Chapter 4

HOME PRODUCTION – A SURVEY

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1. Introduction

Neoclassical theory tends to draw a clear distinction between the theory of production and the theory of consumption. According to the traditional approach, production is undertaken by profit-seeking firms in the market, while consumption is in the domain of utility-maximizing households. The firms sell final output (goods and services) to households in exchange for inputs (labor and capital services).

This distinction became somewhat blurred in the mid-1960s. More and more economists now question the assumptions that the sole objective of firms is to maximize profits and, more important, that production decisions are confined to the market sector. The lines distinguishing the market from the home sector have always been vague in less developed countries. The "new" theory of consumption argues that even in developed countries, production at home is no less important than market production. This approach regards goods and services merely as inputs in the production process that generate utility-bearing outputs (e.g. commodities, activities, characteristics). To understand the exchange between households and firms one has to understand the factors affecting this production process.

2. Theory

Traditionally, consumers are regarded as welfare maximizers:

$$\max U = U(X_1, \ldots, X_n; L) \tag{1}$$

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subject to the budget constraint

$$\sum_{i=1}^{n} P_i X_i = w(T-L)+V, \tag{2}$$

where U denotes utility, X_i the ith good, P_i its price, L is "leisure" time, T the total time available (i.e. $T-L$ is work time), w is the wage rate, and V is other non-labor sources of income.[1] The necessary conditions for an optimum are well known:

$$\begin{aligned} u_i &= \partial U/\partial X_i = \lambda P_i, \\ u_L &= \partial U/\partial L = \lambda w, \end{aligned} \qquad i=1,\ldots,n, \tag{3}$$

where u_i denotes the marginal utility of good i, and λ is the marginal utility of income. The marginal rate of substitution in consumption between goods i and j equals their price ratio ($u_i/u_j = P_i/P_j$), and the marginal rate of substitution between leisure and goods equals the real wage rate ($u_L/u_i = w/P_i$).

The new approach extends the traditional approach on two fronts: (a) it re-examines the assumption that market goods and services are the direct source of utility, and (b) it expands the set of constraints confronting the household. Several economists have questioned the assumption that market goods generate utilities. Lancaster (1966) argued that the source of welfare is not the goods as such, but rather their properties (or characteristics); furthermore, there does not exist a one-to-one relationship between goods and characteristics. The same characteristic (e.g. beauty) is common to many goods, and each good generates more than one characteristic. According to Lancaster, the household chooses that bundle of goods that maximizes its welfare from the desired characteristics. The demand for goods is a derived demand, and depends on the process that transforms goods into characteristics.

Becker (1965) views as the source of utility not the goods but the activities in which they service as inputs. Each activity ("commodity" in Becker's notation, e.g. a meal or a trip) is produced by combining different market goods (e.g. a meal is produced by combining foodstuffs with the capital services of kitchen appliances). The optimality of a set of goods depends both on the utility the household derives from the various commodities, and on the process whereby goods are transformed into commodities.

[1] The standard presentation usually separates consumption and labor decisions. The standard model, assuming implicitly separability of goods and leisure, consists of two parts: (a) the consumption decision $\max U = U(X_1,\ldots,X_n)$ subject to a budget constraint $\sum P_i X_i = Y$, where Y denotes income [$Y = w(T-L)+V$), and (b) the labor supply decision $\max U = U(X, L)$ subject to $X = w(T-L)+V$, where X is the composite good (for simplicity, $P_X = 1$).

On the face of it, the difference between Becker and Lancaster (ignoring the one between the nature of inputs) may seem merely semantic. But as pointed out by Pollak and Wachter (1975) and Atkinson and Stern (1979), the differences go much further; they relate to the nature of the production process converting market inputs into characteristics or commodities. The focus is on the degree of "jointness" in production: whereas Lancaster assumes perfect "jointness," Becker rules out "jointness" in production. While the characteristics approach regards goods as "public inputs," whose marginal productivity in the production of any given characteristic is not affected by its serving as inputs in the production of another characteristic, Becker's approach derives much of its analytical power from the assumption that goods serving as inputs in the production of one commodity cannot be utilized in the production of another.[2] These two extreme assumptions on "jointness" in production lead to two completely different sets of conclusions. This survey will follow (mostly) Becker's approach.[3]

Becker's second breach with traditional theory is in his definition of the relevant inputs. Following Mincer (1963), he argues that inputs serving in the production of commodities are not confined to market goods and services – no less important are the time inputs which go into this process, inputs provided by the consumer himself. The expansion of the inputs set also expands the set of constraints confronting the household. The household maximizes its welfare subject to two sets of constraints: the budget constraint and the time constraint. In effect, when the supply of labor is subject to the household decision, income and the budget constraint become endogenous variables and the household faces one ultimate constraint – the time constraint.

Formally, let us assume a one-period, one-person household. Let Z_i denote the ith commodity, where each commodity (activity) is a combination of time (T_i) and goods (X_i):[4]

$$Z_i = f_i(X_i, T_i), \quad i = 1, \ldots, m. \tag{4}$$

[2] Becker assumes that "if a good was used in producing several commodities these 'joint goods' could be fully and uniquely allocated among the commodities" (p. 495). Grossman (1971) analyzed the method of allocating these joint costs, when feasible. The Lancaster model assumes that these costs cannot be allocated uniquely.

[3] Lancaster's approach has been widely used in the analysis of hedonic prices, the differentiation of products, and the demand for modes of transport [e.g. Quandt and Baumol's (1966) "demand for abstract modes"]. It has, however, left little impact on the field of labor economics.

Muth's (1966) approach is very similar to that of Becker. However, Muth, though he recognized the importance of labor inputs at home, did not incorporate them formally in his analysis.

[4] Both X and T are vectors. X is a vector of market goods and T is a vector of time units, where it is assumed that different time units (e.g. daytime and nighttime) differ in their productivity in the production of Z_i.

The household maximizes its welfare

$$U = U(Z_1, \ldots, Z_m) \tag{5}$$

subject to two constraints: (a) the budget constraint,

$$\sum P_i X_i = Y, \tag{6}$$

and (b) the time constraint,

$$\sum T_i = T. \tag{7}$$

When the household's supply of labor is exogenously given T stands for total non-labor time and there are two separate sets of constraints (i.e. there is no way of converting time into income). The maximization of welfare (5) subject to these constraints, given the production technology (4), yields the necessary conditions for an optimum in consumption:

$$u_i = \partial U / \partial Z_i = \lambda \hat{\pi}_i, \tag{8}$$

where $\hat{\pi}_i = P_i x_i + \hat{w} t_i$ is the shadow price of commodity i, $x_i = \partial X_i / \partial Z_i$ and $t_i = \partial T_i / \partial Z_i$ are the marginal inputs of goods and time in the production of Z_i. $\hat{w}$ is the shadow price of time ($\hat{w} = \mu / \lambda$, where μ is the marginal utility of time and λ is the marginal utility of income).[5]

The optimum combination of inputs in the production of Z_i is determined by the familiar condition that the marginal rate of substitution in production equals the input price ratio:

$$\frac{\partial Z_i / \partial T_i}{\partial Z_i / \partial X_i} = \frac{x_i}{t_i} = \frac{\hat{w}}{P_i}. \tag{9}$$

The demand for goods is a derived demand. It depends on the demand for the commodity, on the share of the market input costs in total costs of producing this commodity, and on the elasticity of substitution between goods and time. The demand for commodity Z_i depends on its price, i.e. on its marginal cost of production. A crucial element in the determination of cost is the value of time for the household, i.e. the scarcity of time.

[5] The optimum condition (8) is obtained by maximizing the Lagrangian

$$L = U(Z_1, \ldots, Z_m) + \lambda\left(Y - \sum P_i X_i\right) + \mu\left(T - \sum T_i\right)$$

with respect to Z_i given the production technology (4).

