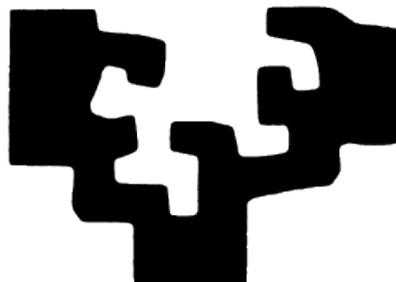


MASTER IN ECONOMICS: EMPIRICAL APPLICATIONS AND POLICIES (EAP)

eman ta zabal zazu



universidad
del país vasco

euskal herriko
unibertsitatea

MASTER THESIS

“Time for children: Parents’ time allocation in Spain”

BERMET KUBANYCHBEKOVA

Supervisors: ARANTZA UGIDOS and VICTORIA ATECA

Bilbao 2013

Abstract

Parental investment in children's human capital is important for their development. One type of investment is time spent with children. Using Spanish Time Use Survey 2009-2010 we analyse the time parents devote to childcare in Spain, considering the couples from 20 to 65 years with children below 18 years old. Results of the estimation using Bivariate tobit suggest that the age of the youngest child is going to affect the parental time with children, as well as the presence of housekeeper in the household. According to the estimation, on weekdays parents spend less time with children than on weekend days. Further, we find that the biggest part of caregiving time is devoted to physical childcare. Household income increases the time of parents in routine childcare comparing to the lowest income interval, whereas it doesn't affect the time in leisure childcare. Since more educated parents dedicate more time to their children, it would be important to give incentives for parents to raise education level, that will increase not only productivity of labor, but also children's human capital.

Keywords: childcare, time, parents, time allocation, children, routine childcare, leisure childcare, Tobit model, Bivariate Tobit model

1. Introduction

Nowadays parents are under significant time pressure. There are not enough hours in the day to do everything that needs to be done. Sometimes, it seems that modern society has increased the pressure on people's participation in market work, household work and leisure activities. Parents with small children are considered to be under higher time pressure, because they need more time and care. The main explanation for any change in the situation of families with children is the increased female labor force participation.

For over the last 50 years individuals' time allocation in activities other than market work has been a cornerstone of many economic models. There are lots of testable hypotheses derived from those models of time allocation and of household production that can be tested with data derived from household surveys and, in particular, from time use surveys. Most of those models are derived from the economic approach to human behaviour by G.S. Becker. For example, in 1965 he proposed a theory of time allocation across different activities in his seminal work "A Theory of the Allocation of Time". In that paper he suggested that "the allocation and the efficiency of non-working time may now be more important to economic welfare than that of working time". In those models he used the assumption that households are both producers and consumers, which produce commodities, using goods and time as inputs:

$$Z_t = F(X_t, L_t)$$

where Z_t represents the commodity produced by the household at time t , which is the function of inputs as goods (X_t) and time (L_t). For example, to cook dinner it is necessary to buy products in the market and spend some time. Commodities enter directly into the utility function of the household.

$$U = U(Z_1, Z_2, \dots, Z_T).$$

In order to maximize the utility function, households combine commodities in the best way, subject to the technological constraints (production function of each of the commodities) and subject to the budget and time constraints. Individuals within a household do the activities in which they have comparative advantages. For instance, someone in the family has comparative advantages in cooking and other one in housework, so that everyone does the activity in which he or she has advantages.

In order to analyze the time allocation problem of individual instead of observing the whole household, Ghez and Becker (1975) consider an individual as decision making unit, instead of observing the households, which allocate his total time between market work and non-market time. Individuals produce commodities using as inputs time and goods, and they maximize utility function with respect to time and budget constraint.

The Spanish Time Use Data allow us to extend the previous studies that use time-diary information, by looking not only at how husbands and wives allocate their time to housework, but also at how they allocate their time to childcare.

In this paper, following the contribution of Sevilla-Sanz, Gimenez-Nadal and Fernandez titled "Gender roles and the division of unpaid work in Spanish households" (2010) we take the conceptualization of childcare a step further and construct alternative definitions of childcare using extra information (as measured in the diary file of time use surveys) that details with whom the activity took place, and the other activities that were being done simultaneously. These definitions of childcare range from the most simplistic one often used in the literature – that is, childcare reported as the main activity – to a more general and wider definition of childcare, that captures any activity done in the presence of a child.

Why is it important to analyze the time parents spend with their children?

There are different reasons why parents spend time with their children. Analyzing why it is so in the case of Spain is out of scope of the paper. However the reasons can be mentioned shortly. There are investment, home production and consumption motives for allocating time to children. Parents invest in children and get their return when the children contribute to the support of their parents. The investment in children can be explained by impure altruism, that is, parents spend much time with their children because they expect that children will support them in the future. Parents invest both material resources and their time into raising their children. Time investment in children is important to the development of human capital. It is also one possible mechanism through which economic status is transmitted from generation to generation. The consumption motives for allocating time for children means that parents derive pleasure and enjoyment from spending time with their children.

The purpose of this work is to analyze parents' time devoted to children aged less than 18 years old, and to see how socioeconomic factors such as income and education affect it. To do so, the

age of children will be particularly taken into account, since fathers' and mothers' time dedicated to childcare may well depend on what children require at different ages.

The contribution of this paper to the literature will be the study of parents' time allocation and the time spent with their children in Spain using the most recent Spanish Time Use Survey (STUS) 2009-2010. The results are to be compared with those obtained in the paper of Sevilla-Sanz et al. (2010) based on the previous release of the Spanish Time Use Survey (2002-2003). The general research question of their paper is to explain women's share of home labor in terms of their relative wages. Their results suggest, that with higher relative wages than that of her husband, women do not spend less time in housework. Actually, when women's relative earnings reach some threshold, women start doing more time in housework (this is what the authors call "start doing gender"). Concerning childcare, the time spent with children does not change much with increases in wives' relative wages. This paper is of interest since they construct different definitions of childcare and apply their analysis to the previous release of the Spanish Time Use Survey, so we can have a benchmark against which we can compare the results of our paper.

The structure of the paper is going to be as following. In the Section 2 research done in different countries is going to be reviewed. Section 3 describes the dataset, the sample and presents some descriptive evidence. In section 4 the empirical specification is introduced and two methods of estimation are described. Section 5 ends with conclusions and some policy recommendations derived from our analysis.

2. Review of the previous research

2.1 Trends in Child Care Time in Spain

Most of the previous research in Spain is based on 2002-2003 Spanish Time-Use Survey, which was already part of Harmonised European Time Use Surveys (HETUS) launched by Eurostat, the statistical office of the European Union.

The paper of Sevilla-Sanz et al. (2010) examines how the woman's share of home labor varies with relative earnings. The results of the estimation based on the 2002–2003 Spanish Time Use Survey (STUS) suggest that in the case of housework, there is a "doing-gender" effect, which means that women spend more time in housework than their husbands if she contravenes the social norm of not being the main breadwinner (a traditional role for husbands). Women's relative earning is potentially related to her bargaining power in the spousal decision making processes. In contrast, a woman's share of childcare doesn't change much with an increase in her relative earnings. Actually women still spend more time in childcare regardless of their bargaining power.

Alvarez and Miles-Touya (2011) study the transmission process of gender norms in the family across generations, especially the relationship between parents and children's housework allocation. They use the 2002–2003 Spanish Time Use Survey. The results of the empirical analysis provide evidence that the time boys devote to the female-typed activities increases

with the father's share in parental time of female-typed housework. It means that fathers doing female-typed housework transmit the gender norms to their sons. However, the transmission of gender norms to girls is weaker.

Gimenez-Nadal and Molina (2013) analyze the relationship between the education level of parents and the time devoted to childcare activities. They compare two countries: Spain and UK and their results suggest that only the education level of the mother really affects the time devoted to educational childcare both in Spain and UK.

Summarizing, results that were obtained from previous research in Spain suggest that, in the last decades, the family structures have changed, and that the female labor force participation rate has increased. However, mothers still spend more time caring for their children than their husbands. The mother's contribution in caring for children affects significantly the children's human capital. The fathers affect their sons housework time allocation. These previous findings can be useful for comparing our results, derived from the use of the 2009-2010 Spanish Time-Use Survey and explaining potential similarities and differences.

2.2 Time Use Patterns in Other Countries

2.2.1 European countries

There is much work that also uses international time use data to measure the trends in time use within other countries or to compare the allocation of time across countries.

Sevilla-Sanz and Gimenez-Nadal (2011) analyse time-use trends for seven industrialized countries and conclude that, in most countries, decreases in men's market work result in increases in time spent on non-market work and child care. For women, time devoted to market work increased in almost all countries and time spent on home production decreased.

Hallberg and Klevmarken (2002) analyze the interdependence between parents' time with their own children and market work, as well as its dependence on out-of home day-care in Sweden. The results suggest that a change in the mother's working hours have a smaller effect on the parents' time spent with her children than a change in the father's working hours.

Using Time-Diary data from the United Kingdom 2000 Time Use study, Kalenkoski and Ribar (2005) investigate how parents' time spent in child care differs with their marital status and other characteristics. Estimation reveals that single, non-cohabiting women and men spend more time in child care and less time in market work than their married counterparts.

The investigation of time allocation between market work, housework and childcare in Italian couples done by Bloemen et al. (2010) suggests that husbands with more educated wives devote more time to children, and that parental time with children is complementary, that is, the parents jointly allocate the time devoted to children. For the analysis the authors used Italian National 2002-2003 Time Use Survey. Further, the findings suggest that Italian husbands participate less in non-market work than in other European countries.

The reviewed research done in European countries suggest that decisions about market work and time for unpaid work and child care are interdependent at the spouses' level. Declines in paid work increases the time in unpaid work and activities with children. The time devoted to childcare depends on the marital status of the person.

2.2.2 USA Time Use pattern

A lot of papers have investigated time allocation decisions using the American Time Use Survey.

Cooksey and Fondell (1996) analyze fathers' time spent with their children, and, in particular, the influence of fathers' time on children's academic achievement. The authors found that both family structure and fathers' activities done with their children are going to affect the children's academic achievement.

Kimmel and Connelly (2007) observe time dedicated to child care distinctly from time spend on home production, leisure and paid market work. These authors find that there is an insignificant effect of one spouse on the level of other spouse's unpaid time use. The results also suggest that higher relative wages of the mother compared to her spouse result in a mother's larger share of child care regardless of the type of day of week (weekdays and weekends).

The literature has shown, that in the United States mothers spend more time with their children than do fathers, though the gender gap is not as wide as it once was. Mothers also spend proportionally more time in routine care of children (what we will define as routine childcare), while fathers spend proportionally more time in teaching or playing activities (that is, on leisure childcare).

2.2.3 International research

The estimation of the effect of family structure on parental childcare time and market work in United States and in United Kingdom was done by Kalenkoski et al. (2007). The findings suggest that single parents dedicate more time to children than married ones in both countries.

Guryan, Hurst and Kearney (2008) examined the data across 17 countries. The paper document that the parental education and their income affects positively child care time, that is, richer and higher educated parents spend more time with their children than poorer and lower educated parents.

3. The data and variables

3.1 Description of the 2009-2010 STUS

The empirical application is carried out using data derived from the 2009-2010 Spanish Time Use Survey (STUS), carried out by the Spanish National Institute of Statistics, and part of the Harmonised European Time Use Surveys programme (HETUS) launched by Eurostat, the statistical office of the European Union. It is based on the preceding Time Use Survey conducted between 2002 and 2003. Compared to the 2002-2003 STUS, which contains

information on 60,493 individuals living in 20,603 households, the sample of the most recent Spanish Time Use Survey (2009-2010) used in this paper, is much smaller. In fact, the 2009-2010 STUS interview 25,895 individuals living in 9,541 households. However, in the empirical analysis only those individuals who answered the diary, are going to be considered (19,295 observations).

In the survey, three basic units of analysis and sampling are considered: the individual members of household aged at least 10 years old, private households and the days of week. Each household should complete a Household Questionnaire, Individual Questionnaire and an Activity Diary. The Household Questionnaire and Individual Questionnaire should be completed via the direct interview with the main person, their spouse, if appropriate, or with any other person able to provide information on the characteristics of the household. The questionnaire collects information on household characteristics such as income, housing, and family composition as well as individual characteristics that include education, employment status, earnings, demographic information and others.

