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THE ALLOCATION OF TIME
FOR HOUSEWORK ACTIVITIES

A. H. Perrels

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**THE ALLOCATION OF TIME
FOR HOUSEWORK ACTIVITIES**

A.H.Perrels

Economisch en Sociaal Instituut

Vrije Universiteit

Amsterdam

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1. Introduction

Decisions of economic actors are often not taken in isolation from others, but concern a choice from a joint supply pool of goods or services, which are linked to each other via a network. Examples are trip decisions of travelers, electricity use of households and information transfer from universities. A main feature of such choice problems is the existence of capacity limits, so that excess demand will lead to peak problems. Such phenomena may lead to social costs caused by congestion (see for instance Miyao and Shapiro, 1981) and call for a thorough analysis of supply-demand patterns at each period of the day.

Two situations may be distinguished, viz. a 'mover' situation where the actor's daily activity pattern has a clear geographical distribution pattern (e.g. in case of travel behaviour; cf. Carlstein, 1983 and Hägerstrand, 1970) and a 'stayer' situation where only the commodity pattern of the consumers has a clear geographical distribution structure (e.g. in case of water, gas or electricity networks). However in both cases an intensive spatial flow, that is intensive consumption in distinct spatial and temporal concentrations, causes peak-load problems. Congestion may imply high social costs (according to a non-linear cost curve), but on the other hand expansion of capital intensive networks in order to meet (any) peak-load demand may also be very expensive as this involves idle capacity. Seen from the viewpoint of the network suppliers this situation calls for a thorough assessment of necessary network capacity in order to avoid inefficient capacity expansion based on peak loads.

Consequently long term planning of network capacity requires a forecasting of future peak-loads. Currently the long term forecasting of peak loads is usually based on conventional, rather straightforward, methods. For instance the long term planning of electricity generation capacity in the Netherlands is based on the assumption that there exists an approximate linear relation between annual consumption from the network and annual maximum load of the network ¹. Such an approach may be valid if the society operates under fairly stable conditions. This happened to be true in the 1950's and 1960's. However in the 1970's and 1980's the economic and social conditions exhibited dramatic changes. Economic growth is not just more moderate than in former decades, but also of a different nature. As regards changing social conditions we observe a substantial slowdown of population growth as well as more differentiated lifestyles and attitudes towards household formation and size. If in general social and economic conditions change two

¹. The form of the relation is: $L_T = (1 + \alpha)^{T - T_0} * D_T$, where L denotes network load, D denotes demand, T is a year index, while α represents a (usually small) positive number ensuring some safety margin in the form of excess capacity.

important aspects with respect to network utilization have to be mentioned:

- 1.the propensity to consume services provided by a network may change;
- 2.the schedule of network requiring activities may alter.

Mainstream economics devoted much effort to the explanation of the first mentioned impact, but unfortunately the second impact received much less attention. The scheduling of production is a kind of decision which can be integrated with some effort in production theory. This is usually based on the specification of an appropriate production function and aims to identify next an optimum solution for a production system (in terms of output, profit,etc.) under certain side conditions (e.g. maximum number of labour hours, maintenance cycles, shiftwork wage premiums, etc.). Besides due to institutional and social barriers, in practice business hours are only occasionally reconsidered. Therefore the available theory has rarely been used for production time decisions. As regards the scheduling of household activities, there exists a body of theory about the allocation of time by household members (see e.g. Kirsch,1988). This theory aims at explaining the allocation of an entire time budget over several activities, but it is hardly capable of explaining the sequence of activities, an element in particular emphasized in the integrated activity approach (cf.Damm, 1982). However in order to forecast future activity schedules we need insight into both the allocation of the time budget (and the marginal substitution rates) and the (preferred) sequence of activities.

The present paper is a contribution to the explanation of network utilization by means of activity analysis. In a former study (see Perrels,1987) attention was paid to the scheduling of production with respect to the load of a public electricity network. In the present paper the emphasis is placed on the behaviour of households in order to obtain an overall and more coherent picture of the scheduling of activities in society.

The next sections will discuss time allocation behaviour. In section 2 some theoretical reflections will be dealt with. Section 3 provides some results from the time allocation study. Section 4 will present conclusions in relation to the significance for the assessment of the load curve.

2. Time Allocation of Households; An Overview

2.1. Basic Theory

The theoretical economic developments concerning time allocation of households have their roots in labor market theory as well as in utility theory. Starting point of the economic theory is to consider an economic subject that has to decide which part of his(her) entire time budget he(she) wishes to devote to paid labor. The remaining part of his(her) budget is defined as leisure time or free time. The willingness to engage in paid labor depends on the wage rate as well as on the non-monetary value (utility) attached to a job and to leisure activities. The actor will be prepared to allocate as much time to paid labor up to the point where the marginal utility derived from an unit of time devoted to work equals the marginal utility derived from an unit of time devoted to a leisure activity. The terms "leisure" and "free" are not very accurate in this context. A part of the so called free time will be usually spent to more or less obligatory activities (like sleeping, eating, waiting, etc.). Nevertheless, in contrast to labor time, one is in principle free to decide how much time to spend exactly to each non-labor activity.

A well known contribution to time allocation theory is the study of Becker (1965). His introduction of a so-called household production function is a fruitful concept to assess time allocation decisions. The crucial notion of this concept is the way consumption is perceived. Consumption of a household is no longer identical to buying commodities, but consumption is an activity that requires the input of market commodities, home made commodities and time. In other words the ultimate consumable product (or service) is produced by the household members themselves. A household faces the problem to allocate the correct amount of time and money to each activity. The first, conditioning, decision is to allocate an amount of time to work. In exchange for labor time the household receives income which can be allocated to market goods (or saved²). If the wage rate increases, a household may be induced to decrease the amount of labor time in order to have more "free" time while the income remains constant.

Unfortunately there are various reasons which limit the operational viability of the Becker model. Especially in the framework of our analytical purposes (i.e., scheduling), the following objections may be mentioned:

- within the range of non-labor activities some activities are highly obligatory while others are pure leisure; these large diversity in character calls for a more differentiated treatment of time allocation;

² In this case it is convenient to regard savings as a commodity. For a correct treatment we should essentially consider life cycle earnings.

- the labor engagement decision is a long-term and infrequent decision, in contrast to most consumption decisions, which are usually short-term oriented and are taken frequently³; furthermore a reconsideration of the engagement in paid labor is mostly related to other factors like a change in the household composition or the opportunity to benefit from a substantially higher (net) wage rate; thus the monetary restriction might be reformulated with a fixed income;
- most final commodities can be provided in a number of ways; therefore, one should be careful in applying technical restrictions on the input-output relations, as is done in the original Becker model;
- the present approach is able to explain shifts between time budgets per activity; however, although this may have some importance for us, our focal point is on sequencing of activities, and hence we will need a more mature model than an adjusted version of the model described above.

A great many number of reseachers have put forward adjustments to the original Becker model, inter alia DeSerpa (1971) and Gronau (1977). Others introduced ideas and concepts from other disciplines, see inter alia Carlstein, Parkes and Thrift (ed.), (1978). Of special interest is the approach of Winston (1982), as this approach is able to combine budgetting (time and money) and scheduling considerations. Before discussing the contribution of Winston we will devote some attention to the approach of DeSerpa as far as it is relevant to the empirical study discussed in chapter 3.

2.2 The Trade-off among Time Budgets and between Time Budgets and Expenditures

We can meet most objections against a fixed income if we distinguish sufficiently between household types. As regards the technical restrictions on consumption we can make use of the model proposed by DeSerpa (1971). DeSerpa assumes that consumption of any final commodity requires at least some time (a technical minimum). For some (in attractive) activities (like cleaning) he expects that the technical minimum amount of time will be used. However many other activities have to some extent a leisure character. For these activities he supposes that usually more than the technical minimum amount of time will be consumed. The advantage of this concept is that it attempts to overcome the objections regarding the leisure content of many non pure leisure activities.

The formal representation of the DeSerpa model is as follows. Consider the production volume Z_i of a final commodity i . The production of this commodity i requires the input of a bundle of market goods and services X_i and the input of time T_i . Then the production function is:

³ Of course there are some notable exceptions like housing.

$$Z_i = f_i(X_i, T_i) \quad , i = 1, \dots, n. \quad (1)$$

The differences between the models concern the constraints used. Contrary to the Becker model in the DeSerpa model wage labor and (consequently) income are assumed to be fixed. So the expenditure constraint is simply described as:

$$\sum_i (p_i \cdot X_i) = Y \quad (2)$$

where Y denotes the sum of fixed property income and fixed labor income.

Secondly the fixed relation between material input and temporal input in the Becker model is replaced by an inequality:

$$T_i \geq a_i X_i \quad (i = 1, \dots, n) \quad (3)$$

This reflects the hypothesis that any activity requires at least a technically⁴ determined minimum amount of time. However depending on personal preferences and personal circumstances an individual may decide to spend more than the minimum amount.

