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ABSTRACT

The aim of this paper is to extend the standard neoclassical consumer theory to explain the allocation of individual time to physical activity and sports. We assume a CES utility function and we estimate the model using the SURE method and the Heckman two-step procedure. We run separate estimates for men and women using the Spanish Time-Use Survey conducted in 2002-03. The results show that there are gender differences in the determinants of the allocation of time to physical activity. Moreover, participation in sports and the time devoted to this activity seem to be based on different decisions.

Keywords: physical activity, sports participation, time allocation, CES utility function.

Introduction

Between the 1960s and the 1990s there was a significant increase in the number of people taking part in sports and in the frequency of sports participation in Europe (Gratton & Taylor, 2000). In Europe, the “Sport for All” campaign had a significant and positive influence on this evolution. Major public investment in new indoor sports facilities led to a striking increase in opportunities for sport. In addition, the private (health and fitness) and voluntary sectors began to play a more prominent role. Also, economic development provided larger sections of the public with access to sports facilities.

Nevertheless, since the turn of the century, sports participation appears to have reached a stagnation point in many European countries (Spain, Finland, Belgium, Portugal and Austria), and has actually begun to decline in some countries such as The Netherlands, Italy, and England (Bottenburg, 2005). In England, for instance, sports participation fell from 48% in 1990 to 46% in 1996, with a further drop to 43% by 2002 (Rowe, Adams, & Beasley, 2004). In Spain, where traditionally sports participation rates are below the European average, sports participation seems to have reached a stagnation point: in the period 1995-2005, sports participation increased by only one percent (García Ferrando, 2006).

This situation is a source of concern, not only in European countries, but also in other areas of the world. Sports participation figures for the adult population in Canada, for example, show a disconcerting decrease from 45% to 31% between 1992 and 2004 (Bloom, Grant, & Watt, 2005). In the United States also, sports participation, as measured by American Sports Data, has either decreased or grown at a slower rate than the overall population over the past decade (Sporting Goods Manufacturers Association, SGMA, 2004).

At the same time, surveys show a dramatic increase in the incidence of over-weight and obesity in the developed societies. There is a large body of scientific evidence regarding the positive impact of sport and physical activity on health and wellbeing (Miles, 2007). Finally, there is a range of evidence demonstrating the value of sport to other important areas of social policy such as education, community regeneration, community safety (e.g. preventing juvenile crime), and the environment.

Consequently, the negative evolution of sports participation in the last ten years, coupled with evidence of sport's health and social impacts, has resulted in a strong increase in academic interest in sports participation research, although there has been only limited theoretical analysis of the economic theories of sports participation (Downward, 2007; Humphreys & Ruseski, 2007).

The aim of this paper is to extend the standard neoclassical consumer theory to analyze the allocation of individual time to physical activity and sports in order to arrive at the main determinants of this decision. Physical activity is important for keeping people healthy, so governments should be interested in promoting recreational sports activities to cut public health expenditure and increase individuals' wellbeing and social integration[1].

In this paper we specify and estimate a structural neoclassical model of individual time allocation assuming that utility depends on time spent on leisure, time spent on physical activity and a composite good of consumption. In particular, we assume a Constant Elasticity of Substitution (CES) functional form for the utility function. We work out the income-leisure and the income-physical activity equations which can be linearised in terms of hourly wages and socio-demographic characteristics (observed heterogeneity). We estimate the two-equation system using Seemingly Unrelated Regression (SURE), as this method accounts for the correlation between the error terms. Moreover, we impose the cross-equation restrictions implied by the theoretical model, control for potential sample selection problems and allow different structures for males and females.

The outline of the paper is as follows. Section 2 reviews the theoretical models and the empirical evidence concerning the determinants of sports participation. Section 3 sets out our theoretical model and outlines the econometric specification. Section 4 describes the data set and Section 5 presents the main estimation results. Section 6 sets out the conclusions and points to some policies and interventions implications.

Review of the Theoretical and Empirical Literature

Following Downward (2007), economic decision-making theories in relation to sports can be broken down into two main types: neoclassical and heterodox approaches.

Neoclassical approaches employ a rational-choice framework to model individual sports participation. Standard consumer theory assumes that individuals choose between consumption and leisure in order to maximize their utility function subject to budget and time constraints. In this context, leisure is defined as time spent away from market work, an assumption that has been frequently criticized because of the heterogeneity of uses of time it involves.

More recent variants, following Becker's theory, have integrated time allocation into the consumption decision. Becker (1965) develops a model for the allocation of time that focuses on non-work activities. He assumes that households combine time and market goods to produce 'commodities' that increase their utility. The main problem with this approach is that the data collected do not include information about commodities or goods and the time devoted to each commodity. Therefore, the empirical applicability of this model is rather limited.

Subsequently, Becker's model has been modified in order to study specific uses of time. In the sports economy literature, Cawley (2004) offers an economic framework to explain physical activity. He assumes that utility depends on a person's weight, health, food, other goods and time spent sleeping (S), at leisure (L), at occupation (O), in transportation (T) and in home production (H). Physical activity and sports are considered leisure activities. He calls this approach the SLOTH model. This model has been employed by Humphreys and Ruseski (2006, 2007) to explain physical activity in the United States. These authors adapted the SLOTH framework to estimate a reduced form model of participation in physical activity and the amount of time spent on physical activity in the USA using the two-step Heckman procedure to correct for the selectivity problem. Also, Késenne and Butzen (1987), following the theory of the allocation of time and specifying an Almost Ideal Demand System (AIDS), estimate the budget shares of sports activities.