Each household is allocated a day of the week (from Monday to Sunday) to complete the Activity Diary. All household members at least 10 years of age were asked to fill out a time diary for one randomly chosen 24-h period (from 6 a.m. 6 a.m. the following day). They were instructed to record their main activity, any secondary activity undertaken simultaneously, and who was with them for each 10 minutes period. The main activity as reported by the individual was then classified into 10 large groups: personal care, paid work, studying, household and family care, volunteer work and meetings, social life and recreation, sports and outdoor activities, hobbies and computers, media, journeys made and unspecified time use. Further, in order to obtain information on effective work periods, a weekly work timetable was designed. This weekly work timetable, which contains one page, was added to the activity diary, and the employed respondents (16 years old and over) should note their effective work timetable during the reference week (the week that ends on the day allocated for completing the diary).

3.2 Sample selection

In this study, only a sub-sample of respondents is used, since the purpose of the research is to study households with children below 18 years old. Time use is likely to depend on marital status, whether single or living in a couple. In particular, the situation of single mothers (fathers) is supposed to be very different from that of married couples with children. Both groups are interesting to study, but in our case, the share of singles with children in the sample is less than 10%. So the study of singles would suffer from small sample size.

Thus, for the empirical analysis, we restrict the sample to those individuals aged between 20 and 65 who are married or cohabiting, and that have children aged less than 18 years old. After this restriction we end up with a sample of 2,069 couples. However, since the empirical analysis consider only couples where both spouses are working, we end up with the sample of 937 couples.

3.3 Childcare measurement

For the empirical analysis we need to define childcare. There are different definitions in the literature. In order to measure the time that parents devote to children in the best way, we construct the definitions of child care following the paper of Sevilla-Sanz et al. (2010).

As in most time-use diary surveys, childcare in the 2009-2010 STUS is categorized in terms of activities. There are three definitions of childcare to be constructed: a restrictive one (childcare1), an intermediate one (childcare2), and an extensive definition (childcare3).

We construct the variable childcare1 as a measure of time devoted to childcare activities during the designated day (teaching, feeding, playing, taking them to school, etc.) to the extent that it is reported as a primary activity. A primary activity is defined in the STUS in response to a question such as “what were you doing?” describing one activity per ten-minute slot. The main advantage of this definition of childcare is that it is the standard one and the definition used in most of papers in the literature, so the results using it can be easily compared. But primary childcare activities, however, cannot be equalized with time that parents spend with children.

Our second definition of childcare draws from the information on secondary activities in the diary file. Secondary activities represent any form of childcare mentioned in response to the question “were you doing anything else?”. Childcare2 measures the time devoted to any childcare activity either as primary or secondary activity. This definition improves on childcare1, including the time devoted to childcare as the simultaneous activity, however it is not entirely satisfactory. Since only a small number of observations is added to childcare1, the second definition doesn't differ much from the first one.

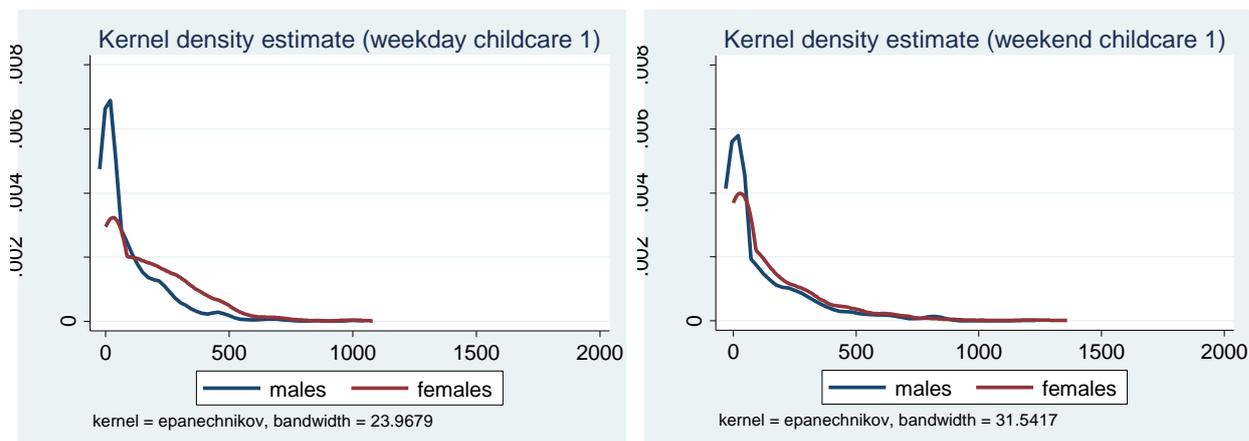
Therefore, we construct a third definition of childcare that measures the time devoted to childcare as either primary or secondary activity and, also, any other time that the respondent spends with children (of 10 years of age or younger) that has not been recorded as childcare in either the primary or the secondary activity. Note, however, that this definition has the disadvantage that only activities with children 10 years old or younger are recorded; since the information is provided only for children below 10 years old that were present while mother or father was doing the main activity.

Further, using the widest definition of childcare, we can also consider another criterion to classify childcare activities, depending on how rewarding they can be for parents and children: routine and leisure childcare.

We construct routine childcare as the sum of any time devoted to childcare reported as either primary or secondary activity (except playing with a child), and any other primary non-leisure activities (cleaning, shopping, eating, etc.) performed in the company of a young child. Routine childcare aims at capturing the sort of childcare that is less enjoyable. The complement variable can be thought of as the more enjoyable childcare, which we call leisure childcare, and is the sum of any time devoted to leisure activities (including playing with children) reported as a primary activity and performed in the company of a child.

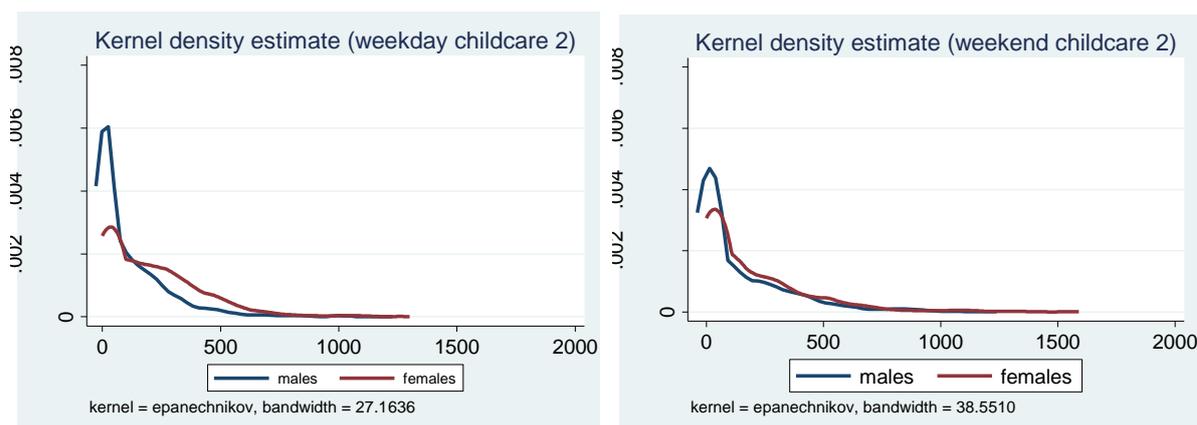
The following graphs show the difference in time devoted to childcare by both spouses on weekdays and weekend. Original data are variables taking values from 0 to 144, corresponding to each of the 144 slots of 10 minutes in a day. We transform those values to minutes (from 0 to 1440) and, instead of presenting the histograms, we present the Kernel density plot estimates for men and women.

1. Daily minutes devoted to childcare1 on weekdays and weekend



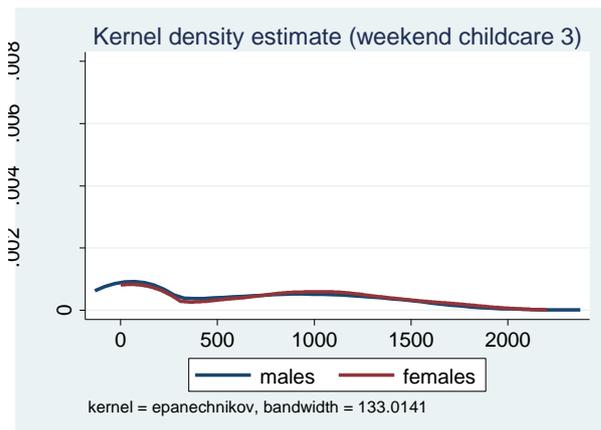
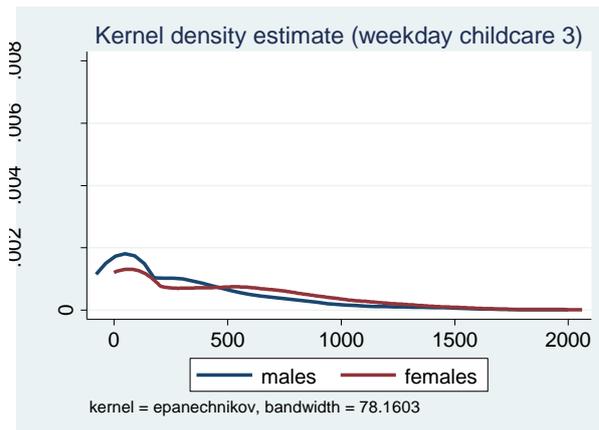
As it can be seen from the graphs above, there is a smaller share of women than men who reports the time devoted to childcare1 equal to zero. On weekend, this percentage of women is higher, and there is not much difference in the density of men and women spending time with children. However, according to this first measure of childcare, wives devote more time to childcare.

2. Daily minutes devoted to childcare2 on weekdays and weekend



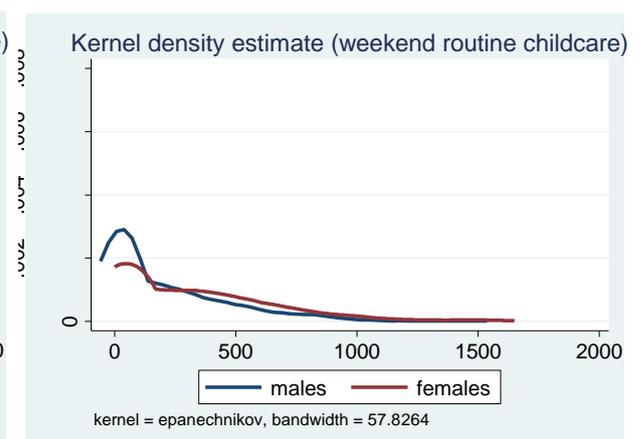
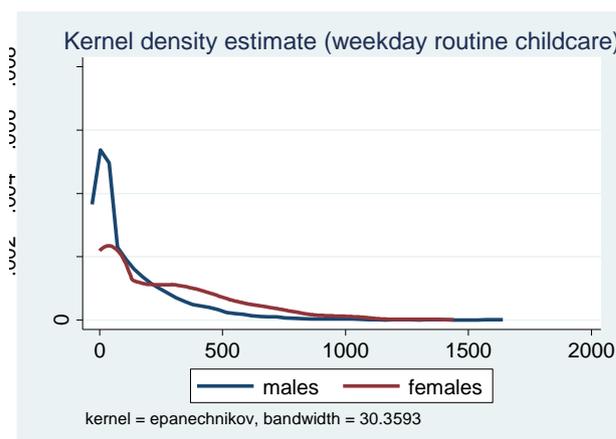
As to childcare 2, it is almost the same situation, on weekend women report more zero time, than on weekdays.

3. Daily minutes devoted to childcare3 on weekdays and weekend

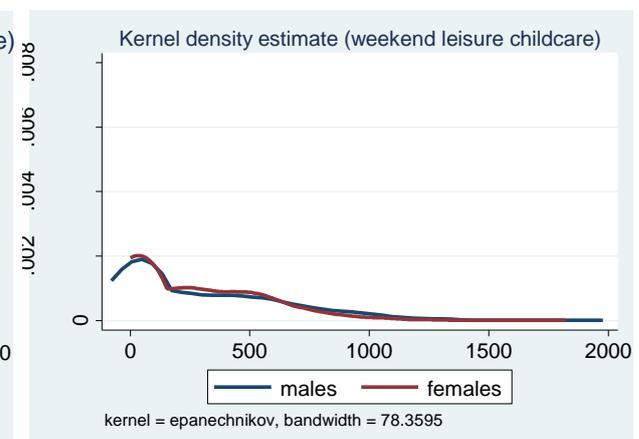
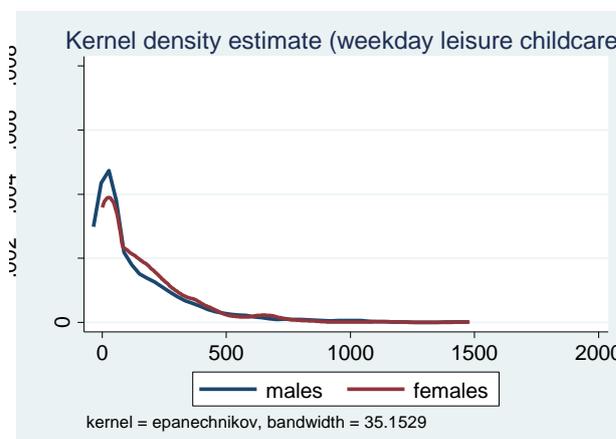


On weekend there is almost the same percentage of people reporting the time spent with children equal to zero. Both on weekdays and weekend we can observe an almost flat pattern, since the definition of childcare 3 adds to childcare 2 any activity that was done in the presence of a child. Therefore, there is a small proportion of people reporting zero minutes devoted to childcare 3. Still, as it can be observed on weekend women and men spend more time on childcare3 than on weekday.