We now assume that each individual will maximize the utility he can derive from consumption. Therefore, let us consider a well behaved utility function U where

$$U = U(Z_1, \dots, Z_n) = U(X_1, \dots, X_n; T_1, \dots, T_n) \quad (4)$$

Next we maximize U subject to constraint (2) and (3). This can be formulated as a Lagrangean function L:

$$L = U(X_1, \dots, X_n, T_1, \dots, T_n) + \pi \cdot (Y - \sum_i p_i \cdot X_i) + \mu \cdot (T - \sum_i T_i) + \sum_i k_i \cdot (T_i - a_i X_i) \quad (5)$$

where $k_i \geq 0$ ($i = 1, \dots, n$), $\pi > 0$, $\mu > 0$, π and μ reflect the marginal utility of money and time respectively, while k_i is a parameter correcting the marginal utility of time in case of activities that are carried out within the minimum amount of time.

Although the utility function in the DeSerpa model is conceptually the same as in the Becker model, abandoning the constraint involving fixed relations between material input and time input implies that an increase of final consumption of a commodity not necessarily does not include an increase of both material input and time input.

Therefore in stead of partial derivatives with respect to Z_i and w (as in the Becker model) optimum solutions can now be

⁴.DeSerpa also points to institutional restrictions like speed limits in relation to travel time.

found by the partial derivatives with respect to material and time separately ⁵:

$$\delta U_i / \delta X_i = \pi \cdot p_i + k_i a_i \quad (i = 1, \dots, n) \quad (6)$$

$$\delta U_i / \delta T_i = \mu - k_i \quad (i = 1, \dots, n) \quad (7)$$

$$k_i \cdot (T_i - a_i X_i) = 0 \quad (i = 1, \dots, n) \quad (8)$$

If an activity is inattractive (but necessary⁶), an individual will allocate the technical minimum amount of time to that particular activity, consequently k_i will be positive in case of necessary activities ⁷. The individual will allocate more than the minimum amount of time to other activities, thus k_i will be 0 in those cases. The marginal rate of substitution between time and money is:

$$\frac{\delta U_i / \delta T_i}{\pi} = \frac{\mu - k_i}{\pi} \quad (9)$$

For activities with a leisure content the marginal rate of substitution is equal to the conventional ratio of the respective shadow prices. However for activities carried out at their minimum time constraint, the ratio is corrected for the fact that time is much more "productive" in this case. In other words, time is more valuable, for as T_i decreases the consumption of X_i (and Z_i) decreases proportionally (at least if no technical time saving device is installed). On the other hand, if time could be saved on an inattractive activity i (for instance by the use of an improved or new time saving device), the individual has the opportunity to allocate more time to a more attractive activity j . The value of the time saved on the inattractive activity i and spent to the more attractive activity j is then:

⁵. Provided the second order derivatives exist and are negative.

⁶. We rule out the perverse possibility of inattractive innecessary activities.

⁷ The possibility exists that $k_i=0$ while $T_i=a_i X_i$, for instance in case of an activity to which the individual is prepared to spend just the amount of time that equals the technical minimum.

$$\frac{(\delta U_j / \delta T_j)}{\pi} - \frac{(\delta U_i / \delta T_i)}{\pi} = \mu / \pi - \frac{\mu - k_i}{\pi} = k_i / \pi \quad (10)$$

It should be noted that the present case presumes that individuals (or households⁸) have prefixed the amount of final output of commodity Z_i in order to meet a certain requirement level with respect to the service that a final commodity Z_i supplies (e.g. cleaning). In other words, the individual finds a way to accomplish the same task within less time. Of course the ultimate decision whether to acquire such a time saving device depends also on the monetary inputs with respect to the activities i and j . Therefore the complete decision for an individual considering the acquiring of a time saving device related to activity i , while having the choice to reallocate time and money over n activities among which at least one attractive activity j , is represented by:

$$dU = \sum_n [(\delta U_n / \delta T_n) dT_n + (\delta U_n / \delta X_n) dX_n] \geq 0 \quad , \quad (11)$$

$$n = 1, \dots, i, j, \dots, m$$

This expression depicts the full range of choices an individual has to make (implicitly or explicitly) when he can reallocate a (released) amount of time from an inattractive to one or more attractive activities. Based on the approach of DeSerpa and assuming only one alternative activity j equation (11) can be simplified as follows (see eq.6 and 7):

$$k_i \geq p_j \cdot \pi \quad (12)$$

Persons with little spare time (e.g. persons with a full time job) will attach a higher value to k_i than persons with abundant spare time (e.g., unemployed persons). On the other hand employed persons will generally have more money to spend than unemployed persons and consequently, in general, employed persons may be expected to have a smaller marginal utility of money. Given this constellation it will be clear that more wealth (without more labor time) opens up a wider range of leisure because:

1. a wealthy person can buy more time saving devices;
2. a wealthy person can put more money into his leisure.

⁸.The basic models of Becker and DeSerpa can be easily extended from the individual to the household, see for instance Deaton and Muellbauer (1980).

2.3. Goal Utility and Process Utility

Winston (1982) suggested the distinction between goal utility and process utility. For some activities an individual is usually only interested in the result, while the activity itself is not attractive to perform, for instance cleaning. In other words cleaning has a positive goal utility and a negative (or at best zero) process utility. On the other hand a lot of leisure activities yield barely any (lasting) result, but are generally regarded attractive to perform, for instance watching a movie. Some leisure activities and sometimes paid labor can have (to a certain extent) both a positive goal utility and a positive process utility. A second important feature in the model of Winston is the possibility that the utility level experienced by an individual is allowed to vary over the day.

Therefore in terms of the model of Winston an individual will try to improve its overall utility by exchanging negative (or low value) process utility by positive (or high value) process utility, while the goal utility of an inattractive activity remains constant. Such an exchange can be accomplished by saving time on inattractive activities (provided the result remains unaltered) and spending the released time on an attractive activity.

The approach of Winston is more flexible compared to more traditional concepts due to the way time is introduced, that is by integrating over time. The household production function is therefore restated as follows. Final commodities are produced and consequently consumed at a certain intensity, i.e. they are provided at a certain rate per time unit. For a given technology in an equilibrium situation with respect to a particular activity this implies that also material input is used at a certain rate per time unit. Formally the intensity of output (consumption) of final commodities is related to material input as follows:

$$z_i = f_i(x_i(t)) \quad (13)$$

where x_i denotes a bundle of inputs used for the production of final commodity z_i . Consequently :

$$Z_i = \int_{T_0}^{T_i} z_i dt = \int_{T_0}^{T_i} f_i(x_i(t)) dt \quad (14)$$

where T_0 denotes the starting time of activity i and T_i denotes the stopping time of activity i (which will be at the same time the starting time of a next activity).

Usually consumers derive utility from the consumption of commodity i . However as explained we may distinguish between goal utility and process utility. This can be described as follows:

$$U_i = U_{gi}(Z_i) + U_{pi}(Z_i) \quad (15)$$

For utility intensity the distinction is described as:

$$u_i = u_{gi}(Z_i) + u_{pi}(z_i) \quad (16)$$

The goal utility depends on the result of an activity (i.e. when the activity is completed), and therefore for both the utility (U_{gi}) and the utility intensity (u_{gi}) the parameter Z_i should be used. The process utility is related to the act of provision of the final commodity and consequently the process utility intensity is a function of the intensity of provision of the final commodity, thus z_i should be used in relation with u_{pi} . To obtain the total process utility one has to integrate the intensity over the relevant time span, that is the duration of the activity. The relations between the separate utilities and utility intensities are displayed in the equations 17 and 18.

$$U_{gi}(Z_i) = T_0 \int_{T_0}^{T_i} u_{gi}(Z_i) dt = u_{gi}(Z_i) \cdot T \quad (T = T_i - T_0) \quad (17)$$

$$U_{pi}(Z_i) = T_0 \int_{T_0}^{T_i} u_{pi}(z_i) dt = T_0 \int_{T_0}^{T_i} u_{pi}(f_i(x(t))) dt \quad (18)$$

As the goal utility is closely related to the requirement level, which is defined by the individual (see section 3.1 for further discussion). The goal utility has a constant (but unknown) level, provided the household characteristics remain unchanged. This means that if the individual succeeds in saving time on a certain activity, the goal utility intensity increases (with the same relative amount as the amount of time saved). The behaviour of the process utility in relation to duration may be not unambiguous, as it depends inter alia on the attractiveness of the activity and the way it is provided.

2.4. Utility Profiles

The concept of goal utility and process utility can be visualized by means of utility profiles. The utility profile is in fact the graphical illustration of a (hypothetical) net utility function. In other words, it illustrates the development of net utility from moment to moment. For a given household the part related to the goal utility is constant as it is closely related to the predefined requirement level and thus it can be pictured by a straight horizontal line (see figures 1 and 2, line a). The trajectory of process utility is less clear, but usually economists assume that for rising quantities of consumption marginal utility will fall. In the case of activities with a leisure content one can for instance assume the utility function to be a parabolic function. That means that during initial stages of the activity utility may increase due to learning effects, however if the activity proceeds substantially longer utility will fall due to boredom and fatigue (see figure 2 line b). In case of strictly necessary activities, one may assume a negative downward sloping function

(i.e. falling marginal disutility) with respect to process utility. The form of the curve (concave or convex) will depend inter alia on the technology applied and the attitude of the performer.

