma_c$, where η is the income elasticity of consumption and s_m is the combined share of male and female time. $\eta(1 - sm)$ corresponds to the income effect; and $s_m\sigma_c$, to the substitution effect.

28. For example, the simple correlation between age and fraction of male whites who were ill was 0.88 in the SEO data.

29. It is expected intuitively that the OLS estimator will be unbiased, since the slope is as likely to be overestimated as underestimated, depending on the tracking order of the residuals. However, our uncertainty (variance) is larger. But standard errors are calculated using computed residuals. These will be too low since the estimated regression line will fit the inappropriate residuals rather well.

30. Of course this approach is open to many criticisms, one of the most important being that it ignores the endogenous character of children in an economic model. My weak defense is that single-equation estimation has a long tradition in labor supply studies. Also, I am attempting to make a somewhat different criticism of the conventional approach—that the effect of family size on the labor market behavior of men and women is related to their life cycle.

31. According to the first equation in tables 2 and 3, an increase in one preschool child would decrease male home time by 0.0178 percent and increase female home time by 0.0359 percent. Evaluated at the mean home time of 6,612 hours for men and 8,196 for women, this implies an increase of 107 market hours for the men and a reduction of 294 hours for their wives. If respective mean wages of men and women are \$3.44 and \$2.16 per hour, this further implies an increase of \$371.52 in men's earnings and a decrease of \$635.00 in women's.

32. In the two groups in which this effect is not strong—the all-black and the elementary school white—the coefficient on the variable for children younger than six years old has the expected sign, but its value is less than unity.

33. One limitation of this variable in SEO is that it is reported for the family unit, rather than being allocated among the individual members. It is not known if the unemployment insurance was awarded to the husband or to the wife. The variable is more significant in the male regressions, perhaps indicating that it is the husband's unemployment that produces positive results.

34. If the income is foreseen, the expected sign of WTHY will be zero. Because it was previously capitalized, it will not vary with age and, therefore, will not affect the timing of the market worker.

35. A more detailed treatment of the relationship between assets and labor supply is contained in Smith (1976).

36. The change in family earnings for an increase of λ percent in the male wage and λ' percent in the female wage is:

$$[w_{mt}N_{mt} + s_{mt}\sigma_c(w_{mt}M_t + w_{ft}F_t) + X_t s_{mt}\sigma_{Mx}]\lambda + [w_{ft}N_{ft} + s_{ft}\sigma_c(w_{mt}M_t + w_{ft}F_t) + X_t s_{ft}\sigma_{Fx}]\lambda'$$

37. An age term is included in the regression because we integrate equation 10 before making the estimate; $\pi_t Z_t[\sigma_c(r - \alpha) - \lambda(s_{xt} + s_{mt}\sigma_c)]$ becomes the coefficient of the age term.

38. There are two reasons for this bias. As age increases, real wealth falls by $s_{xt}\lambda$ percent, depressing consumption and increasing savings. In addition, the lifetime price index falls by $(s_{mt} + s_{ft})\lambda$ percent. The result, holding π_t constant (as in equation 18), is to increase the relative cost of consumption for each increase of one year in age, thus reducing consumption and increasing savings. Note, however, that the wage coefficients in equation 18 are not affected by the presence of secular growth. Another matter worth investigating is the impact of secular growth on observed cross-sectional savings-age profiles. To study this issue, it is necessary to calculate the total effect of the wage change:

$$\begin{aligned} dS_t &= -\lambda(w_{mt} + w_{ft}) - \pi_t Z_t[-s_{mt} - s_{xt} - s_{ft} - \sigma_c(s_{mt} + s_{ft}) + \sigma_c(s_{mt} + s_{ft})] + r dA_t \\ &= -\lambda(w_{mt} + w_{ft}) + \pi_t Z_t(s_{mt} + s_{ft} + s_{xt})\lambda + r dA_t \\ &= X_t - w_{mt}N_{mt} - w_{ft}N_{ft} + r dA_t \\ &= -S_t\lambda \end{aligned}$$

As a new cohort enters with proportionately higher wages at every age, its savings will be proportionate to the level of the previous cohort. The difference between this exercise and the previous one is that in the latter, if the true change in the life cycle wage is dw_{mt}/w_{mt}, the observed change in a cross section will be $(dw_{mt}/w_{mt}) - \lambda$. This is the measured wage change with age and is captured in the wage coefficient in the regression. To get the total effect on the savings profiles, the wage coefficient must be added to the secular change in wages. The change in savings with age will be more negatively sloped at ages at which savings were originally positive and more positively sloped at ages at which dissavings occurred.

