Classification errors and permanent disability benefits in Spain[§]

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1. Introduction

There is a controverted debate about the effects of permanent disability benefits on labor market behavior. Parsons (1980) and Slade (1984) attribute most of the decrease in the participation of the workforce to the increasing generosity of disability benefits. Leonard (1979) also finds that repercussions over labor market are considerable, whereas Haveman and Wolfe (1984a, b), Haveman et al., (1984), Bound (1989) and Haveman et al., (1991) support that the impact is much more limited. Other factors like spouse contributions to family income, the disappearance of the stigma associated with early retirement and more generous early retirement benefits may explain the decline in labor participation of older workers. In this paper we study permanent disability benefits in Spain to test whether they have being used as an instrument to favor pre-retirement (retirement before the early retirement age of 60). $\hat{p}$

In the application for disability benefits, we can distinguish two types of classification errors: *acceptation error* which refers to individuals who receive a benefit but do not deserve it, and *rejection error* which indicates individuals who applied for a benefit and deserve it, but it has been denied. According to article 136 of the General Law of Social Security, an individual deserves a benefit if "after having received the prescribed medical treatment, presents anatomical or functional serious reductions, capable of objective and predictably definitive determination, that diminish or annul his labor capacity". While there are empirical studies in some countries[1] providing evidence about disability benefits, the lack of adequate data explains the absence of studies of this kind in Spain. The availability of the Disabilities, Deficiencies and Health Status Survey (DDHSS from now on) carried out by the Spanish National Bureau of Statistics in 1999, whose results have recently been published, make it possible to conduct such an study. Unfortunately, we only know whether the respondent receives a benefit, thus being not possible to test whether the reason why an individual who deserves a disability benefit does not receive it: is it because he did not apply for it, or because his application was denied? In this sense, we are unable to empirically identify the rejection error.

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[1] For US see, for instance, Bound (1991), Kreider (1991), Benítez-Silva et al. (1999a); Bound et al. (1999) using the Health and Retirement Survey. And for Europe see, Blanchet and Pele (1997), Blundell and Johnson (1997), Brugiavini (1997), Pestieau and Stijns (1997), Borsch-Supan and Schnabel (1997), Palme and Svensson (1997).

It turns out that the fundamental issue is to have a precise and trustworthy measure of what is understood by deserving a disability benefit. The idea that lies behind the concept of disability is not exempt from a high degree of subjectivity. Most studies have used self-reported health and disability measures (Boskin and Hurd, 1978; Gordon and Blinder, 1980; Hanoch and Honig, 1983; Berkovec and Stern, 1991). Others have argued that these indicators are not appropriate for measuring working limitations (Zabalza et al., 1980; Myers, 1982; Parsons, 1982; Chirikos and Nestel, 1984; Bazzoli, 1985; Bound, 1991; Bound et al., 1995; Bound and Burkhauser, 1999). The most common view is that some survey respondents may inflate the incidence and severity of health problems in order to increase the probability of receiving a disability benefit (Burkhauser, 1979; Parsons, 1980 and 1982; Anderson and Burkhauser, 1985; Kerkhofs and Lindeboom, 1995). On the other hand, Nagi (1979), Stern (1989), Dweyer and Mitchell (1998) and Benítez-Silva et al., (1999a) conclude that self-reported measures are good approximations of true disability status. Due to this disparity, we have adopted the definition of what the Social Security understands for permanent disability, and we use this definition as an standard according to which individuals determine their level of disability. We agree that some individuals have incentives to misreport their disability status. They may try to exaggerate health problems when applying for a benefit, although these incentives disappear when answering a survey in which confidentiality is guaranteed. Indeed, in the survey that we are going to use, 48.75% of men and 33.92% of women who receive a disability benefit declare not to suffer any disability.

We measure the acceptation error comparing two variables: the Social Security awarding decision and the deserving indicator designed according to the legal text. The latter variable can be interpreted as the decision that would take the Social Security in case all the information was available[2]. Using information for a set of individuals about whether they receive a disability benefit, and guessing whether they deserve it, we can estimate the joint distribution of the variables *receiving* and *deserving*, from which an acceptation error can be derived. It is convenient to note that the acceptation error is not the same than the error type two. The first refers to the probability of not deserving a benefit conditioned to receiving it, and the second refers to the probability of receiving a benefit conditioned to not being disabled.

[2] We face a situation of asymmetric information with a completely informed principal (the individual) and an agent with incomplete information (the Social Security). The existence of hard-to-diagnose conditions may make it much more difficult for Social Security to tag those unable for work form those that are able bodied because of the imperfect information about the nature of the disability, generating a moral hazard problem.

Our results indicate that individuals aged between 55 and 59, self-employers or working in the agriculture sector have a probability of receiving a benefit without deserving it significantly higher than the rest of individuals. This confirms that disability benefits are being used as an instrument for exiting the labor market for those who do not wish to wait until the early retirement and face the age penalties, or those who do not have right to early retirement because are affiliated to special regime regimes (see Boldrin et al, (1999) for a description of Social Security rules and regimes). We also show that there are significant regional differences in the probability of receiving. Taking into account that awarding process depends on Social Security Provincial Department, this means that some departments are applying loosely the disability requirements for granting disability benefits.

The structure of the paper is the following: in section we design a disability indicator for deserving a disability benefit. In section 3, we present econometric setup for the analysis and describe the data. In section 4, perform several specification diagnostics and in section 5 we present the main estimation results. In section 6 we propose an alternative mechanism for awarding disability benefits. Finally, in section 7 we conclude with some policy implications.

2. Design of the disability indicator

In this section we present our indicator for determining whether an individual deserves a permanent disability benefit. In the Disabilities Questionnaire from the DDHSS, individuals are required to enumerate all disabilities suffered according to a established classification of 36 disabilities[3], indicating also the degree of severity, expected evolution, age when suffering the disability problem, deficiency that caused the disability, origin and duration.

The information about the relationship with economic activity is provided in the Household Questionnaire. However, there are two important limitations: the degree of disability for permanent disability pensioners[4] and the possible denial of an application for disability benefits are unknown. The second limitation prevent us from analyzing the rejection error. Finally, we only know the labor force status and the occupation for disability pensioners when they declare to suffer some disability.

The Spanish legislation applies the professional disability principle to determine who deserves to receive a benefit. This principle takes into account three factors: the set of sequels, ailments and diseases, the occupations affected by limitations and the particular effect on each individual (Barba Mora, 2001). It is not possible to consider the first factor because we do not know the occupation for pensioners without

[3] The concept of disability is "limitation that affects daily living activities for at least one year".

disabilities. As regards to the third factor it is impossible to consider in a model variables such as resistance to pain and personality, which are genuinely unobservable. In order to relieve this disadvantage we are going to restrict the analysis to survey respondents from 45 to 59 years old by gender. This means that we only require elements of pathological character. The determination of the degree needed to establish permanent disability would require very deep medical knowledge. Since we do not rely on this information, we will only look at the external symptoms of the deficiencies, i.e., we focus on disabilities. For each disability we are going to fix a threshold of severity, forecast and origin and we will consider that an individual deserves a disability benefit when satisfying these requirements.