Figure 1. Utility profile of a housework activity

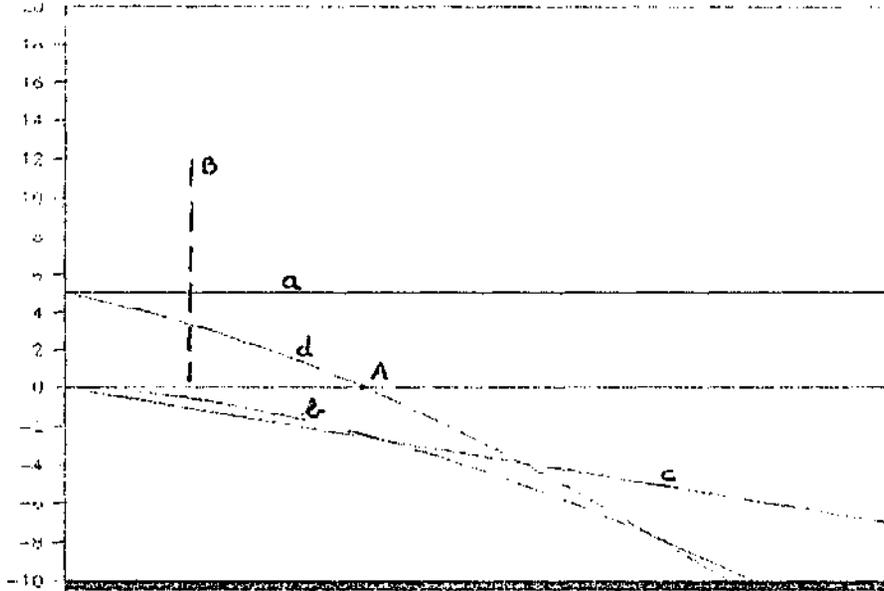
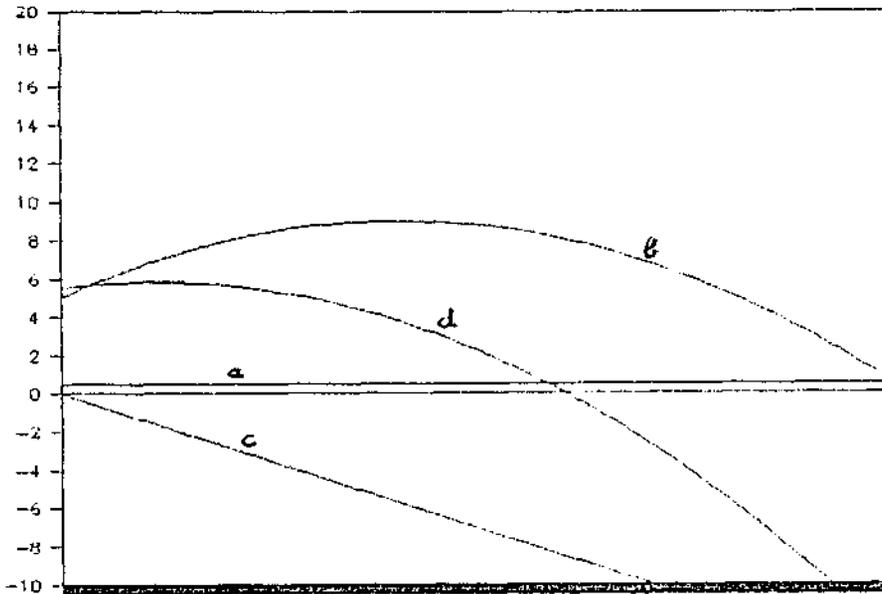


Figure 2. Utility profile of a leisure activity



In figure 1 I assumed convexity (line b) with respect to the housework activity. As regards the monetary costs I assumed a strictly linear relationship between material inputs and time for ease of exposition and presentation, although non-linear relationships are possible as well (see figure 1 and 2 line c). In this context the costs of the use of durables can be included by a capital service rate. Entrance costs (for each time an activity is carried out) can be represented by an intercept. In figure 1 and 2 entrance costs are assumed to be absent.

The net utility of activity i (U_i^*) performed in the timespan $T_0 - T_1$ and applying technology j is defined as

$$\begin{aligned}
 U_i^* &= U_{gi} + U_{pij} - C_{ij} = \\
 &= U_{gi} + T_0 \int_{T_0}^{T_1} u_{pi}(f_i(x(t))) dt - T_0 \int_{T_0}^{T_1} \pi \cdot x(t) dt \quad (19)
 \end{aligned}$$

In the figures 1 and 2 the net utility profiles are depicted by means of line d.

The impacts of changing household composition and of institutionally or technically determined efficiency differentials over time can be highlighted by means of such illustrations of utility profiles. The first type of impact relates to the goal utility while the second type of impact preponderantly influences process utility and sometimes costs of market inputs.

If a household expands, e.g. due to child birth, the requirement levels for several household activities will increase significantly and consequently the goal utility attached to those activities will increase correspondingly. As can be seen in Figure 1 this implies a significant rise of the maximum amount of time one is prepared to devote to a household activity. Line a (U_g) will shift upwards and consequently the place where net utility (line d) crosses the x-axis (A) shifts to the right, thus indicating a rise of the maximum amount of time one is prepared to spend to a housework activity. The actual increase of time spent to a household activity may be expected to depend on, inter alia, other obligatory activities, the division of work within a household, the income level and the level of technology involved. The role of technology is especially important here. If the technically determined lower bound in time consumption (B in figure 1) is rather large, there is not much choice left to the consumer (B is near A) and this can get worse if the requirement level increases. However if the lower time bound is small, increase of the requirement level may have no negative impact on the net utility.

Many network services distinguish between peak and off-peak prices. In other words material costs rise less sharply as time proceeds (line c in figure 1 rotates towards the x-axis with

(0,0) as fixed point). However to benefit from such a low off-peak charge one usually has to perform the relevant activity during a period of the day which is less attractive to many consumers. Consequently for most consumers process utility displays a more pronounced negative development (line b in figure 1 rotates towards the y-axis). The resulting picture is that only a rather small part of the consumers will benefit anyhow, while most consumers derive no advantage from a shift in the timing of their activity although the difference between peak and off-peak prices constitutes an appreciable discount. These theoretical considerations are confirmed by the few domestic load management studies in The Netherlands (e.g. Perfors, 1986). However, unfortunately most studies do not show a very convincing design (van Oortmarssen, 1987).

2.5. Hierarchy among activities

The utility derived from activities does not only depend on the activity itself and on institutional or technological restrictions but may sometimes depend on the completion of other activities. Notably housework activities may condition the utility derived from other activities. Also within the area of housework activities certain activities may condition the attainable utility level of other housework activities. This notion implies the necessity of scheduling of at least groups of activities (housework before leisure). In formal terms we may define an ideal level for the conditioning activity i as Z_i° and consequently with given technology there exists an ideal amount of time T_i° devoted to activity i . If the real amount of time spent to i is smaller than T_i° , the utility that can be derived from another activity j is below its possibility frontier (U_j°). The conditioning property of an activity in relation to other activities may affect the goal utility, the process utility or both. The relation between actual attainable utility and the corresponding utility possibility frontier may now be described by the following (illustrative) equations (activity i has conditioning properties in relation activity j):

$$U_{xj} = U_{gj}^{\circ} \cdot [1 - (T^{\circ} - T_i)/T^{\circ}] \quad \text{or} \quad (20)$$

$$U_{xj} = U_{gj}^{\circ} [1 - (T^{\circ} - T_i)/T^{\circ}] \quad , \text{ where } x = p, g . \quad (9)$$

The interaction properties indicated above are able to affect both the timing and the time consumption of activities. Apart from interaction effects related to the activities of one person interaction effects between activities of different household members may be assumed to exist as well. Last mentioned class of interaction effects is closely related to the division of work within a household (roles). Although a lot of studies have been devoted to roles and the division of work within households there is still a relatively little detailed quantitative knowledge of the consequences of rolepatterns for the time

allocation and the timing of activities. Therefore a rather pragmatic approach has been adopted in the empirical study in order to allow for these interaction phenomena.

