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LEISURE, HOME PRODUCTION AND WORK--
THE THEORY OF THE ALLOCATION OF TIME REVISITED

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Leisure, Home Production and Work -

The Theory of the Allocation of Time Revisited*

I. Time Budget Evidence - Data in Search of Theory

The household production function is by now an established part of economic theory. As formulated by Becker, Lancaster, Muth, and others, the new consumption theory emphasizes the fact that market goods and services are not themselves the agents that carry utility but are rather inputs in a process that generates commodities (or characteristics) which, in turn, yield utility. A second feature, introduced into the analysis by Becker, is that market goods and services are not the only input in this process, the other input being the consumer's time. By this approach (Becker, 1965) the consumer maximizes welfare subject to the time and budget constraints where welfare is a function of commodities, which are "produced" using market goods and time.

The new approach has been put to wide use in the analysis of fertility, health, consumption, labor supply, and transportation demand (to name just a few). A fact that seemed to have slipped the users' attention is that the theory does not really discuss household production in the common sense of the term.¹ It discusses (to use Lancaster's terminology) consumption technology, but has very little to say (in its current form) on home production. It was Mincer who first pointed out (Mincer, 1962) that, at least in the case of women, one should distinguish between work at home and leisure, but this distinction (so common in everyday language) disappeared in Becker's more

general formulation. This omission was partly due to practical difficulties in distinguishing between the two, given the large number of borderline cases (e.g., is playing with a child leisure or work at home?), but partly because it has not been shown that our understanding of household behavior will be enriched by this distinction. Whatever the reason, the theory of the allocation of time in its current form is of little help where it is most needed; namely, in the analysis of time budget data.

From the theoretical point of view, the justification for aggregating leisure and work at home into one entity, "non-market time" (or "home time"), can rest on two assumptions: a. the two elements react similarly to changes in the socio-economic environment and, hence, nothing is gained by studying them separately, and b. the two elements satisfy the conditions of a composite input, i.e., their relative price is constant, and there is no interest in investigating the composition of this aggregate since it has no bearing on production and the price of the output. This study sets out to show that none of these assumptions holds. Recent time budget findings have established that work at home is affected differently by changes in socio-economic variables than is leisure, and this paper shows that the aggregation is also suspect from the analytical point of view.

The time use patterns of U.S. and Israeli families have been studied by Bloch (1973) and myself (Gronau, 1976). Table 1 summarizes these findings, describing the signs of the regression coefficients of the major determinants of the allocation of time. In spite of the differences in methodology and in the nature of the data used,² the two studies are unanimous in pointing out that changes in the socio-economic environment (e.g., changes in the wage

rate, income, education and number of children) have different effects on work at home and leisure and on the allocation of time of husbands and wives.

According to the Israeli data, an increase in the wife's education results in an increase in the time she spends in the labor market. This time is withdrawn primarily from work at home, leaving leisure unaffected (and perhaps even increased). The U.S. findings are much more specific, distinguishing between income effects and price effects. An increase in the wife's wage rate increases her supply of labor and reduces both work at home and leisure. A change in the wife's wage does not affect her husband's work in the market, but is positively correlated with his work at home, and, hence, negatively correlated with his leisure. An increase in the husband's wage rate increases his own supply of labor (mainly at the expense of his work at home), but reduces that of his wife. This change does not affect the wife's work at home, and consequently it increases the wife's leisure. An increase in non-wage income reduces the supply of labor of both husband and wife, it reduces work at home (at least in the case of women) and, hence, increases leisure.

Finally, both studies concur that children cause their mothers to transfer time from market to home tasks. However, the amount of time transferred falls short of the additional time required to care for children, leading also to a reduction of leisure. Children have the same deterrent effect where the fathers' leisure is concerned, but in this case the fathers increase both work at home and work in the market.

The total time available for work at home and leisure depends to a large extent on the person's employment status. Comparing the allocation of time of employed and not employed Israeli married women (table 2), it is

observed that controlling for education, the employed have less leisure than the not employed. The employed Israeli married woman worked in the market on the average 4.3 hours. She was able to conserve 2.8 hours by cutting her work at home, but 1.5 hours had to come at the expense of leisure and time spent on physiological needs.

Married men work more in the market than the not married, and married women spend more time in work at home (and somewhat less in the market) than the not married. Consequently it is observed (Gronau, 1976), that married people have less leisure than the not married, and the difference is greater for males than for females. These differences are explained by two factors - marriage and the existence of children. To isolate the effect of marriage, I ran separate regressions for all males and for all females who did not have young children (i.e., children in age group 0 - 5, or alternatively, children in the age group 0 - 12). The dependent variable is the time spent on the activity, and the explanatory variables include the person's age, schooling, land of origin, length of residence and number of older children; marital status is represented by a dummy variable. (For lack of space, I do not present the detailed regressions here.)

Controlling for the number of children (and the other socio-economic variables), I found that marriage reduces the Israeli wife's supply of work to the market and increases her work at home. The decline in the work in the market (about 1.5 hours a day) is somewhat smaller than the increase in work at home (about 2 hours), but the difference is too small to be significant (the time spent on physiological needs and, to a lesser extent, the time spent on leisure decline, but the decline is statistically insignificant).

As for males, they hardly increase their work at home but increase significantly their supply of labor to the market (by about 2 hours). This results in a significant drop in married males' leisure.

When the interaction terms of marriage and schooling are introduced into the equations, a puzzling asymmetry appears in the Israeli data. In the case of women, the effect of marriage seems to be either the same for all education groups or to depend on the wife's education; none of the activities is affected by the husband's schooling. On the other hand, in the case of males, the effect of marriage on the allocation of time depends invariably on the education of their wives. The greater the wife's schooling, the more the husband works both in the market and at home and the less leisure he has.

These findings give rise to several questions: Why do education, the wage rate, and income have a different effect on work at home and leisure? What explains the effect of children? What explains the differences in the allocation of time between labor force participants and nonparticipants? What explains the differences between females' and males' time use patterns? How can one explain the effect of marriage and what is the source of the asymmetry in the effect of marriage on the husband's and wife's time use patterns? Answering these questions, we shall observe that the distinction between consumption time and production time (i.e., leisure and work at home) has implications reaching far beyond the analysis of home time usage, embracing such topics as labor supply, fertility, marital stability, consumption (and in particular the demand for substitutes for the person's home services) and the reevaluation of the contribution of housewives to total economic welfare.

The paper opens with a description of a theoretical model that seems to provide us with a unifying explanation of the observed time use patterns.

Some of the crucial assumptions of this model are tested in section III. The implications of the model for the analysis of fertility, marital stability, the demand for housemaids and child care, and the evaluation of the output of the home sector are investigated in section IV. A summarizing section discusses some qualifications and suggests some future research.

II. The Model

A. The Simple Case of a Single-Person Household and One Commodity

A layman's distinction between work at home (i.e., home production time) and leisure (i.e., home consumption time) is that work at home (like work in the market) is something he would rather have somebody else do for him (if the cost were low enough) while it would be almost impossible for him to enjoy his leisure through a surrogate. Thus, one regards work at home as that time use that generates services which have a close substitute in the market while leisure has only poor substitutes in the market. In a somewhat extreme case, work at home and work in the market are perfect substitutes as far as the direct utility they generate is concerned, and the person is indifferent to the composition of the goods and services he consumes - whether they are produced at home or purchased in the market.

Formally, let there be a single-person household. The person maximizes the amount of commodity Z , which is a combination of goods and services (X) and consumption time (L):

$$Z = Z(X,L). \quad (1)$$

The goods can either be purchased in the market or produced at home, but the composition of X does not affect Z .³ I shall measure the value of home

goods and services (X_H) in terms of their market equivalents (i.e., the cost of the quality-corrected good in the market). Let X_M denote market expenditures; then total consumption is composed of the consumption of goods purchased in the market and those produced at home

$$X = X_M + X_H \quad (2)$$

Home goods are produced by work at home (H)

$$X_H = f(H), \quad (3)$$

subject to decreasing marginal productivity ($f' > 0$, $f'' < 0$).⁴ The decline in the value of marginal productivity at home is due not only to fatigue or changes in input proportions but also due to changes in the composition of X_H - a shift towards activities that have a cheaper market substitute, as H increases.

The maximization of Z is bound by two constraints: a) the (endogenous) budget constraint

$$X_M = WN + V, \quad (4)$$

where W is the person's wage rate (which is assumed to be constant), N denotes market work and V other sources of income; and b) the time constraint

$$L + H + N = T. \quad (5)$$

The necessary conditions for an interior optimum call for the marginal product of work at home to equal the marginal rate of substitution between goods and consumption time, which in turn equals the shadow price of time (W^*)

$$\frac{\partial Z/\partial L}{\partial Z/\partial X} = f' = W^*. \quad (6)$$

If the person works in the market ($N > 0$), they will also equal the real wage rate (W)

$$\frac{\partial Z/\partial L}{\partial Z/\partial X} = f' = W^* = W. \quad (6')$$

These conditions are depicted in figure 1. The home production function is described by the concave curve $TB_0'A_0C_0$. The more time the individual spends working at home (as measured by the horizontal distance from point T), the greater the amount of home goods produced. If the individual spends all his time in work at home, he can produce an amount of OC_0 units of goods. In the absence of market opportunities, the curve $TB_0'A_0C_0$ is the opportunity frontier enclosing the set of all feasible combinations of X and L. The existence of a market where the person can sell his working time and buy market goods expands this set. Thus, given the real wage rate W (described by the slope of the line A_0E_0), the person can trade his time for goods along the price line A_0E_0 (the line tangent to the production curve $TB_0'A_0C_0$). In the optimum the person may choose a goods-intensive combination of X and L, such as B_0 , where he enjoys OL_0 units of consumption time, spends L_0N time units in work in the market, and spends NT time units in work at home. Alternatively, the person may have a high preference for leisure (i.e., a leisure-intensive

consumption technology), choosing as his optimum combination the point B'_0 . In this case he does not work in the market, splitting his time between leisure (OL'_0) and work at home (L'_0T).

