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Where Does the Time Go?

Concepts and Measurement in the American Time-Use Survey

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* The views expressed in this paper are ours, and do not necessarily reflect those of the Bureau of Labor Statistics. We thank Diane Herz for her helpful comments. Any remaining errors are ours.

"…this is the single most important statistical initiative of the Federal government currently underway." William Nordhaus referring to the American Time-Use Survey in his testimony before the Joint Economic Committee on July 24, 2002.

I. Introduction

Time-use surveys have been around for 80 years. They were conducted in the U.S.S.R and by the U.S. Department of Agriculture (USDA) in the 1920s, and in Finland in the 1930s and 1940s. The Szalai International Study, which was the first multinational study, was conducted in 1965-66 in 12 countries including the U.S. The 1970s saw a large increase in the number of time-use surveys, but relatively few have been conducted in the U.S. In addition to the 1965-66 time-use survey, there have been surveys in 1975-76 (with a follow-up in 1981), 1978, 1985, 1992-94, and 1998-99. All of these surveys have relatively small sample sizes, and none were conducted by the federal government (see Harvey and St. Croix 2003). The ATUS is the first time-use survey conducted by the U.S. government since the USDA studies of the 1920s. It is the only ongoing time-use survey, and within a few months the sample size will exceed that of any other time-use survey.

The Bureau of Labor Statistics (BLS) started looking into measuring time use in 1991 after the Unremunerated Work Act was introduced. That bill, which did not pass, specifically named BLS as the responsible agency. Since then, BLS has engaged in many activities--most importantly the BLS Time-Use Pilot Study and the MacArthur Conference in 1997, and a report to the National Academy of Sciences in 1999--to assess the feasibility of collecting time-use data on an ongoing basis. These activities provided the foundation for the eventual funding and subsequent development of the American Time-Use Survey.

Below, we describe the ATUS, review some of the uses of time-use data, and discuss how to specific features of the ATUS affect two key applications--valuation of household work and estimates of hours worked.

II. The American Time-Use Survey

This section briefly describes the key elements of the ATUS. For a fuller description, and an explanation of rationale for many of the decisions that were made, see Herz and Horrigan (2003).

Data Collection

The ATUS sample is a stratified random sample that is drawn from households that have participated in the Current Population Survey (CPS). Households are in the CPS sample for 8 months.[1] Households that have completed their final CPS interview (Month-in-Sample (MIS) 8 households) are eligible for selection into the ATUS sample.[2] Sample households are selected based on the characteristics of the reference person, and then the designated person (DP) is randomly selected from the list of adult (15 or older) household members. All adults within a household have the same probability of being selected. During 2003 ATUS will interview approximately 1,800 individuals per month, but beginning in January 2004 the sample size will be reduced to approximately 1,250 per month.

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[1] More strictly, addresses are in the sample for 8 months; movers are not followed. The 8 months are non-consecutive, with 4 months in the survey, 8 months out, and 4 months in. Overall CPS sample size is about 60,000 households.

[2] The pool of eligible households is smaller than the MIS 8 sample size, because the CPS oversamples smaller states. To obtain a nationally representative sample, these oversample households have been eliminated from the pool of eligible households.

The ATUS is administered using computer assisted telephone interviewing (CATI), rather than paper diaries as many other countries do. The cost of collecting paper diaries would be prohibitive for an ongoing survey. (The Canadian time-use survey also uses telephone data collection.) If the respondent is unavailable on his or her initial calling day, then subsequent contact attempts are made on the same day of the week. This insures that the reference day is always the same day of the week as the initial reference day, and allows more control over the distribution of the sample over days of the week. Field testing showed that allowing the respondent more flexibility did not improve response rates.

Demographic Information

Because ATUS uses the CPS as a sampling frame, it contains the same demographic information as the CPS. For household members that were present during the CPS MIS 8 interview, all demographic information has been carried over. For new household members, ATUS collects only age, sex, and relationship to the DP.

Labor Force Information

ATUS updates labor force status using a slightly modified version of the Basic CPS questionnaire. These questions allow us to determine whether the respondent is Employed, Unemployed, or Not in Labor Force (NILF), but do not allow one to distinguish between the three categories of NILF (Retired, Disabled/Unable, and Other) as in the CPS.[3] Nor does ATUS ask the CPS questions pertaining to Discouraged Workers, Job History, or Actual Hours at Work. Job History information can be obtained by matching the ATUS

[3] ATUS does distinguish between "At Work" and "With Job But Absent From Work" for the employed, and between "Looking" and "On Layoff" for the unemployed.

interview to the respondent's MIS 8 interview. The ATUS asks respondents to report usual hours, but does not collect actual hours. Actual hours are highly correlated with usual hours, and, for most purposes, usual hours are more relevant.[4]

The reference period for ATUS employment questions is slightly different from that in the CPS. To ascertain the respondent's employment status on the reference day, we ask about work activities during the previous seven days (i.e., the last day is the reference day). This differs from CPS, which asks about the week that contains the 12th of the month, which is the calendar week prior to the interview. It was believed (and examination of gross flows data confirm this belief--see Stewart 2003) that there would be too many transitions between labor force states if the previous calendar week was used. Of course, it is still possible that the respondent was employed at the beginning of the seven-day period, and had lost or left the job by the reference day. But these transitions should be relatively rare.

For respondents who are employed, ATUS asks the earnings questions and the industry and occupation questions. The earnings questions are asked of everybody who had a new job in ATUS. This includes people who changed jobs between the MIS 8 interview and the ATUS interview and people who made a nonemployment-to-employment transition. We also ask the earnings questions if the MIS 8 earnings data were allocated. The earnings data for all other respondents are carried over from the MIS 8 interview.

