The labor supply of disabled people.

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Abstract

This paper develops a framework to investigate family labor supply decisions in a household where a person with disability lives. The study is based on a neoclassical structural labor supply model in which the households are decision makers and their utility depends on income, time of cares for the person with disability and other characteristic of the job developed for this person. The utility maximization problem is solved for a discrete set of job alternatives choosing the optimal job package which is defined by wage (which allow a concrete income) and time of cares (which is related to working time in each alternative). We use data from a sample of 4.790 households in Spain obtained from the Spanish Survey of Disabilities and Attention to the Dependency (EDAD-08). We find different aspects of time of informal care to be associated with the intention to participate in labor market or to chose between jobs. We show that shifts work has less probability to be chosen because it has a negative impact on workers's wealth that must be compensated with higher income and less working hours. Factors such as age or limitation level affect significantly the choice between jobs. There is some variation in the responsiveness to income changes by type of job, being the highest effect for shifts working. In the case of a variation in the time of cares, all the job-specific elasticities are negatives, and conditioned to those already participating in labor market, the effect is also higher for the shift working.

Key words: disability, "non-standard", EDAD 2008, discrete choice model, nested logit model.
JEL classification: I1, I12, I18.

1 Introduction

This article examines the labor decision for a household where a person with disability lives. In our study, we focused on job-type choice taking into account the preferences and characteristics of the household. We are interested in disability because, as education or health, is related with the ability or possibility to perform a concrete job adequately. Intuitively is common to think that people with disability have lower probability of being employed than the rest. However, the productivity is not the only link between disability and labor participation there are other problems that can change the individual's relative utility from working time or out of the labor market[1].

The motivation for this study is that in recent decades several organizations of people with disabilities have worked hard in order to ensure that disability were considered within the framework of equal rights, and to promote a change in the opportunities of employment and integration into society. The relationship between disability and different type of jobs, which is the aim of this study, requires special attention in the context described above given the low participation ratio. The "Olivenza Research of 2010" elaborated by the Statal Observatory of the Disability, showed that only one of three people with disability had a job during the period 2008-2009, concretely the 28%. To understand the labor participation of people with disability is necessary to find the basis on the neoclassical model, whose fundamental principle is to maximize some objective function subject to any restrictions, also taking into account the individual preferences. Usually, traditional economic theory was based on the choice between labor and leisure and both were included as a part of the utility function (Gronau, 1973).

The labor supply for people with disability has been more popular in the last years due to the availability of better databases and the consciousness to equality rights. Most of the studies are focused on the analysis of the participation of people with limitations in the labor market, which affects both supply and demand (Livermore et al. 2000). By the supply side has to be considered that people with disabilities incur in extra costs (transport, rehabilitation, assistance...), in addition to direct costs in the search for employment and other circumstances that reduce their labor participation. The aspects that can influence the reduced labor participation in this group are the fact that disability is perceived by the employer as a sign of low productivity, at the same time that the fear of incurring additional costs such as some adaptation of the work place. Kidd, Sloane and Ferko (2000) using the Labor Force Survey (LFS) of 1996 found that, in the United Kingdom, only 50 per cent of the wage gap between men with and without disabilities is explained by differences in the characteristics of individuals. The authors indicate that legislation on discrimination adopted in 1996 in United Kingdom may reduce the wage gap between disabled and non disabled people, but not the difference in participation between both groups.

Some studies (Schalock and Verdugo, 2003) have focused mainly on the analysis of the objective factors that lead to the well-being of these people and the psychological processes that help to cope with the constraints arising from disability and ageing. The more shared idea is the concept of quality of life as an overall satisfaction with the life style and the control over human and environmental resources that produce satisfaction.

The choice between leisure and work would also be different having a limitation or not (Malo, 2004). The main idea is that is possible that the individual prefer not devote hours to work even if his salary would be equal to that of a person without a disability.

[1]To invest or maintain health status, people with disability have to devote resources (mainly time) for that.

In the line of the approach of the discrete choice model compatible with random utility, we can find some other studies which applied a discrete choice framework for the labor supply of nurses (Saether, 2004) or of married women (Dagsvik and Strom, 2006). Recently, the key characteristics of informal eldercare that are associated with intentions of workers to change their job or to leave the labor market has been investigated for female and male decisions separetaly finding that flexible working time schedules seemed to be beneficial to avoid anticipated labor market exit.(Schneider et al., 2013).

As we had explained, the analysis of the employment of people with disability is not new, but most of the previous studies are referred to participation decisions or salary discrimination in that collective. As first objective, we propose an specific framework to explain choices between labor and time of cares for a person with disability. The novelties of our approach are the followings; we model the choice of four alternatives about the labor market together with time devoted to cares related with each type of job so that we suppose that a characteristic of our labor market is that hours of work are fixed for many types of job. Thus, if a person wants to change the hours of work he would have to change the job. In this paper, households faces two subsequent choices. First, the choice of participate or not in labor market must be taken and secondly the choice of the type of job. We use data from the Spanish Survey of Disability and Attention to the Dependency (EDAD-08), that is the most recent source of information about disability in Spain having detailed information about people with disability and their families.

Summing up, we follow the methodological approach of the random utility model (McFadden, 1984) which has gained a lot of popularity in the last years to analyze labor supply behavior. That approach is based on the election that a household takes from a finite set of type-jobs with specific characteristics such as time of work (or alternatively, free time for cares) or non pecuniary attributes. Most of the specific choice sets of job opportunities are determined by firms or worker unions but are exogenous to individual decision. Our econometric framework is a random utility model due to the existence of several attributes of jobs that are not observed by the analyst. In this paper we argue the use of stochastic choice theory which offers a powerful framework for developing realistic models for labor supply.

The organization of the paper is as follows, we will start with an explanation of the random utility maximization model for labor supply which is the base of our investigation in the specific case of people with disability (Section 2), then we present an extended model applying an stochastic utility model without the independence of alternatives irrelevant property (Section 3). Next we detail the specification of our model, the method, and the variables used in our empirical analysis (Section 4) before presenting our results (Section 5). Finally, we summarize the conclusions and policy implications. (Section 6).