Given the labor supply, time scarcity depends on the household's (or individual's) income and his non-labor time. The higher his income and the smaller his non-labor time (i.e. the greater his supply of labor), the greater the time scarcity and the shadow price of time. An increase in the shadow price of time should raise the relative price of time-intensive commodities (i.e. commodities where t_i/x_i is high) and result in a substitution of goods for time. An increase in income is therefore associated not only with an income effect but also with a price effect favoring goods-intensive commodities and increasing the demand for goods at the expense of time.[6]

When the supply of labor is part of the household decision set, income is no longer exogenous. Income can be increased by giving up consumption time. Thus, instead of the two separate constraints, (6) and (7), the household faces one constraint – the time constraint (7) – where the income–expenditures equality states

$$\sum P_i X_i = W(Z_n) + V, \tag{6'}$$

where Z_n is the activity "work in the market", and $W(Z_n)$ denotes earnings. The optimum condition for Z_n has to be modified:

$$u_n = \partial U/\partial Z_n = \lambda\left[P_n x_n + \hat{w} t_n) - W'\right], \tag{8'}$$

where $W' = \partial W(Z_n)/\partial Z_n$ is the marginal wage rate, and $\hat{w} = \mu/\lambda$ is (as before) the shadow price of time. Following convention, and measuring work in time units ($t_n = 1$), the shadow price of time equals

$$\hat{w} = W' - P_n x_n - (u_n/\lambda). \tag{10}$$

It differs from the average wage rate (w) when the average wage differs from the marginal wage, there are market inputs (e.g. transportation, child-care service) associated with a person's work, and work generates direct utility. Still, one expects the shadow price of time to increase with the average wage rate. In the case of a person working in the market one must therefore distinguish between changes in income due to a change in the wage rate, and changes originating in non-labor sources. A wage change may involve a price effect that may be as important as the income effect.[7]

[6]Strictly speaking, an increase in income and the shadow price of time will increase the demand for the goods-intensive commodity unambiguously only in a two-commodities world. When there exist more than two commodities, the outcome is ambiguous and depends on the cross elasticities of substitution between the various commodities [Atkinson and Stern (1979)].

[7]Strictly speaking, changes in non-labor income may also affect the shadow price of time if they affect the market inputs in market work (X_n) or the element of "psychic income" (u_n/λ).

Of special interest is the case where the wage does not change with the hours of work ($W' = w$), where the marginal market inputs associated with labor are negligible, and where work in the market does not involve any marginal utility or disutility.[8] In this case the value the household places on its time equals the wage rate. If, in addition, one rules out jointness in production (and, specifically, joint usage of time) and assumes that the production functions (4) are linear homogeneous (i.e. x_i and t_i depend solely on w), the price of each activity (commodity) is independent of the level of the activity and the results of the standard theory of demand apply also to the expanded model [Pollak and Wachter (1975), Atkinson and Stern (1979)]. In this case the problem can be restated as one of maximizing welfare (5) subject to the full income constraint

$$\sum \pi_i Z_i = S, \tag{11}$$

where $S = wT + V$ is full income (the income the household can generate if it spends all its time working in the market) and $\pi_i = P_i x_i + w t_i$ is exogenously given. It should, however, be emphasized that Becker's qualitative results do not depend on whether the assumptions specified above (i.e. $w = \hat{w}$ and constancy of x_i and t_i) are satisfied.

In evaluating the "new" consumption theory, and specifically, the theory of home production, one has to distinguish between its two main features: the incorporation of home time as a major determinant of household choices, and the separation of the consumption aspects from the production aspects of household behavior. Time has long been recognized as an important element in certain consumption activities (e.g. transportation). The new approach expands its role, making time a vital part of all consumption activities.

The importance of the distinction between consumption and production in household decisions is more controversial. Since "commodities" are not a measurable concept it seems only natural to combine equations (4) and (5) to express utility as a direct function of market an time inputs (X_i and T_i, respectively, where $i = 1, \ldots, n$). Given the appropriate assumptions about separability and functional form, the maximization of this expanded utility function, subject to the resources constraints, should yield results which are equivalent to those generated by the two-stage home production approach.

Becker defends his seemingly more complicated two-stage formulation, arguing that it "effectively separates objects of choice from the means used to produce them" [Michael and Becker (1973, p. 393)]. It seems, however, that this is only a partial explanation to the popularity of the new approach. The "new" consumption theory did not provide the economists with a new set of tools to analyze

[8] Note that throughout the analysis it is assumed that the utility derived from activity Z_i is independent of how it was produced. Specifically, it is independent of the time inputs involved.

economic problems.[9] Rather, it adapted a familiar language to discuss some old and many new problems in a novel fashion.[10] It re-emphasized that the household's economic decisions in the home sector extend well beyond the consumption decision, and that these decisions have important ramifications for the market sector.

The terminology of the theory of home production has been used to extend economic analysis to such diverse fields as family formation (marriage and divorce), fertility decisions, and involvement in illegal activities. It has been adapted to re-examine the demand for health, the demand for travel and transport choice, and more. Many of these applications have expanded to become research fields in their own right (e.g. the economics of the family, the economics of fertility, and the economics of crime). This survey will not cover all these spinoffs; it will focus on home production in its narrower definition, discussing inputs, shadow prices, production technology, and other aspects of the home production process.

3. The allocation of time

The theory of home production cannot escape the limitations of traditional consumption theory as the outputs (i.e. the commodities) are unobserved. Any empirical investigation based on this theory is therefore confined to the study of inputs, i.e. changes in their level and mix as a result of changes in output, prices, and productivity. Moreover, the study of inputs is hampered by the fact that data on inputs are not readily available, the output (as mentioned) cannot be measured directly, and prices (specifically the price of time) are unknown.

Consumption expenditure surveys constitute a rich source of disaggregate data on market inputs in the home production process, while the national accounting system provides the data on an aggregate level. For most countries, however, there are no official data on the allocation of time at home (the only data reported is the time spent in the market). Time budget data are, therefore, scarce, and the experience in collecting such data is limited.

There are essentially two methods of collecting time budget data: the time-diary method and the recall method; they do not necessarily yield the same results [Robinson (1983)]. The discrepancies between them increase the longer is the recall period, and depend on the object of enquiry (activities or time use).[11] Time-diary data seem to be more accurate, but collecting them is much more

[9] As did, for example, the theory of growth when it introduced the optimum control technique into the economist's arsenal.

[10] This issue will be readdressed in the summarizing section.

[11] When the interviewee is asked how much time he spent on certain activities, rather than what activities he engaged in during a certain time, the results are bound to be less accurate because there is no time constraint (e.g. daily activities usually do not add up to 24 hours).

expensive, and the researcher often has to make do with data that suffer from a large measurement error component.[12] Moreover, both kinds of data usually relate only to one person per household, and are very rarely accompanied by data on consumption.

In the absence of data on outputs one has to control for variables that affect the demand for such outputs (i.e. the household's income and demographic characteristics). Finally, only under very special circumstances is the price of time observable. In general the price of time differs from the wage rate, and one of the questions researchers have tried to answer is what is the value people place on their time, and what are the factors that affect this value.

Given the paucity of information on time use it is worth presenting some of the major patterns of the allocation of time within the household. In a recent study, Hill (1983) presents data for the United States in the mid-1970s. Comparing the time budgets of men and women by marital and employment status (Table 4.1) she found that unmarried men and women devote about the same amount of time to work (about 45 hours per week). Men spend, on average, 1.5 as many hours as women working in the market (33 vs. 22 hours), but this difference is offset by the difference in working hours at home (men spend only half the time that women do in house and yard work, child-care, shopping, and other services). Married men spend slightly more hours at work than married women (54 vs. 52 hours), but here, too, there is a significant difference in the way this time is split between work in the market and work at home. Married men spend, on average, almost 2.5 as much time at work in the market as married women (40 vs. 17 hours). Married women, on the other hand, devote about 2.5 as many hours to work at home (35 vs. 14 hours).

The total amount of work of married men and women depends largely on their market employment status. Women who are not employed work at home about 40 hours a week, about the same number of hours that full-time employed women spend in the market. However, the total number of working hours of full-time working women is almost 50 percent higher than that of their non-employed counterparts (64 vs. 44 hours). The difference between full-time working men and the non-employed is even larger. Holding the employment status constant, married women tend to work more hours than working men, the difference growing as the person's market commitments decline. These differences are, however, offset by the difference in labor force participation (and the prevalence of part-time jobs) between men and women.

[12] The most extensive time study in the United States was conducted by the Institute for Social Research at the University of Michigan in 1975/76. The results of this survey are summarized in Juster and Stafford (1983). This volume contains a series of papers discussing the methodology of the collection of time budget data. Other studies have been conducted by Walker. Time-use data are more prevalent in Europe and particularly Eastern Europe. An international comparisons of time use is contained in Szalai (1972). Time-use data have also been collected for some less developed countries (e.g. Malaysia and the Philippines).

