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On Measuring Convergence in the Use of Time

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Abstract

In the study of the effects of retirement on the allocation of time, this paper discusses methods that evaluate convergence in patterns of time use. Scalar measures of multivariate scatter are revealed to be a more general method than previous devices utilized in the time-use literature. However, since time devoted to some activities could be correlated with time devoted to others, the degree of scatter observed in the data tend to be affected by the level of activity aggregation selected by the researcher.

JEL codes: J22, J26.

Key words: Time-use convergence, retirement, multivariate scatter.

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1 Introduction

The purpose of this paper is to discuss methods that permit to evaluate the level of convergence—or, in other words, the degree of heterogeneity—in patterns of time use. Apart from the behavioral interest that the notion of convergence in the use of time might arise, several authors have proposed methods that complement the collection of time-budget information with measures of the satisfaction people derive from their daily activities.[1] Therefore, in anticipation of the growing availability of hybrid data with information on how people use their time and how they experience their activities,[2] the analysis of convergence in the allocation of time seems a necessary step in order to later study whether groups of individuals or even regions and countries converge in their level of declared or experienced well-being.

The paper is structured as follows. In Section 2 we discuss methods available to assess convergence in the use of time, providing special emphasis to scalar measures of multivariate scatter. For the sake of example, these methods are then utilized to study whether time-use patterns diverge after retirement from the labor market. This framework of discussion has been selected because retirement is accompanied by changes in economic factors such as income and the price and availability of non-market time that, following Becker (1965), could have significant effects on individuals' allocation of time. A formal discussion about the mechanisms through which these economic factors might affect the degree of convergence in patterns of time use of employed and retired individuals is provided in Section 3. Section 4 describes the data used to analyze the effect of retirement on convergence in the use of time. Recent, representative time-use surveys collected in three different countries—the U.S., Germany, and Spain—are utilized in order to study whether the effect of retirement is similar across countries. Results are presented in Section 5. The main conclusion of this study is that, although scalar measures of multivariate scatter constitute the most general method to assess convergence in the use of time, the level of aggregation selected for the classification of individuals' activities might affect the conclusions obtained with them.

2 Convergence in the Use of Time

This section discusses how to assess convergence in the use of time. We start with a review of two methods utilized in the time-use literature that evaluate—either graphically or numerically—the distance between multivariate vectors containing mean times devoted to several activities. After discussing some of their limitations, scalar measures of multivariate scatter obtained from the mathematical literature are proposed as a more general method to evaluate convergence in the use of time.

Gershuny (2000) utilizes a graphical device to study convergence in the allocation of time. Mean proportions of waking time devoted to paid work, unpaid work, and leisure

[1] These methods include the Experience Sampling Method proposed in Csikszentmihalyi and Larson (1987) and the Day Reconstruction Method in Kahneman et al. (2004). Another reference is Dow and Juster (1985), who offer an alternative perspective on the collection of time-budget information and enjoyment ratings of daily activities.

[2] The second wave of the Survey of Health, Ageing and Retirement in Europe, for instance, will probably utilize the method in Kahneman et al. (2004) to collect both time-use and experienced satisfaction information for the population of Europeans aged 50 and older.

by individuals classified into two groups are depicted in the 2-dimensional simplex $\Delta \equiv \left\{\mathbf{t} \in \mathbb{R}^3_+ : t_1 + t_2 + t_3 = 1\right\}$, where t_p represents the mean proportion of waking time devoted to some of the three activities. To have an idea of convergence or divergence in the allocation of time, the distance between the vectors of means for the two groups of individuals is compared in two moments of time (in Gershuny [2000], the 1960s and the 1990s). Clearly, however, the pairs of points depicted in the simplex have to shift in a way that permit to reach unambiguous conclusions by mere observation, what is not always the case. On the other hand, the generality of this method is limited by the number of activities in which individuals' time can be split (p), that has to be depictable, i.e., no greater than four.