2 The Random Utility Maximization Model

In the following section, we will present a model of joint labor supply and time of cares choice. It is a family decision model, where choices are made with respect to the person with disability labor supply, whereas the rest of the family labor supply decisions are exogenous.

Random utility maximization can be understood as a probabilistic representation of neo-classical theory of choice. Our model is based on a discrete choice of a household which has a finite set of types of jobs available for a person with disability. Also, the random utility theory suppose that a rational household always choose the alternative which reports the maximum utility and although all factors associated with this election are completely known by the household are unobserved for the analyst. That means that a household n make an election because the alternative chosen, i ,is better than others given their characteristics; $U^*_{ni} > U^*_{nj}$.

It is assumed that the parameters are common and not variable across households although it may vary across alternatives. ϵ could be defined as the difference between the real utility and that which is observed by the analyst. D denotes the choice set of jobs that are feasible for the person with disability, while C is the choice set of cares. Both sets are supposed to be finite. The individual is assumed to choose a job, i from D which has associated some care t_c from C.

Then, $U(G_i, t_{ci}, i)$ is the utility function of a household where G is the household consumption/disposable income corresponding to job i, t_C is the time devoted to cares for the person with disability in the alternative i and i are the job "package". All jobs are characterized by fixed hours of work and a set of non-pecuniary job attributes unobserved for the analyst. The marginal utility of the non-working time is allowed to vary depending on the limitation level that is suffered, the age and the gender.[2]

For a given hours and wage, the budget constraint for a household is defined as $G_i = f(h_i w_i, I)$ where I is the non labor income which includes wages of the rest of members in the household and other income and $f(.)$ is a general function which describes the transformation of gross income into after-tax household income. Then, given the random utility model, we have:

$$U(G_i, t_{c_i}, i) = v(G_i, t_{c_i}) + \epsilon(i) \; i = 0, 1, 2, 3.$$

Where $v(.)$ is a positive deterministic function and $\epsilon(i)$ is a random component which accounts for unobserved characteristics that affect the utility.

2.1 Assumptions

1. The choice is a discrete event. Here there are three type of jobs $i = 1$ if working in a full-time job, $i = 2$ if working part-time, $i = 3$ if working shifts. The type of job and the non pecuniary attributes affect the choice between alternatives because some kind of jobs may be more attractive than others.
2. The utility varies across individuals as a random variable.
3. The utility function for each household has a deterministic part v and a random component ϵ which is independent to the former.
4. The joint distribution of ϵ is absolutely continuous and non-defective. Then $P(U_i = U_j) = 0$ if $i \neq j$.
5. In the model we consider that realized and observed hour of work are equal to job specific hours of the chosen job. That assumption is only a restriction from actually labor markets in which individuals can not decide completely freely hours of work, since working time is

[2] An assumption underlying our model is that people with disability are influenced by pecuniary as well as non pecuniary variables taking into account the time of care.

fixed for many types of job. That is mean is that if a household wants to devote more o less working time for the person with disability, it is needed to choose other job, (Altonjii and Paxon (1988)).

6. The population is a set of random utility maximizers.
7. To obtain a Probabilistic Choice System (PCS) consistent with a Random Utility Model (RUM), it is needed sufficient flexibility to capture patterns of substitution between alternatives and an structure and parametrization facilitating estimation and computation.
8. The household meets the basic axioms of reflexivity, completeness, transitivity, continuity, not satiation and convexity, its utility function is quasi-concave and twice differentiable. [3]
9. People with limitations usually have to allocate time to their health, that is a need biologically determined according to their status. [4]

2.2 Necessary and sufficient conditions for a choice probability system compatible with RUM

Following McFadden (1981), we define a finite set of alternatives I=(0,1,2,3) and a feasible subset $D \in I$. The choice probability $P(i/D, s)$ specifies the probability of choosing $i \in I$, given that the choice must be from the choice set $D \in I$ and the decision maker has characteristics $s \in S$. Choice probabilities have to satisfy the following conditions (Daily-Zachary-Williams):

1. Choice probabilities are non-negatives, $0 \leq P_i \leq 1$ and sum to one. $\sum_{i=1}^{I} P_i = 1$.
2. Translation Invariance; A common constant may be added to the utility of all alternatives without changing probability. $P_i(V) = P_i(V + C)$.
3. $\lim_{V_i \to \infty} P_i(V) = 1$ and $\lim_{V_i \to -\infty} P_i(V) = 0$
4. Non-negativity; $P_i(V)$ is differentiable with respect to V^i and $\frac{\partial (I-1) P_i}{\partial (V^i)}(V) \geq 0$.
5. Symmetry; $\frac{\partial P_i}{\partial V_j}(V) = \frac{\partial P_j}{\partial V_i}(V)$.

The nested logit satisfies those necessary and sufficient conditions but the satisfaction of condition referent to non-negativity needs also that the association parameter, λ will be in the $[0, 1]$ interval.

2.3 A basic labor supply model for people with disability.

We suppose that a household with a vector s of measured characteristics, one of which is the income, has to choose among a finite set of available types of jobs D. That set denotes the agent's set of available jobs with hours of work $H_i = h$ (or complementary, which allow hours of cares $TC_i = tc_i$) and wage $W_i = w$.

If we assume, in a first moment, that the four alternatives for the household (non-participation, full-time job, part-time job or working shifts) follow the property of independence of irrelevant alternatives, we could establish a model like that;

$$U(G_{ni}, t_{cni}) = V_{ni}(G_{ni}, t_{cni}) + \epsilon_{ni}.i \in D, t_c \in C. \tag{1}$$

[3] There is a utility function that describes how households decide the consumption and the time for cares and for working of the disabled individual subject to a budget and time restriction. When there is an interior solution, the household decide that the individual with disability participate the number of hours for which the ratio of marginal substitution between consumption and working time is equal, in absolute value, to real wage. On the other hand, in our case, is really interesting to study the factors that are associated with a corner solution, we mean, when the household prefers that the individual with disability does not work (no participation), which is usual in this collective.