4. Daily minutes devoted to routine childcare on weekdays and weekend



5. Daily minutes devoted to leisure childcare on weekdays and weekend



Some differences can be observed between routine and leisure childcare within childcare 3. As we can see from the graphs above, there is a higher percentage of men who report the time to routine childcare equal to zero on weekday rather than on weekend. There is higher share of women and men who report the time spent in leisure childcare equal to zero on weekday rather than on weekend. From the graphs, it can also be observed that parents spend much more time on weekend on leisure childcare than on weekday. However women spend more time on leisure and routine childcare than their husbands. On weekday there is high share of women reporting zero time both in leisure and routine childcare.

In general, it can be concluded that there is a higher fraction of husbands that report not dedicating any time at all to childcare, compared with the fraction of wives. On weekdays, there is a higher fraction of women reporting zeros rather than on weekend, and the same is true for husbands. Further evidence is displayed in the descriptive statistics of our sample in the tables 1 and 2.

Table 1. Daily minutes devoted to childcare¹

<i>Childcare time (minutes per day)</i>	% Participate in the activity	<i>Husbands</i>		% Participate in the activity	<i>Wives</i>	
		Mean (fraction who report time >0)	Mean (whole sample)		Mean (fraction who report time >0)	Mean (whole sample)
Childcare 1	59.41	185.81	110.59	75.43	232.8	175.59
Childcare 2	60.90	211.28	128.67	76.61	267.42	204.86
Childcare 3	76.95	660.06	507.9	81.78	755.31	617.71
Routine childcare	75.18	381.9	287.11	81.16	522.97	424.45
Leisure childcare	60.79	367.4	223.35	64.31	303.57	195.23
Observations		2 069			2 069	

The Table 1 shows the proportions of parents that devote time to children and the mean values of daily minutes that parents devote to children below 18 according to the five different definitions of childcare. We can see that a higher percentage of mothers than fathers who

¹ Notes: The sample consists of individuals between 20 and 65 years of age who are married or live in couple and have children under 18 in the household. Childcare1 measures the time devoted to childcare activities reported as a primary activity; childcare2 measures the time devoted to any childcare activity either as primary or secondary activity; childcare3 uses information on whether a child aged 18 years or younger was present while doing the main diary activity plus childcare2; routine childcare is the sum of any time devoted to childcare reported as either primary or secondary activity (except playing with a child), and any other primary nonleisure activities (cleaning, shopping, eating, etc.) performed in the company of a young child; and leisure childcare is the sum of any time devoted to leisure activities (including playing with children) reported as a primary activity and performed in the company of a child.

Source: STUS 2009–2010

reports time devoted to childcare different from zero. In general, wives spend more time with children than their husbands no matter which definition we apply. From the fraction of the sample that reports a positive number of minutes devoted to childcare, on average, wives spend 232.8 minutes in *childcare1* and 267.42 daily minutes in *childcare2*, whereas men devote to *childcare1* and *childcare2* 185.36 and 209.37 minutes, respectively. Women spend about 756 minutes per day with children, whereas men spend on average 655 minutes. It can be observed that there are some specificities regarding the type of childcare: wives spend more time than their husbands in routine childcare (physical childcare, educational childcare or any non-leisure activities in the presence of a child) while husbands devote relatively more time than their wives to leisure childcare (playing with children, watching TV with children etc.).

Moreover, it would be interesting to see how the minutes devoted to childcare vary with the type of the day of the week. For example, on weekends parents are supposed to spend more time with their children, as they don't work. Table 2 shows childcare minutes by the type of the day of the week.

Table 2. Daily minutes of childcare by the type of the day of week²

<i>Childcare time (minutes per day)</i>	<i>Husbands</i>		<i>Wives</i>	
	Weekday	Weekend	Weekday	Weekend
Childcare 1	99.69 (134.59)	120.5 (175.29)	188.27 (185.87)	163.61 (198.81)
Childcare 2	115.27 (160.77)	141.34 (192.57)	213.71 (216.71)	196.5 (238.74)
Childcare 3	355.19 (370.46)	652.24 (565.6)	491.87 (440.28)	736.65 (585.93)
Routine childcare	227.94 (238.95)	343.04 (332.44)	379.13 (344.28)	467.3 (410.26)
Leisure childcare	130.96 (205.18)	310.68 (341.25)	115.36 (168.55)	270.73 (288.2)
Observations	1 269	800	1 269	800

Note from descriptive statistics that most part of respondents (1 269 observations) filled in the diary on a weekday. For childcare 1 and childcare 2 there is interesting evidence that fathers spend more time with their children on weekends (on average 20 minutes more) than on weekday, but for mothers, the situation is the opposite one: they devote more time to childcare as primary or secondary activity on weekdays rather than on weekend. However, mothers spend more time on weekend on childcare3 than on weekdays. Since the definition of childcare3 adds to childcare1 and childcare2 any activity that was done in the presence of a child, the results could be explained by the fact that, on weekends, women spend more time to housework, possibly done in the presence of a child. As to routine and leisure childcare,

² Note: Standard deviations are in brackets. The means of daily minutes devoted to childcare are constructed using weights.

parents devote more time to children on weekend than on weekdays. Fathers spend relatively more time in leisure childcare than mothers, whereas mothers spend more time in routine childcare.

3.4 Descriptive statistics

There are other relevant characteristics of our sample, in terms of description of households and individuals, that deserve some attention before proceeding to the model estimation. The sample contains 2 069 couples with children below 18. In order to analyze the time parents devote to childcare, it is important to take into account the working status of both parents. There are about 54% of spouses that are both working, about 30% of families where only husband works, whereas the share of families where only wife is working is very small, only 8%.

As to household monthly income, the data contains information in 4 income intervals: less than 1200 euros, from 1201 to 2000 euros, from 2001 to 3000 euros and more than 3000 euros. From the descriptive statistics it can be observed that about 27% of households receives income within the interval 1201-2000 euros. There are 15% of respondents who didn't provide with the information about the household income.

The children that are below 10 years old need more care and attention, and the number of little children should affect the time that parents spend with them. From the table, it can be observed that the greatest proportion of households (42%) have only one child younger than 10 years old, 21% of them have two children of the age below 10, whereas about 3% of families have 3 little children.

Since the focus of our paper is to analyze families with children below 18, it is also important to see the number of children in the 10-18 age category. About 37% of households have one child of age from 10 to 18, whereas 13% of them have 2 children and only 1% has 3 children. There are no couples that have more than 5 children aged from 10 to 18.

As to the total number of children of any age category, 50% of couples have only one child in the family and 43% of couples have 2 children. It could be that, the age of the youngest child is important for determining parental time with children. The highest percentage of couples (26%) have the youngest child in the age interval from 0 to 2, about 21% of couples have the youngest child in the age from 13 to 17.

The presence of housekeeper in the house is supposed to increase the time parents spend with their children, since they do not spend so much time doing housework. According to the survey there are only 12% of households that have paid housekeeper.

Taking inspiration from the paper of Sevilla-Sanz et al. (2010), one of the most important points in analysis is to observe the gender specialization in childcare depending on the relative wages of spouses. It is necessary to control for the mother's relative share of income in the household's income and its affect on the time spent with children. Due to missing values on the reported individual income of the spouses, it is hard to construct a variable that measures the share of wife's earnings relative to her husband's ones. Actually, a large percentage (62%) of

information of relative income is not available due to the lack of reporting individual earnings. For those households for which information on wife's and husband's income is available, there are 53% of women in Spanish households that earn less than their husbands. It is also important to see the differences of relative wages according to how far each spouses' earnings are, i.e. how many income intervals measure that the wives earn less or more than their husbands, taking into account that there are 7 intervals of personal income for both spouses. The highest percentage of women, among those earning less than their husbands (27%) earns 1 interval below their husbands'. About 36% of women earn the same as their husbands (spouses' income is in the same interval), and 11% of women who earn more than their partners. Remarkably, there are no women whose earnings are 5 and 6 intervals above their husbands'.

It could be the case that there are disabled people in the family. The existence of disabled persons in the household also could affect the time spend with children, since they also need much care and time, but there is only 0.9% of disabled persons in the sample.

Table 3. General descriptive statistics:

a. For households

<i>For labor market of the spouses</i>	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
Both spouses working in the market	0.54	0.498	1 120
Only husband working	0.30	0.46	620
Only wife working	0.08	0.27	161
No spouse working	0.08	0.27	168
Total			2 069
<i>Household monthly income (euros)</i>	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
<1200	0.17	0.37	345
1201-2000	0.27	0.45	568
2001-3000	0.23	0.42	480
>3000	0.18	0.38	365
No information available	0.15	0.36	311
Total			2 069
<i>Number of children less than 10</i>	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
1	0.42	0.49	864
2	0.21	0.41	432
3	0.02	0.15	50
4 and more	0.003	0.6	8
Total			1 354
<i>Number of children 10-17</i>	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
1	0.37	0.48	759
2	0.13	0.34	272
3	0.01	0.1	23
4	0.0005	0.02	1
Total			1 055
<i>Total number of children</i>	<i>Proportion</i>	<i>SD</i>	<i>Number</i>

1	0.5	0.5	1 037
2	0.43	0.49	881
3	0.06	0.24	122
4	0.012	0.11	25
5+	0.002	0.04	4
Total			2 069
Age of the youngest child	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
0-2	0.26	0.44	535
3-5	0.2	0.4	406
6-9	0.2	0.4	413
10-12	0.13	0.34	280
13-17	0.21	0.41	435
Total			2 069
Paid housekeeper	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
Yes	0.12	0.32	243
No	0.88	0.32	1 826
Total			2 069
Main household's breadwinner	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
wife earns less than husband:	0.53	0.5	500
1 interval less	0.12	0.33	254
2 intervals less	0.07	0.25	140
3 intervals less	0.03	0.18	70
4 intervals less	0.01	0.11	26
5 intervals less	0.003	0.06	8
6 intervals less	0.001	0.03	2
wife earns same than husband:	0.36	0.48	334
wife earns more than husband:	0.11	0.31	103
1 interval more	0.03	0.18	69
2 intervals more	0.01	0.11	25
3 intervals more	0.004	0.06	8
4 intervals more	0.0005	0.02	1
Observations with positive income			937
No available information of income	0.55	0.5	1 132
N			2 069
Disabled people in the household	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
Yes	0.01	0.1	20
No	0.99	0.1	2 049
N			2 069

It is also important to analyze the characteristics of each individual in the household. The table below shows the descriptive statistics for each individual in the sample. Recall that the restricted sample contains couples, so there are the same numbers of men and women within households. The mean age for men is about 42 years and for women about 39 years. The education level of the parents is measured in several dummy variables. There are 17% of men

and 15% of women that have only primary education or less. The modal level of education is secondary for both men (24%) and for women (23%).