We like to be as exhaustive as possible, so we design six different criteria for deserving a disability benefit. The definition of the various criteria used are described in Table 1. We distinguish aspects of the variable severity, evolution, or origin of the each deficiency. Each criteria is represented by a binary indicator that takes the value one it the individual satisfies the criteria and value zero otherwise. Afterwards we choose the best criteria for estimation of the model using exogeneity and consistency tests for each of the variables. We assume that individuals who haven't answered the Disabilities and Deficiencies Questionnaires don't suffer any kind of health problem, so all criteria take the value zero.

Table 1. Classification of criterions for deserving a disability benefit

	Criterion 1	**Criterion 2**	**Criterion 3**	**Criterion. 4**
Severity	Can present one of the following degrees: • Serious difficulty • Cannot do the activity	Same requirement of severity that criterion 1.	Same requirement of severity that criterion 1.	Same requirement of severity that criterion 1.
Forecast	Can present one of the following degrees: • Stable, with perspectives of improvement • Can go worse • It's not possible to determine	Can present one of the following degrees: • Recoverable with restrictions • Stable, with perspectives of improvement • Can go worse • It's not possible to determine	Same requirement of forecast than criterion 1.	Same requirement of forecast than criterion 2.
Origin	All except congenital and problems in the childbirth	All except congenital and problems in the childbirth	All	All
Objective	We consider disabilities with a high degree of severity and unfavorable forecast			

	Criterion 5	**Criterion 6**
Severity	Can present one of the following degrees: • Moderate difficulty • Serious difficulty • Cannot do the activity	Same requirement of severity than criterion 5.
Forecast	Same requirement of forecast than criterion 1 and when severity is moderate we consider that forecast may be: • Can go worse • It's not possible to determine	Same requirement of forecast than criterion 2, and when severity is moderate we consider that forecast may be: • Can go worse • It's not possible to determine.
Origin	All except congenital and problems in the childbirth	All
Objective	We include degenerative diseases (Parkinson, Alzheimer)	

[4] The Spanish system distinguishes between great disability, absolute permanent disability, total permanent disability for usual profession and partial permanent disability for usual job.

3. Econometric model

We can represent Social Security's rule for awarding a permanent disability benefit as:

$$r^* = X' b_r + e_r \tag{1}$$

where X is a vector of characteristics observed by the Social Security administration, b_r is the vector of weights attributed to each one of these characteristics. The term e_r can be interpreted as some kind of information known by the applicant, but unknown by the Social Security. This term can be interpreted as a "bureaucratic" noise that interferes the assignment process. So Xb_r+e_r is the score the applicant gets according to Social Security rules using a continuous scale. Applicants with a high score will receive a disability benefit. The variable r^* is a latent unobservable variable that we can represent using a binary indicator:

$$r = \begin{cases} 1 \ if \quad r^* \geq 0 \\ 0 \ if \quad r^* < 0 \end{cases} \tag{2}$$

To represent if the applicant deserves a permanent disability measure we use a similar equation:

$$d^* = Z' b_d + e_d \tag{3}$$

where Z is a set of variables that try to measure health status and β_d is the correspondent vector of coefficients or "weights". The term e_d gathers some information that is only known by the applicant. As before, the value assigned to the deserving indicator d^* is a latent unobservable variable that we can represent using a binary indicator:

$$d = \begin{cases} 1 \ if \quad d^* \geq 0 \\ 0 \ if \quad d^* < 0 \end{cases} \tag{4}$$

We suppose (e_r,e_d) that are distributed as a bivariate normal with zero mean vector, variances normalized to one an correlation coefficient $r \hat{I} (-1,1)$. We could, a priori, think that the set of variables X and Z have to be the same. This is true for variables related to disabilities and deficiencies, but there are some variables that can affect the probability of receiving although not the probability of deserving. We specially refer to the place of residence because it does not affect heath status but given that the assignment process depends on Social Security Provincial Departments, some differences in the level of exigency of disability requirements can emerge. As there are only four combinations for the variables r and d, the likelihood function can be written in terms of a multinomial distribution:

$$
\begin{aligned}
p_{11} &= L(r=1, d=1 \mid b_r, b_d, r, X, Z) \\
p_{10} &= L(r=1, d=0 \mid b_r, b_d, r, X, Z) \\
p_{01} &= L(r=0, d=1 \mid b_r, b_d, r, X, Z) \\
p_{00} &= L(r=0, d=0 \mid b_r, b_d, r, X, Z) \\
L(r, d \mid b_r, b_d, r, X, Z) &= \prod_{\substack{r=1 \\ d=1}} p_{11} \prod_{\substack{r=1 \\ d=0}} p_{10} \prod_{\substack{r=0 \\ d=1}} p_{01} \prod_{\substack{r=0 \\ d=0}} p_{00}
\end{aligned} \tag{5}
$$

3.1 Description of the data

As stated, our main data source is the Disabilities, Deficiencies and Health Status Survey (DDHSS) carried out by the Spanish National Bureau of Statistics in 1999. A sample of 70.402 households and 218,185 people were interviewed, from which 10,484 were less than 6 years old and 207,701 were 6 or more years. We apply several filters to the initial sample in order to get the relevant samples for the purposes of our study:

- Initial sample (sample A): We eliminate individuals below 45 and above 59. We concentrate in the range of observation in which disability benefits constitute a pathway to (definitive) exit or retirement from the labor force. The surviving sample has 19442 males and 20489 females.
- Restricted initial sample (sample B): To the initial sample we apply the following restrictions. We eliminate individuals without a contributive career and individuals that are working but whose professional situation is unknown. This leaves a sample of 18235 males and 8142 females. In these samples there are individuals with and without disabilities and we are going to use them for exogeneity and consistency tests[5].
- Sample with disabilities (sample B1). From sample B, we drop all individuals that do not answer the Disabilities Questionnaire. We eliminate 24,441 individuals and the sample left is 1,255 men and 681 women. From the sample of individuals who receive a permanent disability benefit and answer the Disabilities Questionnaire we eliminate 145 observations for which we do not know the occupation and 255 observations for which we do not know relation with economic activity before receiving the benefit. In this sample, we define a binary variable that takes the value one if the individual is receiving a contributive permanent disability benefit. This may not be the only relation with economic activity. For example, 6.43% of men and 2.02% of women are also working and 2.66% of men and 0.81% of women are looking for a job. That left a sample of 984 men and 552 women. We will perform the rational expectations test with this final sample.

[5] Those individuals who do not suffer any disability do not answer to the Disabilities and Deficiencies Questionnaire. We do not know if they have an impairment certificate, need a caretaker, have finished a rehabilitation treatment or have changed of house

- Sample without disabilities (sample B0): Those observations that are not assigned to sample B1, excluding the excluded ones, are assigned to sample B0.

In Table 2 we summarize both the characteristics of the samples used throughout the paper.