Table 4.1
The allocation of time by sex, marital status, and employed status.

Activity	Males					Females				
		Married					Married			
	Unmarried	Work FT	Work PT	Not working	All	Unmarried	Work FT	Work PT	Not working	All
	Mean									
Work										
Labor market-related work	(32.85)	(48.62)	(28.52)	(6.60)	(40.18)	(22.17)	(39.08)	(20.94)	(3.22)	(16.73)
Market work	28.90	47.84	25.09	5.09	39.13	20.13	38.55	20.87	2.75	16.31
Education	3.95	0.78	3.43	1.51	1.05	2.04	0.53	0.07	0.47	0.42
Home-oriented work	(11.99)	(12.70)	(17.60)	(20.01)	(14.25)	(23.49)	(24.58)	(33.43)	(40.90)	(34.85)
House/yard work	8.07	7.22	13.08	14.61	8.83	16.02	16.12	22.67	26.79	22.96
Child care	0.33	1.69	1.19	0.69	1.49	2.23	2.83	3.21	6.51	4.88
Services/shopping	3.59	3.79	3.33	4.71	3.93	5.24	5.63	7.55	7.60	7.01
Total work time	(44.84)	(61.32)	(46.12)	(27.42)	(54.43)	(45.66)	(63.66)	(54.37)	(44.12)	(51.58)
Non-work										
Personal care	76.94	75.05	82.64	87.07	77.56	79.42	74.01	77.02	81.71	78.66
Organizations	2.07	2.46	5.21	3.15	2.72	3.13	2.46	2.90	3.97	3.35
Social entertainment	11.82	6.23	5.01	6.93	6.29	10.39	7.00	8.27	8.12	7.81
Active leisure	8.21	4.28	4.86	6.70	4.73	5.67	3.36	3.90	5.66	4.69
Passive leisure	24.20	18.72	24.36	37.61	22.35	23.81	17.59	21.62	24.49	21.98
Total time	168.07	168.07	168.20	168.00	168.08	168.08	168.09	168.09	168.08	168.09

Source: Hill (1983).

The scarcity of time budget data and the non-uniform definitions and methods of data collection prevent a systematic analysis of the changes in the allocation of home time over longer periods. The sketchy information available for the United States indicates that total hours of work hardly changed over the past two decades (they may have declined in the late 1960s and stabilized in the 1970s). There occurred, however, a marked change in the composition of work hours: whereas, in the case of women, work at home declined sharply, the decline being offset by an increase in work for pay, the reverse trend has taken place in the case of men. These shifts are more pronounced for the younger age-groups (25–44) than for the older ones [Juster (1983)].

It is hard to tell whether these patterns are universal. Israeli data, however, reveal similar patterns [Gronau (1976, 1977)]. Schooling has been shown to be the major determinant of labor force participation. Given the strong association between time-use patterns and employment status, Gronau (1976) investigated the effect of schooling on the allocation of time. The Israeli data indicate that in the case of married women, although work in the market increases sharply with schooling, total work time declines as schooling increases. Leisure increases with schooling, at the expense of both work and time spent on physiological needs.

Becker's theory of the allocation of time does not distinguish between activities such as cleaning, shopping, and other household chores and leisure activities. Though the line distinguishing work at home from leisure is sometimes vague, Gronau (1977) regards work at home as intermediate activity. Distinguishing home production time (work at home) from home consumption time, he defines work at home as an activity one could hire someone else to do (while it would be almost impossible to enjoy leisure vicariously). Put differently, work at home is a close substitute to work in the market in terms of the direct utility these activities generate, while there are few close market substitutes for leisure activities.

In an extreme case, work at home and work in the market are perfect substitutes – a 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, assuming a one-period, one-person household, the household maximizes the commodity, Z, which is a combination of goods X and consumption time L:

$$Z = Z(X, L). \tag{12}$$

The goods can either be produced at home (X_H) or purchased in the market (X_M). The two kinds of goods are perfect substitutes:

$$X = X_H + X_M. \tag{13}$$

The person can secure the goods either by selling time in the market at a fixed

real wage, w:

$$X_M = wN + V, \tag{14}$$

where N denotes market work, or by producing them at home subject to diminishing marginal productivity:

$$X_H = f(H), \tag{15}$$

where H denotes work at home, and $f' > 0$, $f'' < 0$. The ultimate constraint is the time constraint:

$$L + H + N = T. \tag{16}$$

The necessary conditions for an interior optimum call for the marginal product of work at home to equal the value the person places on his time $\hat{w}$, i.e. the marginal rate of substitution between goods and consumption time. The value of time equals the wage rate ($f' = \hat{w} = w$) when the person works in the market ($N > 0$), and exceeds the wage ($f' = \hat{w} > w$) if he does not.

The two kinds of equilibrium are depicted in Figure 4.1. The concave curve $TB_0'A_0C_0$ describes the home production function (15). In the absence of market opportunities this curve describes the opportunity set facing the household. Work in the market at a constant real wage, w (described by the slope of the line

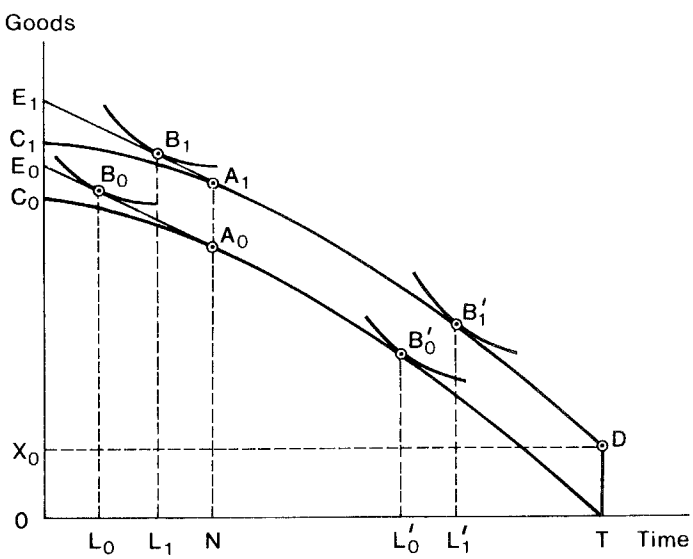

Figure 4.1

A_0E_0), allows the household to expand this set to $TB_0'A_0E_0$. Given a goods-intensive consumption technology (presented by the Z-isoquant passing through B_0), the person allocates OL_0 units of time to leisure, L_0N to work in the market, and NT to work at home. Alternatively, the consumption technology may dictate a more time-intensive combination, B_0'. In this case, the person allocates OL_0' units of time to leisure, $L_0'T$ to work at home, and does not work in the market at all. An increase in non-labor income shifts the opportunity set vertically upward (to $TDB_1'A_1E_1$). If the person works in the market, this change does not affect the equilibrium condition $f' = w$ and, hence, should not affect work at home NT. On the other hand, the increase in income is expected to increase leisure ($OL_1 > OL_0$) at the expense of market work ($L_1T < L_0T$). When the person does not work in the market, the increase in consumption time ($OL_1' > OL_0'$) has to come at the expense of work at home ($L_1'T < L_0'T$). The increase in income is associated with an increase in the shadow price of time, $\hat{w} = f'$.

An increase in the real wage, w (Figure 4.2), reduces the profitability of work at home ($N_1T < N_0T$). Its effect on consumption time and work in the market is indeterminate. The income effect tends to increase leisure, while the substitution effect favors market work.

