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A Life Cycle Family Model

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A Life Cycle Family Model

by James P. Smith*

This essay is one of three to be included in a proposed NBER volume entitled Economic Decision-Making in a Life Cycle Context. The other two essays are written by L. A. Lillard and James Heckman. The volume is expected to be in draft form by September 1973.

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Introduction

In the last two decades, economists have contributed major insights that have enriched 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.[1] His household production model permitted one to enter time in varying intensities in all the commodities produced by individuals.

Jacob Mincer argued persuasively that an individual's decision about the amount of hours to exchange for market dollars is often made in a family context.[2] 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 in which one may analyze 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.

A number of statistical studies have demonstrated that many empirical regularities were consistent with an economic explanation of the allocation of time.[3] Yet, it was apparent that serious deficiencies remained 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 is some concept of life time, the model is best suited to predict average lifetime participation rates. But individuals are also confronted with temporal variations in wage rates and other variables that could elicit timing responses about the long-run levels desired. A complete model of labor supply should incorporate the impact of this variation on the timing of market responses. In recent papers, Ghez and Becker[4] 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. This paper builds on their work by treating explicitly the family context in which these decisions are made and two related issues are investigated. First, for each family member, how is the available life-time stock of time distributed over time between market and non-market activities. Secondly, within the family unit, what potential exists for substituting the time of one member for that of another?

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 the market hours behavior of individual members over time.[5]

Assume for simplicity that the intertemporal utility function of a family that has an horizon of n periods (equal to its life span) is of the CES variety, so that it may be written

$$(1) \qquad U = \left[\int_0^n Z_t^{\frac{\sigma_c - 1}{\sigma_c}} \; e^{-\alpha t} \; dt\right]^{\frac{\sigma_c}{\sigma_c - 1}}$$

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

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

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

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

$$(3b) \qquad \int_o^n X_t \, e^{-rt} dt = \int_o^n (W_{mt} N_{mt} + W_{ft} N_{ft}) e^{-rt} dt + A_o$$

The time constraint (3a) indicates that the total amount of time available to each family member (T, a given) in every period is absorbed either in the household production process 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 discounted market earnings of both the husband and wife and initial property wealth (A_o). The two constraints combine easily into one as follows:

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

where

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

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 (1) subject to the production function (2) and the wealth constraint (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. The result of this maximization is the demand function (or consumption function) for the basic commodity at each age (t), as follows:

$$(5) \qquad Z_t = R\, P^{\sigma_c - 1}\, \pi_t^{-\sigma_c}\, e^{\sigma_c (r-\alpha) t}$$

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

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

$$(6) \qquad \frac{d\, Z_t}{Z_t} = -\sigma_c \frac{d\, \pi_t}{\pi_t} + \sigma_c (r - \alpha)$$

where α is an index of time preference indicating whether the family has time preference for the present ($\alpha > 0$), for the future ($\alpha < 0$) or neutral time preference ($\alpha = 0$).

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 partial elasticity of substitution between inputs i and j:[6]

$$(7) \qquad \frac{dM_t}{M_t} = \frac{dZ_t}{Z_t} - (S_F\sigma_{MF} + S_X\sigma_{MX})\frac{d\, w_{mt}}{w_{mt}} + S_F\sigma_{MF}\frac{d\, w_{ft}}{w_{ft}} - \frac{dB_t}{B_t} .$$

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

$$(8) \qquad \frac{dM_t}{M_t} = -(S_M\sigma_c + S_F\sigma_{MX} + S_X\sigma_{MX})\frac{d\, w_{mt}}{w_{mt}} + S_F(\sigma_{MF} - \sigma_c)\frac{d\, w_{ft}}{w_{ft}} + \sigma_c(r - \alpha) + (\sigma_c - 1)\frac{dB_t}{B_t}$$

$$(9) \qquad \frac{dF_t}{F_t} = -(S_F\sigma_c + S_M\sigma_{MF} + S_X\sigma_{MX})\frac{d\, w_{ft}}{w_{ft}} + S_m(\sigma_{MF} - \sigma_c)\frac{d\, w_{mt}}{w_{mt}} + \sigma_c(r - \alpha) + (\sigma_c - 1)\frac{dB_t}{B_t} .$$

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, and time preference,[7] 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. Because the price of one of the inputs is rising, the relative price of future commodities has risen. The resulting decline in future consumption will, on this "scale" effect, reduce the demand for wife's 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 in total costs of the wife's time. In addition to this intertemporal substitution between commodities, there exists the possibility of substi- in the production process. As w_{ft} increases, the wife's time will be substituted against by the other two inputs. This effect ($S_M \sigma_{MF} + S_X \sigma_{FX}$) will also lead to a decline in the use of wife's time as her real wage rises.[8] It follows that in those periods when the real wage of the wife is high, the model predicts, ceteris paribus, 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 existence of income effects in the static theory which gives rise to the possibility of 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 price of future commodities and induce a fall in the use of all inputs including the time of his wife. However, in the production process, the relative price of wife's time is declining, and F_t per unit of output will increase if the two time inputs are substitutes ($\sigma_{MF} > 0$). Thus, the behavior of hours of work of the wife is ambiguous with respect to the wage of the husband. 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 $\left(\frac{dB_t}{B_t}\right)$ is an interesting one. Since the type of technical change is of the Hicks neutral variety, a one per cent improvement in efficiency will lower future prices by one per cent and increase the amount consumed in the future. The effect on the use of inputs because input requirements per unit of output have also declined by one per cent. 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 one ($\sigma_c - 1 > 0$).

Life Cycle Patterns

Because the available data on the actual age patterns of market work for married men and women was limited in its detail and quality, I constructed a new set of profiles from a subsample of the 1967 Survey of Economic Opportunity. These age profiles turned out to be quite fascinating and illustrate, in a way not possible with multivariate regression techniques, 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 non-farm families whose husbands' 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 into three education classes of the husband. The education groups were elementary grades 1-8; high school grades 9-12; and college grades 13 or higher.

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 both movements along life cycle paths and across profiles of different cohorts. If the between cohort effects are important, these profiles should be adjusted before one has 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.[9] Since these rates have incrased 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. In Appendix C, these profiles obtained from 1967 SEO data are compared to ones obtained from the 1960 U.S. Census.

Table 1 lists 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 dimensions of market work. In an average year, over 40 percent of white women specialize exclusively in activities that occur in the non-market sector. Those women

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]	Yearly LFPR[b]	Weekly LFPR[b]	Annual Hours Worked	Hourly Wage Rate
White Men	2147.5	43.84	48.82	NA[c]	NA	2147.5	3.44
White Women	1486.0	34.46	36.58	.52	.35	563.4	2.16
Black Men	1963.7	40.69	47.71	NA	NA	1963.7	2.37
Black Women	1385.6	33.58	35.36	.65	.52	662.6	1.68
White Men -- Elementary	2039.1	42.43	48.04	NA	NA	2039.1	2.64
White Women -- Elementary	1515.4	35.91	35.33	.48	.31	511.5	1.77
White Men -- High School	2171.6	44.15	49.06	NA	NA	2171.6	3.24
White Women -- High School	1496.2	34.62	37.14	.53	.37	594.0	2.10
White Men -- College	2189.2	44.26	49.33	NA	NA	2189.2	4.44
White Women -- College	1434.5	33.71	35.82	.49	.33	505.6	2.53

Notes:

[a] Averaged over labor market members only.

[b] LFPR = labor force participation rate.

[c] NA = not available.

Source: Smith (1972). These are life-cycle means for 1966.

who are participants work fewer weeks in any year, and a smaller number of 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 quite clearly increase as we move toward the more educated white classes. This rise in annual hours takes place in both dimensions of labor supply--weeks worked and hours per week--a phenomenon readily explained in the one-period model by the rising level of male market wages by education class. Within every education class, men spend approximately four times as many hours in the market sector as women do. Relative to their wives, men's lifetime market participation and hourly wage both increase as we move up the education scale.

The lifetime levels of market participation are, in all dimensions, lower for black males than for white males. These lower levels are paralled by a smaller hourly return for black males from market activity. In fact, the intrafamily wage structure differs by race. Relative male/female wages are lower in black families, offering them market incentives to be less wife-time-intensive in home work. Black women indeed perform more market work, both absolutely and relative to their husbands, than white women. Racial comparisons for women must be made carefully, for the magnitude of the differences by race depends critically on the dimension of labor supply used. Most studies of female labor supply have compared racial groups by their weekly labor force participation rates. These rates are 50 percent higher for black women, but this grossly overstates the true racial differences. Although a smaller fraction of white women than black women are labor force members, those white women in the labor force work more hours per year than black women participants. Therefore, when measures of working time include zero values for non-workers, black women work less than 20 percent (100 hours) a year more 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 males are illustrated in Fig. 1a. The overall pattern of annual working hours with its inverted U shape conforms quite well to implications derived from the life cycle model.[10] The age profile of wage rates combined with a positive interest rate renders intelligible both the inverted U shape and the peaking aspects of these graphs of hours worked. Since wages are relatively low for the younger cohorts, they have an incentive to concentrate their time in non-market pursuits. A positive interest rate is consistent with the falling hours during the older ages and the peaking of hours before wage rates.[11] The resulting lower discounted prices of future consumption increase the derived demand for home time at the older ages. A positive interest rate also implies that discounted commodity prices will decline before real wage rates and that annual working hours will lead wages in their respective peaks.[12] Since the peak in hours precedes that in hourly wages, earnings will decline before hourly wage rates.[13] Wages begin to fall in the late fifties (Fig. 1b), while earnings profiles are known to peak in the late forties or early fifties. Although the existing literature 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 is due to individuals optimally allocating their time towards home activities.[14]

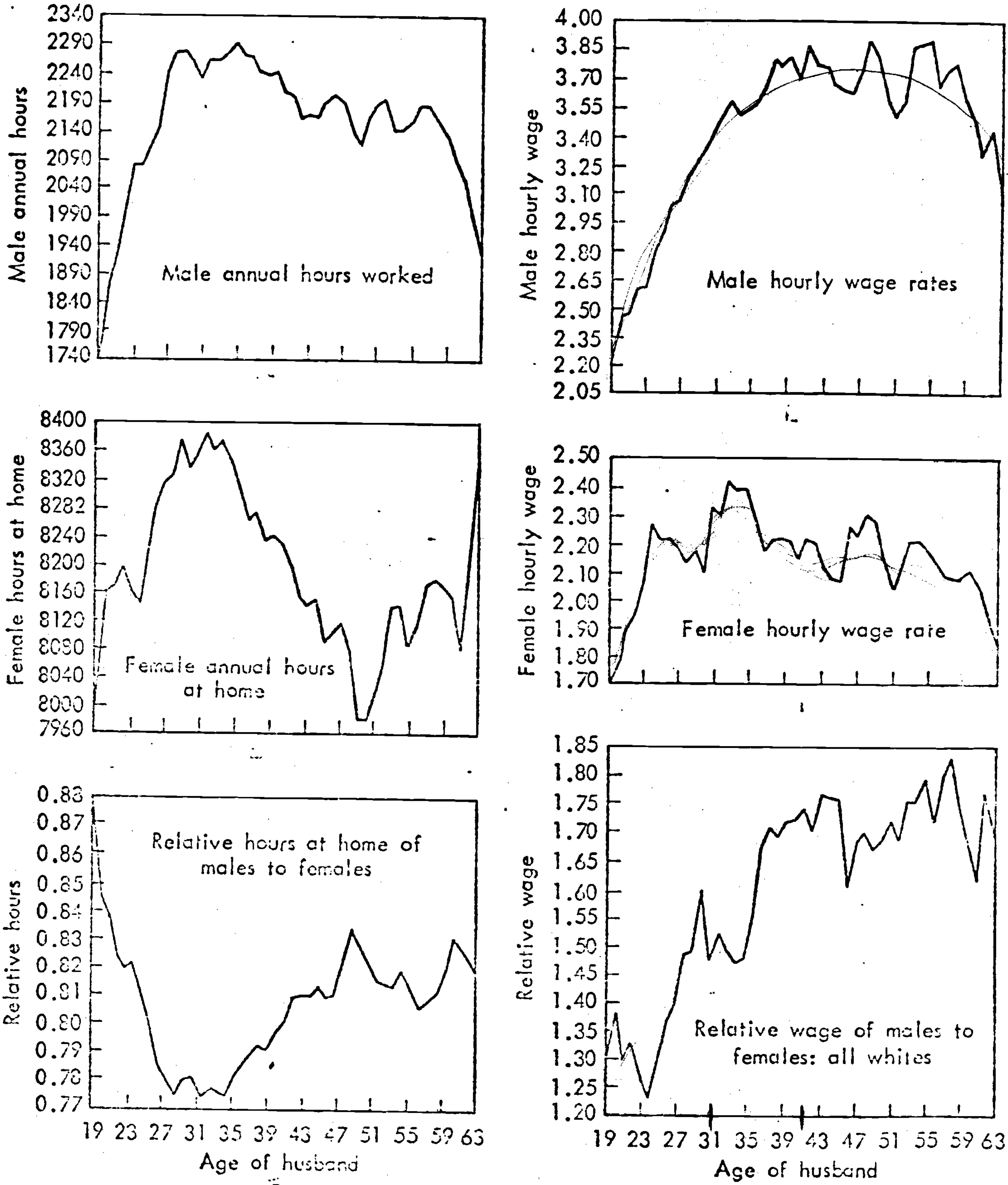
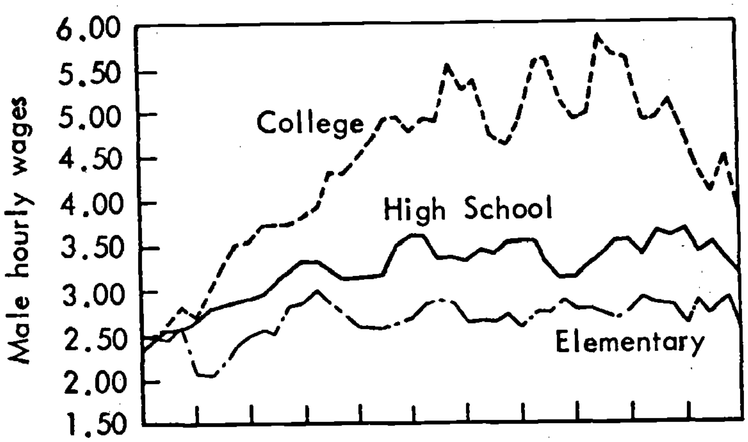


Fig. 1—Annual market or home hours and hourly wage rates, all white married men and women

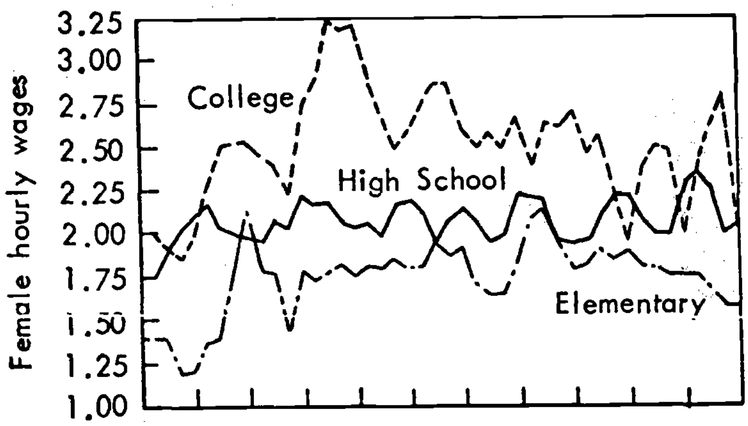
The profiles generated for black males add additional support to the life cycle model. Their annual hours profile (Fig. 5a) also has the inverted U form--the expected shape in view of the age variation in their hourly wages and positive interest rates. Hours worked peak at a younger age, which reflects in our model the earlier maximum value of black hourly wages (Fig. 5b). The latter fact implies that, compared to white males, commodity prices achieve their extreme values at a younger age for Negroes, which in turn leads to the confirmed prediction on the earlier peaking of their market time. Compared to white males, both the working time and wage profiles are somewhat flatter for blacks. 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.

