Economists and Time Use Data

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Outline

A Few Thoughts on Time Use Data

Estimation Issues

How Do Economists Use Time Use Data?

A Few Thoughts on Time Use Data

The distinctive feature of time-diary data, compared with other household survey data, is the short reference period of a single day or at most a few days

- More accurate data
- Relatively free from social desirability bias

But…

- Does not accurately measure long-term time use for any individual

Data from time-use surveys are not a sample of individuals

They are best thought of as sample of person-days

This has important consequences for analysis

A Few Thoughts on Time Use Data (continued)

Estimation Issues – Summary of Paper

Frazis, Harley and Jay Stewart "How to Think About Time-Use Data: What Inferences Can We Make About Long- and Short-Run Time Use from Time Diaries?"*Annales d'Economie et Statistique* (*Annals of Economics and Statistics*) 105/106, January/June 2012, pp. 231-246.

Our Main Question

What can (and can't) be estimated from single-day, single-person time diary data? (American Time Use Survey, for example)

Outline

Time use as a dependent variable

Time use as an independent variable

Time use on both sides of the equation

Time Use as a Dependent Variable

2 sources of variation in time diary data:

1) across persons
2) within persons, across days

Time-use (in activity of interest) of person i on day d :

$$t_{id} = m_i + e_{id}$$

where:

$m_i = E_d(t_{id})$ is the long-run average of individual i's time use.

e_{id} is the deviation from m_i for a given day.

$E(e_{id})=0$, uncorrelated with m_i by construction.

We are *not* assuming e_{id} independent across days.

Time Use as a Dependent Variable (continued)

Does the research question pertain to long-run (m_i) or short-run time use (e_{id})?

Most policy-related questions require information on long-run time use

➔ Mismatch between period of interest (average time use over the course of a month or a year) and reference period of the data (diary day)

Time Use as a Dependent Variable (continued)

What measures of *long-term* time-use can we estimate?

Long-term means and totals are just the sum of daily means and totals—if mean daily time = 1 hour, mean weekly time = 7 hours.

Long-term medians, variances, most other summary statistics aside from means and totals are not the sum of the corresponding daily statistics and cannot be estimated from sample of person-days.