Note that the person may adopt a goods-intensive technology, such as B_0 , but it may still be home-time intensive in the sense that a large part of the goods are produced at home. Thus, leisure intensive and home-time intensive are not synonymous. Note further that if the marginal productivity of work at home at the point T falls short of the real wage rate, there is no home production and we are faced with the familiar Robbins diagram and the dichotomy of work (in the market) and leisure.

To analyze the properties of this model, let it be assumed that there is an increase in other sources of income by an amount of ΔV . An increase in other sources of income secures for the person the amount of OX_0 of market goods even if he spends all his time in consumption. The change is reflected, therefore, in a vertical shift of the production curve $TB'_0A_0C_0$ to $TDB'_1A_1C_1$. The change does not affect the marginal productivity of work at home - it does not affect the shape of the curve but only its location. Since the real wage rate is given, there is no change in the point where the person finds it cheaper to buy the goods in the market rather than produce them at home. If the person prefers a goods-intensive consumption technology which makes him work in the market (combination B_0), he does not change the amount of time he spends working at home (NT), and given the pure income effect, he expands his amount of leisure (if leisure is not an inferior input) at the expense of work at the market (consumption time increase from OL_0 to OL_1 and work in the market is reduced from L_0N to L_1N).⁷

If, on the other hand, the person does not initially work in the market (point B'_0), the increase in income and the resulting increase in Z call for

an increase in consumption time which can come only at the expense of work at home.

Let there be an increase in the real wage rate W (figure 2). If the person works in the market (point B_0), a change in wages affects both the rate of substitution between consumption time and goods and the profitability of home production. The increase in wages lowers the price of goods in terms of time and, hence, makes home production less profitable and encourages substitution of goods for consumption time. This change will, therefore, definitely cut work at home (from N_0T to N_1T), while its effect on leisure is indeterminate. The substitution effect tends to lower leisure, while the expansion effect tends to raise it. As for work in the market, it depends on the extent of the reduction of work at home and on the change in consumption time. If the reduction in work at home exceeds the increase (if there is one) of leisure, the supply of work to the market increases. The tendency of this supply curve to be positively sloped increases the greater the rate of substitution between goods and consumption time, the less sensitive the marginal productivity in home production to changes in the amount of work, and the smaller the income elasticity of leisure.

If the person initially does not work, the change in wages may lure him into the market (point B_0''), or he may be completely unaffected (point B_0').

A third kind of change that is worth examining is a change in productivity. It is impossible to predict the implications of this change without specifying the exact nature of the changes in home productivity (i.e., changes in f) and consumption technology (i.e., changes in Z). In the absence of such knowledge, one's predictions are limited to the case where the person works in the market. In this case a change in consumption technology should

affect work in the market and leisure but would leave work at home unchanged. On the other hand, an increase in the productivity of work at home is associated with an increase in real income and an increase in leisure, but its effect on work at home and work in the market is indeterminate.

Up to this point, it was assumed that entry into the market is costless. In effect, work in the market involves costs both in terms of money and in terms of time. Let these costs be C and t , respectively, and let them be independent of the amount of work N (e.g., transportation costs and time).⁸ The introduction of these costs calls for some modification of the budget and time constraints

$$X_M + \delta C = WN + V, \quad (4')$$

$$L + H + N + \delta t = T, \quad (5')$$

where δ is a dummy variable that describes the person's employment status

$$\delta = \begin{cases} 1 & \text{when } N > 0 \\ 0 & \text{when } N = 0. \end{cases} \quad (7)$$

The person is faced by two alternative opportunity sets (figure 3). If he stays out of the labor force and confines himself to home production, he can choose any point on the boundary TB_1E . On the other hand, if he decides to join the labor force, he suffers a loss of t units of time and C units of X , but his opportunity locus becomes $T'AF$. Given these opportunity sets, a person with a greater preference for goods will join the labor force (point B_0), spending OL_0 units of time on leisure, working in the market for L_0N units,

working at home for Nt units and, say, traveling to work for tT units of time. A person with a greater taste for leisure will decide to stay out of the market (point B_1), dividing his time between leisure and work at home (OL_1 and L_1T , respectively). Given the opportunity set, labor force participation is associated, therefore, with a decline both in leisure and in work at home.⁹ The existence of entry costs does not affect, however, our previous conclusions about the effect of changes in the socio-economic characteristics on the allocation of time.

The predictions of this simple model are by and large consistent with our observations. An increase in the wage rate should not affect the allocation of time of the not employed but should reduce the work at home of the employed. Thus, on the average, one should expect the wage rate and work at home to be negatively correlated. The effect of a change in the wage rate on leisure depends on the relative magnitudes of the income effect and the substitution effect. The tendency for the income effect to dominate increases with the number of hours. Thus, it is not surprising that the substitution effect is the dominant factor in the case of the wife's leisure, but the two factors cancel out (or even the income effect dominates) in the case of the husband. An increase in non-wage income should not affect the work at home of employed persons but should reduce the work at home of the not employed. Consequently, one expects non-wage income and wives' work at home to be negatively correlated. On the other hand, in the case of males who are mostly employed, the negative effect should be much less pronounced and may be insignificant. In either case, one expects non-wage income and leisure to be positively correlated. Finally, in the presence of market entry costs, employed persons should spend less time on work at home than the unemployed, but this difference

is swamped by the difference in the market hours. Consequently, one expects that, other things being equal, the employed work longer hours (in the market and at home) and enjoy less leisure.

Next, one has to explain the effect of children on their parents' allocation of time. This will allow us also to reexamine the conclusions of the model in a somewhat more realistic setting, where there exists more than one activity.

B. A World of Two Commodities - The Effect of Children on Their Parents' Time Use

Let there be two commodities, Z_1 and Z_2 . Each of these commodities is a combination of consumption time and goods (L_i, X_i) , and it is assumed, for simplicity, that their production functions (equation (1)) are linear homogenous. These production functions differ between commodities and are independent of each other (i.e., the production process of Z_1 is unaffected by the level and the way Z_2 is produced). There is no joint production or consumption (i.e., the same unit of time cannot be used simultaneously in the production of two goods or two commodities).¹⁰

The person maximizes his welfare

$$U = U(Z_1, Z_2) \quad (8)$$

subject to the budget constraint (4) and the time constraint (5), where $X_M = X_{M1} + X_{M2}$, $L = L_1 + L_2$ and $H = H_1 + H_2$. I also define (somewhat artificially) $N = N_1 + N_2$ where $N_1 = X_{M1}/W$ is the work time required

to buy X_{M1} , and $T_1 = L_1 + H_1 + N_1$ the total time spent on Z_1 (where $T_1 + T_2 = T$).

Given the allocation of time to any one of the commodities (T_1), one can derive (by equations (6) and (6')) the optimum allocation of this time between its different uses, L_1 , H_1 and N_1 . To give a complete picture of the optimum allocation of time and goods one has, however, to describe the process by which Z_1 and consequently T_1 are determined. This calls for the derivation of the transformation curve between the two commodities.

Let it be assumed that $V = 0$ and that there are no entry costs into the labor force. Given the allocation of time T_1 to each of the two activities, a person works in the market if for any activity i the time allotted to that activity exceeds the time he wants to work at home plus the corresponding amount of leisure

$$T_1 > H_1^* + \frac{f_1(H_1^*)}{\rho_1} = T_1^* \quad (9)$$

where H_1^* is the amount of work at home at which $f'_1(H_1^*) = W$ and where ρ_1 is the goods intensity of activity 1 (X_1/L_1) at the wage rate W . Given the home production function (i.e., given H_1^* and $f_1(H_1^*)$) and given the consumption technology (i.e., ρ_1), there is a greater probability the person works in the market the greater the amount of the activity demanded (i.e., the greater T_1). On the other hand, given T_1 , the probability of participation increases the lower H_1^* and $f_1(H_1^*)$ and the greater the goods intensity ρ_1 .

Assume inequality (9) holds for activity Z_1 for sufficiently large values of T_1 , but is not satisfied for Z_2 regardless of the amount produced

($T_2^* > T$). As long as the person works in the market (i.e., $T_1 > T_1^*$, $T_2 < T - T_1^*$), increasing Z_2 at the expense of Z_1 involves increasing home production of X_{H2} and consumption time L_2 and reducing work in the market N , and the consumption time associated with Z_1 (home production of X_{H1} is unaffected). Thus, regardless of the leisure intensity of Z_1 an increase in Z_2 results in a decline in the supply of labor to the market and an increase in home production. The amount of leisure increases if Z_2 is leisure intensive and declines when Z_2 is goods intensive. Eventually, the point is reached where $T_1 = T_1^*$ and the person drops out of the labor force. Any further increase of Z_2 should reduce work at home and increase leisure when Z_2 is leisure intensive and leads to the opposite result if Z_2 is goods intensive (see figure 4¹¹).