Gauthier and Smeeding (2000) utilize a related method that overcomes these shortcomings. They calculate an index of dissimilarity in patterns of time use by evaluating the distance—using the absolute value norm—between multivariate vectors containing mean percentages of daily time devoted to several activities by two populations of individuals. Although this method is more general than that in Gershuny (2000), it is designed to compare only two groups of individuals,[3] and a comparison dimension in the data is still needed in order to gauge the size of the distance.[4] Furthermore, and as in Gershuny (2000), information at the level of microdata is discarded in the assessment of time-use convergence.

Scalar measures of multivariate scatter constitute a more general method to assess convergence in the allocation of time since they can be applied to situations in which several dimensions of time across several populations are to be evaluated. Instead of comparing the centres of gravity of two swarms of points as in the previous two methods, it is the overall shape of the swarms what these measures examine. Wilks (1932) and Peña and Rodríguez (2003) proposed the generalised variance (ξ) and the effective variance (V_e), respectively, as scalar measures of multivariate scatter. They are defined as:

$$\xi = \det\left(\Sigma_p\right) \tag{1}$$

and

$$V_e = \left(\det\left(\Sigma_p\right)\right)^{1/p}, \tag{2}$$

where Σ_p is the covariance matrix of a p-dimensional random variable $\mathbf{x}$. These measures satisfy a series of properties,[5] including that they are not affected by changes in the origins of the variable and that changes in scale affect them in a way that depends only on the magnitude of the changes themselves.[6] V_e, however, can be used to compare dispersion across variables with different dimensions, while ξ cannot. This property of V_e is important because, if times devoted to daily activities were correlated,[7] the level of dispersion could be affected by the number of dimensions in which daily time is split.

[3] With more than two groups, we could calculate the average distance of the group vectors with respect to, say, the vector containing the average of the groups, what would resemble the concept of dispersion discussed below.

[4] This comparison dimension could be provided by the passage of time or, in the case of cross-section data, by other countries, for instance.

[5] See Peña and Rodríguez (2003) for a detailed review.

[6] This latter property is not satisfied by another measure of multivariate scatter called the total dispersion (see Seber [1984, Ch. 5]). Since changes in scale are frequent in time-use analyses (e.g., hours are converted to minutes, or weekly to daily estimates), the total dispersion is not considered appropriate for this study.

[7] This correlation might simply arise from the 24 hours constraint: If we devote time to some activities, we have to curtail in others.

To obtain the sample counterparts of ξ and V_e, let $\mathbf{x}_1$, $\mathbf{x}_2$,..., $\mathbf{x}_N$ denote a random sample from a p-dimensional distribution with finite mean $\bar{\mathbf{x}}$ and covariance matrix Σ_p. The multivariate analogue of the univariate unbiased estimate of variance is[8]

$$\mathbf{S}_p = \frac{1}{N-1} \sum_{i=1}^{N} (\mathbf{x}_i - \bar{\mathbf{x}}) (\mathbf{x}_i - \bar{\mathbf{x}})'. \tag{3}$$

Therefore, the sample generalised variance and the sample effective variance are given by $\det(\mathbf{S}_p)$ and $(\det(\mathbf{S}_p))^{1/p}$, respectively. The limiting distributions of these statistics are derived in Anderson (1984) and Peña and Rodríguez (2003). Both are asymptotically normally distributed, with estimated asymptotic variances given by

$$\hat{Avar}(\det(\mathbf{S}_p)) = \frac{(\det(\mathbf{S}_p))^2 2p}{N-1} \tag{4}$$

and

$$\hat{Avar}\left((\det(\mathbf{S}_p))^{1/p}\right) = \frac{\left((\det(\mathbf{S}_p))^{1/p}\right)^2 2/p}{N-1}. \tag{5}$$