3. An Empirical Concept of The Time Consumption for Housework

3.1. The Causal Structure

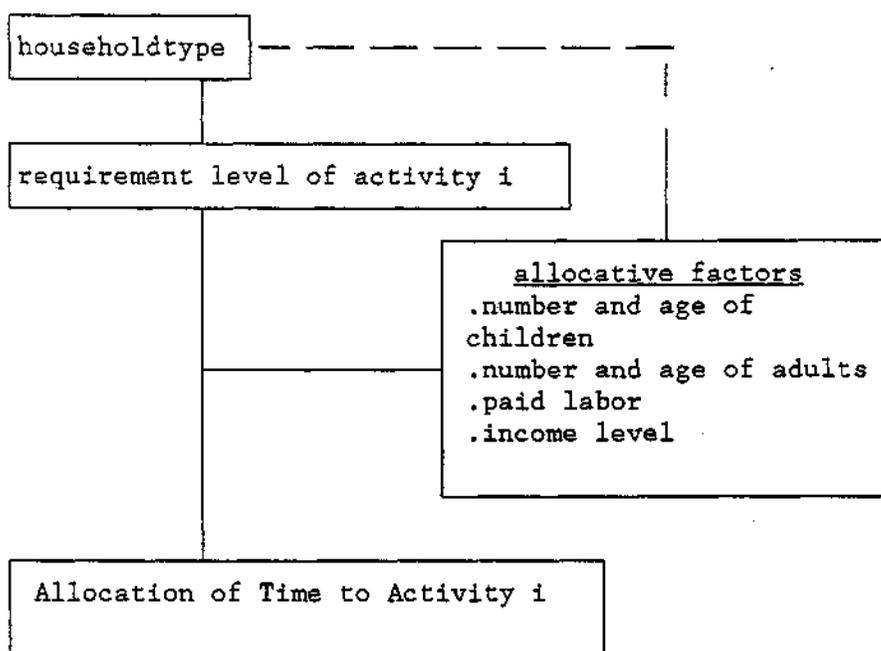
Although duality theory offers the possibility to derive 'complete' consumption functions from the Becker or Winston models, the availability of data often restricts the required specifications. Therefore I will start from the theoretical concepts discussed in chapter 2, but I will adapt the concepts in order to be able to specify time consumption functions that can be estimated by using a large sample among Dutch households (Tijdsbestedingsonderzoek 1980).

I will adhere to the usual concept with respect to time allocation behaviour of households. That is, the household is perceived as an optimizing production unit providing its final commodities ready for consumption by combining market goods and time. In addition to this 'presumption' concept I suppose that each household has a predefined requirement level for each class of final household commodities. In other words each household has a notion of how clean the dwelling should be, how well prepared the meals should be, etc. . This notion of requirement levels was discussed before (§ 2.2,3) in close relation to the concept of goal utility. The requirement level of a household will be influenced by:

- a. the personal views and tastes of the household members;
- b. household characteristics like family size, ages of children and adults, etc.;
- c. the general attitudes in society with respect to roles in the family, labor participation of women, etc. .

The requirement level may be expected to determine to a large extent the allocation of time to housework activities. The actual amount of time allocated to a housework activity will be furthermore determined by the engagement in paid labor, the presence of appliances, the presence of household aid, etc. . Empirical research indicates that there exist several discontinuities in the requirement levels in relation to the presence of children and the distinction retired vs. not-retired earners. This notion is closely related to the experience that the principal changes within the allocation of the household time budget are caused by changes in the composition of the household and by substantial changes in the amount of paid labor supplied by the household (see inter alia Szalai, 1972; Knulst en Schoonderwoerd, 1983; Aldershoff en Baak, 1986). Therefore it promises to be fruitful to distinguish the total population of households at least by size (viz. singles, couples and (one parent) families) and by level of engagement in paid labor (retired and not-retired singles and couples). This enables us in subsequent studies to identify shifts in the activity pattern at the macro level due to shifts in the composition in the total household population.

Figure 3 Relations determining ideal and actual time allocation



The causal structure of household characteristics and other relevant factors is depicted in figure 3. Notice that some variables function also as a basis for classification of household types. The dotted line in figure 3 indicates this influence. In other words some changes in allocative factors will alter the time allocation without altering the requirement level (thus a given goal utility). Other changes will influence both the requirement level and the time allocation (thus (re) allocating time after an adjustment of the goal utility).

3.2. An Overview of Time Allocation Behaviour in the Sample

Prior to the discussion of the estimations this subsection will provide a general impression of time allocation according to the sample. Appendix A contains a description of the technical aspects of the sample used in this study (Tijdsbestedingsonderzoek 1980, see also Knulst and Schoonderwoerd, 1983).

Remarkable differences between time allocation of the several types of respondents are depicted in the figures 4 to 7. The subsequent figures compare respondents from partly similar household types, e.g. retired singles and retired couples (fig. 4). The average time allocated to housework by men is lower than women in the same household type. This can be partly explained by substantial differences in average labor time, however according to figure 4 historically developed role patterns seem to be of importance too. As we consider the decomposition of total housework time in its various components, the largest differences appear with respect to 'time for clothes' and 'time

for food'. Men, notably if they are not retired, devote hardly any time to the cleaning, repair, etc. of clothes and neither do they spend much time to food preparation⁹. Another conclusion we may draw from the pictures 5 and 6 is that retired persons can obviously afford a more leisurely way of life. With respect to housework this more leisurely way of life is translated in substantial extra time for food and to some extent - especially in case of singles - more time is spent to the care of the dwelling.

figure 4. The allocation of time to housework by retired singles and couples

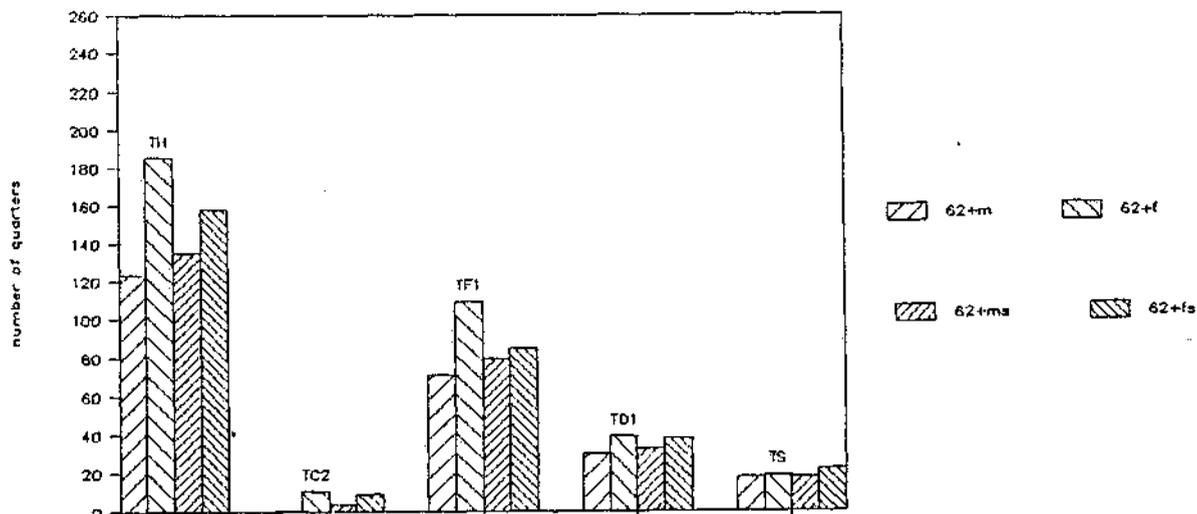
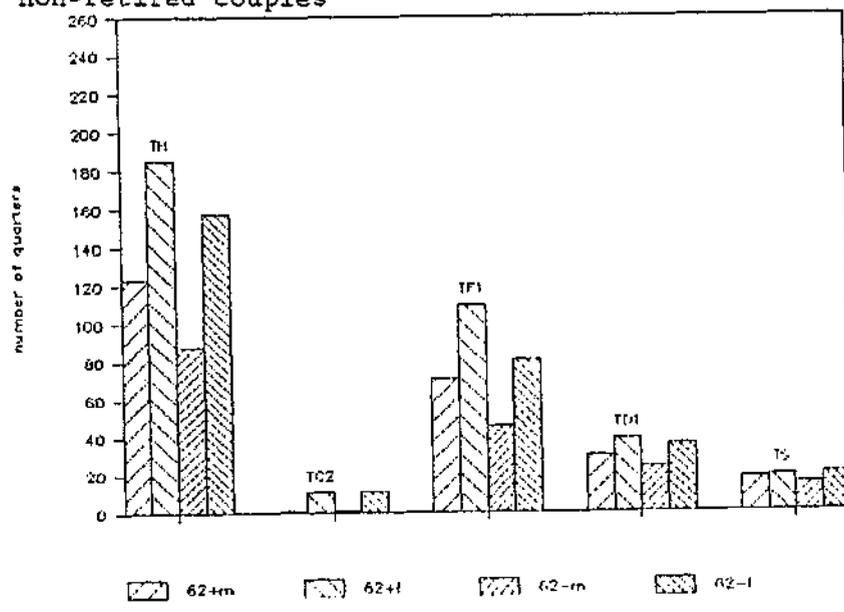


figure 5. The allocation of time to housework by retired and non-retired couples



⁹. TF1 for (non-retired) men comprises mainly time for meals.