The transformation curve is concave. The marginal productivity of time in the home production of the two goods differs, and the increase in time allotted to Z_2 makes a diminishing contribution to the output of Z_2 . A wage increase reduces T_1^* and, hence, increases the tendency to participate in the labor force. It reduces the price of Z_1 in terms of time if $T_1 > T^*$ and shifts the corresponding section of the transformation curve upward.

It is easy to apply the analysis to the case where for both activities $T_1^* > T$, or where $T_1^* < T$ but $\Sigma T_1^* > T$. Of special interest, however, is the case where $T_1^* + T_2^* < T$; i.e., the person buys at least one of the goods X_{M1} in the market. Since it is assumed (for the time being) that the person does not have any other sources of income ($V = 0$), this assumption implies that the person works in the market regardless of the combination

of activities consumed. Let $T_i > T_i^*$ for both activities, i.e., the person buys both X_{M1} and X_{M2} in the market. Given the wage rate W , transferring time from activity Z_1 to activity Z_2 does not involve any change in the amount of time spent in work at home, nor does it affect the marginal rate of substitution between goods and leisure. Assuming the consumption technology is characterized by constant returns to scale, there is no change in the goods intensity of the two commodities. The change in the time allotted to activity Z_1 (ΔT_i) affects, therefore, only consumption time and work in the market and they vary by the same rate

$$\Delta T_i = \Delta L_i + \Delta N_i = \Delta L_i + (\Delta X_i / W) = [(1 / \rho_i) + (1/W)] x_i \Delta Z_i \quad (10)$$

where $\rho_i = \Delta X_i / \Delta L_i$ is the (marginal) goods intensity of activity i and $x_i = \Delta X_i / \Delta Z_i$ is the marginal goods input in Z_i . By the assumption of linear homogeneity, ρ_i and x_i are independent of the level of Z_i and, hence, the price of Z_i in terms of time remains constant as long as W is given and the person works in the market. In the relevant range the transformation curve is a straight line (figure 6).

As more time is withdrawn from Z_1 , the point is reached where the individual decides to drop out of the market for X_{M1} . Beyond this point any additional time has to be withdrawn from leisure and work at home. However, cutting work at home increases the marginal productivity of time $\partial Z_1 / \partial T_1$ and lowers the price of Z_1 in terms of time. The increase in Z_2 due to the increase in its time share T_2 remains constant, resulting in an increasing price of Z_2 (in terms of Z_1) as Z_2 increases. The transformation curve becomes, therefore, concave beyond a certain point (point G'_0).

Alternatively, if one increases Z_1 at the expense of Z_2 , the person may reach the point where he or she stops buying X_{M2} and relies exclusively on home production ($X_2 = X_{H2}$). At this point (G_0) the price of Z_2 in terms of Z_1 declines and the transformation curve becomes concave.

The transformation curve consists, therefore, of a part which is a straight line bounded by two concave segments.¹² Let Z_1 be the leisure-intensive activity. The introduction of Z_2 and the transfer of time from the leisure-intensive to the goods-intensive activity is accompanied by an increase in work at home and a decline in work at the market and leisure. As Z_2 increases there comes a point ($T_2 = T_2^*$) where it ceases to be profitable to increase the home production of X_{H2} . Any additional increase in Z_2 should not affect work at home, and since time is shifted to the goods-intensive activity, work in the market should increase at the expense of leisure. Eventually, the point is reached ($T_1 = T_1^*$) where any additional cuts in Z_1 have to come at the expense of home production; work at home and leisure diminish while the supply of labor is increased (figure 5).

A wage increase shifts the transformation curve upward (a shift from $K_0G_0G'_0K'_0$ to $K_1G_1G'_1K'_1$ in figure 6), and changes the relative price of the two activities. It reduces the price of Z_1 if its production involves market goods ($X_{M1} > 0$), the rate of decline being positively related (by equation 10) to the goods intensity of the activity. Thus, a wage increase should increase the price of Z_1 relative to Z_2 as long as $T_2 > T_2^*$ (i.e., in the section $G_1G'_1K'_1$). However, when the person relies in the production of Z_2 exclusively on home production ($T_2 < T_2^*$), the relative price of Z_2 should increase with wages (section K_1G_1).

It has been shown in the case of the one-commodity world that a wage increase reduces the amount of work at home and its effect on leisure and work in the market is indeterminate. In a two-commodity world, the tendency for the labor supply function to be positively sloped is increased by the substitution effect which favors the market goods intensive commodity (the commodity that entails work in the market). Still, the final outcome depends on the production functions of home goods f_1 , the consumption technology Z_1 , the elasticity of substitution between the commodities and their income elasticities.

Removing the assumption that there exist no other sources of income, the person can obtain market goods without having to work in the market. An increase in other sources of income tends, therefore, to reduce labor force participation. As long as the person works in the market and buys all market goods ($X_{Mi} > 0$ for $i = 1, 2$), an increase in V shifts the transformation curve upward but does not change the relative price of the two commodities.¹³ The parallel shift in the transformation curve creates an income effect which increases both activities. The increase in the derived demand for leisure is satisfied by diverting time from work in the market to leisure, leaving work at home unchanged.

With minor exceptions the analysis of this section supports our previous conclusions. Changes in the wage rate, other sources of income, and home productivity (not discussed here) have a very similar effect on the allocation of time in the two-commodity world as in the one-commodity world.¹⁴ The analysis sheds, however, a new light on the effect children have on the allocation of time. Among economists it is customary to treat children in the analysis as time-intensive commodities, the argument relying on the nega-

tive relationship between the number of children (and in particular young children) and the supply of labor (Willis, 1973). It seems to me this is a somewhat oversimplified view. In my terminology children seem to be essentially a goods-intensive commodity, and hence an increase in the number of children should cut into a person's leisure. The introduction of children, similarly to any other commodity that uses home-produced goods, should increase work at home and decrease labor supply, but eventually this tendency should be reversed and any additional increases in the commodity children should lead to an increase in labor supply at the expense of leisure.

It has been observed that children have a different effect on their mothers' and fathers' supply of labor. The factor dominating women's allocation of time is the increased scope for home production associated with the introduction of children. Time is shifted from other activities to the new activity, involving a shift from work in the market to work at home. As for fathers, given their lower productivity at home and their higher wage rate in the market, their scope for home production is much more limited. Thus, the effect of children on their fathers' work at home is much smaller than on their mothers'. On the other hand, given the goods-intensive nature of children, an increase in the number of children should increase the fathers' supply of work in the market. For the same reason, one expects the leisure of both parents to decline.

The price of market substitutes (maids, nursery school, kindergarten, schools) declines as the child grows older. Said differently, the real wage of the mother (in terms of market substitutes) increases as the child

grows older. This increase leads to a decline in work at home and an increase in work at the market, but may not increase much the demand for leisure.¹⁵

Similarly, it seems that in Israel the prices of market substitutes (maids, nursery school) are cheaper than in the U.S.¹⁶ Thus, an Israeli mother should find it less profitable to divert time from work in the market to work at home when she has a child. The supply of labor of Israeli women, and in particular of the more educated ones, should therefore be less affected by young children than that of their American counterparts (Gronau, 1976).

The introduction of children into the analysis in the context of a single-person household is admittedly of little relevance. To make the analysis more realistic, one has to expand the model to a two-person household. In such a household people interact, and this interaction is often reflected in their allocation of time. It has been argued (Mincer, 1962; Gronau, 1973) that a multiperson household is a framework in which its members can reap the gains from specialization and exchange. Our model gives us new tools to reexamine this exchange.

C. The Case of a Two-Person Household in a World of Two Commodities -
The Gains from Marriage

Marriage introduces into people's choice set a new activity, "married life." The new activity uses in its production home produced goods and, thus, involves an increase in work at home at the expense of work in the market. Furthermore, to the extent that this loosely defined activity is more goods intensive than the other activities, it should also reduce leisure. Marriage may have, however, a more fundamental effect on the household members' allocation of time by allowing for specialization within the family. Much of the preceding discussion is based on the proposition

that a person is reluctant (or finds it unprofitable) to sell his home goods outside his household. The analysis may require some modifications when we expand the definition of the household from a one-person to a two-person entity.

Let it be assumed that the household consists of two persons, husband and wife (denoted by m and f , respectively), and there are only two commodities (one of the commodities may be children). On-the-job training may make the wife a more efficient producer of home goods, and discrimination and smaller market involvement result in the wife's earning a lower wage than her husband $W_m > W_f$. Given this wage differential, the male will be happy to give up $(W_m - \epsilon)\Delta T$ of income (where $\epsilon > 0$) if he could only get in return ΔT units of time. The woman, on the other hand, will be content to do without ΔT of her time if she could secure in return an amount of $(W_f + \epsilon)\Delta T$ of income. Since $W_m > W_f$, there is ample space for exchange. The only problem hampering the exchange is limitations on the sale of nonmarket time. These limitations are, however, somewhat relaxed in the family context.