3 Do Patterns of Time Use Diverge After Retirement from the Labor Market?

In the next section, we make use of the previous methods in order to analyze whether retirement from the labor market modifies the level of convergence in the use of time. Firstly, however, a discussion on why retirement could alter the level of convergence is offered in this section. Retirement is usually accompanied by several changes in individuals' economic circumstances, including a change in income and a change in the price and availability of non-market time. Although individuals might react in the same way to these changes, their magnitude and, therefore, the size of the responses they induce need not necessarily be the same across individuals. To understand the mechanisms through which retirement might affect convergence in the allocation of time, assume that, while working, the individual's utility function is[9]

$$U = U(x_1, ..., x_m; \mu_1 t_1, ..., \mu_n t_n), \tag{6}$$

where x_i is the quantity of good i consumed and t_i is time devoted to non-market activity i. The parameter μ_i ($\mu_i > 0$) denotes the influence of market time on the pleasure experienced when consuming one unit of time in activity i. In Hamermesh (2005), for instance, the μ_is capture the stress imposed on non-market activities by market work ($0 < \mu_i < 1$). On the contrary, a satisfactorily productive working day could enhance the pleasure experienced in non-market activities ($\mu_i > 1$). Utility maximization is performed subject to

$$\textstyle\sum_{i=1}^{m} p_i x_i = I = V + wl \tag{7}$$

[8] See Seber (1984). This sample covariance matrix is easily computed in STATA using the *matrix accum* command with the *deviations* and *noconstant* options added.

[9] The analysis is based on Becker (1965), even though the emphasis here is shifted from the demand for commodities to the demand for their time inputs.

and

$$\sum_{i=1}^{n} t_i + l = T, \tag{8}$$

where p_i is the market price of good i, V is property income, l stands for market time, and w denotes the wage rate. Behavior is therefore governed by Eqs. (7) and (8) and expressions

$$U_{x_i} \leq \lambda p_i \tag{9}$$

and

$$U_{t_i} \mu_i \leq \lambda w, \tag{10}$$

where λ is the marginal utility of full income. Once retired, let the individual's utility function be instead given by

$$U = U\left(x_1, ..., x_m; t_1, ..., t_n\right). \tag{11}$$

The influence exerted by market time on the pleasure derived from consuming non-market activities has now disappeared. Choices are led by a budget constraint in which pension benefits replace labor earnings, by a time constraint in which $l = 0$, by expression (9), and by

$$U_{t_i} \leq \alpha, \tag{12}$$

where α denotes the marginal utility of time.

Apart from changes in preferences, the demand for t_i could be affected, first of all, by the different amount of income and non-market time available to employed and retired individuals. The non-market time freed up by retirement could, on the one hand, rise the time devoted to normal activities—those with a positive time effect—and reduce the time devoted to inferior ones. On the other hand, it could foster the variety of activities consumed by increasing their reservation prices:[10]

$$\frac{U_{t_i}|_{t_{i=0}}}{\alpha}. \tag{13}$$

Likewise, if we assume, as it seems reasonable, that goods and time are non-separable in the individual's preference ordering, the change in income brought about by retirement could generate differences in both the quantity of each activity and the variety of activities demanded. Second, the relative demand for t_i could be altered by the change in the marginal rate of substitution between activities t_i and t_j, which would shift from $\frac{\mu_j}{\mu_i}$ before retirement to 1 after it.

Although necessary, the identification of the economic factors that determine the average individual's allocation of time is not sufficient to explain the level of heterogeneity in the use of time for a group of individuals. The degree of time-use convergence in a population would inversely depend upon the degree of heterogeneity—or, in other words, the degree of dispersion—in factors influencing the allocation of time like those identified above. Therefore, it is the varying degree of heterogeneity in these factors put forward by, say, retirement what would drive the varying degree of convergence in the use of time between employed and retired individuals.

[10] See Gronau and Hamermesh (2001) for further discussion on the demand for variety.