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[4] There are two problems with collecting hours for the previous seven days. First, respondents may have a difficult time determining hours for a seven-day period that does not correspond to a calendar week. Second, asking about hours for the previous seven days would result in a biased estimate of actual hours worked. For example, an individual who worked unusually long hours during a week would be less likely to be contacted during that week, making it more likely that he or she is contacted the following week (and asked to report hours for the busy week). Hence, long work weeks tend to be oversampled. However, the direction of this bias is indeterminate, because vacation weeks also tend to be oversampled.

ATUS does not collect as much information about other household members. For the respondent's spouse or unmarried partner, the ATUS collects basic labor force information--employment status (employed or not employed) and total hours usually worked per week. And for other household members, ATUS does not collect any labor force information.

Time Diary

The core time diary of the ATUS is very similar to those of other time-use surveys. The respondent is asked to take the interviewer through his or her day via a conversational interview. The diary day starts at 4:00am and goes through 4:00am of the following day (the interview day), so each interview covers a 24-hour period. The respondent describes each activity, which the interviewer either records verbatim or, for a limited set of common activities (such as sleeping or watching television), hits a pre-code button. For activities that are not pre-coded, the verbatim responses are coded according to a three-tier scheme so that each activity has a 6-digit code (2 digits per tier). Coders are also interviewers, which means that, when interviewing respondents, they know to probe further when responses are not sufficiently detailed to be coded. For example, when the respondent reports that they were reading without giving more detail, the interviewer asks: "Was that for your current job, to get a degree, pleasure or something else?"

For each episode, ATUS collects either the stop time or duration of the activity (the start time is simply the stop time of the previous activity). For the last activity of the day (the one that spans 4:00am the morning of the interview) ATUS records the actual stop

time, even though the episode "ends" at 4:00am for official estimates.[5] Respondents are also asked to report where they were and who they were with, unless the activity is sleeping or grooming (neither is asked), or working at a job (only where is asked). If the respondent was at home, he or she is to report who else was in the room. If the respondent was away from home, he or she is asked to report who accompanied them. The "who" codes for household members refer to specific individuals, which will be particularly useful for researchers who are interested in estimating the amount of time that parents spend with their children. The "where" code for an activity specifies either a location or a mode of transportation.

It is important to note that the ATUS data only contain information about the respondent's primary activity. BLS is looking into the feasibility of systematically collecting secondary activities. Currently, if the respondent reports two activities, both are recorded by the interviewer, but only the primary activity (as determined by the respondent) is coded. Analysis of these simultaneous activities will allow BLS to determine how often and under what conditions respondents spontaneously report secondary activities, and will provide information about how often interviewers will need to probe for this information.

[5] This gives us the completed duration of the final activity, which is usually sleeping. Otherwise, for most respondents, we would have information on two truncated episodes of sleep. For official estimates of the time spent sleeping, we will use the two truncated episodes, because the total time in all episodes must sum to 1440 minutes each day.

Summary questions

In addition to the labor-force questions and the time diary, ATUS asks several summary questions that are designed to obtain information that cannot readily be obtained from the core time diary.

Childcare as a secondary activity

In the course of developing the survey, BLS determined that the most important activity we are missing by not collecting secondary activities is child care. Examination of data on secondary activities from the Australian National Time-Use Survey indicates that individuals spend 3-4 times as much time in child care as they do in other household work. Further, attendees at the MacArthur Conference and the NAS Workshop expressed a strong preference that ATUS collect child care as a secondary activity (henceforth, we will refer to this as secondary child care). To capture secondary child care, ATUS asks respondents to identify the activities during which a child under 13 was "in your care."

Cognitive testing revealed significant variation in how respondents answered the childcare summary questions (see Schwartz 2001). Specifically, some respondents reported only times when both the respondent and the child were awake, while others included activities and times when either the respondent or the child was sleeping. To mitigate the impact of this inconsistent reporting, it was necessary to put limits on when secondary childcare can occur. For official estimates of secondary childcare, ATUS will

only include activities that occurred when the respondent and at least one child under 13 were awake.[6]

Paid work

The paid work summary questions are designed to do two things. First, they are designed to identify income generating activities. These are typically things like arts and crafts that are not done as part of the respondent's main or secondary job, but may generate income. Second and more importantly, they are designed to identify activities that are done for the respondent's main or secondary job. This could include things like bringing work home or grading papers. It could also include things like taking clients out to dinner. Ideally, the respondent would report these activities as paid work, but that is not always the case. Furthermore, for some self-employed workers the distinction between work and home life can be blurred. Although most self-employed workers report to work just like wage and salary workers, some work at home and intermix work and nonwork activities. For example, a respondent may report that he or she spent 30 minutes doing email correspondence at home, but it may not be clear whether or not this was for work. Like the child care questions, the three paid-work questions as respondents to identify activities that were done for their main job, their other job(s), or that were done for pay (other income).

ATUS asks a similar summary question that asks respondents to identify activities that were done for a volunteer organization. This is necessary because it may not be clear that, for example, baking cookies for a bake sale is volunteer work if the respondent does not say for whom the cookies are being baked in the time diary.

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[6] We begin the childcare questions by asking the respondent when the first child under 13 woke up, and when the last child under 13 went to bed. However, we do not collect any other information about the children's activities, so secondary child care estimates include time when children are taking naps.

Absences from home

Because the ATUS calls respondents at their homes, it only obtains information about the last or next-to-last day of a trip. To fill this gap, ATUS asks "missed days" questions that allow us to estimate the amount of time people spend away from home and to find out the purpose of the absence. We do not envision using these data to augment official time-use estimates, but they should help us better understand what we are missing because we cannot contact respondents while they are away from home. ATUS asks respondents to report the number of absences from home that lasted two nights or longer during the month prior to the initial calling date.[7] For each absence the respondent is asked to report the purpose of the absence and the number of nights the respondent was away from home.