Interpersonal differences in education may be associated not only with differences in the wage rate but also with differences in home productivity. The

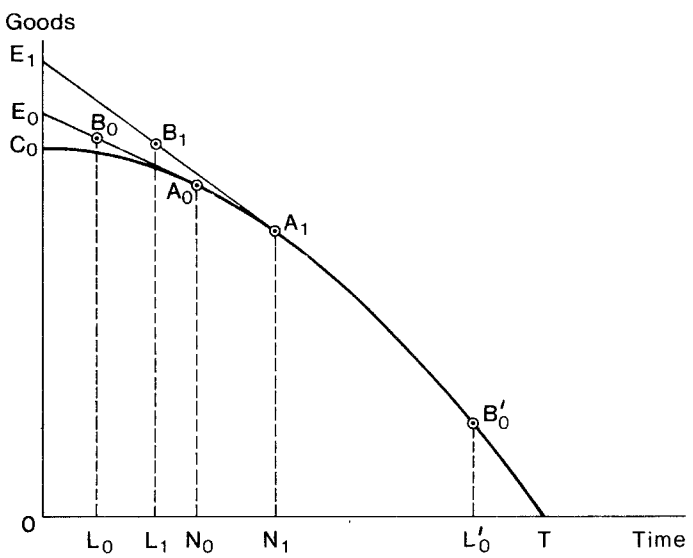

Figure 4.2

implications of such differences are, however, difficult to predict without specifying the exact nature of the change in the production or consumption technology. For example, an increase in the productivity of work at home increases real income and hence the leisure of employed persons, but its effect on work at home and in the market is indeterminate.[13]

Using data from the 1972 panel of the Michigan Study of Income Dynamics, Gronau tested his theory analyzing the allocation of time of employed and non-employed white married women. His findings are consistent with the theory: an increase in the husband's earnings reduces the work at home of the wives who are not employed but does not affect that of wives who are employed (in both cases it increases the wife's leisure). An increase in wives' wages increases their supply of labor at the expense of both work at home and leisure. (The potential wage rate does not affect work at home of the non-employed.) Education is negatively correlated with work at home of the non-employed, but does not seem to affect that of the employed.[14]

Gronau follows Becker in assuming that time inputs do not affect utility directly. Specifically, it is assumed that work at home and in the market generate the same marginal utility. Furthermore, it is assumed that intermediate commodities do not involve any direct utility and, thus, home goods and market goods can be regarded as perfect substitutes. Both assumptions prove crucial to the analysis and, subsequently, to the evaluation of the output of the home sector.

Allowing work in the market and at home to generate direct utility (i.e. psychic income) the welfare function can be rewritten [incorporating (12) and (13)]:

$$U = U(X_M + X_H, L, H, N). \tag{17}$$

Maximizing welfare subject to constraints (14), (15), and (16) yields the following equilibrium conditions:

$$\begin{aligned} \frac{u_L - u_N}{u_X} = f' + \frac{u_H - u_N}{u_X} = w, &\quad \text{when the person is employed,} \\ \frac{u_L}{u_X} = f' + \frac{u_H}{u_X} = \hat{w}, &\quad \text{when the person is not employed,} \end{aligned} \tag{18}$$

[13] It is often argued that an increase in home productivity always increases work at home [Chiswick (1982)]. This is true if the productivity coefficient k is multiplicative [i.e. if eq. (1) can be written $X_H = kf(H)$]. It need not necessarily be true if the productivity change is resource saving [i.e. $X_H = f(kH)$].

[14] Graham and Green (1984) used the 1976 wave of the Panel Study of Income Dynamics to derive the work at home function of employed white married women. Estimating a double-lag regression they find that the wife's work at home is not significantly affected by her husband's wage and schooling, but is negatively correlated with her own wage. Unfortunately, the rest of their conclusions are best treated with caution because of their extreme sensitivity to functional form. Hill (1983) employed a similar model to analyze do-it-yourself repairs and improvements in housing structures using data from the 1975/76 Time Use Study.

where u denotes marginal utility. The value placed by employed persons on their time equals $\hat{w} = w + (U_N/\lambda)$. In this case, an employed person does not equate his value of marginal productivity at home with his wage rate. The value of the marginal productivity is adjusted for the differential in the marginal utilities between work in the market and work at home.[15] An increase in non-labor income, in this case, may affect the work at home of the employed if it differentially affects the direct utilities associated with work at home and in the market.

Similarly, when maintaining the assumption that work does not involve any direct utility or disutility while relaxing the assumption that home-produced goods and market-produced goods are perfect substitutes, the conclusion that the home production of the employed is not affected by non-labor income no longer holds. In this case

$$U = U(X_M, X_H, L), \tag{19}$$

and at the optimum

$$\begin{aligned} (u_L/u_{X_M}) &= (u_{X_H}/u_{X_M})f' = w, && \text{when the person is employed,} \\ (u_L/u_{X_M}) &= (u_{X_H}/u_{X_M})f' = \hat{w} > w, && \text{when the person is not employed.} \end{aligned} \tag{20}$$

In contrast to the previous case, the value of the marginal productivity at home of the employed equals their wage rate, where this value is evaluated at the shadow price the person places on the home-produced goods. The distinction between a person who enjoys work at home per se and one who regards home-produced goods as being of higher quality, is important, as will be shown later, for the evaluation of the home sector output. There is, however, no way in which the two models can be distinguished empirically.[16]

Leisure is usually associated with the home sector (though leisure activities need not necessarily take place at home). A recent study [Stafford and Duncan (1983)] has pointed out that a considerable amount of leisure is spent on the job. According to this study, almost 10 percent of time at work is spent in formal or

[15] When $u_H = u_N$ one obtain's Gronau's result, $f' = w$.

[16] Chiswick (1982) extends Gronau's model to analyze the case where work at home yields utility and where home goods and market goods are imperfect substitutes. Note, however, that in this case one cannot use Figure 4.1 or 4.2 unless it is assumed that the utility function is separable (i.e. that the marginal rate of substitution between goods and leisure is unaffected by the output of home goods or by the time spent working at home). Furthermore, it is incorrect to assume that home production of the non-employed will be unaffected by the changes in the real wage (i.e. by changes in the price of market goods). Graham and Green (1984) tried to estimate such a model empirically, with little success.

informal work breaks. Leisure-on-the-job thus accounts for about 10 percent of all leisure (where leisure excludes time spent on physiological needs).[17]

One aspect of time allocation that has drawn the attention of psychologists, sociologists, and economists alike is the effect children have on their parents' time use.[18] Casual observations indicate that children, and particularly young children, are associated with an increase in their mother's work at home (child care and other housework). Researchers unanimously agree that the increased time inputs in home production come at least partly at the expense of work in the market. Less well documented is the reallocation of time within the home that takes place as a result of having children. Bloch (1973) and Hill and Stafford (1980), in their study of U.S. time-use patterns, and Gronau (1976) in his study of Israeli women, agree that the time withdrawn from the market is not sufficient to compensate women for the increase in home tasks, and hence, children (and in particular preschool children) are associated with a decline in leisure. Gronau observes that Israeli married women reduce their leisure time more than they cut their work in the market, while for American women it seems [Hill and Stafford (1980)] that at least half of the increase in work at home is "financed" through a reduction in market work.

There are indications that parental and, specifically, the mother's investments in children are a key factor in the children's future careers [Leibowitz (1974)]. Does the strong positive correlation between women's education and their market commitment imply a reduced commitment to child care? Though they may differ on some of the details, all the economists who have studied this question are united in their negative answer. Hill and Stafford (1974, 1977) and Leibowitz (1974) found that the time inputs in child care and housework per child increase with education, and consequently, the higher her education the more sensitive a woman's labor supply will be to the existence of children. Lindert (1977), who found no evidence that time spent on child care increases with the wife's education, did not find any evidence of a negative relationship either. Gronau, in his study of Israeli women, found that whereas housework (controlling for children) declines with education, child care does not (education has a positive, though statistically insignificant effect).[19] In their most recent study, Hill and

[17]Stafford and Duncan (1983) claim that time diaries indicate that most data on hours of work (e.g. the CPS data) are overstated due to an inherent positive error of response, and that a substantial amount of time on the job is spent on training and leisure. They find that close to one-quarter of the time spent on the job by young workers (under 25) is spent on break-time and training, while the percentage for older workers (55–64) is less than 10 percent.

[18]In a recent paper Timmer, Eccles and O'Brien (1983) discuss the effect of parents' time use on that of their children. At this stage, however, the study of the allocation of children's time is in its initial stages.

[19]Hill and Stafford (1980) comment that the difference between their findings and those of Lindert and Gronau may be due to the fact that the latter do not allow for interactions between the number of children and education. On the other hand, Hill and Stafford, who estimate the child-care functions separately for each schooling group, base their conclusions entirely on the marginal effect of an additional child – ignoring the differences between schooling groups in the average effect (i.e. the differences in the regressions' constant terms).