By definition leisure is an input which the person has to provide himself. Thus, there is no way in which the wife can conserve on her husband's leisure. She can, however, conserve on his work-at-home time. Indeed, the woman who is reluctant to sell her home goods (e.g., serve as a maid) is willing to exchange them within the family for market goods. The extent to which such an exchange takes place and the terms of the exchange depend to a large degree on her marginal costs of producing these goods.

Let it be assumed that in the absence of exchange the husband is buying some quantity of every good in the market ($X_{Mi} > 0$). Were exchange

to take place, the highest price the husband would be ready to offer for these goods would be their market price. If the woman also buys these goods in the market (though she may produce some of them also at home), she is facing the same prices as her husband, and in spite of the wage differential there is no room for exchange. If, on the other hand, the wife's optimal combination of goods before marriage does not involve one of the market goods, the wife produces that good at a price that is lower than the market price at which the husband buys it, and there is still place for specialization - the wife expands her home production in exchange for market goods.

The amount of goods and services exchanged depends on the terms of trade. In the short run when the exchange is limited to a specific pair of people, we are confronted by a monopoly-monopsony case with an indeterminate solution. In a broader context that also encompasses the marriage decision, the number of players is not limited to two and the terms of trade (the price of the home good in terms of the market goods) are determined by the demand and the supply of the home good. The husband's home goods demand curve has an infinitely elastic section at the prevailing market price. Thus, if at the market price the husband's demand exceeds the wife's excess supply the terms of trade equal the market price, and the gains from the trade accrue solely to the wife.¹⁷ A change in the socioeconomic environment (e.g., an increase in wage rates or in the family's other sources of income) that increases the demand for home goods (or decreases the wife's excess supply) results in an interaction in time usage of husbands and wives only if it gives rise to an increase in the terms of trade. On the other hand, if the terms of

trade are at their maximum (i.e., they equal the market price), they cannot rise any further and the predictions of the two-person model are very similar to the one-person case.

The different effect marriage is observed to have on the husband's and wife's work at home and in the market is due primarily to specialization and exchange taking place within the family.¹⁸ But what explains the negative effect marriage has on the husband's leisure, and the observed asymmetry in the effect changes in the spouse's education and wage rate have on the husband's and wife's allocation of time? One possible answer is that marriage has a redistributive effect. Equality within the family calls for husbands and wives to have the same amount of leisure, and since single men enjoy more leisure than single women, marriage entails a reduction in males' leisure so that it equals that of females. Unfortunately, this explanation provides an answer only to the first question but does not resolve the second.

An alternative explanation traces the effect of the wife's education on her husband's allocation of time to selective mating and to the effect it has on his investment in human capital. It has been observed (Benham, 1974) that the wife's education and the husband's wage rate are positively correlated. If wages have a positive effect on labor supply, wife's education should be positively related to her husband's work in the market and negatively related to his leisure.¹⁹ However, this reasoning falls short of explaining the positive effect wife's education has on the husband's work at home. Furthermore, why don't we observe the same factors working on the wife's allocation of time?

To my mind, the explanation lies in the asymmetry of the exchange process taking place within the family. Marriage increases the demand for the goods in which the woman has a comparative advantage, and thus her gains from marriage may exceed those of her husband's. Specifically, marriage affects the allocation of time in two ways: (a) It creates a demand for a new goods-intensive activity that involves home production; and (b) it allows for specialization within the household. The first of these factors (similarly to the effect of children) should increase the woman's work at home and reduce her work in the market and leisure. It should increase the husband's work both at home and in the market at the expense of leisure. The opening of possibilities for exchange should reinforce this tendency for the wife but should decrease work at home and increase the work in the market of the husband. The possibilities for gains from trade are greater the lower the wife's education. Furthermore, the lower the wife's education, the greater the probability that these gains will be shared by both husband and wife. Thus, the less schooling the wife has, the more home tasks she takes over from her husband; the less he works at home, the more leisure he gets and the less he works in the market. On the other hand, the higher her education, the smaller the total gains from the exchange and the smaller his fraction of the gains. Consequently, he works more both in the market and at home at the expense of leisure. As for the wife, the more schooling she has the smaller the total gains but the greater her fraction of the gains from trade. The wife's leisure is affected by two contradictory forces: marriage tends to lower leisure, but the gains from exchange tend to increase it. The two forces seem to offset each other, regardless of the wife's schooling, leaving the woman's leisure unchanged.

III. Some Empirical Tests

The model gives rise to a wealth of testable hypotheses. Although many of these hypotheses could have been generated also by other models, which use a weaker set of assumptions (e.g., the models discussed in my 1973 and 1976 papers), none of them generates this model's prediction concerning the income effect on work at home. A crucial test of our analysis focuses, therefore, on this effect: Does an increase in nonearning income reduce the work at home of the not employed but leave the work at home of the employed unaffected? The examination of this hypothesis is the subject of this section.

The data used are the 1972 panel of the Michigan Study of Income Dynamics. Given the peculiar nature of the subsample of the not employed males (e.g., a mean age of 68), I confine the discussion to the time usage of married white females. This sample included 1,281 women, of which 660 were employed sometime during the previous year, and 621 reported they did not work in 1971. The dependent variables consist of the time spent working in the market (including travel to work), the time spent in housework, and leisure.²⁰ The explanatory variables comprised the wife's age, education and labor force experience (i.e., full-time work) since the age of 18, the husband's education and wage, the family's nonearning income, the number of children younger than 18, the number of children in school and the number of rooms in the home. The regressions were estimated for the whole sample, and separately for the employed and the not-employed.²¹

The findings for the whole sample closely resemble those reported earlier in section I and, thus, are not presented here. Table 3 presents the results for the two separate subsamples. The results confirm the predictions of the model. When the wife is not employed, her work at home is

negatively affected (and, hence, her leisure is positively affected) by her nonearnings income and by her husband's wage rate. Children tend to increase her home tasks, but school children less so than preschool children. Her work at home is negatively associated with her education, but is positively associated with the size of her house. As predicted, her potential wage rate (as approximated by her past labor force experience) does not affect her allocation of time.

Focusing on employed women, a major determinant of their allocation of time is their wage rate. This variable explains the negative effect of labor force experience on work at home and leisure, and the negative effect of the wife's education on her work at home (education and leisure are positively correlated in this regression, but the regression coefficient is insignificant). Children have a negative effect on their mothers' leisure, the time withdrawn from the market falling short of the increased housework. As the child grows older and enters school, housework diminishes, but this change hardly results in any gains in leisure - the time saved in work at home is diverted back to the market.²² Most important for our analysis is the income effect. The husband's wage has a significant positive effect on leisure, but has no effect on work at home. Similarly, work at home is unaffected by changes in nonearning income; its effect on leisure is positive, though weak. It is also worth noticing that the work at home of employed women is uncorrelated with the size of their house - presumably any extra work associated with a greater number of rooms is done by maids (or other market substitutes).

To isolate the wage effect from other effects associated with education, I introduced this variable directly into the regression. Since the survey does not include direct information on the hourly wage rate, hourly

earnings are computed by dividing annual earnings by annual hours (i.e., by the product of weeks worked and weekly hours). This procedure generates serious measurement errors which hamper any direct attempt to estimate the wage effect. To overcome this problem, I used an indirect approach: in the first stage I estimated the wage function, and in the second stage I introduced the imputed (ln) wage in the time usage functions. The estimated wage function was of the semi-log variety, the explanatory variables being the wife's education, her labor force experience and her husband's wage rate

$$\ln W = - .5955 + .0905 \text{ EDUC} + .0302 \text{ EXPR} - .0006 (\text{EXPR})^2 + .0442 \text{ WAGEH}_2 \quad R^2 = .20$$

(9.18) (4.72) (2.99) (4.75)

where the wages are measured in dollars and the terms in parentheses denote the corresponding t values.

The results of the second stage (table 3) do not vary much from our previous findings. The wage rate has a strong negative effect on both leisure and work at home. Education is positively correlated with leisure, but its effect on work at home (though positive) is not significant. (The direct effect of education on number of hours worked in the market is, therefore, negative.) Finally, the pure income effect is as predicted: Neither non-earnings income nor the husband's wage rate affect the employed woman's work at home. Our theory passes also this test successfully.

IV. So, What's New? - Some Implications

The model has been shown to yield a cohesive interpretation of the findings on the allocation of time between work in the market, work at home and leisure. It explains the different behavior patterns of people with

different incomes, wages and education, and the effect of children on the allocation of time. It accounts for the different patterns observed for males and females, married and not married, employed and not employed, and it seems, in general, to provide the economist with more refined tools to analyze time budget data. But does the theory extend our understanding of household behavior beyond this goal? In this section I shall try to show that the ramifications of the theory reach far beyond the analysis of time use.