Although BLS will not adjust official estimates for time away from home, other analysts may want to adjust their estimates. For example, if one is willing to make some assumptions, estimates of hours worked could be adjusted to account for vacation time and business trips. We discuss how this might be done below.

III. What Can We Learn from Time-Use Data?

Time-use data can shed light on many questions. Below, we discuss a few of these questions, paying special attention to those that are of particular interest to this audience.

[7] We do not call these absences "trips," because they could be hospital stays or jail time. We do not ask about one-night absences, because these are captured by the core time diary.

Extending National Income and Product Accounts

Standard national income accounting is oriented toward valuing goods and services that are exchanged between economic units, most prominently those exchanged in markets. For example, the United Nations System of National Accounts 1993 (SNA) states:

> The System includes within the production boundary all production actually destined for the market, whether for sale or barter. It also includes all goods or services provided free to individual households or collectively to the community by government units or [non-profit organizations].

This definition of production excludes some economic activity from national income accounts. While both the SNA and the US National Income and Product Accounts (NIPA) include within-household production of goods for household use (such as food for farm households), they both exclude non-market services produced within the household (with the major exception of owner-occupied housing).[8,9]

For many purposes the exclusion of within-household services can be justified. The SNA cites "the need to prevent flows used for the analysis of market behavior and disequilibria from being swamped by non-monetary values". However, some questions require accounting for household production. For example, the increasing labor force participation rate of women has led to growth in measured production, but one might want to know to what extent this represents a shift from household to market production.

One way to incorporate household production into the national income accounts is to create a satellite account (examples include Landefeld and McCulla 2000; Australian Bureau of Statistics 2000, Appendix 1). The first step is to define household production.

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[8] This is the only exception in NIPA; SNA also includes major repairs and storage [check cite]

[9] Several countries (Australia, New Zealand, Canada) include volunteer work in their measure of unpaid work. However, Landefeld and McCulla (2000) argue that volunteer work should be excluded from household satellite accounts.

The usual approach is to apply a third-person test (Reid 1934, cited in Landefeld and McCulla 2000): Household production is defined as the output of activities where the same result could be achieved by hiring a third person. For example, cooking a meal is household production, but eating it is not.

Household production (as with other production) can be valued either directly, as the value of output, or indirectly, as the sum of the costs of inputs. The United Kingdom has an experimental household satellite account based on output measures (UK Office of National Statistics, 2002). Drawing on a number of data sources, these accounts estimate the volume and value of such items as clean, warm, furnished, maintained accommodation; total distance traveled; meals and hot drinks prepared in the home; and informal childcare and adult care. Under this approach, time-use data can be used to estimate productivity in household production but they are not used to value output. Most satellite account proposals use the input approach, which tends to require fewer data sources.

As noted by Landefeld and McCulla (2000), the costs of household production include the cost of purchased goods and services that are inputs to household production, the cost of capital services, and the cost of labor input. Purchased goods and services are already part of conventional income accounts. Accounting for capital services would involve imputing rental rates to consumer durables (and reclassifying durables purchases as household-sector investment). Data on labor input must come from time-use surveys.

The literature discusses two approaches to valuing labor input. The opportunity-cost approach uses the individual's market wage to value the time spent in household production. This cost approach has some conceptual and practical difficulties associated with it. On a conceptual level, the implicit assumption that hours of paid work are freely

variable at the margin may not hold; workers, at least in the short run, may have no choice in their working hours. Perhaps more importantly, the opportunity cost approach assumes that people who are highly productive in market work are just as productive doing household work. It is hard to imagine that lawyers are 5 times more productive building a deck than a carpenter. On a practical level, it would be necessary to impute a wage for nonworkers.

The other approach to valuation is the replacement cost approach, which uses the wage rate that would be paid to a third party. Within the replacement cost approach, one can use either a generalist or a specialist wage. If specialist wages are used, the labor cost of each task is the wage of specialists in that task. For example, the time spent caring for children is valued according to the rate of pay for child care workers, food preparation is valued at the wage of cooks, etc. One issue here is that specialists may be more productive than persons working at a variety of tasks in their own household. This shortcoming motivates using the generalist wage, which uses the wages for general household workers, namely housekeepers, as the cost of an hour of unpaid work.

Simultaneous activities complicate the valuation of household production, because it is necessary to allocate time to each activity. The treatment of simultaneous activities is much simpler if a generalist wage is used to value household work. In that case, it is necessary to disentangle the two activities when only one of them is household production. For example, if the respondent is looking after children and doing laundry, then the generalist wage is attached to that time. If the specialist approach is taken, it is necessary to determine the fraction of that time devoted to child care and the fraction devoted to

laundry. Both valuation approaches require disentangling the activities when one of the simultaneous activities is not household work.

Australia apparently does not include simultaneous activities in its measure of unpaid work. New Zealand (Statistics New Zealand 2001) presents some estimates that include simultaneous activities, but excludes passive child care (being "available for care" in their terminology). Conceptually, one might argue for its inclusion on the basis of the third-party test. One could value time spent in passive child care at housekeeper's wage or by wages for child-care workers or baby-sitters.