39. Net worth consists of the sum of assets held in the form of business, land, home, car, bank accounts, government bonds, stocks, personal loans, and other assets minus debts in the form of business, home, land, car, clothing, fuel, medical, bank, and other debts. The other assets are boats, furnishings, clothing, many consumer durables (refrigerators, television, etc.), cash, pension benefits, inheritances, life insurance policies, and human capital investments.

40. Using three-year moving averages, savings at age $t = (A_{t+2} - A_{t-1})/3$.

41. An alternative would have been to use log savings as the dependent variable, but the negative values for savings precluded this.

42. Other weights (the reciprocal of log male hourly wages or log male earnings) were used as well. The results were similar to those reported in the text.

43. Variation in nonmarket productivity biases the wage coefficient in the savings function upward if nonmarket and market productivity are positively correlated. If γ is the percent increase in nonmarket productivity, $dS = (1 - \sigma_c)\,\pi_t F_t \gamma$. Empirical estimates suggest that $\sigma_c < 1$. See Ghez and Becker (1975).

44. The mean male and female hourly wages are \$3.47 and \$2.17. Mean male and female hours per year are 6,604 and 8,201.

45. Arithmetically,

$$(dN_{mt}/N_{mt}) = (-M_t/N_{mt})(dM_t/M_t)$$

is the ratio of male home time to working time and is approximately equal to 3.

46. If the true relation (measured in logs and deviations from their respective means) between annual hours (h) and hourly wages (w) is

(i) $h = Bw + u$

with $\xi(u) = 0$ and var $(u) = \sigma^2 u$. If earnings ($y = w + h$) are used

(ii) $h = [B/(1 + B)]Y + [u/(1 + B)]$ or $h = by + Z$

with $\xi\ (Z) = 0$ and var $(Z) = \sigma_w^2/(1 + B)^2$. Using OLS as the estimator for b gives $\hat{b} = \Sigma yh/\Sigma y^2$, which is a biased and inconsistent estimate, since

$$\hat{b} = \frac{\Sigma y(by + Z)}{\Sigma y^2} = b + \frac{\Sigma yZ}{\Sigma y^2}$$

Plimit as $n \rightarrow \infty$ is $\hat{b} = b + \xi(\Sigma yZ/\Sigma y^2)$

$$\xi(\Sigma yZ) = \xi[\xi(Bw + u)Z] = \frac{B}{1 + B}\xi(\xi Wu) + \frac{1}{1 + B}\xi(u^2)$$

$$= \frac{\sigma_u^2}{1 + B}$$

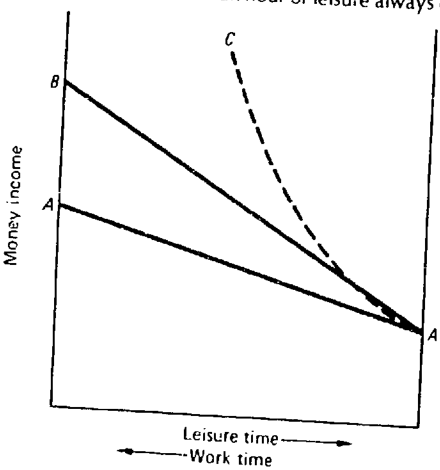
P limit as $N \rightarrow \infty$ is $\hat{b} = b + \sigma_u^2/[(1 + B)/\text{var}(y)]$. As long as $B > -1$ there exists a positive correlation between the disturbance in (ii) and the independent variable (E); hence $\hat{b}$ will be biased upward. Also, since $B = b/(1 - b)$ and $B > -1$ implies $b < 1$, an indirect estimate of B is also biased upward.