The Supply of Labor. The most direct application of our model is, of course, to the analysis of labor supply. In the short run the two most important economic factors affecting the supply of labor of married women are income and wage rates. By our analysis the income effect works primarily through its effect on leisure. On the other hand, wage increases tend to increase the supply of labor by reducing work at home; but their effect on leisure is indeterminate. Given the wage effect on leisure, the labor supply is more elastic the greater the sensitivity of work at home to changes in the wage rate (i.e., the smaller the effect of H on f'). For that reason alone, one should expect the supply of labor of married women to be more elastic than that of males. But the analysis brings up a further point: A wage increase may result not merely in a shift from work at home to work in the market but also in a reduction of leisure - employed women having less leisure than the not employed. Indeed, according to the estimates presented in table 3, though the wage elasticities are almost identical (about 0.4), the marginal effect of a wage change on the leisure of the employed is more than four times that on work at home. Admittedly, some of these changes in leisure may be due to changes in activities which are normally regarded as work at home

but were not defined by the respondent as housework,²³ but it is hard to believe that this misclassification explains such a great difference.

Recent decades have witnessed a great expansion in the labor supply of married women. Still, with only about half the married women participating in the labor force, and with the number of working hours of the employed women being equal to the number of hours they put in work at home, it looks as if this resource has only been partly tapped for future expansion. A natural question is to what extent will the labor supply function of married women resemble that of their husbands' once they reach similar labor force participation rates? Right now any answer to this question should be regarded as sheer speculation, since so much depends on changes in role differentiation, and reallocation of work at home within the family. It is, however, worth noticing that right now women are more willing to dispense with leisure in response to increases in wages than men (a one percent change in wages changes the employed wives' leisure by almost twice that of males'), and that males are apt to increase their leisure in response to increases in income much more than women (the ratio of the income effects is about 5:1).²⁴

In the long run, changes in wages are associated with changes in education. But while wage increases reduce both work at home and leisure, the effect of education is confined to the first factor. The prospects for increased labor supply due to increases in education are, therefore, much more limited than in the short run. On the other hand, one can expect further expansions in labor supply if the increase in education and wages is associated with a decline in fertility.

The Demand for Children. It is customary for economists to argue that children are a home-time intensive activity and, therefore, an increase in children reduces work in the market. A corollary of this conclusion is

the argument that since children are time intensive, an increase in their mothers' wage rates should raise their price relative to that of other commodities. Given our analysis, one has to distinguish between home time intensity and leisure intensity (or average and marginal home-time intensity). Children may be home-time intensive when they are introduced into the household since some of the goods used in the activity can be profitably produced at home. However, as one increases this activity, the profitability of home production diminishes and eventually the family relies (on the margin) solely on market goods. At this point the goods-intensive nature of children becomes apparent. Thus, while in the range where children's goods are produced at home, an increase in wage increases the price of children; when these goods are replaced by market goods, the increase in wage reduces it. The tendency to replace home goods by market goods increases with the mother's wage rate. Thus, one should expect that the price of children increases with the mother's wage for low wage mothers but that this relationship is reversed as the mother's wage increases. Ben Porath (1973) observes for Israeli women a transpose J shape relationship between fertility and education - fertility declines with education but there is a slight inflection at the top. These findings are consistent with the model's prediction.²⁵ The price of housemaids relative to the wife's wage seems to be lower in Israel than in the U.S. and the tendency to replace housemaid services for the wife's time is, therefore, greater there. Consequently, the transpose J shape relationship between fertility and the wife's education should be more pronounced in the Israeli data.

The price of market substitutes relative to the wife's wage declines with the child's age. The goods-intensive nature of children becomes, therefore, more explicit as the child grows older. The relative price of "older

children" has a greater tendency to decline with the parent's wage. The overall effect of changes in the wage rate on the present value of the cost of children is, therefore, indeterminate and depends on the price of market substitutes, the rate of discount, etc.

The Gains from Marriage. Past studies (e.g., Becker, 1973) have asserted that the gains from marriage depend on the husband-wife wage ratio. Other things being equal, the higher the husband's wage rate relative to his wife's the greater the opportunity for specialization within the household and the greater the gains from trade. This conclusion has to be somewhat modified if one realizes that there exists no direct way for trading one's leisure and that the exchange is confined to home goods. The scope for gains from exchange within the household is limited by the profitability of home production. The latter, in turn, depends on the wife's home productivity and the price of market substitutes. Given the wife's home productivity and the price of market substitutes, the higher the wife's wage the greater the probability that any change in her activities may change the composition of her market goods but will not affect her home production. In this case the prices of goods confronting males and females are the same and there are no gains to be reaped from trade. The gains from trade decline, therefore, with the wife's wage rate irrespective of the husband's wage. The increase in marital instability that has accompanied the increase in wives' real wage rates and their increased participation in the labor force is consistent with the prediction of the model, though one does not witness any substantial narrowing of the sex wage gap (Fuchs, 1974)²⁶.

Taxes, Childcare Programs, and the Demand for Domestic Help. It is often claimed that the wife's entry into the labor force involves costs such as childcare and housemaid services which exceed by far the husband's cost of entry. According to this argument, childcare services should be tax deductible, as are books or other costs the person must undertake in order to work. This argument has been accepted by many legislators and incorporated into the tax laws.

The analysis points out the fallacy of this argument. An increase in the expenditures on childcare services is associated with the wife's work in the same way an increase in the expenditures on a gardener is associated with the husband's work. As distinguished from expenditures on books or commuting costs (and time), it is not a cost which is a prerequisite to work but rather a cost which the family willingly undertakes because it finds that it is unprofitable for the wife to spend her time in childcare activities.

The analysis emphasizes, however, an additional point. In evaluating the various childcare programs which have been proposed or enacted in recent years, one has to distinguish between their effect on the marginal rate of substitution between goods and leisure and their effect on the profitability of home production. Assume a one commodity world where the only commodity is "children." A program which gives the mother a fixed childcare subsidy for every hour worked is equivalent to a wage increase and affects both the profitability of home production and the price of leisure. On the other hand, a fixed cash rebate or free childcare services which are conditional on a minimum number of working hours does not affect the profitability of home production of working women and may only affect their demand for leisure. When it comes to non-working women this kind of program

encourages labor force participation (in particular if entry into the market involves fixed costs) and may affect both home production and leisure. Finally, a tax deduction of childcare expenditures which declines gradually with earnings may affect home production but not affect the price of leisure.

It has been argued (Heckman, 1974) that to evaluate and compare the impact the various programs have on labor supply and welfare, it is sufficient to know the indifference curves between market goods and non-market time. Our analysis indicates that this knowledge may not be sufficient and that a thorough evaluation may require specific knowledge of both the household production function $f(H)$ and consumption technology (Z) ²⁷

Finally, it seems at first puzzling that work at home is so insensitive to changes in income, given the high income elasticity of the demand for housemaids.²⁸ The puzzle is, however, resolved if one realizes that the demand for housemaid services (as many other services) is an excess demand. An increase in income does not increase the profitability of producing these services at home when the person is employed and reduces the profitability when he is not employed (the shadow price of time increasing). Thus, changes in income may have a strong effect on the excess demand for these market services and no effect (or even a negative one) on home services.

The Evaluation of the Home Sector Output. A long standing complaint waged against the current national accounting system is its omission of the output of the non-market sector, and specifically, the output of wives at home, which constitutes according to some estimates (Morgan, 1966) close to 40 percent of measured GNP. Several attempts have been made to correct this shortcoming (Morgan, 1966, Nordhaus & Tobin, 1973, Sirageldin, 1969) but these attempts were plagued by an ensuing controversy over what prices should be used in

evaluating the wife's output. Should one use the value women seem to assign to their time (Gronau, 1973) or should one use the market prices of the services rendered by the wives (Sirageldin, 1969, Walker & Gauger, 1973). The model provides an analytical tool to resolve this controversy.

If the wife works in the market and at least some of each good is purchased ($X_{Mi} > 0$), her value of marginal productivity at home equals her wage rate ($f'_i = W$). Since most of the goods produced at home are in the nature of services, she assigns to these goods a value that equals the wage she would have to pay somebody to do the work for her divided by the average productivity of that person ($= W_H/AP_{Hi}$). The value placed on the last unit of work at home equals, therefore,

$$W = W_H f'_i / AP_{Hi} .$$

Using the wage W_H of the service worker who can replace the wife in home production serves as a good approximation for the value of her time only if his or her average productivity equals the wife's marginal productivity. If $f'_i > AP_{Hi}$, the wage of the service worker will underestimate the price the wife assigns to her marginal unit of time in work at home.

To estimate the value of home production, it is not sufficient to know the value of the marginal unit of work at home but one has to know the home production function $f(H)$ itself. Multiplying the number of hours the wife works at home by her hourly wage rate understates the value of her home output if the law of marginal productivity prevails. Furthermore, it has been shown that if some of the goods are not purchased in the market ($X_{Mi} = 0$), the value of the marginal productivity of her time in their production at home exceeds

the wage rate. Finally, if the woman does not work in the market, her shadow price of time exceeds her expected wage rate. It seems, therefore, highly probable that our current estimates of the output of the home sector are highly underestimated.²⁹

V. What's Now?

I believe that this paper provides ample evidence for establishing the distinction between work at home and leisure as an integral part of the theory of the allocation of time and household production. It has been shown that this distinction is a prerequisite for any further investigation of time use patterns and is highly useful in the analysis of fertility, marriage, childcare programs, labor force participation, and the evaluation of the output of the nonmarket sector. I am confident the model will also be found fruitful for the analysis of problems in other fields, such as medical economics or transportation demand, in which the household production model has been put to good use.