figure 6. The allocation of time to housework by retired and non-retired singles

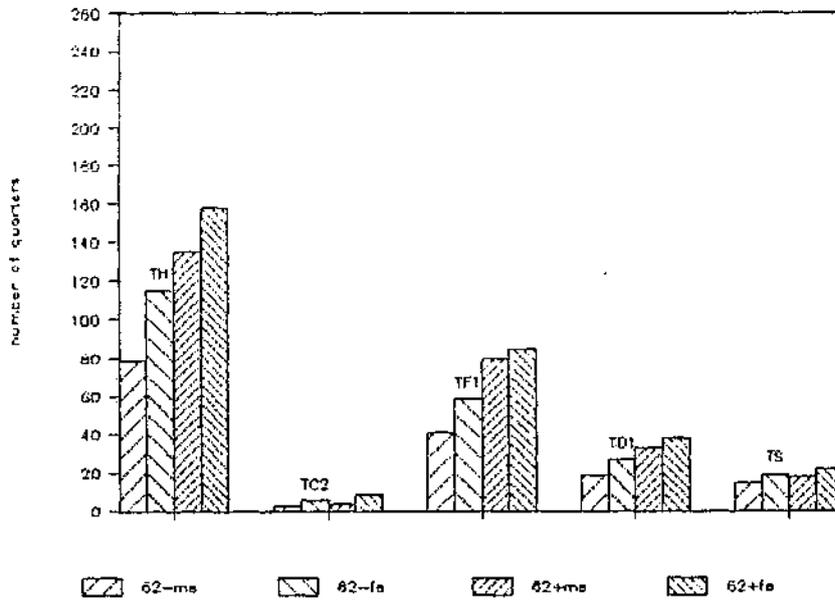
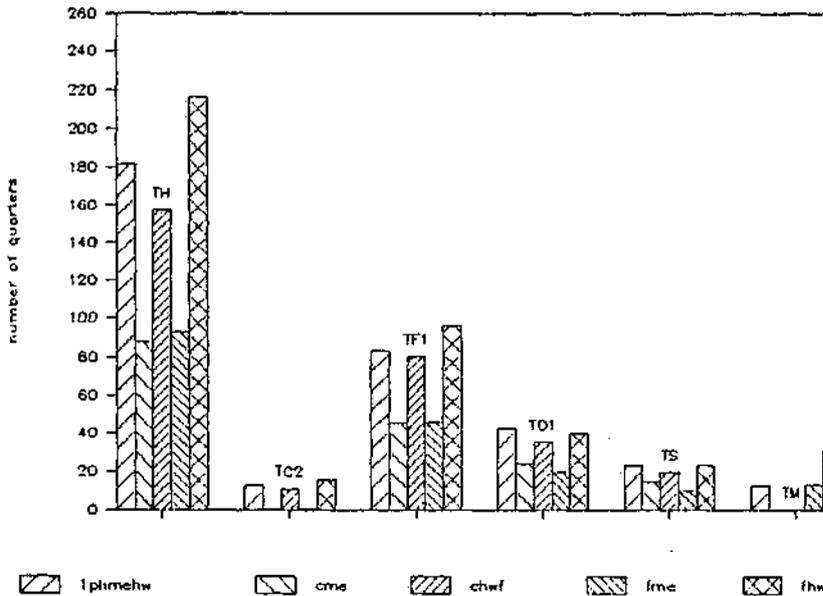


figure 7. The allocation of time to housework by one parent families, non-retired couples and families



legend:

c62-: non-retired couples	s62-: non-retired singles
c62+: retired couples	s62+: retired singles
lph : one parent families	fam : families
lphmehw: combined main earner-housewife from one parent hh.	
cme : main earner from couple	fme : main earner from family
chwf: housewife from couple	fhw : housewife from family
m : male	f : female

If we consider the averages of the principal explanatory variables (figures 8 to 12), we observe the largest differences between household types as well as respondents with respect to age of the respondent (not surprisingly), labor time and to a lesser extent age of the youngest child and income. On the other hand average dwelling type and average number of children show hardly any variation. The penetration rates of appliances are depicted in figure 12. In general, an increase in the number of household members seems to correspond to a higher penetration rate of appliances¹⁰. It seems reasonable that some appliances are generally considered useful beyond a certain household size (i.e., requirement level), due to economies of scale. Differences in net income levels may be expected to be an additional explanation for different penetration rates of appliances. However further investigation on this point by means of crosstabulations reveals that possible income effects with respect to appliance ownership are :

- a. not particularly discriminating;
- b. ambiguous.

The ambiguity relates to the fact that both the highest and the lowest income classes show falling penetration rates. Apparently for the lower income classes this has to do with lack of purchasing power. For the higher income classes we may assume the substitution of appliance based home-production by ready-to-consume market services.

We consider again figure 12 and in particular the last item (domestic help). The household types with below average penetration rates of appliances have above average domestic help. Apparently there will be substitution at this point involving outdoor laundry and cooking services. Moreover the above average domestic help also serves to explain the very small amounts of time allocated to food preparation and care of clothes by the same type of respondents. Consequently the alleged leisurely way of life mentioned above relates in particular to 'young' retired persons. For older retired persons the little time spent on housework may be explained by substitution of own time by domestic aid necessitated by less favourable physical conditions.

With respect to the future, dryers, dishwashers and micro-wave ovens are the most interesting appliances, since they have the highest penetration potential. Their actual further penetration will depend on the development of purchasing power, the engagement in paid labor, the average kitchen size and the prices of the appliances. However despite a higher penetration rate the rise of electricity consumption might be moderate due to the substitution effect at the upper side of the income range

¹⁰. The numbers of observations vary substantially from household type to household type.

families : N = 1731; non-retired couples : N = 464
retired singles : N = 79; retired couples : N = 168
one parent families: N = 135; non-retired singles : N = 128

(apart from conservation measures). Thus a higher penetration rate of appliance ownership will then be accompanied by lower frequencies of appliance use as a result of an increasing substitution of home-produced services by commercial ready-to-consume services (e.g. meals, laundry, house cleaning). Home appliances develop to a kind of back-up facilities in such a scenario.

Figure 8. The averages of the explanatory variables related to retired couples and singles

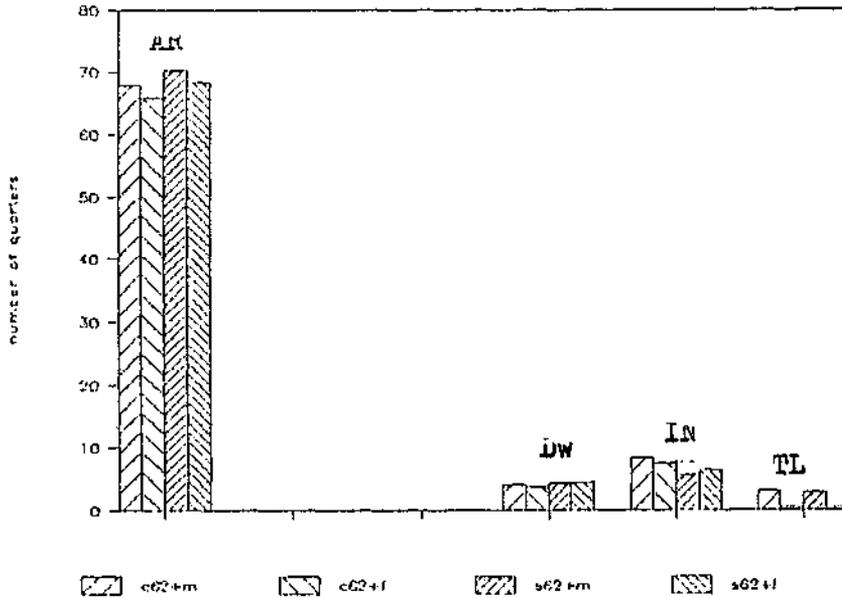


Figure 9. The averages of the explanatory variables related to retired and non-retired couples

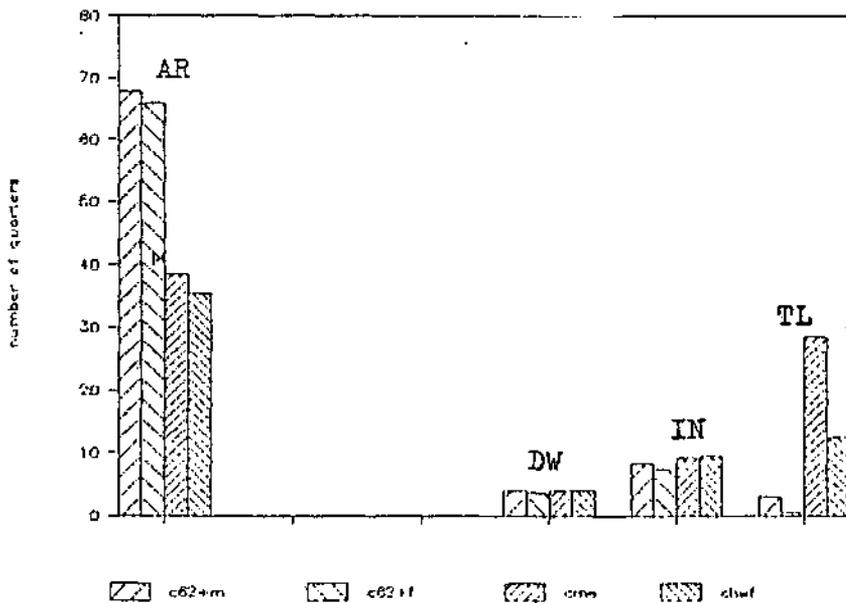


Figure 10. The averages of the explanatory variables related to retired and non-retired singles