47. Only the estimates for male whites are reported, but the conclusions in the text hold for the other samples also.

48. For an excellent theoretical discussion of some distinctions between alternative definitions of labor supply, see Hanoch (1976).

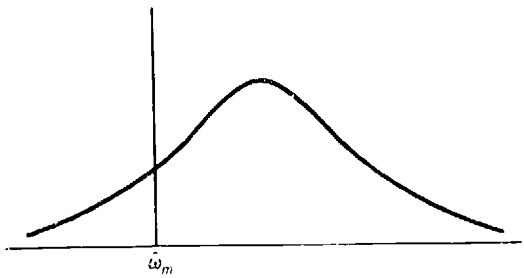
49. It may also be underestimated because of compositional changes in the labor force. As women's wages increase, the annual market hours of the new entrants are likely to be below those of women previously in the labor force.

50. In the accompanying diagram, consider two women who are alike in all respects except that Woman B receives a higher market wage than Woman A. The home wage is measured by the slope of the indifference curve, AC. As drawn below, only Woman B will work. For Woman A, the value of an hour of leisure always exceeds the market wage.



AA = budget line of Woman A
AB = budget line of Woman B
AC = indifference curve between income and leisure

51. Following Ben-Porath, let $f(-\omega)$ be the density function of home wages, illustrated below, where $\hat{\omega}_m$ = market wage.



Distribution of home wages

If all women in this group have the same potential market wage, LFPR is simply the shredded part of the distribution or LFPR $= \int_{-\infty}^{w} f(w_i)\, dw_i = F(\omega)$, where $F(\omega)$ is the cumulative distribution function.

52. This could explain why women's wage elasticities exceed men's. Also, we would expect that as LFPR for women has risen throughout the twentieth century, the estimated wage elasticity would also rise.
53. The logistic function is $P_i = [1/(1 + e)^{-BX}]$, where P is the probability of occurrence of i, given X.
54. The ideas presented in this section were first published in Smith (1975).
55. Throughout, I assume that the characteristics of these programs are properly anticipated. Thus, I ignore all the complex issues associated with the effects of unexpected programs.
56. If it is assumed for simplicity that benefits are received only between time periods t_1 and t_2, the change in the lifetime price index caused by the income maintenance program will be

$$dP/P = -\int_{t}^{t_2} (k_t S_{M_t} + K_t S_{f_t})\, \mu\, dt$$

As an approximation, we may write

$$dP/P = -(\bar{S}_M + \bar{S}_f) \int_{t}^{t_2} k_t \mu\, dt = -(\bar{S}_M + \bar{S}_f)\, \Omega\, \mu$$

Since $S_{M_t} = \bar{S}_M + \delta_t$, where δ_t is the deviation of the share in that period from the mean lifetime share, the approximation involves $\int_{t}^{t_2} k_t \delta_t dt \simeq 0$, that is, a weighted average of the deviations of the time shares from the mean lifetime share is approximately zero. In any case, any error caused by this approximation is likely to be small.

This interpretation of Ω holds precisely if the shares are identical in each period. In that case, $\int_{t}^{t_2} k_t dt = nk_t = n/N = \Omega$, where n is the number of time periods during which the family receives benefits and N is the total number of time periods in its lifetime. Even if the shares are not equal, Ω is a positive monotonic function of the number of periods of eligibility, and that is the interpretation maintained in the text.

57. Since both male and female wages fall by the same percent (μ), we may write

$$\frac{dM_t}{M_t} = -[\sigma_c (\bar{S}_M + \bar{S}_f)\Omega - S_{M_t}(\sigma_{MM} - \sigma_c) - S_{f_t}(\sigma_{MF} - \sigma_c)]\mu$$

or

$$\frac{dM_t}{M_t} = \sigma_c[(S_{M_t} + S_{f_t}) - (\bar{S}_M + \bar{S}_f)\Omega] + S_{X_t}\sigma_{MX}$$

By a similar proof the female equation is

$$\frac{dF_t}{F_t} = [\sigma_c(\bar{S}_M + \bar{S}_f)(1 - \Omega) + S_{X_t}\sigma_{FX}]\mu$$

and the market goods demand function is

$$\frac{dX_t}{X_t} = [(\bar{S}_M + \bar{S}_f)\sigma_c(1 - \Omega) + S_X\sigma_{XX}]\mu$$