Interpretation of the differences among male white education groups is more difficult because of fluctuations evidently caused by the smaller cell sizes for these groups.[15] Still, the age pattern of male annual hours within each education class (Fig. 2c) is on the whole similar to that of the complete white sample although the presence of an initial period of rising hours in the elementary profile is questionable. The small cell sizes make the pre-thirty-year-old section of the elementary profile so erratic that no clear trend is discernible. The tendency for the annual hours profiles 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 (Fig. 2a), the empirical finding that annual market hours peak at an older age the more educated the group also is a confirmation of one implication of the life cycle model.

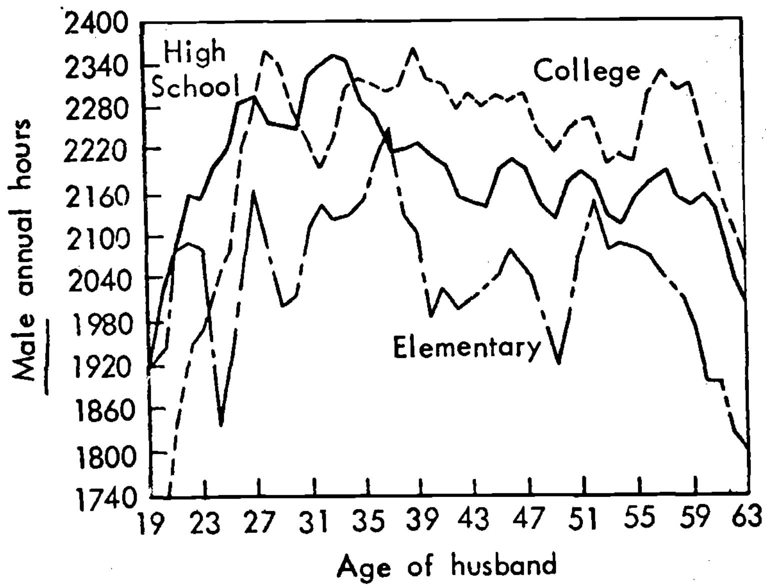
Economists have used a number of operational definitions of women's labor supply, weeks worked, weekly or annual hours of working women, and



(a) Male hourly wage rates



(b) Female hourly wage rates



(c) Annual hours worked by education class males

Fig. 2 — Male and female hourly wage rate, all white married men and women by education level of husband

weekly labor-force-participation rates. In recent papers, Reuben Gronau and H. Gregg Lewis[16] 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 to their argument. It is clear in Fig. 3 that any single definition, if considered in isolation from the others, would yield a misleading description of the life cycle pattern of female labor supply. The best single descriptive statistic combines the labor-force-participation dimension with the annual working hours of working wives. Average time at home (Fig. 1c) at any age is defined to be a weighted average of the time spent at home of working and non-working women with the weights being the fraction of women working and not working.[17] At the beginning of the cycle, average market hours of all married white women (Fig. 1c) are relatively high with a substantial fraction of women working at some time during the year (Fig. 3d), but on an irregular and short term basis as indicated by the low number of weeks worked (Fig. 3a). Then time at home increases continuously into the middle thirties as many white women leave the labor force completely. This incrase in home time is mainly a consequence of the 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 labor market withdrawal of women whose working time was well below the average. Following the home time peak in the thirties, these 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

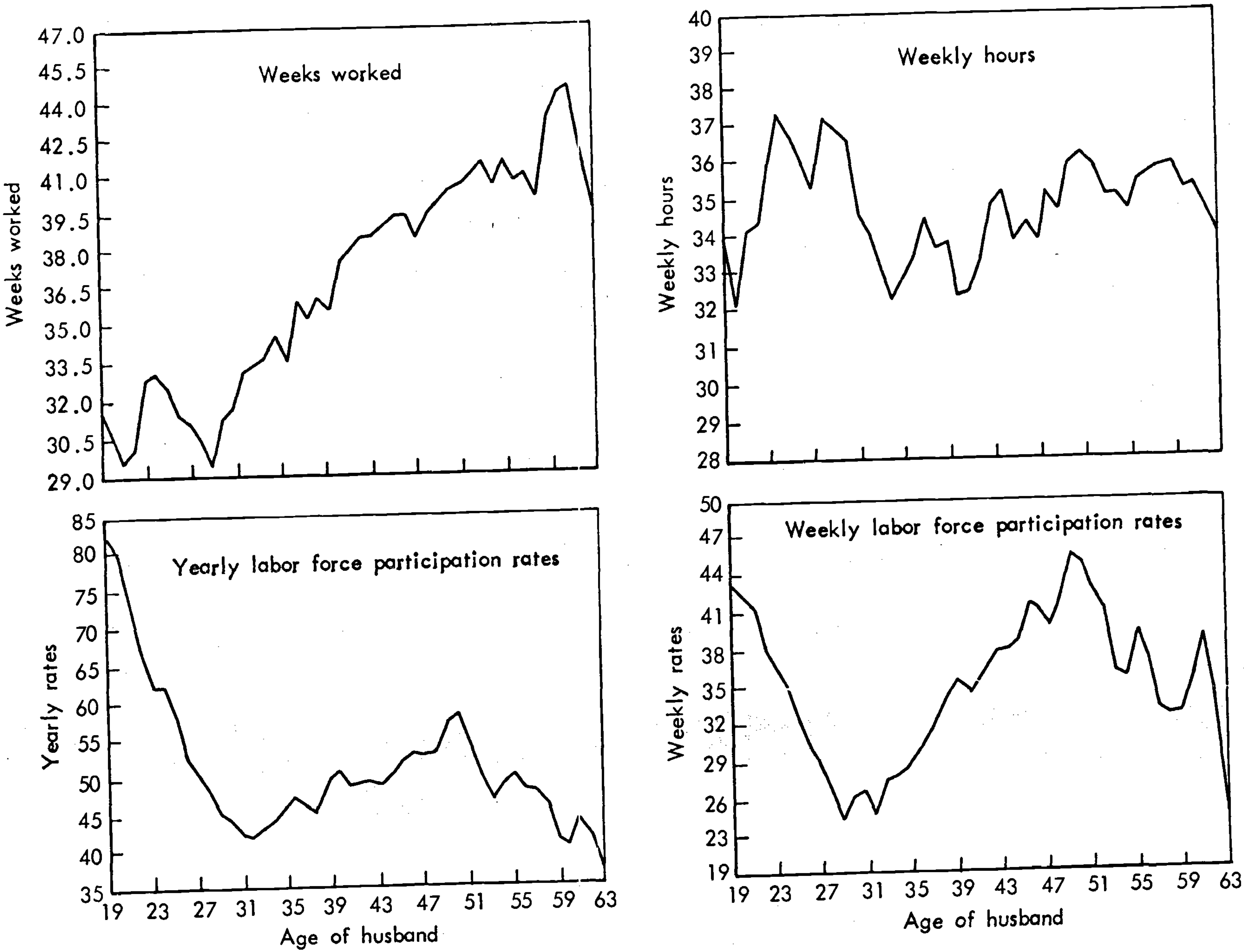


Fig. 3 — Weeks worked, weekly hours, yearly and weekly participation rates, all white married women

One should recognize, however, that many aspects of the women's profiles are also consistent with life-cycle variations in the relative wages of the marriage partners. Compared to their husbands, white female hourly wages are relatively age invariant (Fig. 1d) and also peak at an earlier age. One prediction of human capital theory is that wage profiles will rise more rapidly and peak later, the greater the amount a worker invests in himself.[19] Because of the smaller fraction of future time they will spend in the market, women have less incentive to invest in market forms of human capital. The profile of the relative wage of husbands to wives (Fig. 1f) has a concave shape with the largest increases in male relative wages occurring at the youngest ages.[20] Relative to his wife, both a husband's wage and market time are lowest at the youngest ages. The most rapid increases in his relative market time (Fig. 1e) before the mid-thirties occur simultaneously with the sharpest increases in his relative wages. Therefore, these profiles are not in conflict with a model allowing inter-family substitution of time as the value of 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 husband's education level (Fig. 4), the principal differences are the following: (1) before age thirty, wives' non-market hours are negatively related to their husbands' educational attainment; (2) between age thirty and fifty, women in the college group engage in home activities to a much greater extent than women 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

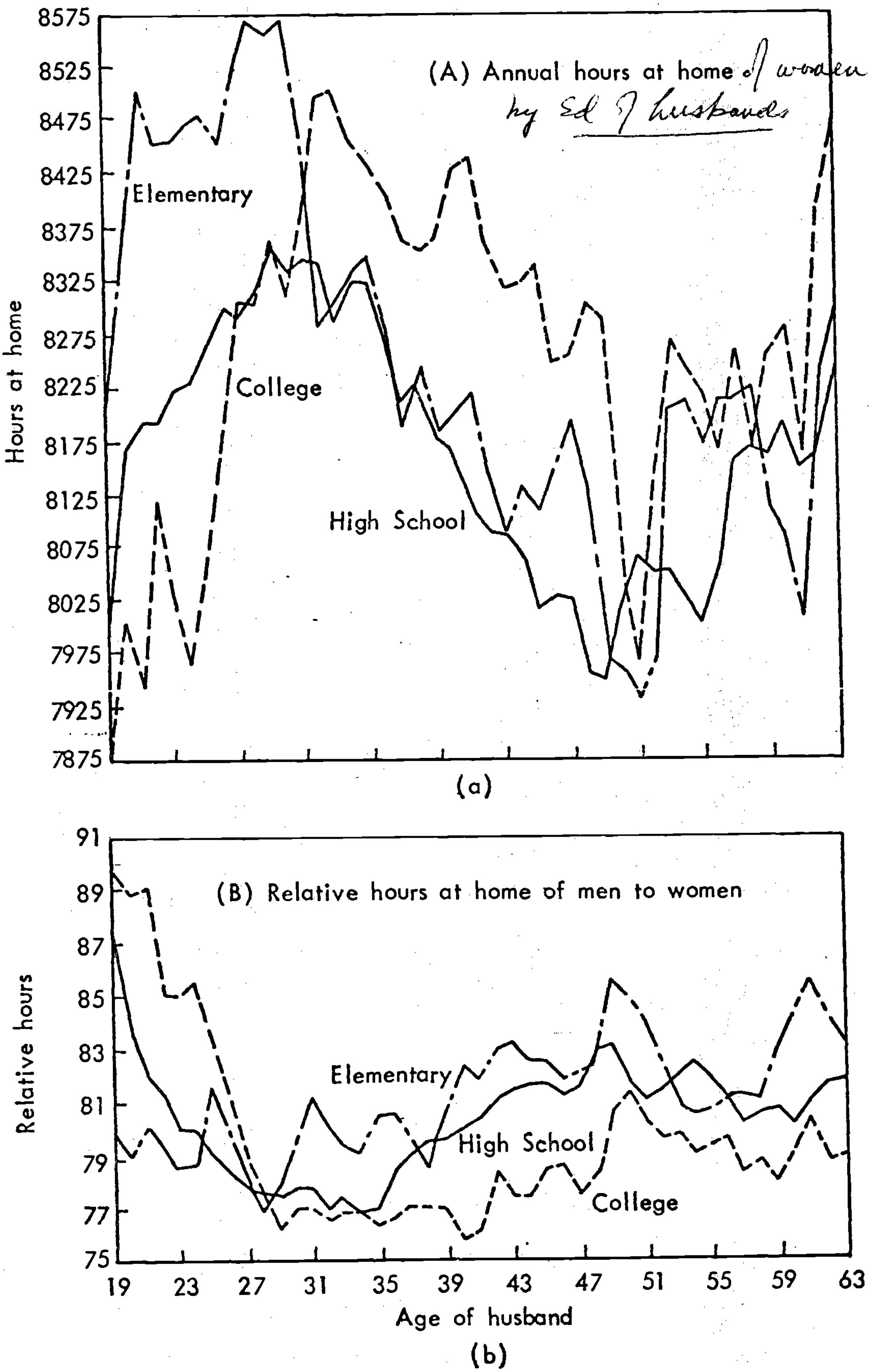


Fig. 4—Annual time at home and relative time of men to women at home, all white married females by education of husband

between high school and elementary groups; (4) the peak level of home time occurs at an older age, the more educated the group; and (5) there is a tendency for women's hours profiles (particularly in relative terms (Fig. 4b)) to flatten out, the lower the education level of the husband.

All five dissimilarities are consistent with differences among education groups in age-related variations within family units in market and non-market productivities. The positive correlation at the youngest ages between female market participation and educational attainment presumably results from the larger expected levels of relative male wages in future periods for the more educated. This supplies the more educated women with incentives to concentrate their market activity at those ages in which the husbands' comparative advantage in market activities is not as strong. The more rapid withdrawal of educated women from the market sector into the mid-thirties coincides with a steeply rising relative male wage.[21] Between ages thirty and fifty, relative male wages and market hours increases with education level, and the largest differences in both relative hours and relative wages is between the high school and college groups. The peak levels of both female relative home time and male relative wage are achieved at an older age the more educated the group.[22] 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 each education subsample, variations in relative market productivities of spouses become less important as the family unit ages. The profiles of relative husband/wife market time begin increasingly to mirror life cycle movements in the relative non-market productivities of spouses. The decline in relative male market time between ages thirty and fifty is caused by changes in female non-market productivity flowing from the declining fraction of women with young children at home. After age fifty, this variation in non-market productivity is also less important as children leave home. The lack of variation in either relative market or non-market productivity is matched by a generally constant relative hours profile during this period.