Table 2. Description of the samples

Sample	Characteristics	Gender: Size	Purposes
A	Individuals aged 45-59	Men: 19442 Women: 20489	Screening mechanism
B	+some requirements on economic activity	Men: 18235 Women: 8142	Exogeneity and consistency test Bivariate probit
B1	Ind. with disabilities + requirements on labor force status	Men: 984 Women: 552	Rational expectations test Bivariate probit
B0	Ind. without disabilities+ requirements on labor force status	Men: 16980 Women: 7461	Prob. of receiving being healthy

4. Diagnostics on the disability indicators

4.1 Exogeneity test

Before estimating the model and using the results with policy purposes, we would like to be sure that the deserving indicator is strictly exogenous. In other case, all the estimators would be inconsistent. We use Heckman's (1978) proposal using a two equation system to make such a test. The first structural equation represents the Social Security award decision and the second one indicates whether the individual deserves a disability benefit:

$$\begin{aligned} r_i &= W_{1i}\,b_1 + d_i a_1 + u_{1i} \\ d_i &= W_{2i}\,b_2 + u_{2i} \end{aligned} \qquad (6)$$

where r and d are two latent continuous variables, X is a vector of exogenous variables referred to disabilities and deficiencies, and we are going to use different explanatory variables for both equations. Then, excluded variables in one equation serve as identification restrictions. We assume that (u_1,u_2) are distributed according to a bivariate normal distribution with zero mean vector, variances normalized to one and correlation coefficient $r \hat{I}(-1,1)$. In first instance, we estimate the parameters using a bivariate probit using the restricted initial sample (sample B). The exogeneity of the deserving equation can be checked, after estimated through the test $r=0$.

Another possibility to test exogeneity of the deserving indicator is the Lagrange multiplier test. Under the null of exogeneity, the model is composed by two independent probit equations and bivariate probabilities and densities coincide with the product of the corresponding marginal ones. To build the test we follow Kiefer (1982) and Greene (1993). First, we denote $g_{1i}=2r_i-1$ and $g_{2i}=2d_i-1$. In this way, we have captured all the necessary changes of sign to calculate the probabilities that r or d be equal to zero or one,

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because of a disability. But we suppose that the answer to all these questions is negative because in other case they would have filled in the questionnaire.

because $g_{ji}=1$ if $r_i=1$ or $d_i=1$ and $g_{ji}=-1$ if $r_i=0$ or $d_i=0$, for $j=1,2$. We denote $\delta_{1i}=\gamma_{1i}\beta_1'X_{1i}$ and $\delta_{2i}=\gamma_{2i}\beta_2'X_{2i}$. Then the likelihood function is the following,

$$L^* = \ln L = \sum_{i=1}^{n} \ln \Phi_2(d_{1i}, d_{2i}, r^*) \tag{7}$$

where $r^*=g_{1i}g_{2i}r$. The LM or score test is a quadratic form which uses the first derivatives of the unrestricted likelihood function whose weighting matrix is the inverse of the information matrix for the unrestricted likelihood function when both equation are evaluated under the null. The statistic is distributed according to χ^2 with one degree of freedom.

$$LM = \left(\frac{\partial L^*}{\partial q'}\right)' \left(\frac{\partial^2 L^*}{\partial q \partial q'}\right) \left(\frac{\partial L^*}{\partial q'}\right); \quad q = (b, r) \tag{8}$$

$$LM = \frac{\left[\sum_i g_{1i} g_{2i} \frac{f(d_{1i}) f(d_{2i})}{\Phi(d_{1i})\Phi(d_{2i})}\right]^2}{\sum_i \frac{[f(d_{1i}) f(d_{2i})]^2}{\Phi(d_{1i})\Phi(-d_{1i})\Phi(d_{2i})\Phi(-d_{2i})}} \tag{9}$$

Table 3 reports the exogeneity test by gender for the set of criteria defined. We cannot reject the null of exogeneity for indicators 3 to 6 in the case of men and for any criteria in the case of women, at standard significance levels.

Table 3. Exogeneity test. Restricted initial (Sample B)

	Men [N=18235]		Women [N=8142]	
	Statistic	p-value	Statistic	p-value
Criterion 1	6.6919	0.0071	2.5732	0.2698
Criterion 2	5.2417	0.0299	1.6519	0.4846
Criterion 3	2.4496	0.2936	1.2539	0.6020
Criterion 4	1.1703	0.6282	0.6004	0.8136
Criterion 5	0.9991	0.6829	0.0085	0.9976
Criterion 6	0.0172	0.9951	0.0032	0.9990

4.2 Consistency test

The second diagnosis refers to consistency. We want to test whether the deserving indicator based on self-reported disability status is an unbiased estimator of the permanent disability award indicator.

$$E[r - d \mid X] = 0 \tag{10}$$

where X is a vector that includes dummy variables for 36 disabilities and 27 deficiencies. Unbiasedness can be tested through different ways. First, we can regress by LS, *(r-d)* on a set of explanatory variables and test the hypothesis that all coefficients are equal to zero. Second, using a multinomial logit model we can regress *(r-d)* over the same set of explanatory variables and test the same hypothesis using a

likelihood ratio test against a restricted model which only includes a constant. Finally, we can perform a likelihood ratio test using the results of a probit model of $|r-d|$ on a set of variables against a restricted probit model which only includes a constant term. In all cases we use the restricted initial sample or sample B.

In all regressions we have included dummies for 36 disabilities and 27 deficiencies. We have only carried consistency test for criterions 3 to 6 because criterions 1 and 2 did not satisfy exogeneity. The results of the test are reported in Table 4. For men, only criterion 6 satisfies all consistency tests, and for women both criteria 5 and 6 are valid under the results of these diagnostics. Therefore, in what follows we use criterion 6 both for men and women.

Table 4. Consistency test. Restricted initial sample (Sample B)

	Men [N=18235]				Women [N=8142]			
	Criterion 3		Criterion 4		Criterion 3		Criterion 4	
	Statistic	pvalue	Statistic	pvalue	Statistic	pvalue	Statistic	pvalue
OLS	F(63,18171)=1.76	0.0002	F(63,18171)=1.76	0.0002	F(63,18171)=1.47	0.0097	F(63,18171)=1.57	0.0028
Probit	$\chi^2(63)$=86.81	0.0251	$\chi^2(63)$=89.20	0.0166	$\chi^2(63)$=93.55	0.0075	$\chi^2(63)$=92.06	0.0099
MLogit	$\chi^2(63)$=93.20	0.0080	$\chi^2(63)$=95.55	0.0051	$\chi^2(63)$=99.72	0.0022	$\chi^2(63)$=98.55	0.0028
	Criterion 5		Criterion 6		Criterion 5		Criterion 6	
	Statistic	pvalue	Statistic	value	Statistic	pvalue	Statistic	pvalue
OLS	F(63,18171)=1.36	0.0313	F(63,18171)=1.01	0.4525	F(63,18171)=1.27	0.0736	F(63,18171)=1.15	0.1920
Probit	$\chi^2(63)$=96.66	0.0041	$\chi^2(63)$=73.40	0.1740	$\chi^2(63)$=51.22	0.8560	$\chi^2(63)$=52.97	0.8122
MLogit	$\chi^2(63)$=104.47	0.0008	$\chi^2(63)$=81.44	0.0590	$\chi^2(63)$=52.97	0.8122	$\chi^2(63)$=63.12	0.4720

4.3 Rational expectations test

The results of the previous sections suggest that the deserving indicator based on self-reported disability status is an exogenous determinant and consistent estimator of the Social Security award decision. However, the tests presented above are based on asymptotic properties of the relevant test statistics, but in small samples they might have little power. Our key hypothesis is that applicants have a through understanding of the award process, including full knowledge of the weights b_r that Social Security places on various characteristics X, so the null hypothesis that we want to test is: $b_r=b_d$.