[4] The amount of work offered may vary depending on the state of health of the individual and the needs of care or attention that this will add. For these people we can assume that care are a good intensive in time and that its consumption produces utility, as do other goods. We assume that health care take simply time and not goods, even though they reduce the amount of time available to work and generate income.

As we have suppose above, the households are rational, so the alternative which reports the higher utility will be the chosen.

$$P(U_{ni} > U_{nj} - > (V_{ni} + \epsilon_{ni}) > (V_{nj} + \epsilon_{nj})). \tag{2}$$

$$P_{ni} = (V_{ni} - V_{nj}) > (\epsilon_{nj} - \epsilon_{ni}). \tag{3}$$

The analyst do not observe $(\epsilon_{nj} - \epsilon_{ni})$, hence can not determine if $(V_{ni} - V_{nj}) > (\epsilon_{nj} - \epsilon_{ni})$. One can only make statements about choice incomes up to a probability of occurrence. If we suppose an independent, uncorrelated type I extreme value distribution $P(\epsilon_{nj} \leq \epsilon = exp(-exp - \epsilon) = e^{-e^{-\epsilon}}$, we obtain the multinomial logit of Mcfadden(1973). Then:

$$P_{ni} = (\epsilon_{nj} < \epsilon_{ni} + V_{ni} - V_{nj}) = \pi_{j=1}^{J} exp(-exp - [\epsilon_{ni} + V_{ni} - V_{nj}]. \tag{4}$$

This can be simplified to:

$$exp(-\epsilon_{ni}) exp[-\sum_{j=i}^{J} exp - (\epsilon_{ni} + V_{ni} - V_{nj})]. \tag{5}$$

The probability of choosing a particular alternative i, can be calculated by integrating the probability density function over all positive values of ϵ:

$$P_{ni} = \int_{\epsilon_{ni}=0}^{\epsilon_{ni}=\infty} exp(-\epsilon_{ni}) exp[-\sum_{j=i}^{J} exp - (\epsilon_{ni} + V_{ni} - V_{nj})] d\epsilon_{ni}. \tag{6}$$

If we call the sumatorium term a and also replacing $exp(-\epsilon_{ni})$ with z then:

$$P_{ni} = \int_{0}^{\infty} exp(-za) dz. \tag{7}$$

$$P_{ni} = -exp(-za)/a]_{0}^{\infty} = -[\frac{1}{a}(0-1)] = \frac{1}{a}. \tag{8}$$

Taking into account that $a = \sum_{j=i}^{J} exp - (\epsilon_{ni} + V_{ni} - V_{nj})$, we obtain:

$$P_{ni} = \frac{1}{\sum_{j=i}^{J} exp - (\epsilon_{ni} + V_{ni} - V_{nj})}. \tag{9}$$

$$P_{ni} = \frac{exp(V_{ni})}{\sum_{j=i}^{J} exp(V_{nj})}. \tag{10}$$

This model, which is the most commonly used assumes that the choice from a given set of alternatives satisfy the Independence of Irrelevant Alternatives (IIA) proposed by Luce in 1959[5]. This theoretical approach had been carried out by Dagsvik (1994) who developed a very complete and general framework to model that kind of issues. Dagsvik and Strom (2006) and Aaberge, Colombino and Strom (1999) used it for studying labor supply decisions for married females, as example of empirical applications, and complete the approach with stochastic choice sets. Additionally, Aaberge, Colombino and Wennemo (2009) used simulation techniques to built the choice set. Also in 2009, Di Tommaso et al. applied that modelization to study the labor supply of registered nurses. The IIA property could be a limitation as it implies equal competition between all pairs of alternatives, that may result so restrictive in our study, so in a second step we are going to relax it[6].

[5]This property implies that the random elements in utility are independent across alternatives and are identically distributed.

[6]The approach based on the idea that non participation ($h = 0$ and $w = 0$) is an alternative more from the choice set is the followed in previous studies. We can establish that there are two main steps in the choice process corresponding to the decision of participation or not, and once the participation is decided, take place the choice between different types of jobs.

3 An extended model of households' job decisions.

We consider that the identification of the employment choice is a crucial issue and as employees are not random samples of the population, the election of participation determine the second choice about the type of job.

The nested logit model can be thought as a way to estimate a choice model recognizing that within a choice set there can be alternatives that can be partitioned. That idea lies in the grouping of similar alternatives into nests and thus to create a hierarchical structure of the alternatives (Ben-Akiva and Lerman, 1985; Train, 2003).[7]

In this study, we construct a two level nested logit model; the upper level (marginal) is a participation nest and non-participation nest, while the lower level (conditional) is composed by the three kind of jobs corresponding to the participation nest. In that sense, a multinomial logit is subject to violations of the IID error assumption and it is necessary to propose a more general random utility model to accommodate the relaxation of it. The nested logit provides a way not only to link different but independent decisions, but also to decompose a single decision.

Conditioned on their participation in labor market, people with disability have a set of choices about their "job-packages" ($i = 1, 2, 3$). It is necessary to include additional parameter for each choice partition, equal to the inverse of λ attached to an index variable commonly called Inclusive Value (IV) which is defined by a set of utility expressions associated with a partitioned set of alternatives. Then, our model:

$$U_{ipart} = U_{part} + U_{i/part} = V_{part} + V_{i/part} + \epsilon_{part} + \epsilon_{i/part}. \tag{11}$$

Random components are supposed to be independent of hours of work or wage and follow a extreme value type I distribution, with density function $e^{-e^{-\epsilon}}$. As the variance assumption of the unobserved effects is relaxed. Thus, the scale parameter of the distribution, λ, becomes an additional (constant) multiplicand of each of the attributes that influence the choice.

The probability of household n choosing the alternative i , $p(y_n = i)$, is equal to the product of the probability to choose some alternative in nest $part$, $P(y_n \in part)$, and the conditional probability to choose exactly the alternative i given the set p, $P(y_n = i/y_n \in part)$. We suppose that the alternatives can be put into M nest (in our case two; $Part$ or $No - part$)[8].

