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## Staff Papers Series

# MODELING THE VALUE OF HOUSEHOLD PRODUCTION AND LEISURE TIME: AN HISTORICAL DEVELOPMENT 

by<br>Jean Kinsey

## 4

## Department of Agricultural and Applied Economics

# modeling the value of household production and 

 LEISURE TIME: AN HISTORICAL DEVELOPMENTJean Kinsey<br>May 1986

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# MODELING THE VALUE OF HOUSEHOLD PRODUCTION AND 

 LEISURE TIME: AN HISTORICAL DEVELOPMENT
## INTRODUCTION

Over the last century, interest in estimating the value of time spent outside of the labor force has grown as the uses of that information have increased. This time is variously referred to as mon-market time, leisure time or hausehold productiar time, i.e., the time household members sperd producirg goods arid services for their own cornsumptior.

This paper starts with a brief gevview of how the value of non-market $t i m e$ has proved useful for varieus ecoriomic analyses. The definition of household production, its relationship to the value of time, arid how household time has been varicusly valued is reviewed rext. Ther, methods for estimating the opportunity cost of time in agricultural household models is discussed followed by applicaticins af household ecomomics models for studying the value of travel time arid recreational facilities. A brief discussiarn af the research frontiens for valuing household time and for irocrporatirg it into other ecomomic analyses comclude the paper.

An early, major impetus for estimatirig the value af time spent producirg goods ard services in the household came from efforts to document how much househald production iricreases the welfare of individuals beyond that indicated by their iricarnes and, of nations, beyord that iridicated by their grass natigral product (GNP). Adding the value of househald productiari to the

```
value of market gogds was found to alter the measured
distributior of welfare among households arod amorig maticirs.
Interhousehold and intemmational comparisoms af "livirg
standards" fostered interest ir studies of household time
allocation which date back to at least 1915 (Eailey, 1915). Ir,
that same era, economists at the National Eureau Gf Ecomomic
Research (NEER) began estimatimg the value of household
production time in order to determime now much it would imorease
the matigm's gross maticmal product (GNP) (Murphy, 1980;
Mitchell, 19こ1, 19Eこ). Similar studies coritirue to be darie
arourid the world (Mourphy, 1980; Chadeau, 1985).
    Determinimg the value of rionlabor force time has
subsequeritly proven useful for analyzirg its impact on the demamd
for market gocds, the supply of labor, arid irvestmerits iri humar,
capital. Estimatirg the value of services lost by disabled or
deceased household members has been essential for insurarice
settlements and other litigation. The value of productive
services in ard cut of the labor market has also been used in
valuing humam lives for various types of benefit cost analyses.
The value of household producticim is gemerally measumed by the
value of the producer's time, a symoriym for the value of the
labor input. Whether one is iriterested in the tatal value af
household production, or the value added by household labor, or
how the value af time affects its allocatiom arid the subsequert
demand for purchased imputs, determiries haw the value of time is
most appropriately measured as well as the data requiremerits.
Four gerieral methods far valuirg household productigin time have
```

beer, used: (1) the value added approach, ( B ) the market cost af replacing the nousehold member's time with a gerieral domestic worker, (3) the market cost of hiring a specialist to perfarm each of the nousehold furictions for the same lemgth af time it would have been performed by household members, arid (4) the opportunity cost of foregone activities.

Critiques of each approach are fourd ir Murphy $(1980$, 198こ): Hawrylyshyn (1976); Chadeau (1985); Zick arid Eryarit (1983); and Galdschmid-Clemmont (1983a, 1983b). Galdschmid-Clemmerit (1983b) and Murphy (1980) bath include extensive reference 1 ists ard review studies measurirg the value of household time. All of the above four methods have beer widely used, but ecomomic and ecomometric models for estimatimg the opportunity cost of $t$ ime as a functicor of the value of margiral productivity in the labor market were mat farmalized until the 1960s. Mincer (1963) and Eecker (1965) brought consideration of the value of time irito the mainstream of ecomomic thought and analysis. Variations of the Eecker (1965) model have been applied to studying everythirg from the domestic food demand to the impact of agricultural policies in developirg countries. A large branch af the literature focuses ar the supply of (female) labor (Smith, 1980). Numerous studies have analyzed the impacts of various sacio-demegraphic characteristics on the value and allacation of time (T.W. Schultz, 1974; Binswanger et al., 1980). Others have estimated the demand for investments in humari capital (Reserizweig, 1976, 1977; Roserizweig and Schultz, 198E; DeTray, 1974; Michael, 1974; T.P. Schultz,

1980b). These applied studies have rarely piorieered mew methods for valuing time arid will mot, therefore, be systematically reviewed here.

The literature or the value of time and its relaticiship to household production is vast, scattered, and ranges fram highly technical articles to heuristic arguments. That which is reviewed in this paper is representative, nat comprehersive. Extensive reference lists which appear irn other works are identified but rict reproduced.

## HOLSEHOLD PRODUCTION

Although attempts to defime household production cam be fourd ir the 1 iterature priar to 1934 (Ardrews, 19Е3:393; Richards, 1917:Es), Margaret G. Reid's discussiams and definitions have proved to be widely useful (Reid, 1934). Early defiritions of production that required a persor to labor arm a material good and somehow change its form were iriadequate far households simce they elearly produced both material gacds arid services. Yet, production defired as the creation of utility proved equally inadequate arid hopelessly gemeral iri applicatior. Thus, Reid posited the definition af household productiar as:

> ". ". those umpaid activities which are carried Gri by ard for the members, which activities might be replaced by market goods or paid services, if circumstarices such as income, market comditiors, arid persomal inclimaticrs permit the service beimg delegated to someore outside the household group" (Reid, $1934: 11$ ).

This arnitted fram hausehold praductigu: (1) thase activities where the experience or the process increases utility directly
and (e) those activities deemed to be perscial. Eath persarial and experience activities are ores that must be performed by omeself or with a particular other person in order to yield utility. For example, playing with ore's own child may yield direct utility while playing with other children may be viewed as producing a service.

