

Household Production

A. Overview

1. the standard static model allows for two uses of time – market and non-market time; we will extend the static model to
 - a. allow for different objects of preferences
 - b. allow for additional uses of time
 - c. allow for more complicated interactions of goods and the uses of time

2. we will also discuss
 - a. data on the various uses of time
 - b. how time data are collected

B. Model

1. assumptions
 - a. people have preferences defined over a set of m commodities, Z_1, Z_2, \dots, Z_m such that
$$U = U(Z_1, Z_2, \dots, Z_m)$$
 - b. commodity production functions
 - 1) each commodity is produced with inputs of goods, X_i , and time, T_i , according to the production function $Z_i = f_i(X_i, T_i)$, $i = 1, m$
 - 2) household acts as a small factory that combines raw inputs (goods and members' time) to produce a final product (the commodity)
 - 3) same commodity can be produced with different combinations of goods and time; commodities can be time or goods intensive

- 4) time associated with a commodity includes time necessary for production of the commodity and time necessary for consumption
 - 5) goods and time in this model are intermediary or instrumental factors, not direct objects of preferences—commodities are the direct objects
 - 6) production functions represent a set of technological constraints on the household
- c. time constraint
- 1) needs to be modified to account for additional possible uses of time
 - 2) new constraint is $K = H + \sum_{i=1}^m T_i$
- d. budget constraint is $WH + N = \sum_{i=1}^m P_i X_i$

2. maximization problem

- a. individual chooses inputs of time and goods to maximize utility subject to the technological, time, and budget constraints

$$\begin{aligned}
 \text{Max}_{T_1, \dots, T_m, X_1, \dots, X_m} \quad & L = U(Z_1, Z_2, \dots, Z_m) \\
 & + \lambda \left(W K + N - W \sum_{i=1}^m T_i - \sum_{i=1}^m P_i X_i \right) \\
 & = U \left(f_1(X_1, T_1), f_2(X_2, T_2), \dots, f_m(X_m, T_m) \right) \\
 & + \lambda \left(W K + N - W \sum_{i=1}^m T_i - \sum_{i=1}^m P_i X_i \right)
 \end{aligned}$$

- b. first-order conditions

$$\frac{\partial U}{\partial Z_i} \frac{\partial f_i}{\partial T_i} - \lambda W = 0 \quad \text{for } i = 1, m$$

$$\frac{\partial U}{\partial Z_i} \frac{\partial f_i}{\partial X_i} - \lambda P_i = 0 \quad \text{for } i = 1, m$$

- c. rearranging terms, we can re-express the first-order conditions for each commodity

$$\frac{\partial f_i / \partial T_i}{\partial f_i / \partial X_i} = \frac{W}{P_i} \quad \text{for } i = 1, m$$

- 1) these are the efficiency in production conditions
- 2) people balance the marginal productivity of goods and time against the marginal cost

- d. we can also rearrange terms to examine pairs of commodities; doing this yields

$$\begin{aligned} \frac{\partial U / \partial Z_i}{\partial U / \partial Z_j} &= \frac{\partial f_j / \partial T_j}{\partial f_i / \partial T_i} \\ &= \frac{(\partial f_j / \partial X_j) / P_j}{(\partial f_i / \partial X_i) / P_i} \quad \text{for all } i \text{ and } j \end{aligned}$$

- 1) these are the *efficiency in consumption* conditions

- 2) indicate that people balance the relative time and goods costs in selecting levels of commodities
 - 3) also show that the productivity of times and goods into household production are important components of the implicit prices of commodities
3. effect of a change in unearned income, N
- a. expands entire production possibility curve but leaves relative prices unchanged
 - b. consumption of normal commodities increases; consumption of inferior commodities decreases
 - c. if a sufficient number of commodities are normal, total non-market time increases and H decreases
 - d. however, if a sufficient number of commodities are inferior and time intensive, total non-market time may decrease and H may increase
 - e. this latter result runs counter to the predictions of the static labor model – changes in income may have ambiguous effects on labor supply
4. An increase in the wage rate, W , leads to ...
- a. an income effect as described previously
 - b. changes in the efficiency in production conditions which lead to a substitution from time inputs to goods inputs
 - c. changes in the efficiency in consumption conditions which lead to substitution from time-intensive to goods-intensive commodities
 - d. net effects on labor supply are ambiguous

