doi:10.1111/j.1435-5957.2011.00395.x

The role of gender, age and location in the values of work behind time use patterns in Santiago, Chile*

Sergio Jara-Díaz[1], **Marcela Munizaga**[1], **Javiera Olguín**[1]

[1] Universidad de Chile, Casilla 228-3, Santiago, Chile (e-mail: jaradiaz@ing.uchile.cl, mamuniza@ing.uchile.cl, javieraolguin@gmail.com)

Received: 3 January 2011 / Accepted: 28 July 2011

Abstract. We apply a time assignment model system to estimate and analyse spatial differences in the values of work and leisure for segments of travellers who work in Santiago, Chile, a large, spatially segregated South American capital. The sample was obtained from the latest available Origin Destination Survey; it includes weekly time use and socio-economic characteristics, which represent the differences across zones. Seventeen segments are defined according to gender, age, family structure and zone of residence. Positive values of the marginal utility of work are obtained for women and youngsters, and negative for men and elders. Women without children showed larger values than mothers. Results are explained in terms of income hierarchy and committed time.

JEL classification: J22, R23

Key words: Time values, work, leisure

1 Introduction

The importance of time allocation in consumers' behaviour theory emerged with the study of labour supply. Although formal models date back to the work of pioneers such as Jevons (1871), it was Becker (1965, pp. 496–497) who first linked work, income, consumption and time value into an integrated and widely adopted framework. His model is the origin of the identification of the wage rate as the value of time: "time can be converted into goods by using less time at consumption and more at work". As originally presented, Becker's theory lacked an important element that later on was the source of much criticism: work time was not included in utility, meaning that the individual extracted neither pleasure nor pain from work irrespective of the amount of hours worked or goods consumed. This was the main element of discussion in Evans's (1972, p. 5) lucid reformulation of the theory of time valuation, where he states that

* This research was partially funded by Fondecyt grants 1090204 and 1080140, and the Millennium Institute Complex Engineering Systems (ICM P-05-004-F, CONICYT FBO16).

there is "no logical reason why the marginal utility of work should not be equal to zero in some cases". One year earlier, De Serpa (1971) had developed a microeconomic model of time allocation that included a complete set of definitions for the different dimensions of time values: the value of time as a resource, the value of saving time and the value of assigning time to an activity. As a result, new analytical constructs emerged with a very precise meaning, most importantly the value of leisure and the marginal valuation of work time.

Using De Serpa's framework, Jara-Díaz et al. (2008) expanded the model proposed by Jara-Díaz and Guevara (2003) and developed a theoretically justified econometric model for time allocation that was applied to samples obtained from three different settings, including a neighbourhood in Santiago (Chile), Karslruhe (Germany) and Thurgau (Switzerland). They found that individuals in the Chilean neighbourhood exhibited the largest dislike of work relative to their wage rate. However, Santiago is a highly heterogeneous metropolitan area; as with other Latin American capital cities, it concentrates a large proportion of the country's population (35%, approximately 6 million inhabitants) and presents very unevenly distributed income and car ownership, reproducing Chile's income inequalities (Gini coefficient above 56 for income distribution). Representing this population with a single value for work and leisure is clearly misleading. The objective of this paper is to apply the set of concepts explained above to understand time valuation for different groups of travellers who work in Santiago, Chile, accounting for age, gender, zone of residence and family structure. We show that there are relevant differences in the subjective valuation of work across all four dimensions. The analysis will be done using time use data derived from the workers' detailed information regarding their travel activities available in the 2001 Origin Destination Survey ODS (DICTUC 2003). The remainder of this section contains a detailed description of Santiago, showing its richness as a case study. Section 2 contains the model formulation. In Section 3 we describe the weekly database and justify the segments that are used for model estimation in Section 4. The values of work and leisure obtained are explained using characteristics of each segment. Section 5 concludes.

Let us begin by describing the main characteristics of Santiago 2001 elicited from the ODS (DICTUC 2003) sample, representative of the population of Santiago. Using the cut-off values defined by the Chilean Marketing Research Association for 2001, the ODS reports that 40 per cent of the households belong to the low-income segment (monthly income below 442 US$ per month), 54.4 per cent to the medium income segment (monthly income between 442 and 2,524 US$ per month), and only 5.6 per cent to the high-income segment (monthly income over 2,524 US$ per month). Despite the large percentage of low-income households, a gross 75 per cent of households own their own house. On the other hand, only 18 per cent of households have access to the Internet. The average car ownership rate is 0.56 vehicles per household and only 25 per cent of the total population has a driving licence. Regarding education, 40 per cent of the population has only primary education or no education at all, 35 per cent has secondary education and 25 per cent has some type of higher education (technical or university studies), but only 8.5 per cent of the population has completed university studies. As said earlier, Chile in general and Santiago in particular has a very uneven income distribution. According to the official data (MIDEPLAN 2003) the ratio between the average income of the richer 20 per cent and that of the poorer 20 per cent is over 14. This is reflected in the spatial distribution of households in Santiago, such that the upper East zone concentrates the high income groups, which, as expected, have more years of education and more access to different types of devices that might help domestic life, such as washing machines, microwave ovens, internet connections, computers and cable TVs. To illustrate the spatial differences, we include below a description of Santiago 2001 in six aggregate zones according to the information obtained from the ODS, properly expanded to the population using complementary information of the 2002 census. The average values of the most relevant zone variables are shown in Figure 1.