There are also some variables that should be taken into account when analyzing time devoted to childcare. These variables are: number of weekly working hours, type of job and day of the week. Men work in average 43 hours in week, whereas women work in average 34 hours. About 82 % of men and 45% of women have full-time job. There are more women than men that have part-time jobs. The day of the week in which the diary is filled in is supposed to affect the time that parents spend with their children. On weekends, in general parents have more time for children because they do not go to work. The descriptive statistics shows that most of the respondents (61%) filled in the diary on a weekday (from Monday to Friday).

b. For individuals

Gender	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
Men	0.5	0.5	2 069
Women	0.5	0.5	2 069
Age	Mean	SD	Number
For men:	42.09	7.17	2 069
For women:	39.72	6.6	2 069
Education level	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
<i>For men:</i>			
Primary or less	0.17	0.38	357
Secondary	0.24	0.43	498
Bachiller	0.16	0.37	339
Professional trainings	0.19	0.4	400
University	0.23	0.42	475
Total			2 069
<i>For women:</i>			
Primary	0.15	0.36	315
Secondary	0.23	0.42	468
Bachiller	0.15	0.35	301
Professional trainings	0.19	0.4	403
University	0.28	0.45	582
No available information	0.05	0.22	119
Total			2 428
Number of weekly working hours	<i>Mean</i>	<i>SD</i>	<i>Number</i>
For men:	43.09	9.04	1 740
For women:	34.42	10.9	1 284
Type of working day	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
<i>For men:</i>			
full time	0.82	0.38	1 702
part-time	0.02	0.13	38
No available information	0.16	0.37	329
Total			2 069

For women:			
full-time	0.45	0.5	922
part-time	0.17	0.38	362
No available information	0.38	0.49	785
Total			2 069
Type of the day of week	<i>Proportion</i>	<i>SD</i>	<i>Number</i>
weekday	0.61	0.49	1 269
weekend	0.39	0.49	800
Total			2 069

Following Sevilla-Sanz et al. (2011), time devoted to childcare by each of the spouses is supposed to be affected by his/her relative earnings. Thus, it is important to observe who is the breadwinner in the family and how this affects the time that each spouse spends with his\her children. It is specially interesting to see whether wives earning more than their husbands spend less time with children (since they supposed to have more working hours), or if they do not spend less time (i.e. if there is a “doing-gender” effect). In table 4, ratios of feminization of childcare are defined as the time devoted to childcare by the wife divided by the sum of time devoted to childcare by both spouses. These ratios show the degree of female’s participation in childcare. We can examine how they change depending on wives’ relative earnings.

Table 4 Childcare by relative earnings

	Husbands	Wives	Ratio	Observations
Daily minutes of childcare 1	Mean (St.dev)	Mean (St.dev)	wive/(wive+ husband)	
Wife earns less than husband	117.45 (164.55)	163.68 (179.47)	0.58 (0.52)	500
Wife earns same as husband	115.42 (157.48)	181.19 (217.2)	0.61 (0.58)	334
Wife earns more than husband	94.49 (125.09)	130.57 (180.74)	0.58 (0.59)	103
Daily minutes of childcare 2				
Wife earns less than husband	130.32 (176.96)	183.39 (200.54)	0.58 (0.53)	500
Wife earns same as husband	133.89 (170.38)	200.75 (229.46)	0.6 (0.57)	334
Wife earns more than husband	130.96 (164.24)	163.39 (212.69)	0.55 (0.56)	103
Daily minutes of childcare 3				
Wife earns less	495.86	571.96	0.54	500

than husband	(478.14)	(484.54)	(0.50)	
Wife earns same as husband	429.72 (447.7)	535.37 (489.48)	0.55 (0.52)	334
Wife earns more than husband	433.95 (481.06)	485.76 (531.78)	0.53 (0.53)	103
<i>Daily minutes of routine childcare</i>				
Wife earns less than husband	278.44 (284.5)	390.6 (340.09)	0.58 (0.54)	500
Wife earns same as husband	264.41 (263.37)	373.36 (349.92)	0.59 (0.57)	334
Wife earns more than husband	284.87 (332.42)	347.56 (412.85)	0.55 (0.55)	103
<i>Daily minutes of leisure childcare</i>				
Wife earns less than husband	217.79 (281.83)	182.17 (239.62)	0.45 (0.46)	500
Wife earns same as husband	169.39 (243.74)	164.84 (212.26)	0.49 (0.47)	334
Wife earns more than husband	151.74 (215.73)	133.18 (189.47)	0.47 (0.47)	103

Table 4 shows how childcare changes with relative earnings. In the case of childcare 1, wives spend more time with children when they earn less than their husbands. The variation in the time devoted to childcare3, i.e. the time spent in the presence of a child, decreases with relative earnings both for the husband and the wife. In the case of leisure childcare (defined over childcare3), husbands spend much time with children (playing with them or doing any leisure activity in the presence of a child) when their wives earn less. Wives also spend more time devoted to leisure childcare in this last case, compared with the case when they earn same or more. The time devoted to routine childcare decreases for women and increases for men, as female relative earnings rise.

Regarding the pattern of the ratios (which represent the women's participation in the total time to child care in the household) as her relative wage increases, we observe an inverse U-shape for all the definitions of childcare. The highest value of the ratio is for the households where the wife's earnings lies in the same interval of earnings as her husband's. However, it decreases when women earn more than their husbands. The ratios for the three definitions of childcare follow the same pattern. The more extensive definition of childcare is (i.e. the more

activities with children it includes), the smaller is the value of ratio. Comparing to the results obtained using 2002-2003 STUS by Sevilla-Sanz and her coauthors (2010), the female participation in childcare is lower in 2009-2010. As we observed before (Table 1) there are some gender specificities in routine and leisure childcare, that is, men spend more time in leisure childcare and less time in routine childcare than women. As a result, the ratio of women dedicating time to leisure childcare is relatively smaller.

In our sample, children’s age varies from 0 to 18. For our empirical analysis we classify children by age into five age intervals, following a classification close to the age brackets that correspond to the Spanish education system. For little children from 0 to 2, there are not free education institutions, all of them are private. From 3 to 5 years old, there is pre-school level that is non compulsory. From 6 to 12, children attend primary school, and from 12 to 16 they have the compulsory secondary education. We use this age classification to compute the number of minutes that mothers and fathers dedicate to different childcare activities, according to the age of the children.

Table 5. Daily minutes of childcare by age of children (according to the definition of childcare1)

<i>Age of children</i>	Wives					Husbands				
	<i>0-2</i>	<i>3-5</i>	<i>6-9</i>	<i>10-12</i>	<i>13-17</i>	<i>0-2</i>	<i>3-5</i>	<i>6-9</i>	<i>10-12</i>	<i>13-17</i>
<i>Physical childcare</i>	176.6 (129.33)	132.98 (113.9)	96.4 (94.9)	53.74 (79.69)	26.42 (52.84)	86.08 (95.92)	63.52 (78.86)	40.7 (65.46)	20.56 (37.64)	14.25 (39.2)
<i>Teaching children</i>	3.4 (13.63)	5.3 (19.96)	14.35 (29.3)	9.65 (25.08)	6.33 (20.27)	1.76 (9.37)	3.95 (17.76)	6.31 (20.92)	5.92 (28.83)	3.62 (18.7)
<i>Reading, playing and talking with children</i>	31.41 (47.94)	31.06 (46.49)	14.99 (32.3)	6.99 (21.25)	2.43 (13.0)	33.52 (56.19)	28.56 (49.77)	16.65 (36.65)	7.94 (25.27)	2.23 (13.5)
<i>Accompanying children</i>	6.23 (26.75)	6.15 (24.08)	8.19 (27.2)	8.77 (33.63)	4.53 (23.04)	1.54 (11.54)	6.05 (28.78)	5.81 (25.44)	4.5 (24.47)	3.85 (24.3)
<i>Observations</i>	535	543	662	493	729	535	543	662	493	729

Table 5. shows the daily minutes devoted to different types of childcare depending on the age of children: physical childcare (feeding children, dressing them, putting them to bed, getting them up, washing them, supervise them at home and outside), teaching children (helping children with their homework, teach them to do specific things), reading, playing and talking with children, accompanying children (go to the doctors with children, waiting for them at school, parents’ meeting with teacher). The parents devote much of their time to physical childcare, especially caring for little children because they need a lot of time. Mothers spend in physical childcare about 90 minutes more than their husbands when, caring for children of

0 to 2 years of age and 70 minutes more when the child is from 3 to 5 years old. The older the child is, the less care and time he needs. The highest value for time that both mothers and fathers spend in physical childcare caring for the children is for the age 0 to 2. Actually, parents spend a lot of time in physical childcare with children below 10 years old. Comparing with other types of childcare, both fathers and mothers spend relatively more time in physical childcare. Mothers spend 14.35 minutes to teach children, when they are from 6 to 9 years old (peak intensity for this activity), whereas fathers spend 6.31 minutes. In leisure childcare, which includes reading, playing and talking with children, mothers also spend more time than fathers; they devote more time to children from 3 to 5 years old. In accompanying children, parents spend from 2 to 9 minutes per day.

4. Empirical specification and methods

Time use surveys collect the information about each individual within the household. Each individual from 10 years old should complete the Activity Diary reporting their main activity and secondary activity for each 10 minute-slot of 24 consecutive hours (from 6 a.m. to 6 a.m. of the following day). Researchers analyzing time-use data often deal with large fraction of observations in the sample reporting zero for many activities. Since individual is interviewed on one random day, it could be the case that the individual did not do this activity that precise day (measurement error) or that zeros can represent usual nonparticipation in the activity (true zeros).

Apart from this problem with the high fraction of zeros (particularly high for activities that are not done on a daily basis), we should also take into account that mothers and fathers do not take their optimal time allocation decisions separately. They rather take joint decisions to optimally satisfy their children needs. Thus, the possibility that parents make joint decisions is going to be present in the choice of estimation methods, since it could be that they share or that they specialize in household activities.

As it was observed from the table 2, the fraction of men and women reporting time devoted to childcare³ equal to zero is high enough (about 23% for men and 18% for women). That fraction was higher for narrower definitions of childcare. Therefore, for our analysis, the third definition of childcare will be analyzed, since it is the most extensive one and measures in the best way the total time that parents spent with their children.

In what follows, we discuss some concerns regarding the suitability of some estimation methods. Recall from previous section that, if we want to control for relative earnings in the estimation the sample size reduces to 937 households, those in which both spouses are working. This implies that models are to be estimated with a sample of 937 households (alternatively, a sample of 937 wives with their respective 937 husbands).

4.1 How to deal with zeros in the dependent variable: Tobit or OLS?

Time-use researchers wonder whether it is more suitable to estimate time use models as censored regression models (Tobit) with maximum likelihood, or as linear models using Ordinary Least Squares (OLS).

However, the Tobit model would seem to be a more suitable approach, because it was developed specifically for situations where the dependent variable is truncated at zero or some other censored point. And in this case OLS estimation will not be consistent.

From the papers considered in the review of the literature in the Section 2, most of them use Tobit models in estimation of time use. For instance, the paper of Sevilla-Sanz and her coauthors (2010) use Tobit model to analyze the dependence of women's share of housework on the relative wages of spouses. Besides, Alvarez and Miles-Touya (2011) use the same model in their paper "Exploring the relationship between parents' and children's housework time in Spain". From the authors that analyze trends in time use in USA and other countries, Guryan, Hurst and Kearney (2008) also estimate Tobit model, analyzing the effect of parental education level and income on the time devoted to children. The large number of papers that use Tobit model to study time use allocations justify that estimating tobit models to explain the number of minutes spent in an activity is the state of the art.

However in the case when reported zeros are the result of mis-measurement, that is, when the person usually participates in the activity, but on that particular day he did not participate for some reasons, some researchers suggest to use OLS estimation which is more robust to measurement errors (Stewart 2009).

In this section of the paper two ways of estimating time use models are going to be considered: Tobit and OLS. Latter, the results are to be compared.

In order to see the differences in the estimation method and to choose the most appropriate one, we briefly present the empirical specification. For both cases, the dependent variable of the estimation is the daily minutes dedicated by parents to childcare as the primary or secondary activity, or any activity that was done in the presence of a child aged below 10. The estimation will be separately done for fathers and for mothers. Explanatory variables in parental childcare include relative earnings of spouses (taking into account their distance in terms of different income intervals), household income, age of spouses (mother's and father's), educational levels of both parents, number of children aged 0-2, number of children aged 3-5, number of children aged 6-9, number of children aged 10-12, number of children aged 13-17, the age of the youngest child, the squared number of children, occupation, regions, the presence of housekeeper, the type of the day of week (weekday, weekend), whether the job is full-time or part-time and whether parents are self-employed or not. The choice of those explanatory variables relies on the paper of Sevilla-Sanz et al. (2010) and complements their analysis in some dimensions. It could be interesting to include variables indicating the type of the job sector (public or private), but, unfortunately, the survey doesn't provide us with that information.

4.1.1 OLS model

The goal of the linear regression is to estimate the parameters of the linear conditional mean of the number of minutes dedicated by fathers and mothers to childcare:

$$E(y_{if} | x_{if}) = x_{if}'\beta = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n$$

$$E(y_{im} | x_{im}) = x_{im}'\beta = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n$$

where β_0 is the intercept, x_{if} is a $K \times 1$ column vector of explanatory variables for fathers and x_{im} is a $K \times 1$ column vector of explanatory variables for mothers (in our empirical specifications, we consider the same set of explanatory variables)..

