

Notes on time use

Time-use data alone are insufficient for estimating household technology and the behavioral relationships that determine the allocation of time among activities; to estimate household technology requires data on all outputs and all inputs, whereas to estimate behavioral relationships requires recognizing the roles of preferences, intrahousehold allocation, and technology

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Time-use data can be used to estimate both structural relationships, such as household technology, and behavioral relationships, such as the determinants of the allocation of time among activities.¹ The implications of economics for collecting time-use data for estimation depend critically on the underlying theory. For economists, the starting point for theory is Gary S. Becker's "household production" model, in which households are "assumed to combine time and market goods to produce more basic commodities that directly enter their utility functions."² Elaborating on this model, Robert T. Michael and Becker cite applications to such commodities as "'good health,' children, marriage, or 'intercity visits'"³ and urge its application to "new variables . . . more global in nature than the goods and resources traditionally considered."⁴ Examples of these more global variables include "children, prestige and esteem, health, altruism, envy, and pleasures of the senses."⁵

The household production model is an application of the rational actor model: Bentham updated by Becker. Becker's assumption that households "combine time and market goods to produce more basic commodities that directly enter their utility functions" appears to place restrictions on the constraints households face. But without specific assumptions about household technology, there are no restrictions: the conventional economic model in which market goods enter the utility function directly is a special case of the household production model in which the number of commodities is equal to the

number of market goods and each market good corresponds to ("produces") a single commodity. The power of the household production model to place restrictions on household behavior derives from specific assumptions about the technology households use to transform goods and time into commodities and about the relationship between the number of goods and the number of commodities—Becker insists that commodities "are much smaller in number than the goods consumed" and cites, with apparent approval, Bentham's list of 15 fundamental sources of "pleasure and pain."⁶

Commodities

Robert A. Pollak and Michael L. Wachter, in an early critique of the household production approach, raise concerns about observability and measurability, arguing that

in some potential applications, the variables being investigated are not "commodities" (the outputs of production processes) but rather utilities (numbers representing preference orderings). These misapplications confound tastes with technology by interpreting specific utility functions as production functions.⁷

Although the household production terminology is misleading when applied to activities that do not produce observable and measurable outputs, a major contribution of Becker's model has been to call attention to the possibility of applying economic analysis to the allocation of time among activities.

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In contrast to the problem of observing and measuring activities and commodities, that of *identifying* them does not appear to have been discussed in the household production literature. This silence is not surprising, considering that an analogous problem exists for market goods.⁸ The range of admissible definitions of goods is somewhat limited by the need to remain consistent with the definitions used in market transactions. Because this consistency requirement is absent for activities and commodities, they are, to a greater extent than goods, socially constructed by researchers who study them.

Simultaneous activities (for example, walking and chewing gum) present problems for the collection and analysis of time-use data. I propose to distinguish between two types of simultaneous activities: *parallel* and *on call*. Parallel simultaneous activities include walking and chewing gum; driving a car and listening to the radio; and flying in a plane and reading. On-call (or standby) simultaneous activities usually involve responsibility for the care of another person (“monitoring,” “watching,” “minding”) in situations in which the time demands are stochastic. On-call activities include cooking while caring for a child who is sleeping, cleaning house while caring for a disabled spouse who is reading, and reading while caring for an elderly parent who is watching television. An individual who is on call may engage in other activities, but the range of activities that are compatible with being on call is constrained in terms of location and is limited to activities that may be interrupted. For purposes of data collection and analysis, simultaneous activities can be handled by defining compound activities (for example, treating walking and chewing gum as a single activity), but handling simultaneous activities in this way would greatly expand the number of activities. By focusing on a limited number of compound activities (for example, those involving the care of children and those involving the care of the elderly) and ignoring the rest, we may be able to obtain most of the advantages of defining compound activities without creating an unmanageable number of categories.