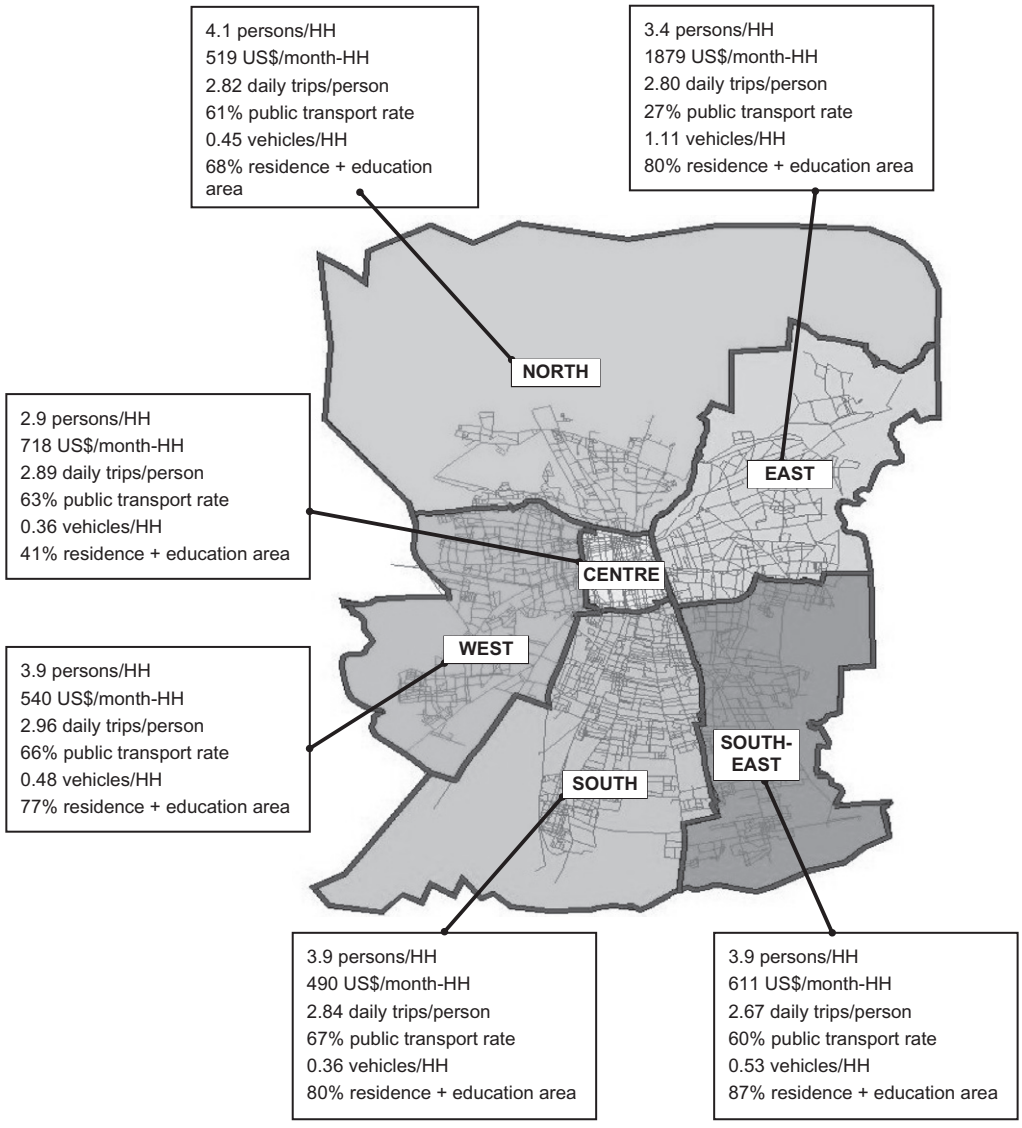

Fig. 1. Aggregate description of Santiago in six zones

The East zone is clearly the wealthier, with an average household income that more than doubles the second ranking zone (and almost four times that of the poorest one). It concentrates 80 per cent of the high-income households and more than half of the individuals with a university degree. The land use is mainly residential but includes a significant percentage of commerce and services; there is very little industrial activity. The South, North and West zones are the poorest, in that order. In the South zone more than half of their households belong to the low-income range, and only 0.6 per cent to the high-income range. The North zone has the largest proportion of land dedicated to industrial activity, and is the second in terms of low-income population, with 46.7 per cent low-income households. The South zone has the smallest car ownership rate (equal to that of the Centre zone) and less access to Internet, cable TV and driving licences. The North zone exhibits slightly larger values in all these variables, but lower

educational level. Another characteristic of these three zones is that the household size is larger than the average, especially in the North zone.

The West zone has a slightly higher average income than the South and North zones and a slightly lower proportion of low-income households (44.6%); also, it has an important proportion of industrial activity and is subject to severe pollution problems, especially during wintertime.

The Southeast zone has developed as a residential area in the last decades, mainly with houses oriented to family life. Not surprisingly, it has the largest proportion of residential areas and the largest proportion of children among its population. The Centre zone – which includes the central business district – is not only the smallest in terms of area but also exhibits the smallest proportion assigned to residence and education. It has the second average income and the smallest average household size. The age distribution shows a larger proportion of elderly people and a smaller proportion of children regarding all other zones.

In terms of mobility, all zones have similar average number of trips per person, but modal split is different. While the distribution between public transport trips (motorized trips excluding combined private/public transport modes) and those made by car or taxi, is around 30 per cent – 70 per cent in the East zone, in the other zones it is rather the opposite, with public transport proportions going above 60 per cent.

The spatial differences synthesized above can be easily expressed quantitatively. There are other characteristics that are more difficult to represent, such as lifestyle, environment, urban structure and family structure, which one can expect to have an influence on time assignment and time values. This makes Santiago an interesting case study to explore the determinants of the value of work beyond income.

2 The model for the value of work

Consider Jara-Díaz et al's (2008) version of DeSerpa's model (1971) represented by Equations (1) to (5), where utility U depends on the consumption of goods, X_j, and time assigned to activities T_i. T_w is working hours, w is the wage rate, τ is the length of the work-leisure period, T_i^{min} and X_j^{min} are the minimum time assigned and minimum goods consumption respectively. θ_i and ϕ_j are preference parameters; λ, μ, κ_i and η_j are multipliers.

$$Max\ U = \Omega T_w^{\theta_w} \prod_i T_i^{\theta_i} \prod_j X_j^{\varphi_j} \tag{1}$$

Subject to

$$wT_w - \sum_{i=1}^{n} P_i X_i \geq 0 \rightarrow \lambda \tag{2}$$

$$\tau - \sum_{i=1}^{n} T_i = 0 \rightarrow \mu \tag{3}$$

$$T_i - T_i^{Min.} \geq 0 \leftarrow \kappa_i \ \forall i \tag{4}$$

$$X_j - X_j^{Min} \geq 0 \leftarrow \eta_j \ \forall j \tag{5}$$

As defined by De Serpa (1971), μ/λ is the money value of time as a resource; the ratio between the marginal utility of activity i and λ is the value of the time assigned to that activity; and κ_i/λ is the value of reducing the minimum time necessary to perform activity i, that is, the value of saving time in that activity or the willingness to pay to reduce that time, which is zero for non-active activity constraints (4) or leisure activities. First order conditions regarding activities (including work) are:

$$\frac{\kappa_i}{\lambda} = \frac{\mu}{\lambda} - \frac{\partial U/\partial T_i}{\lambda} \tag{6}$$

$$\frac{\mu}{\lambda} = w - \frac{\partial U/\partial T_W}{\lambda} \tag{7}$$

Equation (6) shows that μ/λ is the value assigned to all leisure activities (for which κ_i/λ is zero) and Equation (7) shows that this value of leisure has to be equal to the total value of work, given by the wage rate (money received for an extra hour worked) plus the value of the time assigned to work (value of the marginal utility of work), which is what we want to estimate. Unlike Becker, DeSerpa's model admits a valuation of time assigned to work different from zero or – equivalently – a value of leisure different from the wage rate. Such values have been discussed in the literature from both angles: the perception of work, as in Spencer (2004), and the value of leisure, as in Lee and Kim (2005) or Shaw (1992). In the last decade, some authors have reformulated the classical model by including subsistence levels (Dessing 2002), or the possibility of unpleasant leisure (Prasch 2000), in order to explain observed behaviour regarding the relation between the wage rate and work time. However, none of these authors have explored the consequences of including work time in utility as in models (1)–(5), which permits an empirical examination of its marginal value, as we will now see.