Stafford (1980) reiterate their earlier conclusion that time inputs in child care increase with schooling, that these inputs decline as the child grows older, and that this decline is more pronounced in the case of the less educated.[20] In contrast with their earlier findings, Hill and Stafford detect a change in the way these increased inputs are "financed". Whereas in the 1960s the tendency of college graduates with young children was to drop out of the labor force, the 1970s witnessed an increased reluctance on the part of college-educated women to curtail their labor supply and, for these women, a larger fraction of the increase in housework and child care comes at the expense of leisure and physiological needs.

Finally, although the major burden of child care and housework is still on the woman, both the United States and Israeli studies concur that husbands, though reluctant to increase their time inputs in housework as a result of an additional child, actively help in child care, their time inputs increasing with their (or their wives') schooling.

4. The allocation of goods

The theory of home production had a major impact on the analysis of the demand for home activities, ranging from children to health. The scarcity of data that restricted the study of the allocation of time also hampered the application of the theory to the analysis of the allocation of goods and consumption patterns.

There exists a wealth of data on consumption behavior. Disaggregate data on the allocation of *both* goods and time is, however, non-existent. In its absence, researchers have to resort to data describing the allocation of goods and total non-market time. The results of the analysis of the interaction between time and goods in consumption and home production depend, therefore, to a large extent on the underlying assumptions.

Abbot and Ashenfelter (1976) investigated the interaction between home-time and goods employing the traditional model [eqs. (1) and (2)]. Examining annual aggregate time series for the United States on personal consumption expenditures, hours of work, and money wage rates for the period 1929–67, they find weak evidence that housing, transportation, and "other services" tend to be complementary with non-market time, while durables tend to be substitutable. The evidence, however, is far from conclusive, the results depending uncomfortably on functional form.

Atkinson and Stern (1979) expanded the study, adopting a home production framework. In the absence of data, they resort to a stronger set of working

[20] Hill and Stafford (1980) examine the effect of children on child care and housework. Surprisingly, they find that the differences between schooling groups in housework exceed those of child care.

assumptions on the consumption and production technology. Specifically, they assume that the utility function is of the Stone–Geary variety, that labor conveys no direct utility, and that time and goods are employed in the production of each activity in fixed proportions. Using a subsample of the U.K. 1973 Family Expenditure Survey they estimate (among other parameters) the time intensity of the activities associated with major consumption groups. The results of this exploratory study prove, however, to be poor (some basic restrictions are violated). As the authors emphasize, the study should be regarded merely as a first step in an ongoing project.

Are there scale economies in home production? The literature does not treat this question explicitly, and given that home output cannot be directly measured and that information on time inputs is very sketchy, the question seems to be insoluble. Still, a surprising amount of effort has gone into answering the related question of scale economies in consumption. It is only rarely couched in terms of home production technology, but rather in terms of adult equivalence scales. The issue at heart seems, however, to be the same one.[21]

Equivalence scales are index numbers intended to allow comparisons of welfare or real income across households of different size and composition. They are used to correct for variation of "needs" with a person's age and sex, and for scale economies in home production and consumption: "Three people do not need proportionally more bathrooms or cars than two people; buying and cooking food in bulk is cheaper; clothes can be handed down from older to younger children" [Deaton and Muellbauer (1980, p. 192)]. The estimation of these equivalence scales on the basis of the observed households' expenditure patterns has generated an extensive literature, going back to Engel's pioneering study at the end of the last century (1895).[22] The studies are unanimous in concluding that there are substantial returns to scale in consumption, but there is disagreement on their exact magnitude.[23] Unfortunately, a more thorough examination indicates that there is only little in the discussion of equivalence scales to teach us about home production technology. This examination points out some of the major shortcomings of these scales.

To demonstrate some of these limitations let us follow one of the more popular schemes, one originally suggested by Barten (1964). By this scheme, welfare depends on the adjusted quantity of goods consumed, the deflators being the

[21] One of the few exceptions are Lazear and Michael (1980) who address the problem in terms of production technology.

[22] For a survey of this literature, see Deaton and Muellbauer (1980, ch. 8).

[23] The only study claiming that home production is subject to decreasing returns is Graham and Green (1984). Typically, the BLS uses a scale where the "needs" of a three-person household can be provided at a cost that is only one-third higher than those of a two-person household, and those, in turn, are only two-thirds higher than those of a one-person household. For an analysis of the sensitivity of these estimates to the underlying theoretical assumptions see Deaton and Muellbauer (1983).

goods-specific equivalence scales M_i:

$$U = U(X_1/M_1, X_2/M_2, \ldots, X_n/M_n), \tag{21}$$

where M_1 depends on the size and age composition of the household. Utility is maximized subject to a standard budget constraint $\sum P_i X_i = Y$. It is tempting to rephrase the problem in terms of "commodities":

$$\max U = U(Z_1, \ldots, Z_n) \tag{22}$$

subject to $\sum \pi_i Z_i = Y$, where $Z_i = X_i/M_i$ and $\pi_i = M_i P_i$.

This information raises the question: Whose welfare are we measuring? Children are not one of the elements of the welfare function (22), and hence the utility derived from children is not reflected in the measurement of adult equivalence scales.[24] More important to our discussion, this formulation does not account for the time inputs going into home production and consumption. Thus, traditional equivalence scales overstate the scale economies in home production if the household shifts to a more time-intensive activity mix as it increases (for example, if activities associated with children are more time intensive than other activities). Furthermore, the household activity mix depends on both production and distribution decisions (i.e. the allocation of goods within the household), and one cannot separate empirically the two.

Similar difficulties hamper other attempts at measuring productivity in the household. Schooling and other forms of investment in human capital (health, information, on-the-job training) are a major source of increases of productivity in the market. It is of interest, therefore, to examine how much they affect home productivity. Michael (1972, 1973) examines the effect of schooling on home productivity. The increase in productivity at home reduces the shadow prices of all activities and increases the household's real income. However, it need not affect all activities identically and, hence it may result in a change in the activities' relative prices. Furthermore, it may affect differently the productivity of goods and the time inputs. Focusing on the percentage change in expenditures on good i

$$\tilde{X}_i = \tilde{Z}_i^{\mathrm{d}} - \tilde{MP}_i + wT_i\sigma\left[\tilde{MP}(X_i) - \tilde{MP}(T_i)\right], \tag{23}$$

where $\tilde{Z}_i^{\mathrm{d}}$ is the (relative) change in the demand for activity i, $\tilde{MP}_i$ the change in

[24] This issue was raised by Pollak and Wales (1979, 1981), who object for this reason to the use of equivalence scales for welfare comparisons. This formulation gave rise to another controversy which is not relevant to our discussion. Given the analogy to price indices, a lengthy discussion turned around the question to what extent can one derive the estimates of M_i from information on prices and income elasticities.

the marginal productivity in this activity, σ the elasticity of substitution between time and goods, and $\tilde{MP}(X_i)$ and $\tilde{MP}(T_i)$ the change in factor productivity. The increase in demand for Z_i depends on the increase in real income ($\tilde{MP}$), on the (full) income elasticity for this activity (η_i). Hence

$$\tilde{X}_i = \tilde{MP}\cdot\eta_i - \tilde{MP}_i + \varepsilon_i\left(\tilde{MP}_i - \tilde{MP}\right) + wT_i\sigma\left[\tilde{MP}(X_i) - \tilde{MP}(T_i)\right]. \tag{24}$$

In the absence of direct observations on the change of productivity, the demand for activities and the allocation of time, Michael resorts to the simplifying assumption that schooling has a neutral effect on the activity mix (i.e. $\tilde{MP} = \tilde{MP}_i$), and on the input mix [$\tilde{MP}(X_i) = \tilde{MP}(T_i)$]. In this case

$$\tilde{X}_i = \tilde{MP}(\eta_i - 1), \tag{25}$$

or in elasticity terms,

$$\varepsilon_{iE} = (\eta_i - 1)\varepsilon_{YE}, \tag{26}$$

where ε_{iE} denotes the elasticity of X_i with respect to schooling and ε_{YE} is the elasticity of real (full) income with respect to schooling. Thus, if the neutrality assumptions are satisfied, an increase in schooling will be associated with an increase in expenditures on luxuries (for which $\eta_i > 1$) and a decline in expenditures on necessities.