It is importarit to distinguish betweer the value af household producticir and the value of time. The full value of household praduction is the morietary value af the utility received from the cammadity praduced. It includes nat arily the value of labor time plus the cost of purchased goods but carisumer surplus realized in consumption. When household members produce commodities for their owr consumptior, the commodity's value equals the househalds" willingress to pay for it includimg the value of their time. As in evaluating the demand for market goods, this willingriess to pay can be measured by the total area urider the demand curve up to the quaritity consumed. Assurnirig household commodities are normal goods with dowrward slepirg demand curves, the total value of cormadities produced ir the household (labeled $Z$ ) can be ideritified as area oabc in figure 1. If $Z$ were purchased in the market at price $p *$ the area dab would represent corsumer surplus, or the value af utility received over and above the money experditure. If $Z$ is produced and consumed in the same home, $p^{*}$ represerts the "shadow price" of production which is the value of the time plus the cast af goads that were nat used to produce altermative cammodities
(Fetter, 1Э1已). The "shadow experiditure" for quaritity $Q^{*}$ of $Z$ is area odbc; the total (utility) value still exceeds the experditure by area dab. 1

In practice, the full value of hausehald produced ard consumed commodities to the user (area oabc in Figure l) is rut measured; rarely is the full shadciw experiditure measured. Amomg the reasans for this is the difficulty af identifying the separate household produced commodities arid, therefore, ar inability to estimate their demand ar supply. Alsc, allacatirg the same period of time to the productigu of more tham ore commadity leads to joint production. This makes determiring the separate costs of irputs into each commodity very difficult to estimate. What is left, is measuring the value of the time used to produce and comsume composite household commodities. This will be some portior of area odbc and can gererally be expected to underestimate the value of household productior. Haw its value has been variously measured and modeled is discussed riext.

MEASURING THE VALUE DF TIME

## Value Added

The value added method is canceptually corisistert with adding the value of household productian to the GNP sirme the value of most market (purchased) goods is already courited ir the national iricome accounts. This method involves ideritifyirg the price of the home produced commodity if it were purchased in the commercial market ( $P_{z}$ ), subtractirg the cost of purchased iriputs $\left(\sum_{i=1}^{n} r_{i} x_{i}\right.$ ) leaving the value of the housenald services (VHS) ir


FIGURE 1. DEMAND FOR HOUSEHOLD COMMODITIES
the production of commodity $z$.

$$
\begin{equation*}
\mathrm{VHS}_{z}=P_{z}-\sum_{i=1}^{n} r_{i} x_{i} \tag{1}
\end{equation*}
$$

where $r_{i}$ is the price per unit of imput $x_{i}$ used to praduce cire unit of commodity $z$. To determine the wage rate, $\mathrm{VHS}_{2}$ is summed over all commodities and is divided by the number of hours spent producing those commodities $\left\langle\sum_{z=1}^{m} t_{z}\right.$ ) in a specified time period.

$$
\begin{equation*}
W=\sum_{z=1}^{m} \quad V H S_{z} / \sum_{z=1}^{m} t_{z} \tag{2}
\end{equation*}
$$

The value added method was used ir an early study of Iowa farm households to measure the value of praducing facd for hame consumptior. The value of time was determined by valuirig the food products at their retail price, subtracting direct production expenses, and dividing the riet value added by the number ef hours spent praducing the food (Reid, 1943:1こ4). The value of this time was found to average $G 3$ cents per hour ir agmicultural households in the early 1940 . Volker ard giveris (1983), using the value added method, fourid the value of time spent in preparing purchased foad for home consumption to be出. 17 per hour in umban households in the late 1970s. This implies a real imorease in the value of focd preparatiam time of about $\$ .24$ or 12 percent since the 19405. Volker arid Eivens valued home produced meals at the average cast af meals eaten away from home. Subtractimg the dollar cost af the purchased food left the value added by capital goods, iritermediate gouds (e.g. energy) and labor and management. Ir that study, regressicir analysis was used to determine the praportior of the value added by each of the three irputs with tine representimg the labar and
management imput. Hill (1985) discusses this method arid measures the value added in several home improvement projects usirig data collected in the Panel Study af Iricome Dynamics by the Survey Research Center at the University of Michigar.

The value added methad is the least used method af valuing time partly because it requires large amourits af micro-data on the iriputs arid outputs of household praduction activities and their equivalent market prices. Sanik and Stafford (1983) argue these prices are mo mare difficult to firid thar various alternative wage rates reeded for other methods. Iri addition, massive time use surveys provide much of the meeded input arid output data (Walker ard Wocds, 1976; Family Time Use, 1981; Szalai, 197ق). Goldschmid-Clermorit (1983a) argue that the value added method is arie way to price the outputs af household production as opposed to just the value of time -- ore of the imputs. Nevertheless, the erormous detail irivolved has left this method imoperative. Studies designed to estimate the value of household services as a portion of GNP rarely, if ever, use this method even though it is conceptually correct (Murphy, 1980:176).

Peskin (198こ) discusses the market amd opporturity cost methods of valuing household work as a portion af GND. She fourd that in the United States in 1976 gereral domestics wages valued household time $e 8$ percent less than specialists' wages. Specialists, wages yielded about the same valuation as the opportunity cost measured as net compensation (after tax income minus work related costs).

On average the total value of household work was fournd by Peskin to equal 44 percert af the 1976 U. S. GND. This compares favorably to estimates by Murphy (198き) arad Nomdhaus arad Tabir (1965) who each found 47 percent. Earlier studies (Mitchell, 19е1; Reid, 1947) foumd the value of household wark equivalent to ES-31 and 20-EE percent, respectively, of U.S. GNP. These are consistent with studies in European couritries. Adler arid Hawrylyshym (1978) found the value of housework to be 40 percerit of Canada's GNP. They also found no trend irithis ratio aver time and that addirg the value of housewark to GNP did mat affect the general pattern of ecomomic growth ir, Carada. The cortribution of household production to GNP is gererally expected to be higher iri the developing world. Kusric arid Davanag (1980) fourid, however, that the value of household activities increased Malaysian household's money income by only 33 percerit.

## Market Cost

The two market cost methods of valuing household productiar time use the cost of substituting hired labor for household labor. There are two primary methods af determiririg the costs of hired household labor. One is to use the wage rate of a general housekeeper who performs a variety of household tasks for the same rumber of hours required by hausenald members. This may be written as the (ammal) value af a household's services (VHS) equalling the total number of hours sperit (per week) producing household goods or services that could be
purchased in the market ( $\sum_{z=1}^{m} t_{z}$ ) times the wage rate of general domestic labor ( $W^{d}$ ) times $5 \Xi^{\text {. }}$

$$
\begin{equation*}
\mathrm{VHS}=52\left(\sum_{z=1}^{\mathrm{m}} \mathrm{t}_{\mathrm{z}}\right) \mathrm{w}^{\mathrm{d}} \tag{3}
\end{equation*}
$$

The primary advantages of this method are its simplicity ard its approximation to reality. Little data on inputs arid outputs is needed and the experience of hiring a sirgle person to perform a plethora of household tasks is quite commar. Although it underestimates the value of managerial skills, it avaids the problems of rori-jairt productiar and double counting irivalved in the market cost method using specialists' wages. It generally yields the lowest overall value of household services among the latter three methods, mairily because the wage rates for uriskilled domestic workers are relatively low.