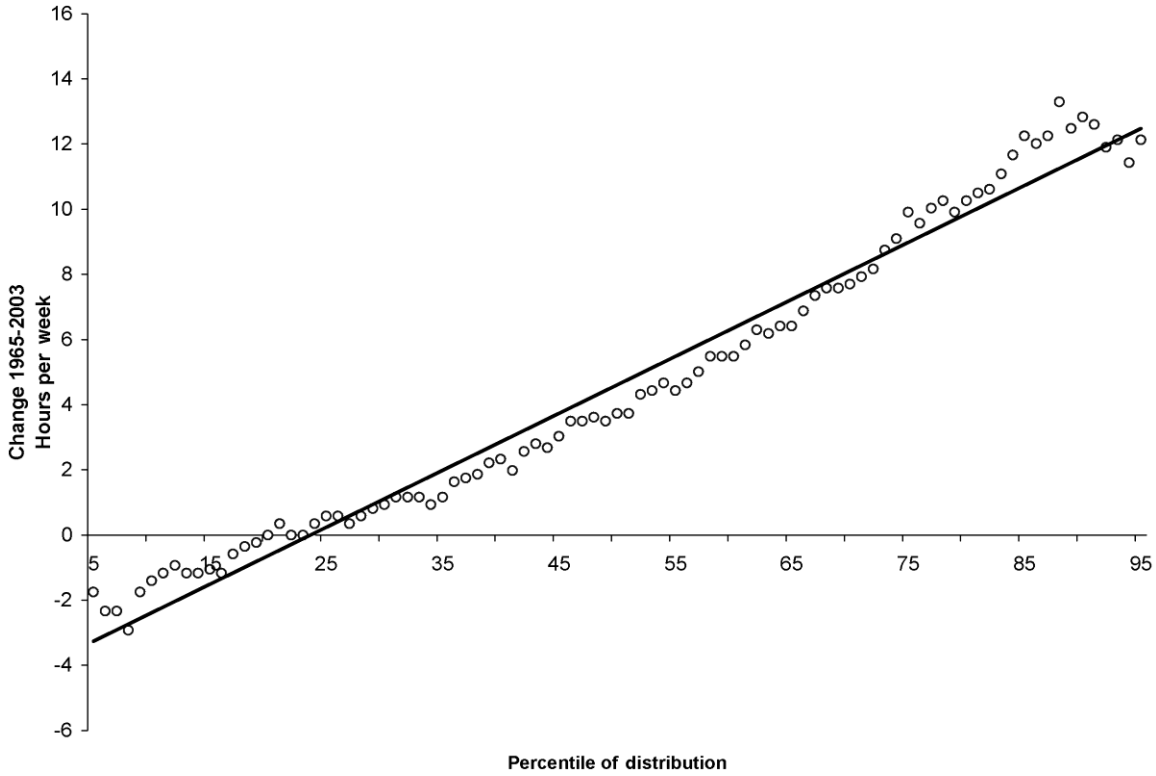
Examples

Variance of 2 days' time use

$$Var(t_1 + t_2) = Var(t_1) + Var(t_2) + 2Cov(t_1, t_2)$$

dependent on unobserved covariance between t_1, t_2.

The median and other percentiles are other statistics whose long-run value cannot be calculated from daily data.



Change by Percentile Point for Leisure, 1965–2003
This figure plots the change at each percentile point of the Leisure distribution (from Aguiar and Hurst 2007).

Examples (continued)

The data compare the endpoint years (1965 and 2003) from single-day surveys

The implicit interpretation in paper is that leisure grew more unequal across persons

But another interpretation is that distribution of time spent in leisure activities across days within persons grew more unequal with no change (aside from mean shift) in between-person distribution

We cannot distinguish the two from the data

Functional form

Time-diary data typically have a large number of "zeros"

There is a long tradition of treating these zeros as censored observations and using Tobit to estimate regression equations

But the zeros in time-diary data are typically not due to censoring because researchers are typically analyzing the amount of time spent in an activity by *people who do the activity*

Given the zeros in time-diary data are not due to censoring, it is not clear that Tobit is appropriate

Functional form (continued)

Tobit model:

$y^* = \beta_0 + \beta_1 X + \varepsilon;\ \ \varepsilon \sim N(0, \sigma^2)$

- If $y^* > 0$, $y = y^*$
- If $y^* \leq 0$, $y = 0$

Stringent assumptions:

· Determinants of participation same as determinants of duration conditional on participation.

· No fixed costs (small values not unlikely).

Note that if OLS is right in the long run it's right in the short run—large number of zeros do not imply E(t|X) nonlinear.

So OLS is viable alternative.

Time use as an Independent Variable

Suppose we would like to estimate the following equation:

$$Y_i = X_i\beta + t_{id}\gamma + u,$$

where Y is a long-term outcome such as obesity or wages

A single day's time use virtually no effect on Y

In this case t_{id} a proxy for long-run time use, m_i

We can view this as a case of classical measurement error:

$(t_{id} - m_i) = e_{id}$, which is uncorrelated with m_i

Time-use as an Independent Variable (continued)

The coefficient on t_{id} is biased downward in magnitude if only one time-use variable is included as a RHS variable

If more than one time-use variable is included, then the sign of the bias cannot be determined (*i.e.*, sign reversal is possible)

Solutions:

- Instrumental variables (Pinkston and Stewart 2009)
- Aggregation (Faberman 2010)

  The variables used to group observations should have no independent effect on the dependent variable.

Time Use on Both Sides of the Regression Equation

Suppose we would like to estimate the following equation:

$$t_{id}^{A} = \alpha + \beta t_{id}^{B} + u_{id}$$

Time spent in activity *A* is a function of the time spent in activity *B*.

What does OLS estimate?

Time Use on Both Sides of the Regression Equation (cont.)

The OLS coefficient can be expressed as:

$$\beta = \frac{Var(m_i^B)\beta_m + Var(e_{id}^B)\beta_e}{Var(m_i^B) + Var(e_{id}^B)}$$

where:

β_m coefficient from regression $m_i^A = \alpha_m + \beta_m m_i^B + u_m$ (LT)

β_e coefficient from regression $e_{id}^A = \alpha_e + \beta_e e_{id}^B + u_e$ (ST)

➔ The OLS estimate is a weighted average of these two effects, where the weights are not known

Time Use on Both Sides of the Regression Equation (cont.)

Interpretation of the coefficients:

- Across person (β_m): do people who spend a lot time in activity A also spend a lot of time in activity B?
- Within day (β_e): do people tend to do activities A and B on the same day?