The linear regression model specifies an additive error so that

$$y_{if} = x_{if}'\beta + u_{if}, i=1, \dots, 937 \text{ (for fathers)}$$

$$y_{im} = x_{im}'\beta + u_{im}, i=1, \dots, 937 \text{ (for mothers)}$$

The starting point for the analysis is to assume that u_i satisfies the following classical conditions:

1. $E(u_i | x_i) = 0$ (exogeneity of regressors)
2. $E(u_i^2 | x_i) = \sigma^2$ (conditional homoscedasticity)
3. $E(u_i u_j | x_i, x_j) = 0, i \neq j$ (conditionally uncorrelated observations)

4.1.2 Tobit model

Regression with censored data

Our data consists of $(y_i, x_i), i=1, \dots, 937$. The x_i represents the vector of explanatory variables and it is fully observed, but the dependent variable y_i , which represents the time parents devote to child care, is not always observed. Some of y_i are equal to zero. Our interpretation is that zero is a censored observation, and we denote y^* as a latent variable, that can be considered only if some known constant threshold, denoted by L , is passed. In our sample L represents the value of zero. So we observe y^* only when $y^* > 0$. Thus the sample consists of censored and uncensored observations. Observations can be left-censored and right-censored. To simplify our analysis, we only consider the left-censored process in our sample (of course, the dependent variables are also right-censored at 1440, but those values are rarely reported. Censoring implies a loss of information, since censoring is similar to having missing observations on y .

Tobit model setup

The regression is specified in linear terms with respect to some unobserved latent variable, y^* :

$$y_{if}^* = x_{if}'\beta + \varepsilon_{if}, i=1, \dots, 937$$

$$y_{im}^* = x_{im}'\beta + \varepsilon_{im}, i=1, \dots, 937$$

where $\varepsilon_i \sim N(0, \sigma^2)$, and x_i denotes the $(K \times 1)$ vector of exogenous and fully observed regressors.

Fathers' and mothers' equations are to be estimated separately, therefore the regression for fathers will be specified as following:

$$y_{if}^* = x_{if}'\beta + \varepsilon_{if}, i=1, \dots, 937$$

And for mothers:

$$y_{im}^* = x_{im}'\beta + \varepsilon_{im}, i=1, \dots, 937$$

The observed variables y_{if} and y_{im} are related to the latent variables y_{if}^* and y_{im}^* through the observation rule

$$y_{if} = \begin{cases} y_{if}^* & \text{if } y_{if}^* > 0 \\ 0 & \text{if } y_{if}^* \leq 0 \end{cases}$$

$$y_{im} = \begin{cases} y_{im}^* & \text{if } y_{im}^* > 0 \\ 0 & \text{if } y_{im}^* \leq 0 \end{cases}$$

The probability of an observation for men being censored is $\Pr(y_{if}^* \leq 0) = \Pr(x_{if}'\beta + \varepsilon_{if} \leq 0) = \Phi\{(x_{if}'\beta)/\sigma\}$ where $\Phi(\cdot)$ is the standard normal cumulative distribution function.

For women the same probability will be as following:

$$\Pr(y_{im}^* \leq 0) = \Pr(x_{im}'\beta + \varepsilon_{im} \leq 0) = \Phi\{(x_{im}'\beta)/\sigma\}$$

The expected value of the variable y for the noncensored observations of fathers will be:

$$E(y_{if} | x_{if}, y_{if} > 0) = x_{if}'\beta + \sigma \frac{\phi\left\{\frac{x_{if}'\beta}{\sigma}\right\}}{\Phi\left\{\frac{x_{if}'\beta}{\sigma}\right\}}$$

where $\phi(\cdot)$ is the standard normal density. This expected value differs from $x_{if}'\beta$ because of censoring, which leads to the inconsistency of OLS estimation.

The expected value of the variable y for the non-censored observations of mothers can be shown as following:

$$E(y_{im} | x_{im}, y_{im} > 0) = x_{im}'\beta + \sigma \frac{\phi\left\{\frac{x_{im}'\beta}{\sigma}\right\}}{\Phi\left\{\frac{x_{im}'\beta}{\sigma}\right\}}$$

Tobit estimation

The analysis can be done with two estimators: maximum likelihood (ML) and two-step regression. We will consider the maximum likelihood estimation.

For the case of left-censored data with the censoring point 0 ($L=0$), the density functions for father and mothers can be written as following:

$$f(y_{if}) = \left[\frac{1}{\sqrt{2\pi\sigma^2}} \exp \left\{ -\frac{1}{2\sigma^2} (y_{if} - x'_{if}\beta)^2 \right\} \right]^{d_{if}} \left[\Phi \left\{ \frac{0 - x'_{if}\beta}{\sigma} \right\} \right]^{1-d_{if}}$$

$$f(y_{im}) = \left[\frac{1}{\sqrt{2\pi\sigma^2}} \exp \left\{ -\frac{1}{2\sigma^2} (y_{im} - x'_{im}\beta)^2 \right\} \right]^{d_{im}} \left[\Phi \left\{ \frac{0 - x'_{im}\beta}{\sigma} \right\} \right]^{1-d_{im}}$$

where $d=1$ denote the censoring indicator for the outcome that the observation is not censored, and $d=0$ denote a censored observation.

The tobit maximum likelihood estimator is inconsistent if the errors are not normally distributed or if they are heteroskedastic.

However most of the researchers using Time Use data consider tobit models as suitable estimation methods. As justified above, the nature of the dependent variable makes this estimation method adequate to estimate the effect of the explanatory variables in the dependent variable “number of minutes dedicated to an activity”. When the empirical specification has been designed to explain the fraction of time dedicated to an activity, rather than the number of minutes, fractional models (as fractional logit models) have been estimated (as in Rute-Cardoso, et al. 2010).

In recent years, the suitability of tobit models for the estimation of time allocation equations for activities that are rarely done has received some critiques. Some authors (Stewart, 2009 and Foster and Kalenkoski, 2013) have argued that, in the presence of a high percentage of zeros, the zeros reflect at the same time mis-measurement (activities not done very frequently can suffer for some “sampling” error) and true non-participation. In that case, OLS may lead to better estimation. The results obtained by Kalenkoski and Foster (2013) suggest that in samples with large number of zeros, Tobit estimation is not appropriate and consistent, to the extent that there is true non-participation in the activity. Moreover, even if there is few number of false zeros, Tobit estimation is not appropriate if sample contains a large number of zeros, whereas OLS shows statistically significant results.

We present, in the Table 6, the results of the estimations that were done using OLS and Tobit.

Table 6. Estimation of daily minutes of childcare 3

Daily minutes of childcare 3	Husbands		Wives	
	OLS	Tobit	OLS	Tobit
Wife earns 6 intervals less than husband	385.373** (168.477)	364.78* (190.327)	403.608** (167.025)	379.31** (183.627)
Wife earns 5 intervals less than husband	-33.828 (156.875)	64.761 (193.607)	33.900 (155.523)	68.146 (181.411)
Wife earns 4 intervals less than husband	37.167 (78.897)	13.64 (90.834)	10.796 (78.217)	30.035 (86.255)
Wife earns 3	32.388	67.519	-36.607	-36.729

intervals less than husband	(49.150)	(57.906)	(48.727)	(55.284)
Wife earns 2 intervals less than husband	-52.554 (38.353)	-66.938 (45.485)	-70.083* (38.022)	-95.953** (43.585)
Wife earns same as husband	-40.373 (30.941)	-26.142 (36.522)	-11.931 (30.674)	-9.668 (34.673)
Wife earns 1 interval more than husband	45.978 (52.607)	94.897 (63.465)	5.383 (52.153)	4.985 (61.164)
Wife earns 2 intervals more than husband	-111.895 (76.593)	-51.385 (88.43)	-120.273 (75.933)	-101.84 (85.812)
Wife earns 3 intervals more than husband	192.755 (162.42)	366.957** (183.281)	245.393 (161.02)	220.762 (188.876)
Wife earns 4 intervals more than husband	-41.152 (311.063)	-1759.684	-40.432 (308.382)	-1776.213
Household income 1201 - 2000 euros	68.362 (64.36)	72.91 (79.539)	92.947 (63.805)	78.796 (73.230)
Household income 2001- 3000 euros	126.601* (67.051)	126.506 (81.877)	129.058* (66.473)	107.022 (75.861)
Household income <3000 euros	96.991 (74.026)	106.969 (89.699)	92.392 (73.388)	74.274 (83.524)
No information available	35.707 (100.213)	25.819 (122.799)	119.158 (99.349)	100.521 (114.56)
Wife's age	-4.694 (3.849)	-7.749* (4.691)	-0.909 (3.816)	0.642 (4.468)
Husband's age	2.722 (3.351)	1.9 (4.039)	-1.708 (3.322)	-5.511 (3.881)
Husband's level of education:				
Secondary	70.245 (47.882)	73.098 (58.241)	130.165** (47.47)	125.709** (54.74)
Bachiller	28.933 (49.205)	40.812 (60.620)	64.54 (48.781)	88.865 (56.001)
Professional training	85.991* (48.794)	116.292** (59.047)	100.871** (48.374)	120.815** (56.125)
University	107.116* (54.810)	138.083** (66.864)	153.076** (54.337)	158.738** (62.873)
Wife's level of education:				
Secondary	34.997 (50.868)	17.546 (62.363)	-102.879** (50.43)	-117.274** (59.136)

Bachiller	-112.626** (52.914)	-136.757** (65.008)	-118.776** (52.458)	-108.071* (60.975)
Professional training	-24.060 (53.248)	-49.990 (64.513)	6.029 (52.79)	7.828 (61.286)
University	-55.484 (55.135)	-64.315 (66.42)	-55.374 (54.66)	-37.19 (62.825)
Number of children ages 0-2	-148.906 (111.509)	-130.246 (128.648)	-86.197 (110.548)	-94.001 (122.827)
Number of children ages 3-5	-199.173** (94.105)	-180.278* (108.752)	-250.296** (93.294)	-257.959** (103.937)
Number of children ages 6-9	-141.986 (90.365)	-133.202 (104.890)	-301.482** (89.586)	-320.239** (100.152)
Number of children ages 10-12	-227.667** (97.156)	-196.583* (112.968)	-401.104*** (96.319)	-413.88*** (107.989)
Number of children ages 13-17	-189.030** (91.511)	-150.316 (109.812)	-309.609** (90.722)	-312.334** (103.693)
Age of the youngest child: 3-5	-105.662 (90.053)	-95.592 (101.396)	123.121 (89.277)	137.430 (97.979)
Age of the youngest child: 6-9	-226.275** (93.119)	-199.988* (105.356)	144.096 (92.316)	170.434* (101.578)
Age of the youngest child: 10-12	-530.545*** (97.194)	-649.328*** (112.04)	-293.387** (96.356)	-395.728*** (107.375)
Age of the youngest child: 13-17	-676.524*** (94.456)	-960.250*** (110.484)	-490.098*** (93.642)	-700.941*** (106.070)
Squared number of children	45.879* (23.73)	44.467 (27.549)	71.294** (23.525)	74.055** (26.285)
Paid housekeeper	-106.794** (34.271)	-128.186** (40.455)	-100.153** (33.976)	-106.545** (38.844)
Week day observation	-287.200*** (22.928)	-318.252*** (27.384)	-284.068*** (22.731)	-308.597*** (25.972)
Self-employed husbands	-40.144 (33.464)	-68.482* (41.501)	17.579 (33.176)	23.465 (38.444)
Self-employed wives	-54.494 (40.758)	-44.297 (49.152)	-74.045* (40.407)	-97.033** (46.235)
Full time work for men	15.034 (74.852)	47.227 (84.736)	117.883 (74.207)	114.677 (81.836)
Full time work for women	-23.458 (31.171)	-24.387 (36.587)	-67.799** (30.902)	-58.776* (34.81)
Control for regions (CCAA)	Yes	Yes	Yes	Yes
Control for occupation	Yes	Yes	Yes	Yes

Observations	937	937	937	937
R-squared	0.0	0.07	0.06	0.07

- *-Significant at 10% confidence level
- ** - Significant at 5% confidence level
- *** - Significant at 1% confidence level

Note: In the estimation, the regions (Autonomous Communities) and occupation (classified by National Classification of Occupations 1994) are controlled for, though none of the estimated coefficients have the significant values, so we don't include them in the table. The standard deviations are in brackets. The STUS 2009-2010 uses two digit system of classification of occupations. The main categories of occupations are the following:

- 0. Armed Forces
- 1. Management of companies and public administrations
- 2. Scientific and intellectual technicians and professionals
- 3. Support technicians and professionals
- 4. Administrative type employees
- 5. Workers in catering, personal, and protection services and trade salespersons
- 6. Skilled agricultural and fishery workers
- 7. Craftspersons and skilled workers in manufacturing and construction (except installation and operators)
- 8. Installation and machinery operators and assemblers
- 9. Unskilled workers

Where Armed Forces is the reference group for occupation.