In model (1)–(5) the total time committed to unpleasant activities that are assigned the minimum required (T_c), and the total amount of money committed to minimum consumption (E_c) define the feasible space of time and money from which the individual chooses (optimal) time use and discretionary consumption. From the first order conditions regarding time assigned to work and to freely chosen activities A^f, Jara-Díaz et al. (2008, pp. 948–949) derived the time use equations as:

$$T_w^* = \beta(\tau - T_c) + \alpha\frac{E_c}{w} + \sqrt{\left(\beta(\tau - T_c) + \alpha\frac{E_c}{w}\right)^2 - (2\alpha + 2\beta - 1)(\tau - T_c)\frac{E_c}{w}} \tag{8}$$

$$T_i^* = \frac{\gamma_i}{(1-2\beta)}(\tau - T_w^* - T_c) \quad \forall i \in A^f \tag{9}$$

where $\beta = (\Phi + \theta_w)/2(\Theta + \Phi + \theta_w)$, $\alpha = (\Theta + \theta_w)/2(\Theta + \Phi + \theta_w)$ and $\gamma_i = \theta_i/(\Theta + \Phi + \theta_w)$, with $\Theta > 0$ the summation of the (positive) exponents θ_i over all unrestricted activities, and $\Phi > 0$ is the summation of the (positive) exponents φ_j over all unrestricted goods. So α and β are a convenient normalization of the preference parameters that appear in the direct utility function (related to the marginal utilities), and their definition evidently implies that both must be less than 0.5.

The relevant role played by committed expenses E_c and committed time T_c is apparent, as they vary across individuals and prevent the equations to collapse into a fixed proportions model, overcoming the usual limitations of the Cobb-Douglas based demand equations. This formulation makes it necessary to distinguish between those activities that the individual would like to

diminish but cannot because of the technological constraints (4) and those s/he would like to increase but cannot because of the time constraint (2). The former are the ones that add up to T_c.

As both Equations (8) and (9) have common variables, parameters and errors, it is best to estimate α, β and γ_is jointly as explained in Section 4 below, including all but one unconstrained activities equations. As shown by Jara-Díaz et al. (2008, pp. 949–950) the values of leisure and work can then be calculated as:

$$\text{Value of leisure} \quad \frac{\mu}{\lambda} = \frac{1-2\beta}{1-2\alpha} \cdot \frac{(wT_w^* - E_c)}{(\tau - T_w^* - T_c)} \tag{10}$$

$$\text{Value of work} \quad \frac{\partial U/\partial T_w}{\lambda} = \frac{2(\alpha+\beta)-1}{1-2\alpha} \cdot \frac{(wT_w^* - E_c)}{T_w^*}. \tag{11}$$

Finally, the marginal utility of income λ is expected to decrease with income, which tends to make the absolute values of time increasing with income. In order to facilitate comparison of time values across segments with different incomes, one can control for this effect by re-writing Equation (7) dividing both sides by w, which yields:

$$\left(\frac{\mu}{\lambda}\Big/ w\right) + \left(-\frac{\partial U/\partial T_w}{\lambda}\Big/ w\right) = 1 \tag{12}$$

Equation (12) expresses the values of leisure and work (with the reverse sign) as a fraction of the wage rate, which will be used when presenting and analysing our results.

3 Description of the weekly data and definition of segments

As mentioned above, the empirical analysis is made with a database extracted from the Santiago ODS conducted from July 2001 to April 2002 (DICTUC 2003), which contains large samples of workers for each of the seven days of the week. In Munizaga et al. (2011), a method is presented and applied to derive time use information for these workers from their individual travel diaries, and to construct weekly observations on their time use. Time assignment is obtained from the trip purpose information contained in the individuals' travel diaries, and a new method is used to create twins that link the weekday and weekend observations in order to construct the weekly database. This was supplemented with expenditure data available from the Instituto Nacional de Estadísticas (INE).

Given the focus of this research, we looked at time use of workers observed during the normal season only. The 9,464 workers in the final sample belong to 6,212 households with an average size of 4.2 persons and 1.8 workers. In this sample, 36.8 per cent of the workers are women and 49.2 per cent are the household heads. The most frequent age range is 35–44 (29%), followed by the 25–34 range (27%) and 45–54 (21%). Workers older than 54 and younger than 25 years are 13 per cent and 10 per cent, respectively. The mean and median of age is 40 years. Most individuals reached secondary school (42%). Only 3.8 per cent of the interviewees study besides working. Spatially, the majority of individuals surveyed belong to the South zone (25%), followed by the Southeast zone (21%) and the West zone (21%). Workers living in the North and East zones are 15 per cent and 14 per cent respectively. The smallest proportion lives in the Centre zone (only 4% of the sample). The average monthly income (and its variation coefficient)