As long as passive child care is the only secondary activity collected in ATUS, one can take one of two approaches to incorporating simultaneous activities in valuing household work. The easiest approach would be to value only primary activities and ignore secondary child care. There is some logic to this approach in that it treats all secondary activities the same. But data from the 1992 Australian National Time-Use Survey, which collects secondary activities, indicates that individuals spend very little time (9 minutes per day for women and 5 minutes per day for men) doing “domestic activities” (household work) as a secondary activity. In contrast, men spend 17 minutes per day doing child care as a secondary activity and women spend 39 minutes.[10] The magnitudes of these differences suggests that more is lost by ignoring secondary child care than by treating secondary activities asymmetrically. Hence, ignoring secondary child care seriously underestimates the time spend in household production. This leads us to the alternative approach, which is to value the time spent in secondary child care when the primary activity is not household work. In that case, it would be reasonable to use the

[10] These estimates exclude times when the primary activity was housework, child care, or sleeping. Also keep in mind that the childcare estimates are averages over the entire population, not just parents.

baby-sitter wage (even if one takes a generalist approach), because babysitters typically engage in other activities while children are in their care.

A number of studies have used data from earlier time-use surveys to incorporate household production into estimates of national product. Because the earlier surveys were conducted very infrequently, these studies typically assume that there are no within-group changes in the time spent in nonmarket production, so that any changes in nonmarket production come through changes in the composition of the population (see Eisner 1988). In contrast, once enough data become available the ATUS will generate a consistent time series that will allow analysts to incorporate within-group changes in household production, enhancing our ability to examine long-term trends. Just as important, ATUS data will permit the first analysis of the cyclical behavior of household production.

Measuring Hours of Work

Statistics on hours worked are inputs into estimates of productivity and hourly wages, two numbers of great interest to economists. Currently, there are two sources of hours data: (1) the Current Employment Statistics (CES) survey, which is a monthly survey of over 300,000 establishments, and (2) the CPS, which is a monthly survey of approximately 60,000 households. Because of the nature of the surveys, they measure very different concepts.

The CES measures "hours paid," which includes paid vacations and paid breaks, and excludes off-the-clock work. BLS uses CES hours in its productivity estimates, making the following two adjustments to account for shortcomings of the CES data.[11,12]

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[11] BLS also uses data from the CPS to provide hours for small fraction of workers not covered by the CES (farm workers, proprietors, and unpaid family members).

First, because the CES does not collect hours data for nonproduction and supervisory workers, BLS must estimate the hours worked by these employees (see Eldridge, Manser, and Otto 2001 and 2003). And second, because hours worked is a more appropriate concept for productivity estimates, BLS adjusts the CES hours data for paid vacations using data from the National Compensation Survey.[13] These adjusted data still exclude off-the-clock work, but they are much closer to an hours-worked concept. The May 2001 supplement to the CPS (BLS 2002) provides some evidence on the extent of off-the-clock work. Approximately 10.3 million workers did some off-the-clock work, with the average among these workers being about 7 hours per week.

The CPS measures something closer to an hours-worked concept, because CPS respondents likely include paid breaks and off-the-clock work in their reported hours. (For many purposes, paid breaks are appropriately included in work. Hamermesh (1990) showed that breaks can enhance productivity, so it is reasonable to include paid breaks when estimating productivity.) Published estimates from monthly CPS data include paid vacations.[14] But it is possible to construct an hours measure that excludes vacations by dividing total actual hours worked in the previous week by all employed individuals, rather than just those who worked during the previous week.[15]

It has been noted that CPS-based and CES-based hours exhibit very different trends (see Abraham, Spletzer, and Stewart 1998,1999 and Robinson and Godby 1997), which has implications for estimates of hourly wage trends. Abraham, Spletzer, and Stewart

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[12] This paragraph draws heavily from Eldridge, Manser, and Otto (2001,2003)
[13] Prior to 2000, the CES hours data were adjusted using data from the Hours at Work Survey.
[14] By this, we mean that if the average weekly hours estimate is multiplied by 52, the resulting estimate annual estimate includes vacation time.
[15] Measures of annual hours computed from March Income Supplements would include paid vacations, because these are included in the weeks worked measure.

show that the different trends in hours accounts for all of the divergence between hourly wages derived from the National Income and Product Accounts (NIPA), which use CES hours, and estimates from the CPS.

One explanation for this divergence is that CPS respondents over-report hours and that the extent of over-reporting has increased over time. Robinson and Bostrom (1994) argue that to accurately answer a question about hours worked during the previous week respondents need to recall for each day of the preceding week whether they worked or not and how many hours they actually worked, but respondents rarely make this effort. Moreover, given the alternative definitions of "hours worked" mentioned above, it may not be clear what is being asked for--time actually worked, time scheduled for work, time paid, or some other concept. (It is worth noting that the CPS asks several hours questions compared with the single question asked in the time-use surveys used by Robinson and Bostrom. The CPS begins by asking about usual hours and then asks about extra hours worked and time off.) Finally, answers to the CPS hours-of-work questions are often provided by proxy respondents, whereas the responses are always self-reported in the time-use surveys.

For most purposes, analysts are more interested in trends than levels. Hence, biases that remain constant over time are less of a concern than biases that change over time. So it is essential to have time-use data at several points in time to determine whether estimated trends in hours measures have been affected by changes in under- or over-reporting of hours. Our existing knowledge of trends in biases in reporting of hours worked is sketchy. For example, Robinson and Bostrom (1994) report on three time-use studies conducted in 1965, 1975, and 1985. Robinson and Bostrom's analysis of these data yielded estimates

that when answering a CPS-like question workers over-reported weekly hours by an average of 1 hour in 1965, by an average of 4 hours in 1975, and by an average of 7 hours in 1985. However, sample sizes are only 1,244 in 1965, 2,406 in 1975, and 5,358 in 1985. Moreover, these surveys have different samples, cover different times of the year, and use different survey methods, making comparisons difficult.