Heterodox economic theories, in contrast, consider a wider set of methodological and theoretical principles than neoclassical theory (Downward, 2007). These theories involve economic, sociological and psychological approaches.

The Post-Keynesian approach emphasizes that individual behavior is linked to broader aspects of social behavior such as the importance of social values, and the consumption of sport involves learning by doing and spillover effects (Lavoie, 2004). The sociological analysis of sports focuses on explaining sporting activities in terms of concrete social situations and the construction of identities by individuals in choice situations (Scraton & Watson, 1999). According to this theory, sporting styles and individual preferences are linked not only to individual feelings, but also to social pressure (Bourdieu, 1984). This author presented two different factors to explain divergent tastes in sports: economic capital (income) and cultural capital (education).

Finally, the psychological approach argues that the individual's preferences and tastes are not given (Scitovsky, 1976); they therefore evolve and change over the life-span. Sensation-seeking, awakening, concern, pleasure or anxiety can be potential sources of demand for sport and leisure activities as the individual attempts to balance boredom and stimulation (Burgham & Downward, 2005). Thus, individual work-versus-leisure choices are based on interdependent individual preferences and motives which change over a person's life span due to situational influences in the personal environment. As a consequence, this approach focuses on the constraints of participation at the individual level, minimizing the role played by social constraints.

While the neoclassical theories emphasize income, time and domestic work influence, the heterodox economic theories highlight interdependent and hierarchical demands and social relations. Downward (2007) and Burgham and Downward (2005) have developed a sports participation model following the heterodox economic theories which distinguishes individual and social characteristics, economic variables and sport characteristics.

Unfortunately, only some of the most recent existing studies make any explicit reference to the economic theory underlying their sport decision modelling. The first study dealing with leisure and sports participation considering a wide range of activities was by Cicchetti, Davidson and Seneca (1969). They employed a two-step econometric model to look at decisions to participate as well as their frequency. At the European level, the first evidence was provided by Rodgers (1977). It showed substantial similarities in the pattern of sports participation across different European countries.

In the 1980s and 90s, many studies highlighted the fact that younger, male, more educated people from higher social classes and with higher income participate more in sports (Andreff & Nys, 2001; Gratton & Taylor, 2000; Shamir & Ruskin, 1984). In the last five years, sports participation decision modelling has increased in complexity, including logistic and two-step Heckman models as well as multiple classification analysis (Breuer & Wicker, 2008; Downward & Riordan, 2007; Downward, 2007; Farrell & Shields, 2002; Humphreys & Ruseski, 2006, 2007).

Nevertheless, due to the different approaches used to study sporting and physical activities, it is not easy to make a clear comparison of the economic determinants of sports and physical activity decision. Firstly, the list of sporting and physical activities varies from one study to another. Secondly, the sports participation variable is measured in different ways. Relatively few studies consider the time spent on sports participation or the frequency of such participation (Downward & Riordan, 2007; Humphreys & Ruseski, 2006, 2007; Lera-López & Rapún-Gárate, 2007; Stempel, 2005).

Despite these differences, it is possible to make general assessments concerning the role played by the economic, individual and social variables. The empirical evidence has shown that the probability of sports participation decreases with age (Barber & Havitz, 2001; Breuer & Wicker, 2008; Downward, 2007; Downward & Riordan, 2007; Farrel & Shields, 2002; Humphreys & Ruseski, 2006; Moens & Scheerder, 2004; Scheerder, Vanreusel, & Taks, 2005; Wicker, Breuer, & Pawlowski, 2009). The differences in sports participation can be attributed to biological and physical limitations and to changes in the types of activities preferred by the older age groups (Barber & Havitz, 2001). In fact, walking is positively associated with age (Humphreys & Ruseski, 2007; Lera-López & Rapún-Gárate, 2007). Nevertheless, the frequency of sports participation increases with age in some studies (Humphreys & Ruseski, 2006; Lera-López & Rapún-Gárate, 2007).

Gender roles have been found to be a highly important form of social pressure and, correspondingly, a meaningful source of constraints in leisure participation. Thus there is consensus about the fact that men, in general, not only participate in sport more than women (Downward, 2007; Humphreys & Ruseski, 2006, 2007; Lera-López & Rapún-Gárate, 2007; Moens & Scheerder, 2004; Stamm & Lamprecht, 2005; Wilson, 2002) but they also show a higher frequency of participation (Barber & Havitz, 2001; Humphreys & Ruseski, 2006, 2007). These differences can be attributed to different variables such as biological factors, and cultural and social influences, reflecting differences in family responsibilities as well as differences regarding behaviour, social expectations and work.

Traditionally, the economic perspective emphasizes the relevance of economic variables in sports participation. The common variable used to measure a person's economic situation is income. The literature provides evidence that lower income may act as a barrier to sports participation (Breuer & Wicker, 2008; Farrell & Shields, 2002; Humphreys & Ruseski, 2006, 2007; Lera-López & Rapún-Gárate, 2007; Stempel, 2005; Wicker et al., 2009; Wilson, 2002). Nevertheless, among regular practitioners, income has no influence on the frequency of their sports participation (Gratton & Taylor, 2000) or the influence is negative (Downward & Riordan, 2007; Humphreys & Ruseski, 2006).