If the rational expectations hypothesis holds, then the deserving indicator constitutes a valid measure of the degree of disability required for receiving a disability benefit, and it can be used to measure the magnitude of the classification errors in the permanent disability benefits award process.

Table 5 provides the results for the sample of men and women that have declared to suffer some disability (sample B1). We have estimated a bivariate probit model in which we have included as explanatory variables 27 deficiencies and 36 disabilities for the Social Security and for the applicant's equation. For both samples we cannot reject, at standard significance levels, the null hypothesis that the parameter vectors are equal.

Table 5. Rational expectations test. Restricted initial sample (Sample B).

	Test $\beta_r=\beta_d$	p-value
Men [N=984]	$\chi^2(48)=48.10$	0.4689
Women [N=552]	$\chi^2(48)=54.98$	0.1981

In Figures 1 to 4 we plot the estimated density functions for the awarding and deserving decisions based on our preferred self-reported disability indicator. To comp lete the picture we present in Table 6 the main statistics of the estimated density functions. Note that deserving' density function is slightly more skewed to the right than the corresponding to Social Security. This means that there are more individuals who consider themselves as disabled with respect to what Social Security thinks about them. For women this result is even more evident. If we place the estimated density function for Securidad Social over that of the individuals, we only find one density function. It could not have happened like that, since we might have obtained density functions with similar means and modes, but that were totally distinguishable for having very different variances. This is an implication of the rational expectations test, because it shows that individuals have internalized the rules that Social Security uses in the process of awarding benefits.

Figures 1 to 4. Estimated density functions

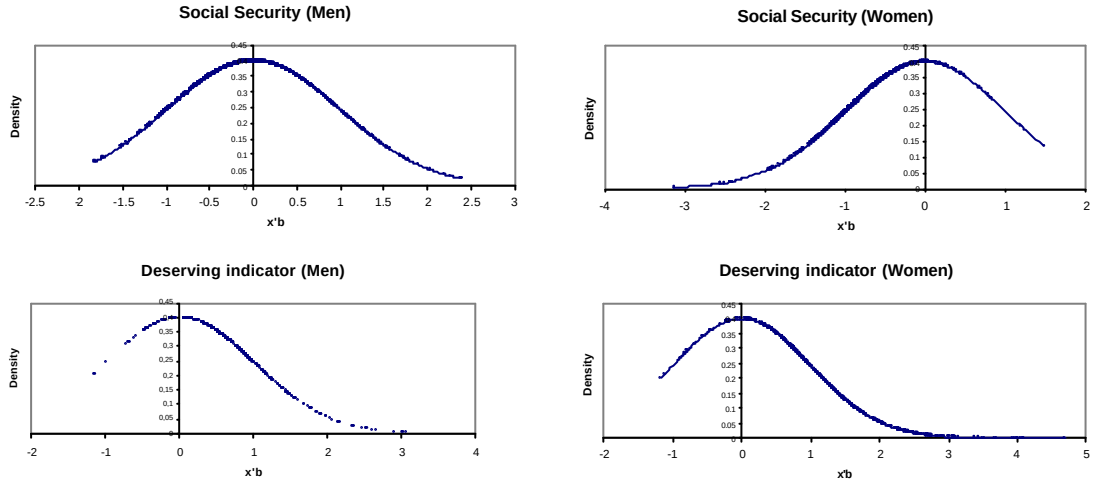


Table 6. Statistics on the estimated density function

	Men [N=984]		Women [N=552]	
	S. Security	Individuals	S. Security	Individuals
Mean	-0.2671	0.4206	-0.8186	1.0862
Median	-0.3196	0.3195	-0.8192	0.9255
St. Deviation	0.7130	0.6044	0.5623	0.9317
Maximum	2.3946	3.0452	1.4789	4.6874
Minimum	-1.8173	-1.5510	-3.3142	-1.1755
IQ Range	1.1120	0.7957	0.6462	1.1752

5. Empirical results

5.1 A first look at the data

The analysis of descriptive data gives very interesting result. First, from the sample of 984 men and 552 women, 20.05% of men and 13.99% of women who receive a benefit do not deserve it using our preferred criteria #6. So, the acceptation error is much larger for men than for women.

There are several disabilities that are not present among individuals who receive but do not deserve the benefit (disability for global visual tasks, for hearing any sound, for communicating through alternative languages, not sealed gestures or reading-writing, for remembering people/objects or informations/past episodes and for executing simple or complex orders are examples)[6]. Among women, in the acceptation error area, there is nobody with disabilities for hearing strong sounds, listening the speech, maintaining body postures, washing oneself, controlling physical needs, eating and drinking, dressing and undressing. On the other hand, individuals who receive but do not deserve usually declare to suffer osteoarticular or musculoskeletal deficiencies in column and upper and low extremities, and disabilities for moving not heavy objects and using utensils and tools. Undoubtedly, these deficiencies are painful, but is hard to check how strong they are (Pérez Rueda et al., 2000). Moreover, none of these individuals needs a caretaker for daily activities. As regards those individuals who receive and deserve, the most common disabilities are for getting up and down, moving not heavy objects, moving without way of transport, going in public transport or driving own vehicle.

A look at socioeconomic characteristics (Table B.2) reveals that there are more married men pensioners than women, and 90% of men who do not deserve are heads of the household. Approximately half of pensioners that deserve are between 55 and 59 years old and around 30% of those who do not deserve belong to this age interval. Most of male pensioners only have elementary education and previously were skilled workers. Most pensioners only have elementary education, but while most men were skilled workers, women only developed unskilled tasks.. In Table B.3 we report the spouse's labor force status for married/cohabiting individuals in sample. If he/she is married but is not a pensioner, the probability of the spouse working is higher than if he/she is a pensioner and deserves, and twice larger than if he/she is pensioner and does not deserve. In all cases, the probability of husband working is twice the probability of wife working. It is very interesting to realize that if he/she is a pensioner and does not deserve the probability that the spouse receives a permanent disability benefit is five times than if he/she is not a pensioner. This result is more evident for the case of husbands (37.5% with respect to 9.06%).

Finally, when the husband is a pensioner there is a higher percentage of houseworker wives. Alternatively, when the wife is the pensioner the husband is more likely to be in any other situation.

5.2 Estimation results and forecasts

In this section we present the results of the empirical analysis by gender for three different subsamples: (1) individuals with disabilities (sample B1); (2) individuals with and without disabilities (sample B); and (3) individuals without disabilities (sample B0).

5.2.1 Individual with disabilities

We have estimated a probit model for the decisions of deserving and receiving a permanent disability benefit (see Table C.1) restricting the sample to individuals with disabilities. We assume that deserving precedes in time to receiving. In order to calculate the marginal effect of each determinant we have included the same set of explanatory variables in both equations.