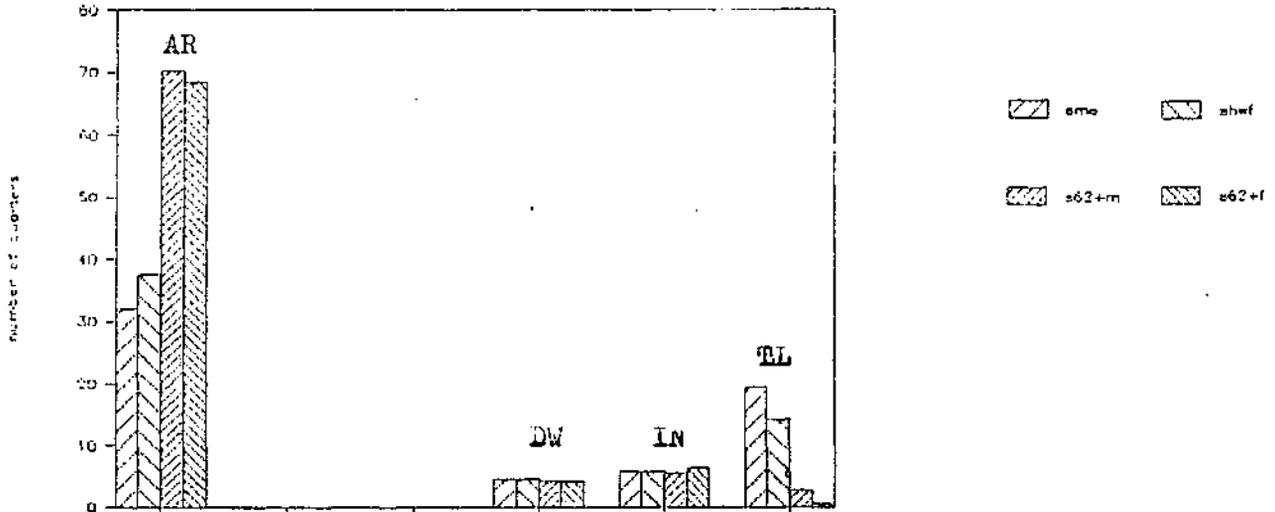


Figure 11. The averages of the explanatory variables related to one-parent families, non-retired couples and families

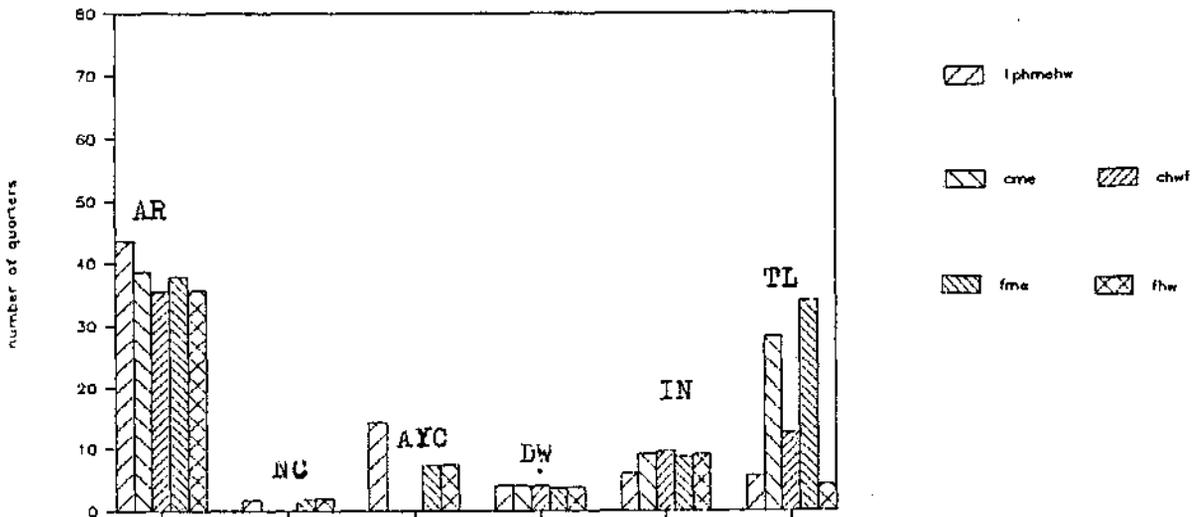
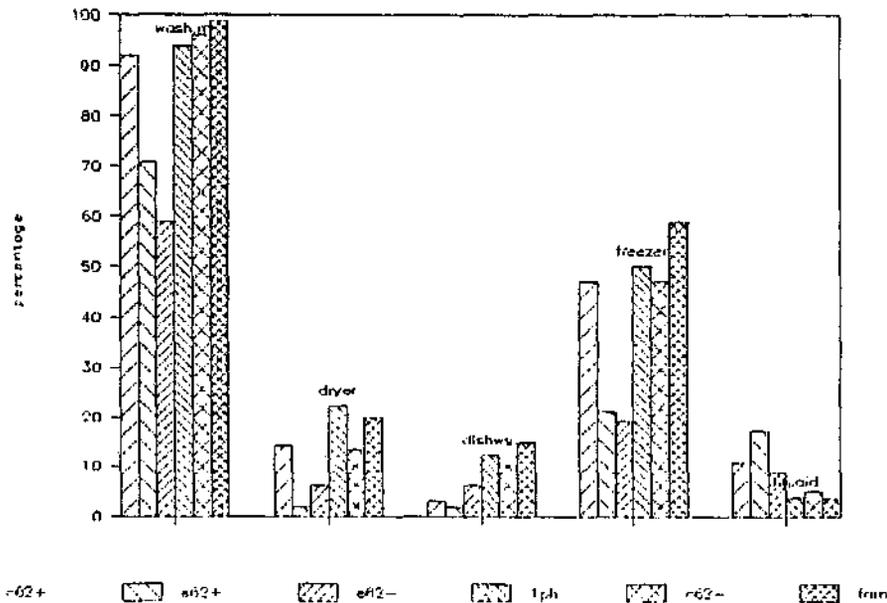


Figure 12. The penetration rates of appliances in various household types



3.3 Specification Options

The database used in this study has the advantage of a large number of observations. However there are also several disadvantages, notably as regards the measurement of income and dwelling size. Consequently a wage rate and other price elements could not be introduced in the specification. Therefore the following approach has been adopted.

Consider the concept of a theoretical requirement level which constitutes the (average) ideal level of production of final commodities a certain household type. This concept was already discussed and depicted in section 3.1. The difference between the (average) ideal requirement level and the actual time consumption should be explained by allocative factors like labor time, number of children, age, etc. On the other hand we may assume an (average) minimum requirement level from which the actual time consumption may differ as the allocative factors allow for the achievement of a more (or less) favourable requirement level. Both approaches of time consumption result in a pragmatic formal description of the allocation process, which can be achieved by assuming that the time consumption functions can be approximated by Taylor series. So essentially the equations below describe the substitution of time to and from housework activities as a result of variations in allocative factors.

To start with, a simple linear specification was chosen, that is:

$$T_i = C_i + \sum_n (\alpha_{in} \cdot AF_n) \quad (21)$$

T_i denotes time consumption with respect to activity i , C_i is the constant term, α_{in} is the parameter related to variable AF_n as regards activity i .

In this form appliance ownership dummies were excluded. In the next step I allowed for possible interaction effects between various variables. Recall (see section 2.4) that some activities are conditioning with respect to the efficiency and effectiveness of other activities. The same notion applies to variables describing the household environment, for instance number of children in relation to number of labour hours. If interaction terms are included (ignoring dummies for the moment) equation (21) should be reformulated as:

$$T_i = C_i + \sum_n (\alpha_{in} \cdot AF_n) + \sum_m \sum_n (\beta_{im} \cdot AF_m \cdot AF_n) , \quad (22)$$

where both α_{in} and β_{im} are parameters and AF_n and AF_m represent both explanatory variables ($AF_n = AF_m$ included).

The inclusion of some interaction variables implied significantly better estimation results in several cases. Finally dummies were added. We could opt for several specification alternatives:

- a. dummies correcting the constant term;
- b. dummies correcting the parameters of one or more variables (including interaction effects);
- c. a combination of a. and b.

Thus in its most general form (c.) the inclusion of dummies results in the following function to be estimated:

$$T_i = (C_i + \sum_n \tau_{in} \cdot D_n) + \sum_n (\alpha_{in} \cdot AF_n) + \sum_n [(\alpha_{in} + \delta_{in} \cdot D_{in}) \cdot AF_n] \\ + \sum_m \sum_n (\beta_{im} \cdot AF_m \cdot AF_n) + \sum_m \sum_n [(\beta_{im} + \mu_{in} \cdot D_{in}) \cdot AF_m \cdot AF_n], \quad (23)$$

where D_n stands for the n 'th appliance dummy, α_{in} , β_{im} , δ_{in} , τ_{in} and μ_{in} are all parameters.