Joint production

Even when commodities are observable and measurable, commodity shadow prices still pose serious problems. Unless the household technology exhibits constant returns to scale and no joint production, commodity shadow prices depend on preferences, as well as on the prices of market goods, wages rates, and the parameters of the household technology. As Pollak and Wachter point out,

Households with different tastes [and the same technology] will select different commodity bundles, and, . . . the commodity bundles they select will imply different commodity prices. The unwary economist might attribute some part of the difference in the [commodity] consumption pattern of our two households to these differences in commodity prices, but such an interpretation would be highly misleading; the

differences in commodity prices are a reflection of differences in tastes, not differences in opportunities.⁹

Thus, if joint production is pervasive, as Pollak and Wachter argue that it is, commodity shadow prices are not useful independent variables. Indeed, despite their prominence in Becker’s theoretical expositions of the household production approach, commodity shadow prices have played an insignificant role in empirical work.

Joint production arises when a production process or activity produces two or more “outputs.” Pollak and Wachter consider a model with two processes, one producing a “home cooked meal” and the other a “clean house.”¹⁰ Each process requires the input of market goods and time. If the time is provided by a paid worker from outside the household, then we can model the situation as involving two “outputs” or “commodities” that enter the utility function: “home cooked meal” and “clean house.” If, on the other hand, time is provided by a member of the household—to avoid extraneous complications, consider a one-person household—additional “commodities” will enter the utility function unless the individual is indifferent between these uses of time. That is, two individuals with the same household technologies and the same preferences for “home cooked meal” and “clean house” will allocate their time differently if one of them enjoys “time spent cooking” relative to “time spent cleaning” more than the other. F. Thomas Juster and Frank P. Stafford characterize such direct preferences for time use as “process benefits,”¹¹ which can be negative (“disbenefits”) or positive; there is no presumption that time spent cooking or cleaning increases utility. From a technical standpoint, process benefits imply joint production—instead of two commodities, there are four: “home cooked meal,” “clean house,” “time cooking,” and “time cleaning.”

The number of commodities severely limits the number of activities that an efficient household needs to operate at positive levels. More precisely, if there are m commodities, and if household technology exhibits constant returns to scale, then any commodity vector can be produced efficiently by operating no more than m activities at positive levels. Thus, if there are constant returns to scale and 15 commodities, then at most 15 activities are required to produce them efficiently. With the number of commodities and activities so constrained, the commodity short list is unlikely to include such specific commodities as “home cooked meal,” “clean house,” “time cooking,” and “time cleaning.”

Household preferences versus individual preferences

The assumption that households produce “basic commodities that directly enter their utility functions” implicitly assumes that households have utility functions. For a one-person household, this is unobjectionable, but often the focus is on two-person

households. In the years since Becker's 1965 paper was published, economists have become increasingly uncomfortable with models that rely on household utility instead of individuals' utilities. Bargaining models of marriage allow us to begin with individual preferences rather than household preferences.

The earliest bargaining models of marriage were cooperative models in which the "threat point" was divorce and the "private good" over which the spouses bargained was leisure. Bargaining models of marriage stand in contrast to "common-preference models," in which households behave as if they are maximizing household preferences. Resource pooling provides an empirical test of common-preference models: if households behave as if they are maximizing a utility function, then which spouse controls resources would have no effect on household behavior—expenditure patterns and time-use patterns would be unaffected by the distribution of control over resources between husbands and wives. Empirical evidence, however, shows that household expenditure patterns *are* sensitive to control over resources, implying the rejection of resource pooling and, hence, all approaches that assume or entail the existence of a household utility function.¹²

Application: housework in one-person households

Even for one-person households, we need strong, restrictive assumptions about preferences to reach strong conclusions about the effects of changes in wage rates on time allocation. For example, suppose individuals derive no process benefits from time spent in household production or in the market, so that time is allocated between the household sector and the market sector solely on the basis of the physical commodities produced. Suppose further that home production requires household time, but not market goods. Then the problem of the consumer reduces to allocating time among household production, market work, and leisure so as to maximize utility. Even under these conditions, additional assumptions about the structure of preferences are needed to obtain strong results about the effect of wage changes on time allocation. Two special cases are instructive.