As already noted, another important consideration in the economic analysis of demand for sport is time. Since time is finite, any increase in the time devoted to sport will always be constrained by competing demands for time for leisure, work and other uses. Time-related constraints have been perceived as one of the most relevant barriers to physical activity and sports participation (Alexandris & Carrol, 1999). The influence of the time variable is analyzed through three proxy variables: occupation and professional status, household size and marital status. Less sports participation in general has been found among certain occupational segments in the lower socio-economic groups (García Ferrando, 2006; Lera-López & Rapún-Gárate, 2007). Other studies have looked at work time, which is negatively associated with sports participation (Breuer & Wicker, 2008; Downward, 2007).

The evidence has also revealed that household profiles can be important in explaining sports participation. Size of household, according to Downward (2007), Humphreys and Ruseski (2007, 2006) and Scheerder et al., (2005) was negatively associated with sports participation. In Downward (2004) and Farrell and Shields (2002) the effect was not clear and varied according to the type of sports considered. Children may limit the time available for adult sporting activities such as aerobics and running while increasing participation in child-orientated sports such as football or swimming (Downward, 2004). Married people participate less in sport and physical activities (Humphreys & Ruseski, 2006), although there are differences according to the type of activity and the frequency of sports participation (Humphreys & Ruseski, 2007, 2006).

The sociological perspective highlights the role of education in explaining sports participation. A higher level of education might lead to a greater awareness of the benefits and importance of sport as well as being associated with higher hourly wages. Education also includes habits developed as a student, when access to facilities is easy and relatively inexpensive. Also, educational attainment is identified as having the potential to provide opportunities to access sport indirectly through education's potential to raise employment and income opportunities. Thus, we would expect a positive relationship between education and sports participation, as the empirical evidence has indeed shown (Downward, 2007; Humphreys & Ruseski, 2007, 2006; Stempel, 2005; Wilson, 2002). Nevertheless, the frequency of sports participation seems to be negatively associated with educational attainment (Downward & Riordan, 2007; Humphreys & Ruseski, 2006).

Many studies include the role played by the size of population in terms of the availability of sports facilities. In fact, the empirical evidence might lead us to expect less access to certain types of sporting facilities in rural areas than in the suburbs or cities (Andreff & Nys, 2001). This could have a negative effect on the general level of sports participation, as demonstrated by Moens and Scheerder (2004) and Scheerder et al. (2005).

A Model of the Allocation of Time to Physical Activity and Sports

To study the determinants of time spent on physical activity and sports, we specify a static neoclassical consumer model which assumes that individuals maximize their utility subject to their own budget constraints. Individual preferences are written in terms of time spent on physical activities (l_1), leisure time not devoted to physical activities (l_0), and net income (c).

This approach can be seen as a simplified version of the SLOTH model specified by Cawley (2004), since we only assume three uses of time, and we ignore the influence of weight and health on utility.

As Gronau (1977) points out, the division of leisure is justified if the allocation of time to different activities reacts differently to changes in the explanatory variables. We think that this is the case when studying physical activity and sports, and the estimation of the model will allow us to check this statement.

In order to have specific demand functions, we must choose a particular functional form for individual preferences. The structure of preferences is assumed to be a Constant Elasticity of Substitution (CES) utility function. This function has often been used in the labour supply literature because of its convenience in estimation. In this case, the individual optimization problem is:

$$\begin{aligned} &\max_{c,l_0,l_1} \quad U(c,l_0,l_1) = \left[c^{-\gamma} + \beta l_0^{-\gamma} + \delta l_1^{-\gamma}\right]^{-\frac{1}{\gamma}} \\ &s.t. \qquad c = w(T - l_0 - l_1) + y \end{aligned} \tag{1}$$

where U denotes utility, β and δ are positive parameters, γ is a parameter that must be greater than -1, w is hourly earnings, y represents non-labour income, and T is time endowment (24 hours a day).

By solving the previous optimization problem, we obtain individual demands for consumption, sports and other leisure activities:

$$c = \left(\frac{\delta}{w}\right)^{\left(\frac{-1}{1+\gamma}\right)} \left[\frac{wT + y}{\left(\frac{\delta}{w}\right)^{\left(\frac{-1}{1+\gamma}\right)} + w\left(\frac{\delta}{\beta}\right)^{\left(\frac{-1}{1+\gamma}\right)} + w} \right] \qquad (2)$$

$$l_0 = \left(\frac{\beta}{\delta}\right)^{\left(\frac{1}{1+\gamma}\right)} \left[\frac{wT + y}{\left(\frac{w}{\delta}\right)^{\left(\frac{1}{1+\gamma}\right)} + w\left(\frac{\beta}{\delta}\right)^{\left(\frac{1}{1+\gamma}\right)} + w} \right] \qquad (3)$$

$$l_1 = \left[\frac{wT + y}{\left(\frac{w}{\delta}\right)^{\left(\frac{1}{1+\gamma}\right)} + w\left(\frac{\beta}{\delta}\right)^{\left(\frac{1}{1+\gamma}\right)} + w} \right] \qquad (4)$$

From equations (3) and (4) we conclude that an increase in β has a positive effect on leisure activities (l_0), whereas δ has a positive influence on sport activities (l_1). The CES utility function does not allow inferior goods.

The previous demand functions are hard to estimate because of their non-linear functional form, but from the first order conditions we can derive a simpler specification:

$$\frac{c}{l_0} = \left(\frac{w}{\beta}\right)^{\left(\frac{1}{\gamma+1}\right)} \qquad (5)$$

$$\frac{c}{l_1} = \left(\frac{w}{\delta}\right)^{\left(\frac{1}{\gamma+1}\right)} \qquad (6)$$

In addition, we allow both observable and unobservable factors to enter preferences through the parameters β and δ, as follows:

$$\beta = e^{(Z_0\varphi_0 - \eta_0)} \qquad (7)$$
$$\delta = e^{(Z_1\varphi_1 - \eta_1)} \qquad (8)$$

where Z_0 and Z_1 are vectors of explanatory variables that may have an influence on individual wellbeing and η_0 and η_1 are random variables capturing unobservable factors that affect individual valuation of both leisure activities.