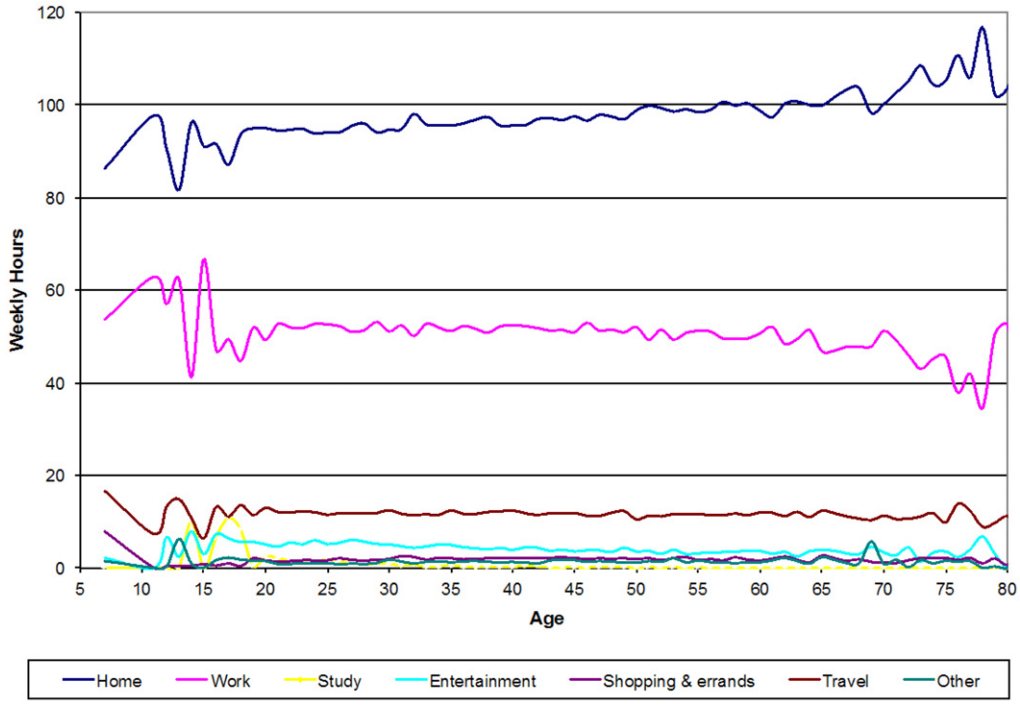

Fig. 2. Average activity time assigned by age

is US$ 488.3 (1.4) for the whole workers sample;[1] US$ 547.3 (1.5) and US$ 387.1 (1.1) for men and women respectively. The South zone shows the smaller average income (US$ 317.8) and the largest coefficient of variation (1.7). The East zone has the largest average income (US$ 1,264.1), followed by the Centre (US$ 534.4), Southeast (US$ 425.8), West (US$ 342.4) and North (US$ 320.7).

The procedure for the transformation into activities' duration forced some aggregation, such that seven activities were finally considered: home, study, entertainment, travel, shopping and errands, work and other. Note that unlike detailed activities, aggregates get rid of potential censoring in time use data. We explored the sample to look for possible segmentation variables, and found some interesting differences. Figure 2 shows the average weekly time assignment by age. Not surprisingly, older people spend more time at home and less time at work. Youngsters and elderly exhibit marked differences with the rest both in average and in terms of variability.

Eighty seven per cent of the observations are concentrated in the 25–64 age range, which permits further exploration of the differences in time use by gender and zone of residence within that age range; Figure 3 shows the work activity patterns for men and women living either in the East or the rest of the zones, whose distribution exhibits marked differences along hours of the day and days of the week.

Men from the East present a larger proportion at work during weekdays, while men from other zones work more on weekends. A lower proportion of women living in the East are at work at almost any time. Men and women from the East exhibit a significant lunchtime break, and also a significant proportion of women from that sector do not go back to work after that break. Note

[1] One dollar = 634.94 pesos (average 2001).

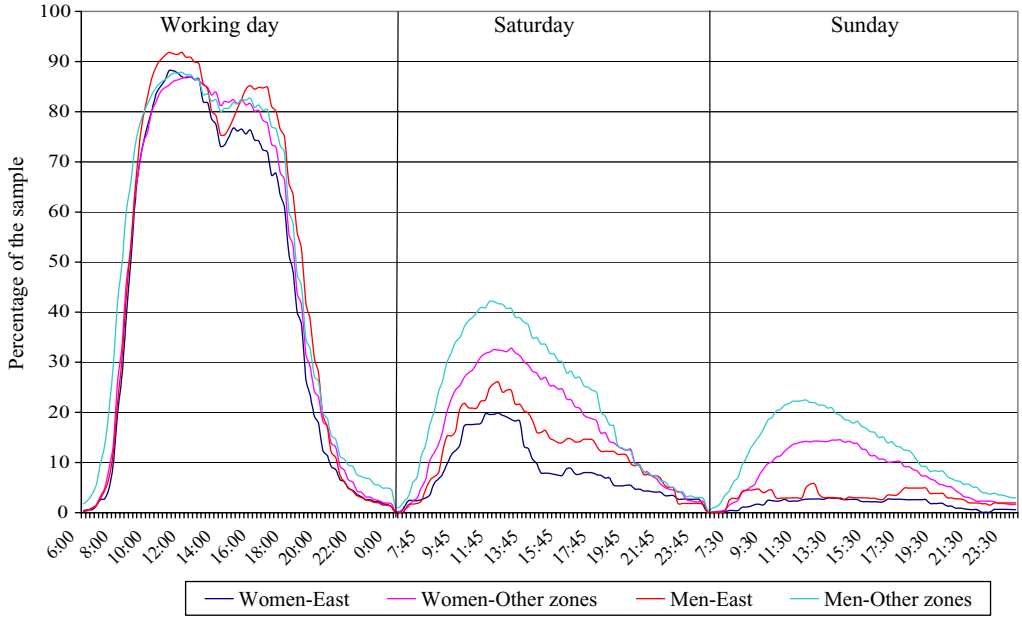

Fig. 3. Work activity pattern by gender and zone for the 25–64 age group

also that the difference between days of the week reinforces the need to construct the behavioural model in a whole work-leisure cycle including all activities; a single day would suggest time use choices that are not decided on a daily basis.

As the number of observations by gender outside the East zone is still large, further disaggregation is feasible. Figure 4 shows the average duration of all activities – and the number of observations – for each gender-zone group. Across zones, women spend more time at home and less time at work than men. Shopping & errands is more important for women in all zones but West, and women from the East have the largest average for that activity. Controlling for gender, people from the East spend more time at home and shopping & errands, and less time at work than the rest. Also, they dedicate more hours to recreational activities and less to travel than workers from all zones but the Centre. Study and other are of little importance for all groups. Each zone-gender group contains more than 400 observations; the exceptions are men and women living in the Centre, with less than 200 observations each.

This exploratory analysis made us initially define six segments. Some of them were then further disaggregated taking into account some modelling considerations and the number of observations available. The description of the six aggregated segments is presented in Table 1, in terms of the main average characteristics and modelling variables.

The first group, called youngsters, includes all persons under 25 years old; they have the smallest relative income in average, most of them are young men, most live with their parents, and most are not the breadwinners in the household. At the other extreme we have the elderly, also a majority of men, but in this case they are mainly heads and the main providers (largest income) of their households. In the 25–64 age group – whose time assignment is described in Figure 4 – men are usually the breadwinners in their households, while women are not (Table 1). As expected, the income difference between the East zone and the rest is remarkable, both for men and women. Controlling for age and zone of residence we observe a difference between income of men and women (favourable to men).