Finally, it is important to note that the reference period for CPS is the week that contains the 12th of the month, while the CES reference period is the pay period that includes the 12th of the month. These reference periods were chosen to minimize the effect of holidays. But if one is interested in total hours (for example, to measure productivity), then complete coverage is desirable. ATUS sample are introduced continuously, and most holidays are covered (because the telephone centers are open the day after most holidays), supplying almost complete coverage of the calendar.[16]

Data from the ATUS have a number of advantages for measuring hours worked. Respondents need not try to recall over periods longer than a day, and by reporting individual episodes of work, they avoid having to add the lengths of different episodes. Paid work can include work at home or otherwise not at the workplace, so off-the-clock work will be collected. Moreover, as mentioned above, after the core time diary summary questions will be asked giving the respondent additional chances to identify an activity as paid work. This improves identification of paid work activities for the self-employed and others who do not "go to work" in the traditional sense.

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[16] Reference days before major holidays will be missed, as the telephone centers will be closed. The remaining days in the month that fall on the same day of the week as the missing day will have their weights inflated to make up for the missing day, in effect making the assumption (which we make in the absence of other information) that the activities on the missing day are similar to those on other days with the same day of the week.

ATUS data will allow analysts to exclude paid breaks from hours worked if they choose. Interviewers prompt respondents by asking "did you take any breaks of 15 minutes or longer?" whenever a work episode is reported.[17] Paid leave presents a more difficult challenge. Workers who travel away from their home are unavailable for interviewing, which means that these trips are missed in the time diary. This biases estimates of hours worked, but it is not clear what direction the bias will take. Missed business trips will bias hours downward, while missed vacations will bias hours upward. The ATUS allows analysts to correct for this missed-days bias by collecting information about the amount and purpose of absences from home as described in Section II. This missed-days correction requires an assumption about the hours worked during business travel, because they are not collected.

Because ATUS collects time diaries only for a single day, diary-based hours data cannot be used to compute hourly wages for ATUS respondents.[18] Further, sample sizes are too small to compute monthly, or even quarterly, estimates of aggregate hours for the purpose of estimating productivity. However, time-use data can be used to estimate biases of other sources of data. Analysts typically construct synthetic weeks that are representative of the group of interest (usually the entire population or a specific subgroup). For example, it would be possible to compute average weekly hours worked for everyone who is employed or for major industry groups.

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[17] Beginning in 2004, this prompt will be incorporated into the instrument. The prompt will automatically pop up whenever work episodes of 4 hours or longer are reported.

[18] It will be possible to use ATUS data to construct an hours-weighted average hourly wage, which would be comparable to hourly wage estimates from the CES and NIPA, and the CPS estimates in Abraham, Spletzer, and Stewart (1998).

Analyzing trends in paid work using ATUS, either by itself or in comparison with other surveys, will clearly not be possible for some time. However, ATUS will offer the advantages of relatively large sample sizes and consistent survey methods over time.

For purposes of illustration, we have identified four different measures of hours worked that can be estimated using ATUS data. Each of these definitions corresponds to a different concept of hours worked. Going from the most restrictive measure to the least restrictive measure, these are:

(1) Time spent in activities coded as "Worked at main job" or "Worked at other job" plus activities coded as "Travel related to job" (not commuting).
(2) Definition (1) plus activities identified as breaks.
(3) Definition (2) plus activities that were coded as being done for the respondent's job.
(4) Time between the beginning of the first episode of work and the end of the last episode of work, where separate computations are made for main and other jobs.

The final definition was motivated by speculation about how respondents respond to hours questions. Abraham, Spletzer, and Stewart (1998) speculated that the apparent increase in over-reporting of hours may be due to the increase in flexibility that workers have over their work schedules. Robinson, Chenu, and Alvarez (2002) analyze data from "work grids" that respondents use to identify specific times they worked during the last week. Their evidence (from French workers) is consistent with the conjecture that greater work-schedule flexibility results in greater over-reporting. A study by Jacobs (1998) suggests that respondents may be reporting the time between when they arrived at work and when they left, ignoring any intervening time away from work.

Table 1 contains the widths of 95-percent confidence intervals for these five alternative measures of average weekly hours using ATUS data from the first quarter of 2003. Note that these are not official standard errors. ATUS weights are not yet available,

so we used CPS weights and made a day-of-week adjustment. The procedure we used accounts for the complex survey design of the ATUS, but is not the same as the official procedure, which uses replicate weights. We believe that these confidence intervals should be fairly close to the official estimates. It is also worth noting that these confidence intervals will increase when the sample is reduced in January, 2004.

One can see that the width of the 95-percent confidence intervals for the various hours worked estimates are in the 2.5 - 3.0 hour per week range. Given that monthly changes in average weekly hours tend to be rather small, ATUS data will not be useful for detecting changes in hours worked on a monthly or even a quarterly basis. However, note that the differences in hours worked among the different definitions are more precisely estimated.

Correcting for Missed Days

As noted above, time-diary data estimates of hours worked generally ignore time when the respondent is absent from home. However, using the missed-days data and making a few assumptions it will be possible to adjust ATUS estimates to account for absences from home. As a first step, let us illustrate the problem.

Consider the example of a trip where the respondent is away from home for four nights and five days (the vertical lines indicate nights away from home).

Day 1	Day 2	Day 3	Day 4	Day 5
travel |	activities |	activities |	activities (pre-return) |	travel

The time diary will collect data about Day 5 of the trip (the day the respondent returned from home) with the same probability as any other day. ATUS also collects data about the day before the return day (which we call a "pre-return" day), but with lower probability

than the return day (because travel can consume much of the day, leaving little time to contact the respondent). So we would like to devise a way to use the data from the missed-days questions to count the first three days of the trip.