Substituting expressions (7) and (8) into equations (5) and (6), and taking logarithms, we obtain the following equation system for estimation:

$$\log\frac{c}{l_0} = \frac{1}{\gamma+1}\log w - \frac{Z_0\varphi_0}{\gamma+1} + \frac{\eta_0}{\gamma+1} \qquad (9)$$

$$\log\frac{c}{l_1} = \frac{1}{\gamma+1}\log w - \frac{Z_1\varphi_1}{\gamma+1} + \frac{\eta_1}{\gamma+1} \qquad (10)$$

Assuming that η_0 and η_1 are distributed as a bivariate normal distribution with zero means and constant variances, this linear equation system can be estimated using the Seemingly Unrelated Regression method (SURE). In the estimation we impose the constraint that the coefficient on log wage must be the same in both equations. Once this equation system has been estimated, we can recover the structural parameters γ, φ_0 and φ_1.

Data Description and Methodology

Our data source is the Spanish Time-Use Survey conducted by the Spanish Office for National Statistics (INE) in 2002-03. It is a nationally representative household survey and contains economic and socio-demographic information at the individual level. Moreover, the survey reports very detailed time diary information collected during a day. It is the first official survey of its kind carried out in Spain.

The survey consists of a household questionnaire, an individual questionnaire, a one-day diary for those individuals aged 10 or over and, a one-week work sheet for workers. The **one-day** diary collects information about the main and secondary activities of the respondent every ten minutes during twenty-four hours. There are 176 activities classified into ten groups: personal care, work, study, housework and childcare, voluntary work, social life, sports, hobbies and games, media and travel. The one-week work sheet reports the working time every day during a week.

Our sample consists of individuals between the ages of 18 and 65 who have non-missing values for the variables used in the empirical analysis. We drop those workers who have more than one job or who have had an unusual working week, as we try to compute hourly earnings as accurately as possible.

Sports time (l_1) is defined as the amount of time (in hours a day) allocated to physical activities and sports such as walking, running, cycling, football, basketball, gym, athletics, swimming, windsurfing, dancing, horse-riding, motor sports and fishing, to name but a few. It is worth noting that sports time may be zero for one of two reasons: either the individual does not participate in any sport or s/he does, but not on that particular day.

Leisure time (l_0) is the time devoted neither to work nor to playing sports. Note that it includes housework and child care, besides other uses of time such as sleeping, reading, watching TV, going to the cinema and so on. It takes a positive value for everyone in the sample.

Consumption (c) is the total daily income per person. It is computed using information about monthly family net income from all sources and household size. As income is reported in ranges, we assign the corresponding interval midpoint[2] to each household.

The explanatory variables are defined in the Appendix. In keeping with economic theories of sport participation, we have included the following variables: age, marital status, number of children, education and degree of urbanisation. We also looked at self-reported health status. This variable seems to have a positive impact on sports participation and on frequency of participation, as shown by Downward and Riordan (2007), Downward (2007), and Humphreys and Ruseski (2006, 2007). However, experiencing bad health may lead an individual to increase participation in certain sports on medical advice (Farrell & Shields, 2002). As control variables, we have included the region, the quarter of the year and the day of the week the information was collected.

We fit separate models for men and women because the empirical literature on the allocation of time reveals important gender differences in behaviour. In particular, in Spain a wide gap in sports participation rates between males and females has been detected (García Ferrando, 2006) similar to other southern European countries (Bottenburg, 2005). Examples of other studies that have made separate analyses according to gender are those by Wilson (2002), Stamm and Lamprech (2005), and Sylvia-Bobiak and Caldwell (2006).

In the empirical analysis, we faced two main methodological problems. The first one is the lack of information about non-working people's earnings and the possible endogeneity of this variable. The second problem is that we only know the time devoted to sports for those individuals who did this activity during the reported day. This sub-sample may not be random, so we must control for this problem. To deal with these problems, our estimation procedure consists of four steps:

First, we fit Probit models for the probability of working and compute the inverse Mills ratio to solve sample selection problems in the next step.

Con formato: Numeración y viñetas

Second, we estimate log-linear earnings equations by interval regression methods using the workers sub-sample. We apply interval regression procedures because individual earnings are recorded in group format. The dependent variables are the logarithms of hourly earnings and, among the explanatory variables, we include the inverse Mills ratio estimated in the first stage to solve sample selection problems. With the estimated coefficients we predict hourly earnings for everyone in the sample.

Third, we fit Probit models for the probability of doing sports and obtain the inverse Mills ratio.

Last, we estimate the demand system (9)-(10) employing SURE methods, using the sub-sample of people who have a positive value for l_1, and including the inverse Mills ratio computed from the previous step.

The results from steps one and two are given in the Appendix. Next, we present the Probits for the probability of engaging in sports and the estimates of the relative demand for physical activity and sports.

Empirical Results

Table 1 present the Probit estimates for the probability of engaging in any sports or physical activity. We assume that this probability depends on age, age squared, health status, marital status, number of children under six and number of children between 6 and 15 years old, the quarter of the year, the day of the week the information was collected, degree of urbanization, region and educational attainment.