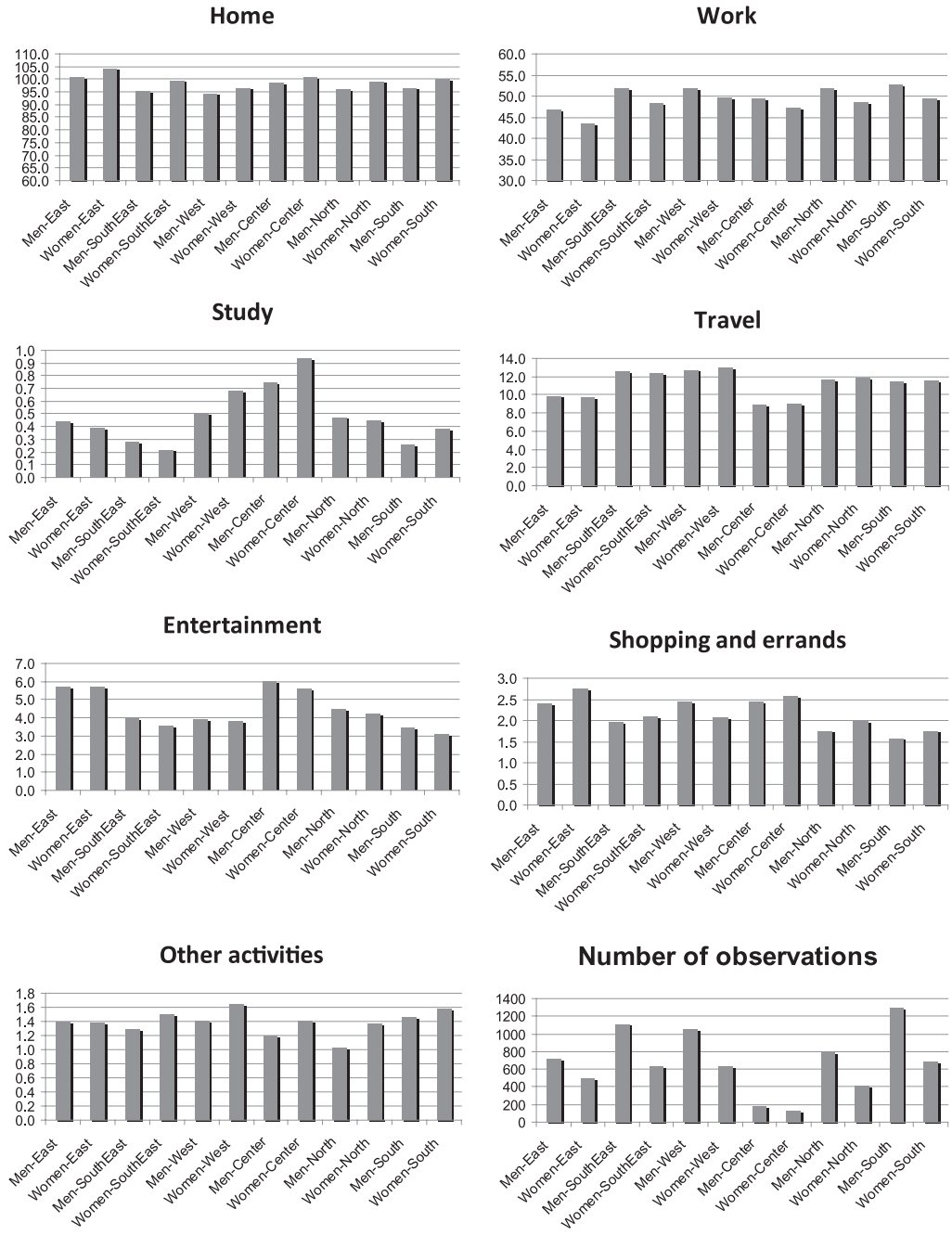

Fig. 4. Average activity time assigned (hours/week) and number of observations by gender and zone of residence for the 25–64 age range

4 Modelling and results

The model described in Section 2 requires the identification of those activities contributing to T_c and those that can be modeled with Equation (9) as leisure. Among all activities in the data,

Table 1. Workers segments description

Average values	Youngsters	Individuals within the range 25–64 years old				Elderly
		Women		Men		
		East	Other zones	East	Other zones	
Age	22.0	41.0	41.0	43.0	41.0	70.0
Workers income [US$/Week]	52.1	199.1	74.2	375.7	96.5	133.8
Household income [US$/Week]	166.0	534.0	185.1	553.3	160.8	234.9
Wage rate [US$/hour]	1.1	5.3	1.7	8.6	2.0	3.5
Workers per household	2.6	2.2	2.2	2.0	1.9	2.1
Household size	5.0	3.9	4.3	4.1	4.4	3.8
Committed expenses [US$/Week]	23.4	69.7	31.4	129.6	38.3	51.1
Percentage of men	59	0	0	100	100	75
Percentage of breadwinners in the household	27	34	37	77	70	60
Relation with household head (%)	Son* (70)	Wife (52)	Wife (45)	Head (79)	Head (71)	Head (77)
Sample size	969	499	2.515	721	4.452	308

Note: * Son or daughter.

study, shopping & errands, travel and other were assumed to contribute to T_c, while home and entertainment were assumed as leisure activities at the margin under a De Serpa framework. We estimated the time assignment model system formed by Equations (8) for work and (9) for home. In the work equation explanatory variables are E_c, $\tau - T_c$ and w, and the parameters to be estimated are α and β. In the home equation the explanatory variables are T_w, $\tau - T_c$, with parameters β and γ_{home}. We used the full information maximum likelihood method, as suggested by Munizaga et al. (2008), allowing for heteroscedasticity and correlation between error terms assumed multivariate normal. The parameters representing the error structure are the standard deviations σ_{work} and σ_{home} of the errors of work and home equations respectively, and the correlation between both $\rho_{work\text{-}home}$.

In Table 2 we report the estimated coefficients together with the error structure parameters. It can be seen that α, β and γ_{home} are significant and fall within the expected domain in all cases. The standard deviations of work and home and the correlation between work and home equations are also significant. They tell us that there is heteroscedasticity between equations, and negative correlation between unobserved effects affecting time assigned to work and time spent at home. We used the likelihood ratio test to verify that the joint estimation is far superior to the time use models omitting correlation.