The profiles for black married women (Fig. 5c) are more similar to the observed male profiles than they are to those of white females.[23] Both black married men and women have inverted U shaped market hours profiles. This translates into a very erratic black husband-wife relative hours profile (Fig. 5e) with no clear trend discernible. The sharpest contrast between the hours behavior of black and white married females occurs before age 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 betwee white and black married women. The relative male/female wage structure for blacks exhibits less variation over the cycle (Fig. 5f) 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 offers a partial explanation for the hours behavior of black women. Black women do not generally concentrate their childbearing in 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 facing black women. This

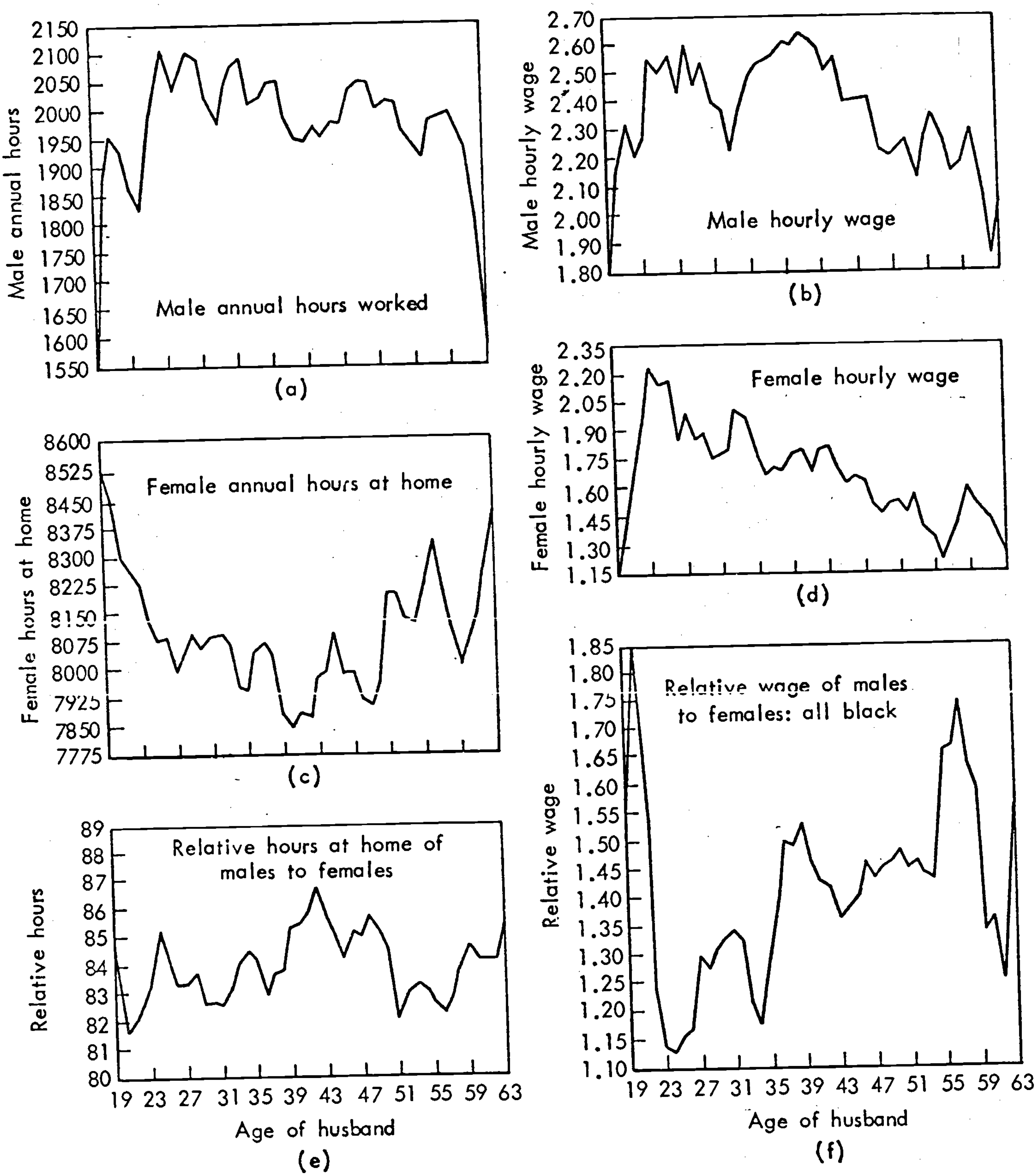


Fig. 5—Annual work or home hours, and hourly wage rates, all black married men and women

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 (Fig. 5f) 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

The ideal data to use to test a life cycle theory would be observations on the same individuals over a number of years. But the absence of extensive panel data forces a researcher to attempt to simulate it with the more available cross sectional surveys. Fortunately, Ghez[24] has developed techniques that, under appropriate assumptions, enable one to use cross sectional information. First, the sample is stratified by the age of the husband. Within every age group, mean values of all variables 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 a cohort's expectations are unbiased on average.[25] Using equations (8) and (9) and aggregating over all families at each age (t) of husbands, we have, neglecting changes in home productivity[26]

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

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

Upon integrating

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

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

Equations (10) and (11) are the demand equations for male and female home time that were estimated. 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 both lowering the amount of time at home. No a priori predictions can be made on the signs of c_2 and d_2 because altering the wage of one spouse produces conflicting incentives for the use of time of the other spouse. c_3 and d_3 are the age coefficients that 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, one is implicitly assuming that families at age j in 1967 would in i years be in a situation identical to families of age i + j in 1967. Yet, we know that real wages have grown over time so that younger cohorts have a higher expected real wealth. As long as real wages grow at a constant rate secularly, the estimated wage coefficient will be unbiased, but the age coefficient will be a biased estimate of the interest rate effect.[27] Intuitively, 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 empirical results are based on the subsample of the 1967 SEO described above. Although all the variables used are listed and defined in Table 1, a few deserve additional comments. Hours spent in home production is a difficult variable to measure precisely. One simple solution for husbands is to treat all non-working hours as time spent at home. This approach uses CHR1M which is simply the difference between total number of hours per year (8760) and the number of working hours. This method has several shortcomings since many non-working hours are spent neither producing nor consuming but in investments in Human Capital, both through formal schooling and on-the-job investments, 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 including persons in each schooling class who are 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 for 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 ill.[28] The second definition of male home time subtracted from total yearly hours, the time spent working, looking for work and ill.

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 non-workers. 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.[29] The second definition of female home time (CHR2F) excluded from home time time working, looking for work, and time ill.

Table 1

Definition of Variables

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 8760 - HRYRM
LFPWK	Fraction of women working in SEO survey week
LFPYR	Fraction of women working in 1966
CHR1F	Female Hours at Home = (1-LFPYR)8760 + LFPWK(8760-HRYRF) + (LFPYR-LFPWK)(8760-(WKSWK4F·HRSF(WKSWK4F/WKSWK3F))
HEALTH	Annual Hours Ill
CHR2M	Male Annual Home Hours = 8760-(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	Workingmen's compensation from 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 Males
KUSV	Number of children under seven years old

[a]In the regression tables, some variable names include as a final letter either the letter M or F which indicates that the variable refers to males or females respectively. If the variable name is preceded by the letter L, the variable is in logs.

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 by weighting each observation (age cell) by its cell size.[30]

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 towards positive values. Hourly wages are computed by dividing weekly wages by hours worked last 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 spend in job training activities is expected to decline with age so that 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 2 towards zero values. Using the male survey week weekly wage in place of male hourly wages provides some control over the measurement error biases since the 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 male hourly wages. The extent of the bias present with 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 were larger in those samples with the smaller cell sizes--the black and education specific white samples. In all five samples of Table 2, the sizes of the male weekly wage coefficients was similar and all had the predicted negative sign.

An additional test of the errors in variables problem was performed. A second weekly wage measure was available from the SEO by dividing last year's earnings by last year's weeks worked. With the weekly wage variable in the text, the dependent hours variable and independent wage variable are constructed independently of each other. This is not true for this second weekly wage definition so that regressions with this wage variable still contain the spurious negative correlation between market time and wages. If one compares the coefficients of the two weekly wage variables, one would expect based on the errors in variables problem, that the coefficient for the second weekly wage is less negative than those reported in the text. Also the difference between with the two wages should be negatively related to the average cell size. Both these 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 female wages is small compared to that of male wages so that it should play a smaller role is explaining the timing of market participation of family members. Secondly, during any week approximately sixty 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 mean female wage is probably a less reliable statistic describing the true wage of working individuals. The third problem is that the value of time (shadow home wage) of non-working women is not necessarily equal to the observed wage of workers. Reuben Gronau has pointed out that for population subgroups in

Table 2

Male Time at Home

Dependent Variable[b]	LHRWGM	LHRWGF	AGE	KUSV	LWKWGM	LWTHY	LWKY	LUADI	constant	R^2
					Independent Variables[a]					
A. All White Men (Ages 22-64)										
LCHR1M	-.1040	.0202	.00014	-.0178					8.92	.75
	(6.88)	(.82)	(.67)	(4.60)					(52.45)	
LCHR1M		.0283	.00007	-0.158	-.1065				9.31	.88
		(1.71)	(.49)	(5.92)	(11.71)				(241.6)	
LCHR1M	-.0667	-.007	.0004	-.0222		-.0105	.0103	-.0014	8.91	.80
	(2.86)	(.26)	(1.36)	(5.45)		(1.79)	(2.12)	(.45)	(281.0)	
LCHR2M		.0160	-.0006	-.0185	-.0796				9.19	.76
		(.82)	(3.46)	(5.83)	(7.45)				(203.1)	
B. All Black Men (Ages 22-64)										
LCHR1M	-.0643	.0455	.00001	-.0107					8.86	.22
	(2.16)	(1.71)	(.031)	(1.35)					(255.6)	
LCHR1M		.0480	-.00002	-.0070	-.0937				9.23	.43
		(2.21)	(.061)	(1.07)	(4.50)				(96.2)	
LCHR1M	-.0816	.0609	.0000	-.011		-.0043	.0011	.0047	8.87	.27
	(2.50)	(2.07)	(.01)	(1.1)		(1.30)	(.20)	(1.27)	(221.6)	
LCHR2M		.0589	-.0005	.0149	-.0701				9.12	.25
		(2.11)	(1.06)	(1.75)	(2.62)				(73.89)	
C. College White Men (Ages 26-64)										
LCHR1M		.0454	-.00002	-.0180	-.0872				9.21	.48
		(3.29)	(.07)	(2.81)	(5.60)				(15.8)	
LCHR2M		.0466	-.0001	-.0161	-.0805				9.17	.46
		(3.37)	(.32)	(2.51)	(5.16)				(115.3	
D. High School White Men (Ages 22-64)										
LCHR1M		.0413	-.00008	-.0160	-.1092				9.31	.76
		(2.24)	(.37)	(4.15)	(7.31)				(133.8)	
LCHR2M		.0546	-.0001	-.0145	-.1032				9.26	.55
		(2.20)	(.41)	(2.81)	(5.20)				(100.1)	
E. Elementary School White Men (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
		(.11)	(.68)	(.42)	(1.95)				(69.9)	

[a] t values are in parenthesis below coefficients.

[b] If the variable name is preceded by the letter L, the variable was entered in log form. If the final letter in the variable name is M or F, the variable refers to males or females respectively.

Table 3

Female Time at Home

Dependent Variable[b]	Independent Variables[a]									
	LHRWGF	LHRWGM	AGE	KUSV	LWKWGF	LWTHY	LWKY	LOADI	constant	R^2
A. All White Females (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 (.36)	-.001 (.48)	9.40 (125.2)	.92
LCHR2F		.0358 (3.04)	.00001 (.08)	.035 (9.37)	-.0856 (4.31)				9.30 (106.2)	.92
B. All Black Women (Ages 22-64)										
LCHR1F	-.039 (1.27)	-.1367 (4.0)	-.0004 (.78)	.0048 (.53)					9.14 (229.5)	.44
LCHR1F		-.1127 (4.11)	-.0011 (2.4)	.0034 (.46)	-.0695 (4.54)				9.40 (138.6)	.62
LCHR2F		-.096 (3.70)	-.0016 (3.70)	.0018 (.254)					9.38 (146.2)	.61
C. College White Women (Ages 26-64)										
LCHR1F		.0416 (1.36)	.0006 (1.16)	.032 (3.66)	-.0547 (2.52)				9.17 (91.9)	.54
LCHR2F		.0421 (2.16)	.0003 (.51)	.0329 (3.46)	-.0394 (1.69)				9.10 (85.3)	.61
D. High School White Women (Ages 22-64)										
LCHR1F		.0188 (1.11)	.00075 (2.96)	.038 (8.40)	-.0115 (.68)				8.99 (120.1)	.84
LCHR2F		.0297 (1.56)	-.00007 (.25)	.0335 (6.58)	-.0024 (.12)				8.95 (106.0)	.88
E. Elementary School White Women (Ages 19-64)										
LCHR1F		-.0407 (1.24)	.00057 (1.49)	.029 (4.12)	-.040 (2.12)				9.18 (121.4)	.62
LCHR2F		-.046 (1.23)	.0001 (.26)	.0349 (4.14)					9.19 (104.9)	.74

[a] t values are in parenthesis below coefficients.

[b] If the variable name is preceded by the letter L, the variable was entered in log form. If the final letter in the variable name is M or F, the variable refers to males or females respectively.

which a large fraction are not working, the observed wage distribution represents only one section of the total wage offer distribution.[31] The unobserved section of the wage offer distribution 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 due to what he calls a selectivity bias. For example, in time periods when young children are present, 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 3) 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 with female hourly wages. Thus, the negative sign of the own wage coefficient in both the male and female regressions support 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,[32] the sign of the cross substitution wage term will be positive. In almost every male sample, an increase in the female wage increased 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 female home time regressions. The only troublesome results are the negative signs of male wages in the white elementary and especially black female regressions. 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 male time than they are for female time. For the total white sample, this appears to be the case. In the education specific samples, goods are a better substitute for male home time than for female time only in the college and high school samples. In the all black and elementary white sample, this relation switches and goods appear to substitute more easily against female time.

One test of consistency suggested by consumer demand theory is that the slopes of these cross substitution terms should be equal (that is, $\frac{\partial M_t}{\partial W_{ft}} = \frac{\partial F_t}{\partial W_{mt}}$). However, both in elasticities and in terms of absolute slopes the effect of an increase in the male wage has a larger effect on female home time than an increase in the female wage has on male home time. However, it is 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 30-plus hours per week and thus it is not surprising that the $\frac{\partial F_t}{\partial W_{mt}} > \frac{\partial M_t}{\partial W_{ft}}$.

Table 2 also reports regressions for alternative definitions of home time. In addition to working time, time spend looking for work is not counted as available for home production in constructing LCHR3. Theoretically, one cannot predict the effect of excluding time looking for work on the home time wage elasticity. On one hand, this elasticity evaluated at any wage will be greater (in absolute value) since mean home hours are lower. But the slope component of the elasticity expression ($\partial M/\partial W$) should decline so that the net impact of excluding search time depends on which effect is stronger.[33] Although the results do not differ substantially from those with the first definition of home time,[34] there is a tendency for the own wage elasticity to decline for all male groups suggesting that the demand curve slopes have decreased sufficiently to offset the lower mean home hours.[35] The other definition of home time, LCHR2, subtracted from total yearly true annual hours spent working, looking for work, and ill. The additional exclusion of ill time generally had the effect of reducing the observed wage elasticities so that any negative relation between wages and ill time was not strong enough to offset the reduction in mean home hours.

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 includes all non-working hours, the only male sample in which age has a significant positive sign is the elementary. The age variable is 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 of inter-cohort changes are important. The measured age difference is capturing both a movement along a life cycle hours path 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.[36] For males, the time series evidence indicates that the income effect outweighs the substitution effect so that the cohort effect conflicts with the life cycle expectation. The substantial increases in recent decades in married female labor force participation rates 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 is the strong positive correlation of sick time with age.[37] When the definition of home time is used which excludes time searching for work and time ill (CHR2), the positive age effect in the elementary male and white female samples is eliminated. In fact, a significant negative sign appears in the all white male and black female samples.

The low values of the Durbin-Watson statistics indicate that positive serial correlation exists in these regressions. Since each observation is a three-year moving average, errors tend to perpetuate themselves and autocorrelated residuals were expected.[38] In this situation, OLS will not generate biased coefficients, but the calculated standard errors are too low. In evaluating the t values, a degree of caution is in order.

The serial correlation that plagued the male regressions is present in the female ones as well. The use of three-year moving averages is not sufficient to explain all the autocorrelation. Female home time is 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 will not result from a three-year moving average, but are caused by other factors related to the age ordering of the observations. Some possibilities are examined in the section below on children.

Within a family unit and across different families, the demand for home time is related to a variety of family characteristics which could affect or strengthen the incentives provided by the market sector. To proxy these factors, I followed the conventional approach of economists by including as an independent variable the number of children less than seven (KUSV).[39] The depressing effect of young children on the market participation of females has been well documented by others. But my work shows that it is also a factor in white male supply functions--having the opposite effect of increasing male 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 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 increases when young children are present. Since the absolute size of the coefficient of KUSV is greater for wives than husbands, both the percentage and absolute number of female hours withdrawn from the market exceeds the percentage and absolute increase in market hours of their husbands. Evaluated at the mean levels, an increase in one young child less than seven would lead to a net reduction of approximately $263 in family earnings.[40] The number of young children has no significant effect on the working time of black wives or husbands. Indeed, this lack of response to the presence of children is a major behavioral difference between the two racial groups. A complete study of the causes of this dissimilarity should be considered high priority research. My work does offer two explanations--the racial patterns of child spacing and timing and the higher rates of marital instability among blacks. According to Table 4, the fraction of the life cycle when young children are present is longer for blacks than for whites.