Reference groups for other variables:

- Relative earnings: wife earns 1 interval less than husband
- Household income: less than 1200 euros
- Level of education: primary education
- The age of the youngest child: 0 to 2
- The day of the week: weekend
- Self-employed or not: employee (not self-employed)
- The type of job: part-time job

Recall that in our sample for the models is composed by 937 observations for fathers and 937 observations for mothers, since we take into account both working parents.

From the table 6, where the coefficients for the model of childcare3 are displayed, it can be observed that in both estimation models, Tobit and OLS, the estimated number of children from 3 to 17 years old decreases mother's time with children, the higher is the number of children whereas the time of husbands with children is affected by number of children aged from 10 to 12 in Tobit estimation and from 10 to 17 in OLS estimation. However, the age of the youngest child in the family affects more husband's time with children. As it is observed from the table, the higher is the age of the youngest child, the less time husband's spend with children, whereas wives spend less time with children if the age of the youngest child is from 10 to 17. It is obvious, taking into account that little children need more care and attention. The reference group is the age of the youngest child 0 to 2. The squared number of children, which is the quadratic term, is significant for wives and increases her time with children.

In order to see the effect of income on parental time with children, relative earnings of spouses and household income are controlled for in the estimation. The data provides with income intervals, so for relative incomes we constructed dummy variables to measure the distance between wife's and husband's earnings (when the wife earns 1 interval less, 2 intervals less etc.

than her husband). The variable defining that wife earns 1 interval less than husband is taken as the reference in the estimation. The Tobit and OLS estimations suggest that wife earning 2 intervals less than husband decrease her time with children comparing to the wives earning 1 interval less than husband. It is interesting that we observe the opposite situation for wives earning 6 intervals less than husbands. Both in OLS and Tobit estimation, wives and husbands spend more time with children in this case. In the OLS estimation husbands spend 385.37 minutes more with children, on average, whereas in the Tobit estimation they spend 364.78 minutes more than husbands earning 1 interval more than their wives. Also, in the situation when wife earns 3 intervals more, her husbands spend about 367 minutes more with children.

Concerning the household income, only OLS estimation shows statistically significant values. The household income within the interval from 2001 to 3000 euros increase father's time for about 126.6 minutes and mother's time for 129.058 minutes comparing to the lowest income interval, which is less than 1200 euros.

As to the education of parents, primary education was taken as reference group. The husband's secondary education increases wife's time (in 130.16 minutes as estimated in OLS estimation, and in 125.71 minutes in Tobit estimation). The husbands that got vocational training highest level of education achieved devote to children 86 minutes more (in OLS estimation) and 116.29 minutes more (in Tobit estimation) as well as their wives, which spend about 100.87 minutes more with children (in OLS estimation) and 120.81 minutes more (in Tobit estimation). Wives with husbands having university level spend more time with children in OLS estimation. Concerning wife's level of education, if she has "bachiller", she spends less time with children than wives that have only primary education as well as her husband, whereas wife having secondary education affects negatively only her time with children in OLS and Tobit estimations.

The other variables that are significant in both estimation models include: whether households have the paid housekeeper and the type of the day of week (weekday or weekend).

The results show that the presence of housekeeper decreases the time parents spend with their children. If we observe the results for Tobit estimation, it decreases the time with children for fathers for 128.19 minutes and for 106.54 minutes for mothers. For OLS estimation the time for fathers decreases for 106.79 minutes per day and for 100.15 minutes per day for mothers.

The parents are supposed to spend less time with children on weekdays rather than on weekend. The results of Tobit estimation suggest that fathers spend with children 318.25 minutes less on weekday than on weekend and mothers spend about 308 minutes less. If we consider OLS estimation, fathers spend 287 minutes less on weekdays and mothers spend 284 minutes less.

Since this paper takes inspiration from the paper of Sevilla-Sanz et al. (2010), the results should be compared with the results of that paper based on STUS (2002-2003). However, it should be mentioned that they used childcare 2 (childcare as primary and secondary activity) as the

dependent variable, whereas in our estimation the dependent variable represents wider definition of childcare, including also activities that was done in the presence of a child.

In the paper of Sevilla-Sanz et al., they worked with 736 observations. The results suggest that the household income is significant when determining the time devoted to childcare. In the opposite of our estimation, in their paper, estimation showed that number of children in any age range is not significant as well as the presence of housekeeper. The significant variable is the type of the day of week, that is, weekday or weekend. Their estimation using Tobit model suggest that on weekdays parents spend with children on average 185 minutes less than on weekend. In our Tobit estimation, as it was mentioned before, fathers spend with children 318.25 minutes less on weekday than on weekend and mothers spend about 308 minutes less. These results show that for the 7 years, comparing to the results of 2002-2003 STUS, parents decrease their time with children on weekdays for about 123-133 minutes. OLS estimation, based on 2009-2010 STUS show that on weekdays fathers devote to children about 31 minutes less than in Tobit estimation, whereas mothers devote about 24 minutes less than in Tobit estimation.

After doing the estimations and comparing two methods, it can be observed that the Tobit estimation is more sensitive and more appropriate in analyzing the data. As it was mentioned in the previous section, Tobit model is used especially in the samples with high percentage of zeros (Stewart 2009), taking into account that there is no mis-measurement. This is possibly due to the fact that childcare3 is not a too rare activity for mothers and fathers with children below 18 years, so sampling zeros are not such a big issue.

4.2 Intracouple estimation

Household time allocation models recognize that individuals take their optimal decisions taking into account what other members of the households do. Researchers are often faced with the joint problem of censoring and simultaneity, working with microeconomic data. One class of models that overcome those two problems is the Multivariate Tobit models. Multivariate Tobit model generalize univariate Tobit models to systems of equations. In our sample the time devoted to childcare is observed separately for fathers and mothers, so that the specialization of Tobit model will be the following:

$$y_{if} = \begin{cases} y_{if}^* & \text{if } y_{if}^* > 0 \\ 0 & \text{if } y_{if}^* \leq 0 \end{cases} \quad (\text{for fathers})$$

$$y_{im} = \begin{cases} y_{im}^* & \text{if } y_{im}^* > 0 \\ 0 & \text{if } y_{im}^* \leq 0 \end{cases} \quad (\text{for mothers})$$

The regression of Tobit model is specified as following:

$$y_{if}^* = x_{if}\beta + \varepsilon_{if}, \quad i=1, \dots, 937 \quad (\text{for fathers})$$

$$y_{im}^* = x_{im}\beta' + \varepsilon_{im}, \quad i=1, \dots, 937 \quad (\text{for mothers})$$

Since the unobservable error terms of fathers (ε_{if}) and mothers (ε_{im}) are potentially correlated (think about measurement error and unobserved mothers', fathers' and households'

characteristics in the error term, taking into account that they have similar household characteristics), it is reasonable to make the joint estimation for parents. So, we define:

$$u_i = \begin{pmatrix} \varepsilon_{if} \\ \varepsilon_{im} \end{pmatrix}$$

where $u_i \sim N(0, \Sigma)$

In our case a Bivariate Tobit is going to be used, since we consider the time allocation decisions for fathers and mothers simultaneously. The dependent variable is childcare 3. We also extend the analysis and run the estimations separately for routine and leisure childcare in order to see the differences. The explanatory variables are still the following: relative earnings of spouses taking into account different income intervals, household income, ages of spouses, educational levels of both parents, number of children aged 0-2, number of children aged 3-5, number of children aged 6-9, number of children aged 10-12, number of children aged 13-17, the age of the youngest child, the squared number of children, occupation, regions, the presence of housekeeper, the type of the day of week (weekday, weekend), whether the job is full-time or part-time and whether parents are self-employed or not.

The results of the Bivariate Tobit estimation are shown in the table 7.

Table 7. The results of the Bivariate Tobit estimation

Childcare 3	Bivariate Tobit			
	Husbands		Wives	
	Coefficient	Standard error	Coefficient	Standard error
Wife earns 6 intervals less than husband	409,110**	189,598	400,722**	182,777
Wife earns 5 intervals less than husband	-48,421	202,429	3,637	185,790
Wife earns 4 intervals less than husband	33,687	89,852	30,836	85,915
Wife earns 3 intervals less than husband	70,166	57,191	-35,995	54,906
Wife earns 2 intervals less than husband	-71,653	45,049	-94,189**	43,123
Wife earns same as husband	-29,367	36,221	-14,170	34,545
Wife earns 1 interval more than husband	61,283	63,155	-15,258	60,301
Wife earns 2 intervals more	-66,668	88,425	-119,861	85,682

than husband				
Wife earns 3 intervals more than husband	332,509*	182,419	256,097	181,565
Wife earns 4 intervals more than husband	-1 484,382	87195,348	-1 530,666	92611,019
Household income 1201 - 2000 euros	82,836	77,521	90,771	73,113
Household income 2001- 3000 euros	136,425*	80,142	117,324	75,766
Household income <3000 euros	111,448	88,096	76,226	83,394
No information available	22,857	121,752	115,748	114,250
Wife's age	-6,069	4,630	0,214	4,405
Husband's age	1,194	4,013	-4,823	3,840
Husband's level of education:				
Secondary	70,794	57,117	130,206**	54,323
Bachiller	44,403	58,805	89,392	55,632
Professional training	101,430*	58,053	112,406**	55,480
University	131,430**	65,581	163,649***	62,343
Wife's level of education:				
Secondary	30,154	61,425	-128,221**	58,490
Bachiller	-140,003**	63,768	-125,105**	60,253
Professional training	-44,519	63,840	-3,463	60,564
University	-47,791	65,519	-45,391	62,175
Number of children ages 0-2	-138,047	127,292	-106,764	122,255
Number of children ages 3-5	-177,212*	107,706	-258,300**	103,465
Number of children ages 6-9	-131,569	103,784	-325,903***	99,620
Number of children ages 10-12	-189,087*	111,709	-413,126***	107,211
Number of children ages 13-17	-143,714	107,809	-312,559***	102,825
Age of the youngest child:	-111,453	101,004	120,028	97,518

3-5				
Age of the youngest child: 6-9	-227,679**	104,867	157,283	101,105
Age of the youngest child: 10-12	-685,926***	111,007	-422,419***	106,750
Age of the youngest child: 13-17	-984,601***	109,536	-707,815***	104,861
Squared number of children	43,767	27,228	75,610***	26,135
Paid housekeeper	-133,378***	40,055	-114,661***	38,458
Week day observation	-283,771***	27,042	-290,021***	25,753
Self-employed husbands	-86,075**	40,697	8,603	38,214
Self-employed wives	-35,470	48,190	-84,699*	45,762
Full time work for men	44,641	84,262	117,177	81,307
Full time work for women	-27,604	36,305	-63,344*	34,615
Control for regions (CCAA)	Yes		Yes	
Control for occupation	Yes		Yes	
Sigma1	367.042***	9.784		
Sigma2	354.88***	9.229		
Rho12	0.63***	0.022		
Observations	937			

*-Significant at 10% confidence level

** - Significant at 5% confidence level

***- Significant at 1% confidence level

Note: In the estimation, the regions (Autonomous Communities) and occupation (classified by National Classification of Occupations 1994) are controlled for, though none of the estimated coefficients have the significant values, so we don't include them in the table. The standard deviations are in brackets. The STUS 2009-2010 uses two digit system of classification of occupations. The main categories of occupations are the following:

0. Armed Forces
1. Management of companies and public administrations
2. Scientific and intellectual technicians and professionals
3. Support technicians and professionals
4. Administrative type employees
5. Workers in catering, personal, and protection services and trade salespersons
6. Skilled agricultural and fishery workers
7. Craftspersons and skilled workers in manufacturing and construction (except

installation and operators)
8. Installation and machinery operators and assemblers
9. Unskilled workers
Where Armed Forces is the reference group for occupation.
Reference groups for other variables:
Relative earnings: wife earns 1 interval less than husband
Household income: less than 1200 euros
Level of education: primary education
The age of the youngest child: 0 to 2
The day of the week: weekend
Self-employed or not: employee (not self-employed)
The type of job: part-time job

In the Bivariate Tobit estimation there are three extra parameters to be estimated: σ_1 , σ_2 and ρ_{12} . σ_1 is the variance of the reduced-form equation for the endogenous regressor for fathers and σ_2 is for mothers (i.e. σ is the variance of unobservable characteristics of fathers and mothers). The more interesting parameter is ρ , which is evidence of the correlation between wives' and husbands' error terms. ρ being equal to zero is equivalent to saying that there is no correlation between error terms (unobservable characteristics) of fathers and mothers.