C. Applications of the time use model

1. model is very useful for describing unpaid activities within households
2. some applications include modeling health outcomes for individuals, especially children, within families
 - a. health production literature
 - b. health is treated as a commodity
3. also used to examine determinants of children's development and families' use of child care
 - a. child "quality" is treated as a commodity
 - b. important determinant of the cost of fertility
4. used generally to examine women's labor supply
5. used to examine transportation decisions
 - a. transportation mode choices
 - b. optimal tolls
6. used to examine behavior in developing and rural economies
 - a. examples include analyses of household agricultural activities and work in informal markets
 - b. seldom observe formal wages for either of these activities; nevertheless, the activities may reflect economic decision making

D. Measurement of time use

1. time diary approach

- a. 24-hour or one week logs where people record what they are doing as or soon after they do it
 - b. generally very accurate
 - c. some limitations such as
 - 1) recording multiple activities
 - 2) generating distributions of infrequent activities
 - d. method is also somewhat intrusive
 - e. a variation on this approach is to use a pager to prompt people to enter their activities into a diary
2. recall surveys
- a. surveys like the CPS ask about activities during the previous week or year
 - b. inexpensive but inaccurate
 - c. scheduled work hours appear to be reported accurately
 - d. actual work hours and some other activities are over-estimated
 - e. some infrequent activities such as household repairs tend to be under-estimated
3. implications for standard labor supply analyses
- a. actual labor supply may be poorly measured in conventional surveys
 - b. diary data suggest that work hours are more variable and fewer than recall surveys
 - c. diary data appear to be more sensitive to differences between actual and scheduled hours
4. for some activities it is important to account for joint uses of time and for the intensity of time use

- a. Bianchi (2000) describes trends in mothers' time spent caring for children; despite changes in rise in women's employment and single parenthood, Bianchi found that time mothers spent caring for children was virtually the same in 1965 and 1995
- b. Bianchi reports other evidence that
 - 1) mothers' employment reduces time spent *with* children
 - 2) however, it has little effect on child care as a primary activity
 - 3) main reduction occurs in child care as a passive or secondary activities; suggests a quality/quantity trade-off

5. major U.S. time-diary surveys

- a. Maryland Time Use Surveys ("America's Use of Time")
 - 1) conducted in 1965, 1975, 1985 and 1995
 - 2) personal interviews used in 1965 and 1975; phone interviews used in 1985 and 1995
 - 3) 1965 survey limited to urban residents
 - 4) relatively small samples
- b. Institute for Survey Research Time Use Longitudinal Panel Study
 - 1) conducted in 1975 and 1981
 - 2) relatively small sample
 - 3) source of longitudinal data
 - 4) collected data on several people in household
- c. Bureau of Labor Statistics American Time Use Survey
 - 1) ongoing monthly time use survey, began in 2003

- 2) large samples drawn from outgoing rotation groups of the Current Population Survey
- 3) includes most economic and demographic measures from the CPS (more covariates than earlier surveys)
- 4) some supplements, such as the Eating & Health Modules in 2006-8 and the Well-being Module in 2010
- 5) responses can be linked to other CPS data
- 6) only interviews one person per household

E. U.S. trends (Aguiar & Hurst 2007)

1. used data from several time-diary surveys going back to 1965, including the America's Use of Time and ATUS
 - a. tried to construct consistent measures and samples over time
 - b. studied adults 21-65 who were neither students nor retired

2. trends for the U.S. are reproduced on the next page
 - a. market work
 - 1) core activities are standard "work" activities
 - 2) total market work adds commuting and breaks/meals while at work
 - b. nonmarket work
 - 1) excludes child care
 - 2) core activities are mainly indoor activities
 - 3) shopping is a separate activity
 - 4) total includes shopping & outdoor activities
 - c. child care
 - d. balance of time (= leisure?)