OLS estimates are a weighted average of these two effects (where the weights are unknown)

Either question might be of interest, but it is hard to imagine what question a mixture of the two effects might answer

Time Use on Both Sides of the Regression Equation (cont.)

Instrumental variables can be used to estimate either β_m or β_e

Example: Christian (2009) used traffic accidents on the diary day as instrument for commuting time, which implies that he is identifying β_e and that it is short-run time use (e_{id}^{B}) that is of interest

An alternative would be to use a long-run measure of traffic patterns, such as average commute time (by metropolitan area) to instrument for m_i

Another alternative to identifying the effect on long-run time use would be to use traffic accidents on the diary day, but aggregate over the entire year

Time Use on Both Sides of the Regression Equation (cont.)

Other survey designs:

Multiple household members:

Can estimate

$$t_{id}^{H} = \alpha + \beta t_{id}^{W} + u_{id}$$

where H denotes husband and W denotes wife.

Issues analogous to previous case: OLS estimates a weighted average of β_m—effect of long-run average wife's time use on long-run husband's time use—and β_e—controlling for long-run average, to what extent do husbands and wives do activities on the same day?

Time Use on Both Sides of the Regression Equation (cont.)

Again, weights are unknown.

As above, instrumental variables can estimate either β_m or β_e.

Note that the data for husbands and wives do not need to be from the same household. Having data on couples does not add to identification.

Conclusions

The short reference period of time diaries has important implications the analysis of time-use data

In particular, time spent in an activity on the diary day is a noisy measure of long-term time use

Time diary data are best thought of as a sample of person-days—they are not a sample of individuals

Conclusions (continued)

Implications

- Estimated means from time-diary data accurately reflect the long-run means of individuals
- Other statistics such as medians, variances do not accurately reflect long-run counterparts for individuals
- Day-to-day variation in time-use variables needs to be accounted for when they are used as explanatory variables
- Association between different time-use variables is a mixture of the long-term and short-term relationships. Simple least-squares estimates of the association are uninterpretable.

What Questions Have Economists Examined?

- Trends in leisure
- Accuracy of hours data in household surveys
- Household decision-making
- Job search and behavior of the unemployed
- Time use and health/obesity
- Household production
- Timing of activities

Hours of paid work

Harley Frazis and Jay Stewart, “What Can Time-Use Data Tell Us About Hours of Work?", Monthly Labor Review (December 2004).

Harley Frazis and Jay Stewart, "Where Does the Time Go? Concepts and Measurement in the American Time Use Survey", in Hard to Measure Goods and Services: Essays in Memory of Zvi Griliches, Ernst Berndt and Charles Hulten, eds., NBER Studies in Income and Wealth, University of Chicago Press (2007).

Hours of paid work

Hours worked for pay:

- Measure of labor utilization
- Component of productivity (= Output/Hours)
- Component of hourly wages (= Earnings/Hours)

Two major sources of data:

- Current Employment Survey (CES)
- Current Population Survey (CPS)
  - Usual weekly hours
  - Actual hours worked reference week

Labor Force Information for ATUS Respondent

ATUS asks a subset of questions from the CPS

- Labor force status (E,U,N) -- Reference period is previous 7 days
- Usual hours worked per week

- Can link to MIS 8 interview.
- ATUS does not ask actual hours worked last week.

Alternative Hours Measures From ATUS

- Time spent in activities coded as "Worked at main job" or "Worked at other job"
- Definition (1) plus activities identified as breaks of 15 minutes or less and work-related travel between work sites
- Definition (2) plus activities that were coded as being done for the respondent's job

Comparing ATUS and CPS weekly hours

- Construct ATUS weekly hours by multiplying daily hours by 7. Records are reweighted so each day of the week has equal weight.

- 2003 ATUS response rate 58 percent. Need to account for possible bias due to sample composition.

- CPS reference week is week containing the 12th of the month. ATUS is continuous (including many holidays).