Table 4

Fraction of Black and White Families with Children Less Than Six Years Old

	Age					
	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 time their market participation at those ages when young children are not present. With a higher expected probability of a dissolution of the marriage partnership, each black spouse should avoid being too specialized in either the market or non-market sectors. The costs in terms of lost job seniority and the depreciation in market skills of leaving the market sector for even a short period decreases with the expected duration of marriage. The labor force dimension that produces much of the racial differences in the female hours behavior is the Labor Force Participation Rates. During the childbearing period, there is a substantial decline in the white female participation rates. Black female participation rates are remarkably constant for most of the cycle. This suggests a reluctance on the part of black women to completely leave the market sector.

A simple count of the number of young children at home can not be expected to measure many changes during the course of the life cycle in those characteristics of family structure 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 hours were overestimated in the age intervals twenty-eight to forty-one and fifty-five to sixty-five 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 (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 fraction of women at each age with children present in a set of mutually exclusive child age categories.

In Table 5 which summarizes the results obtained with these variables, it is evident that the allocation of female time varies considerably with the ages of her children. Since young, pre-school children are notoriously high demanders of their mother's time, it is not surprising that in almost all samples[41] an increase in the fraction of families with only pre-school children reduces the working hours of wives. An interesting interaction occurs when the pre-school 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 withdraw 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, this

Table 5

EFFECT OF CHILDREN'S AGE ON WORKING TIME OF THEIR MOTHERS[a]

Sample Group	Child Groups, by Age (years)						
	< 6	< 6, 6-13	< 6, > 13	< 6, 6-13, > 13	6-13	> 13	6-13, > 13
All whites	-	-	?	?	+	+	-
All blacks	?	?	+	?	+	?	?
College whites	-	-	?	?	?	+	-
High school whites	-	-	-	-	?	+	?
Elementary school whites	?	-	?	-	+	?	?

Note:

[a]+ indicates effect is to increase hours of work.
- indicates effect is to decrease hours of work.
? indicates t value less than 1.

labor supply evidence indicates that the factor intensity of children might well switch as a child proceeds through his aging process. Although parents with pre-school children are consuming a relatively (wife) time intensive commodity, these children become less time intensive as they age so that there are stages in the life cycle when the presence of an older child makes household consumption more goods intensive than consumption in childless families. Some additional evidence supports this notion of factor reversals during the cycle. In every sample except elementary 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 the college whites have children attending college, it is also consistent with this hypothesis that the additional hours wives work with children over thirteen increases with the education level of white families.

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

To measure the rate at which hours are withdrawn from the market due to a "pure" income change, economists generally used an aggregate of all current period nonearnings income. This income measure often contained income receipts that did not correspond to the theoretical construct. For example, the unemployment compensation, disability insurance, and pension income is usually contingent upon the absence of market work and if these receipts were included in the income measure, a spurious negative correlation between work and income would be introduced. Because of this, I divided all current period nonearnings income into three categories; the first (WKY) consisted of income received because one did not work (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. It was hoped that this last category was independent of the work-leisure choice, and thus was the appropriate one to use when estimating an income effect.

The necessity of separating income in this manner receives empirical backing in Tables 2 and 3. In the all white male sample, WKY has the expected negative impact on working hours.[42] Because this income is received only when one does not work, this is at best a confirmation that it is reasonably well reported. The second income variable, OADI, had no detectible influence on working hours. If WTHY is viewed as the appropriate non-labor wealth statistic, the sign of WTHY should be positive as long as this income had not been previously capitalized.[43] But non-market 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. This income is largely the return on the accumulated saving of the family unit. The magnitude of these savings is determined by <u>current</u>, <u>past</u>, and <u>future</u> expected levels of market work. Individuals with large past and current levels of market work have generated the assets that produce this income making the positive correlation between WTHY and market time understandable.

One advantage of placing the labor supply decision in a life cycle context is that one can develop a unified theory of asset accumulation, savings, and labor supply.[44] Too often, individuals have attempted to force assets and non-labor income into the confines of a single period model, but it is only when we consider the life cycle dimension that motivations for savings and asset accumulation become sensible. The life cycle approach clearly demonstrates that any observed relation between assets (or non-labor 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 one's position in the life cycle.

These ideas may be illustrated by a simple example. Equations 8 - 9 describe the life cycle paths of market goods consumption and hours of market work. If an exogenous wage path is assumed, the life cycle pattern of earnings is also given. These earnings and consumption profiles in turn define the savings behavior of the individual at each age, and by appropriately accumulating savings, the asset position at each point of the life cycle is given.[45] In a purely Fisherian world, the only factor determining the time path of consumption is a divergence between the interest rate and rate of time preference.[46] Consumption and earnings are equal and age-invariant when the interest rate equals the rate of time preference. Of course, savings and net assets are equal to zero at every point in the life cycle. But consider another individual (diagram # 6) who does not discount the future so severely. Consumption will rise throughout the cycle while market earnings decline. Since earnings exceed consumption at the early stages of the cycle, the savings generated will become positive net assets. Net assets continue to grow until the consumption and income profiles cross and savings are equal to zero. From this point onward, this individual

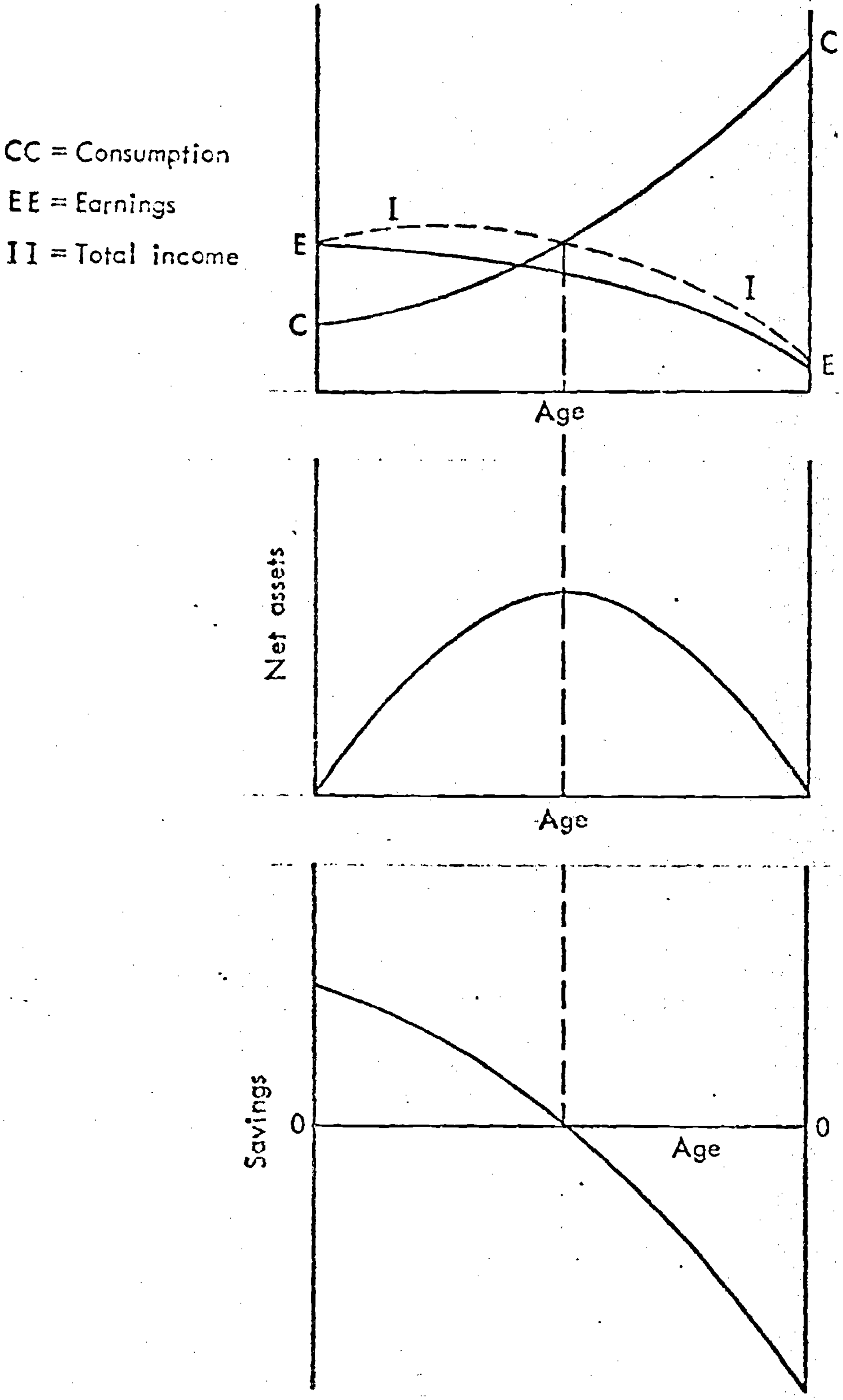

CC = Consumption
EE = Earnings
II = Total income
C
E
I
I
C
E
Age
Net assets
Age
Savings
0
0
Age

Diagram 6

dissaves and the rate of dissaving increases until net assets are once again zero at the end of the cycle.

In this Fisherian world, any empirical association between assets and labor supply depends on the life cycle stage. At the younger ages, one would find a positive correlation between assets or other income and market work, because those with stronger future time preferences have larger assets at every age, but work more during the younger ages. However, the sign of this correlation reverses at the older ages. Those individuals with greater future preferences still have greater assets but now will be working less. Even if we confined ourselves to these periods when the relation between non-earnings income and market work remains positive, the size of an estimated income elasticity is a negative function of age. Thus, we see that economic theory does not predict an unambiguous sign for the relation between non-labor income and hours worked and that the relation does not reflect a wealth effect.

These theoretical considerations and empirical results makes one question the usefulness of existing estimates of the income responsiveness of working hours. The direction and magnitude of the effect on hours of the individual income components vary greatly. Therefore, income measures that are aggregates of these components would yield income elasticities that differ considerably from sample to sample, because the distribution of the components within the total depends greatly on the age, sex, and education composition of the sample being investigated.[47]

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, Tables 6 and 7 report results using annual market hours as the dependent variable. As expected, the coefficients on annual hours for males have the opposite sign and are approximately three times larger than the coefficients on home time.[48] Cross section studies have usually found negatively sloped male supply functions. The positive slopes I estimate are partly due to the degree of aggregation used in this study. This 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--male hourly wage, weekly wage, and earnings. Becker in his study suggested using annual earnings to indirectly calculate a less biased wage elasticity. He argues that earnings have the advantage of eliminating the spurious negative correlation between computed hourly wage 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, $\hat{b}$ will be biased upwards since hours enter on both sides of the regression.[49]

Table 8 compares the estimates with the three alternative wage variables.

Table 6

Male Market Time

Dependent Variable[b]	Independent Variables[a]						
	LHRWGM	LHRWGF	AGE	KUSV	LWKWGM	CONSTANT	R^2
A. All White Men (Ages 22-64)							
LHRYRM	.3217 (6.90)	-.058 (.77)	-.0005 (.78)	.0529 (4.41)		7.31 (139.5)	.75
LHRYRM		-.083 (1.63)	.0003 (.66)	.0465 (5.66)	.3293 (11.8)	6.08 (51.3)	.87
LWKSWKM		-.036 (1.46)	.0002 (1.07)	.0116 (2.89)	.1515 (11.1)	3.15 (54.5)	.83
LHRSM		-.0576 (1.27)	-.0005 (1.38)	.0373 (5.10)	.1980 (7.98)	2.83 (26.9)	.85
B. All Black Men (Ages 22-64)							
LHRYRM	.2305 (2.15)	-.1562 (1.63)	.0001 (.07)	.0346 (1.21)		7.45 (59.7)	.20
LHRYRM		-.1654 (2.12)	.00001 (.009)	.021 (.91)	.337 (4.5)	6.13 (17.8)	.42
C. College White Men (Ages 26-64)							
LHRYRM		-.1320 (3.27)	.0001 (0.14)	.0548 (2.88)	.2583 (5.67)	6.45 (27.7)	.49
D. High School Men (Ages 22-64)							
LHRYRM		-.1246 (2.30)	-.0003 (.48)	.0464 (4.10)	.3283 (7.49)	6.14 (30.1)	.76
E. 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] t values are in parenthesis below coefficients.

[b] If the variable name is preceded by the letter L, the variable was entered in logs. If the final letter was M or F, the variable refers to males and females respectively.

Table 7

Female Market Time

Dependent Variables	LHRWGF	*log hourly wage of husband* LHRWGM	*age of husband* AGE	*# children under 7* KUSV	*log of wages of wife* LWKWGF	CONSTANT	R^2
A. All White Women (Ages 22-64)							
Logistic for participation rates yearly		-.8841 (4.77)	-.0341 (10.88	-.7847 (13.43)	1.438 (4.62)	-.373 (2.72)	86
Logistic for weekly participation rates		-.0185 (.10)	-.0245 (7.45)	-.8358 13.51	1.083 (3.38)	4.14 12.94	88
LHRYRF *— LF workers* *log annual hours worked*		~~-.3036~~ ~~(3.48)~~	~~.0028~~ ~~(1.94)~~	~~-.085~~ ~~(3.10)~~	~~.5618~~ ~~(3.82)~~	~~5.25~~ ~~(8.09)~~	~~.74~~
~~LHRYRF*~~ →		-.3974 (2.90)	-.0121 (5.20)	-.5843 (13.5)	1.15 (4.98)	2.53 (2.49)	.91
LWKSWKF *log weeks worked in the year*		~~.061~~ ~~(1.07)~~	~~.0036~~ ~~(3.73)~~	~~-.1163~~ ~~(6.50)~~	~~.0307~~ ~~(.32)~~	~~3.37~~ ~~(8.02)~~	~~.96~~
~~LWKSWKF*~~ →		-.2559 (2.39)	-.0135 (7.39)	-.5361 (15.8)	.7663 (4.2)	.53 (.67)	.92
LHRSF *log hours worked in survey week.*		-.2780 (4.69)	.0017 (1.71)	.0018 (.10)	.4299 (4.30)	2.0 (4.53)	.55

Table 8

Comparison of Direct and Indirect Estimates of Wage Elasticities for Males

	All White Males	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 direct estimates using earnings are higher than those obtained using hourly wage rates. The difference in the estimates are largest for the college and elementary groups. It is in these groups with the smallest cell size that the negative bias of hourly wages is most critical. Male annual hours were separated into its weeks worked and weekly hours dimensions to determine if the model would work as well in explaining the separate components.[50] In view of the comparable R^2 and the similarity in signs and magnitude of the explanatory variables, it is apparently not necessary to develop separate theories for different male supply definitions.

When one compares alternative measures of women's labor supply, a different conclusion emerges. Two definitions of annual market hours and weeks worked were tried: (1) the average annual hours or weeks worked of those women who were labor force members; (2) the annual hours or weeks worked of all women including the zero values for non-workers, and the estimated coefficients differ substantially. The most striking contrast is the age variable which changes sign. Age has a positive effect when we consider life cycle variation in the extent or intensity of market work of labor force members. But this should not be viewed as a refutation of the life cycle model because the rising age trend of weeks worked of participating women is one measure of the declining turnover in the female labor force over the cycle. Among the older cohorts, there is a larger percentage of full time workers. Because of their stronger labor market commitment, these older women in the labor force will increase the return on their market oriented human capital by working more hours in any week. Only when the zero values are included is it permissible to interpret age in the manner suggested by the life cycle model - a measure of the influence of interest rates or cohort wealth.