It is clear that the model is incomplete. I expect major criticism to be launched against the assumption that work at home involves the same marginal utility as work in the market. Childcare, cooking, gardening, etc. clearly create direct utilities (positive or negative). The psychic income derived from these activities relative to that derived from work in the market may vary with the person's socioeconomic characteristics and affects his behavior. Admitting the validity of this criticism, I contend that it is not more serious than in the case of the dichotomy of home time vs. work in the market. Psychic income (or leisure at work) is an important determinant of investment in human capital, occupational choice and the supply of labor.

Economists have not been able up to now to derive a satisfactory method to isolate this factor. This has not hampered research on the determinants of the supply of work to the market and it should not block research on the supply of work at home.

A second point of criticism may focus on the neglect of joint production and joint consumption. These are important features of human behavior which are not adequately treated by our analysis.³⁰ But in this respect our model does not do worse (or better) than the current model of household production.

Finally, in the empirical part of this paper I have investigated only a small fraction of the implications of the model for the household allocation of time and consumption patterns. Topics such as the interaction between work at home and substitute market services, or the interaction between entry costs (time and money) and time usage have only been touched upon. More ambitious endeavors such as the estimation of the household production function and the value of home output are still in a blueprint stage. However, given the right data, it is hoped that this paper will provide the framework that will facilitate their realization.

REFERENCES

- G.S. Becker, "A Theory of the Allocation of Time," Economic Journal, 75 (September 1965):493-517.
- _____, "A Theory of Marriage: Part I," Journal of Political Economy, 81 (July/August 1973):813-846.
- L. Benham, "Benefits of Women's Education Within Marriage," Journal of Political Economy, 82 (March/April 1974, Part II):557-571.
- Y. Ben-Porath, "Economic Analysis of Fertility in Israel: Point and Counter-Point," Journal of Political Economy, 81 (March/April 1973, Part II): S202-S233.
- F. Bloch, "The Allocation of Time to Market and Non-Market Work Within a Family Unit," Institute for Mathematical Studies in the Social Sciences, Stanford University, Technical Report No. 114, November 1973.
- J. Cogan, "Labor Supply with Endogenous Time and Money Costs of Entry," Mimeo, April 1976.
- V. Fuchs, "Recent Trends and Long-Run Prospects for Female Earnings," American Economic Review, Papers and Proceedings, 64 (May 1974):236-242.
- R. Gronau, "The Intrafamily Allocation of Time: The Value of Housewives' Time," American Economic Review, 78 (September 1973):634-651.
- _____, "The Allocation of Time of Israeli Women," Journal of Political Economy, 84 (August 1976 Supplement).
- J.J. Heckman, "Effects of Child-Care Programs on Women's Work Effort," Journal of Political Economy, 82 (March/April 1974, Part II):S136-S163.
- J. Mincer, "Labor Force Participation of Married Women," in Aspects of Labor Economics, edited by H. Gregg Lewis, Universities-National Bureau Conference Series No. 14, Princeton, N.J.: Princeton University Press, 1962.
- J.N. Morgan, I.A. Sirageldin, N. Barewaldt, Productive Americans, Ann Arbor: University of Michigan Press, 1966.
- W. Nordhaus, J. Tobin, "Is Growth Obsolete?" in The Measurement of Economic and Social Performance, Studies in Income and Wealth, edited by M. Moss, Vol. 38, National Bureau of Economic Research, New York: Columbia University Press, 1973.

- R. Perlman, Labor Theory, New York: Wiley, 1969.
- R.A. Pollak and M.L. Wachter, "The Relevance of the Household Production Function and Its Implication for the Allocation of Time," Journal of Political Economy, 83 (April 1975):255-278.
- S. Sharir, "The Income Leisure Model: A Diagrammatic Extension," The Economic Record, (March 1975):93-98.
- I.A. Sirageldin, Non-Market Components of National Income, Ann Arbor: University of Michigan Press, 1969.
- K.E. Walker, W.H. Gauger, "The Dollar Value of Household Work," New York State College of Human Ecology, Cornell University, 1973.
- R.J. Willis, "A New Approach to the Economic Theory of Fertility Behavior," Journal of Political Economy, 81 (March/April 1973, Part II):S14-S64.

FOOTNOTES

This paper has been written while on sabbatical at the National Bureau of Economic Research. It has not undergone the full critical review accorded the NBER studies.

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¹One exception is (Perlman, 1969, Ch. 1). After writing the initial draft of this paper, I have become aware of another two exceptions; namely, Bloch (1973) and Sharir (1975). Both suggest models that are in many respects similar to the one suggested here but do not analyze all the implications of this model.

²The U.S. and the Israeli data differ both in the nature of the dependent variables and in the degree of detail of the explanatory variables. In the American survey (the 1964 Productive American study), people were asked how much time they spent annually in regular and irregular housework and how much in market work. Leisure was defined in this study as the residual. In the Israeli survey (conducted by the Institute of Social Research in Jerusalem), people were asked how they spent each hour of the previous day. The survey included 48 activities which I classified into four major groups (work in the market, work at home, leisure and physiological needs, only the

first three of which are reported in table 1). The respondents' background data are much more detailed in the American survey. The Israeli survey does not contain any information on the person's wage rate, and one has to use education as a very imperfect proxy.

³This assumption is crucial to the model and distinguishes this model from previous formulations such as $Z = Z(X_M, X_H, L)$ (Gronau, 1973) that had only very limited predictive power.

⁴For simplicity I ignore the market goods that enter into the production of home goods.

⁵Thus, one can easily rewrite equation (1)

$$Z = Z(X, L) = Z'(X, L, T-L) = Z'(X, L, H + N), \quad (1')$$

i.e., H and N are perfect substitutes as far as the consumption technology (Z) is concerned.

⁶Equations (6) and (6') are derived by maximizing the Lagrangian function

$$G = Z[(X_M + f(H)), L] + \lambda[WN + V - X] + \mu[T - L - H - N]$$

with respect to L, H, N and X_M . The shadow price of time (measured in real terms) equals

$$W^* = \mu/\lambda$$

where μ and λ are the marginal utilities of time and income, respectively.

The wage rate may fall short of the value of marginal productivity at home ($W < f'$) either because of the person's reluctance to perform the home services outside of his own home or because of differences in the value of marginal productivity between home and the outside, due to transportation costs, monitoring costs and efficiency (the person being self-employed in his own home).

⁷The decline in work in the market may result in some cases in the person's dropping out of the labor force altogether.

⁸One can easily treat variable time and money costs (i.e., costs that vary with N) by an appropriate modification of the wage rate.

⁹An alternative interpretation of the different patterns of time use of the employed and not employed traces them to differences in productivity at home, the less productive person having a stronger inclination to join the labor force.

¹⁰This assumption has come recently under heavy criticism by Pollak and Wachter (1975). I adopt it reluctantly for the sake of simplicity.

¹¹The figures 4 and 5 do not pretend to describe the relative magnitudes of L , H , and N but only the direction of their change as more time is allotted to Z_2 .

¹²In the special case where the productivity of the person in the production of one of the home goods is very low and he relies exclusively on market goods ($X_{H1} = 0$), the transformation curve has only one concave segment.

¹³As long as $N > 0$ for any combination of Z_1 and Z_2 , the concave sections of the transformation curves are unaffected by changes in V . However,

if the increase in V is sufficiently large to make the person withdraw from the labor force, for a given set of Z_1 and Z_2 , the transformation curve becomes concave for those sets. If V is sufficiently large, the person may drop out of the labor force altogether. If $V > \text{Max}_1[\rho_1(T - H_1^*) - X_{H1}^*]$ the person does not work regardless of the combination of commodities chosen.

¹⁴One exception is the case where $T_1 > T_1^*$ but $T_2^* > T$ (i.e., the person works in the market, $N > 0$, but does not purchase Z_2 market inputs, $X_{M2} = 0$). An increase in V that increases both commodities entails an increase in leisure and work at home at the expense of work in the market.

¹⁵The goods intensity of children may decline with their age, resulting in an increase in leisure as the child grows older. However, as long as children are more goods intensive than other activities, they should be associated with a decline in leisure.

¹⁶In Israel many of the 2-year-olds and most of the 3-4 year-olds attend a nursery for at least four hours a day. In 1968 over 40 percent of the working mothers with a child less than 3 years old employed a maid (the fraction for working mothers with 13+ years of schooling was two-thirds.)

¹⁷The wife, however, may find it advisable to "bribe" her husband to maintain this trading relationship.

¹⁸The wife's tendency to specialize in work at home is reinforced if work in the market involves fixed entry costs. Marriage offers the woman a job which does not involve these fixed costs at terms which may not be much inferior to her market wage rate. As a result, the wife may be tempted to drop out of the labor force and concentrate on work at home.

¹⁹The positive correlation between the wife's education and the husband's work in the market reported earlier for Israeli families is observed by Benham also in the case of American data.

²⁰The families reported on the number of weeks worked, the number of hours the wife worked per week, and the number of hours spent in housework in an average week. (Housework is not defined in the questionnaire, but the examples mentioned are cooking, cleaning and other work around the house. Thus, it is not known whether the families included such activities as childcare and shopping in housework). Leisure was defined by me as the difference between 8,760 annual hours and the number of hours reported worked in the market and at home.