4 Data

In order to see whether the effect of retirement on convergence in the use of time exhibits country-specific features, data from three different countries are considered in what follows. The American Time Use Survey 2003 (ATUS), the German Time Use Survey 2001/2002 (ZBE), and the Spanish Time Use Survey 2002/2003 (EET) have recently collected nationally representative time-use data.[11] ATUS is a continuous survey which collects time-use information for the noninstitutionalised population aged 15 years old and older by means of computer assisted telephone interviews. Between January and December 2003, ATUS interviewed 20,720 individuals, each of whom filled out one time diary.[12] ZBE and EET are non-periodical surveys which collected time-use information for the noninstitutionalised population of individuals 10 years old and older by means of personal interviews.[13] ZBE interviewed 11,962 individuals between April 2001 and March 2002, each of whom filled out three time diaries. EET interviewed 46,774 individuals between October 2002 and September 2003, each of whom filled out one time diary.[14]

In these surveys, we selected individuals who declared to be either employed or retired from the labor market.[15] To isolate the effect of retirement on convergence in the allocation of time net of age and cohort effects, only individuals in the age range 60-64 were included in the samples. As reported in Blöndal and Scarpetta (1998), the average age of transition to inactivity of older American, German, and Spanish workers is contained in this age interval. Table 1 provides descriptive statistics. Retired individuals tend to be older on average than employed ones, but the difference seems small so as to be concerned with the presence of significant age effects. Although some differences between employed and retired individuals do exist—education, health status—, it is not the purpose of this paper to study the causes of retirement, but to isolate the consequences that these causes exert on the dispersion in the allocation of time.

Individuals' uses of time are classified into a system of comprehensive, mutually exclusive time-use categories. Although the number of categories could affect the measurement of convergence in the use of time, we start with a particular classification and then assess the robustness of our results to deviations from it. Thus, the allocation of time is initially split into 18 categories in ATUS—those corresponding to the first-tier activity classification system in Bureau of Labor Statistics (2003)—, and into 10 categories in ZBE and EET—

[11] Survey respondents were requested to complete one or more time diaries—24 hours accounts—, a survey method considered to provide valid (i.e., unbiased) time-use measurements (see, for instance, Robinson [1985]).

[12] See Bureau of Labor Statistics (2004) for more information regarding ATUS.

[13] Households were contacted twice, and, in the meantime, all 10+ individuals completed one or more self-administered 24 hours retrospective diary.

[14] See Commission of the European Communities (2000) for more information regarding ZBE and EET.

[15] Employment status was obtained from variables *pemlr* (ATUS), *stat* (ZBE), and *h1a5* (EET). In ATUS, the definition of retirement follows that in the Current Population Survey, that is, is based on a subjective criterion of self-identification: Individuals respond *Yes*, *No*, *Retired*, *Disabled*, *Unable to work*, *Don't know*, or *Refused* to the question *Last week, did you do any work for (either) pay (or profit)?* On the other hand, retirement is equivalent to receiving a pension in ZBE (*Rentenbeziehereinnen)* and EET (*Cobrando pensión de jubilación o prejubilado/a*). The different definition of retirement across surveys, however, is not crucial to the main result in this paper. Institutional background on retirement in the U.S., Germany, and Spain is documented in Gruber and Wise (2004).

Table 1 **Descriptive Statistics (individuals aged 60-64)**

	ATUS		ZBE		EET	
	Employed	Retired	Employed	Retired	Employed	Retired
Age	61.6 [1.4]	62.2 [1.4]	61.5 [1.3]	62.0 [1.4]	61.6 [1.4]	62.2 [1.4]
Male	.49 [.50]	.40 [.49]	.65 [.48]	.49 [.50]	.68 [.47]	.75 [.43]
Married	.61 [.49]	.66 [.47]	.78 [.41]	.71 [.46]	.83 [.37]	.84 [.37]
Family size	2.0 [1.0]	2.0 [.94]	2.3 [1.0]	2.0 [.83]	3.0 [1.3]	2.7 [1.2]
High educ	.57 [.50]	.47 [.50]	.41 [.49]	.27 [.44]	.26 [.44]	.20 [.40]
Bad health			.05 [.23]	.07 [.25]	.06 [.24]	.16 [.37]
Income						
mean	52,033	43,026	2,725	2,221	2,005	1,381
std dev	26,621	26,580	1,199	1,040	1,183	882
coef var	.51	.62	.44	.47	.59	.64
Market work						
mean	4.6 [4.1]	.35 [1.6]	3.7 [4.0]	.03 [.38]	6.0 [4.2]	.11 [.87]
coef var	.89	4.6	1.1	12.7	.70	7.9
N	565	431	279	407	707	642