The estimations to be discussed in the next section will have various specification forms. The simple linear form (21), the extended linear interaction form (22) and the extended linear interaction form with dummies (23) occur. The estimations constitute a first more elaborate analysis of the data. Without doubt more analysis is needed.

3.4 Estimation Results

In stead of discussing each equation separately the main structure of this section is formed by the comparison of parameter estimations with regard to two sets of respondents. The first set of respondents contains all respondents who report to be the main wage earner in a household. The second set of respondents contains all respondents who report to be the housewife in a household. Respondents reporting the combination of main wage earner and housewife are allocated to the first group (main wage earners). Within both sets of respondents comparisons are made between the several household types.

In table 1 below the parameter values of the demand function for housework time (TH) for main wage earners from different households are compared. The principal variable to compare its parameter values is labor time (TL). Therefore this variable functions as a kind of reference point at the top of table 1. This implies that at least the parameter values of labor time can be compared. Additionally some comparison can be made with respect to other variables. As can be seen in table 1 the specification of the demand function is not the same for every household type. Of course this limits the comparability of the parameter values, but the parameter of labor time (TL) seems to be quite stable irrespective of other included variables. This stability is only affected if interaction terms involving labor time are included. In case two parameter values are indicated for the same respondent type, these figures represent the minimum and maximum value respectively. The tables 2 to 4 are set up in the same way as table 1, however the subsequent tables

refer to different activities and/or different respondents. In all tables labor time (TL) functions as reference variable.

Table 1. Parameter values of the demand for time for housework (TH) of main wage earners (mwe) from families and one parent households (mwe+hwf)

variable name	mwe family		mwe + hwf 1 par.hh.		
labor time(TL)	-0.59...	-0.64 **	-0.46...	-0.64	.*
age of rsp(AR)			3.15		=
age of chd(AYC)	-0.81...	-0.86 **	-3.46...	-4.2	=.
nr. of chd(NC)	-11.84...	-16.40 **	66.80...	4.9	..
car avail.(CAR)		25.49 *			
TLxNC	1.01		-0.83		.
ARxNC			1.40		.
ARxAYC				0.035	.
CARx(TLxNC)		1.40 *			
Constant	175.4	154.5	96.9	223.4	
R ²	0.37	0.40	0.37	0.34	
F	64.2	50.6	5.6	7.8	
N	430	378	64	64	
TH	93		182		

variable name	mwe couple		mwe + hwf single		
			w	m	f
labor time(TL)	-0.10...	-0.27.*	-0.24	-0.13	-0.25 **
age of rsp(AR)			1.69	1.49	1.78 ***
net hh.inc(IN)	4.41		*		
TLxIN	-0.02		=		
ARxIN	-0.0069		.		
Constant	81.4	118.9	52.3	39.9	62.6
R ²	0.30	0.25	0.43	0.28	0.42
F	18.6	61.0	11.8	8.3	25.8
N	187	180	34	45	74
TH	87		74	79	108

* indicates significance of related variable at 95% level
 = indicates significance of related variable at 90% level
 . indicates no significance of related variable at 90% level

Table 2. Parameter values of the demand for time for food (TF1)

of main wage earners (mwe) and one parent households (mwe+hwf)

variable name	mwe		mwe + hwf	
	family		1 par.hh.	
labor time(TL)	-0.21	*	-0.33...	-0.34 **
age of res(AR)			0.44	.
age of chd(AYC)				0.35 .
nr. of chd(NC)			5.69	.
TLxNC	0.18	*		
ARxNC				0.14 =
Constant	69.25		62.3	75.9
R ²	0.33		0.27	0.27
F	95.7		7.7	7.5
N	378		64	64
TF	46		83	

variable name	mwe		mwe + hwf		
	couple		single		
			w	m	f
labor time(TL)	-0.099	*	-0.101	-0.025	-0.093 ..*
age of res(AR)	0.29	*	1.15	0.91	0.93 ***
net hh.inc(IN)	0.615	.			
Constant	39.7		14.9	17.9	28.4
R ²	0.24		0.40	0.37	0.38
F	19.4		10.1	8.2	21.8
N	187		34	45	74
TF	46		39	41	60

* indicates significance of related variable at 95% level
 = indicates significance of related variable at 90% level
 . indicates no significance of related variable at 90% level

A comparison of the parameter values for labor time in the tables 1 and 3 shows that there is a significant difference between households with children and households without children. These differences are not only attributable to direct claims (of children) on the time of parents but also to substantial differences in lifestyles. For instance singles enjoy their meals significantly more frequent outdoor than adults from families. A second (provisional) conclusion is that labor time seems to be the most important factor as regards time allocation for a given type of respondent. Closely related to this conclusion is the relatively large stability of the parameter values of labor time in the several specifications, irrespective the exact form of the specification.
 Table 3. Parameter values of the demand for housework time (TH)

of housewives with (w) or without (nw) a job

variable name	families			couples	
	w	nw		w	nw
labor time(TL)	-0.70..-0.71			** -0.85	*
age of rsp(AR)	-1.37..	0.67	-1.18	...	
age of chd(AYC)	-3.93..-3.11	-7.33	==**		
nr. of chd(NC)	9.77..	8.19	10.53	***	
net hh.inc(IN)			-0.76	.	4.31 =
dwelling (DW)	-17.26		-12.97	= *	
TLxAR				0.98	*
ARxAYC	0.025		0.094	.	*
ARxDW	0.58..	0.12	0.35	***	
ARxIN					-0.076 *
Constant	270.7	199.1	285.1	188.2	177.8
R ²	0.52	0.51	0.17	0.58	0.05
F	33.3	43.0	12.8	61.1	2.3
N	220	212	445	90	91
TH	193.7		230.6	188.2	177.8

* indicates significance of related variable at 95% level
 = indicates significance of related variable at 90% level
 . indicates no significance of related variable at 90% level

Table 4. Parameter values of the demand for time for clothes (TC2) of housewives with (w) or without (nw) a job

variable name	families		couples		
	w	nw	w	nw	
labor time(TL)	-0.061		* -0.054		*
age of rsp(AR)		-0.21	.	0.019	.
age of chd(AYC)	-0.61		*		
nr. of chd(NC)		-2.94	.		
net hh.inc(IN)		-0.27	* -0.30	0.098	.
dryer (DDU)	1.77	-1.62	..	12.64	*
ARxAYC		0.014	*		
ARxNC		0.12	*		
ARxDDU				-0.257	*
NCxDDU	1.65		.		
Constant	12.6	26.5		17.5	36.9
R ²	0.14	0.07	0.21	0.06	
F	11.3	5.0	11.5	1.3	
N	212	445	90	97	
TC2	13.4	16.6	8.7	13.7	

Apart from labor time (TL), age of the youngest child (AYR) and

number of children (NC) are often significant. However the parameter values of these variables seem to be more sensitive to changes in specification compared to labor time. On the other hand, as interaction effects play especially a role with regard to children, age and dwelling type the larger sensitivity of the related parameter values is no surprise. At the same time the significance of interaction terms in many specifications confirms the theoretical considerations made in section 2.4. However more information is needed in order to be able to construct more reliable models.

Special attention deserves the interaction between labor time and number of children (TLxNC). This variable happens to be significant in several specifications concerning 'pure' main wage earners (table 1 and 2). However in the specifications concerning housewives (table 3 and 4) this variable does not even occur. Here something seems to be revealed about the preponderant decision process concerning division of tasks in a household. The main wage earner (to date still almost exclusively men) has a (full time) job, irrespective (and usually prior to) the presence of children. The housewife, on the other hand, tries to find a (part time) job given the presence of children. Consequently more children implies an extra claim on the time budget of the main wage earner, which may increase the 'time tension' in case of a full time job (as is mostly the case). To housewives, however, the decision sequence is different, they try to find a job that fits to the time claims of the household (notably the children). In other words by trying to find a suitable job housewives preclude significant interaction effects.

The importance of age of the respondent (AR) becomes not completely clear. The variable appears to be mainly significant in relation to the time consumption of singles (and couples once). Moreover the reported parameter values indicate quite a strong impact from aging compared to the indications of other studies (see among others Aldershoff and Baak, 1986). It is beyond doubt that this study as well as other suggest a positive relation between age and time consumption for housework activities (up to a certain age), but the values in this study seem too high. Further study concerning the impact of aging will be necessary.

Remarkable is the almost complete insignificance of housework appliances, e.g. dishwasher, dryer, etc. In some cases the sign of the parameter is not what might be expected. An explanation for this insignificance and unexpected sign is the fact that quite some appliances are bought because time consumption with respect to the related activity is already high. Although the appliance will save some time the resulting time consumption with respect to that activity remains high compared to the sample average. As regards time saving behaviour more might be unveiled if additional information about accurately measured incomes or preferably accurately measured wage rates became available.

Finally the poor results for non-working respondents (table 3 and 4) are remarkable. Additional research concerning the sensitivity and the mutual consistency of the specifications indicated that for housewives from couples as well as from families the specification for working respondents behaved quite well if applied to not working respondents. Apparently the sample selection bias seems to be not very strong in these subsamples.