²¹Separating the sample according to employment status may give rise to selectivity biases. I tried to correct these biases, but had very little success because of the strong multicollinearity between the correction coefficient and the rest of the explanatory variables. It is comforting to learn that recent attempts to correct selectivity biases in labor supply have generated results that do not differ much from simple OLS estimates based on the working wives sample (Cogan, 1976).

²²The effect of children on leisure, as presented in table 3, is significant at the conventional 5 percent level only if one uses a one-tailed test. However, if one removes the variable "school children" from the regression, the variable "number of children" turns out to be highly significant by any standard (i.e., t values that exceed 3).

²³See note 20. According to the Israeli data, "housework" (not including childcare) is only two-thirds of the time defined by me as work at home.

²⁴The findings for the employed married men (not presented here) are based on the same sample as those for the women.

²⁵Ben Porath (1973) explained this relationship in a somewhat similar fashion, arguing that if the elasticity of substitution between time and goods in the production of children exceeds unity, children may be a time-intensive commodity for low-wage mothers but a goods-intensive commodity for high-wage mothers.

²⁶Fuchs (1974) reports that the sex differential in hourly earnings of white non-farm employed hardly changed in the last decade (from .61 in 1959 to .64 in 1969). Moreover, the differential for the young (less than 35) married (the group more prone to divorce) has even slightly increased (from .73 to .70).

²⁷One can easily incorporate in the analysis additional proposals (e.g., a subsidy confined to formal source of childcare) and complicate it by introducing additional activities or exchange within the household, but this would not change our basic conclusion.

²⁸Using Israeli data (the Family Expenditure Survey 1968/9), I found that, even when one controls for the wife's education and employment status, the income elasticity of housemaids exceeds unity.

²⁹One has to qualify somewhat this conclusion because the wage rates used in the imputations may exceed the nonworking wives' expected wages (Gronau, 1973).

³⁰It may very well be that the observed goods intensity of children can be traced to joint consumption and production. Much of the satisfaction one derives from his children and much of the childcare activity involves

just having the children around while doing other things, e.g., cooking, watching TV, etc. Children may not require, therefore, an increase in leisure to allow the enjoyment from them.

Table 1: The Determinants of the Allocation of Time: U.S. and Israel

	<u>Work in the Market</u>	<u>Work at Home</u>	<u>Leisure</u>	<u>Work in the Market</u>	<u>Work at Home</u>	<u>Leisure</u>
<u>U.S. (1964)¹</u>						
Husband's Wage	-	0	+	+	-	+(?)
Wife's Wage	+	-	-	0	+	-(?)
Non-Wage Income	-(?)	-	+	-	0	+
Total Number of Children	-	+	-	+	+(?)	-
Existence of Preschool Children	-(?)	+	0	+	+(?)	-
<u>Israel (1968)²</u>						
Husband's schooling				0	0	0
Wife's schooling	+	-	+(?)			
Total Number of Children	-	+	-	+	+	-
Number of Preschool Children	-	+	-	0(?)	0(?)	0(?)

¹The results are based on Bloch (1973). Question marks denote cases where the direction of the effect depended on the functional form of the regression equations.

²Based on Gronau (1976). Question marks denote cases where the regression coefficients are barely significant.

Table 2: Time budget survey: time uses of Israeli married women by education and employment status - 1968

	0-8			9-12			13+			Total		
	Employed	Not Employed	Total	Employed	Not Employed	Total	Employed	Not Employed	Total			
Age	40.22	42.80	42.13	40.18	40.25	40.22	38.50	38.20	38.40	39.77	41.43	40.84
Schooling	4.80	4.92	4.89	10.63	10.52	10.56	14.13	13.57	13.94	9.58	7.83	8.46
Land of Birth:												
Asaf	0.61	0.58	0.59	0.19	0.28	0.25	0.04	0.08	0.06	0.29	0.42	0.38
No. of Children:												
Age 0-5	0.46	0.74	0.66	0.41	0.68	0.58	0.44	0.70	0.53	0.43	0.71	0.61
Age 6-12	0.98	0.93	0.94	0.24	0.51	0.42	0.34	0.49	0.39	0.51	0.73	0.65
Age 13-17	0.85	0.90	0.89	0.38	0.35	0.36	0.34	0.35	0.34	0.53	0.64	0.60
Monthly Income	670.16	545.94	578.21	989.96	843.27	896.08	1379.93	914.86	1220.60	982.65	693.97	796.52
Labor Force Participation			0.26			0.36			0.66			0.36
Time Use*:												
Work at Home	4.85	7.67	6.94	4.30	6.71	5.84	3.97	6.26	4.75	4.40	7.18	6.19
Work in the Market	4.34	0.12	1.21	4.52	0.13	1.71	3.90	0.02	2.57	4.30	0.11	1.60
Total Work	9.18	7.79	8.15	8.82	6.84	7.55	7.87	6.28	7.32	8.70	7.29	7.79
Physiological Needs	9.95	10.30	10.21	9.49	10.36	10.04	9.78	10.62	10.06	9.71	10.35	10.12
Leisure	4.63	5.27	5.10	5.16	6.14	5.78	5.86	6.50	6.08	5.16	5.71	5.52
No. of Observations	93	265	358	117	208	325	71	37	108	281	510	791

*Because of missing data the time uses do not always add up to 24 hours.

Table 3: The Determinants of the Allocation of Time of U.S. Married Women by Employment Status

	<u>Not Employed</u>		<u>Employed</u>					
			<u>Work In</u>		<u>Work In</u>			
	<u>Work at Home</u>		<u>the Market</u>	<u>Home</u>	<u>Leisure</u>	<u>the Market</u>	<u>Home</u>	<u>Leisure</u>
Constant	1669.40 (6.74)	1677.29 (6.69)	1953.51 (8.44)	1155.30 (5.32)	5651.19 (21.37)	-9310.70 (9.14)	3213.34 (3.30)	14857.36 (12.61)
Wife's Age	-1.1650 (.37)	-1.3125 (.41)	-15.7448 (5.01)	3.8952 (1.32)	11.8496 (3.30)	-14.9648 (5.08)	4.0841 (1.45)	10.8807 (3.19)
Wife's Education	-53.4693 (3.28)	-53.8111 (3.29)	20.7398 (1.36)	-36.2618 (2.53)	15.5219 (.89)	-241.3122 (8.47)	11.8830 (.44)	229.4293 (6.97)
Husband's Education	22.6684 (1.82)	22.5114 (1.81)	-32.7809 (2.38)	14.4118 (1.12)	18.3691 (1.17)	-31.0277 (2.30)	13.9999 (1.09)	17.0277 (1.09)
Husband's Wage ¹	-16.1287 (2.21)	-16.1992 (2.22)	-24.0172 (1.80)	-8.0482 (.64)	32.0654 (2.11)	-151.8965 (8.89)	15.2644 (.93)	136.6322 (6.91)
Nonearnings Income ²	-.0441 (2.23)	-.0445 (2.24)	-.0660 (2.39)	.0210 (.81)	.0451 (1.43)	-.0598 (2.21)	.0197 (.76)	.0401 (1.28)
Children 0-17	327.6538 (6.94)	327.8430 (6.94)	-198.7814 (4.94)	278.1406 (7.37)	-79.3593 (1.73)	-189.5587 (4.81)	276.0247 (7.31)	-86.4661 (1.90)
Children In School	-125.1955 (2.86)	-124.9259 (2.85)	123.2164 (3.24)	-104.4647 (2.93)	-18.7516 (.43)	98.3938 (2.64)	-100.0978 (2.81)	1.7041 (.04)
Rooms	83.2513 (3.17)	83.2066 (3.16)	6.4456 (.28)	27.4669 (1.29)	-33.9125 (1.31)	-3.5018 (.16)	29.1479 (1.37)	-25.6461 (1.00)
Wife's Experience	---	.8077 (.21)	38.4975 (9.57)	-6.2440 (1.65)	-32.2535 (7.02)	---	---	---
Wife's Expected Wage (LN) ³	---	---	---	---	---	2810.95 (11.11)	-514.77 (2.13)	-2296.18 (7.85)
R ²	.2593	.2593	.1934	.1657	.1052	.2267	.1680	.1207
No. of Observations	621	621	660	660	660	660	660	660

¹In \$ per hour.²In \$ per year.³In ¢ per hour.