Notes: Standard deviations appear in brackets unless explicitly noted. The variable *High educ* takes on value 1 for individuals with at least high school (ATUS) or with more than 10 years in school (ZBE and EET). *Bad health* takes on value 1 when an individual reports suffering from a bad or very bad general health condition (only available in ZBE and EET). *Income* is family income during the last 12 months (ATUS, in dollars) or average family monthly income (ZBE and EET, in euros). *Market work* is measured in hours and provides weighted estimates. *N* is the number of observations.

the main activities in Commission of the European Communities (2000, Annex VI). Table 2 provides the centres of gravity of the swarms of points whose degree of convergence is evaluated in the next section.[16]

[16] The estimates are weighted to reflect behaviour on a representative day of the week.

Table 2 **Time Use in an Average Day by Individuals Aged 60-64 (hours)**

	ATUS		ZBE		EET	
	Employed	Retired	Employed	Retired	Employed	Retired
Personal care	9.01 (.09)	9.53 (.11)	10.63 (.09)	11.53 (.05)	10.72 (.08)	12.19 (.09)
Household (hh) activities	2.02 (.12)	3.14 (.15)				
Caring for hh members	.06 (.01)	.10 (.03)				
Caring for non-hh members	.32 (.08)	.49 (.09)				
Working and work-related act.	4.59 (.21)	.35 (.10)				
Education	.01 (.01)	.00 (.00)				
Consumer purchases	.35 (.03)	.56 (.05)				
Professional and care services	.10 (.02)	.13 (.03)				
Household services	.02 (.01)	.08 (.03)				
Gov. Serv. and civic obligations	.00 (.00)	.00 (.00)				
Eating and drinking	1.27 (.04)	1.26 (.06)				
Socializing, relaxing, and leisure	4.18 (.14)	5.79 (.18)				
Sports, exercise, and recreation	.21 (.03)	.47 (.07)				
Religious and spiritual activities	.21 (.04)	.21 (.04)				
Volunteer activities	.09 (.02)	.24 (.05)				
Telephone calls	.10 (.02)	.17 (.03)				
Traveling	1.28 (.07)	1.30 (.11)				
Data codes	.17 (.04)	.19 (.05)				
Employment			3.73 (.18)	.03 (.01)	5.98 (.18)	.11 (.04)
Study			.05 (.02)	.06 (.01)	.01 (.01)	.04 (.02)
Household and family care			2.66 (.12)	3.96 (.07)	1.86 (.10)	3.34 (.13)
Volunteer work and meetings			.53 (.07)	.63 (.05)	.27 (.05)	.54 (.09)
Social life and entertainment			1.46 (.07)	1.68 (.05)	1.02 (.06)	1.53 (.08)
Sports and outdoor activities			.52 (.05)	.66 (.03)	.60 (.05)	1.59 (.09)
Hobbies and games			.36 (.04)	.48 (.03)	.18 (.03)	.39 (.06)
Mass media			2.50 (.08)	3.58 (.06)	2.06 (.07)	3.29 (09)
Travel and unspecified time use			1.56 (.06)	1.39 (.05)	1.32 (.05)	.97 (.05)

Notes: Weighted estimates. Standard errors are in parentheses. Time-use categories in bold face are joint to ATUS, ZBE, and EET. Time-use categories in normal face are exclusive to ATUS. Time-use categories in italics are exclusive to ZBE and EET.