TABLE II
HOURS PER WEEK SPENT IN MARKET AND NONMARKET WORK OVER TIME
FOR FULL SAMPLE, MEN, AND WOMEN

Time-use category (hours per week)	Average hours per week spent in market and nonmarket work over time					Difference: 2003–1965
	1965	1975	1985	1993	2003	
Panel 1: Full sample						
Core market work	29.63	28.79	27.74	29.93	28.63	-1.00
Total market work	35.98	33.79	32.67	33.22	31.71	-4.27
Core nonmarket work	13.02	11.34	10.82	8.75	8.66	-4.35
Obtaining goods and services/ shopping	6.18	5.40	5.84	5.20	5.19	-0.99
Total nonmarket work	22.09	20.15	21.00	18.40	18.31	-3.78
Child care: primary	2.82	2.37	2.73	2.30	3.72	0.90
Child care: educational	0.35	0.41	0.38	0.25	0.72	0.38
Child care: recreational	0.51	0.33	0.53	0.56	1.06	0.55
Child care: total	3.67	3.11	3.64	3.11	5.50	1.83
Total market work + total nonmarket work	58.07	53.94	53.67	51.61	50.02	-8.05
Total market work + nonmarket work + child care	61.74	57.05	57.31	54.73	55.53	-6.21
Underlying sample size	1854	1673	3168	5347	15091	
Panel 2: Men						
Core market work	42.09	39.80	36.86	38.52	35.54	-6.55
Total market work	51.58	46.53	43.35	42.74	39.53	-12.05
Core nonmarket work	1.96	2.01	3.82	2.90	3.40	1.44
Obtaining goods and services/ shopping	4.85	4.44	4.59	3.83	4.34	-0.51
Total nonmarket work	9.67	10.85	13.96	12.44	13.43	3.75
Child care: primary	0.77	1.06	1.04	0.90	1.89	1.12
Child care: educational	0.12	0.15	0.17	0.17	0.43	0.31
Child care: recreational	0.54	0.19	0.44	0.39	0.92	0.38
Child care: total	1.44	1.40	1.66	1.47	3.24	1.80
Total market work + total nonmarket work	61.25	57.38	57.32	55.18	52.96	-8.29
Total market work + nonmarket work + child care	62.69	58.78	58.97	56.65	56.20	-6.49
Sample size	833	756	1412	2483	6699	
Panel 3: Women						
Core market work	18.83	19.24	19.84	22.49	22.65	3.82
Total market work	22.45	22.74	23.41	24.97	24.93	2.48
Core nonmarket work	22.61	19.43	16.89	13.83	13.23	-9.38
Obtaining goods and services/ shopping	7.33	6.23	6.92	6.38	5.93	-1.40
Total nonmarket work	32.86	28.21	27.10	23.56	22.55	-10.31
Child care: primary	4.59	3.51	4.20	3.52	5.30	0.71
Child care: educational	0.54	0.64	0.56	0.32	0.98	0.44
Child care: recreational	0.48	0.45	0.60	0.70	1.18	0.71
Child care: total	5.60	4.60	5.36	4.54	7.46	1.86
Total market work + total nonmarket work	55.31	50.95	50.51	48.52	47.48	-7.83
Total market work + nonmarket work + child care	60.91	55.55	55.87	53.06	54.94	-5.97
Sample size	1,021	917	1,756	2,864	8,392	

All means are calculated using fixed demographic weights, as described in the text. See Table IX and text for category definitions. The sample restrictions are described in the footnote to Table I.