Using data from the 1960–61 U.S. Consumer Expenditure Survey, Michael argues that his model can quite successfully predict the direction of education's effect on consumer expenditure patterns on non-durables. Given the estimates of the schooling elasticity ε_{iE} and the income elasticity η_i, Michael attempts to estimate the elasticity of real full income with respect to schooling (holding money income constant), and his estimates range between 0.1 and 0.75. These estimates are lower than the elasticity of money income with respect to schooling. Unfortunately, these estimates are flawed because Michael erroneously uses the money income elasticities, whereas his theory deals with full income elasticities. The direction of the bias introduced by this error cannot be ascertained a priori.[25]

A partial answer to the question of the effect of schooling on home productivity can be obtained by examining the effect schooling has on the price people assign their non-market time.

[25] The bias depends on the elasticity of money income with respect to full income. In a cross section, this will depend on the source of variation between households in money income (wages, hours of work, other sources of income). Another source of bias – the fact that the estimates do not control for changes in wages and hence for substitution between time and goods – is recognized by Michael.

5. The value of time and the value of home output

The value people place on their time affects the optimum combination of inputs in home production, the price they assign to the various "commodities", and the amount of the commodities produced. Its effect is, therefore, not confined merely to the time inputs going into home production and the allocation of time at home, but is reflected in the household's supply of labor and demand for goods. The importance of the price of time for the analysis of the allocation of time within the household and the demand for goods increases the greater is the elasticity of substitution between time and goods in the production of a certain activity, the more time-intensive that activity, and the more elastic its demand.

The price of time has therefore become an important component of the analysis of time-intensive activities (such as children), and time-saving market inputs (e.g. the demand for air transport). In the field of public policy it figures prominently in the evaluation of public projects involving time saving (mostly in the field of transportation). It is, naturally, an integral part of labor supply analysis. Finally, it is a crucial component of any analysis of the value of home production.

Whereas the collection of data on the inputs going into home production involve serious technical problems, the problem involved in estimating the price of time are conceptual. In the absence of formal transactions taking place within the home, data on prices are unavailable. Instead of direct evidence one has to rely on imputations.

A first approximation for the value people assign to their time is the price they can charge for it in the marketplace, i.e. the wage rate. However, as the analysis in the previous sections indicates, the accuracy of this estimate depends on the extent to which the average wage equals the marginal wage, there are no market inputs associated with the supply of labor (e.g. transportation costs, childcare services), and work does not involve any direct utility or disutility. Furthermore, this approximation is inapplicable when the person does not work in the market.

The shadow price of time, $\hat{w}$, affects customer's choice of the optimum combination of time and market inputs [eq. (9)] and the decision whether to participate in market work or not. The imputation of this shadow price is therefore based on the observation of choices where timed is traded for goods, and the choice concerning labor force participation. Unfortunately, most often in situations where goods are traded for time, the amount of time saved is unrecorded (e.g. eating out, fast food, and time-saving home utensils). One of the few exceptions is the field of transportation.

The demand for transportation is a derived demand. The trip is basically an "intermediate activity" serving as an input in the production of the final output – at the point of destination. To produce a trip the traveller combines his own time inputs with the transport services he purchases in the market. His

modal choice depends on the utility derived from travelling by the various modes and the shadow price he assigns to the trip [Gronau (1970)]. Formally, let Z_V denote the activity "visit", Z_A and Z_B the activities "trip by mode A" and "trip by mode B," and $\bar{Z}$ all other activities. The "trip" is a necessary ingredient in the production of a "visit",

$$Z_V = f_V(Z_A, Z_B, X_V, T_V), \tag{27}$$

where the "trip" in turn is produced through a combination of goods and time;

$$Z_i = f_i(X_i, T_i), \quad i = A, B. \tag{28}$$

Maximizing utility

$$U = U(Z_V, Z_A, Z_B, \bar{Z}) \tag{29}$$

subject to the time and budget constraints, yields:

$$u_i - u_V\left(\frac{\partial Z_V}{\partial Z_i}\right) = \lambda \hat{\pi}_i, \quad i = A, B, \tag{30}$$

where $u_i = \partial U/\partial Z_i$ and $\hat{\pi}_i = P_i x_i + \hat{w} t_i$. Facing a choice whether to travel by mode A or mode B, and assuming the contribution of both modes to the production of the visit is the same (i.e. $\partial Z_V/\partial Z_A = \partial Z_V/\partial Z_B$), the decision depends on the cost of travel $\hat{\pi}_i$ and the direct utility derived from travelling by mode $i(u_i)$. Mode A is preferred if

$$\hat{\pi}_A - (u_A/\lambda) < \hat{\pi}_B - (u_B/\lambda), \tag{31}$$

where u_i/λ denotes the money equivalent of the direct utility. Put differently, mode A is preferred if

$$(P_B x_B - P_A x_A) + \hat{w}(t_B - t_A) + (u_A - u_B)/\lambda > 0. \tag{32}$$

Had all three components of this equation been known, and with the appropriate assumptions about the distribution of the unobservables, the shadow price of time, $\hat{w}$, could be derived by comparing the effect of the time differential, $t_B - t_A$, on the binary choice between A and B, with that of the money cost differential, $P_B x_B - P_A x_A$.

The most serious problem plaguing the estimates of the value of time based on modal choice data is that the time and cost differential data are measured inaccurately, and that utility differentials are unknown. The errors of measurement are due to differences between the perceived time and cost differentials and the measured differentials. The difference may be due to incomplete information (in particular, information concerning the rejected alternative), interpersonal

heterogeneity of costs and travel time (the measurements being based on averages), consistent biases (the variable costs of private cars are consistently underestimated), and conceptual differences.[26] These "measurement errors" can be quite substantial.[27]

Even more serious is the misspecification of the estimating function due to difficulties in quantifying the variables affecting the direct utility generated by the trip. The omission of these variables becomes a crucial factor in the estimation of the price of time. To demonstrate, let us assume that the binary choice variable D (say, choice between modes) is regressed on the time and cost variables Δt and ΔP:[28]

$$D = b_1 \Delta t + b_2 \Delta P. \tag{33}$$

If travel did not involve any direct utility, or if this utility was not correlated with time and cost of travel, one could derive an unbiased estimate of the shadow price of time comparing the time and cost coefficients ($b_1/b_2 = \text{est}\,\hat{w}$). Unfortunately, the assumption that travel does not convey direct utility seems to be unjustified. Moreover, utility (or, more often, disutility) is correlated with time of travel (utility declines as length of travel increases), and, perhaps with the fare (an increase in convenience, safety, and frequency may be reflected in higher fares).

There is no a priori way to ascertain the direction and extent of the misspecification bias (as long as the effect of the omitted variable on b_2 is not specified), but it seems that the upward bias in b_1 is dominant.

Most studies of modal choice focus on the choice of commuters.[29] The decision studied is most often the choice of mode (private car vs. public transport), and sometimes the choice of route (tollroad vs. regular road, or the use of toll bridge vs. roundabout routes). Allowing for biases, the concensus of these studies is that the shadow price of time in commuting is significantly lower than the wage rate, most studies placing it in the range of one-fifth to one-half of the wage rate. The failure to control for differences in comfort, convenience, effort, etc. results in estimates of the value of walking and waiting time which are 2.5–3.0 times higher than the estimate of the value of in-vehicle time,[30] and estimates of the value of

[26] A business air traveler asked for the time saved by using air may respond "one day", since it saved him a workday, though the measured time differential maybe only a few hours.

[27] Quarmby (1967) reports that the perceived variable operating costs of the car are only about half the true costs; Reichman (1973) shows that there are significant differences in the case of time.

[28] Most studies of modal choice use the binary logit, a few use multi-logit, probit, or discriminant analysis.

[29] There are quite a few surveys of the literature on the estimations of the value of time. For an early survey, see Harrison and Quarmby (1969). Subsequent surveys are Hensher (1976), Heggie (1976), and Bruzelius (1979).

[30] Heggie (1976) reports that weather conditions affect the value of walking and waiting time and that it seems that the direction of the journey (to and from home) may have an effect.

travel time by bus that are higher than travel by car. For the same reason, the shadow price of time is sometimes shown to increase with the length of the trip.[31] Finally, differences between gross and net wages and constrained working hours are reflected in higher estimates for value of time on interurban business trips than on personal trips.