Perfect substitutes. Suppose that housecleaning services available in the market are a perfect substitute for home-produced cleaning or, more generally, that the home-produced commodity and the market good are perfect substitutes. With perfect substitutes, an increase in the wage rate must cause a decrease in time allocated to home production. The intuition behind this result is that the individual allocates time to home production, until the marginal product of home production is driven down to the level at which an extra hour would produce the same return in the market as in the home; beyond that point, nonleisure time is allocated to the

market, earning income which is used to purchase the market good. Furthermore, even with perfect substitutes, theory predicts only the direction of the change, not its magnitude.

Perfect complements. If the home-produced commodity, the market good, and leisure are perfect complements (that is, if the utility function has fixed coefficients), then utility increases only when all three increase simultaneously. Thus, in response to an increase in the wage rate that is not offset by a reduction in other income, a utility-maximizing individual decreases time allocated to market work and increases both time allocated to home production and time allocated to leisure.

Theory does not imply that single women and single men with the same wage rates will allocate the same amount of time to home production or to other activities. This would be the case if men and women had identical household technologies *and* identical preferences. But if women care more about a clean house relative to market goods than men do, then this gender difference in preferences implies a corresponding difference in time allocation. Similarly, if women and men derive process benefits from home production and women like housework relative to market work more than men do (or dislike it less), then these gender differences in preferences imply corresponding gender differences in time allocation. To incorporate process benefits into the analysis requires expanding the number of arguments in the utility function beyond the home-produced commodity, the market good, and leisure to include the time devoted to home production and the time devoted to market work. Gender-related differences in preferences imply gender-related differences in time allocation, but economics generally has little to say about differences in preferences.

The "gender display," or "gender construction," literature argues that housework is culturally or socially defined as "women's work," while market work ("breadwinning") is defined as "men's work." The literature not only goes on to argue that women and men internalize these definitions of gender-appropriate activities, but also attempts to explain the sources of these differences.¹³ But regardless of their sources, differences in preferences imply differences in patterns of time use.

Application: housework in two-person households

A starting point for discussing time allocation in two-person households—consisting of, say, husbands and wives—is to suppose that each individual is concerned with the same five commodities as in the one-person household: the home-produced commodity, the market good, leisure time, time devoted to home production, and time devoted to market work. Interdependent preferences, which arise when one spouse's utility function depends on the other spouse's consumption or time use, complicate the picture. With *paternalistic* interde-

pendent preferences, a wife may, for example, want her husband to exercise more, because “it’s good for him,” even though he would rather spend his time watching television. More generally, paternalistic interdependent preferences are compatible with each spouse preferring a different consumption and time-use pattern for the other spouse than the other spouse would choose for himself or herself. With *nonpaternalistic* (also called altruistic or nonjudgmental) interdependent preferences, each spouse cares about the other’s utility. Thus, nonpaternalistic interdependent preferences respect “consumer sovereignty”: the wife wants her husband to allocate his time between exercise and television in just the way he wants to allocate his time between these activities.¹⁴ Plainly, then, preferences are more complex in two-person than in one-person households.

Constraints are also more complex. One new issue is the substitutability of the husband’s time and the wife’s time in household production; the simplest assumption is that they are perfect substitutes, but this assumption seems implausible and is unsupported by empirical evidence. A second new issue is the construction of a “household technology” from the husband’s technology and the wife’s technology, an issue that has not been addressed in either the theoretical or the empirical literature.

In two-person households, gender display can accommodate the possibility that husbands and wives may care not only about their own time use, but also about the time use of their spouses. That is, socialization may go beyond the internalization of preferences for one’s own gender-appropriate behavior and also instill a preference for gender-appropriate behavior by one’s spouse. Such preferences imply that each spouse’s utility function includes both spouses’ time use.