The marginal distribution of the ϵ's are univariate extreme value, but now there is some correlation within nest. $1 - \lambda_m$ is a measure of the correlation.

$$P_{ipart} = max_{p/M} max_{i \in Part}(U_{part} + U_{i/part}) \tag{12}$$

$$P_{ipart} = P(y_n = i) = P(y_n = i/y_n \in part)P(y_n \in part) \tag{13}$$

$$P_{ipart} = \frac{exp(V_{part} + \lambda_{part} IV_{part})}{\sum_{m=1}^{M} exp(V_m + \lambda_m IV_m)} \frac{exp(V_{ipart}/\lambda_{part})}{\sum_{j \in D_{part}} exp(V_{j/part}/\lambda_{part})}. \tag{14}$$

The first term $P(y_n = i/y_n \in part)$ is the conditional probability o choosing alternative i is the nest $part$ is chosen. It is often referred as the lower level. The second term $P(y_n \in Part$ is the marginal probability of choosing the nest $part$ and belongs to the upper level.$\lambda_{part} IV_{part}$ is the expected extra utility for being able to choose the best alternative in the nest. The inclusive value (IV) links the two models and it would be:

$$IV_{part} = Ln[exp(V_{Comp}/\lambda_{part}) + exp(V_{parc}/\lambda_{part}) + exp(V_{turn}/\lambda_{part})]. \tag{15}$$

[7] Some of them have similar standard deviations that differs from others, whose standard deviations are similar to each other but different from the first group. However, the overall variance of unobserved components is supposed to be constant, in order to can derive the model from utility maximization.

[8] This implies the following distribution for the error terms $exp(-\sum_{m=1}^{M}(\sum_{j \in D_m} e^{(\frac{-\epsilon_j}{\lambda_m})})^{\lambda_m})$.

Let $\phi_{ipn}(h, w; I, t_c, s)$ to be the probability that the household n choose a particular job with offered hours h (and consequently time for cares) and wage w (allowing a concrete income), such as i within D taking into account the non-labor income, the time of cares needed and the household characteristics shall be the feasible job with the highest utility conditioned on participate in the labor market.

$$\phi_{ipn} = max_{p \in M} U_{part}(G, t_c; s) + U_{i/part}(G, t_c; s). \tag{16}$$

$$\begin{aligned} \phi_{ipn} &= \frac{exp(V_{part}(f(wh, I), t_c)/\lambda_{part} + \frac{\lambda_{part}}{\lambda_i} \sum_{j=1}^{3} exp(V_{i/part}(f(wh, I), t_c)/\lambda_{part}}{\sum_{p \in M} exp((V_p(f(xy, I), t_c) + \frac{\lambda_p}{\lambda_j} \sum_{j=1}^{3} exp(V_{j/part}(f(xy, I), t_c)/\lambda_p} \\ &\times \frac{exp(V_{i/part}(f(wh, I), t_c)/\lambda_{part}}{\sum_{j=1}^{3} exp(V_{j/part}(f(xy, I), t_c)/\lambda_{part}}. \end{aligned} \tag{17}$$

Where x is equal to hours of work in category j and y is the wage in category j and M are the available alternatives in the first level (in our model, to participate or not).

We must take into account that we have a degenerate branch, that is mean that the inclusive value for the non participation is 1. Then, in our model, the choice probabilities for the lower level nested alternatives conditional on the participation choice:

$$P(Full - time/part) = \frac{exp(\frac{V_{full}}{\lambda_{part}})}{exp((\frac{V_{full}}{\lambda_{part}}) + exp(\frac{V_{parc}}{\lambda_{part}}) + exp(\frac{V_{shifts}}{\lambda_{part}})}. \tag{18}$$

$$P(Part - time/part) = \frac{exp(\frac{V_{parc})}{\lambda_{part}}))}{exp((\frac{V_{full}}{\lambda_{part}}) + exp(\frac{V_{parc})}{\lambda_{part}} + exp(\frac{V_{shifts}}{\lambda_{part}}))}. \tag{19}$$

$$P(Shifts/part) = \frac{exp(\frac{V_{shifts}}{\lambda_{part}})}{exp((\frac{V_{full}}{\lambda_{part}}) + exp(\frac{V_{parc})}{\lambda_{part}} + exp(\frac{V_{shifts}}{\lambda_{part}}))}. \tag{20}$$

The marginal choice probabilities about the participation are:

$$P(part) = \frac{exp(V_{part})}{exp(V_{No-part}) + exp(V_{part} + \lambda_{part} IV_{part})}. \tag{21}$$

$$P(No - part) = \frac{exp(V_{No-part})}{exp(V_{No_part}) + exp(V_{part} + \lambda_{part} IV_{part})}. \tag{22}$$

4 Methodology

We present a full information maximum likelihood (FIML) estimates of a two level with a degenerate branch nested logit. The nested logit model can be estimated by sequential estimation which involves separate estimation of each choice situation in the lowest level, once the inclusive values are calculated in that first step they are included as explanatory variables of the election in the upper level. Because the models are estimated separately for each level, there is a considerable loss of information affecting the distribution of the levels of attributes and the sample size, due to in the lower level estimation the sequential approach includes only those observations that have been chosen in the other step. Then, sequential estimation is statistically inefficient because parameter estimates at all levels above the lowest level do not have minimum variance parameter estimates (Hensher,1986). A more common approach is the full-information maximum likelihood which is efficient although difficult computationally. The full log-likelihood expression for a FIML nested model is of the form:

$$logL = \sum_{n=1}^{N} \sum_{i \in D} \delta_{in} log[P(i/S_n, \beta, \lambda]. \tag{23}$$

Where $n = 1, ..., N$ are observations, $i \in D$ are the available alternatives, λ is the parameter estimated for the inclusive value, S_n are the set of exogenous attributes and β their utility parameters. Finally, $\delta_{in} = 1$ if the alternative i is chosen and zero otherwise.. For a two level logit model of the form;

$$P_{ipn} = P(part) * P(i/part). \tag{24}$$

the joint cumulative distribution function of the unobserved random components is (McFadden, 1981);

$$F(\epsilon_1, \epsilon_2, ...\epsilon_n) = exp{-}G[exp(-\epsilon_1), ...exp(-\epsilon_n)] \tag{25}$$