The missed-days questions collect information about the number of trips, the number of nights away from home, and the purpose of the trip. These data can be used to generate aggregate estimates of the time not captured by the time diaries (the first three days of the trip in the above example). Because the missed-days section captures the first four days of the trip, "pre-return" days are counted twice. This means that it is necessary to subtract any "pre-return" days in the time-diary data from the count of days away from home. For multiple-night trips, the number of days away from home that are not accounted for in the time diary is:

$$M = TN - A_M, \quad (1)$$

where M is the number of days away from home (multiple-night trips), TN is the number of nights away from home (from the missed-days section), and A_M is the total number of "pre-return" days for multiple day trips.

Overnight trips are captured only in the time diary. As with multiple-day trips, the time diary captures the last day of the trip and, in some cases, the "pre-return" day. Because we do not have a count of the number of overnight trips, this is estimated as L − T, where L is the number of last days of a trip and T is the total number of trips (from the missed-days section). As above, we must subtract the number of "pre-return" days captured in the time diaries. Thus the number of days away from home on overnight trips is:

$$O = L - T - A_O, \quad (2)$$

where A_O is the total number of "pre-return" days for overnight day trips. Adding equations (1) and (2), we have:

$$D = M + O = TN - A_M + L - T - A_O = TN + L - T - A,$$

where D is the number of days away from home (all trips), and $A = A_O + A_M$. To estimate D using ATUS data, we must be able to reliably identify "pre-return" days and the last day of a trip. As it turns out, it is very difficult to do this,[19] making it impossible to obtain estimates of L and A. However, if we assume that L = A, then it is possible to estimate the number of missed days as:

$$D = TN - T.$$

This will underestimate the number of days traveling, because, as noted above, the probability of sampling an away day is lower than that of the last day of a trip. But it may be the best we can do.

The next step is to adjust the time-diary estimates of hours worked. First, we must make additional assumptions about hours worked while on travel. We assume that respondents work 8 hours per day if the trip is work-related and 0 hours per day otherwise. Letting D_M be the total number of person-days in the month, we have:

$$\text{Total hours of work in month} = (D_M - D) \times H_{TD} + D_W \times 8,$$

where D_W is the number of work-related travel days and H_{TD} is the average hours worked per day estimated from the time diary.

[19] The respondent is not asked about location if the activity is sleeping or grooming, because BLS judged this to be too intrusive. This makes it difficult to identify the location of the first activities of the day.

Other uses for time-use data

In addition to measuring non-market work and improving measurement of market work, time-use data can be used for a variety of other purposes of interest to economists. We mention a few uses here.

Intrahousehold allocation of time

Although ATUS will interview only one household member, some analysis of intra-household time allocation will be possible. Because the survey sample will be drawn from the CPS, which gathers demographic and labor market information for the entire household, analysts will have available a rich set of controls for household members other than the respondent. Most of this information will have been collected in prior months, but, as noted above, ATUS will update the spouse's labor force status and usual hours of work.

This background information from the CPS allows ATUS to be used in the analysis of the intra-household allocation of time. One can examine mean hours of time spent in a given activity by individuals in given living arrangements, and compare means across different individuals in that same arrangement. For example, one can examine the hours spent in leisure activities for married men and married women. More complicated examples include comparing the leisure time (and difference in leisure time) of husbands and wives when both work full time to leisure time when the husband works full time and the wife works part time. Since the CPS collects data on wages,[20] it will also be possible to estimate the average difference in time spent in an activity between husbands and wives

[20] Note that the analyst will have information on the respondent's wages as of the previous CPS month, and as of the current ATUS month if he or she has changed jobs. The analyst will have information on the spouse's wages as of the previous CPS month.

with a given wage rate for the wife, or a given difference in wage rates between the husband and wife.

Income and well-being.

In addition to allowing construction of measures of non-market production at the aggregate level, ATUS data will also allow non-market production to be measured by demographic group. It is widely known that differences in money income between more and less educated households have increased over the past two decades. With ATUS, it will be possible to examine differences among education groups using an income concept that includes household production, either using CPS MIS-8 earnings data (which ignores unearned income) or (for some months) March Income Supplement data. Similarly, it will be possible to compare differences in income inclusive of household production among racial groups, or among other demographic categories. Differences in leisure between demographic groups could be analyzed in a similar fashion.

Activities of non-workers.

While prime-age males have higher labor force participation rates than prime-age females, an increasing percentage of prime-age males are not in the labor force (see Juhn 1992 and 2003, Welch 1997, and Stewart 2003). So one might wonder, what do male non-workers do?

Stewart (2003) examines this question using data from a 1992-94 time-diary study conducted by the University of Maryland. He compares how male workers and nonworkers use their time. He finds that full-time workers spend about 6 hours more per day in work and work-related activities than do nonworkers. Put another way, nonworkers

have about 6 hours more per day to "spend" in activities other than paid work. How do they spend this time? Stewart finds that they spend just over one-quarter of this time in productive activities such as education and household work. The remaining three-quarters are spent in leisure (mainly watching TV) and personal care (mainly sleeping).

ATUS data could add to our understanding of male nonworkers in two ways. First the sample size will be significantly larger. Stewart had only 1,775 observations, of which only 137 where nonworkers. A larger sample would generate more precise estimates (although the differences found by Stewart are significant at the 5 percent level), and would allow more detailed comparisons. Second, the ATUS has more detailed information about labor market activities. For example, by matching to previous CPS interviews it will be possible to distinguish between long-term and short-term nonworkers.

IV. Comparability to Other Time-Use Surveys

Researchers will undoubtedly want to compare estimates from the ATUS to those from earlier time-use surveys. For these comparisons to be valid, it will be necessary to make the data sources as comparable as possible. This will require accounting for differences in coding systems, samples, and survey methods.