5 Results

This section presents results on whether older adults' patterns of time use diverge after retirement from the labor market. Since daily time is split into more than four activities, the graphical method in Gershuny (2000) can not be utilized to assess this issue. To compute the scalar measures of multivariate scatter, the sample observations used in the calculation of the sample covariance matrix are weighted so that dispersion is evaluated with respect to average behavior on a representative day of the week. Based on the time-use categories listed in Table 2, Table 3 offers a first set of results.

The index of dissimilarity (I_d) proposed in Gauthier and Smeeding (2000) cannot measure whether the degree of heterogeneity in the use of time has been altered by retirement. Instead, and given that we have available data for three countries, we observe that patterns of time use between employed and retired individuals are more convergent in Germany ($I_d = 32.3$) and the U.S. (35.5) than in Spain (51.6). To provide an answer to the question of whether retirement affects the level of convergence in the use of time, we have to rely on scalar measures of multivariate scatter. The sample generalized and effective variances

Table 3 **Dispersion in Patterns of Time Use of Individuals Aged 60-64**

	ATUS		ZBE		EET	
	Employed	Retired	Employed	Retired	Employed	Retired
I_d	35.5		32.3		51.6	
ξ	1.35E-21	2.70E-19	1.70E-11	2.57E-13	1.18E-13	3.55E-12
	(3.41E-22)	(7.81E-20)	(4.55E-12)	(5.70E-14)	(1.99E-14)	(6.27E-13)
V_e	.0693	.0930	.0838	.0551	.0510	.0716
	(.0010)	(.0015)	(.0022)	(.0012)	(.0009)	(.0013)
p	18	18	10	10	10	10
N	565	431	279	407	707	642

Notes: Weighted estimates. Standard errors (shown in parentheses) are computed using expressions (4) and (5) in the text. N is the number of unweighted observations and p is the number of categories in which daily time is splitted.

reported in Table 3 suggest that in the U.S. and Spain retired individuals in the age range 60-64 have time-use patterns more disperse than those exhibited by employed persons of the same age range. The opposite occurs, however, in Germany, where retirement from the labor market is accompanied by a greater convergence in older adults' allocation of time. For the three countries, the difference in the level of time-use dispersion between employed and retired individuals is statistically significant at the 95% of confidence level.

How much of these results are due to the level of aggregation in activities chosen? To answer this question, two tests of robustness are performed. In the first, ATUS time-use categories are further disaggregated into the 107 2nd-tier activities in Bureau of Labor Statistics (2003), while ZBE and EET time-use categories are disaggregated into the 42 secondary activities in Commission of the European Communities (2000, Annex VI). In the second, and in order to have a similar set of activities for the three countries that permit to do cross-country comparisons, ATUS time-use categories are re-aggregated into a set of ten activities roughly equivalent to the main activities in European surveys.[17] Results are provided in Tables 4 and 5, respectively,[18] and, as pointed out in Section 2, comparisons in the level of dispersion across tables are to be done by means of the effective variance.

In Table 4, the qualitative conclusions we had reached for the U.S. and Spain in Table 3 remain the same, but for Germany, however, we do not reject now that the level of dispersion in the use of time is the same for employed and retired persons. In Table 5, although retired Americans in the age range 60-64 continue showing a greater dispersion in the allocation of time, the difference with respect to employed persons in the same age range is not statistically significant. Therefore, the evidence suggests that the classification of activities selected influences the measurement of dispersion. Furthermore, although we do not observe reversals in our conclusions about convergence in the use of time, the statistical significance of some findings is affected. The correlation of times devoted to daily activities, which might increase or reduce the variance of an aggregate activity with respect to the sum of the variances of the activities being aggregated, seems to be at the heart of this result.

[17] Details of this aggregation are provided in Table A1 in the Appendix.

[18] In Table 4, the standard errors of the sample generalised variances computed with ATUS data cannot be calculated because the size of the numbers is too small.