The second market cast methad requires determining how many hours household members spend on various productive activities and substituting the market wage rate of a specialist in that activity for the same number af hours. This may be written as the annual value of a household's services being equal to the sum of the weekly hours spent in each activity ( $t_{2}$ ) $t$ imes the wage rate for a specialist in that activity ( $W^{5} z^{\prime}$ ) times $5 \Omega$.

$$
\begin{equation*}
\text { VHS }=52 \sum_{z=1}^{m} t_{z} W_{z}^{s} \tag{4}
\end{equation*}
$$

An obvious upward bias exists if the productivity of hired specialists is greater than that of household members. Alsc, the specialist approach does not allow for the possibilities af joint production which can be accomplished by the generalist or the


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household member. For example, the gereralist might praduce clear windows and clean clothes ir the same hour whereas a specialist in lauridry would probably not wash wiridows.


#### Abstract

Gpportunity Cost The third major appraach to valuirg household praductiGri time is by its opporturity cost -- the actual ar poteritial labor market earnings foregone while working ir the household. Murphy (198こ) argues that the theoretically correct valuation of the apportunity cost is the average ret wage. After tax comperisatigri mirus work related costs comes clase to this net wage. Ir practice, total earned income (gross or met) is simply divided by the number of hours worked to determire the opporturity cast far those who are ir the labor force. Empirical problems with this method arise when people mismeport their irncome arid/ar report the stardard work week as the rumber of hours worked rather than the actual hours worked. Nevertheless, it is fairly stardard procedure. For those who are not in the labor force a wage rate must be imputed. Techmiques for dairg this are provided by economic hausehold praduction models, discussed in a later sectiom.


The opporturity cost method assigns a sirgle wage rate to all activities. A single wage rate is thearetically justified by assuming every individual is able to freely allacate all their time between working in the labor force, workirg at home, ar taking leisure. With mo constraints orn how time is used or the sequencing of activities, the ratiaral persom will allacate it so
that the marginal utility from the last units of time are equal in all activities and, therefore, equal to a sirgle wage rate. Reid (1943) pointed out that equal amourits of nourly labor may have quite differerit opportunity costs. Tasks that can be dore in slack periods or are flexible as to the time of the morith, week, or day, are likely to involve lower costs thar, tasks which must be performed at or for a fixed time. Winsten (198こ) specifically modeled the timing of household activities within a household production framework. Both the optimal duration arid sequencing of aetivities can be determined by his model, but they still depend on an exogenous, single wage rate. Attempts to fird various wage rates include the work of Haroch (1980) who proposed a utility function with two kinds of leisure tine, one for weekdays and one for weekends. Other models that define various opportunity costs are generally variations of the work by DeSerpa (1971).

Since individuals certairily do not value each and every unit of their time equally, serious errors are probably made when the imputed (or even the actual) market wage rate is iriterpreted as the individual's subjective value of $t i m e ~ i n ~ a l l ~ a c t i v i t i e s . ~$ Other problems arise when the opportunity cast of an individual's time (i.e., their wage rate) is interpreted as the value of household productior. The value of commodities produced will be greater for persons with higher market wages than for those with lower market wages even though the latter may be more efficient (Hill, 1985:EO6-20日). The market wage rate generally underestimates the marginal productivity of household time unless orie


#### Abstract

assumes constant returns in the produetion of household commodities. Or the other hard, Graham and Green (1984) argue that the market wage averestimates the value of household production, primarily because of significant joint production in the household. Deacon and Sonstelie (1985) provide some insight irito now individuals subjectively value their time, at least, while waiting in lines. They found the subjective value of time was about equal to the after-tax wage rate except for very law income persons in which case the subjective value of time was higher than the wage rate.


## Time Surveys

Household time allocation surveys have not focused primarily on determining the value of nousehald time, but they have collected irivaluable data that allews that value to be estimated. Among these studies is ane by Varneck (1974) in the United States and an iriterrational comparison by Szalai (1975). Walker and woods (1976) provide a tome of information about household time allocation, including a compreherisive reference list of U.S. household time studies done between 1915 and 1975. A major regional project undertaken in 1977 by 11 of the U.S. agricultural experiment stations established a data bank of urbari and rural families' use of time (Family Time Use, 1981). Out of over 150 maruscripts resulting thus far from that regional project, seven of them indicate by their title that the data was used to estimate a value of time. Four of these are authored or coauthored by Bryant (Zick and Eryarit, 1983; Eryarit arid Zick,


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1984a, 1984b; Eryarit, 198玉-83). The others are by Gauger arid Walker (1980), Goldschmidt-Clermorit (1983a) and Simmoris (1984). E The methods for valuing time in the studies mentioned above vary. Gauger and walker (1980) used the market wages of specialists, Zick and Eryant (1983) estimated the opparturity cost, and Goldschmidt-Clemmont (1983a) used the value added method to value household output. Zick arid Eryart (1983) compared their estimated apparturity cost ta the wage rate obtained by Gauger and Walker (1980) for the same set of households. They found that the opporturity cost is gemerally higher than the market costs af specialists. For example, the market method found an hourly wage for uriemployed New York wives with their youngest child age one to be $\$ \mathrm{O}_{\mathrm{C}} .99$ compared to ar opporturity cost of $\$ 3.74$. In all cases, the opporturity east (estimated as the reservation wage) was lawer for employed wives than for unemployed wives, supportirg the thearetical prediction that the market wage uriderstates the value of the infranargirial urits of $t$ ime spent in household production.


## ECONDMIC HOUSEHDLD PRODUCTION MODELS

Studies which employ the apportumity cost of valuirg time, qenerally have their theoretical roots in ecomomic household production models based or "A Theary of the Allacaticm of Time" by Gary Eecker (1965). This theoretical framework was dubbed the "mew home ecoriomics" by Nerlave (1974). It is also known as the "new household ecomomics." It has spawred rumerous hausehold productiar madels.