There is research currently under way that will shed light on these differences. A report by Ann Gauthier compared the ATUS coding system to those used in other time-use surveys, and made recommendations, most of which were followed, on how to make the coding systems more compatible. Andrew Harvey and Jonathan Gershuny are examining impact of methodological differences between the ATUS and earlier U.S. time-use surveys

(Harvey) and other countries' time-use surveys (Gershuny). Table 1 summarizes some of the important differences in the major U.S. time-use surveys.[21]

As can be seen, there are some significant differences across surveys. The 1965-66 survey sampled individuals in small cities, while the others were nationwide. The 1965-66 and 1975-76 surveys contacted respondents in person, while the 1985 survey used several interview modes. The quota sample of days in the 1965-66, 1975-76 and 1985 surveys means that individuals were not randomly assigned to days of the week, but that days were assigned to distribute interviews across the days of the week. Respondents in these surveys were contacted using a convenient-day approach. The "yesterday" diaries were collected either in person or over the telephone, and the diary day is the day before the interview. The reference day for "tomorrow" diaries is the day following the interview. Respondents fill out a paper diary, which is either picked up by the interviewer or mailed back to the respondent.

Some methodological differences will be innocuous, while others could have an unexpectedly large impact. To illustrate how seemingly minor differences in survey methods can affect estimates, we consider the case of contact schedules.

Differences in Contact Schedules

Typically DPs are randomly assigned to initial calling days, and contact schedules specify eligible days for subsequent contact attempts. Because the reference day is always the day before the interview, this reassignment of calling days introduces the possibility that the probability of interviewing the respondent about a given reference day is correlated with the activities on that reference day.

[21] The information in this table is from Robinson and Godby (1997) and Harvey and St. Croix (2003).

Contact schedules fall into two main categories: designated-day schedules and convenient-day schedules. Both types of schedule randomly assign each respondent to an initial calling day. If and when the respondent is contacted--either on the initial or a subsequent calling day--the interviewer attempts to collect information about the reference day (the day before the calling day). Designated-day schedules specify that subsequent contact attempts be made on the same day each week until the DP is contacted, whereas convenient-day schedules specify that contact attempts be made on consecutive days.[22] While the ATUS uses a designated-day contact schedule, many of the earlier time-use studies conducted in the U.S. have used a convenient-day schedule. It is important to note that the following discussion refers to "yesterday" diaries, but not "tomorrow" diaries.

Stewart (2002) has examined the bias that can be introduced by alternative contact schedules. He finds that, under the most common patterns of activities, the convenient-day schedule systematically overestimates activities that are negatively correlated with the probability of contacting the respondent (typically activities done away from home such as paid work) and underestimates activities that are positively correlated with the contact probability (typically activities done at home such as housework). The intuition behind this result is straightforward. If an individual is initially contacted on a busy day,[23] he is less likely to be interviewed on the initial contact day and more likely to be interviewed on the following day (about the busy day). Regardless of the number of subsequent contact attempts, the DP is more likely to be contacted on non-busy day that immediately follows a

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[22] In practice, the DP will be contacted, but will ask to reschedule the interview to a more convenient time. Because respondents are not likely to schedule interviews on busy days, allowing them to choose their interview day is really no different than the interviewer proposing consecutive days (or calling on consecutive days) until the potential respondent accepts. Hence, one may think of the convenient-day schedule as being functionally identical to an every-day contact attempt schedule.

[23] By busy, we mean difficult to contact.

busy day. Hence, the reference day is more likely to be a busy day. In contrast, the designated-day schedule does not generate any systematic bias. This means that estimates generated using a convenient-day schedule are not comparable to estimates generated using a designated-day schedule.

How important is this bias likely to be? Perhaps the best way to illustrate the potential importance of this bias is to examine some of the results from a paper by Hamermesh (1990) that compares hours at work between the 1975-76 survey and its 1981 follow-up. The 1975-76 survey used a convenient-day contact schedule. The 1981 follow-up survey interviewed the same people and used a designated-day contact schedule. Hamermesh found that time spent at work fell sharply--by 4.5 percent--between the two surveys. Because hours worked from the CPS-like question remained constant, Hamermesh speculated that biases in reported hours from household surveys may be increasing. However, subsequent research by Stewart (2002) suggests that the convenient-day schedule overestimates hours of paid work by 2.9 percentage points, implying that the differences in contact schedules could have accounted for 64 percent of the decline in time spent at work. While the assumptions underlying the simulation could be incorrect, this example illustrates that differences in contact strategy may seriously affect the comparability of time-use surveys. Other properties of the convenient-day schedule are discussed in Stewart (2002).

VI. Concluding Remarks

Economists have been aided by time-use surveys in seeking to understand the behavior of hours worked, the extent of household production, and other issues. However,

existing surveys have been conducted infrequently, with small sample sizes and with differences in methods between surveys. As a result, analysts have used data from a single survey and assumed that all changes in time use over time were due to compositional changes. Or they have constructed a time series from several surveys that use different methods.

The ATUS will allow analysts to track trends in time use. The survey can also track trends in differences between hours in an activity (such as paid work) as shown in a time-diary and hours as shown in other surveys using simpler questions. The sample size over periods of a year or more will allow more detailed analyses of time use than has been possible in the past.

References

Abraham, Katharine G., James R. Spletzer, Jay C. Stewart. 1998. "Divergent Trends in Alternative Wage Series." In *Labor Statistics Measurement Issues*, NBER Studies in Income and Wealth, v. 60, ed. John Haltiwanger, Marilyn E. Manser, and Robert Topel, 293-324. Chicago: University of Chicago Press.

Abraham, Katharine G., James R. Spletzer, Jay C. Stewart. 1999. "Why Do Different Wage Series Tell Different Stories?" *American Economic Review Papers and Proceedings* 89:2, 34-39.