Hours of paid work in ATUS and CPS

Time Period	Jan. 2003 - Dec. 2003				Oct. 2002 - Sept. 2003	
Survey - Hours response from…	ATUS			CPS	CPS	CPS
Sample - Respondents participated in…	ATUS			CPS	ATUS	CPS MIS 8
Hours Measure	Def. 1	Def. 2	Def. 3	Actual CPS	Actual CPS	Actual CPS
Average Weekly Hours	37.3	37.7	37.9	39.0	38.5	38.8
Difference from CPS actual hours	-1.7**	-1.3**	-1.1**			
Difference from CPS actual hours adjusted for sample composition	-1.4**	-1.0**	-0.8**			

Hours of paid work in ATUS and CPS

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Survey - Hours response from…	ATUS			CPS	CPS	CPS
Sample - Respondents participated in…	ATUS			CPS	ATUS	CPS MIS 8
Hours Measure	Def. 1	Def. 2	Def. 3	Actual CPS	Actual CPS	Actual CPS
Average Weekly Hours in CPS Reference Weeks	38.6	39.0	39.1	39.0	38.7	38.8
Difference from CPS actual hours	-0.5	-0.1	0.1			
Difference from CPS actual hours adjusted for sample composition	-0.3	0.1	0.3			

Matched data

Hours of paid work in ATUS and CPS (continued)

Time Period	Jan. 2003 - Dec. 2003			Oct. 2002 - Sept. 2003		
Survey - Hours response from…	ATUS			ATUS	CPS	CPS
Hours Measure	Def. 1	Def. 2	Def. 3	Usual	Usual	Actual
Average Weekly Hours	37.3	37.8	37.9	39.3	39.3	38.6
Difference from CPS actual hours	-1.3	-0.8	-0.7			
Average Weekly Hours in CPS Reference Weeks	38.8	39.3	39.5	39.7	39.7	39.3
Difference from CPS actual hours	-0.5	0.1	0.2			
Average Weekly Hours in Non-reference Weeks, Nonholiday	37.4	37.9	38.0	39.3	39.2	38.4
Diff. from CPS actual hours	-1.0	-0.5	-0.4			

Demographic breaks (matched data)

Time Period	Jan. 2003 - Dec. 2003			Oct. 2002 - Sept. 2003
Survey - Hours response from…	ATUS			CPS
Hours Measure	Def. 1	Def. 2	Def. 3	Actual
Men	40.4	40.9	41.0	40.9
Women	34.2	34.6	34.7	36.2
HS Dropout	38.5	39.1	39.2	39.0
HS Grad	37.5	38.2	38.2	38.7
Some College	37.8	38.3	38.4	38.9
College Grad	37.8	38.1	38.2	39.8

Conclusions

- CPS respondents report actual hours worked correctly on average
- Some groups over-report hours, while others under-report
- People work longer during the CPS reference week (the week that includes the 12th of the month) ➔ CPS hours are not representative of the entire month

An additional point on hours of work: Sufficient data to begin to look at cyclical properties. ATUS diary hours less cyclical than CPS but more cyclical than CES. (Burda, Hamermesh and Stewart, AEA Papers and Proceedings 2013).

Household Bargaining

Leora Friedberg and Anthony Webb. "The Chore Wars" (2006). Unpublished paper. Available at: http://works.bepress.com/anthony_webb/30.

Nabanita Datta Gupta & Leslie Stratton, 2010. "Examining the impact of alternative power measures on individual time use in American and Danish couple households," Review of Economics of the Household, vol. 8(3), pages 325-343.

Household Bargaining

In recent decades economists have moved away from considering household as unit with single decision maker/utility function.

Consider models of decision-making within household. Allocation within household depends on relative bargaining power.

Observable consequences—expenditures and time.
Unlike expenditures, possible to assign time cleanly to one member of household.

Household Bargaining (continued)

Alternate measures of bargaining power:

- share of total wages
- share of years of education (related to earning power, but not dependent on being in labor force)

Empirical approach: Time use as a function of bargaining power measure and other observables.

Household Bargaining (continued)

Note in ATUS time use observable for one spouse but rich set of observables for couple from CPS:

- labor force status,
- earnings,
- education,
- presence of children...

Coefficient on Power Measure, minutes per day of leisure, ATUS 2003-06

	Women		Men	
	Work days	Nonwork days	Work days	Nonwork days
Actual wage share	-27.27	-31.34	-31.6	2.73
	(21.66)	(32.10)	(24.74)	(41.47)
Predicted wage share	20.03	66.59	30.15	169.74***
	(47.76)	(51.13)	(37.59)	(64.80)
Years of education share	17.14	121.23**	43.77	138.85*
	(48.80)	(49.20)	(45.44)	(73.21)

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