In these models, time is treated as an argumerit in the utility function, as a comstraint an utility maximizaticur, ard as the labor input into the production of household commadities. Eompowing from reaclassical labor economics, it is generally assumed that utility increases with "leisure time" arid does nat imcrease with work time. 3

The fundamental properties of this approach car be illustrated formally as follaws. Utility is a furnction (s) af commedities produced by the household $\left(Z_{i}\right)$. Each commodity has a praduction function (6) that depends an a vector af purchased inputs $\left(X_{i j}\right)$ and $t i n e\left(t_{i}\right)$.

$$
\begin{align*}
& u=u\left(z_{1} \ldots z_{r_{1}}\right)  \tag{5}\\
& Z_{i}=f_{i}\left(x_{i j}, t_{i}\right) \tag{E}
\end{align*}
$$

where $X_{i j} i s$ the $J$ th purchased input used to produce the $Z_{i}$ th commodity, $i=1-m$ commodities and $j=1-m$ purchased inputs. Substituting (6) into (5) results in restating utility as a function of the production technology (7).

$$
\begin{equation*}
u=v\left(f_{1} \ldots f_{r_{1}}\right) \equiv v\left(x_{1 j} \ldots x_{n j}, t 1 \ldots t_{r_{1}}\right) \tag{7}
\end{equation*}
$$

Ir Eecker"s ariginal madel utility is maximized subject to a full imeome coristraimt which is the sum of expenditures on goods and services used to produce the $Z_{i}$ th commedity plus the value of all nomlabor force $t i m e$ ( $t_{i}$ ) measured as the number af non-labor firce hours times a constant wage rate (w).

$$
\begin{equation*}
I=\sum_{j=1}^{m} \sum_{i=1}^{n} P_{j} x_{i j}+\sum_{i=1}^{n} t_{i} W \tag{8}
\end{equation*}
$$

Simce experiditures require momey which is presumably
earmed via labor time, $\sum_{j=1}^{m} \sum_{i=1}^{n} P_{j} X_{i j}$ equals the value of $t i m e$ in
the labor force or $t w W$ plus ariy uriearmed income (A). Ari alternative way to write equation ( 8 ) is

$$
\begin{equation*}
I=A+t_{W} W+\sum_{i=1}^{n} t_{i} W \quad i \neq w \tag{9}
\end{equation*}
$$

This assumes that total time (T) is divided betweer the labor farce ( $t_{w}$ ) arid the productiom of household commodities ( $t_{i}$ ) orie of which is "leisure time," more appropriately called "rest arid recreatior". Therefore, the full iricorne coristrairt equals the rumber af hours ir a day times the wage rate (TW) plus asset imome. If ame chocses to spend some time rot workirg far wages, the morey income farfeited measures the opporturity cost af obtairing utility from alternative activities. The $t$ ime sperit rot workirig for wages increases utility because: (a) it is used tg produce commodities iri the household for members' own carsumptiar, or (b) it is experience or persoral time accordimg ta Reid's classic definitiar (Reid, 1934).

In mast of the empirical work utilizimg hausehald productiar madels, leisure time has roct beer explicitly valued or iricluded ir, the full income corstrairit but it gerierally appears as an argument in the utility functigm. This allaws the construction of an indiffererice curve representing preferemces between leisure time ard commadities which further allaws the aptimum allacation of time to be determined, given the productiom possibility set. Time spent producing household commodities is ther valued at a market (or imputed) wage rate equal to the margiral utility of the last unit of productive hausehold time. Sametimes household production time has been lumped tagether with leisure, as ir regclassical theory, ard excluded from full
iricome. At amy rate, somethimg less tham Eeckergs full iricome
carstrairit appears in most empirical applicaticis af the thegry.

## Agricultural Household Models

Applicatigns of the new hausehald ecoromics madels have proliferated amorig agricultumal amd developmerit ecomomists. This is due, ir part, to the appropriateness of these models for explairimg the production activities of households which emgage ir their own small busimess or farming erterprise. Several models have been developed to arialyze the behavior of subsisterice fammers in developirg couritries. Ir these madels, the commodities produced by the households are defimed as the agricultural commodities (usually crops), some of which are sold ar the market for money arid some af which are comsumed at home. Im most of these models, maragricultural commodities produced by the household, such as home cooked meals om clean clothes, are rot comsidered at all arid the time spert producirng them is treated as if it were leisure. To those who are interested in the value af commadities produced in the household or in how time is allgcated amorig varicus household activities this may seem uriforturate. However, research studies that did mot require kricwledge about househald productigu activities themselves have praved very useful far studyirg impartarit humarimuritiam arid agricultural policy questians in developing couritries. The earliest of these agricultural househald productior models focused or farm households withgut ar outside labor mamket (Nakajima, 1ЭEЭ; Mellgr, 1ЭEЗ; Sem, 19EG). With these models,


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raisirg the market price of agricultural commadities was after fournd to lead to a decrease iri fammers' productior. This seemingly perverse result accurs because increased output prices increased farmers' income which apparently irmoreased their demand for household gr leisure time. In a model where family labor (time) is the corly variable input to productiori ard ari increase ir irncome decreases its supply, agricultural producticir will likely decrease.

About the same time, models were developed which included a labor market. Farmers could allocate time to offofarm work or hire farm labor ar both. Iri these cases, a rise in the market price of farm products generally increased the demand for farm labor ard that terded to iricrease productior. Such models were discussed by Nakajima (1969) and used by Jerngerisari arid Lau (1969). They formed the basis of mast of the empirical wark that followed. Househald praductiarl ard comsumption decisions were gerierally estimated separately, a corveriemce allowed by assuming a two-stage decision pracess. (1) The decisian ta maximize farm revenue (ar profits) subject to the productior furactiari, and ( $\Xi$ ) the consumptian deaision comsistert with utility maximizatiam subject to moriey income generated by the production process. Same of the first empirical estimates af agricultural hausehold madels af this type (Yatopoulas arid Lau, 1974) were used to study households in Taiwan Yotopoulos, Lau, and Lir, 197E; Lau, Lirı, and Yotopoulas, 1978), Japan (Kurada ard Yotopoulas, 1978, 1980), ard Malaysia (Barmum arad Squire, 1978, 197Эa, 197Эb). A11 Gf these studies estimated households' demarid


for imput (rian-farm praduced) gagds, as well as the quaritity af farm praducts sald ori the maroket arid the amourit retairied for owri cGrsumptigri. Family labers supplied to the farm arid tatal farm 1abor demarided were also estimated as a furictiari of chariges iri autput prices, wage rates, and same family characteristics. Im gerieraly these studies showed that for farm hauseholds that praduced faud im excess af their cmesumptiam meeds, arimarease in the Gutput price resulted iri an imcome effect that gutweighed the price effect. Corisequeritly, while production imereased, Gwri corsumptian imcreased more amd the amourit sold ori the market demlined. The irmarne effect alsa reasulted irimousehold members irmereasimg their" leisure amd nirimg morne autside farm labor. Far thase hausehalds that praduced little ar mame af their awr ficd (Iaridless paør), ari irıcrease iri the autput price gerierally led ta less leisure arid less fagd carisumptigri, diminishirg their welfare. These reesults comtrast with those cbtaimed fram madels Where the allocatigri arid value of time are mat accourited far arid where farm prafits are not allawed ta vary as price chariges iriduce raeallacatiors of laborn (time). These results are impGrtart ta policymakerns irı develapira couritries wha typically Warit ta iriduce farmers to praduce arid seli more farm praducts for urbari corisumers Gr for export. Sirigh, Squire, arid Strauss (forthaamirg) provide a review af studies fram araumd the warld which shaws that the use af hausehold praduction madels yield differerit amd mare realistic results thar madels which igricre the Value af time arid full iricame effects.