Having a disability or deficiency has a positive and significant impact on both equations. We find some additional variables with significative impact on the probabilities: age between 55 and 59, change of house because of a disability, impairment certificate, caretaker, rehabilitation treatment, level of education, active, unemployed and professional occupation. However, the married and head of household dummies, variables related to the economic activity of the spouse, and the place of residence are not significant in the receiving equation. The latter results should not cause any surprise since these variables are supposed not to affect the health status. But interestingly, all these determinants have significant effects in the receiving equation, for both men and women. In terms of regional dummies, living in Murcia seems to guarantee the highest probability of receiving a disability benefit[7]. Andalucia and Extremadura, for men, and only Andalucia, for women, are also significant although their coefficients are slightly smaller than those from Murcia.

In order to evaluate the marginal effects we use the following baseline: men/women less than 55 years old, not married, college education, white collar occupation, living in Murcia, with only moderate severity disabilities, without impairment certificate, who has not received treatment of rehabilitation nor changed of residence because of a disability and does not need caretaker[8]. The baseline probabilities of deserving are 0.324 for men and 0.211 for women. We could think that these probabilities are too high given that individual only suffers disabilities of moderate severity. But we have to take into account that although we have tried to consider the maximum number of daily living activities when elaborating the

[6] See Appendix B.1. Data about deficiencies are available upon request.
[7] In the estimation of the bivariate probit model (Table C.1) we excluded the dummy variable corresponding to "living in Murcia".

self-reported disability indicators, there are several unobserved factors such as pain or personality that cannot be controlled for (Pérez Rueda et al., 2000). The baseline probabilities of receiving are 0.439 for men and 0.295 for women. That is, they are 40.31% and 40.29% higher than the corresponding deserving probabilities. Moreover, men have a probability of deserving and receiving higher than women (53.68% and 47.61%, respectively), but differences between deserving and receiving are about the same regardless the gender.

Disabilities, deficiencies and health variables: For men, the probability of deserving is smaller than the probability of receiving for deficiencies in upper an lower extremities (152.61%), houseworking (96.89%) and communicating (53.21%). As regards women, the same happens for executing orders (165.81%), moving inside home (61.09%) and maintaining body postures (60.02%). Disabilities for moving inside home, houseworking and maintaining body postures are related to deficiencies in the vertebral column and upper and lower extremities. In most cases they have an osteoarticular origin (arthritis, rheumatism, curvature of the spine, disc hernia) and this make diagnosis quite difficult because the aptitude for bearing pain is neither measurable not unobservable.

Age between 55 and 59 is another important determinant of both probabilities. The probability of deserving increases 8.28% and 30.64% for men and women, respectively. Interestingly, the probability of receiving is higher than the probability of deserving (45.02% for men and 24.69% for women). Without any doubt, these results demonstrate that disability pensions have been used as an alternative pathway to early retirement (Boldrin et al. (1999) mentioned this use but they only show indirect evidence).

Needing a caretaker for daily living activities increases the deserving probability in 92.46% for men and 40.73% for women. This variable is quite trustworthy because an individual who needs somebody to take care of him obviously deserves and should receive a disability benefit. Whether an individual has changed of house because of a disability, increases the receiving probability 53.03% for men and 66.73% for women. If he/she has an impairment certificate, these probalities raise 59.84% for men and 77.17% for women. It is important to underline that for the case of men with an impairment certificate, the probability of receiving is nearly twice the deserving one. This implies that the impairment certificate, which gives some fiscal advantages, is being used for policy purposes.

[8] Marginal effects for men are reported in Table C.2, and table of marginal effects for women are available on request..

Socioeconomic variables: Being unemployed increases the probability of deserving by 52.49% for men and 31.88% for women[9]. Unemployed individuals may be less prone to apply for disability benefits because the amount of the benefit would be proportional to the regulatory base, which is lower in unemployment than in activity[10].

Clearly marital status and head of the household are additional policy variables for benefit concession. While marital status is not significant in the deserving equation, being married increases the receiving probability 8.65% for men and 1.66% for women. Moreover, if the individual is the head of the household, the receiving probabilities increase 7.53% for men and 18.86% for women. Concerning variables related to the economic activity of the spouse[11] if the individual is a pensioner the probability that the spouse is working decreases 10.65% for men and 28.87% for women. On the other hand, there is a positive correlation for the case of both spouses being disability pensioners. If one spouse receives a disability benefit, the probability that the other also receives benefits increases by 22.47% for men and 35.46% for women. This evidences some scale economies in benefit claim (when one of the spouses is a pensioner, he/she knows the awarding mechanism and it is easier for the other spouse to apply for it) and/or complementarities in leisure.

The receiving probability achieves its maximum when the individual has elementary education and an unskilled job, and it decreases as the level of education and/or the quality of occupation increases. For both gender, the probability of receiving increases more with the educational level than with the occupation. Moreover, it seems to have a relationship with the manual character of the jobs[12]. Table 7 reports a cross-tabulation of occupation with the estimated percentage of individuals with disabilities for using hands and fingers. This kind of disabilities are concentrated in unskilled workers, specially for women.

Table 7. Manual disabilities and professional occupation (Sample B1)

	Men [N=984]			Women [N=552]		
	White collar	Skilled	Not skilled	White collar	Skilled	Not skilled
Moving not heavy objects	16.32	34.21	49.47	14.81	17.28	67.90
Using tools	11.39	33.66	54.95	13.51	14.86	71.62
Manipulating small objects	14.60	32.12	53.28	15.32	12.61	72.07

[9] The binary variable "unemployed" takes the value one in two events. First, if at the time of the survey the individual is unemployed. Second, if the individual is receiving a permanent disability benefit but relation with economic activity before becoming pensioner was unemployed.

[10] If unemployment were the consequence rather than the cause of poor health status, we would face an endogeneity problem. To check what is the reason of joblesness we have used one of the questions of the DDHSS: "Have you change your relation with economic activity due to disability?". Only 10% of unemployed answered "yes".

[11] Several studies, for example Peracchi and Welch (1994), Blau and Riphahn (1999) or Jiménez et al. (1999) have observed that the spouse's labor force status affects retirement behavior of the other member of the couple. In this paper we have proxied the spouse's labor status using two dummy variables indicating whether he/she is working or receiving a permanent disability benefit.

5.2.2 Individuals with and without disabilities

We have estimated a bivariate probit model pooling the sample of individuals with and without disabilities (18235 men and 8142 women, sample B)[13]. In the deserving equation we have included the following dummy variables: marital status, age between 55 and 59, head of household, professional situation and occupation, activity sector and level of education. We have not included regional dummies because they do not contribute to the likelihood of deserving, as we have tested in the previous models. In the award equation we have included dummies for being married, household sustainer, age between 55 and 59, region and educational level. We do not include variables referred to activity sector and occupation in the award equation because of the lack of information about the sector for those individuals who receive a disability benefit but which are not working at the same time. We only know the occupation before receiving benefits for those who have answered the Disabilities Questionnaire. Moreover, we have not included any of the 36 disabilities because in this sample most individuals did not fill in the Disabilities Questionnaire, so we assume that they have a healthy status (94.60% of men and 93.22% of women). Anyway, we control health status by a dummy variable "being healthy" that takes the value one when the individual declares not to suffer any disability.