In general, the results are consistent with our prior beliefs about the determinants of the probability of sports participation and are also consistent with previous literature on this issue, although separate analysis of males and females offers additional interesting results. The analysis shows that more educated people are more likely to participate in sports. Moreover, participation appears to fall with the number of school-age children. Marital status has an opposite effect depending on gender: being married increases the probability of females engaging in physical activity, but reduces the probability of males doing so.

Table 1. Probit Estimates for the Probability of Playing Sports

Dependent variable:	*Females*		*Males*	
Dummy = 1 if l_1>0	*Coefficient*	*t-Student*	*Coefficient*	*t-Student*
Age	*-0.028*	*-4.43*	*-0.050*	*-7.47*
Age^2	*0.041*	*5.47*	*0.073*	*9.21*
Health	*-0.004*	*-0.17*	*-0.135*	*-4.53*
Married	*0.109*	*3.82*	*-0.059*	*-1.69*
No. children 0-5	*0.020*	*0.74*	*-0.009*	*-0.31*
No. children 6-15	*-0.062*	*-3.28*	*-0.091*	*-4.18*
1st quarter	*0.023*	*0.78*	*-0.030*	*-0.90*
2nd quarter	*0.114*	*3.82*	*0.067*	*2.01*
3rd quarter	*0.155*	*5.03*	*0.108*	*3.17*
Weekend	*0.215*	*9.62*	*0.456*	*18.65*
Degree of urb. 1	*0.051*	*1.97*	*0.133*	*4.67*
Degree of urb. 2	*0.053*	*1.75*	*0.102*	*3.08*
Andalucia	*-0.027*	*-0.65*	*0.086*	*1.91*
Aragón	*0.099*	*1.37*	*0.019*	*0.24*
Asturias	*0.060*	*0.89*	*0.226*	*3.02*
Baleares	*-0.015*	*-0.18*	*-0.055*	*-0.60*
Canarias	*-0.038*	*-0.62*	*0.104*	*1.52*
Cantabria	*0.272*	*3.89*	*0.145*	*1.95*
Castilla-León	*0.382*	*6.51*	*0.276*	*4.33*
Castilla-La Mancha	*0.078*	*1.19*	*0.066*	*0.91*
Cataluña	*-0.002*	*-0.05*	*-0.003*	*-0.06*
Comunidad Valenciana	*-0.002*	*-0.04*	*0.067*	*1.09*
Extremadura	*0.325*	*4.52*	*0.335*	*4.04*

Galicia	*0.082*	*1.68*	*0.163*	*2.98*
Murcia	*0.163*	*2.31*	*-0.050*	*-0.65*
Navarra	*0.340*	*5.33*	*0.257*	*3.82*
País Vasco	*0.415*	*5.40*	*0.334*	*3.94*
La Rioja	*0.193*	*2.36*	*0.238*	*2.80*
Primary education	*0.086*	*2.92*	*0.039*	*1.19*
Secondary education	*0.031*	*0.89*	*0.086*	*2.40*
Higher education	*0.146*	*3.80*	*0.212*	*5.10*
Constant	*-0.296*	*-2.34*	*0.130*	*0.95*
Sample size	*14801*		*12467*	
Log L	*-9592.70*		*-7914.49*	

We find that there is no linear relationship between age and sports participation. In fact, as age increases, the probability of doing sports decreases up to the age of 34, after which the relationship is reversed. It seems, therefore, that sports participation follows a U-shaped curve with two peaks, one occurring during the youth phase and the other around retirement age. As we would expect, the probability of playing sports is higher in spring and summer, and at weekends. This probability is higher in medium or large-size cities and also depends on the region. The influence of the degree of urbanization and the region may be explained by differences in the sporting facilities and climate. In the case of the degree of urbanization, it could also reflect spillover effects in more densely populated localities. Finally, the results also reveal that perceptions of health are important in decreasing the probability of sports participation. Healthy individuals are less likely to play sports, though this variable is not significant for women.

Table 2. SURE Demand System Estimates

	Females		*Males*	
	Coefficient	*t-Student*	*Coefficient*	*t-Student*
log (c/l_0)				
log w	*0.878*	*29.63*	*1.186*	*24.66*
Age	*-0.012*	*-2.20*	*0.048*	*7.56*
Age^2	*0.010*	*1.48*	*-0.068*	*-8.74*
Health	*0.124*	*6.25*	*0.214*	*8.57*
Married	*0.035*	*1.52*	*-0.044*	*-1.56*
No. children 0-5	*-0.208*	*-10.12*	*-0.189*	*-7.41*
No. children 6-15	*-0.217*	*-14.19*	*-0.240*	*-11.74*
1st quarter	*0.037*	*1.60*	*0.067*	*2.52*
2nd quarter	*0.025*	*1.05*	*0.130*	*4.84*
3rd quarter	*0.035*	*1.41*	*0.104*	*3.67*
Weekend	*-0.026*	*-1.28*	*-0.056*	*-1.44*
λ	*-0.224*	*-2.80*	*0.162*	*1.43*
Constant	*-0.982*	*-8.17*	*-3.315*	*-22.56*
log (c/l_1)				
log w	*0.878*	*29.63*	*1.186*	*24.66*
Age	*-0.019*	*-2.50*	*0.062*	*6.89*
Age^2	*0.016*	*1.80*	*-0.092*	*-8.35*
Health	*0.108*	*3.83*	*0.223*	*6.27*
Married	*0.086*	*2.64*	*0.004*	*0.11*
No. children 0-5	*-0.155*	*-5.25*	*-0.125*	*-3.34*