Formally, the agricultural household model assumes that utility is a furictian af purchased and/ar home produced commodities ( $X_{i}$ 's) ard leisure time. This is like equatiom (7) with all t's left out except thase used ir leisure time activities. Recall that leisure activities maw include househald production that is not directly related to producirig farm products.

Max $U=u\left(X_{0} ; X_{1}, \ldots, X_{r_{1}}\right)$ where
$X_{0}$ is leisure $t i m e$ and ( $X_{1}, \ldots . X_{m_{1}}$ ) are commodities camsumed by the household. Utility is maximized subject to the full income coristraint (11) where $p_{i}$ represents the shadow price of the $i t h$ commodity.

$$
\begin{equation*}
Y=\sum_{i=0}^{n} P_{i} X_{i} \tag{11}
\end{equation*}
$$

The full irncome coristrairit far an agricultural household is written as (1こ) where $W$ is the wage rate ard $T$ is the tatal time erdownent of fanily members. T.W is the poteritial eammirgs if all time was spent working off the farm and $t w W$ is the value Gf the time sperit working on the farm by family members.

$$
\begin{equation*}
Y=T \cdot W-t_{W} W+\sum_{j=1}^{m} P_{j} Q_{j}+A \tag{12}
\end{equation*}
$$

As in equatigri ( $Э$ ), A is unearned, exogenous irmome. Net revenue from farm praduction is represented by $\sum_{j=1}^{m} P_{j} Q_{j}$ where $Q_{j}$ is positive if an output arad regative if a variable iroput iricludimg hired labar; $P_{j}$ is the respective output price ar iriput cost. With rig aff-farn laborn, $W\left(T-t_{w}\right)$ is the value af housengld arid leisure time. The implicit productiar furnction (13) iraludes awn
farm labor ( $t_{w}$ ), Gther variable iriputs (-Qu), Gutputs $\left\langle Q_{i}\right.$ ), arid fixed imputs (KJ), $i=1 . . . r_{1}, j=r_{1}+1 \ldots . .$.

$$
\begin{equation*}
G\left(t_{w}, Q_{1} \ldots Q_{i},-Q_{J} \ldots-Q_{M}, K_{1} \ldots K_{r_{1}}\right)=0 \tag{13}
\end{equation*}
$$

As lorg as wages and all prices are exogenous, maximizirg utility (10) subject to full income (1巳), ara praduction techrolagy (1J) car be estimated as a separable model. The household behaves as if it maximizes profits subject to productian first arad ther maximizes utility subject to incame.

Househald ard leisure time, as such, imorease utility ir this model and the first order carditiors from utility maximization show that the price of time equals the ratig of the marginal utility of labor (time) in household production to the margiral utility af full income times the marginal productivity af hausehald labor. If the marginal utility of heusehold labar time is assumed to be negative, then (W) is megative ard the shadow price of time becomes an (opporturity) cast. Relatimg this to equatigr (1E), the first two terms an the right -harnd side, $W\left(T-t_{w}\right)$, represerit the apporturity cast af not participatirg ir, the labor market far a wage (Sirgh, Squiree, arad Strauss, farthcoming).

Household productign furgetions. There have beer a few attempts to model ard directly estimate household praduction functigns far commadies mut traded in a commernial market. Ore of the first was by Hymer arid Resrick (1969) who referred to (Z) commodities as moragricultural, mom-leisure activities, such as home care, facd preparation, or child care. They assumed labor ard leisure were mot choice variables ard, therefare, specified
mo value af time im, their madel. Ey relaximg the assumpticm that labor arid leisure are exagenaus, Groriau (1973, 1974, 1977) used similam models to estimate the implicit price of time arnd subsequently the value of household commodities (Grorau, 19日0). He was one of the first to differentiate household production time from leisure time.

A few studies have estimated household productign fumctiors for specific household commodities. Eryarit et al. (1983) and Stafford ard Sarick (1983) estimated production furnctigris for home lauridry ard facd preparatiorig respectively. Huffinar (1976) and Larige arid Huffmari (19日E) estimated farm househald production in order to determine its impact an wives" labor force participation arad the marginal productivity of their time ari the farm. Grorian (1980) proposed a model to estimate household production by estimating the margiral productivity of housewives. This was actually accomplished by estimatirg the rumber af hours spent in household activities which is reasarable as lang as the wage rate equals the value af the margimal household product. Pollack ard Wachter (1975) point out that the prevalence of joint production in the hausehald renders irivalid the estimation of household production functions that assume no jaint production. Hawrylyshyri (1977) propased a household production madel to solve the joint praductiar prablem but did ract attempt to estimate it.

Estimated wane rates. Hausehold praductian madels are used exterisively to predict how labor supplied ta the househald and to the work force changes with changes in the wage rate. Ir
cases where labor is rot bought or sold in the market various estimates of the implicit price of time, called the "shadow" wage or the "poteritial" wage, have been made. Such estimates occupy much of the applied economics literature using the household production theary.

The shadow wage rate at which a household member would be irdifferent between warking in the household or in the labar force is called the "reservatigr" wage. It is the mirimum wage that wauld draw a persan aut af hausehold productian arm inta the labor market. This is most relevant for housewives (or farmers) whose value of marginal product is iritially greater im the household (orm the farm) thari in the labor market. The poteritial wage that ore could expect to earm irn the labor market giver their locatior, education, and other persoral characteristics is often estimated ard interpreted as their (constarit value af time. The estimated poteritial wage may be more or less thar the reservation wage but if it is more, they should (ratianally) be ir the labor market. Figure $\quad$ illustrates the differences.