This model require to choose a functional form in order to estimate it, but there is a lack of consensus in the determination of the mentioned functional form. Usually, the imposition of a functional form of the utility function is not imposed directly by economic theory so usually is determined by the data. That approach is unsatisfactory in the context of structural modeling. The common approach in this context is to find a flexible family of parametric or semi-parametric specifications. We want to estimate household preferences with a static structural discrete choice model of labor supply, with the same objective Van Soest (1995) used a polynomial to represent the utility function whereas Aaberge et al. and Dagsvik and Strom choose the Box-Cox function. The empirical specification of the deterministic part of the utility function is conditioned by the assumption made for the analyst. It is important to remember that the translog and the polynomial functional form do not imply that the deterministic part of the utility function is globally concave and monotonic.

The invariance assumption mentioned above capture the notion that when the individual basic needs (subsistence) are fulfilled then the absolute levels of quantities tend not to be essential, rather the individuals relate to relative consumption levels. Dagsvik and Strom (2004) demonstrate that under general regularity conditions, the above invariance assumptions imply that the systematic part of the household utility function has a form, similar to;

$$v(G_{ni}, t_{cni}; s_n)] = \beta_g \frac{G_{ni}^{\alpha_g} - 1}{\alpha_g} + \beta(s_n) \frac{t_{cni}^{\alpha_c} - 1}{\alpha_c}. \tag{26}$$

Where $\beta(s_n) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$ We assumed that $v(G, t_c)$ is additive separable in consumption and time of cares. Each utility component is supposed to have a Box-Cox functional form (see Dagsvik and Strom,2006). In that sense, we take the advantage of having an specification which is globally concave and increasing in disposable income. S_n is a vector of characteristics of the household and of the person with disability and α_i and β_i are constants with $\beta_i > 0$. For the utility function to be quasi-concave, we require $\alpha_g < 1$ and $\alpha_c < 1$. Note that if $\alpha_g \to 0$ and $\alpha_c \to 0$, the utility function converges to a log-linear function.

The explicative variables are:x_1 =Age of the person with disability, $x_2 = 1$ if the person with disability is a man and 0 otherwise and x_3 =Limitation grade of the person with disability.

As we said before, the income (consumption) is mainly determined by wage (which is affected by human capital characteristics) but that in real life it vary across sectors and jobs even if worker have identical characteristics. For that reason, households choose between packages with different wage and time available for cares. G, that is the consumption had been constructed as a function of the net household income per month controlled by salary of the person with disability and other economical public aids received[9].

[9]The hourly wage w is calculated according to the Survey of Labor Cost for Spain in 2008 depending on the occupation and controlled by the education. In order to prevent the sample selection bias due to participation, we estimate wages using the Heckman two-step procedure. (See appendix 1)

Time of cares is constructed also depending on the job type, "job packages" because the schedule associated with their actual job affect the time devoted to cares. A Heckman two-step procedure (Heckman, 1979) is applied for estimating the time of cares equation, with a significant selection effect. Then, we repeat this procedure for each one of the jobs categories. (See appendix 2).

5 Data

The available surveys about disability in Spain cover most of the needs for information of the disability, dependency, the ageing of the population and the health status of their population[10]. In its first edition, in 1986, the survey of disabilities, established that it was five million seven hundred thousand people with disabilities in Spain, the 15% of the total population. Thirteen years later, the second wave of the survey, EDDES (1999) - mainly due to a more restrictive design criteria for the identification of population - established the total people with disabilities in Spain, above three million, the 9% of the population. During the last three months of 2007 and the first quarter of 2008, almost 100,000 households in Spain have been visited by the INE (National Statistics Institute) for the third edition of the Survey on Disabilities, (EDAD 2008) and it showed a rate of less than 8.5 per cent of population with disability (although the number of people with limitations increased, the hole population growth more, which makes to reduce the rate of disability).

We have joint the household's questionnaires with the limitations questionnaire associated with at least one of the family members in order to have a complete information of the variables of interest. From the 14.706 Individuals with limitations that answered the questionnaire only 1632 were workers. Only 0.8% of the respondents said to have benefited from the quote of reserve employment for individuals with disabilities in the public sector and 0.68% if we focus on the private sector. The 2.20% of the sample said that it had benefited from a contract of employment for individuals with disabilities, 0.84% said it benefited from a deduction from Social security contributions for workers with limitations and 1.07% said benefit from other mechanisms to promote employment among individuals with disabilities.

Therefore, the incidence of these initiatives of social policy is insufficient, even if they are available, they seem to play a secondary role in the determination of the probability of finding employment for the individual with limitations. (See table 1).

Usually, the idea is that having a disability makes the individual not able for any kind of work. This is totally unfounded and it is necessary a true effort to match their capabilities with the opportunities of the labor market. An increase in the number of people with disabilities in the labor market can be a good way of reducing the pressure on the financial stability of social security.

According to the EDAD 2008, in Spain, of the 7.4 million seniors, 2.227.500 declared a disability in 2008, 30.3%. The overall disability rate stands at 8.5%, with an absolute value of 3.847.900 people with disabilities, of which 1.547.300 are men (40 per cent) and 2.300.500 women (60%). It should be noted that the age range in which most people with disabilities is between 55 and 64 years (14.18% of the total).

[10]Three surveys have been carried out: the Survey on Disabilities, Deficiencies and Disabilities (EDDM1986), the Survey on Disabilities, Deficiencies and State of Health (EDDS1999) and the Survey of Disability, Personal Autonomy and Situations of Dependency (EDAD2008).

Table 1: Main results of the survey EDAD-2008.