Australian Bureau of Statistics. 2001. *Unpaid Work and the Australian Economy 1997*.

Bureau of Labor Statistics. 2002. "Work at Home in 2001." Press release USDL 02-107.

Eisner, Robert. 1988. "Extended Accounts for National Income and Product." *Journal of Economic Literature* 26, 1611-84.

Eldridge, Lucy, Marilyn E. Manser, and Phyllis Otto. 2001. "The Impact of Alternative Measures of Nonproduction and Supervisory Worker Hours on Productivity Growth." Mimeo, BLS.

Eldridge, Lucy, Marilyn E. Manser, Phyllis Otto 2003 "Alternative Hours Data and Their Impact on Productivity Change." Mimeo, BLS

Hamermesh, Daniel. 1990. "Shirking or Productive Schmoozing: Wages and the Allocation of Time at Work." *Industrial and Labor Relations Review* 43:3, 121S-133S.

Harvey, Andrew and Aimee St. Croix. 2003. unpublished table, Time-Use Program, St. Mary's University.

Herz, Diane and Michael Horrigan. 2003. "A Study in the Process of Planning, Designing and Executing a Survey Program: The BLS American Time-Use Survey." Mimeo, BLS.

Jacobs, Jerry A. 1998. "Measuring Time At Work: Are Self-Reports Accurate?" *Monthly Labor Review* 121:12, 42-53.

Juhn, Chinhui. 1992. "Decline of Male Labor Market Participation: The Role of Declining Market Opportunities." *Quarterly Journal of Economics* 107, 79-121.

Juhn, Chinhui. 2003. "Labor Market Dropouts and Trends in the Wages of Black and White Men." Industrial and Labor Relations Review 56:4, 643-662.

Landefeld, J. Steven and Stephanie H. McCulla. 2000. "Accounting for Nonmarket Household Production Within A National Accounts Framework." *Review of Income and Wealth* 46:3, 289-307.

Nordhaus, William. 2002. "An Economist's View of the Statistical State of the Nation." Testimony before the Joint Economic Committee of the U.S. Congress, July 24, 2002.

Reid, Margaret G. 1934. *Economics of Household Production*. New York: Wiley and Sons.

Robinson, John and Ann Bostrom. 1994. "The Overestimated Workweek? What Time Diary Measures Suggest." *Monthly Labor Review* 117:1, 11-23.

Robinson, John P., Alain Chenu, and Anthony S. Alvarez. 2002. "Measuring The Complexity Of Hours At Work: The Weekly Work Grid." *Monthly Labor Review* 125:4, 55-63.

Robinson, John P., and Geoffrey Godbey. 1997. *Time for Life: The Surprising Ways Americans Use Their Time*. 2nd ed. State College, PA: Penn State Univ. Press.

Schwartz, Lisa K. 2001. "Minding the Children:Understanding How Recall and Conceptual Interpretations Influence Responses to a Time-Use Summary Question." Mimeo, BLS.

Statistics New Zealand. 2001. Measuring Unpaid Work in New Zealand 1999.

Stewart, Jay. 2002. "Assessing the Bias Associated with Alternative Contact Strategies in Telephone Time-use Surveys." *Survey Methodology*, Dec. 2002.

Stewart, Jay (2003) "What Do Male Nonworkers Do?" Mimeo, BLS.

UK Office of National Statistics. 2002. *Household Satellite Account (Experimental) Methodology*.

United Nations. 1993. *System of National Accounts 1993*.

Welch, Finis. 1997. "Wages and Participation." *Journal of Labor Economics* 15:1 (Part 2), S77-S103.

Table 1: 95 Percent Confidence Interval Widths for Alternative Weekly Hours Measures from ATUS - Q1:2003

Definition	#1	#2	#3	#4
Confidence interval for measure	±1.234	±1.246	±1.246	±1.520
Confidence interval for difference				
#2	±0.035			
#3	±0.056	±0.043		
#4	±0.607	±0.606	±0.607	

Key:

Definition #1: Time spent in activities coded as "Worked at main job" or "Worked at other job" plus activities coded as "Travel related to job" (not commuting).

Definition #2: Definition #1 plus activities identified as breaks.

Definition #3: Definition #2 plus activities that were coded as being done for the respondent's job.

Definition #4: Time between the beginning of the first episode of work and the end of the last episode of work, where separate computations are made for main and other jobs.

Note: Authors' calculations (see text) -- THESE ARE NOT OFFICIAL ESTIMATES. Confidence intervals are expressed as deviations from the mean.

Table 2: Comparison of Major U.S Time-Use Surveys

Survey / Description	Americans' Use of Time	Time Use in Economic and Social Accounts	Americans' Use of Time	American Time-Use Survey
Dates survey was conducted	Nov. 15 - Dec 15, 1965 March 7 - April 29, 1966	Oct. - Nov. 1975, and reinterviewed in Feb., May, and Sept. of 1976	Jan. 1 - Dec. 30, 1985	Continuous beginning in January, 2003
Data collection mode	Self-administered diary collected through personal interviews and leave-behind diaries Quota sample of days	Personal interviews Quota sample of days	Self-administered diary collected through mail-backs, telephone, and personal interviews Quota sample of days	Computer assisted telephone interviewing
Sample description	Nationwide: 44 cities with population of 30,000 - 280,000 18-65 year olds At least one household member must have worked 10+ hours in nonfarm sector	37 states and Washington, D.C. 18+ year olds	Nationwide 12+ year olds Restricted to urban population	Nationwide 15+ year olds
Diary type and sample size	Yesterday (130) Tomorrow (1,244)	Yesterday (2,405)	Yesterday (1,468) Tomorrow (3,890)	Yesterday (approx. 1,850/month in 2003 and 1,250/ month thereafter)