Curve de ori Figure $e$ represerts the household's production function where $Z$ is the output and $t$ ime is the orily variable imput. Distarice ce represerits the total number of hours available for work per day (or week ar morith). At point (a) the househoid member is indifferemt between warkimg im the home and iri the labor force. The reservation wage rate equals the margimal productivity af time in praducing household commadities (slape of the producticin passibility curve de) at the poirt where it is alsgequal to the marginal rate af substitutiam betweem


FIGURE 2. HOUSEHOLD PRODUCTION POSSIBILITIES AND WAGE RATES
commodities and leisume time (slepe of the indiffererice curve $U_{g}$ ). A hausehald member with imdifference curve Ue would not eriter the labor force at expected wage Pwi which is lawer thari their reservation wage. This would mesult in a lawerimg af utility. They would enter the labor market at poteritial wage Pwe because this would put them on a higher indifferemce curve. Piomeerimg work by Mincer (19E3) and Heckmari (197E, 1979) developed what have become stardard pracedures for estimating potential and reservatiom wages. Ecomometrically, the firnst three steps are similar. First, usimg probit analysis, the probability gf being in the paid labor force is estimated over the ertire sample which includes those who are in the labar farce ard those who are rot. The results of this probit estimate imclude an irverse prabability ratio krawri as the "iriverse Mills ratio," which is used as an explanatory variable in a secand equation that estimates the parameters of a wage equation for those iri the labor force. (Wages are regressed ari various labor market and persorsal characteristics, plus the iriverse Mills ratio). The parameters from this secard equation cars then be used to predict the potential wage rate of individuals (or homogeneous groups) by substituting their particular labor market arad persoral characteristics into the wage equatiori. Iri the literature this estimated poteritial wage has been interpreted as the "implicit value of time" ard used as the wage rate by which househald praductiar and/ar leisure time is valued (Serauer et a1., 1784; Peck, 1983; McCracker ard Erardt, 1986).

Note that the estimated poteritial wage could be higher or lower thar the actual wage for those in the labor force arad it is most certairily lower than the reservatior wage for those wha are mat im the labor force. The model assumes that given the preferemces of those mot in the labar force, the value of their margimal productivity ir hausehold activities exceeds the wage rate they could capture in the labor market ar they would not have rejected it. Agair, Figure $E$ is illustrative. Fom thase who are mot in the labor force, their estimated pateritial wage must be tamgerit to the praductiar furictiori curve (de) to the left af (a). Recall that the wage rate that is just tarigent at (a) represerits the reservation wage.

The reservatior wage can be estimated by a three stage procedure similar to the orie described above. The first three estimatirg equatiors sthe probit, the wage equation, and the predicted poteritial wage) are the same. The results are used ta estimate a labor supply equatiar, which predicts the rumber of hours ome would be iri the labar farce given their potertial wage. TMis labor supply furuction is estimated Gever the eritire sample usirg tabit analysis by regressing hours in the labar force on the predicted wage (from the third equatior of the Heckman procedure), household iricome, arod other characteristics. The reservatiom wage is them calculated from the estimated caefficierts ${ }^{4}$ 〔T.P. Schultz, 1980b; Gibrey, 19日3:7E; Heckmari, 1980). Gibriey (1983) found reservatian wages for mon-labor force participants were greater thar the estimated poteritial wage for bath mer, and wemer. Her firdirgs alang with those af Zick and

Eryarit (1983) are corsisterit with theoretical predictioms af the househald praductiar madel.

Two ather methods af estimatimg a shadow wage are cirie developed by Glsor, (1980) ard an earlier maximurn likelihacid method by Heckmari (1974). The latter is gemerally too experisive to calculate but was presented in McCracker arid Eraridt (19日6). The olsori procedure, which requires brily limear regressiciris has produced results very similar to Heckman's three stage procedure described above. Larige arid Huffmar (198Eb) employed the Olsor procedure to estimate the poteritial wage for men ard wamen in a study of farm and gff-farm labor force participaticim in I owa. Their model of am agricultural household iricluded the joirt productigr of farm and household commodities.

The implications af the chariging value of time grithe demand for commodities produced in the household, their market substitutes, and the form of the productian imputs are vast. Semauer et al. (1985) were able to show that iricreasimg the value of time in Sri Lankan housenolds led to ari iricreased demarid for more coriveniert foods, i.e., baked bread vs. flour. McCrackeri arid Erandt (1986) iri a United States study found that higher estimated poteritial wages lead to imcreased demamd for the mumber af meals eater away from home and increased expenditures at fast food facilities. Expenditures at restaurarits were mot affected. Ari earlier study by Prochaska arid Shrimper (1973) arid a recerit orie by Hull, Capps, arid Havlicek (1983) also showed that imoreasing the value of household time imoreased the demand for fand away from home ard mare camveniert fagd, respectively.


#### Abstract

These studies pairt out the poteritial usefulness af incorporating the value of time into the analysis af demand for gonds arid services. Household production models have already beem used extensively to arialyze the demand for childrem (Gronau, 1977; Earskota and Eversori, 1975; DeTray, 1974, 1980; T.P. Schultz, 1980a; Michael, 1974; Een-Porath, 1974; Hashimota, 1974; Roserizweig, 1977), health care (Pitt and Roserizweig, 1983), arid education (Raserizweig and Schultz, 198き). 5

For all of its mathematical rigor ard rumercus useful applications, estimatimg the value of househald time with mew household ecomomics models is limited because of the meed for detailed micro data and because a constant wage rate is assigmed to all activities. This wage rate represents the gpportunity cost of not workirg in the labor force, if there are mo excogemous time constrairits on individual activities.