	Men	Women	Total
Percentage of workers between 16 y 65 years old.	32% (1.287)	22% (1.030)	27% (2.317)
Are you working or your last job was in a Special Centre of Employment for disabled people? YES	1.97% (148)	1,44% (117)	1,7% (265)
Are you working or your last job was in an entity without lucre animi for disabled people? YES	2,36% (177)	2,02% (164)	2,18% (341)
Have you benefit from the reserve quote for disabled people in the Public Sector? YES	0,85 % (64)	0,75% (61)	0,80% (125)
Have you benefit from the reserve quote for disabled people in the Private Sector? YES	0,89 % (67)	0,48% (39)	0,68% (106)
Have you benefit from a specific contract for disabled people? YES	2,81% (211)	1,64% (133)	2,20% (344)
Have you benefit from some incentive for the recruitment or Social Security deduction? YES	0,92% (69)	0,77% (63)	0,84% (132)
Total Survey			
Total Sample. Households	96.075		
People who answered the questionnaire	22.795		
People with limitations who answered the questionnaire	14.706		
People with limitations who have a job	1.632		
People with limitations who work : How do you found your current job?	41,4% Friends/Family; 18,7% for the firm; 4,2% the firm recruit him; 2,62% public service of employment; 1,15% disability association		
People with limitations. Are you looking for a job? (<65 years old)	10,16 % (610)		
Why do you think you don´t find a job?	43,65 % (of the 10,16 %) for the disability		
Why don´t look for a job?	23,85 %think is difficult because of the disability; 50 % can´t work		
Do you feel discrimination in your job for your disability?	9,42 % (2.462)		
Do you feel discrimination when you were looking for a job?	20,8 % (2.462)		

Source: EDAD 2008. INE

Table 2: Evolution of contracts to people with disabilities, according to mode. Spain. 2008 and 2009

	2008	
	Absolutes	**Percentages**
Temporary people with disabilities	11.960	27,90
Indefinite people with disabilities	8.147	19,00
Work and service	5.839	13,62
Eventual	5.777	13,48
Interim	4.545	10,60
Converted into Indefinites	3.236	7,55
Indefinite FCF	2.310	5,39
Ordinary Indefinited	548	1,28
In training	433	1,01
Other contracts	68	0,16
Practices	6	0,01
Total	**42.869**	**100,00**

Source: Public State employment service, 2009.

In 2008, there were 42.869 contracts to people with disabilities (27.90% were temporal). The 19% of the total were indefinite followed in importance by "work or service contracting" and the "eventual contract" (13.62 and 13.48% respectively). That information from the State employment service indicates a high temporality in hiring people with disabilities[11]. (Table 2)

Table 3: Percentage of workers with a disability according to the professional activity. Spain. 2008 Units: percentages

	Both sex	**Men**	**Women**
Employer or worker/self-employed with employees	5,77	7,41	3,69
Employer or worker/self-employed t without employees	9,56	8,84	10,43
Family help	0,68	0,34	1,07
Employee	82,12	81,77	82,62
Member of a cooperative	0,24	0,17	0,32
Other situation	1,08	0,93	1,28
No information	0,54	0,51	0,59
Employees for type of contract			
Civil Servant	11,24	9,32	13,66
Indefinite contract	50,98	53,86	47,31
Temporary contract	17,21	16,53	18,06
Verbal o without contract	2,84	1,65	4,34
Other	5,31	4,94	5,76
No information	12,42	13,70	10,81

Source: EDAD, 2008. INE

According to the EDAD-08, the 82,12% Of workers with disabilities are employees, being the second most important group the employers or self-employed without employees, which represents 9.56% of the total.The majority of workers with disabilities who were employees (50,98%) have

[11] According to the informative Bulletin of the National Institute of statistics (INE); (Panoramic view of disability in Spain, 2008), from the total of people with disabilities who were working in 2008, the 15.3% benefited from some measure of access to employment for this group. The measure which more people manifest have benefited is the specific contract for people with disabilities (about 35,000). On the other hand, there is a substantial increase over 1999 (last survey of disability before that) about those who say have accessed with the reserve of public employment quota for people with disabilities (it goes from 3,900 in 1999 to 14.200 in 2008).

an indefinite contract, in second place with a significant proportion (17,21%) is the temporary contract and 11,24% of employees are civil servants. (Table 3).

6 Empirical Results

The results of estimation are summarized in tables 4 and 5. The maximum likelihood method is used to estimate the parameters of the multinomial logit model and the nested logit model. As we discussed above, Full Information Maximum Likelihood has been chosen instead of the estimation in two steps in order to avoid the problems mentioned in previous section about the later. Firstly, we are going to show the parameters affecting anyone of the function utilities (for each alternative).

Tables 4 and 5 reports the estimates of the parameters in the utility function according to the final specification of the model. For the nested logit model we also report the estimate of λ and its standard deviation.

Table 4: Discrete choice. Multinomial Logit

Variable	**Cofficient**	**Standard error**	$b/St.Er.$	$P[/Z/ > z]$
Consumption	2,596	0,403	6,442	0,000
Time of cares	-2,521	0,200	-12.557	0,000
non part* Age	0,095	0,006	15,011	0,000
non part* Gender	-0,192	0,208	-0,922	0,356
non part* Limit.	-0,770	0,112	-6,829	0,000
Full time* Age	0,036	0,006	5,914	0,000
Full time* Gender	0,258	0,209	1,238	0,215
Full time* Limit.	0,391	0,110	3,546	0,000
Part time* Age	0,006	0,007	0,925	0,354
Part time* Gender	0,381	0,238	1,603	0,109
Part time* Limit.	0,246	0,125	1,967	0,049
Number of Observations	4790			
R^2	0,270			

Source: Authors' elaboration.

Table 4 displays the results of multinomial logistic regression on job choices. As we observe, working part or full time is preferred to working shifts for men, for those who has no limitation or moderate and also as they get older. On the other hand, non participation is preferred to shifts working if the individual is old but is less preferred if the person has less level of limitation and men prefer participate developing shifts working than not participate.