Finally, if an individual is concerned with the “fairness” of the distribution of housework, then that individual’s utility function must include both his or her own time use and that of the spouse. Sociologists have found that, although many wives spend considerably more time working (that is, doing market work plus housework) than their husbands, many wives consider the unequal division “fair.” A concern with “fairness” implies that individuals have preferences regarding the time allocation of their spouse, as well as their own time allocation.¹⁵

Application: parents and homework

Time that parents spend helping children with homework provides a useful counterpoint to housework because the activity is more specific and the output is, at least arguably, measurable. There are two relationships that we might attempt to estimate:

1. The “production” relationship, in which the output is a measure of school performance and one of the inputs is parental time, and

2. The behavioral “supply” relationship, in which parents allocate their time among alternative uses (for example, helping with homework, watching television, cleaning house, or working for pay).

The production relationship determines the return on parental homework time, just as the wage rate determines the return on parental time on the job; hence, the production relationship plays a key role in estimating the behavioral supply relationship.

The statistical association between parental homework time and school outcomes has no clear interpretation, nor is it obvious a priori whether we should expect a positive or a negative correlation. To estimate the production relationship between school performance and parental homework time requires specifying and measuring the other inputs into school performance. Omitted inputs may lead to biased estimates of the effect of parental time, unless the omitted inputs are independent of parental homework time. For example, a problem may arise if “good parents” spend more time on homework and also spend more time talking with their children at dinner. If dinner conversation affects school performance and we fail to measure dinner conversation, then our estimate of the effect of homework time will be biased, reflecting not only the effect of parental homework time, but also the effect of the correlated portion of dinner conversation. In order to obtain an unbiased estimate of the effect of parental homework time, we need data on all of the other variables that determine school performance, except those that are independent of parental homework time. These other variables are likely to include measures of the child’s ability and measures of the parents’ ability and education.

To estimate the production relationship between school performance and parental homework time also requires recognizing that parental homework time reflects parental time allocation decisions. Estimates based on the implicit assumption that parental homework time is randomly assigned to children are likely to be biased. Instrumental variables, a standard technique for dealing with this type of endogeneity, require deciding on appropriate instruments and collecting data on them.

Suppose that, after estimating the production relationship, we want to estimate the behavioral supply relationships describing the allocation of parental time among alternative activities. To estimate this behavioral relationship requires specifying competing uses of time (for example, helping other children with homework, cleaning house, or working for pay) and the returns associated with these activities. The presence of other children in the household may represent additional demands on parental time; the presence of other adults, on the other hand, increases the supply of adult time potentially available for meeting those demands.

IN SUM, A THEORETICAL FRAMEWORK for time-use research has

three components: technology, preferences, and intrahousehold allocation. Household technology specifies the constraints, other than market constraints, that define the household's feasible set. Because of the importance of process benefits, the specification of household technology must allow for joint production. Individual preferences specify the objective functions individuals seek to maximize; interdependent preferences are likely in two-person households. An intrahousehold allocation rule, perhaps derived from an explicit bargaining model, determines the division of benefits and burdens within the household. On one crucial issue, however, the theoretical framework provides no guidance: theory does not identify the empirical counterparts of the "commodities" that are produced by the household technology and that enter individuals' utility functions.

To estimate household technology, researchers need data on all outputs and all inputs. For instance, if we want to estimate the effect on children's reading comprehension of a parent reading to them for an additional hour a week, then we need a measure of output (for example, of reading comprehension or improvement in reading comprehension). This reading comprehension example suggests two general lessons. First, output data imply measurable commodities, and measurable commodities imply narrowly defined commodi-

ties. Broad global categories such as "child quality" are unlikely to be measurable. The second lesson relates to the choice of inputs. Although estimation might be easier if some children were randomly assigned to treatments with a lot of reading and others assigned to treatments with only a little, data are not generated by random assignment. Too often, however, data are analyzed as if they were generated that way, even though such an analysis is likely to produce misleading estimates. Omitted variables are the obvious problem: if parents who read more to their children also talk more with their children, and if talking with children improves their reading comprehension, then analyzing the data as if reading were a randomly assigned treatment will overestimate the reading effect by attributing to it the effects of correlated omitted variables.