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HOLSEHOLD PRODUCTION MODELS WITH VARYING TIME VALUES
Several economists have tried to develop models that allaw for differing values af time to be estimated far various household activities. Much of this work has been darie by rescurce ecomomists interested in the value af time as a cost af usirg recreatignal facilities. Cesarig ard Knetsch (1970) were arnang the first to recogrize the importance of the opporturity cast af time in the demand far outdaar reareation. DeSerpa's (1971) theoretical model has a utility furiction that lacks exactly like the Gne Eecker prapased ir 1965 (Equatiar 7 above). \(\epsilon\) However, DeSerpa assumes that the price af time is endogerious;
```

utility may be received mot amly from the comodities consumed but from the time allacated to the comsumptiar activity. Na specific allacation af time is assumed to yield positive ar regative utility, a priori. Conceptually this is a differert appraach thar that discussed above. In most of the agricultural household productian models only leisure time increases utility; work time is assumed to decrease utility ard it rarely eriters the utility fumctigr. (Excepticms are foumd in studies by Lopez (1982) arad Sussmar (1785).) In the DeSerpa approach, both momey iricome ard the amourit of time are fixed over the decisiar perigd. Orie cammot trade time for momey as in the Eecker model. Ome cam orily reallacate time among differemt production/comsurnptign activities. Sirme there is mo way to irorease the total stack of time, DeSerpa argues that ar absolute value of time has little meaning. The value of "saving time" im orre activity sa it car be tramsferred to arother is mome mearingful and is gre of the outcomes af this model. In this approach, the data are used to determime the subjective value an irdividual places on time sperit ir different activities. This subjective gpporturity cost is measured by the value of time ir alternative activities that could feasibly be engaged iri during a specific time period, mat the value of time in the labor market, i.e., the wage rate. Farmally this approach is to maximize utility subject ta a budget comstrairit (15), a time constrairit (1G), arid a productign furnction (17). Time is the orly variable imput.

$$
\begin{gather*}
\operatorname{Max} U=u\left(x_{1} \ldots x_{r_{1}} t_{1} \ldots t_{r_{1}}\right)  \tag{14}\\
\text { s.t. } \sum_{i=1}^{n} P_{i} x_{i}=Y  \tag{15}\\
 \tag{16}\\
\sum_{i=1}^{n} t_{i}=T  \tag{17}\\
t_{i} \geq a_{i} x_{i}
\end{gather*}
$$


#### Abstract

where $X_{i}$ derates the quantity of the $i t h$ carisumptiar gacd ar activity iricluding rest and recreatiori arid $t i$ denotes the amourit of time allacated to producing arid corsuming the ith gacid ar,  thought of as all uriallacated $t i m e t h a t$ cam be divided amomg m activities iricluding leisure ard labar. $T$ is the firite time eradawment and $a_{i}$ is the technolagically determined minimum amaunt of time required to produce and comsume gme urit of $X_{i}$. As in the household models discussed earlier, time is comsidered a resource by the secard constrairit (16). The third coristrairit (17) is new. In this contrairit time is corsidered a commodity that may yield utility directly. Aryore who allacates more thar the mirimum amourit of time to ariy activity does so because the time spent ar that activity yields direct utility ${ }^{7}$ (Deserpa, 1971).


Maximizatigu irivalves the Lagrangiari (1B) ard first arder conditions which are (19-21):

$$
\begin{align*}
\operatorname{Max} L= & u\left(X_{1} \ldots X_{n}, t_{1} \ldots t_{n}\right)+\lambda\left(Y-\sum_{i=1}^{n} P_{i} X_{i}\right)+ \\
& \mu\left(T-\sum_{i=1}^{n} t_{i}\right)+\sum_{i=1}^{n} K_{i}\left(t_{i}-a_{i} X_{i}\right)  \tag{18}\\
& \frac{\partial U}{\partial X_{i}}=U_{X_{i}}=\lambda P_{i}+K_{i} a_{i}  \tag{19}\\
& \frac{\partial U}{\partial t_{i}}=U_{t_{i}}=\mu-K_{i}  \tag{20}\\
& K_{i}\left(t_{i}-a_{i} X_{i}\right)=0 \tag{21}
\end{align*}
$$

Dividirg $U_{t i}$ by $\lambda$ yields $U_{t i} / \lambda=\mu / \lambda-K_{i} / \lambda$. $U_{t i} / \lambda i s$ interpreted as the margirial rate af substitutiar af time far money in the consumption of goad $i$ and represerits the value af time allacated to the activity of producing and comsuming the ith commodity. It is the value of $t i m e$ as a "commodity" because it is the charge in utility from commadity $i$ due to a change in the amourit of time sperit on it. Iri coritrast, $\mu / \lambda$ represents the Gppartumity cost of $t$ ime as a "resource" used in the praductian and comsumption of gowd (i), i. E. the value of that $t i m e a t i t s$ best altemmative mse. It is the margimal utility of time divided by the margirial utility of maney and may be interpreted as the wage rate as it is ir the (agmicultural) househald models.

Sirice each consumptian activity requires a mirimum amourit of time, relaximg the ith time consumption comstraint is equivalert to saving time irn that activity. Therefore $K_{i}$ is
interpreted as the marginal utility af saving time amd the ratio $K_{i} / \lambda i s$ the value of saving $t i m e ~ i r n a c t i v i t y ~ i . ~$

Either $t_{i}=a_{i} x_{i}$ (the mirimum amourit of time is iri fact sperit producirg arid/or corisumirg $x_{i}$ ) or $K_{i}=0$ implying no marginal utility of saving time im activity i. If the time actually sperit is greater thar the minimum amourit required (tion ${ }_{i} a_{i} x_{i}$ ), $K_{i}$ must equal zero.

More comventignal econamic theories with leisure-income ar leisure-commodity tradeaffs igmame the third time comstraimt built into this model. They assume $K_{i}=0$ for all commodities. If work time is rot in the utility furnction fimplyimg its marginal utility $=0), \mu / \lambda=U_{t i} / \lambda, i . e .$, the value of $t i m e ~ a s a$ resgurce equals the value of time as a commodity arid both equal the wage rate. If the margimal utility of work time is, in fact, negative $\left(K_{i} / \lambda<0\right), \mu / \lambda=U_{t i} / \lambda-K_{i} / \lambda$. This implies that the value of leisure time (as a resgurce $=\mu / \lambda$ ) is less than the wage rate. This model posits a defirition of "leisure" activities as those for which the time-consumptiorn corstrairt (El) is rot birading and consumers spend more time orn the activity tham the technalogically determined minimum.

Since utility carmot be measured irı ary mearingful way, $\mu / \lambda$ carmot be empirically estimated. However, $K_{i} / \lambda$ car be obtained from observable data. It has beer iriterpreted as the value af saving time and, thus, as the "price af time" in varigus activities. Incarporating this time price into demarad furictiars results in being able to show that the time elasticity of demand firn leisure activities is zera (i.e., the demard for leisure
activities does not depend ar the price of time ir that activity). But, the models do mot predict that the demand curves for timemelastic activities will slope downward. Only empirical evidence can determine the outcome. Herein lies one of the problems with this type of model. Different sets of data can yield different, but equally correct, results.