58. In equation 19, the term $\sigma_c(\bar{S}_M + \bar{S}_f)(1 - \Omega)$ summarizes the interperiod substitution component.
59. It may be rewritten $E_t^* = E_t^p(1 - C_t^*)$, where $C_t^* = C_t/E_t^p$ and $\mu E_t^* = \mu(1 - C_t^*)E_t^p$. This concept of the fraction of potential earnings that is invested was introduced by Jacob Mincer.
60. In Mincer's terminology $C_t^* = k_t$. Mincer uses the age or experience distribution of k_t to explain age profiles of log earnings of individuals. The optimal life cycle investment model was developed by Ben-Porath (1967).
61. This assumes that the male and female investment profiles are parallel. Obviously, this need not be the case. Also, μ now is the percent reduction in female wages. The female equation is

$$\frac{dF_t}{F_t} = [\sigma_c(1 - \Omega)(\bar{S}_M + \bar{S}_f) + S_{X_t}\sigma_{FX} + (1 - \lambda)\sigma_{Mf}S_M]\mu$$

62. From the relation,

$$\frac{d(DM_t/M_t)}{d\lambda} = \sigma_c(1 - \Omega)S_M - S_f\sigma_{ff}$$

This derivative is positive.
63. From the relation

$$\frac{d(dF_t/F_t)}{d\lambda} = S_M(\sigma_c - \sigma_{Mf}) - \Omega\,\sigma_c$$

Since empirically $\sigma_c < \sigma_{Mf}$, this derivative is negative.
64. If job training is completely general, all investment costs will appear as forgone earnings.
65. From Smith (1972) on the basis of data from the 1967 Survey of Economic Opportunity. The regressions covered white families in which the husband and wife were both present in the household and husband's age was in the range 22-64.
66. It is possible to calculate the substitution effect in the life cycle model only because we have assumed that a single cohort has unbiased expectations of future incomes, with the result that real wealth remains constant throughout a cohort's life cycle experience. The age variable also contains differences in wealth between cohorts and this wealth effect cannot be disentangled from the effects of the interest rate and time preferences. Of course, it is the appealing feature of the life cycle equation that the substitution effect can be isolated.
67. Ghez also found this to be true for the life cycle equations for market goods consumption, thus providing direct support for the argument in the text.
68. The largest increase in market work during the period of ineligibility will occur when a family participates in the IMP for all years but one.

69. For the minimum estimates, it is also necessary to know $\sigma_{Mf}S_f$ and $\sigma_{Mf}S_M$. But from the life cycle model $\sigma_{Mf}S_f - S_f\sigma_c + 0.0283$ and $\sigma_{Mf}S_M - S_M\sigma_c + 0.0246$; hence $\sigma_{Mf}S_f \sim 0.0485$ and $\sigma_{Mf}S_M \simeq 0.0448$.
70. For a technical discussion of the sampling techniques used and the biases that might be present in the SEO sample, see "1966 and 1967 SEO Sample Design and Weighting," and "The Current Population Survey—A Report on Methodology," *Technical Paper No. 7.* Washington, D.C., 1963.
71. Basically the method used was to impose a cutoff for sample inclusion based on the percent of nonwhites in an area. This percent varied by region and SMSA size. For those sampling districts above the cutoff, the standard CPS methods were used to select households.
72. Farm families were eliminated both because of the difficulty of separating their labor income from the return on physical capital and because the division between market and home activities is not clear-cut.
73. Relatively few families had this characteristic. They were not included owing to the absence of yearly income data.
74. These military families were not included because their reported wage rates were not a reflection of their opportunity costs since they were subject to the coercion of the draft system in effect then.
75. The respective intervals used were 1-13, 14-26, 27-39, 40-47, 48-49, and 50-52 weeks. If, as seems plausible, the distribution of weeks in each interval is negatively skewed, my weeks worked variable is biased downward. This will also introduce a spurious negative correlation between annual hours worked and the hourly wage.
76. The official definition counts as members of the labor force those individuals who claim to be looking for work.

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