3. trends

- a. market work decreased for men and increased for women
- b. nonmarket work increased slightly for men and decreased substantially for women
- c. child care
 - 1) flat for men up to 2003, increased in 2003
 - 2) same pattern but from a higher level
- d. total work, including child care, for men and women decreased over time
- e. total work times very similar across men and women (men slightly higher) when child care taken into account
- f. Bianchi et al. (2000) report similar trends for housework and Bianchi (2000) reports similar trends for child care
- g. demographic decomposition indicates that demographic changes have contributed to more market work and slight decreases in housework and child care

F. Issues in the valuation on non-market time

1. production-oriented approach
 - a. uses the cost to obtain an equivalent service to value household time
 - b. alternatively, could look at money saved by a household from do-it-yourself projects
 - c. does not capture household welfare
 - d. does not capture differences in the productivity of households or differences between households and professionals

2. opportunity cost approach
 - a. can value time in terms of foregone opportunities; specifically, can value time in terms of the after-tax wage rate
 - b. trouble approximating value of time for individuals (at corner solutions) who do not work
 - c. also, some conceptual difficulties – e.g., if a lawyer (\$100/hr) and a dishwasher (\$6/hour) each spend an hour in household repairs, is the lawyer's repair really worth more?

3. unresolved issues
 - a. valuation systems generally ignore individual preferences
 - b. systems also tend to make very simple assumptions about the trade-offs between market and non-market productivity
 - 1) ignores set-up time
 - 2) ignores transportation costs
 - 3) ignores time required to develop skills
 - c. hard to get some data on equivalent services

G. Econometric issues

1. framework has been very useful in motivating loose, reduced-form approximations for empirical models
 - a. typical study regresses either
 - 1) a measure of a commodity such as children's physical or developmental well-being or
 - 2) a measure of an input such as time spent caring for children or amount spent on child care

- b. measures regressed against wages, prices, non-labor incomes
 - c. models use some convenient functional form (linear, log-linear, etc.)
 - d. models are useful for motivating the inclusion of explanatory variables
2. tests of derived demands
- a. theoretical model distinguishes between derived demands and direct demands
 - 1) theoretical distinction is between goods that are desired because they are used in the production of commodities (i.e., like factors of production in firms) and goods that are just valued for their own sake
 - 2) distinction arises because preference function and production functions are different
 - b. empirically, however, it is virtually impossible to distinguish between the preference and production functions
 - 1) Pollak and Wachter (1975) show that very strong assumptions (e.g., constant returns to scale in the production functions and no joint production) are necessary to identify each element
 - 2) advocate a direct demand approach
3. accounting for censoring
- a. as with analyses of labor supply, analyses of other types of time use need to address features of the time use measures
 - b. censoring, non-negativity

- 1) measures censored from below at zero
- 2) some type of censored regression methodology is recommended
- c. what do the zeroes represent?
 - 1) are the incidence and intensity of an activity determined by the same underlying function or by separate functions
 - 2) do zeroes represent not performing an activity that day (or time period) or *never/seldom* performing that activity
- d. variety of models have been used; each has strengths and weaknesses
 - 1) OLS—ignores censoring issue but convenient
 - 2) standard Tobit—addresses censoring but makes strong distributional assumptions and relies on a single underlying index
 - 3) two part models (e.g., correlated or uncorrelated Heckit)—treat incidence and intensity separately; may be hard to identify if correlation is included
 - 4) double hurdle models—attempt to distinguish between different reasons for zeroes; strong assumptions needed for identification
 - 5) Censored Least Absolute Deviations—single index median regression model; requires that at least half the observations have positive responses
4. accounting for other features of the outcomes
 - a. many studies consider several uses of time together, such as child care and work
 - b. outcomes should be related

- 1) outcomes chosen by the same person, so unobservables are likely to be correlated across outcomes
 - 2) outcomes are subject to the same time constraint; this also leads to correlation
 - 3) suggests that some SUR-type of procedure should be used
- c. activities usually reported as spells; Kalenkoski et al. (2011) recommend using event-history methods that can address many of these issues

5. timing of activities

- a. recognition for some time that time use varies by type of day; many analyses of daily outcomes routinely distinguish between non-holiday weekdays and other days
- b. growing amount of research that considers activity patterns *within* days
 - 1) usually thought to reflect a coordination issue
 - 2) evidence from Kalenkoski et al. that accounting for timing patterns leads to a better description of the overall distribution

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