No. children 6-15	*-0.151*	*-6.88*	*-0.222*	*-7.49*
1st quarter	*-0.001*	*-0.02*	*0.075*	*1.94*
2nd quarter	*-0.075*	*-2.20*	*0.106*	*2.70*
3rd quarter	*-0.061*	*-1.73*	*0.083*	*2.03*
Weekend	*-0.099*	*-3.41*	*-0.162*	*-2.99*
λ	*-0.116*	*-1.03*	*-0.096*	*-0.62*
Constant	*1.832*	*10.67*	*-0.720*	*-3.70*
Sample size	*5606*		*4837*	
R-sq ($log (c/l_0)$)	*0.207*		*0.219*	
R-sq ($log (c/l_1)$)	*0.122*		*0.150*	

Table 2 shows the SURE estimates [equations (9) and (10)]. The explanatory variables vector contains the predicted logarithms of hourly earnings, age and age squared, health status (a subjective measure), marital status, number of children under six, number of children between 6 and 15 years old, and dummies for weekend and quarter of the year. Additionally, we include the inverse Mills ratio computed from the Probits presented in Table 1 to solve possible sample selection problems, though there is only one that is significant, the one included in the female leisure equation.

In order to test the error correlations, we applied the Breusch-Pagan test, the null hypothesis being that the covariance matrix of disturbances would be diagonal. In view of the results, we can reject the null hypothesis: we found that the residuals of the leisure and sports demand equations were positively correlated.

Given the aim of our paper, we focus our attention on the physical activity equation. From the estimated coefficients shown in Table 2, we can compute the structural parameters, which are reported in Table 3. These parameters provide information about the influence of the explanatory variables on the relative demand for sports time for the people who participate in this activity.

Table 3. Demand for Physical Activity: Structural Parameters

	Females	*Males*
γ	*0.139**	*-0.157**
φ_1		
Age	*0.022**	*-0.052**
Age²/100	*-0.018*	*0.078**
Health	*-0.123**	*-0.188**
Married	*-0.098**	*-0.004*
No. children 0-5	*0.176**	*0.105**
No. children 6-15	*0.172**	*0.188**
1st quarter	*0.001*	*-0.063**
2nd quarter	*0.085**	*-0.089**
3rd quarter	*0.070**	*-0.070**
Weekend	*0.112**	*0.137**

Note: * denotes that the level of significance is 10% or less.

From the value of γ, we can affirm that the relative demand for physical activity decreases with hourly earnings, as expected. This is because the higher the earnings, the higher the opportunity cost of time spent on any leisure activity. Regarding the vector φ_1, note that when a parameter is positive, the independent variable has a direct impact on δ and the relative demand for sports, and vice versa. As can be seen from a comparison of the coefficients in

Table 3 with those in Table 1, the effect of some variables on participation in sports is different from their effect on the amount of time spent on this activity conditional on participation.

In particular, the female relative demand for sports increases with age, whereas this pattern is reversed for men. A striking result is that good health decreases the relative demand for sports, for both men and women. It may be that when a person feels bad, they are more worried about their health and so engage in more physical activity in order to keep fit or do so on medical advice.

The effect of marital status depends on gender. Married women have a lower demand for physical activity compared to single or divorced women. However, this variable is not significant for men. This result could be explained by gender differences in the allocation of time to housework. However, children have a positive influence on the relative demand for sports, for both men and women. Therefore, children decrease the probability of doing sports, but people with children who participate in physical activity allocate more time to sports than people without dependants. This positive effect suggests that physical activity in which parents and children participate may be a complementary 'good' and reinforces the role of sport as a family socialization factor.

The season of the year may be relevant, since some sports take place outdoors and are therefore affected by climate, while some sports are practised at a particular time of year (e.g. skiing). The estimates confirm the influence of these variables. Females devote more time to sports during the second and third quarters, whereas men demand more physical activity during the last quarter of the year. Finally, everyone spends more time on sports at weekends, when people usually have more spare time.

Conclusions and Policy Implications

In this paper we specify and estimate a structural model for explaining individuals' decisions to do sports and physical activity. We assume a CES utility function and take into account possible sample selection problems. Considering differences in time constraints by gender, we fit the model separately for men and women using a Spanish data base which contains detailed information about individual allocation of time on a specific day. We estimate the model using the SURE method and the Heckman two-step procedure.

The CES utility function has two main advantages. The first is that it does not impose a linear relationship between wages and time allocated to physical activity and sports. The second is that it yields a system of equations that can be estimated by linear regression methods.

The results support our initial decision to separate men and women when studying time allocation to physical activity and sports, as the influence of some explanatory variables is very different according to gender. The estimates also provide evidence that participation in sports and the amount of time allocated to it depend on two different decisions explained by different variables.

In summary, the results show that the probability of sports participation reaches a minimum at the age of 34. Moreover, being more highly educated and living in certain regions or in populated areas tend to raise sport participation, whilst having school-age children and being healthier reduce participation. On other hand, the estimates reveal that the time allocated to physical activity and sport depends on the opportunity cost of time, personal characteristics (age and health), family variables (marital status and children), and other factors such as the time of the year, the day of the week, the region and the degree of urbanization. These predictions are consistent with the neoclassical model presented in a previous section.