The decline in market hours due to the presence of young children is much smaller when the zero values are not included. The bulk of the labor market adjustment to the presence of children is through a total market withdrawal (a fall in participation rates) rather than a decline in the amount of work by those who remain in the labor force. In fact, the addition of a young child has no effect on the number of weekly hours. The wage elasticities are also smaller when the supply functions ignore the zeros. By restricting adjustments to take place only through the number of hours per worker, the hours response to a wage change is surely underestimated.[51] 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. Thus the more appropriate definitions to test the life cycle model are those that include the zero values for non participants. When the zero values are included, the results for the annual hours and weeks worked dimensions are similar and consistent with the implications of the model.

There are theoretical and statistical distinctions that must be made between those labor supply definitions that measure variation in hours and weeks among labor force members and those that simply indicate whether one is a labor force participant.[52] Labor Force Participation Rates (LFPR) are the most common example of the latter definitions. On the theoretical side, we are confronting the corner solution problem. 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.[53] LFPR measure the proportion of women for whom the market wage exceeds the home wage at zero hours of work and can be interpretated as a point in the cumulative distribution function of home wages.[54] When LFPR are used as the dependent variable in a supply equation, one cannot interpret the estimated wage coefficients 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: 1) The supply elasticity for each firm, and 2) the distribution around any price (wage rate) of the entry points for firms. For LFPR the magnitude of the wage coefficients depend only on the density of the distribution of entry points for women. The denser the distribution the larger the estimated wage response.[55] Clearly, wage responsiveness is partly a function of the level of participation with the largest responses expected as we move towards the mean and the smallest at the two extremes of very low or high participation. Unfortunately, economists have tended to equate results obtained for LFPR with these for hours and weeks worked, and also to compare groups with quite different average

LFPR (men and women for example).[56]

The statistical difficulties encountered result from the categorical nature of LFPR if they are used as the dependent variable [57] at the micro level, the decision to participate can be represented by a binary variable which receives the value of one if a woman participates and zero if she does not. When the dependent variable is binary, the use of OLS is inappropriate for several reasons; (1) the error term is constrained to also take two values so that the errors are necessarily heteroscedastic, (2) a simple linear regression could easily produce estimates that lie outside the 0-1 range; (3) at both extreme values the relationship is surely non linear. Nor are these difficulties eliminated when the individual data are grouped to form labor force rates.

To deal with these problems, several transformations have been proposed to eliminate the 0-1 range of the dependent variable. The simplest computionally is the logit Transformation which defines the dependent variable as the natural log of the odds of working. Therefore the following regressions were run.

$$\ln \left(\frac{P}{1-P}\right) = B'X'+U$$

Where B' is a vector of unknown coefficients and X' is a vector of values of the explanatory variables.[58] 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.[59]

The SEO survey allowed me to consider 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 time interval, economic theory is not of much help in specifying the appropriate time interval. There may in fact be some reason to prefer the less used yearly rate which is presumably less affected by transitory elements. The age, children, and female wage variable give comparable results for the two definitions, but the male wage elasticity is much lower for the weekly rates. If changes from year to year in male wages are a reasonable proxy for life cycle variation, an inter-year increase in male wages should reduce the fraction of women in the labor force on a yearly basis. Its impact if the percentage of participants in a particular week is less clear. While weekly rates measure in part the yearly variation, they also reflect some intra-year changes. The latter is a function of within year wage variation, seasonal forces, temporary health problems, and a number of other factors not specified in these regressions.

Conclusion

In this paper, a model to explain intertemporal time allocation of family members was developed and tested. For white families, the observed cross-section 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) the dominance of the cross-section profiles by the inter-cohort effects; (2) the pattern of child spacing; and (3) the uncertainty of the duration of the family itself.

Footnotes

*I would like to thank Professors Gary Becker, Gilbert Ghez and H. Gregg Lewis for the contributions they made to many sections of this paper.

[1]Gary S. Becker, "A Theory of the Allocation of Time," Economic Journal, Vol. LXXV (September, 1965), pp. 493-517.

[2]Jacob Mincer pioneered in the treatment of labor supply in a family context. See his "Labor Force Participation of Married Women," in Aspects of Labor Economics, Universities National Bureau Conference. Studies 14, Princeton, 1962, pp. 63-97.

[3]The number of such studies has expanded so rapidly that it precludes listing them all. Some of the more important are: Bowen and Finegan, Economics of Labor Force Participation, (Princeton: Princeton University Press, 1969); T. A. Finegan, "Hours of Work in the United States: A Cross Section Analysis," Journal of Political Economy, Vol. LXX (October, 1962); Hiam Ofek, "The Allocation of Time in a Family Context," unpublished Ph.D. dissertation, Columbia University, 1971.

[4]See Gilbert Ghez, "A Theory of Life Cycle Consumption," unpublished Ph.D. dissertation, Columbia University, 1970; and Gary Becker, "The Allocation of Time over Time," unpublished manuscript, 1969.

[5]The following model was developed in Smith (1972). It relies on the work of Becker and Ghez.

[6]A derivation is given in R.G.D. Allen, Mathematical Analysis for Economists (New York: St. Martin's Press, 1967), pp. 503-508.

[7]Equations (8) and (9) assume an interior solution.

[8]We know that $S_F\sigma_{FF} + S_M\sigma_{MF} + S_X\sigma_{FX} = 0$ and 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, loc. sit.

[9]For men, this problem is not a major one. Profiles for men may be derived by linking cross sections of different years. These are essentially identical to those obtained with any cross section.

[10]The changes at both tails of the profile are a consequence of varia- in both weeks worked and weekly hours. However, the decline in annual hours during the middle ages reflects primarily a fall in hours worked per week as yearly weeks are somewhat stable throughout this period. 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 so that a corrected weeks worked measure may also exhibit a decline.

[11]More precisely, the crucial factor is the difference between the rate of interest and the rate of time preference $(r - \alpha)$.

[12]Assume for simplicity, 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 $\eta_{mm} \frac{dw_{mt}}{W_{mt}} = \sigma_c r$. Therefore, wages will still be rising $(\frac{dW_{mt}}{W_{mt}} > 0)$ when annual working hours are at a maximum.

[13]Earnings (E) are the product of wage rates (w) and annual hours worked (h); E = wh. Therefore,

$$\frac{dE}{E} = \frac{dw}{w} + \frac{dh}{h} . \quad \frac{dE}{E} = 0 \text{ when } \frac{dw}{w} = \frac{-dh}{h} .$$

Since hours decline first $(\frac{dh}{h} < 0)$, wages must still be rising when the percentage change in earnings is zero.

[14] Observed wages are the net earning capacity of individuals. If human capital depreciates, observed wages will peak after gross earning capacity. Our model predicts that market time will peak before gross wages and therefore before net or observed wages.

[15] The average cell size for the college, high school and elementary groups are 45, 90, and 34 respectively.

[16] See Reuben Gronau, "The Effect of Children on Housewife's Value of Time," and H. Gregg Lewis, "Hours of Work and Labor Force Participation Rates," unpublished manuscripts.

[17] For example, let the yearly labor force participation rate be .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 non-market time, 8,100.

[18] Family size is defined as the number of children living at home.

[19] For the original treatment, see Gary Becker's Human Capital.

[20] Because of individually financed investments in human capital, observed wages will be below the true opportunity cost of time. Since these investments take place with greater frequency during the younger ages and for males, the relative wages of females to males are being overestimated at the early ages.

[21] 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 pre-school age, children. In their hypothesis, college women have a comparative advantage in investing in the human capital of their children.

[22]The dating of the peak in female home time also reflects the fact that younger children are present at an older husband age, for the more educated.

[23]Because of the small cell sizes, these black female profiles contain large amounts of measurement error. With the high rates of marital instability among blacks, this is especially true at the older ages.

[24]This method follows the suggestions of Ghez in his, "A Life Cycle Theory of Consumption."

[25]That is, individual members of a cohort are permitted to under or over estimate their future wage levels. If the cohort's average expectation is unbiased, the wealth effects flowing from any individual mistakes will be eliminated in the aggregation.

[26]I am waiving consideration of all the familiar aggregation problems.

[27]If male and female wages grow at λ per cent per year over time, the demand equation for male home time is

$$\frac{dM_t}{M_t} = S_m(\sigma_{mm} - \sigma_c)\frac{dW_{mt}}{W_{mt}} + S_F(\sigma_{mF} - \sigma_c)\frac{dW_{ft}}{W_{ft}} + \sigma_c(r - \sigma)$$

$$+ (1 - \sigma_c)(S_m + S_F)\lambda - \lambda .$$

[28]Each interviewed individual was asked the length of his latest illness. The codes for this question were 0, 1-3 months, 4-6 months, 7-12 months, and then in number of years. The month intervals 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.

[29]For women who worked only last year, no direct information exists on the number of hours they work in a week. Their weekly hours were computed by assuming that their weekly hours were in the same proportion to category (2) women as their weeks worked were to weeks worked of women in category (2) (WKSWK4F/WKSWK3F).

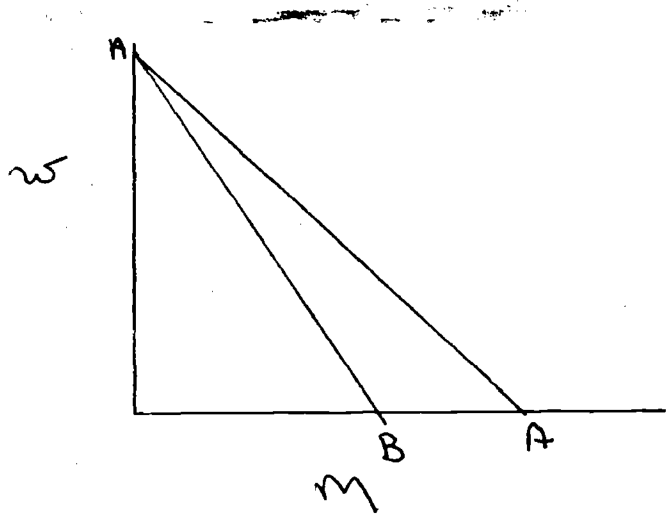
[30]The motivation behind such a weighting procedure is straightforward. To achieve the most efficient estimate, one should assign a lower weight to those observations that are least reliable. (have the highest variance). However, a cost is incurred with this weighting procedure. The observations that receive the smallest weight occur at the youngest and oldest age groups. Yet, these are the observations that possess the largest relative variation in hours and wages.

[31]See Reuben Gronau, "The Wage Rates of Women - A Selectivity Bias," unpublished manuscript.

[32]The sign is positive when σ_{MF} exceeds [illegible]

[33]The home time wage elasticity is $\frac{\partial M}{\partial W} \frac{W}{M}$.

It is reasonable to assume that hours searching for work are larger at lower wages. In the diagram below two demand curves for home time are drawn. Demand curve BB differs from AA in that BB excludes search time.



At any wage, home time is lower with BB but $\frac{\partial M}{\partial W}$ is also lower. It is interesting to note that the measured elasticity of the supply curve of market hours must fall when search time is counted as part of total market hours. Total market hours are larger, and the increase in market hours per dollar increase in wage is smaller.

[34]Many recent studies have asserted that the correct labor supply function should include searching time. None of these have confronted the conceptional problems involved. For example, if unemployment is partly (a seasonal phenomenen) seasonal workers would be compensated for their low hours by higher wages. It would be unappropriate at their current wage rates to add to their working time this "unemployment."

[35]The following table tests the Mean Values of time spent looking for work or ill.

Male Hours Looking for Work or Ill

	All White	Elementary	High	College	All Black
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

Female Hours Looking for Work or Ill

	All White	Elementary	High	College	All Black
Looking for Work					
Ill Time					

[36]If real wages of husbands and wives increase at λ per cent over time, the age coefficient is $\sigma_c(r - a) + \eta(1 - s_m) - S_m\sigma_c$ where η is the income elasticity of consumption and s_m the combined share of male and female time

$\eta(1 - sm)$ corresponds to the income effect and $s_m \sigma_c$ the substitution effect.

[37]For example, the simple correlation between fraction of white males ill and age was .88 in the SEO data.

[38]Intuitively, the OLS estimator is unbiased since overestimating the slope is as likely as underestimating it depending on the tracking order of the residuals. However, our uncertainty (variance) is larger. But standard errors are calculated using the computed residuals. These will be too low for the estimated regression line will fit the tracking data rather well.

[39]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 there exists a life cycle dimension to the effect family size has on the labor market behavior of males and females.

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

[41]According to the first equation in Tables 2 and 3, an increase in one pre-school child would decrease male home time by :0178 per cent and increase female home time by .0359 per cent. Evaluated at the mean home time of 6612 hours for males and 8196 for females, this implies an increase of 107 market hours for males and a reduction of 294 for their wives. Using the mean male and female wages of 3.44 and 2.16, this further implies an increase of $371.52 in male earnings and decrease of $635 in female earnings.

[42]One limitation of this variable in SEO is that it is reported for the family unit and is not allocated among the individual members. One does not know if the unemployment insurance is the result of the husband or wife not working - the variable is more significant in the male regressions, perhaps indicating that it is the husband's unemployment that produces it.

[43]If the income is foreseen, the expected sign of WTHY is zero. Because it was previously capitalized, it will not vary with age and thus would not affect the timing of market worker.

[44]The following is adopted from my unpublished paper "Assets and Labor Supply."

[45]Savings (S_t) is the difference between current income and current market goods consumption (X_t)

$S_t = E_t - X_t + r\,A_{t-1}$ where A_{t-1} are assets in the previous period. Assets at any age are defined as $A_t = A_o\,(1 + r)^t + \sum_{j=1}^{t} S.$

[46]The Fisherian model may be isolated by assuming the following: (1) The wage level is constant over the cycle and the same for every individual (that is $\frac{dw_{mt}}{w_{mt}} = 0$); (2) initial assets ($A_o$) and desired terminal assets are equal to zero. With these assumptions, all individuals have the same wealth, and the life cycle demand equations for goods and these are $\frac{dMt_t}{M_t} = \frac{dX_t}{X_t} = \sigma_c\,(r - d)$.

[47]The distribution of this income by education and race is

TABLE

Sources of Non-Labor Income

	All White	Elementary	High	College	Black
WTHY	271.55	92.82	189.38	599.53	83.15
WKY	44.29	79.20	42.84	18.64	60.63
OAD1	121.69	74.49	133.70	147.65	79.60
TOTAL	437.53	246.51	365.92	765.82	223.36

[48] Arithmetically, $\frac{dN_{mt}}{N_{mt}} = \frac{-M_t}{N_{mt}} \frac{dM_t}{M_t}$. $\frac{M_t}{N_{mt}}$ is the ratio of male home time to working time and is approximately equal to 3.