Socioeconomic variables: Table 8 provides information about the probability of receiving benefits for individuals without disabilities (i.e., individuals for whom the "being healthy" indicator is equal to one) depending on their occupation and activity sector [14]. Agriculture is the activity which shows the highest probability of receiving being healthy regardless the occupation. The ranking of probabilities is completed, respectively, by construction, industry and services. It seems very surprising that the probability in agriculture is even higher than in construction, which has a higher professional hazard. The explanation is that for agriculture workers the compulsory retiring age is 65. Perhaps, the acceptation error could be reduced if early retirement was allowed. The difference in the probability of receiving between agriculture and services is around 25%, regardless the occupation. For a given sector, the probability of receiving decreases as the qualification increases. For women, we have joined industry with construction in order to compute the probabilities because the sample is very small in both sectors of

[12] For example: assembly lines, seamstresses in court and confection workshops, workmen of toys factories, replacers of supermarkets. In all these occupations, there are many unskilled workers that become unable for doing their jobs if they suffer any kind of manual disability.
[13] Estimations are available upon request.
[14] We have related activity sector with the occupation because we think that working tasks have more to do with occupation than with the level of education. Moreover, occupation determines not only the wage but also personal satisfaction and an individual is going to take into account these two variables when applying for a disability benefit.

activity. The probabilities of receiving corresponding to women are half of those for men for any professional occupation and activity sector.

Table 8. Probability of receiving being healthy depending on professional occupation and activity sector (Sample B)

	Men			Women		
	White collar	Skilled	Not skilled	White collar	Skilled	Not skilled
Agriculture	0.1424	0.1776	0.2007	0.0719	0.1098	0.1161
Industry	0.1064	0.1553	0.1708	0.0666	0.0924	0.1067
Construction	0.1209	0.1736	0.1887			
Services	0.1189	0.1535	0.1709	0.0569	0.0869	0.0959

Table 9 shows the probability of receiving conditional on being healthy by schooling level and professional situation. For men, the self-employed have the highest probability of receiving being healthy. This results confirm that the absence of early retirement for the self-employed increases the probability of applying for a disability benefit, even when healthy. Working in the private or public sector does not cause any differences in the probability of receiving. For women, there are no significant differences in neither case. Finally, the probability of receiving decreases with the level of education.

Table 9. Manual disabilities and professional occupation (Sample B)

	Men			Women		
	College	High School	Elementary	College	High School	Elementary
Self-employed	0.1003	0.1406	0.2045	0.0454	0.0636	0.0942
Public Sector	0.0687	0.1183	0.1715	0.0453	0.0634	0.0939
Private Sector	0.0705	0.1207	0.1749	0.0455	0.0637	0.0943

5.2.3 Individuals without disabilities

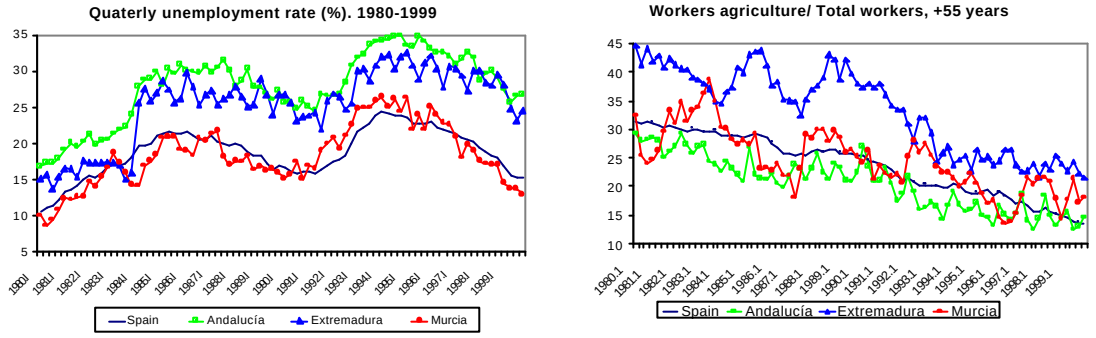
We have conducted a final test of the awarding process in the subsample which only contains individuals without disabilities (sample B0). Our purpose is to study the probability of receiving a benefit conditioned on being healthy[15]. The set of explanatory variables includes controls for education, professional occupation, place of residence, marital status, head of household and age between 55 and 59. We are not able to capture differences related to the activity sector or professional situation since they are not available for non-working pensioners. Once we have estimated the model, we compute the marginal effects with respect to a baseline corresponding to an individual of less than 55 years, not married, not being head of the household, with high school education, skilled job and living in Murcia (Table C.3).

If the individual is aged between 55 and 59 years old the probability of receiving a benefit being healthy increases with respect to the baseline 117.69% for men and 166.66% for women. This confirms that the regulator allows healthy individuals to get (disability) benefits without any penalties before the early retirement age. We also detect in this case significant regional differences in the probability of receiving benefits. Like in the previous section Murcia, Andalucia and Extremadura have the highest

[15] Estimations are available upon request.

probabilities. This may be because of in these regions the unemployment rate is greater (and the income level is lower) than the national average and the authorities are using disability benefits as a way of artificially decreasing the unemployment rate (and of increasing per capita income). When looking at the quarterly unemployment rate for the period 1980-1999 (see Figure 5) we observe that this is true for Andalucia and Extremadura, but not for the case Murcia, which fluctuates around the national mean. Alternatively, we have represented in Figure 6 the working population in agriculture with respect to total number of workers for individuals older than 55 years[16]. Figures for Andalucia and Extremadura fluctuate below and over the (decreasing) national mean, respectively. But the trend for Murcia is completely different and fluctuates without pattern around the mean. Perhaps this unexpected behavior is the explanation for the large figures of disability pensioners in Murcia during the eighties.

Figures 5 and 6. Trends in unemployment rate and working population in agriculture for Andalucia, Extremadura, Murcia and Spain.



Source: Active Population Survey, INE.

In Table 10 we report the probability of receiving a pension when the individual has declared not to have any disability for every combination of education and occupation. The highest probability occurs when the individual is an unskilled worker, which happens for 21.95% of men and 31.82% of women[17]. The probabilities for women are smaller than for men, although differences between both gender become smaller as the professional qualification decreases. As level of studies increases or occupation decreases, the probability of receiving a disability benefit without deserving it raises. The maximum probability occurs for an individual with college education and having an unskilled job (0.92% of men and 1.59% of women). This may be explained because these individuals are not having a correct match in the labor market, so they try to exit from the labor market through permanent disability.

Table 10. Probability of receiving being healthy depending on level of studies and professional occupation (Sample B0)

	Men			Women		
	White collar	Skilled	Not skilled	White collar	Skilled	Not skilled
College	0.0107	0.0137	0.4063	0.0011	0.0038	0.1771

[16] As we only look at workers older than 55 years old, we do not observe seasonal variations because these individuals are not usually temporary workers. We have represented only until 1999 to avoid distortions with the figures of immigrants.
[17] There are some empty cells because there are not any individual without studies and being white collar or skilled worker, or with elementary education and being white collar.