An initial conclusion from this may be that sports policy should distinguish between encouraging current participants to increase their frequency of participation and committing resources and efforts in an attempt to expand the base of possible participants. A second conclusion is related to gender differences in the decision to do sport and the time allocated to it. There are relevant differences between men and women in regard to the time allocation decision as well as the participation decision. Consequently, different sports policy interventions should be developed for females and males. Existing campaigns aimed at increasing levels of physical activity in the general population should be discouraged. A third conclusion highlights the key role played by the opportunity cost of time and family characteristics to explain the time allocated to sport and physical activities. In a fourth step, the results point to the fact that there is still a social stratification of sports involvement in Spain. Also, the positive relevance of geographical variables may be indicative of the influence of supply-side factors and spillover effects in explaining sports participation. Finally, both participation and time spent on sport and physical activity display seasonal variation.

From a policy point of view, the results have significant implications and consequences. Firstly, if expansion of the base of sports participants is desired, it is crucial to avoid the sports participation drop-out rate of middle-aged people. Secondly, the results suggest that programmes aimed at increasing participation by older women might be more effective than those aimed at increasing participation by older men because, as a consequence, relatively more time might be spent on physical activity and sport by females. Thirdly, the results have pointed out that although people with children are less likely to participate in sports, those who do choose to participate spend more time on physical activity than people without children. One implication of this result is that intervention aimed at increasing the participation of people with children might be effective. Also, the development of sports programmes associated with family sports where parents and children could play sports at the same time should be encouraged. Fourthly, policy interventions aimed at increasing sports participation should take into account the seasonal variation.

Fifthly, the relevance of geographical factors may be indicative of positive supply-side factors and significant differences in sports investment and policy among the Spanish regions. An actively coordinated sports policy should ensure that sporting facilities are available for all, as well as providing information about the health benefits of continued sports practice and putting in place specific programmes according to people's physical condition (age and gender, primarily) so as to gain new participants and increase the frequency of existing sports practitioners.

Finally, although the results may offer some help in the design of public policies aimed at enhancing physical activity, we should be cautious, as the explanatory variables only explain a small part of the total variation of individual time allocated to physical activity. For future research, it would be interesting to try different functional forms for preferences in order to check to what extent the results are driven by the choice of utility function.

Notes

1. See Késenne (2006) for a review of the main justifications of public intervention in the recreational sports sector.

2. For the unbounded top range, the coded level of income is 20% higher than the lower limit. We also tried a different value (150% of the limit) and the results hardly changed.

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Appendix

Table A1. Explanatory Variables

Age	*Years*
Health	*Dummy = 1 if either good or very good*
Married	*Dummy = 1 if married*
No. children 0-5	*Number of children under 6*
No. children 6-15	*Number of children between 6 and 15 years old*
1st quarter	*Dummy = 1 if January, February, March.*
2nd quarter	*Dummy = 1 if April, May, June.*
3rd quarter	*Dummy = 1 if July, August, September.*
Weekend	*Dummy = 1 if Saturday, Sunday.*
Degree of urb.1	*Dummy = 1 if >100,000 inhabitants/regional capital*
	Dummy = 1 if 20,000-100,000 inhabitants
Degree of urb. 2	*Dummy =1 if primary education completed.*
Primary education	*Dummy =1 if secondary education completed.*
Secondary education	*Dummy =1 if university degree completed.*
Higher education	*Dummies for Andalucía, Aragón, Asturias, Baleares,*
Region	*Canarias, Cantabria, Castilla-León, Castilla-La*
	Mancha, Cataluña, Comunidad Valenciana,
	Extremadura, Galicia, Murcia, Navarra, País Vasco
	and La Rioja. Omitted category: Madrid.

Table A2. Summary Statistics: Total Sample

	Males (N=12467)		*Females (N=14801)*	
	Mean	*Std. dev.*	*Mean*	*Std. dev.*
Sports time (hours)	*0.819*	*1.397*	*0.626*	*1.031*
Leisure time (hours)	*18.638*	*4.283*	*21.316*	*3.380*
Consumption	*18.67*	*12.35*	*17.28*	*11.35*
Age	*41.17*	*13.40*	*41.58*	*13.29*
Health	*0.78*	*0.42*	*0.74*	*0.44*
Married	*0.63*	*0.48*	*0.65*	*0.48*
No. children 0-5	*0.16*	*0.44*	*0.16*	*0.44*
No. children 6-15	*0.30*	*0.63*	*0.32*	*0.65*
1st quarter	*0.28*	*0.45*	*0.27*	*0.44*
2nd quarter	*0.26*	*0.44*	*0.26*	*0.44*
3rd quarter	*0.23*	*0.42*	*0.23*	*0.42*
Weekend	*0.33*	*0.47*	*0.33*	*0.47*
Degree of urb.1	*0.45*	*0.50*	*0.47*	*0.50*
Degree of urb. 2	*0.22*	*0.41*	*0.22*	*0.41*
Primary education	*0.35*	*0.48*	*0.34*	*0.47*
Secondary education	*0.28*	*0.45*	*0.25*	*0.44*
Higher education	*0.15*	*0.35*	*0.15*	*0.35*
Worker	*0.70*	*0.46*	*0.39*	*0.49*
Family size	*3.60*	*1.32*	*3.57*	*1.33*
Predicted log earnings	*1.80*	*0.25*	*1.32*	*0.32*
Region:				