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

(1) $h = Bw + u$

where $\xi\,(u) = 0$ $Var\,(u) = \sigma^2 u$

If earnings $(y=w+h\,)$ are used

(2) $h = \frac{B}{1+B}\,Y + \frac{u}{1+B}$ or $h = by + Z$

Where $\xi\,(u) = 0$ $Var\,(Z) = \frac{\sigma^2_w}{(1+B)^2}$

Using OLS as the estimator for b gives

$$\hat{b} = \frac{\Sigma yh}{\Sigma y^2}$$

$\hat{b}$ is a biased and inconsistent estimate since

$$\hat{b} = \frac{\Sigma(y\ (by + Z)}{\Sigma y2} = b + \frac{\Sigma yZ}{\Sigma yZ}$$

$$P \text{ limit as } n \rightarrow \infty\ \hat{b} = b + \xi\ (\frac{\Sigma yZ}{\Sigma yZ})$$

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

$$+ \frac{1}{1+B}\ \xi\ (u^2) = \frac{\sigma^2_u}{1+B}$$

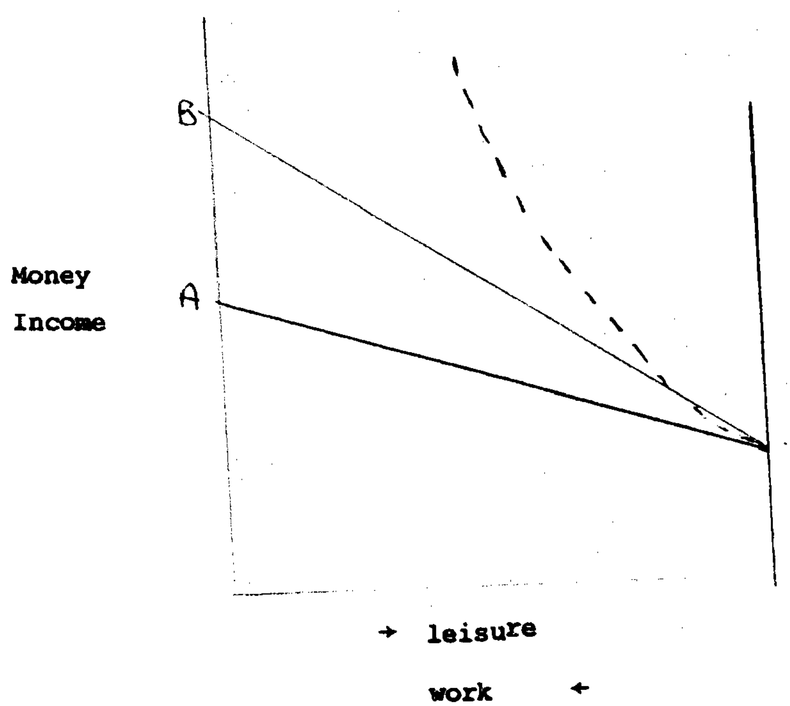
$$P \text{ limit as } N \to \infty \ \hat{b} = b + \frac{\frac{\sigma_u^2}{1+B}}{\text{Vary}}$$

As long as B > - 1 there exists a positive correlation between the disturbance in (2) and the independent variable (E) so that $\hat{b}$ is biased upwards. Also since $B = \frac{b}{1-b}$ and $B > -1$ implies $b < 1$ so that an indirect estimate of B is also biased upwards.

[50]Only the estimates for white males are reported. The conclusions in the text hold for the other samples also.

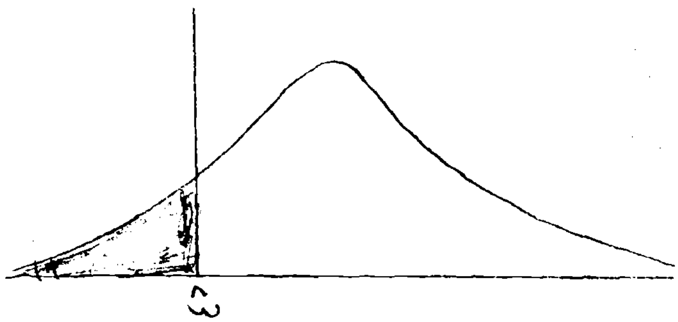
[51]It may also be an underestimation because of compositional changes in the labor force. As the female wage increases, the annual market hours of the new entrants is likely to be below that of women previously in the labor force.

[52]Some important contributions on this subject are Gronau ( ), Heckman ( ), Ben Porath ( ), and Lewis ( ).



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. As drawn above, only woman B will work. For Woman A, the value of a hour of leisure always exceeds the market wage.

[54]Following Ben Porath let f ($\tilde{w}$) be the density function of home wages illustrated below



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

[55]Following the argument of the previous footnote $\frac{\partial LFPR}{\partial W} = f(w)$

[56]This could explain why wage elasticities for women exceed those of men. Also we would expect as LFPR for women have risen throughout the 20th century, the estimated wage elasticity would also rise.

[57]For a discussion of the binary dependent variable problem see Thiel ( ), pp. 632-636.

[58]The logistic function is $$Pi = \frac{1}{1+e^{-BX}}$$

[59]For a proof of this weighting procedure see Theil pgs 632-636.

A. Mathematical Appendix

Let family maximize lifetime utility

$$(1)\quad U = [\,{}_0\int^N Z_t^{\frac{\sigma_c - 1}{\sigma_c}} \; e^{-\alpha t} \, dt]^{\frac{\sigma_c}{\sigma_c - 1}}$$

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

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

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

$$(3b)\quad {}_0\int^N X_t \, e^{-rt} \, dt = {}_0\int^N (W_{mt}N_{mt} + W_{ft}N_{ft}) \, e^{-rt} \, dt + A_0$$

$$(4)\quad R = {}_0\int^N \pi_t Z_t e^{-rt} dt = T \; {}_0\int^N (W_{mt} + W_{ft}) \, e^{-rt} \, dt + A_0$$

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

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

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

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

and since

$$(7)\quad R = {}_0\int^N \pi_t Z_t e^{-rt} dt = {}_{-t}\int^{N-t} \pi_{t+j} Z_{t+j} e^{-r(t+j)} d_j$$

we may substitute (6) into equation (7)

$$(8)\quad R = Z_t \pi_t^{\sigma_c} e^{(\alpha-r)t\sigma_c} \int_{-t}^{N-t} (\pi_{t+j} e^{-r(t+j)})^{1-\sigma_c} e^{-\alpha\sigma_c(t+j)} d_j$$

or

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

Define the Lifetime Price Index P as follows

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

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) presented in the text.

R and P are constant over the life cycle so

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

and

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

The demand for male home time is

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

Finally substituting equation (12) into (11) and (11) into (13) gives the demand function for home time described in the text

$$(14)\quad \frac{dM_t}{M_t} = -(S_M\sigma_c + S_F\sigma_{MF} + S_X\sigma_{MX})\frac{dW_{mt}}{W_{mt}} + S_F(\sigma_{MF}-\sigma_c)\frac{dW_{ft}}{W_{ft}}$$

$$+ \sigma_c(r-\alpha) + (\sigma_c - 1)\frac{dB_t}{B_t}$$

APPENDIX B

THE SURVEY OF ECONOMIC OPPORTUNITY

The empirical results presented are based on 1967 Survey of Economic Opportunity (SEO) sample. In the spring of that year this survey was conducted by the Bureau of the Census for the Office of Economic Opportunity to supplement information regularly collected in the Current Population Surveys (CPS) for February and March of each year. The survey comprising 30,000 households (90,000 individuals) consists of two samples:

1. A national self-weighting sample of 18,000 households conducted in the same manner as the monthly CPS survey.[1/]

2. In an attempt to increase the reliability of information on blacks, a supplemental sample of 12,000 households was taken in areas with relatively large concentrations of non-whites.[2/]

For each family interviewed, information is provided on geographical location, assets, liabilities, and income other than earnings. Age, sex, race, educational attainment and family relationship data exists for every individual

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[1/] 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.

[2/] Basically the method used was to impose a cut-off for sample inclusion based on the percentage of non-whites in an area. This percentage varied by region and SMSA size. For those sampling districts above the cut-off, the standard CPS methods were used to select households.

in the family. Finally, adult members were additionally questioned on their work experience, earnings, last week's salary, personal health, marital status, and women on their childbearing history.

Since the life cycle model I desired to test is set in a family context, I created a new tape by matching individuals by their marital status. This new tape, consisting of 17,874 families in which both spouses are present, 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 before a family was used in the final aggregations. The final sample was limited to non-farm[1/] Negro and white families whose husband's age was between 18 and 65 inclusive, and in which the husband 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.[2/] Finally, those families in which the husband was under 25 years old and in the military were excluded.[3/] The remaining families were divided into 36 cells; two race cells (black and white) each subdivided into three education cells (1-8, 9-12, and greater than 12 grades of husband's schooling completed) and finally further subdivided into 6 labor force cells (one division determined

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[1/] The 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.

[2/] There were relatively few families with this characteristic. They were not included due to absence of yearly income data.

[3/] These military families were not included because their reported wage rates are not a reflection of their opportunity costs as a consequence of the coercion present in the draft system.

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 working weeks, 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 is arbitrary but a more precise estimate would require knowledge about the shape of the distribution in each class.[1/] By SEO definitions, only civilians were considered working so I assumed that men over 25 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.[2/] Table B-1 reports the means and standard deviations for the variables used in this study.

[1/] The intervals used were 1-13, 14-26, 27-39, 40-47, 48-49, 50-52 weeks respectively. If, as seems plausible, the distribution of weeks in each interval is negatively skewed, my weeks worked variable is biased downwards. This will also introduce a spurious negative correlation between annual hours worked and hourly wage.

[2/] The official definition counts as members of the labor force those individuals who claim to be looking for work.

Table B-1

Means[a] and Standard Deviations (in parenthesis) of the Variables Used in This Study

	Subsamples by Level of Education[b]				
Variables	All Whites	Elementary Whites	High School Whites	College Whites	All Blacks
	(1)	(2)	(3)	(4)	(5)
Hours Variables (Males)					
CHR1M	6612.5 (113.6)	6720.9 (96.41)	6588.4 (109.17)	6570.8 (184.6)	6796.3 (108.48)
HRYR1M	2147.5 (113.60)	2039.1 (96.41)	2171.6 (109.17)	2189.2 (184.6)	1963.7 (108.48)
HRYR2M	2179.5 (99.22)	2109.2 (99.60)	2202.2 (92.33)	2201.7 (180.56)	2013.4 (113.76)
WKSWK1M	48.82 (1.63)	48.04 (1.28)	49.06 (1.84)	49.33 (1.49)	47.71 (1.54)
HRSM	43.84 (1.34)	42.43 (1.93)	44.15 (1.30)	44.26 (2.83)	40.69 (1.63)
Hours Variables (Females)					
CHRF1	8196.6 (108.5)	8248.5 (166.4)	8166.0 (113.84)	8254.4 (148.23)	8097.4 (152.5)
HRYR1F[c]	1486.0 (118.9)	1515.4 (198.1)	1496.2 (112.51)	1434.5 (211.6)	1385.6 (187.4)
HRYR2F[c]	1508.0 (113.7)	1563.2 (193.66)	1522.5 (106.1)	1440.1 (218.1)	1457.7 (164.1)
WKSWK1F[c]	36.57 (4.34)	35.33 (6.85)	37.14 (4.42)	35.82 (4.45)	35.36 (5.94)
WKSWK2F[c]	37.64 (4.37)	37.02 (6.81)	38.27 (4.45)	36.32 (3.24)	38.65 (5.56)
WKSWK3F[c]	42.00 (2.81)	41.29 (6.91)	42.27 (2.85)	41.13 (3.66)	40.24 (5.13)
WKSWK4F[c]	17.50 (3.67)	16.18 (5.47)	18.19 (4.52)	15.90 (3.99)	16.80 (3.23)
HRSF[c]	34.36 (1.46)	35.91 (2.87)	34.62 (1.19)	33.71 (3.25)	33.58 (3.21)

Table B-1 Continued

Variables	All Whites	Elementary Whites	High School Whites	College Whites	All Blacks
LFPWK	.351 (.057)	.307 (.103)	.366 (.059)	.337 (.106)	.435 (.074)
LFPYR	.516 (.093)	.481 (.073)	.530 (.086)	.493 (.145)	.647 (.091)
Earnings Variables (Males)					
EARNM	7474.6 (1332.3)	5372.3 (724.09)	7172.4 (1127.0)	9718.3 (2705.3)	4736.4 (578.3)
WKWG2M	155.30 (25.66)	113.38 (15.00)	148.35 (21.25)	201.8 (54.29)	99.42 (10.15)
HRWG2M	3.82 (.606)	2.91 (.406)	3.59 (.503)	4.98 (1.33)	2.67 (.207)
Earnings Variables (Females)					
EARNF	1304.1 (208.97)	1049.3 (335.5)	1343.3 (231.1)	1350.4 (337.3)	1296.6 (379.5)
WKWG2F	68.05 (5.04)	57.01 (10.02)	66.94 (6.36)	77.69 (12.19)	54.30 (11.23)
HRWG2F	2.16 (.146)	1.77 (.208)	2.10 (.122)	2.53 (.331)	1.68 (.262)
Non Labor Income					
WKY	44.29 (9.24)	79.20 (30.39)	42.84 (15.61)	18.64 (12.63)	60.63 (26.63)
OAD1	121.69 (80.64)	74.49 (63.25)	133.7 (97.35)	147.65 (136.9)	79.65 (73.43)
WTHY	271.55 (160.03)	92.82 (79.54)	189.38 (119.97)	600.3 (401.1)	83.13 (63.06)
Health					
HLTWKM	.0577 (.041)	.0767 (.059)	.0614 (.043)	.0286 (.020)	.057 (.045)
HLTWKF	.093 (.060)	.131 (.076)	.098 (.064)	.054 (.041)	.135 (.088)

Table B-1 Continued

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

[a]Means are calculated for ages 19-64 inclusive and are the 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.

Source: The 1967 Survey of Economic Opportunity.

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 to seriously impair the reliability of the results presented. First, the overwhelming majority of married males were in the sample since only a relatively minor fraction of husbands are not members of the labor force. Moreover, if non-workers were included, one would again encounter the problem (as we did for females) of the absence for these observations of the necessary wage data. A second consideration is the hypothesis that complete male home specialization is due primarily to factors such as ill health and participation in schooling and military activities. In particular, it is not generally the consequence of the family relative wage structure. Hence, eliminating the nonparticipants allows one to concentrate on those families where the "economic" model is more applicable. To check these suppositions a pass was made through the SEO tape not only to count the number of non-working married males in 1966 but also to find the reason given by them for their non-participation. Tables B-2 and B-3 summarize the results of that run for white and black males respectively. If we included these men, our sample size of approximately 18,000 would increase only by around 600 observations. More importantly, only 18 white and 13 black males were not working because of an inability to find work. For both races approximately ninety per cent 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 decisions to exclude these families from this study.

Table B-2

REASON NOT WORKING IN 1966 (WHITE MARRIED MALES, AGES 18-70)[a]

Age Group	Reason Given:	Could Not Find Work	Ill or Disabled	Caring for Home of Family	Going to School	In Military	Retired	Other	Total # of Observations By Row
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 # of Observations by column		18	282	1	18	18	326	18	679

[a]Each cell gives the fraction of non-working males in that age group who gave that reason for not working.

Table B-3

REASON NOT WORKING IN 1966 (BLACK MARRIED MALES, AGES 18-70)[a]

Age Group	Reason Given: Could Not Find Work	Ill or Disabled	Caring for Home or Family	Going to School	In Military	Retured	Other	Total # of Observations By Row
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 # of Observations by column	13	225	0	7	7	86	7	345

[a]Each cell gives the fraction on non-working males in that age group who gave that reason for not working.

APPENDIX C

A single cross-section provides an inadequate representation of life cycle behavior. Hopefully, longitudinal data will soon render the use of cross-sections for this purpose unnecessary. To some degree, one can disentangle the cohort and life cycle influences by pooling a series of cross-sectional samples of different calender years.[1/] Depending on the number of such samples available, we can identify individuals of the same age who are members of different cohorts.[2/] Profiles similar to those obtained from the 1967 SEO were derived from the 1960 U.S. Census, and in this appendix the two sets of profiles are compared to determine the extent of the bias present due to the use of a simple cross-section.