To summarize, estimating household technology or the behavioral relationships determining time allocation among activities requires time-use data, but time-use data alone are not enough. At a 1997 conference in Washington, DC, F. Thomas Juster, a leading authority on the analysis of time-use data, rightly disparaged time-use surveys that merely "collect dependent variables." He is clearly right. Indeed, if time-use surveys collect only time-use data, then time-use researchers can do no more than regress one endogenous variable on another. □

Notes

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¹ Time-use data also are required to construct national product accounts that reflect nonmarket as well as market activity; that, however, is not the subject of this article.

² Gary S. Becker, "A Theory of the Allocation of Time," *Economic Journal*, September 1965, pp. 493–517; reprinted in Gary S. Becker, *The Economic Approach to Human Behavior* (Chicago, University of Chicago Press, 1976), see especially p. 91.)

³ Robert T. Michael and Gary S. Becker, "On the New Theory of Consumer Behavior," *Swedish Journal of Economics*, December 1973, pp. 378–96; reprinted in Becker, *Economic Approach*.

⁴ Becker, *Economic Approach*, p. 147.

⁵ Gary S. Becker, *A Treatise on the Family* (Cambridge, MA, Harvard University Press, 1981 (enlarged ed., 1991)), p. 8.

⁶ *Ibid.*, p. 24.

⁷ Robert A. Pollak and Michael L. Wachter, "The Relevance of the Household Production Function and Its Implications for the Allocation of Time," *Journal of Political Economy*, April 1975, pp. 255–77; quote from p. 273.

⁸ See Pollak's discussion of "What is a good?" in his comment on the Boskin Commission's proposals in Robert A. Pollak, "The Consumer Price Index: A Research Agenda and Three Proposals," *Journal of Economic Perspectives*, winter 1998, pp. 69–78; quote from p. 74.

⁹ Pollak and Wachter, "The Relevance of the Household Production Function," p. 265.

¹⁰ *Ibid.*, p. 270.

¹¹ F. Thomas Juster and Frank P. Stafford, "The Allocation of Time: Empirical Findings, Behavioral Models, and Problems of Measurement," *Journal of Economic Literature*, June 1991, pp. 471–522; see especially pp. 492, 495.

¹² See Marilyn Manser and Murray Brown, "Marriage and Household Decision-Making: A Bargaining Analysis," *International Economic Review*, February 1980, pp. 31–44; Marjorie B. McElroy and Mary J. Horney, "Nash-Bargained Household Decisions: Toward a Generalization of the Theory of Demand," *International Economic Review*, June 1981, pp. 333–49; and Shelly Lundberg and Robert A. Pollak, "Bargaining and Distribution in Marriage," *Journal of Economic Perspectives*, fall 1996, pp. 139–58.

¹³ Beth Anne Shelton, *Understanding the Distribution of Household Work between Husbands and Wives* (Department of Sociology and Anthropology, University of Texas, Arlington, TX, 1999), is a useful introduction to the gender display literature.

¹⁴ From a formal standpoint, interdependent preferences imply that each spouse's consumption and time-use pattern is a household public good.

¹⁵ See Constance T. Gager, "The Role of Valued Outcomes, Justifications, and Comparison Referents in Perceptions of Fairness Among Dual-Earner Couples," *Journal of Family Issues*, September 1998, pp. 622–48; and Herbert L. Smith, Constance T. Gager, and S. Philip Morgan, "Identifying Underlying Dimensions in Spouses' Evaluations of Fairness in the Division of Household Labor," *Social Science Research*, September 1998, pp. 305–27. These articles discuss the literature on fairness and suggest that a wife evaluates the fairness of the division of labor in her marriage relative to what she observes in other marriages, comparing herself to other wives rather than to her husband.