As α and β have no direct interpretation, we prefer to analyse the values of work and leisure calculated using Equations (10) and (11). The value of work happens to be negative for the elderly and the two male groups, larger in absolute value for the richest one (likely to have smaller marginal utility of income) but quite similar regarding their values relative to the corresponding wage rates (Equation 12). Youngsters and both female groups exhibit positive values of work, somewhat larger for the richest sub-group, but smaller when corrected by income. The values of leisure relative to wage rate are relatively similar within each gender, but there are important differences between genders, as women have a much larger value of leisure relative to their wage rate than men.

The number of observations by gender outside the East zone and the description of time use in Figure 4 suggest exploring further spatial disaggregation for all other zones but Centre (due to the small sample size). In Table 3 we present the model parameters and the values of time obtained for different groups within the 25–64 age segment, subdividing by gender and all zones

Table 2. Model parameters and values of work and leisure for the six segments

	Individuals within the range 25–64 years old											
	Youngsters		Women				Men				Elderly	
			East		Other zones		East		Other zones			
	Est.	t-stat	Est.	t-stat	Est.	t-stat	Est.	t-stat	Est.	t-stat	Est.	t-stat
α	0.435	73.2	0.410	42.7	0.415	94.1	0.334	22.7	0.335	54.1	0.381	24.0
β	0.133	43.1	0.104	28.0	0.114	52.3	0.095	17.8	0.100	37.4	0.090	12.2
γ_{Home}	0.696	115.6	0.752	103.6	0.744	173.8	0.765	74.4	0.767	149.1	0.793	54.6
σ_{Work}	11.0	44.0	10.5	31.6	10.8	70.9	9.8	38.0	10.5	94.4	11.2	24.8
σ_{Home}	12.3	44.0	11.4	31.6	11.5	70.9	10.8	38.0	11.2	94.4	11.8	24.8
$\rho_{\text{Work-Home}}$	−0.837	−86.9	−0.810	−52.7	−0.885	−204.9	−0.783	−54.3	−0.870	−238.1	−0.926	−113.2
Log-likelihood	−7.141		−7.094		−6.889		−7.027		−6.894		−6.756	
Average values of time		(US$/h)										
Work	0.7	4.6	0.6	1.0	0.4	3.7	−2.5	−5.2	−0.5	−10.5	−0.6	−1.5
Leisure	1.8	11.8	5.8	10.1	2.1	21.2	6.1	13.0	1.5	32.0	2.9	8.5
Average wage rate	1.1		5.3		1.7		8.6		2.0		3.5	
Work/wage rate (%)	63.4		10.5		21.6		−29.1		−25.4		−16.2	
Leisure/wage rate (%)	163.4		110.5		121.6		70.9		74.6		83.8	
Sample size	969		499		2,515		721		4,452		308	

Table 3. Parameters and values of time estimates by gender and zone*

	East		South-East		West		North		South	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Model parameters										
α	0.334	0.410	0.346	0.417	0.327	0.410	0.365	0.423	0.331	0.418
(t-stat)	(22.7)	(42.7)	(27.9)	(50.0)	(24.8)	(44.5)	(28.0)	(40.8)	(31.0)	(50.7)
β	0.095	0.104	0.109	0.115	0.095	0.113	0.108	0.118	0.099	0.115
(t-stat)	(17.8)	(28.0)	(21.0)	(28.7)	(16.2)	(23.9)	(18.1)	(22.8)	(21.8)	(27.0)
γ_{Home}	0.765	0.752	0.748	0.744	0.778	0.745	0.748	0.734	0.773	0.747
(t-stat)	(74.4)	(103.5)	(74.4)	(95.1)	(68.8)	(80.5)	(65.2)	(72.5)	(87.7)	(89.9)
σ_{Work}	9.8	10.5	10.2	10.7	10.1	10.9	10.7	10.8	10.7	10.7
(t-stat)	(38.0)	(31.6)	(47.3)	(35.9)	(45.8)	(35.6)	(39.8)	(28.8)	(51.1)	(37.2)
σ_{Home}	10.8	11.4	11.3	11.2	11.0	11.7	10.9	11.8	11.2	11.2
(t-stat)	(38.0)	(31.6)	(47.3)	(35.9)	(45.8)	(35.6)	(39.8)	(28.8)	(51.1)	(37.2)
$\rho_{\text{Work-Home}}$	−0.783	−0.810	−0.871	−0.904	−0.857	−0.873	−0.872	−0.872	−0.881	v0.892
(t-stat)	(−54.3)	(−52.7)	(−120.1)	(−125.4)	(−104.8)	(−92.2)	(−102.7)	(−73.8)	(−142.6)	(−115.0)
Log-likelihood	−7.027	−7.094	−6.872	−6.776	−6.887	−6.970	−6.885	−6.977	−6.877	−6.833
Values of time										
Work [US$/h]	−2.5	0.6	−0.5	0.5	−0.5	0.3	−0.2	0.5	−0.5	0.4
(t-stat)	(−5.2)	(1.0)	(−3.3)	(2.1)	(−6.1)	(1.4)	(−1.7)	(2.0)	(−6.6)	(2.1)
Leisure [US$/h]	6.1	5.8	2.0	2.3	1.4	1.9	1.5	2.0	1.3	1.9
(t-stat)	(13.0)	(10.1)	(14.8)	(10.9)	(15.9)	(10.9)	(12.1)	(8.1)	(18.9)	(11.0)
Average wage [US$/h]	8.6	5.3	2.4	1.9	1.9	1.6	1.7	1.5	1.7	1.5
Work/wage rate (%)	−29.1	10.5	−19.0	24.2	−28.3	15.8	−12.4	33.1	−26.7	24.2
Leisure/wage rate (%)	70.9	110.5	81.0	124.2	71.7	115.8	87.6	133.1	73.3	124.2

Note: * 25–64 age range.

but Centre. Again, α and β are less than 0.5 and γ_{home} is positive in all segments, as expected. The pattern of the error structure found previously is also observed here (significant heteroscedasticity and negative correlation according to *t* and likelihood ratio test). The results show that both men and women keep the original sign of their marginal utility of work when disaggregated into zones (negative for men and positive for women). However, there are some differences across zones. The largest difference between male and female is observed in the East zone, where men have the largest disutility and women have the largest utility. Note that the smaller difference in wage by gender observed previously for the rest of the zones holds at a disaggregate level as well. Comparing North and South, the poorest zones, we can verify that both men and women in the South reveal a lower marginal utility from work than their counterparts in the North. These differences by geographical sector show that there is something beyond income and gender affecting the values of work and leisure, likely to be related with lifestyle and quality of leisure.