Table 5: Estimated parameters of the utility function. Nested Logit

Variable	**Cofficient**	**Standard error**	$b/St.Er.$	$P[/Z/ > z]$
Consumption	0,344	0,080	4,29	0,000
α_G	-1,19			
Time of cares	-2,409	0,210	-11.421	0,000
α_{tc}	0,40			
non part* Age	0,089	0,005	17,576	0,000
non part* Gender	-0,268	0,157	-1,702	0,088
non part* Limit.	-0,827	0,088	-9,408	0,000
Full time* Age	0,035	0,006	5,314	0,000
Full time* Gender	0,239	0,226	1,059	0,289
Full time* Limit.	0,417	0,119	3,481	0,000
Part time* Age	0,011	0,007	1,578	0,114
Part time* Gender	0,336	0,249	1,350	0,177
Part time* Limit.	0,241	0,131	1,836	0,066
IV parameter PART	0,669	0,059	11,290	0,000
Number of Observations	19160			
R^2	0,287			

source: Authors' elaboration.

The parameters α_G and α_{tc} are estimated to yield a cuasi-concave utility function, being both of them less than 1 (-1,19 and 0,40 respectively). In the table above we can observe the parameters of the utility functions for the different alternatives. It is useful to analyze (given its importance in the choice of a job) the consumption, G and the time devoted to cares t_c. The results show a positive sign of the consumption (income), as we expected, because with more income in the household more is the utility and they prefer jobs that reports more earnings if otherwise is similar.

We have tested other taste-modifying variables but we have selected those having more significant effects on preference for time of cares, and that on the other hand, were related with theoretical findings.

The time of cares has a negative sign, that is, when more time is devoted to care less is the utility in the alternative chosen[12].The positive sign in age show a preference for the time of cares when the age increases, and that is, people with disabilities prefer jobs which allow more time for cares when they get older[13].

Men prefer jobs with more working hours and shorter time for cares but that variable is not significative. The limitation level implies, as we expected, that less limitations are related with less preference for time of cares, as the individual is less limitated he preferred jobs allowing shorter time for cares. On the other hand, people with more level of limitation would have more preference for time to cares and prefer jobs that could allow that dedication.We also provide an estimate of McFadden's goodness of fit measure which indicated that model fits quite well. Most of variables are individually significant and the model is globally significant too. We carried out the test developed by Hausman and McFadden (1983) to test the validity of the IIA assumption. As the statistic takes a value of 205,6 which is higher than the critical value associated

[12]That can be explained for the direct relation between that variable and the bad health status that reduce welfare, causing less utility for the household in every alternative chosen.

[13]This may be caused by the fact that disabilities are more frequent in advanced ages and the time of cares is then, more valorated.

Table 6: Utilities for each kind of job

	Non participation (2.492)		Full-time (1.923)		Part-time (298)		Shifts (77)	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
G	5,77	1,26	5,25	1,30	5,221	1,16	5,27	1,16
Tc	1,01	0,56	0,96	0,59	1,004	0,60	0,88	0,60
Age	54,85	32,41	45,76	29,65	46,82	29,10	45,70	31,42
Gender	0,58	0,66	0,707	0,66	0,75	0,66	0,68	0,46
Limitation	2,02	1,42	2,58	1,69	2,62	1,73	2,71	1,82

Source: Authors' elaboration.

to a chi-square distribution, we reject the null hypothesis of the following of the IIA property, then the relevant model is not the multinomial logit model but the nested model. The degree of independence in unobserved utility among the upper nest is estimated to 0,67, so our model satisfy the necessary condition about that parameter must be between 0 and 1. On the other hand, the fact that this parameter is not 1 corroborates our hypotheses that nested logit is best than multinomial logit model.

In the table 6 we can see the number of households which had chosen each alternative. In the first part the parameters of the utility function are shown again for each of the alternatives and then there is a pondered average, each attribute is weighted by the percentage of choices of that alternative and the all values from each alternative are summed up and the average is obtained.

Taking into account all that information we can see that the alternative preferred in this survey is the non-participation (chosen for 2.492 of the respondents), while the shift-job is the alternative chosen with less frequency (only 77). People with disability who choose shift-jobs are in average, the youngest (about 45 years old in mean), that result is logical with our intuition because this kind of job is less flexible and requires more effort than the others. In that sense, as we expected, in average, older people prefer the non-participation (54,85 years old).

We consider that the results referred to time of cares are also logical; people who devote more time to cares chose, in average, more frequently the non participation (1,01), this alternative is followed by the part-time jobs (1,00) which also allow more time out of the labor market. We think conciliation between personal and professional life is more difficult for people developing shift-jobs or full-time jobs, and that is reflected in the data (people who choose working shifts has the lower figure about time of cares, 0,88). In average, people with more level of limitation (2,02) choose the non-participation alternative and contrarily people working shifts are those having the minimum level (2,71).

Table 7:Elasticities of disabled people'labor supply with respect to an overall income (or time of care) increase.

Job-type	Total Effect Income increase	Total Effect Time of cares increase
Elasticity of households for person with disability labor supply with respect to an overall income/time of cares increase.		
• No participation	0,895	-1,135
• Full-time	0,998	-1,093
• Part-time	1,676	-2,198
• Shifts	1,763	-2,340

Source: Authors' elaboration.

For each household we predict the job status for the person with disability to be the one having the highest estimated probability and calculate the numbers of households for which the predicted status is equal to the actual status. In that sense, the results obtained about the prediction power of the model are encouraging. As we can observe in the table above, the 52,67% are predicted to choose to not participate in the labor market while the 52,02% are observed non participating. 34,32% are predicted to have full-time jobs while 40,14% are observed working full-time. 8,85% are predicted to develop part-time jobs while the observed are 6,22%. Finally only 4,1% are predicted working shifts while the observed are 1,6%. The main difficulty is for the model to predict shift work and part-time jobs, but in general terms, the level of prediction for the model is good.