For retired respondents (results not displayed here) the estimation results were very poor. This seems to be in line with the conclusion in section 3.2 that retired persons show a rather leisurely way of life (provided they are physically able) caused by the absence of most scheduling stimuli. Hence personal variations in time consumption dominate the picture and consequently little remains to be modeled.

4. Conclusions

The analysis of time allocation behaviour confirms the idea that there are structural differences between the household types distinguished in this study. Different household types imply different concepts of division of work within a household. In other words roles get a different content if the number of adults or the number of children alters. This change of role content also applies to the transition to retirement. In terms of modeling the presence of these structural differences means that it is sensible to include interaction terms.

Labor time appears to be the most important factor in the time allocation process. To a lesser extent number and age of children and age of respondent show also significant influence. These conclusions are in line with former studies (Szalai, 1972; Knulst and Schoonderwoerd, 1983). New is the fact that this study provides a quantitative indication of the impact of labor time, number of children, etc. on the time budget for housework.

Although this study provided some reasonable estimations, notably for labor time, further research based on more advanced specifications is necessary. For instance it is unlikely that individuals will swap time from housework activities to other activities in a strict linear way. It is more likely that individuals will first try to consume their time more efficiently (cutting away slack). Next they may try to swap time more or less proportionally to a new activity e.g. paid labor. If still more time is needed for the new activity the individual probably has to cut down relatively much of his leisure time, because saving more on his housework time would affect essential tasks. This illustration implies the idea of a kind of necessity piramide for several classes of activities resulting in a kind of reverse saturation curve with respect to the relation between housework time and paid labor.

It is rather premature to draw already conclusions at this stage of the study. Nevertheless it will be clear that the expected rise of the participation rate of women as well as the expected increase of the share of one parent households and singles in the household population may be expected to bring about a decrease in the average time allocated to housework. On the one hand the required time savings may be achieved by using more appliances. On the other hand a further penetration of ready-to-consume outdoor services is likely as well. As a consequence the annual electricity consumption of households might increase not as much as might be expected. However the combination of social and economic changes is quite likely to cause substantial shifts in the timing of the use of particular electric devices.

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Appendix A

1.A Description of the Sample

The data used for the OLS-estimates are based on a sample among 2730 households in the Netherlands in 1980. In each household one respondent¹¹ was requested to keep up a diary of activities during a week. For each quarter of an hour the respondent had to register what has been his principal activity. Two databases were derived from the sample, one containing the time allocation per week for each activity per respondent and another containing the sequence of activities from quarter to quarter per respondent. Of course both data bases contain additional information about the economic, social and cultural status of the respondent¹².

The sample does not reflect exactly the composition of the Dutch population in 1980 in several respects. Compared to the CBS population statistics women are overrepresented in the sample. The same applies to pensioners (65⁺). On the other hand the age class of 21 - 34 years as well as the unemployed are underrepresented groups. All these features correspond with the high rate of absence during the daytime of persons with a job. The misrepresentation of several groups causes no harm to the analyses per group. Clearly nationwide averages should not be based directly on sample means.

The sample distinguishes 169 activities¹³, which are grouped together in 10 main activity groups, that are:

1. paid labor;
2. housework (preparing meals, cleaning, gardening, etc.);
3. childcare;
4. shopping;
5. personal care;
6. school, education;
7. church, politics, societies, trade unions, etc.;
8. leisure ('passive'), social and cultural activities;
9. sports, leisure ('active');
10. communication (talking, reading, mass media, keeping up the diary).

As this paper is a contribution to a study about the utilization of the public electricity network, we will concentrate on activities requiring electricity. Almost all appliances in home using substantial amounts of electricity are related to housework. Important exceptions are the central heating pump,

¹¹.The required minimum age was 12 years.

¹².A full scale report of the analysis and the results is presented in Knulst and Schoonderwoerd, 1980.

¹³.Reading a newspaper or a magazine is considered here as one activity. However each newspaper and magazine is counted separately in the original study.

lighting and the television. However only the last appliance is subject to a more complex choice behaviour. The momentary electricity consumption of a central heating pump and lighting are largely determined by weather conditions and the presence (or absence) of the household members. Within this framework we made a new grouping with respect to housework. The new main activity 'housework'(TH) includes housework(2), shopping(4)(excluding medical aid), childcare(3)(as far as applicable) and meals at home(from 5). Also travel time related to the included activities is taken into account. The new main activity housework (TH) is subdivided into:

- time for clothes (TC1, TC2 incl. outdoor laundry);
- time for food (TF1, TF2 incl. restaurants);
- time for dwelling (TD1, TD2 including related traveltime);
- time for shopping (TS, all travel time related to TH);
- time for children (TM1, TM2 incl. other household members).

Estimations were carried out with respect to TH, TC2, TF1, TD1, TS and TM1. For all activity subgroups outdoor related activities were excluded with the exception of time for clothes (TC2). The reason to choose TC2 instead of TC1 is that this is the only activity where the outdoor part will generally lack any leisure component. In the present study the adopted classification of activities has not been tested on seperability. However compared to other studies the adopted distinction seems to be valid (see among others:Aldershoff and Baak, 1986). The estimations were carried out for several classes of respondents. Respondents were distinguished by role in the household, composition of the household (number adults, presence of children), age (over and under or equal to 62) and sex (in case of singles and retired persons). Applying these criteria resulted in the following subsamples:

- | | | |
|-----------------------|---------------------------|-----------------|
| - retired singles | - male | |
| | - female | |
| - retired couples | - male | |
| | - female | |
| - non-retired singles | - male | @ ¹⁴ |
| | - female | @ |
| | - working | @ |
| | - non-working | |
| - non-retired couples | - main earner | @ |
| | . with working spouse | |
| | . with non-working spouse | |
| | - housewife | |
| | . working | @ |
| | . non-working | @ |

¹⁴. The estimation results concerning the subsamples marked with a '@' are displayed and discussed in section 3.4 .

- one-parent household - main earner+housewife @
- families - main earner @
 - . with working spouse
 - . with non-working spouse
- housewife . working @
 - . non-working @

By subdividing the respondents according to the classification above we overcome the technical estimation problems created by discontinuities and/or large clusters of observations at one value with respect to some explanatory variables (sample selection bias). Several subsamples (e.g. children) have been left out due to insufficient observations and/or lack of homogeneity. Notice that respondents from the last three household types are distinguished by their role while the respondents of the first three household types are distinguished by sex. There are two reasons for this different treatment. In the first place singles are automatically registered as main earner+housewife and thus the criterion 'role' does not make sense here. As other studies indicated a significant difference between males and females 'sex' was chosen instead of 'role'. However to maintain comparability between the retired singles and the retired couples this distinction was also chosen for retired couples. Moreover the relation between earnership and hours spent to a (present) job hardly exists in the subsample of retired couples. On the other hand 'role' has definitely more profile in the last three household types. Besides one has to be more careful to identify role and sex with respect to these household types. Although at present this identification seems to be still more or less valid. This correspondence may be expected to decrease in the future.

2. The Included Variables

All dependent variables represent time consumption with respect to housework as described in the preceding section (TH, TC2, TF1, TD1, TS, TM1). The explanatory variables concern age(2x;respondent, youngest child), labor time, number of children, sex, net household income, dwelling type, car availability, presence of appliances, domestic help and interaction terms.

The time consumption (including labor time) of the respondents is measured in quarters of an hour per week. Domestic help is measured in hours per week. Age and number of children are also measured in their original observed value. Income and dwelling size are represented by indexvalues. For income each indexnumber represents an interval of Hfl.500,- of net household income. The dwelling index indicates the dwelling type. The classification of dwelling types may be identified to a large extent with dwelling size. However contrary to the income index there is no

clear cut linear relation between size and index. Car availability is expressed in an index ranging from 1 to 4 indicating descending availability (from an own car to no car). The presence of household appliances as well as the sex of the respondent are expressed by means of dummy variables. A complete overview of variables and variable names (abbreviations) is presented in table 1 .

table 1. Variables and variable names used in the estimations

Description	Abbreviation
- time for housework	TH
- time for clothes	TC2
- time for food	TF1
- time for dwelling	TD1
- time for shopping	TS
- time for children	TM1
- labor time of respondent	TL
- domestic help	TDH
- age of respondent	AR
- age of youngest child	AYC
- number of children	NC
- net household income	IN
- dwelling type	DW
- sex of respondent	SX
- car availability	CAR
- washing machine dummy	WDU
- dryer dummy	DDU
- dishwasher dummy	DSDU
- freezer dummy	FDU
interaction terms	
- labor time * age of respondent	TLxAR
- labor time * number of children	TLxNC
- labor time * net hh. income	TLxIN
- age of resp. * age of youngest ch.	ARxAYC
- age of resp. * number of children	ARxNC
- age of resp. * dwelling type	ARxDW
- age of respondent * net hh.income	ARxIN
- age of respondent * dryer	ARxDDU
- number of children * dryer	NCxDDU