Although in Chile fathers have an increasing role in parenting, children are still mostly in the mothers' charge across income segments. Time assigned to child caring at home could be interpreted in two opposite ways: as contributing to the minimum time commitment (diminishing free time) or as reflecting preferences within leisure time; this is something we cannot detect *a priori* with our data, but could be revealed through further segmentation. As there are enough observations to explore this factor within zones, we split the women subsample and estimated the model for women who do not have children and those who do for each zone; the results are reported in Table 4. They show remarkable differences in the values of work and leisure within the same geographical sector: women with children (mothers) present very small (not significantly different from zero) values of work, while women without children (women) present positive values. As reported in the Table, mothers are older in average and tend to have larger wage rates. However, it is worth pointing out that models estimated for distinct age segments by gender showed no major differences, suggesting that it is not age what explains the difference in time values between mothers and other women within each zone.

In summary, within geographical sectors we observe important differences in the value of work between men and women, and between women without children and mothers. In Figure 5 we show the ordered point estimates of the value of work as a percentage of the wage rate. The values are ranked from highest to lowest for all the seventeen previously defined segments, including youngsters, elderly, men and women aged 25–64 by zone, dividing women into those who have children (Mothers) and those who do not (Women).

This way of presenting the results makes it very evident that: (*i*) women (without children) from all zones and youngsters have the largest positive values of work; (*ii*) mothers exhibit lower values than other women and youngsters, some close to zero; and (*iii*) men from all zones and elderly have negative values. The lowest value is observed for men from the East zone.

One of the most interesting results is the positive sign for the value of the marginal utility of work for the youngsters and women who do not have children. We believe that there is a clear explanation for this, supported by the information previously reported about the socioeconomic characteristics of the subgroups. Regarding the youngsters, they usually belong to households with many workers (2.6 average), where their income is not a significant contribution to the total (more than two thirds are not the main income), and the majority declares to be the son (or daughter) of the household head. These characteristics suggest that work pressure is not a driving force. Something similar seems to explain the result for women in general, as they usually are the second or third income in their family ranking. Furthermore, besides less constrained money budgets, women without children are less constrained in their time budget as well, unlike mothers, who have less relative freedom; this contributes to explain the smaller value of time assigned to work relative to women without children, but larger than those of men.

Table 4. Results for women (25–64) with and without children by geographical zone

	East		South-East		West		North		South	
	Women	Mothers	Women	Mothers	Women	Mothers	Women	Mothers	Women	Mothers
Model parameters										
α	0.425	0.402	0.438	0.409	0.426	0.398	0.440	0.416	0.443	0.399
(t-stat)	(30.6)	(30.5)	(37.5)	(37.8)	(33.7)	(30.4)	(32.9)	(28.4)	(44.3)	(32.0)
β	0.113	0.099	0.134	0.105	0.123	0.107	0.130	0.111	0.134	0.099
(t-stat)	(19.6)	(20.4)	(22.8)	(20.6)	(17.2)	(17.0)	(18.2)	(16.0)	(24.8)	(15.9)
γ_{Home}	0.730	0.764	0.707	0.763	0.719	0.762	0.706	0.750	0.709	0.778
(t-stat)	(64.3)	(80.7)	(61.4)	(76.6)	(51.6)	(62.1)	(50.3)	(55.3)	(66.8)	(63.7)
σ_{Work}	10.1	10.7	10.6	10.5	10.9	10.8	10.1	11.4	10.4	10.7
(t-stat)	(20.2)	(24.2)	(22.5)	(27.9)	(23.2)	(27.1)	(19.6)	(21.1)	(25.5)	(27.1)
σ_{Home}	11.3	11.5	11.1	11.0	12.3	11.2	11.6	11.8	11.1	11.0
(t-stat)	(20.1)	(24.2)	(22.5)	(27.9)	(23.1)	(27.1)	(19.6)	(21.1)	(25.5)	(27.1)
$\rho_{Work\text{-}Home}$	–0.779	–0.831	–0.920	–0.889	–0.813	0.398	–0.862	0.416	–0.859	–0.916
(t-stat)	(–28.3)	(–45.9)	(–95.1)	(–84.1)	(–39.3)	(30.4)	(–46.5)	(28.4)	(–58.9)	(–109.1)
Log-likelihood	–7.109	–7.067	–6.667	–6.812	–7.198	–6.667	–6.924	–6.995	–6.919	–6.697
Values of time										
Work [US$/h]	1.6	0.0	1.2	0.2	0.6	0.1	1.0	0.3	1.2	–0.0
(t-stat)	(1.5)	(0.0)	(2.4)	(0.8)	(1.8)	(0.3)	(2.0)	(1.1)	(2.7)	(–0.1)
Leisure [US$/h]	6.3	5.7	2.8	2.3	2.2	1.8	2.5	1.9	2.6	1.5
(t-stat)	(5.8)	(8.0)	(5.7)	(9.3)	(6.5)	(8.7)	(4.8)	(6.3)	(6.2)	(9.1)
Average wage [US$/h]	4.7	5.7	1.6	2.1	1.6	1.7	1.5	1.6	1.5	1.5
Work /wage rate (%)	34.9	0.5	71.7	9.5	39.2	3.2	69.3	20.4	80.0	–1.3
Leisure/wage rate (%)	134.9	100.5	171.7	109.5	139.2	103.2	169.3	120.4	180.0	98.7
Average age	36.6	44.3	35.2	43.5	37.4	43.5	37.0	43.6	38.0	43.4

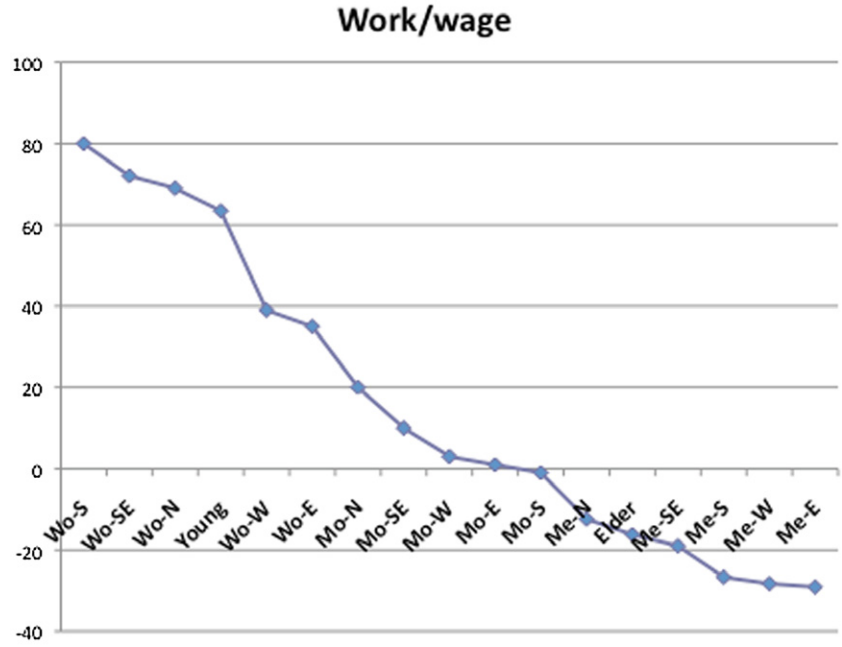

Fig. 5. Value of work relative to wage rate by segment
Notes: Wo: women (no children). Mo: mothers. Me: men S: South. SE: Southeast. N: North. W: West. E: East. Young: youngsters. Elder: elderly