The coefficients σ_1 , σ_2 and ρ_{12} are statistically significant in the Bivariate Tobit estimation. The parameters σ_1 and σ_2 are the variances of error terms (unobservable characteristics) for fathers and mothers. Since the coefficients are significant we reject the null hypothesis of their endogeneity, which means that errors of parents within the household are correlated.

The results of bivariate Tobit estimation suggest that wife's relative wages partly affect parental time with children. The situation when wife earns 1 interval less than her husband is considered as the reference. As it can be observed from the table, if wife earns 2 intervals less than husband, she spends 94.19 minutes less with their children. If the difference in wages of spouses is significant, that is if wife earns 6 income intervals less than her husband, both wives and husbands spend more time with children comparing with the situation when wife earns 1 interval less than husband. If wife earns 3 intervals more than husband, husbands devote on average 332.5 minutes more to children.

In general, household income of spouses doesn't affect the parental time devoted to childcare, though husbands living in the family with household income within the interval from 2001 to 3000 euros, devote about 136.42 minutes more to children, than those who earn less than 1200 euros.

As to education, primary education was taken as the reference. From the table, it can be observed that husband's education level totally positively affects his wife's time with children. The higher is husband's level of education, the more time his wife spend with children. And also husbands themselves who have professional training spend with children about 101 minutes more than those with primary education. Concerning the wife's level of education, wife who have bachiller level spend 125 minutes less and their husbands spend 140 minutes less with children. Moreover, wives with secondary education spend on average 128 minutes less than those with primary education.

It is interesting that the number of children in the family almost doesn't affect father's time with children (only the number of children from 10 to 12 is statistically significant at 10%), whereas the number of children from 3 to 17 years old decreases mother's time with children. However the variable indicating the age of the youngest child in the household has effect on both spouses. The higher the age of the youngest child is, the less time parents dedicate to childcare 3.

The presence of housekeeper decrease father's time in 133.4 minutes and mother's time in 114.7 minutes. It can also be observed that, on weekdays, both parents spend less time in childcare than on weekend. Fathers spend on average 284 minutes less than on weekends and mothers devote about 290 minutes less on weekday than on weekends. From the estimation, it can be seen the age and occupation of spouses don't affect the parental time with children. Concerning the work time of spouses, we include in the estimation, whether parents are self-employed or not, whether they have part-time or full-time job. Unfortunately, in the survey there is no information about the sector where spouses work (private or public), so we could not explore alternative empirical specifications. From the table, it can be observed that self-employed husbands spend with children on average about 86 minutes less than employees, and self-employed wives dedicate about 84.7 minutes less. Women with full-time job devote about 63.34 minutes less to children than those with part-time job, whereas it doesn't affect husbands' time with children.

Since within childcare 3 we can further distinguish between routine and leisure childcare , and since we saw some different gendered patterns in the descriptive analysis, we proceed to present the estimation for both types of childcare. The results for routine childcare are shown in Table 8 and those for leisure childcare in Table 9.

Table 8. Bivariate Tobit for routine childcare

Routine childcare	Bivariate Tobit			
	Husbands		Wives	
	Coefficient	Standard error	Coefficient	Standard error
Wife earns 6 intervals less than husband	372,779***	102,583	193,475	123,772
Wife earns 5 intervals less than husband	-18,028	117,736	-48,738	127,838
Wife earns 4 intervals less than husband	31,756	49,091	26,416	58,827
Wife earns 3 intervals less than husband	14,589	31,483	-147,881***	38,879
Wife earns 2 intervals less than	-43,358*	25,092	-89,948***	29,617

husband				
Wife earns same as husband	-5,492	20,071	-41,853*	23,624
Wife earns 1 interval more than husband	69,613**	34,568	-49,630	41,480
Wife earns 2 intervals more than husband	32,222	48,266	-69,187	58,516
Wife earns 3 intervals more than husband	177,887*	102,440	142,850	127,743
Wife earns 4 intervals more than husband	-683,994	48 432,833	-944,019	52707,825
Household income 1201 -2000 euros	103,825**	44,924	136,356***	51,406
Household income 2001-3000 euros	109,997**	45,890	120,500**	52,974
Household income >3000 euros	90,708*	50,148	97,489*	58,202
No information available	31,839	70,717	118,536	79,644
Wife's age	-0,693	2,587	5,420*	3,064
Husband's age	-2,178	2,243	-7,280***	2,668
Husband's level of education:				
Secondary	24,524	32,145	65,187*	37,547
Bachiller	55,712*	32,890	8,701	38,344
Professional training	61,552*	32,392	53,605	38,197
University	84,185**	36,739	61,589	43,231
Wife's level of education:				
Secondary	-54,639	34,669	-114,404***	40,684
Bachiller	-44,303	35,543	-7,576	41,557
Professional training	-13,110	35,432	-3,078	41,890
University	-12,026	36,436	30,941	42,950
Number of children ages 0-2	19,647	70,234	58,833	83,549
Number of children ages 3-5	17,900	59,651	-140,468**	70,660

Number of children ages 6-9	-7,096	57,662	-226,787***	68,304
Number of children ages 10-12	-69,196	62,041	-236,470***	73,424
Number of children ages 13-17	-15,805	60,853	-195,907***	71,288
Age of the youngest child: 3-5	-98,575*	54,520	153,750**	65,999
Age of the youngest child: 6-9	-62,426	56,812	200,344***	68,447
Age of the youngest child: 10-12	-229,494***	60,891	-133,779*	72,786
Age of the youngest child: 13-17	-430,015***	60,591	-330,935***	72,263
Squared number of children	0,927	15,170	43,662**	17,904
Paid housekeeper	-18,327	22,027	-31,331	26,539
Weekday	-38,073**	14,985	-56,731***	17,721
Region: Madrid	92,444***	24,690	132,062***	29,510
Region: Basque country	92,115**	38,690	100,859**	46,091
Self-employed husbands	-33,000	22,776	4,864	26,468
Self-employed wives	-29,066	26,939	-30,355	31,483
Full time work for men	18,813	45,619	45,176	55,166
Full time work for women	20,496	20,035	7,407	23,681
Control for regions (CCAA)	Yes		Yes	
Control for occupation	Yes		Yes	
Sigma1	197.114***	5.533		
Sigma2	239.254***	6.372		
Rho12	0.451***	0.029		
Observations	937		937	

*-Significant at 10% confidence level

** - Significant at 5% confidence level

*** - Significant at 1% confidence level

Note: In the estimation, the regions (Autonomous Communities) and occupation (classified by National Classification of Occupations 1994) are controlled for, though none of the estimated coefficients have the significant values, so we don't include them in the table. The standard deviations are in brackets. The STUS 2009-2010 uses two digit system of classification of occupations. The main categories of occupations are the following:

0. Armed Forces

1. Management of companies and public administrations
2. Scientific and intellectual technicians and professionals
3. Support technicians and professionals
4. Administrative type employees
5. Workers in catering, personal, and protection services and trade salespersons
6. Skilled agricultural and fishery workers
7. Craftspersons and skilled workers in manufacturing and construction (except installation and operators)
8. Installation and machinery operators and assemblers
9. Unskilled workers

Where Armed Forces is the reference group for occupation.

Reference groups for other variables:

Relative earnings: wife earns 1 interval less than husband

Household income: less than 1200 euros

Level of education: primary education

The age of the youngest child: 0 to 2

The day of the week: weekend

Self-employed or not: employee (not self-employed)

The type of job: part-time job

From the table 8 we can see that wife earning 2 or 3 intervals less than her husband, devote less time to routine childcare, whereas if she earns 6 intervals less, it affects positively husband's time with children. In this case husbands spend on average about 373 minutes more than women earning only 1 interval less than her husband. If within the household spouses have wages in the same income interval, then wives spend 41.8 minutes less with children. In the cases wives earn 1 or 3 intervals more, then husbands devote more time to children, which could mean that in this case women have the bargaining power.

The household income is also significant in determining the parental time devoted to routine childcare. Comparing to the lowest household income interval wives' time with children increase. Husbands increase their time with children for 103.8 minutes if household income is within the interval from 1201 to 2000 euros. If household income is from 2001 to 3000 euros, then husbands spend about 110 minutes more than if household income is below 1200 euros. And if household income is higher than 3000 euros, husband's time with children increase for 90.7 minutes per day.

Concerning the age of spouses, both wife's and husband's age affect wife's time with children. The higher age of wife increase her time in routine childcare for 5.42 minutes whereas her husband's age decrease her time for 7.28 minutes.

From the estimation, it can be observed that education affects parental time in routine childcare. Bachiller level increase father's time for 55.7 minutes comparing to the fathers having only primary education. Professional trainings increase father's time in routine childcare for 61.5 minutes and university level increase father's time for 84.2 minutes. As to wife's level of education, if she has secondary education, her time in routine childcare decrease for 114.4 minutes.

The important variables affecting parental time with children are number of children in the household and the age of the youngest one. Thus, from the estimation we can see that the number of children affects only mother's time in routine childcare. With increase in the number

of children aged from 3 to 5 years old, mother's time decrease for 140.5 minutes per day, whereas with increase in the number of children from 6 to 9 years old decrease her time for 226.8 minutes. The increase in the number of children from 10 to 17 also decrease mother's time in routine childcare. Concerning the age of the youngest child, if the age is from 3 to 5, fathers on average spend 98.6 minutes less, than if the age is below 2 years old. And wives spend 153.8 minutes more in routine childcare. If the age of the youngest child is from 6 to 9, mothers spend 200.344 minutes more doing non-leisure activities with children, than if the age is below 2 years old. If the youngest child in the household is from 10 to 12, fathers decrease their time for 229.5 minutes whereas mothers spend 133.7 less in routine childcare. If the age of the youngest child is from 13 to 17, then both parents spend less time with children.

Evidently from the estimation parents spend on weekdays less time in routine childcare than on weekends. Fathers spend on average 38.1 minutes less, whereas mothers spend 56.7 minutes less.

In the estimation all the regions are controlled, but only two of them are significant. Households living in Madrid spend more time in routine childcare than households living in Andalucia. Fathers spend 92.444 minutes more and wives spend 132.062 minutes more. Couples living in the Basque country also spend more time in routine childcare than in Andalucia. Fathers spend 92.115 minutes more, whereas mothers spend 101 minutes more.

The parameters σ_1 , σ_2 and ρ_{12} are also significant, that is we reject the null hypothesis of their endogeneity, which means that errors of parents within the household are correlated.

Below, in the table 9 the results for leisure childcare are presented.

Table 9. Bivariate Tobit for leisure childcare

Leisure childcare	Bivariate Tobit			
	Husbands		Wives	
	Coefficient	Standard error	Coefficient	Standard error
Wife earns 6 intervals less than husband	-14,474	125,977	45,326	105,265
Wife earns 5 intervals less than husband	-26,787	138,130	37,095	110,796
Wife earns 4 intervals less than husband	-9,508	60,636	31,461	49,854
Wife earns 3 intervals less than husband	37,234	38,914	41,200	31,913
Wife earns 2	-49,456	30,400	-40,372	25,238

intervals less than husband				
Wife earns same as husband	-42,741*	24,390	-1,714	20,175
Wife earns 1 interval more than husband	-38,572	43,506	-42,110	35,980
Wife earns 2 intervals more than husband	-96,326	63,560	-101,512*	52,343
Wife earns 3 intervals more than husband	181,421	125,603	92,870	106,774
Wife earns 4 intervals more than husband	-920,765	59884,433	-816,040	45553,364
Household income 1201 - 2000 euros	-35,506	51,685	-60,181	42,761
Household income 2001-3000 euros	19,146	53,513	-24,432	44,288
Household income >3000 euros	-7,788	58,981	-57,488	48,772
No information available	-5,056	82,571	22,111	66,543
Wife's age	-6,940**	3,185	-3,705	2,618
Husband's age	3,388	2,776	0,649	2,292
Husband's level of education:				
Secondary	28,773	38,777	56,846*	31,802
Bachiller	-3,135	40,302	85,895***	32,702
Professional training	42,230	39,922	67,483**	32,790
University	65,611	44,672	106,158***	36,654
Wife's level of education:				
Secondary	114,769***	42,288	-46,575	34,430

Bachiller	4,480	44,098	-77,329**	35,646
Professional training	15,656	44,100	-21,011	35,687
University	40,687	45,172	-33,794	36,604
Number of children ages 0-2	-61,523	85,127	-78,120	70,671
Number of children ages 3-5	-137,160*	72,114	-39,315	59,898
Number of children ages 6-9	-53,969	69,683	-59,097	57,761
Number of children ages 10-12	-78,426	74,971	-114,556*	62,228
Number of children ages 13-17	-85,285	73,253	-55,216	60,166
Age of the youngest child: 3-5	7,049	66,981	-48,003	56,073
Age of the youngest child: 6-9	-133,113*	69,743	-16,567	58,277
Age of the youngest child: 10-12	- 378,185***	74,416	-264,104***	62,098
Age of the youngest child: 13-17	- 552,660***	74,616	-429,493***	61,491
Squared number of children	34,708*	18,277	19,095	15,151
Paid housekeeper	- 131,646***	27,615	-86,475***	22,665
Weekday	- 179,697***	18,409	-155,267***	15,177
Region: Valencia	-98,849***	34,697	-94,803***	28,915
Self-employed husbands	-60,109**	27,627	-14,590	22,528
Self-employed wives	-13,457	33,050	-43,865	27,255

Full time work for men	24,483	56,654	56,723	46,875
Full time work for women	-36,846	24,429	-56,928***	20,210
Control for regions (CCAA)	Yes		Yes	
Control for occupation	Yes		Yes	
Sigma1	242.29***	6.823		
Sigma2	203.222***	5.565		
Rho12	0.622***	0.023		
Observations	937		937	

*-Significant at 10% confidence level

** - Significant at 5% confidence level

***- Significant at 1% confidence level

Note: In the estimation, the regions (Autonomous Communities) and occupation (classified by National Classification of Occupations 1994) are controlled for, though none of the estimated coefficients have the significant values, so we don't include them in the table. The standard deviations are in brackets. The STUS 2009-2010 uses two digit system of classification of occupations. The main categories of occupations are the following:

0. Armed Forces
1. Management of companies and public administrations
2. Scientific and intellectual technicians and professionals
3. Support technicians and professionals
4. Administrative type employees
5. Workers in catering, personal, and protection services and trade salespersons
6. Skilled agricultural and fishery workers
7. Craftspersons and skilled workers in manufacturing and construction (except installation and operators)
8. Installation and machinery operators and assemblers
9. Unskilled workers

Where Armed Forces is the reference group for occupation.