The aggregate elasticity of people with disability labor supply is obtained by calculating the relative change in mean disabled people labor supply (over all disabled people in the sample) that results from a 1% income (or alternatively time of cares) increase for these people, ceteris paribus. In table 7 we show the elasticities of aggregate labor supply with respect to an overall increase in family income in all four different alternatives of types of job. Then, we do the same to an increase in the time of cares. The idea of an increase in the income of the household (due mainly to an increment in the wage for the person with disability) shows a variation in the probability of choose a determinate alternative. The income elasticities are positive over all alternatives as it has been predicted by the model. That increase is more likely to affect people working shifts (1,763) who are the more income-sensitives, the smaller variation corresponds to the non participation (0,895). That conclusion is completely reasonable with our findings, the component which influence the most the income is the salary and working shifts is usually the kind of job with higher wage per hour due to the compensation for working at night or maybe on the weekends. If there is an increase in wages there could be a replacement effect to working shifts instead other kind of jobs. The time of cares elasticities are negative in all alternatives, but an increase in time of cares is more likely to affect people working shifts (-2,34) than in the other alternatives.

Table 8: Elasticities

Job-type	Total Effect Income increase	Total Effect Time of cares increase
Elasticity of households for person with disability labor supply with respect to an income/time of cares increase in non-participation.		
• **No participation**	0,699	-0,774
Full-time	-0,752	0,966
Part-time	-0,823	0,657
Shifts	-0,900	0,428
Elasticity of households for person with disability labor supply with respect to an income/time of cares increase in full-time job.		
No participation	-0,318	0,418
• **Full-time**	0,780	-0,953
Part-time	-0,827	0,979
Shifts	-0,639	0,482
Elasticity of households for person with disability labor supply with respect to an income/time of cares increase in part-time job.		
No participation	-0,091	0,072
Full-time	-0,217	0,253
• **Part-time**	1,549	-1,480
Shifts	-0,056	0,149
Elasticity of households for person with disability labor supply with respect to an income/time of cares increase working shifts.		
No participation	-0,046	0,021
Full-time	-0,077	0,055
Part-time	-0,164	0,065
• **Shifts**	1,569	-0,860

Source: Authors' elaboration.

The elasticity expressions for the nested logit model are differentiated between cases in which the alternatives being considered is or is not in the same nest as the alternative which is changed. Then, in order to assess the impact of job-specific income varies the labor supply, we show in table 8 the changes affecting the choice probabilities of the alternatives. In this case, instead of the sample mean we use the weighted mean using the predicted choice probabilities as weights in each alternative. The results suggest that authorities are able to use public policies to improve labor supply of people with disabilities. We note that when the income level related with non-participation is increased by 1% the decision probability of this alternative increases about a 0,6% (most of that increase is due of a decrease in the probability of choosing shifts working, -0,9%). The higher increase in the probability to chose an alternative is the referent to shifts working, when the income in this alternative is raised by a 1%, then the probability of choice for that type of job increases by 1,56%.

7 Conclusions

This research present the results of an study of labor supply in population with disability using information from the survey of disabilities and attention to the dependence for 2008 (EDAD), elaborated by the Spanish National Institute of Statistics, that collected data about households where a person with some disability lives and the personal characteristics of this person.

A discrete choice model for labor supply and time of cares for households where a person with disability is living is presented. Households are assumed to make choices from a finite set of job possibilities and a finite set of hours devoted to cares. Jobs are characterized by a fixed wage rate, working hours and other variables related to job satisfaction.

We have carried out a discrete choice labor supply model for the kind of job among people with disability. Conditioning on their participation in labor market, they facing a set of choices of their "job-package". In a first moment a choice between participate or not is presented and secondly between working in a full-time, part-time job or to work shifts. A high share of people with disability are not in labor market and is easy to understand in our model, where time for cares affects the utility in a significant way.

An overall income increase seems to increase the probability of working shifts, the effect shows that non participation is the less elastic choice. The results indicate that the time of cares depends mainly on the health status of the person with disability and that time is more valuable with age and limitation affecting significantly the choice decisions about labor activities. Given that conclusion, authorities have to put their efforts in trying to join older people and with severe limitation with more flexible jobs which respect their needs of care.

Budget cuts in some developed countries do more difficult to obtain the resources able to provide health care according to a demand which is rising too. In our study we have explained the behavior of households where a person with disability lives in relation with the labor market. We have confirmed the high inactivity that exists in that collective and the importance given to the time devoted to cares, which affects directly the choice among job-types.

Our results suggest that a generalist policy against some types of jobs considered undesirable for the main population could not be the best option. People with disability have spacial needs and they need flexible jobs. Also, the time of cares is a priority for households where a person with disability lives, preferring not to participate in labor market if there are not a compatible job with their situations. Besides, it is important looking for the improvement of accessibility to labor market for people with disabilities. Finally, for health policy makers it is necessary to evaluate healthcare for people with disability and promote the hiring of these population in more flexible jobs which can estimate them to participate although they need to devote some time to cares.

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Appendix 1: Estimation for wages.Spain.2008.

	Coefficient	Standard error	z	P> |z|
Wage				
No studies	-0,531	0,133	-3,97	0,000
Primary studies	0,047	0,111	0,43	0,670
Superior studies	0,489	0,131	3,71	0,000
Const.	19,574	0,119	164,41	0,000
Participation				
Age	-0,051	0,001	-47,78	0,000
Chronic illness	-0,079	0,025	-3,08	0,002
Gender	0,464	0,020	22,20	0,000
Health status	-0,262	0,012	-21,18	0,000
Cares	-0,050	0,005	-8,85	0,000
Const.	3,487	0,084	41,28	0,000
Mill's λ	0,337	0,137	2,45	0,014
Prob > Chi2= 0,000				

Appendix 2: Heckman estimation for the time devoted to cares.

	Heckman Selection model two-step estimates time of cares.		
	Coef.	Std. Err.	P>|z|
Time of Cares			
Gender	0,775	0,257	0,003
Age	-0,547	0,107	0,000
Age_2	0,005	0,001	0,000
Schedule in alternative chosen	-0,188	0,052	0,002
const	23,241	2,588	0,000
Cares			
Chronic illness	0,308	0,029	0,000
Economical Aids	-0,055	0,042	0,199
Married	0,119	0,022	0,000
Health status	0,427	0,013	0,000
Cont	-2,154	0,046	0,000
/ Athrho	-0,235	0,040	0,000
Prob > Chi2	0,000		