The negative values for men and people over 64 can be explained partially by the fact that most of them are heads and usually the breadwinner of their households. Moreover, elderly in our sample are a group of people who could be retired but have to work in spite of age, which undoubtedly explains the negative marginal value of work for this group. Some of the other effects, that could not be assessed in this study, could be detected using more disaggregate data, particularly detailed information regarding time assignment inside the house. Very likely, the differences detected for the time values of mothers might be reflecting time assigned to childcare inside the house coupled with aspects such as family structure.

5 Conclusions

We have calculated the value of the marginal utility of work for each of many segments of travellers who work in Santiago, Chile, in order to verify and explain the expected differences due to the marked spatial socio-economic heterogeneity that has been detected in the city. Six segments were identified initially: youngsters, elderly, men and women between 25 and 64 years old, living in the East and other zones. Further segmentation by geographical sector and family structure produced 17 final segments.

First we obtained that the marginal utility of work is positive for youngsters and women and negative for men and elders. When comparing East against the rest of the zones, the values of work and leisure relative to the wage rate were not as different as the marginal utilities, for both genders. Further disaggregation by zone confirmed the results by gender regarding the sign of the marginal utility of work, but revealed differences in the values of work relative to wage for zones of similar income; neighbourhood seems to play a role. Within each gender, individuals

in the East revealed the lowest value of work/wage. Segmentation of women into those not having children and mothers unambiguously showed that for all zones the value of work relative to wage is larger for the former; nevertheless, mothers still exhibit either positive or non significantly different from zero marginal utilities of work.

The time assignment model captures the effect of committed expenses, committed time and the wage rate. Beyond the direct effect of these explanatory variables, the relative position of the individual both as income provider and on parenting responsibilities within a household seem to play an important role on explaining time values. When applying the framework to unveil the hidden values of work and leisure of travellers who work in Santiago, we found that there are important differences by gender, family structure (elderly living alone, youngsters living with parents, women with children) and zone of residence. We have been able to reveal all these effects but the latter, which would require a larger database to allow further spatial segmentation.

References

Becker G (1965) A theory of the allocation of time. *The Economic Journal* 75: 493–517

De Serpa A (1971) A theory of the economics of time. *The Economic Journal* 81: 828–846

Dessing M (2002) Labor supply, the family and poverty: The S-shaped labor supply curve. *Journal of Economic Behaviour and Organization* 49: 433–458

DICTUC (2003) Actualización de encuestas origen destino de viajes, V etapa, informe final a SECTRA, Santiago (Origin Destination Travel Survey Update, V Stage, Final Report to SECTRA, Santiago). DICTUC, Santiago

Evans A (1972) On the theory of the valuation and allocation of time. *Scottish Journal of Political Economy* 19: 1–17

Jara-Díaz SR, Guevara A (2003) Behind the subjective value of travel time savings: The perception of work, leisure and travel from a joint mode choice-activity model. *Journal of Transport Economics and Policy* 37: 29–46

Jara-Díaz SR, Munizaga M, Greeven P, Guerra R, Axhausen K (2008) Estimating the value of leisure from a time allocation model. *Transportation Research B* 42: 946–957

Jevons WS (1871) *The theory of political economy*. Macmillan and Co, London

Lee K, Kim I (2005) Estimating the value of leisure time in Korea. *Applied Economics Letters* 12: 639–641

MIDEPLAN (2003) Informe regional región metropolitana de Santiago: Encuesta de caracterización socio-económica nacional: CASEN (Regional eeport for the metropolitan región: National socio-economic characterization survey: CASEN). MIDEPLAN, Santiago

Munizaga M, Jara-Díaz SR, Greeven P, Bhat C (2008) Econometric calibration of the joint assignment-mode choice model. *Transportation Science* 42: 1–12

Munizaga M, Jara-Díaz SR, Olguín J, Rivera J (2011) Generating twins to build weekly time use data from multiple single day OD surveys. *Transportation* 38: 511–524

Prasch R (2000) Reassessing the labor supply curve. *Journal of Economics Issues* 34: 679–692

Shaw WD (1992) Searching for the opportunity cost of an individual's time. *Land Economics* 68: 107–115

Spencer D (2004) Deconstructing the labour supply curve. *Metroeconomica* 55: 442–458

doi:10.1111/j.1435-5957.2011.00395.x

Resumen. En este artículo aplicamos un modelo de asignación de tiempo para estimar y analizar las diferencias espaciales en los valores del trabajo y del ocio para segmentos de viajeros que trabajan en Santiago de Chile, una ciudad capital grande y espacialmente segregada de América del Sur. La muestra se obtuvo a partir de la última Encuesta Origen-Destino disponible. La muestra incluye el uso semanal del tiempo y las características socioeconómicas que representan las diferencias entre zonas. Se definen diecisiete segmentos en función del género, la edad, la estructura familiar, y la zona de residencia. Se obtuvieron valores positivos de la utilidad marginal del trabajo para las mujeres y los jóvenes, y negativo para los hombres y los ancianos. Las mujeres sin hijos mostraron valores mayores que las madres. Los resultados se interpretan en términos de jerarquía de ingresos en el hogar y tiempo comprometido.

要約　本論文では、時間配分モデルシステムを用いて、空間的に分離された南アメリカの大都市であるチリのサンチアゴで働く通勤労働者の仕事と余暇の値における空間的差異の推計と分析を行う。最新の起点終点調査のデータからのサンプルを使用した。調査項目には週ベースの時間の使用および社会経済的な特性が含まれており、地域ごとの差異を現している。性別、年齢、家族構成、居住地域により17のグループに分類されている。労働から得られる限界効用の値は女性および若年者でプラスとなる一方、男性と高齢者ではマイナスとなった。また、子どものいない女性の値が母親の値を上回っている。分析結果は所得階層と拘束時間により説明できる。