Table 4 **Dispersion in Patterns of Time Use of Individuals Aged 60-64**

	ATUS		ZBE		EET	
	Employed	Retired	Employed	Retired	Employed	Retired
I_d	40.6		32.9		52.1	
ξ	2.27E-167	1.95E-148	3.87E-36	8.20E-37	2.04E-42	7.93E-32
			(2.13E-36)	(3.73E-37)	(7.04E-43)	(2.87E-32)
V_e	.0277	.0416	.1435	.1383	.1017	.1818
	(.0002)	(.0003)	(.0019)	(.0015)	(.0008)	(.0016)
p	107	107	42	42	42	42
N	565	431	279	407	707	642

Notes: Weighted estimates. Standard errors (shown in parentheses) are computed using expressions (4) and (5) in the text. *N* is the number of unweighted observations and *p* is the number of categories in which daily time is splitted.

Table 5 **Dispersion in Patterns of Time Use of Individuals Aged 60-64**

	ATUS	
	Employed	Retired
I_d	35.4	
ξ	3.46E-12	4.81E-12
	(6.52E-13)	(1.04E-12)
V_e	.0714	.0738
	(.0013)	(.0016)
p	10	10
N	565	431

Notes: Weighted estimates. Standard errors (shown in parentheses) are computed using expressions (4) and (5) in the text. *N* is the number of unweighted observations and *p* is the number of categories in which daily time is splitted.

The qualitative results for Spanish older adults seem to be robust, however, to the level of activity aggregation selected. What could be driving the larger time-use dispersion observed among Spanish retirees? As discussed in Section 3, the degree of dispersion in factors like income could influence the level of convergence in the use of time. Therefore, besides average values of some variables, Table 1 also provides their standard deviations. Interestingly, the degree of dispersion in income—measured by means of the coefficient of variation—is larger among retired than among employed Spaniards in the age range 60-64. Another factor that could influence dispersion in the use of time is health. Individuals' health status could affect the well-being experienced when performing some activities, therefore affecting the marginal rates of substitution between activities. The evidence reported in Table 1 for the case of Spain shows that dispersion in health status is larger among retirees. Although we would like to have data on the degree of dispersion in factors such as the price of non-market time, the available evidence seems consistent with the hypotheses derived in Section 3.

6 Conclusions

This paper has analyzed the measurement of convergence in the use of time. If information on the level of satisfaction experienced when performing daily activities is linked to raw time-use information (as Kahneman et al. [2004] propose, for instance), then convergence in the level of well-being across some populations could be assessed by knowing the degree of convergence in their patterns of time use. Several methods have been utilized to study whether retirement from the labor market leads to a varying degree of convergence in the use of time. In comparison with previous methods employed in the time-use literature, scalar measures of multivariate scatter constitute a more general method to evaluate convergence in the use of time, since these measures can be applied to situations in which several temporal dimensions across several groups need to be evaluated. However, they are not free of limitations. In particular, the classification of activities selected affects the magnitude of dispersion observed in the data and, most important, it might modify some of the conclusions obtained regarding convergence in the use of time.

A Appendix

Table A1 Aggregation of ATUS Activities into Equivalent ZBE and EET Activities

Main activities in ZBE and EET	Major ATUS categories	2nd-tier ATUS categories	3rd-tier ATUS categories
Personal care	01, 11		
Employment	05		
Study	06		
Household and family care	02, 03, 07, 08, 09		
	10	01, 04[a], 99	
	10	03	01, 02, 99[a]
Volunteer work and meetings	04, 14, 15		
	10	02, 04[a]	
	10	03	03, 99[a]
Social life and entertainment	16		
	12	01, 02, 04, 05, 99	
	12	03	01, 02, 99
	13	02, 99[a]	
	13	03, 04	02, 99[a]
Sports and outdoor activities	13	01, 99[a]	
	13	03, 04	01, 99[a]
Hobbies and games	12	03	07, 08, 09, 10, 11, 13
Mass media	12	03	03, 04, 05, 06, 12
Travel and unspecified time	17, 50		

Notes: The names of the activities are those in Commission of the European Communities (2000, Annex VI). The numerical codes are established in Bureau of Labor Statistics (2003). [a]: Includes half the time devoted to this activity.

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