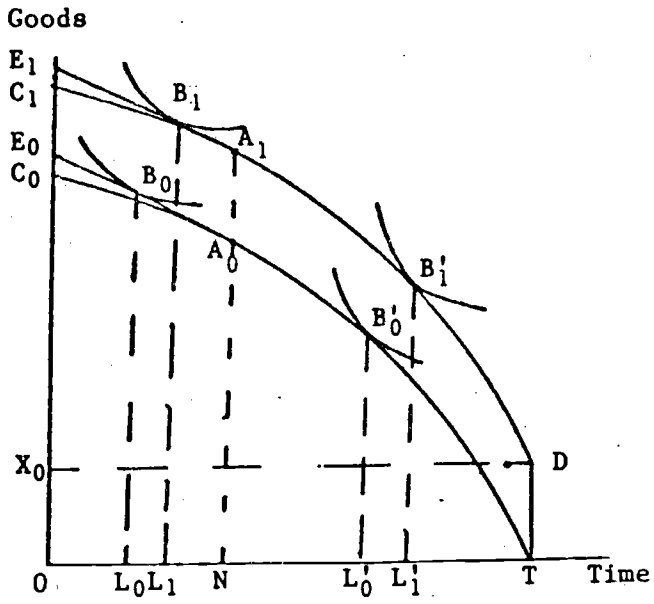


Figure 1

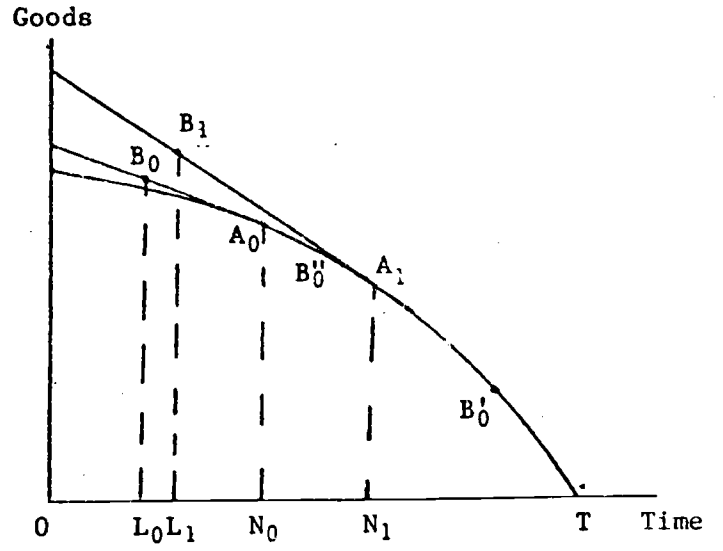


Figure 2

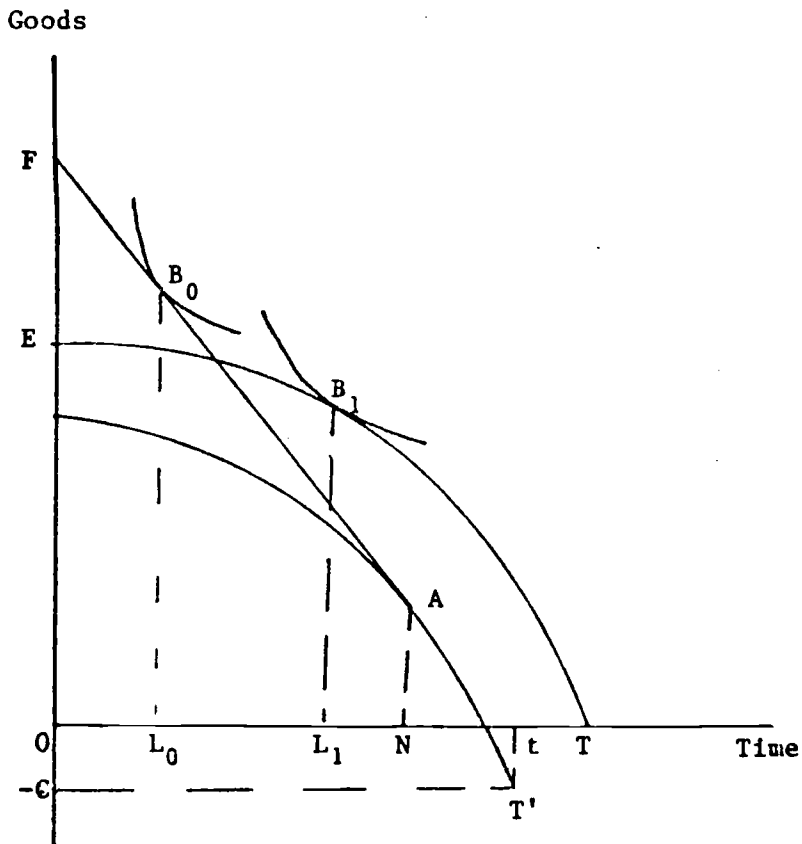


Figure 3

Z₂ Goods Intensive

Z₂ Leisure Intensive

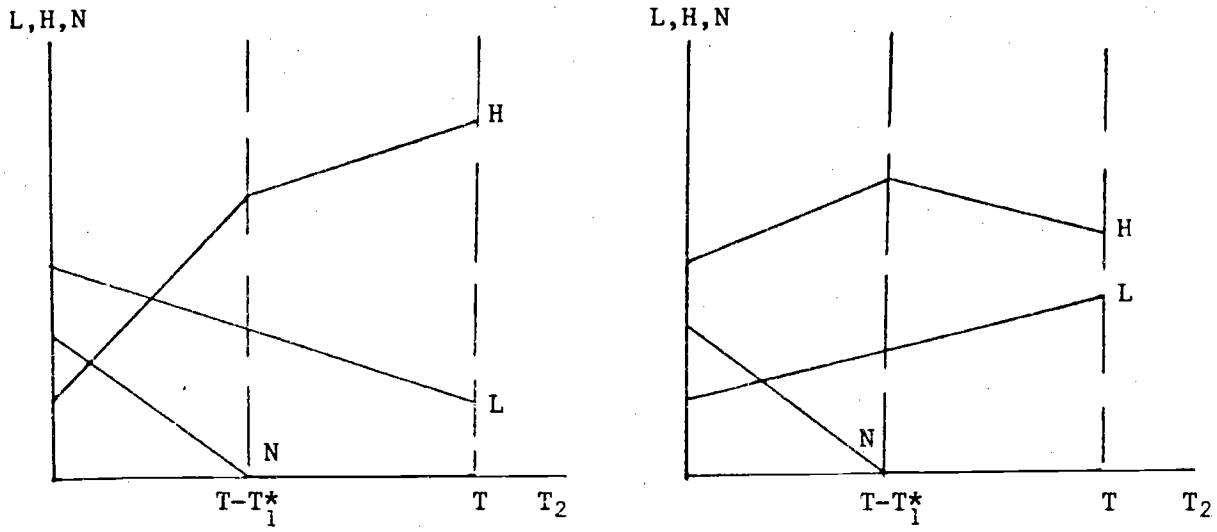


Figure 4

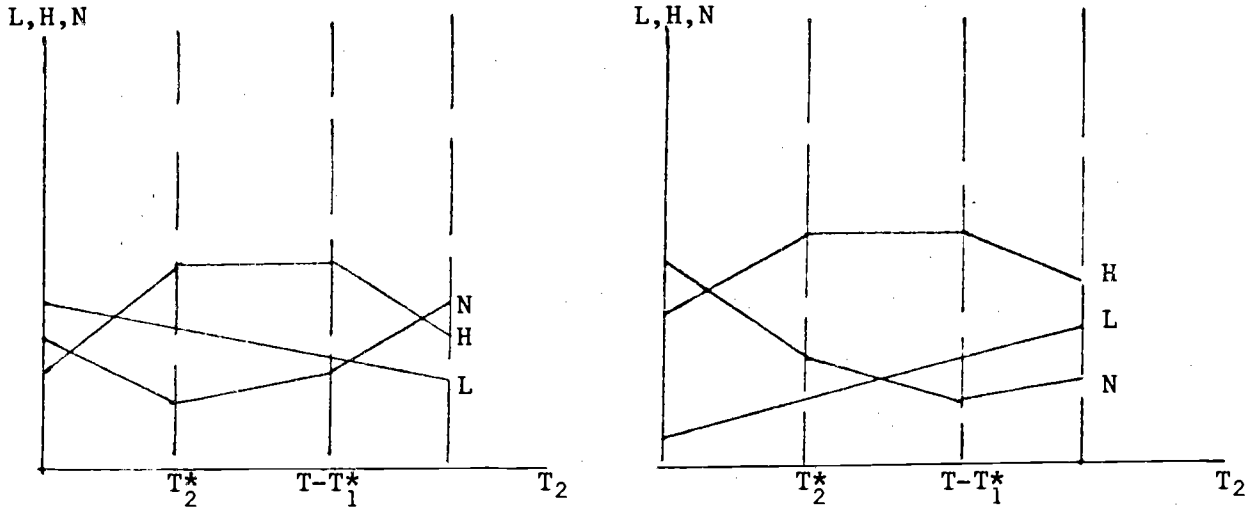


Figure 5

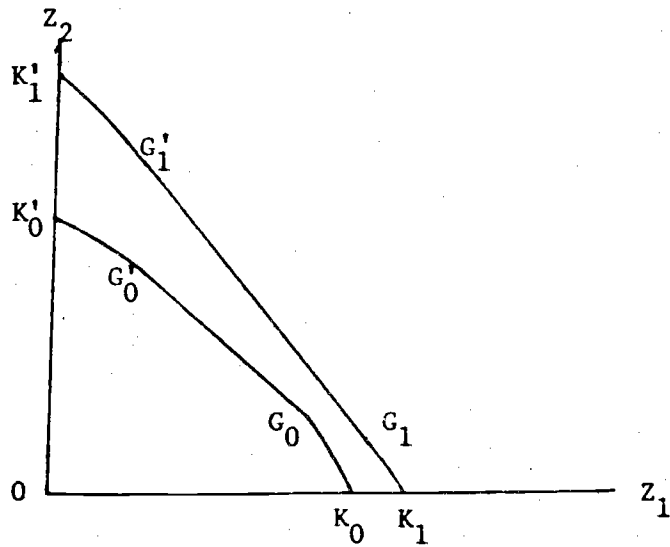


Figure 6