Male Profiles

Figures C1 and C2 compare the 1960 and 1967 annual hours profiles for males. For both years, these profiles have a similar inverted U shape. Apparently, this profile has shifted upward between these years except at

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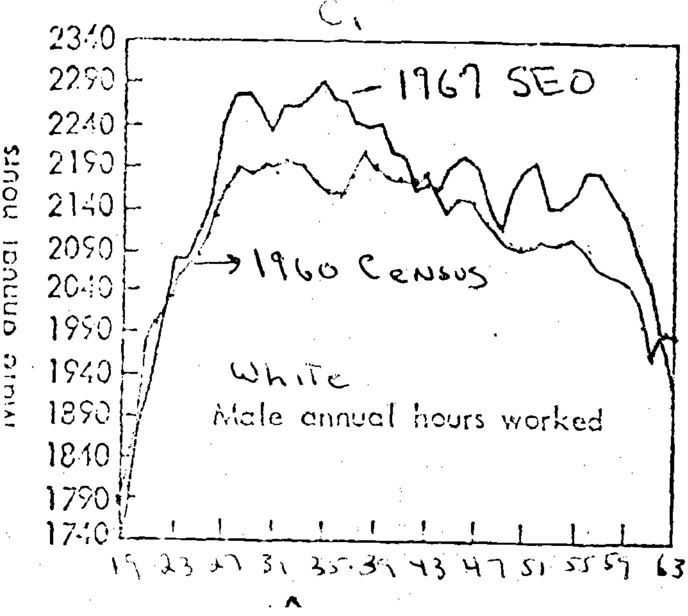
[1/] Welch used this technique to study the returns to schooling. See his "Black-White Differences in the Return to Schooling," Unpublished, Jan. 1972.

[2/] For example, if a 1960 cross-sectional sample is used, the individuals who are forty years old, are members of the 1920 cohort. Each age will correspond to a distinct cohort, and there would be no way of separating the cohort and age effects. If we used a 1970 survey in addition to the 1960 one, people aged forty would be members of the 1920 and 1930 cohorts and a separate estimate would then be possible.

Figures

C1



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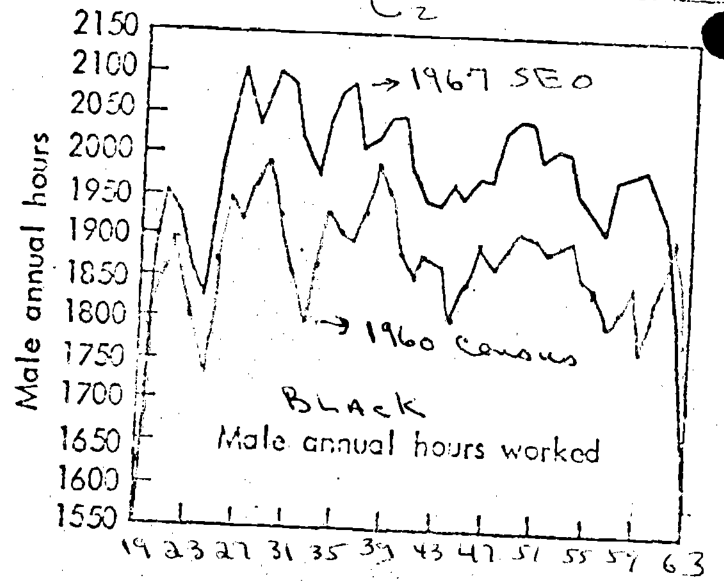

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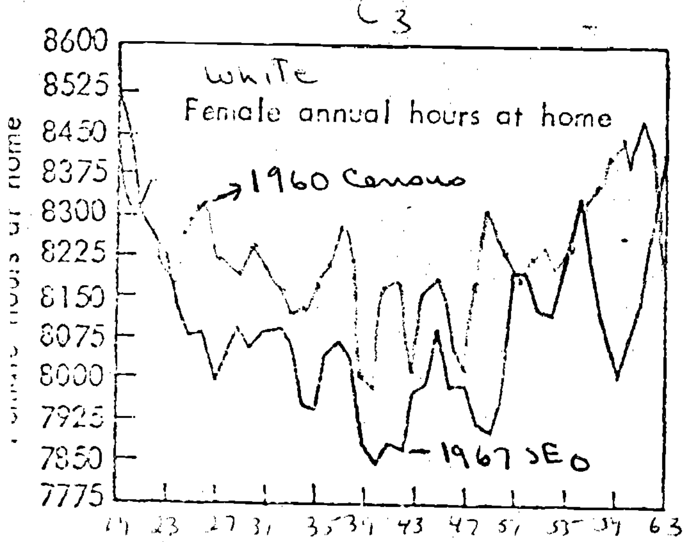

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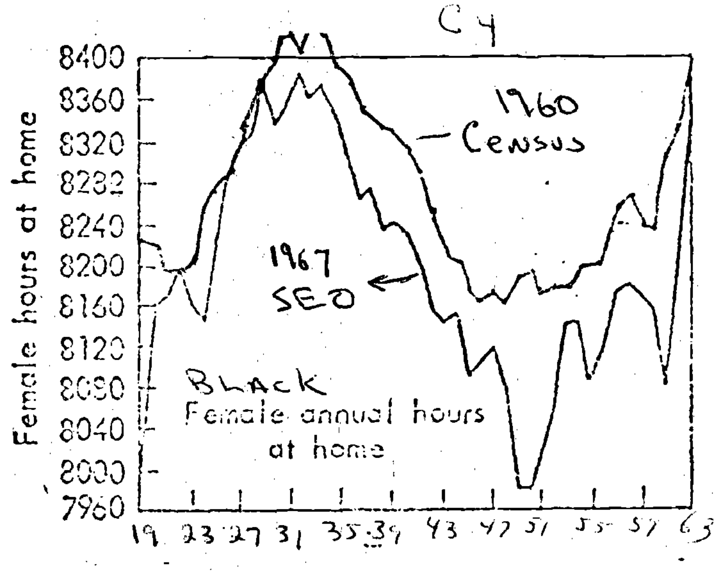
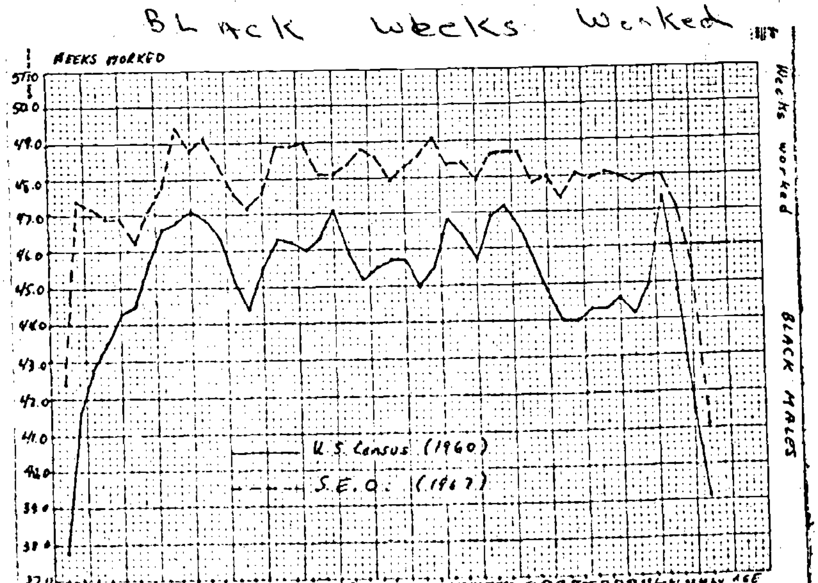


C5

Black Weeks Worked



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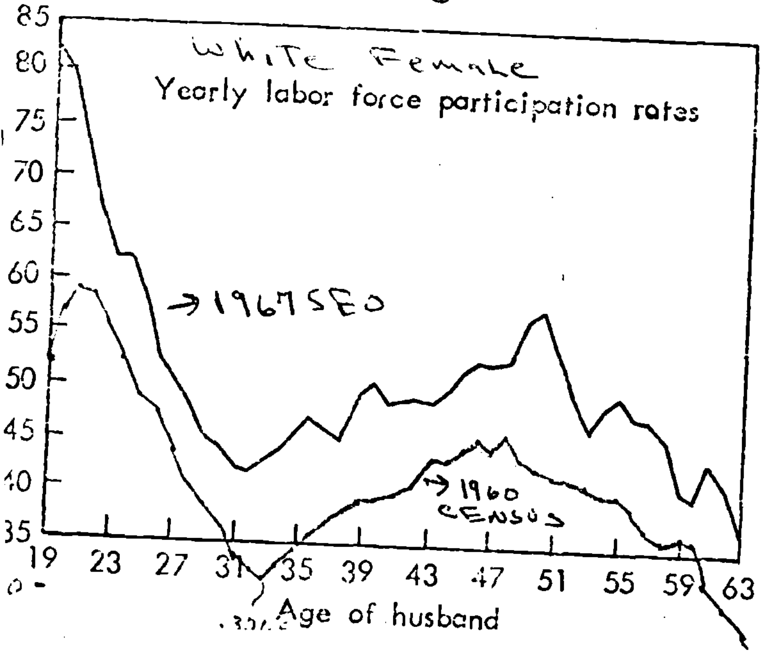

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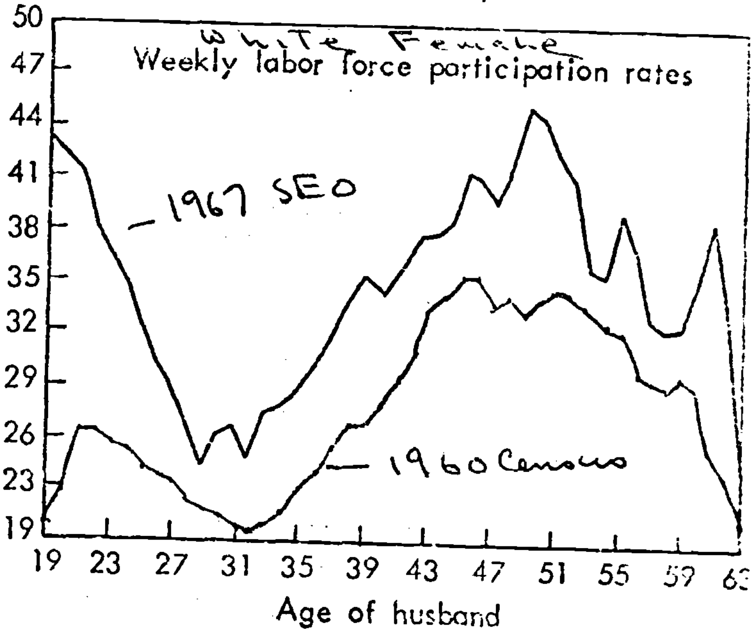
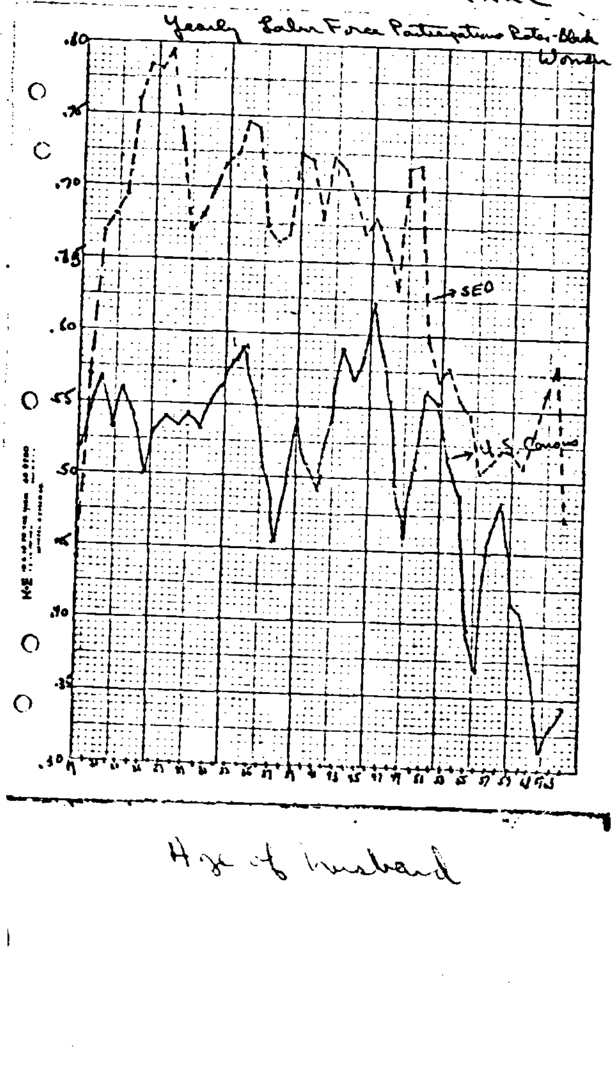