Reference groups for other variables:

Relative earnings: wife earns 1 interval less than husband

Household income: less than 1200 euros

Level of education: primary education

The age of the youngest child: 0 to 2

The day of the week: weekend

Self-employed or not: employee (not self-employed)

The type of job: part-time job

The estimation of leisure childcare shows that wives earning 2 intervals more than husband spend on average 101.5 minutes less in leisure childcare than wives earning 1 interval less. The situation when wife earns the same as husband decrease husband's time for 42.7 minutes. Household income doesn't affect parental time devoted to leisure childcare, whereas age of wife affects husband's time with children negatively, i.e. the higher is wife's age, the less time husband devotes to children.

Concerning the husband's education level, it affects only his wife's time. The husbands with secondary education decrease their wives time in leisure childcare in 56.8 minutes. If he has "bachiller", his wife spend about 86 minutes more in leisure childcare. Husbands having professional trainings increase their wives' time with children for 67.8 minutes. Wives living with

husbands with university level spend about 106.158 minutes more doing leisure activities. As to wife's level of education, if she has secondary education, her husband spend 114.8 more minutes. Wives with bachiller spend on average 77.329 minutes less than wives with primary education.

The number of children in the household is almost not significant for both spouses as opposed to the routine childcare. The number of children in the age from 3 to 5 decreases fathers' time in 137 minutes (statistically significant at 10% level), and the increase in the number of children from 10 to 12 decrease mothers' time in leisure childcare in 114 minutes. However, for mothers the age of the youngest child is significant if the age is from 10 to 17.

If the youngest child is from 6 to 9 years old, then fathers devote about 133 minutes less to children doing leisure activities. So if the age of the youngest child is from 10 to 12, fathers spend in leisure childcare 378.185 minutes less, whereas mothers spend 264.104 minutes less than if the youngest child is below 2 years old. If the youngest child is from 13 to 17 years old, then fathers spend 552.7 minutes less, and mothers devote about 429.5 minutes less in leisure childcare.

In routine childcare the presence of housekeeper was not significant, however in leisure childcare, the presence of housekeeper decrease father's time for 131.646 minutes and mother's time for 86.475 minutes.

On weekdays parents dedicate less time to leisure childcare than on weekends as in routine childcare. Fathers spend about 180 minutes less whereas mothers devote 155.3 minutes less than on weekends.

From the regions of Spain, only one is significant. Households living in Valencia spend less time in leisure childcare than households living in Andalucia.

The job characteristics are also important in determining parents' time with children. Self-employed men spend in leisure childcare about 60.109 minutes less than employees. Wives working full time at work spend about 57 minutes less than those who have part-time job.

It should be mentioned that the marginal effects after Bivariate Tobit estimation have the same values as coefficients in Bivariate Tobit.

4. Conclusions

The purpose of my Master Thesis was analyzing parents' time with children, considering the most extensive definition of childcare, which includes leisure and routine childcare. Moreover, it was observed whether socioeconomic factors such as income, education and others affect this time with children.

So, the results of the estimation of the parent's time devoted to childcare can be summarised as following:

Wives spend more time in childcare than their husbands, they report less zeros in the activities with children than their husbands. However, there is gender specificities: fathers spend more time in leisure childcare and less time in routine childcare than mothers. Moreover, parents devote relatively more time to physical childcare than to other types of childcare no matter how old is the child.

According to the estimation, the fathers spend with their children more time on weekend rather than on weekday, whereas mothers spend more time to childcare 1 and childcare2 on weekdays. Concerning childcare 3, mothers spend with children more time on weekend; it can be explained by the fact that mothers do a lot of activities at home in the presence of a child.

The relative earnings of spouses are going to affect the childcare time. Comparing with the results of the paper of Sevilla-Sanz et al.(2010) which were based on 2002-2003 STUS, the female participation in childcare has decreased.

The most consistent estimator for our sample is Bivariate Tobit model. The results of the estimation are the following:

First of all, the significant values of σ_1 , σ_2 and ρ_{12} mean that the error terms of parents are correlated, because living in one household they have the same characteristics. It means that the Bivariate Tobit estimation is consistent.

The relative earnings of spouses are partly significant in the estimation. Estimation of childcare 3 (childcare as primary or secondary activity or any activity with children) shows that if the difference in earnings of spouses is big, that is, if she earns 6 intervals less than her husband, then both parents spend more time with children.

Note that time devoted to leisure childcare doesn't depend on the household income, whereas the time devoted to routine childcare decrease with household income though not monotonically. However, comparing to the lowest household income interval (below 1200 euros), parents spend more time in routine childcare.

From the estimation we can see that the age of spouses affect wife's time in routine childcare. The higher is her age, the more time she devotes to children, doing non-leisure activities, whereas the higher age of her husband decrease her time with children.

Concerning the education level, fathers having professional trainings or university level of education spend more time with children than those who have primary education. The father's time in leisure childcare is not affected by his education, but if his wife have secondary education, it increases his time in leisure childcare.

The most of the regions are not significant for determining the time spent with children, but it is interesting that in Madrid and Basque country parents spend more time in routine childcare, and in Valencia parents spend less time in leisure childcare than in Andalucia.

The important variables affecting the parents' time with children are the number of children of different ages and the age of the youngest child. The larger number of children from 3 to 17

years old decrease mother's time in routine childcare, whereas the time spent in leisure childcare almost doesn't depend on number of children. Concerning leisure childcare, father's time decrease if the age of the youngest child is from 6 to 17.

On weekdays parents spend with children less time than on weekend. The presence of housekeeper is going to decrease parents' time with children.

Self-employed parents on average spend less time in leisure childcare than employees. Women working full-time evidently spend less time in leisure childcare, whereas the time in routine childcare is not affected by the type of working day.

Comparing with the paper of Sevilla-Sanz et al. (2010), which was based on STUS (2002-2003) and taking into account that they estimated childcare as primary and secondary activity (childcare 2), their results suggest that household income is significant and the number of children is not significant in determining the parents' time with children whereas in our estimation household income and number of children are statistically significant for routine childcare.

The obtained results can be compared with the previous investigations that were done in different countries. Kalenkoski et al. (2005) in their paper document that women devote less time to primary child care on weekends than on weekdays, whereas men devote more time on weekend to secondary child care. The results of our estimation is opposite and suggest that on weekdays both spouses spend less time in childcare (as primary, secondary or any activity with children) than on weekends.

Some other researchers (Guryan et al. 2008, Gimenez-Nadal and Molina 2012) observed education as explanatory variable that affects the parental time with children and evaluated that higher educated parents spend more time with children, whereas in our estimation husbands with high education level devote more time to routine childcare and wives with highly educated husbands spend more time in leisure childcare.

From the results of the estimation, it can be observed, that the increase in female labor force participation decreased the time that mothers spend with children. We have seen that the higher household income decrease parents' time in routine childcare. Moreover, more educated fathers spend more time in routine childcare and in this situation their wives devote more time to leisure childcare. Since the participation of fathers in childcare increased with time, in future researches it would be interesting to analyze the change in time that fathers spend with their children. As it was observed in the first section, parental time devoted to children is very important for children's development and well-being. Therefore, in order to increase the time allocated to children, some policies should be implemented. The work schedule should be flexible according to the family structure (number of children), especially concerning women that have children. Moreover, as we observed, that more educated parents devote more time to their children, the government should give some incentives for parents to raise the education level, that will be important not only for the productivity of labor but also for the children's human capital.

References

- [1] Aguiar M., Hurst E. and Karabarbounis L. (2012) "Recent developments in the Economics of time use" *Annual Review of Economics* 4, 1056-8700/97/0610-00
- [2] Alvarez B. and Miles-Touya D. (2011) "Exploring the relationship between parents' and children's housework time in Spain" *Review of Economics of the Household* 10:299–318.
- [3] Amemiya T. (1974) "Multivariate regression and simultaneous equation models when the dependent variables are truncated normal" *Econometrica* Vol.42, No.6
- [4] Becker G.S. (1965) "A theory of the allocation of time" *The Economic Journal*, Vol.75, No.299, pp. 493-517
- [5] Bloemen H.G., Pasqua S. & Stanca E.G.F. (2010) "An empirical analysis of the time allocation of Italian couples: are they responsive?" *Review of Economics of the Household* 8:345–369
- [6] Cameron C., Trivedi P.K (2009) "Microeconometrics using Stata" *Stata Press*, 4905
- [7] Carrasco C. and Rodríguez A. (2000) "Women, families, and work in Spain: structural changes and new demands". *Feminist Economics* 6(1), 45–57
- [8] Connelly R. and Kimmel J. (2007) "Spousal Influences on Parents' Non-Market Time Choices" *Review of Economics of the Household* Vol.7, 361-394
- [9] Foster G. and Kalenkoski C.M. (2013) "Tobit or OLS? An empirical evaluation under different diary window lengths" *Applied Economics*, 2994-3010
- [10] Ghez G. and Becker G.S. (1975) "The allocation of time and goods over the life cycle" *National Bureau of Economic Research* 83-132
- [11] Gimenez-Nadal J.I. and Molina J.A. (2012) "Parents' education as a determinant of educational childcare time" *Journal Population of Economics* 26:719–749
- [12] Guryan J., Hurst E. and Kearney M. (2008) "Parental education and parental time with children" *Journal of Economic Perspectives* Volume 22, Number 3, Pages 23– 46
- [13] Hallberg D. and Klevmarck A. (2003) "Time for children: a study of parents' time allocation" *Journal of Population Economics* 16:205–226
- [14] Hamermesh D.S. and Biddle J.E. (1990) "Sleep and the allocation of time" *The Journal of Political Economy*, Vol.98, No.5, Part 1, 922-943
- [15] Kalenkoski C.M, Ribar D.C. and Stratton L. (2005). "Parental child care in single-parent, cohabiting and married –couple families: Time-Diary evidence from the United Kingdom". *The American Economic Review*; 95, 2; ProQuest Central pg. 194

- [16] Kalenkoski C.M, Ribar D.C. and Stratton L. (2007) "The Effect of Family Structure on Parents' Child Care Time in the United States and the United Kingdom" *Review of Economics of the Household* 5:4, 353-385
- [17] Rute-Cardoso A., Fontainha E. and Monfardini C. (2010) "Children's and parents' time use: empirical evidence on investment in human capital in France, Germany and Italy" *Review of Economics of the Household* 8:479–504
- [18] Sevilla-Sanz A., Gimenez-Nadal J.I. and Fernandez C. (2010) "Gender roles and the division of unpaid work in Spanish households". *Feminist Economics* 16(4) 137-184.
- [19] Sevilla-Sanz A. and Gimenez-Nadal J.I. (2011). "Trends in Time Allocation: A Cross-Country Analysis" *Economics Series Working Papers* 547
- [20] Stewart J. (2009) "Tobit or not tobit?" *U.S. Bureau of Labor Statistics*