Mary of the models developed for estimating differerit values of time for different activities was mativated by a reed to estimate the demarid for, and the costs ard beriefits of public gocids such as highways or recreational facilities. Clearly it makes a difference whether time on a recreation site is valued differently from $t i m e$ sperit in travel since one could be a cost ard the other a benefit. Including time costs in the final value af recreational facilities was fourd to increase total consumer surplus of recreational activities by four times in a study by Bishop ard Heberlein (1979). This difference was fourd even though time costs were valued at arly half the wage rate and compared to time costs of zerc. Studies by Wilman (1980) and McConnell (1975) showed that beith travel and recreatiari time impose opportunity costs. Wilman argues that recreation is appropriately valued at the scarcity value (wage rate) ard that travel time is best valued in terms of the "value of time saved", i. e. the difference between the commodity and scarcity value of time. 8 Wilman"s model which assumes the number af trips and visits to a recreation site are equal resulted in recreation time (akin to leisure) being valued higher than travel time. However, dropping the assumed equality of trips and visits resulted in



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better thari allawirig the gpporturijty cost ta be a caristarit जre-thirad of the wage rate (Cesario, 1976).

Smith et al. (19日З) pravide a reeview arid evaluatiariaf the propasals far valuirg travel time im mecreaticur demarid madels based gri a hobsehald productigu framewark. They recenfirmithe impartarice of irıcludimg the value af ari-site time as well as the casts of travel iri estimating the demand for reareatiori facilities but reject the idea of treatirig the apporturityy cost as sGme fixed multiple of the irudividual's wage raten A key point is that apparturity costs appear ta be determiried by the time comstraants faced by individuals arid the tatal leisure time they Mave available. The prapased madel treats tatal time available far recreatian as a corstrairit but armsite time as a chaice. Their apparturity cast is a riri-lirear furictiarig wages. This mbdel allows apporturity costs to vary far travel and arisite time arid fur differerit types af recreatiaral facilities.


## THE FRDNTIERS

Clearly a variety of methads have been used to estimate the value of time spent producimg household commodities. Intersive iriterest in determimimg ar apprapriate value has beeri motivated by recognitian that much of the praductive activity ir ary ecomomy takes place ir the housenold arad its value is unaccourted for in rational irncome statistics. Eeirg urable to accurately identify ard value the output of household productior, various models have been developed to value me of its major inputs, namely time. This is appropriate for augmeritimg GNP
since it represerits the value added to market gouds. The value af time is used for predicting and explairirg the supply af labor arid the demarid for market commodities. The value of time is alsa useful for explairimg intrafamily decisions about childrem, education, irivestments in humar capital, and the allocation of humar resources. Ir short, haw people value their time is believed to impact all ecomarnic choices. Determinimg the value af $t$ ime emables researchers to better explain or predict humam behavior.

Major comceptual breakthroughs accurred in the 1930 s with wank by Kymk (1933) and Reid (1934) ard im the l9E0s with werk by Mincer (1963) and Becker (1965). Heckmarıs (1976, 1977, 1980) methodalagies were a major contributiom. DeSerpa's (1971) madel is a Variatigr Gn Becker's, but resulted in rew directicirs far empirical studies. Data collected or household time use have been an irivaluable part of the GVerall research effort (Walker and Wogds, 1976; Family Use Time, 1981).

The frontiers af future work iri valuing household production time and in uses of that imformation lie in: (1) mare extensive applications in demand aralysis, arid (E) better estimates of the value of time in specific activities. The first froritien irivalves using the new household economics approach, includirg the value and allacatiom af time ard the full iricome constraint, for estimating the demand for market gacds and services. Much of the work attempting to estimate the demand far (agricultural) praductigri inputs has used data from developing courtries. In a westermized world where demagraphics are


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changimg dramatically and labor force participation patterns are changing rapidly, the value of time could also go a lomg way towards explaimimg market behavior.

The secard frantien irivalves devel Gping thearetical madels and methadalagies for assigring a shadow wage to time spent in specific activities that more closely approximates the individual's subjective value af time in that activity. The literature is rife with eriticisms of a coristant wage rate (actual or imputed) being used to value all uses af time; arly a few have tried to deal with the problen shart af gairg to the market cost approach. Ir additicor, a clearer distinction reeds to be made between opporturity costs associated with different activities at different times of the day, week, or year ard the value of the marginal product assaciated with househald activity. Everi if the various subjective opporturity costs carm be found, they may mot be close appraximations of the value af the margiral praduct for an individual producirg household commadities. Margimal praductivity is more difficult to defime ard measure because it is determired largely by effort arid skill and other endowmerts of human resources which are difficult to quaritify. Furthermore, it involves identifying individual commedities being produced ard mesurfaces all the problems of Estimating househald productiam functiars. Information and techmalagy alters the margimal praductivity af househald labar  factors meed to be comsidered in models for valuing time if they are to be useful gver the larig ruri.


## FOOTNOTES

1. In the household, the cast of production equals the price af consumptign simce once $Q^{*}$ has been decided upar, $Q^{*}$ in Figure 1 becomes the supply. $p^{*}$ is determined by demarid if the supply (at least of labor) is perfectly inelastic (Gronau, 1973). If supply is infiritely elastic as implied by the common practice of equating marginal arid average wages, $Q^{*}$ arid the expenditure is demarid driver. If, however, household time has dimirishirg margimal productivity, arid the supply curve slapes upward, the valuing of household praductian by area dboc overestimates the cost by the area of producers' surplus, i.e., the value received by the household producer above the marginal shadow cost incurred.
E. Other publications associated with that regiciral project may have estimated a monetary value of $t$ ime but their titles do not reveal it (Publicaticms and Paperns of NE-113, 1986).
2. Leisure $t$ ime is an uriforturate term. "Uriallocated $t i m e "$ better conveys the idea of a finite mumber of hours that cari be allocated to various activities all of which contribute ta ane's utility directly or indirectly.
3. The reservation wage estimate invalves reversing the signs of the estimated parameters ard multiplyirig each by the reciprocal of the estimate on the own wage variable (see T. P. Schultz, 1980b:43-45).
4. A rumber of studies have alsa estimated how various stocks of humar capital impact en productivity arod on the value af time. R. Michael's study of educatiomal impacts is a classic example (197E).
G. Dther models by McCommell (1975) and Smith et al. (1983) have arily a composite commodity arid recreation irn the utility furictiarm Smith, et al"'s madel utilizes the full-imoome cornstraint of the household production model.
5. Related to this poirit is the discussiom by Dow ard Juster (1985) who estimate (utility) berefits derived from the "pracess" of performing activities. Their "process well being" is a furnction af the time spert in ary one activity and a subjective measure of satisfaction derived from that activity.
6. Most studies af the value of time sperit iri commutirg alsa use the "value of time saved" as its appropriate value.

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