The errors of measurements and the omission of variables need not impair the predictive power of the modal choice equation [eq. (24)]. Furthermore, since many of the public projects involving time saving are also associated with greater convenience, comfort, or safety of travel, the use of a biased estimate of the shadow price of time need not jeopardize the cost–benefit analysis.[32] However, it seems that this bias is sufficiently serious to prevent comparisons of the estimates of the value of time in commuting with other estimates of the value of time.[33]

Allowing for all reservations, the low price commuters assign to their time and the large difference between the price travellers assign to their time on business and personal trips indicates that they are not free (at least in the short run) to exchange home time for market work.[34] The wage rate will therefore be a poor approximation for the value of time at home of the employed. This approximation is especially poor in the case of the non-employed.

Traditionally, the value assigned to the time of the non-employed is their "potential" wage, i.e. the average wage of an employed person with the same observed market characteristics. This procedure raises two problems: (a) the employed may be a self-selected group that differs in its unobserved characteristics (e.g. "taste" for work in the market or career commitment) from the non-employed, and (b) even if the wage offers were known, they could hardly be used as an estimate of home productivity since these offers were implicitly rejected by those who decided to stay out of the labor force. The first of these problems is the censoring problem discussed at length by Heckman (1974), Gronau (1974), and others.

The second involves estimating a person's reservation wage, i.e. his minimum acceptable wage. Barring additional constraints (e.g. that working hours have to exceed a certain minimum), a person is assumed to join the labor force only if the wage he is offered exceeds the value of his time at home (in the absence of market opportunities). The shadow price of time of the non-employed therefore equals their reservation wage.

[31] Small time savings may have no value at all. The relationship between $\hat{w}$ and t may be discontinuous.

[32] The value of time saving is often the major benefit in public projects [Tipping (1968)].

[33] Gronau (1970), in his study of inter-city air travelers, finds that their value of time equals their wage rate.

[34] Earp, Hall and McDonald (1976) report a value of time on business trips that is twice as high as that on personal trips.

The reservation wage can be derived either directly (in answer to a question on the minimum acceptable wage), or indirectly. The indirect method infers the reservation wage from labor force participation patterns. Given a person's expected wage offer, the lower his reservation wage the greater his tendency to participate in the labor force. Put differently, given the mean wage offer of a group, the higher the participation rate the lower the mean reservation wage of the group. The information on wage offers and participation rates becomes the key to the estimation of the shadow price of time.[35] Moreover, it allows a detailed analysis of the socio-economic variables affecting the shadow price of time at home.

Gronau (1973) used data from the 1960 U.S. census to investigate the factors affecting married women's reservation wage. He found that women's education is a major determinant of housewives' value of time, but its effect is felt mainly at higher levels of education. Whereas there is no significant difference between the value of time of persons who have completed elementary or high school, the value of time of college graduates exceeds that of high school graduates by over 20 percent (the differential in the average wage of the employed is 30–40 percent). The husband's income, education, and age have a relatively small effect, and the existence of children has, as expected, a major effect on their mother's value of time. A child less than 3 years old increases this value by over 25 percent, but its effect diminishes as the child grows older. This effect is especially pronounced in the case of college graduates, and the decline in value as the child grows older is much more gradual.

The exclusion of the output of the home sector has long been recognized as the major omission in the national accounting system [Kuznets (1944)]. Given the changes that have taken place in this sector over time, and the differences in share of this sector between different economies (specifically, economies in different stages of development), this omission may bias the traditional measures of growth and international comparisons of standards of living. Not surprisingly, several attempts have been made to correct this lapse.

The value of output in the home sector, as in other non-market sectors (e.g. government), is measured by the value of the inputs. A major obstacle to the evaluation of the output is the choice of the value of time. There are essentially two methods of evaluating the productive services rendered by family members at home:

(a) evaluating time inputs at their market opportunity costs, and

(b) evaluating time inputs at the market alternative.

According to the first approach, the value of a person's time inputs at home is the price this time would have commanded in the market. The second approach

[35] Throughout this discussion it is assumed that there exists no joint production and that time inputs in a certain activity per se do not yield any direct utility. If these assumptions are relaxed, there will be no unique value of time common to all non-market activities. The value of time in a certain activity depends in this case not merely on the time scarcity but also on the marginal utility of time in that activity and on the degree of "jointness" between the activities.

evaluates such time at the price it would have cost the household to purchase the same services in the market. Both methods abound with technical and conceptual difficulties.

The major objection raised in the literature to the value of opportunity-cost method originates in the following alleged paradox [Hawrylyshyn (1976)]: "consider two housewives with equivalent family size and homes, and suppose that they are both equally good at the work, doing the same amount in the same number of hours. This suggests the output value in both cases is the same. Yet if one of them has an M.A. in microbiology with a potential wage of \$10/hour and the other is a former stenographer potentially employable at \$4/hour this method tells us the value of one's housework is 2.5 times that of the other!" The major reservation to the evaluation of time inputs using the market price of home services is "that these market prices have been explicitly rejected by the household as a true measure of its productivity. The family could have bought the home services in the market but preferred not to do so, either because it found their prices too high, or because it found their quality wanting" [Gronau (1980, p. 414)]. A secondary question is what market values should be used: an overall measure (e.g. the wage of domestic servants) for all work hours, or should one distinguish between the different tasks the homemaker performs at home and assign a different market price to each task?

Had market services and home services been perfect substitutes, and provided work at home does not involve direct utility, the conceptual problem would never crop up. In this case, any discrepancy between the opportunity cost approach and the market alternative approach would be attributed to measurement errors or to disequilibrium in the labor market. The source of the conceptual controversy is the direct utility generated by work at home and the heterogeneity of home output. The issue is a complicated one because, as has been argued in Section 3, one cannot distinguish between the case where work at home generates direct utility and the case where market services and home services are not perfect substitutes.

In the first case, the explanation of the "homemaker's paradox" lies in the fact that the micro-biologist and the stenographer must be deriving different utilities from their home and market jobs. Traditional measures of market output do not incorporate a measure of workers' "job satisfaction" and, by the same token, should not include a measure of their enjoyment from work at home. A person's market wage differs [by eq. (18)] from the value of his marginal productivity at home and should not be used to measure home outputs.[36]

[36] Note that in the Hawrylyshyn example the value of marginal productivity f' may equal 10 where the stenographer enjoys her job in the market more than does the micro-biologist, or 4 if the micro-biologist enjoys work at home more than does the stenographer, or any other value (not necessarily confined to the range 4 to 10). Note, too, that empirical studies have shown that, on average, \$10/hour micro-biologists spend less time working at home than \$4/hour stenographers.

On the other hand, if work at home and in the market are not perfect substitutes, but it is still assumed that work (at home and in the market) does not generate any direct utility, the resolution of the paradox lies in the different values the micro-biologist and the stenographer assign to their home output. The micro-biologist regards her output superior to the market substitute. She is ready to forgo \$10 per hour of output, whereas other women, who place a lower value on their output, are ready to forgo much less.[37] Once we remove the assumption that home services are a homogeneous output, the market alternative approach has to be discarded. By eq. (20) the value of the marginal productivity of an employed person equals his wage rate, and his time inputs in home production should be evaluated according to this wage.[38]

There is no empirical way of telling which is the correct underlying model (both assumptions are probably correct – work at home generating direct utility and home service being non-homogeneous). Thus, there is no way of rating the two methods of evaluation of home output and, preferably, both should be used.

Given the often heated debate concerning the advantages and the disadvantages of the different methods of imputation, and the imprecise nature of the data, there is surprising unanimity on the share of the household output constitutes in total economic activity. Hawrylyshyn (1976) examined 9 studies based on U.S., U.K., and Swedish data,[39] and shows that if one uses as the value of time the net wage (rather than the gross wage), the opportunity cost method and the market alternative method yield, on average, the same estimate of the share of the home sector output in GNP – 35 percent (the estimates ranging from 32 to 39 percent).[40]

A much more important bias in the estimation of the value of the home sector may arise from the fact that almost all studies focus on the value added of the labor inputs (sometimes only the wives' labor) in the home sector, ignoring other inputs in the process. Most notably, we ignore the rewards to entrepreneurship in this "industry". A person working at his home is, in essence, self-employed, and one should, therefore, incorporate in the estimate not merely the value of his labor inputs, but also the "producer surplus". Redrawing Figure 4.1, the opportunity cost method, ignoring the decline in marginal productivity in home

[37] Note that since home output is not measurable one can phrase the same argument in terms of efficiency [Chiswick (1982)] – the micro-biologist regards herself as more efficient in home production than the stenographer.