High School	0.0101	0.0130	0.3989	0.0010	0.0036	0.1735
Elementary		0.0123	0.3906		0.0036	0.1685
None			0.3829			0.1705

6. An alternative mechanism for awarding disability benefits

In this section we propose a simple screening mechanism alternative to the Social Security awarding process[18] We evaluate the relative efficiency, evaluated by the acceptation error, committed by both methods of classification. The best mechanism will be the one providing the minimum number of undeserved disability benefits.

If Social Security were to know the true disability status of the applicants, d^*, could use this information in the process of awarding benefits. We have mentioned that some individuals have incentives to misreport to Social Security, but these incentives disappear when they are answering a private and confidential survey. Under the hypothesis of rational expectations, we can regress our preferred deserving indicator (based on self-reported measures) on a set of explanatory variables X.[19] After estimation, we compute the probability of deserving conditional on X, $\hat{P}(d \mid X)$. Then, we award (A) a benefit to those individuals having a probability of deserving above a given threshold, $a \hat{I} [0,1]$:

$$A = I\{P(d \mid X) \geq a\} \tag{11}$$

Adjusting the level of a we obtain different percentages of benefits, the bigger a the smaller the number of disability benefits. Consider that the Social Security administration objective is to achieve a given fraction of disability pensions, say p. Then a would be given by the minimum of the following expression:

$$\underset{a}{Min}\ p = \int I\{P(d \mid X) \geq a\} f(X) dX \tag{12}$$

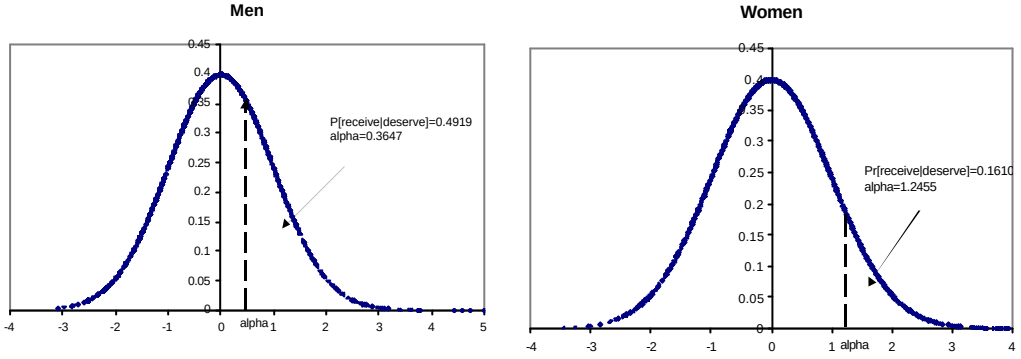
We can compute the sample analog of expression (11) and obtain the optimal value of a, say $\hat{a}$, for which the percentage of individuals which receive benefits is equal to the Social security objective, p. Figures 7 and 8, for men and women respectively, show the corresponding estimated (by using a probit) density functions. We indicate with a discontinuous line the index r that makes the right tail equal to the

[18] See Benítez Silva et al. (1999b) for an alternative screening mechanism.

[19] In the probit model the dependent variable is the preferred criterion # 6. The set of explanatory variables includes: rehabilitation treatment, caretaker, impairment certificate, change of house because of a disability and the 36 disabilities mentioned in Appendix B.1. With respect to disabilities we have defined a dummy variable that takes the value one if disability is suffered with moderate or higher severity and with a forecast different from recoverable. The size of the sample is bigger than in the bivariate probit model because we do not need to drop observations for which some economic variables are unknown. That's why we can estimate all disabilities separately. The results of the estimation procedure are available on request.

probability of receiving a disability benefit conditioned to deserving it[20]. This probability is 0.4919 for men and 0.1610 for women, and the corresponding indexes are 0.3647 for men and 1.2455 for women, with a standard deviation equal to 0.0016 and 1.2455, respectively.

Figures 7 and 8. Estimated probabilities of deserving (Sample A)



We award a disability benefit to those individuals with a value of $\hat{P}(d \mid X)$ greater than $\hat{\alpha}$. Then we compare the efficiency between the Social Security and the screening mechanism. Our mechanism will be better than Social Security if satisfies three requirements. First, reduces the number of individuals that receive with Social Security but don't deserve. Second, includes all individuals that are receiving according to Social Security and deserve. And third, doesn't award benefits to new individuals who don't deserve it.

Table 11 presents some summary measures obtained from the analysis. First, we observe that all individuals who receive and deserve benefits with Social Security also receive with this alternative mechanism. Second, the number of individuals who receive but do not deserve decrease from 63.46% to 7.38% for men and from 49.18% to 9.84% for women. Third, this mechanism does not assign benefits to any individual who does not deserve benefits. Finally there are 2.77% of men and 4.33% of women who deserve but do not receive according to Social Security. If we have known whether these individuals have applied for a benefit in some moment we could determine whether they belong to the rejection error. But in some circumstances, although the applicant presents a degree of disability that justifies a permanent disability benefit, he may not satisfy the economic requirements of number of years working and quotations to Social Security. Finally, we have reduced the number of benefits by 58.89% for men and 49.18% for women.

[20]We could have used the rate of award (nº of applications/nº of awards), but with the information from the survey we only know if the individual receives a benefit but not if he has applied for and it has been denied. The economic interpretation for using the

Table 11. Comparison between Social Security and screening mechanism

	Men	Women
Social Security		
* Total	1333	429
* Receive and deserve	487(36.53%)	218(50.82%)
* Receive but not deserve	846(63.47%)	211(49.18%)
Screening mechanism		
* Total	542	254
* Receive now, with SS and deserve	487(89.85%)	218(85.83%)
* Receive now, with SS and not deserve	40(7.38%)	25(9.84%)
* Receive now, not with SS and deserve	15(2.77%)	11(4.33%)
* Receive now, not with SS and not deserve	0	0

It is not strange that we have obtained better results in the benefits awarding with our screening mechanism. It is simply a consequence of the use of confidential self-reported disability information. We do not propose the disappearance of the whole bureaucracy of the Social Security, just because individuals could be tempted to misreport disabilities when answering the survey with the purpose of increasing the probability of deserving. In order to avoid these problems, we suggest several control measures over the applicant and the disability referees. For example, a medical team should visit the home and the working place of the applicant and study the way of displacement between both. Also random audits should be performed on medical judgements, conditioning examiner's wage earnings to the coincidence between his verdict and that of the auditor.

7. Conclusions

In this paper we partially audit the permanent disability awarding process in Spain. First, we have designed a deserving indicator using self-reported disability measures from the DDHSS survey. Then, we have estimated a latent variable bivariate econometric model for the decisions of receiving and deserving for those individuals who have developed contributive careers.

The main conclusion is that individuals aged between 55 and 59, the self-employed or workers in the agricultural sector have a probability of receiving a benefit without deserving it significantly higher than the rest of individuals. This confirms that disability benefits have being used as a pathway to retirement below the early retirement age. We have also shown that there are significant regional differences and the probability of receiving is higher in Murcia, Andalucia and Extremadura. If we take into account that the awarding process depends on Social Security Provincial offices, it becomes clear that something abnormal is happening in the evaluation of the worker health status.