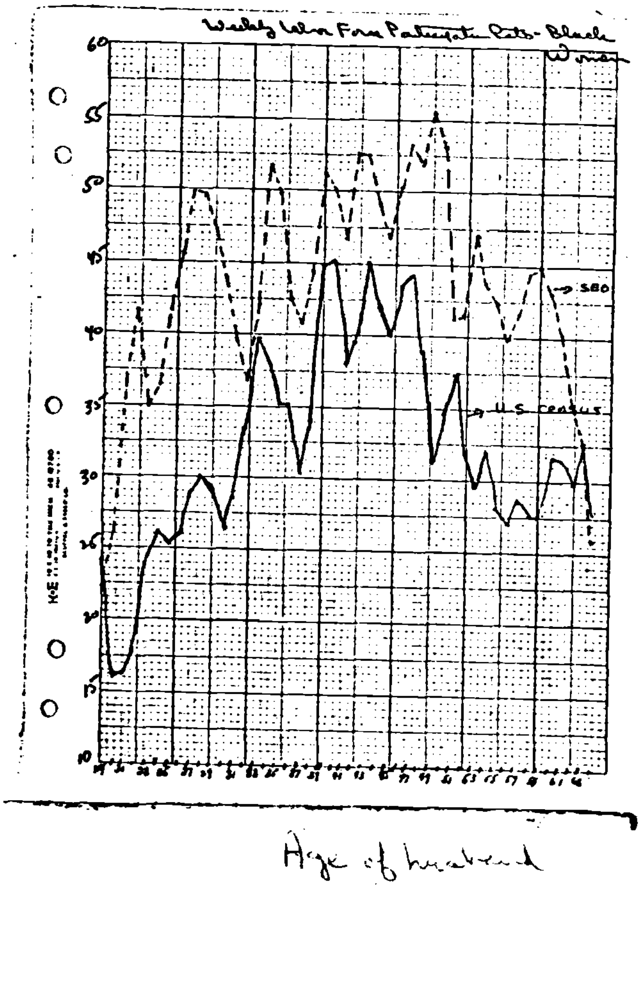
C8

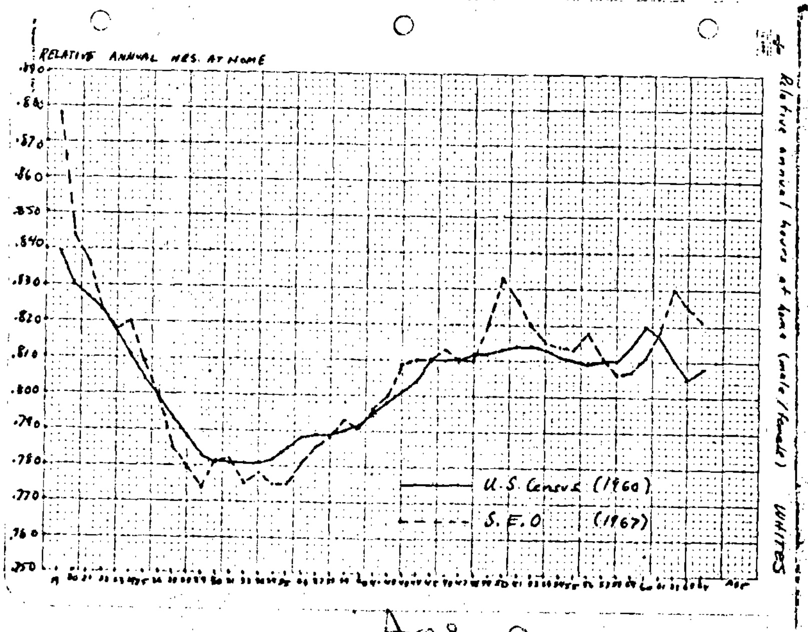
Black Female



C9

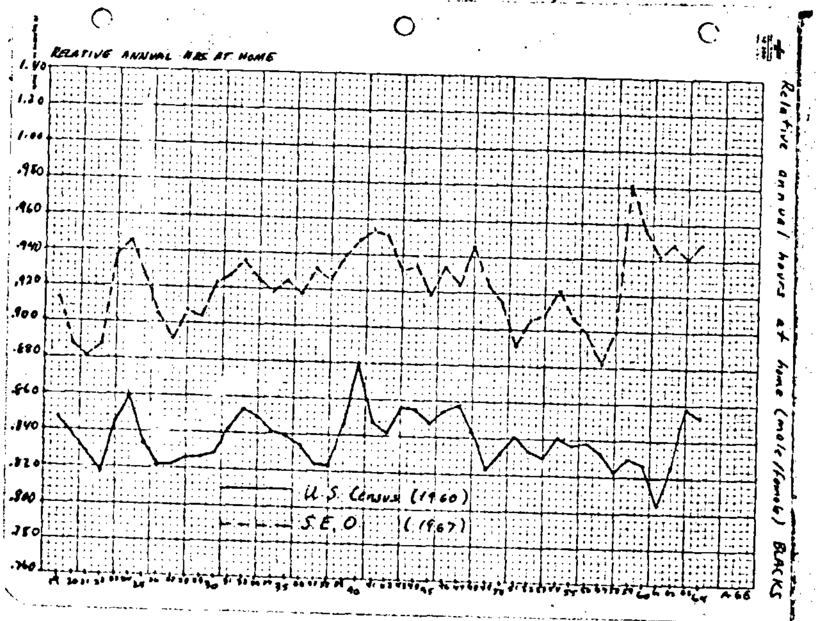
Black Female





Relative Home Hours of Men to Women White Families

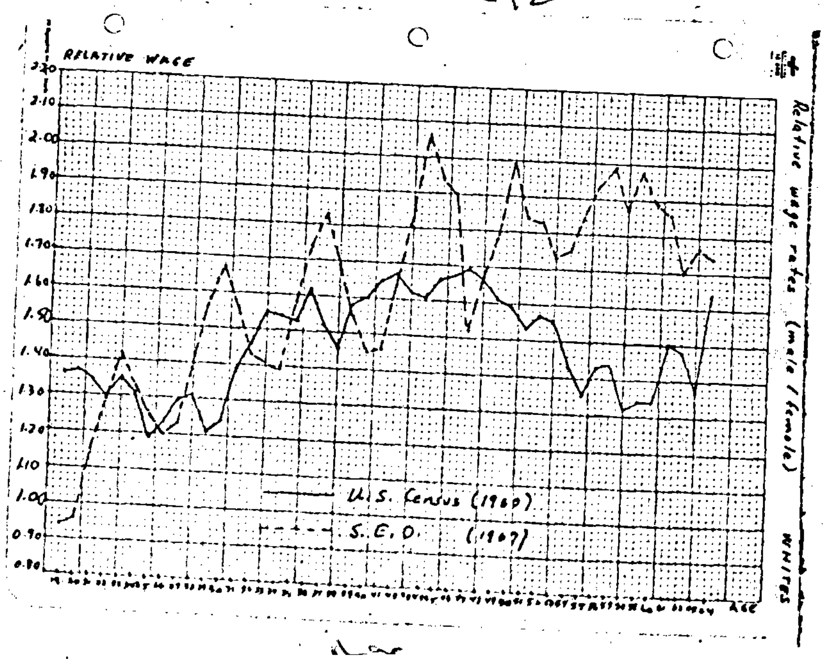
Age C11



Relative Home Hours of Men to Women Black Families

Age

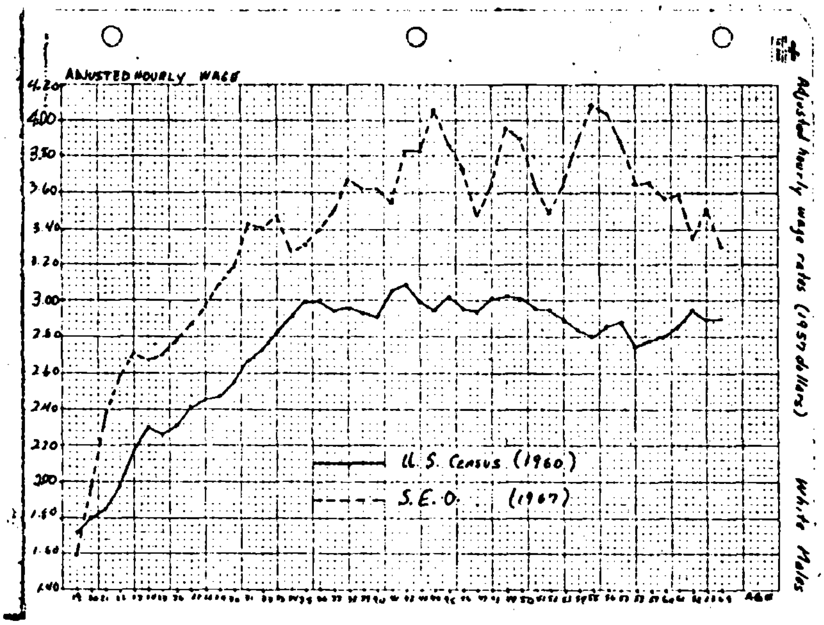
C12



Relative Hourly Wage White Men - Relative to White Women

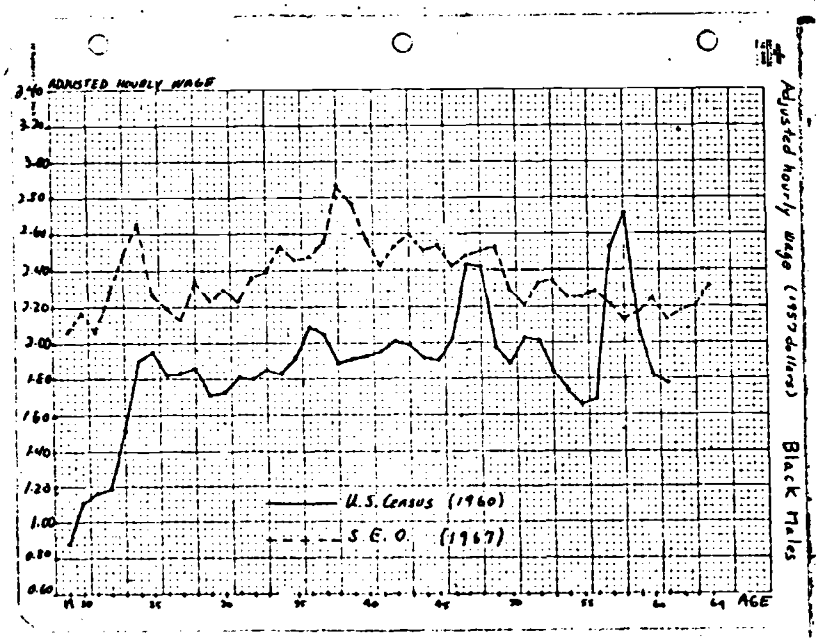
Age

C.13



White Male hourly Wage
Constant 1957 dollars

C 14



Black Male hourly Wage
Constant 1957 dollars.

Table C-1

Mean Lifetime Market Participation of Married Men and Women, Ages 19-64
By Race and Education
A Comparison of the 1960 Census and The 1967 SEO

Group		Annual Hours[a]	Weekly Hours[a]	Weeks Worked[a]	Yearly LFPR[b]	Weekly LFPR[b]	Annual Hours Worked	Hourly Wage Rate
White Males	1960	2102.4	43.46	48.08	NA[c]	NA	2102.4	2.77
	1967	2147.5	43.84	48.82	NA	NA	2147.5	3.82
White Females	1960	1510.6	35.8	35.12	.41	.27	478.1	1.88
	1967	1486.0	34.46	36.58	.52	.35	563.4	
Black Males	1960	1859.2	40.35	45.11	NA	NA	1859.2	2.01
	1967	1963.7	40.09	47.71	NA	NA	1963.7	2.67
Black Females	1960	1252.0	31.90	36.07	.51	.32	522.2	1.68
	1967	1385.6	33.58	35.36	.65	.52	662.6	
White Males Elementary	1960	2005.7	42.60	46.63	NA	NA	2005.7	2.28
	1967	2039.1	42.43	48.04	NA	NA	2039.1	2.91
White Females Elementary	1960	1522.1	36.8	34.14	.39	.25	443.2	1.59
	1967	1515.4	35.91	35.33	.48	.31	511.5	

Table C-1 Continued

Group		Annual Hours[a]	Weekly Hours[a]	Weeks Worked[a]	Yearly LFPR[b]	Weekly LRPR[b]	Annual Hours Worked	Hourly Wage
White Males High School	1960	2133.7	43.74	48.55	NA[c]	NA	2133.7	2.74
	1967	2171.6	44.15	49.06	NA	NA	2171.6	3.59
White Females High School	1960	1535.2	36.2	35.62	.43	.29	512.4	2.10
	1967	1496.2	34.62	37.14	.53	.37	594.0	
White Males College	1960	2130.9	43.63	48.42	NA	NA	2130.9	3.67
	1967	2189.2	44.26	49.33	NA	NA	2189.2	4.98
White Females College	1960	1436.3	34.37	34.92	.42	.28	467.0	2.53
	1967	1434.5	33.71	35.82	.49	.33	505.6	

Notes: a. Averaged over labor market members only.

b. LFPR = labor force participation rate.

c. NA = Not available.

Source: 1960 Census and 1967 SEO.

the youngest ages. With only two calender years represented, it is impossible to determine whether this upward shift represents a secular trend or is produced by cyclical factors. Compared to 1960, 1959 was a year of relatively high unemployment and the procyclical behavior of hours worked could conceivably account for the different levels. Since low skilled workers are more sensitive to cyclical fluctuations, this may also explain the larger upward shift for blacks.[1/] The absence of an increase in the levels at the youngest ages partly reflects the secular increases in education level. The main conclusion from this comparison is that for males at least the use of cross-sectional data does not give that misleading a picture of their true life cycle profiles.

Female Profiles

The stability of the cross-sectional profiles between calender years that characterized the male profiles does not hold for the female profiles. The substantial secular increases in market participation of married females is of course well known. In terms of the most comprehensive definition of home time, for both black and white married females the profile shape remains

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[1/] The education specific profiles for white males in 1960 are not given to conserve space. These 1960 profiles are again quite similar to those in 1967 with the 1967 profiles lying above the 1960 ones for each education class.

[2/] In terms of weeks worked and hours per week, for whites there exists very little difference in the two samples except for the somewhat higher levels in 1967. For blacks, almost all the increase between these years appears in the weeks worked dimension which generally lies 3-4 weeks below the 1967 profiles. For weekly hours in 1960, there exists little between age dispersion for blacks with most ages reporting slightly more than 40 hours.

quite similar with an increase in average market work at all ages. The striking racial difference in the life cycle profiles that was observed in 1967 also appears in 1960. For the education specific profiles for white married women, the general shapes are preserved, but there apparently has been little shift in the college profiles. The most striking comparison between the two years takes place for the various supply dimensions for women. It is well established and gives support to the rapid secular increases in the fraction of women who participate in the labor force. This increase in participation rates for whites is especially pronounced at the younger ages. But this rapid increase in market participation among married females does not appear in the other labor supply dimensions--annual or weekly hours. Indeed, weekly hours for white females was generally higher in 1960 than in 1967. Also we see from Table C-1, that the annual hours worked for women who did participate was 25 hours higher in 1960 than in 1967. Thus, concentrating on the LFPR dimension of labor supply exaggerates the secular increase in female market participation. On average, all married women in 1967 worked 85 hours more in 1967 than in 1960. This is a smaller average increase than occurred for black males between those two years (104 hours). For black married women there has been a tendency for the market work of participants to rise between 60 and 67. There is also a larger increase in average market work for black women than for white women. Thus, for women the potential advantages of longitudinal data over a simple cross-section seems more clear cut.

A Comparison With Becker's 1960 Census Study

Gary Becker, in his empirical work with the 1960 U.S. Census, produced regressions quite similar to those summarized in this chapter. The consis-

Table C-2

Comparison of Regressions With Becker's[a] For Males[b]

	Hourly Wage Male	Wages Wife[c]	Age	Family Size[d]
All White Males				
Becker	-.128	.011	.011	.020
	(4.14)	(2.24)	(2.13)	(0.91)
Smith	-.1040	.0202	.00014	-.0178
	(6.88)	(.82)	(.67)	(4.60)
White Males College				
Becker	.022	-.003	-.002	-.100
	(.72)	(.55)	(2.67)	(4.54)
Smith	-.0405	.0195	-.00002	-.0092
	(2.24)	(1.17)	(.041)	(1.13)
White Males High School				
Becker	-.077	.003	-.00004	-.018
	(3.24)	(.67)	(.76)	(1.66)
Smith	-.0852	.0510	-.00003	-.0198
	(4.16)	(2.10)	(.097)	(4.02)
White Males Elementary				
Becker	-.081	.022	-.0003	-.0007
	(.09)	(2.29)	(.68)	(.42)
Smith	-.0029	-.0415	.009	.0072
	(.084)	(1.92)	(2.08)	(.92)
Black Males				
Becker	-.025	.015	-.041	-.003
	(2.28)	(2.40)	(3.42)	(1.97)
Smith	-.0643	.0455	.00001	-.0107
	(2.16)	(1.71)	(.031)	(1.35)

[a]Becker's regressions include one additional variable: other non-labor income.

[b]T-values in parenthesis.

[c]Becker's variable is other family income.

[d]Becker's variable is family size, while mine is number of children less than seven.

tency between his work and mine provides a strong check on the power of the life cycle model. Not only does nis data pertain to a different calender year, but the sampling design of the Census is quite distinct from that of the SEO survey. Table C-2 compares the two studies. The two studies gave remarkably similar estimates for the male wage variable in the all white, high school, and elementary group. In my work, the estimated coefficient on male hourly wages is better (more negative and significant) than Becker's in the college and all Black runs. Since I had a more appropriately defined wage variable for wives, the increase in the size of the cross wage elasticity is encouraging.[1/] The sign of the age variable appears to be as inconsistent across the studies as it is among the groups in either study. The number of children under seven seems a better variable than simply family size. On the whole the similarity in the results of these two separate works is a rather rare affirmative test of a theory.

[1/] Becker's variable was deficient for three reasons: (1) it includes income other than earnings; (2) it is reported income for all other family members not simply the wife; and (3) it is a yearly and not hourly (price of time) concept.

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