Andalucía	*0.21*	*0.41*	*0.23*	*0.42*
Aragón	*0.03*	*0.16*	*0.03*	*0.16*
Asturias	*0.03*	*0.17*	*0.03*	*0.18*
Baleares	*0.02*	*0.14*	*0.02*	*0.14*
Canarias	*0.04*	*0.20*	*0.04*	*0.20*
Cantabria	*0.03*	*0.18*	*0.03*	*0.17*
Castilla-León	*0.05*	*0.22*	*0.05*	*0.21*
Castilla-La Mancha	*0.04*	*0.19*	*0.04*	*0.19*
Cataluña	*0.15*	*0.36*	*0.14*	*0.35*
Comunidad Valenciana	*0.06*	*0.23*	*0.06*	*0.24*
Extremadura	*0.02*	*0.16*	*0.03*	*0.16*
Galicia	*0.09*	*0.29*	*0.10*	*0.29*
Madrid	*0.08*	*0.27*	*0.08*	*0.27*
Murcia	*0.03*	*0.17*	*0.03*	*0.17*
Navarra	*0.04*	*0.20*	*0.04*	*0.19*
País Vasco	*0.02*	*0.15*	*0.02*	*0.15*
La Rioja	*0.02*	*0.15*	*0.02*	*0.14*

Table A3. Probit Estimates for the Probability of Working

Dependent variable:	*Females*		*Males*	
Dummy = 1 if worker	*Coefficient*	*t-Student*	*Coefficient*	*t-Student*
Age	*0.194*	*27.50*	*0.272*	*36.34*
Age^2	*-0.002*	*-28.48*	*-0.003*	*-38.04*
Health	*0.290*	*10.08*	*0.714*	*21.97*
Married	*-0.342*	*-11.36*	*0.472*	*11.55*
No. children 0-5	*-0.210*	*-7.62*	*0.051*	*1.24*
No. children 6-15	*-0.113*	*-5.92*	*0.009*	*0.30*
Andalucia	*-0.314*	*-7.44*	*-0.343*	*-6.74*
Aragón	*-0.077*	*-1.01*	*0.165*	*1.69*
Asturias	*-0.159*	*-2.22*	*-0.421*	*-5.06*
Baleares	*0.382*	*4.53*	*0.165*	*1.51*
Canarias	*-0.042*	*-0.65*	*-0.089*	*-1.16*
Cantabria	*-0.086*	*-1.19*	*-0.235*	*-2.82*
Castilla-León	*-0.197*	*-3.16*	*-0.142*	*-1.95*
Castilla-La Mancha	*-0.148*	*-2.17*	*0.111*	*1.33*
Cataluña	*0.287*	*6.38*	*0.212*	*3.78*
Comunidad Valenciana	*0.064*	*1.14*	*0.006*	*0.08*
Extremadura	*-0.258*	*-3.32*	*-0.383*	*-4.22*
Galicia	*0.079*	*1.59*	*-0.203*	*-3.34*
Murcia	*-0.106*	*-1.43*	*-0.122*	*-1.41*
Navarra	*0.108*	*1.63*	*0.197*	*2.45*
País Vasco	*-0.105*	*-1.29*	*-0.049*	*-0.49*
La Rioja	*0.093*	*1.09*	*0.188*	*1.79*

Primary education	*0.201*	*6.31*	*0.301*	*8.29*
Secondary education	*0.489*	*13.78*	*0.215*	*5.43*
Higher education	*0.870*	*21.80*	*0.292*	*6.22*
Constant	*-3.971*	*-29.06*	*-5.133*	*-34.38*
Sample size	*14801*		*12467*	
Log L	*-8447.216*		*-5697.708*	

Table A4. Log Hourly Earnings Equation

Dependent variable:	*Females*		*Males*	
log w	*Coefficient*	*t-Student*	*Coefficient*	*t-Student*
Age	*0.067*	*10.63*	*0.008*	*1.18*
Age^2	*-0.001*	*-8.33*	*0.000*	*0.59*
Primary education	*0.129*	*4.41*	*0.070*	*4.56*
Secondary education	*0.420*	*13.02*	*0.246*	*15.35*
Higher education	*0.861*	*21.63*	*0.615*	*32.32*
Andalucia	*-0.150*	*-5.12*	*-0.112*	*-5.64*
Aragón	*-0.170*	*-3.73*	*-0.110*	*-3.47*
Asturias	*-0.249*	*-5.34*	*-0.049*	*-1.27*
Baleares	*0.087*	*1.83*	*-0.078*	*-2.29*
Canarias	*-0.007*	*-0.17*	*-0.067*	*-2.39*
Cantabria	*-0.092*	*-2.17*	*0.002*	*0.06*
Castilla-León	*-0.143*	*-3.52*	*-0.195*	*-6.95*
Castilla-La Mancha	*-0.049*	*-1.13*	*-0.130*	*-4.39*
Cataluña	*-0.070*	*-2.52*	*-0.106*	*-5.26*
Comunidad Valenciana	*-0.193*	*-5.60*	*-0.131*	*-5.31*
Extremadura	*-0.282*	*-4.65*	*-0.241*	*-6.18*
Galicia	*-0.242*	*-6.60*	*-0.210*	*-7.66*
Murcia	*-0.198*	*-3.79*	*-0.167*	*-5.38*
Navarra	*0.019*	*0.53*	*0.029*	*1.09*
País Vasco	*0.011*	*0.25*	*0.041*	*1.18*
La Rioja	*-0.137*	*-2.56*	*-0.192*	*-5.64*
λ	*0.209*	*4.16*	*-0.279*	*-7.27*

Constant	*-0.349*	*-2.23*	*1.315*	*9.55*
Sample size	*5765*		*8788*	
Log L	*-7833.162*		*-14612.799*	