[38] The micro-biologist may be ready to pay her physician (or hairdresser) a fee that is 2.5 as high as that paid by the stenographer to her physician, though the services seems, by all accounts, the same. Still, nobody will argue that all medical services should be assigned the same price.

[39] In a more extensive study, Goldschmidt-Clermont (1982) reports the results of over 70 studies on the value of unpaid work in the household.

[40] Studies that adopted the market alternative method, where each household function is priced separately, yield, on average, a lower value than those using the market-opportunity costs method.

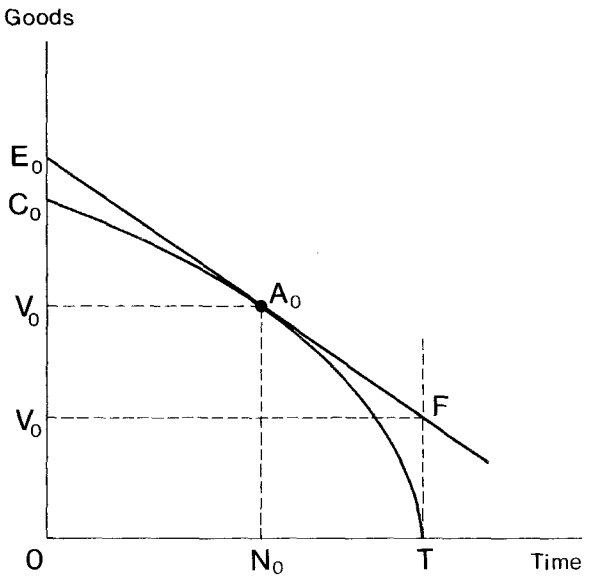

Figure 4.3

production, imputes a value of V_0V_1, whereas the value of home output is $0V_0$ (Figure 4.3).

To correct for this bias, Gronau (1980) examines the effect of the wage rate on hours of work at home of employed wives. Assuming the wage equals the value of marginal productivity at home, he generates the relationship between hours of work at home and the value of total output. By his estimates, the value of home production in 1973 equals, on average, two-thirds of the family's monthly income, and reached almost 90 percent for families with pre-school children.[41] This value by far exceeded the wife's monthly earnings. Schooling increases the wife's productivity at home; but to a smaller degree than her (or her husband's) productivity in the market. Hence, there exists a negative correlation between the husband's schooling and the share of home output in total money income. This share depends heavily on the wife's employment status. It is only one-half for families when the wife is employed and 80 percent when she is not employed. It increases with age, but peaks earlier than money earnings. Finally, these estimates are, on average, almost twice as high as those based on the opportunity cost method (the difference is even larger for families with young children).

[41] Gronau ignores the contribution of husband and children to home production.

6. Summary and evaluation

The theory of home production had a major impact on the development of the economics of human resources, generating a host of studies investigating its implications. At first glance this popularity seems to be misplaced: the theory's major elements were either quite familiar or were criticized as redundant. Thus, travel time was recognized long before Mincer's and Becker's studies as an important factor determining the demand for transport services. Admitting time into the utility function, it has been argued, one can derive all the theory's conclusions by making the appropriate separability assumptions, without recourse to the home production framework. Finally, it has been shown that the assumption of exogenous prices, a vital ingredient in traditional analysis, is very often violated in the new context of demand for "commodities".

The present survey goes only part of the way in explaining this paradox. Rather than discussing the full range of the theory's applications it focuses on home production in its narrow definition. Thus, the survey does not do justice to the theory's ramifications for the economics of fertility, health, crime, and other spinoffs. Nonetheless, the survey highlights the theory's points of strength as well as its weaknesses.

The theory played a leading role in the widening recognition of the importance of time, not only for the analysis of the demand for certain time-intensive activities, but also for analyzing the demand for all market goods and services. It shed light on a usually forgotten facet of consumption behavior, and forged a natural link between consumption and the supply of labor. But its contribution does not lie merely in pointing to the role of time in the demand for children, domestic servants, information, etc., but in reformulating this role. Even when time was recognized as affecting demand (e.g. the demand for transport services), it was implicitly treated as a variable affecting "taste". The new approach stresses the resource constraint facing the decision-maker, and its implications for the opportunity costs of time.

Without denying the effect of time on the utility of travel, the emphasis is shifted to the analysis of the price effect, where the price consists both of pecuniary costs and the cost of time. Whereas economists have little to contribute on the factors determining utility, they are comfortable with the analysis of prices. For example, whereas in the past the analysis of the effect of distance or the traveler's income on modal choice required specification of the effect of these variables on the utility of travel by the various modes, the new approach can circumvent this cardinal concept of utility by specifying the effect these variables have on the cost of time and the trip's price. There is nothing inherent in economic theory that explains why travel by bus is inferior (i.e. generates less utiles) than travel by air. However, the theory is very explicit in discussing the effect of distance on the cost of time, the effect of income on the price of time,

and their implications for the relative prices of bus and air travel [Gronau (1970)]. The analysis of the cost of time gave the theory the predictive power that the earlier approach lacked.

The importance of the distinction between consumption and production is much more controversial. Pollak and Wachter (1975) show that "commodity" prices are endogenous to the system and depend on the optimum commodity mix (and hence on tastes) whenever the production function is not linear homogeneous, or when there is joint production (which is often the case when time is an input in the process). In the absence of information on "commodity" prices, one cannot estimate their demand. In this case one is better off, they suggest, to analyze the demand for inputs given input prices. Others have claimed that the distinction is barren, since all the theory's implications can be derived by incorporating time into the utility function. The criticism, though correct, seems to be misplaced.

The theory of home production has rarely been used as a guideline in an empirical study of the demand for commodities.[42] Most often, the quantity of "commodities" consumed defies measurement, and their price (even when they are exogenous) is unobserved. As the survey indicates, it was measurement problems, rather than conceptual problems, that led economists to focus on the demand for inputs.

Separability is a powerful tool in the analysis of the demand for input. But the rationale underlying the separability assumption and the distinction between different time uses is the belief that the relation between different units of time is determined by their usage. Thus, "cooking time" and "driving time" are substitutes to the extent that "eating at home" and "eating out" are substitutes, and "eating time" and "theatre time" are complements to the extent that "eating out" and "going to a play" are complements.[43] This belief is incorporated explicitly in the theory of home production.[44]

The theory of home production, rather than serving as a blueprint for empirical research, is an analytical tool. The distinction between consumption and production is essential to the analysis of work at home (as distinct from consumption time). It consequently proves important for the analysis of labor supply (in particular that of married women), and the measurement of home output.

The distinction is also important for the measurement of the returns to the investment in human capital. Market returns in the form of higher wages and

[42] Few of the exceptions can be found in the analysis of the demand for health [Grossman (1972), Rosenzweig and Schultz (1983)].

[43] Were it not for the different uses, the specification of the utility function should have been in terms of an "activity free" measure of time such as "summer time", "day time", etc.

[44] DeSerpa's paper on time allocation (1971) demonstrates the dangers of leaving these assumptions implicit.

market productivity have been shown by Leibowitz, Michael, and others to be only part (and in the case of women, perhaps even the less important part) of total returns. No less important is the effect of investment in human capital on home productivity. It affects the productivity of the investment itself [Ben-Porath (1967, 1970), Heckman (1976)], and of home production.

The theory is sometimes criticized for replacing the traditional terminology by a more complex one. But one should not scoff at the importance of language. For example, an economist may feel reluctant to assume that schooling affects the marginal utility of time and goods by the same rate, but may feel comfortable with the assumption that schooling has a neutral effect on the productivity of time and goods [Michael (1973)].

The theory of home production played a major role in the realization that economic considerations are as important in the home sector as in the market. The informal nature of the economic transactions taking place within the household hinders the detection of flows of goods and services within the home sector. In the absence of direct measurement, the distinction between consumption and production must necessarily remain conceptual. After twenty years, and in spite of the many studies it generated, the full potential of the theory has yet to be realized. With few exceptions, it has not yet served in the analysis of specific time uses. We do not know much more about the interaction between time and goods in specific activities than we did twenty years ago. For all its shortcomings, the new theory of home production has made an enormous contribution to our understanding of economic processes in the non-market sector. Its full potential has yet to be realized.

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