One solution would be to carry out more diagnosis tests and explorations, although this would increase audit expenditures. For example, in the case of the osteoarticular pathologies in which pain plays

probability of receiving conditioned to deserving is that individuals with a high probability of deserving should receive a benefit.

a crucial role there is a trade off between the accomplishment of some expensive tests and the risk of paying undue benefits.

8. References

1. Anderson, K., Burkhauser, R., 1985. The retirement-health nexus: a new measure of an old puzzle. *Journal of Human Resources* 20, 118-137.
2. Barba Mora, A., 2001. *Incapacidad permanente y Seguridad Social*. Editorial Aranzadi.
3. Bazzoli, G., 1985. The early retirement decision: new empirical evidence on the influence of health. *Journal of Human Resources* 20, 214-234.
4. Berkovec, J., Stern, S., 1991. Job exit behavior of older men. *Econometrica* 59, 189-210.
5. Benítez-Silva, H., Hiu-Man, C., Rust, J., Shedvasser, S., 1999a. An empirical analysis of the Social Security Disability, application, appeal, and award process. *Labour Economics* 6, 147-178.
6. Benítez-Silva, H., Hiu-Man, C., Rust, J., Shedvasser, S., 1999b. Social Security disability award process: how large is the bias in self-reported disability? Manuscript. Yale University.
7. Blanchet, D., Pele, L. P., 1997. Social Security and retirement in France. Working Paper NBER, nº 6214.
8. Blaud, D. M., Riphahn, R. T., 1999. Labor force transitions of older married couples in Germany. *Labor Economics* 6, 229-251.
9. Blundell,, R., Johnson, P., 1997. Pensions and retirement in the UK. Working Paper NBER, nº 6514.
10. Boldrin, M., Jiménez-Martín, S., Peracchi, F., 1999. "Social Security and Retirement in Spain", in J. Gruber and D. Wise (Eds.), *Social Security Programs and Retirement around the World*, Chicago University Press for the NBER.
11. Borsch-Supan, A., Schnabel, R., 1997. Social Security and retirement in Germany. Working Paper, nº 6153.
12. Boskin, M., Hurd, M., 1978. The effect of Social Security on early retirement. *Journal of Public Economics* 10, 361-377.
13. Bound, J., 1989. The health and earnings of rejected disability insurance applicants. American *Economic Review* 79, 482-503.
14. Bound, J., 1991. Self reported versus objective measures of health in retirement models. *Journal of Human Resources* 26, 106-138.
15. Bound, J., Burkhauser, R. V., 1999. Economic analysis of transfer programs targeted on people with disabilities. In Ashenfelter, O., Card. D. (Eds.), *Handbook of Labor Economics*, vol 3C, 3417-3528. Elsevier, Amsterdam.
16. Bound, J., Schoenbaum, M., Waidmann, T., 1995. Disability status and racial differences in the labour force attachment. *Journal of Human Resources* 30, 227-267.
17. Bound, J., Schoenbaum, M., Stinebrickner, T., Waidmann, T., 1999. The dynamic effects of health on the labor force transitions of older workers. *Labour Economics* 6, 179-202.
18. Brugiavini, A., 1997. Social Security and retirement in Italy. Working Paper NBER, nº 6155.
19. Bukhauser, R., 1979. The pension acceptance decision of older worders. *Journal of Human Resources* 14, 63-75.
20. Chirikos, T., Nestel, G., 1984. Economic determinants and consequences of self-reported work disability. *Journal of Health Economics* 3, 117-136.
21. Dwyer, D., Mitchell, O., 1998. Health problems as determinants of retirement: are self-rated measures endogenous? National Bureau of Economic Research. Working Paper 6503.
22. Gordon, R., Blinder, A., 1980. Market wages, reservation wages and retirement decisions. *Journal of Public Economics* 14, 277-308.
23. Greene, W.H., 1993. *Econometric analysis*. Second Edition, Pretince Hall, New Yersey.
24. Hanoch, G., Honig, M., 1983. Retirement, wages and labor supply of the elderly. *Journal of Labor Economics* 1, 131-151.
25. Haveman, R., de Jong, P., Wolfe, B., 1991. Disability transfers and the work decision of older men. *Quaterly Journal of Economics* 106, 131-161.
26. Haveman, R., Wolfe, B., 1984a. The decline in male labor force participation: comment. *Journal of Political Economy* 92, 532-541.
27. Haveman, R., Wolfe, B., 1984b. Disability transfers and early retirement: a causal relationship?. *Journal of Public Economics* 24, 47-66.
28. Haveman, R., Wolfe, B., Warlick, J., 1984. Disability transfers, early retirement, and retrenchment. In Aaron, H., Burtless, G., (Eds.), *Retirement and economic behavior*, 65-93. Washington, DC; Brookings Institution.

29. Heckman, J., 1978. Dummy endogenous variables in a simultaneous equation system. *Econometrica* 46, 931-959.
30. Jiménez-Martín, S., Labeaga, J.M. and Martínez-Granado, M., 1999. Working Paper Universidad Carlos III de Madrid.
31. Kerkhofs, M., Lindeboom, M., 1995. Subjective health measures and state department reporting errors. *Health Economics* 4, 221-235.
32. Kiefer, N., 1982. Testing for dependence in multivariate probit models. *Biometrica* 69, 161-166.
33. Kreider, B., 1999. Latent work disability and reporting bias. *Journal of Human Resources* 34, 734-769.
34. Leonard, J. S., 1979. The Social Security Disability program and labor force participation. National Bureau of Economic Research. Working Paper 392.
35. Myers, R., 1982. Why do people retire from work early? *Social Security Bulletin*, September, 10-14.
36. Nagi, S., 1979. The concept and measurement of disability. In *Disability Policies and Goverment Policies*. New York: Praeger.
37. Palme, M., Svensson, I., 1997. Social Security, occupational pensions and retirement in Sweden. Working Paper NBER, nº 6137.
38. Parsons, D., 1980. The decline in male labor force participation. *Journal of Political Economy* 88, 117-134.
39. Parsons, D., 1982. The male labour force decision: health, reported health and economic incentives. *Economica* 49, 81-91.
40. Pérez Rueda, B., García Blázquez, M., García Blázquez Pérez, M., 2000. *Fundamentos médico legales de la incapacidad laboral permanente*. Editorial Comares, 4ª edición.
41. Peracchi, F., Welch, F., 1994. Trends in labor force transitions of older men and women. *Journal of Labor Economics* 12, 210-242.
42. Pestieau P., Stijns, J. P., 1997. Social Security and retirement in Belgium. Working Paper NBER, nº 6169.
43. Slade, F., 1984. Older men: disability insurance and the incentive to work. *Industrial Relations* 23, 260-269.
44. Stern, S., 1989. Measuring the effect of disability on the labor force participation. *Journal of Human Resources* 24, 361-395.
45. Zabalza, A., Pissarides, P., Barton, M., 1980. Social Security and the choice between full-time work, part-time work and retirement. *Journal of Public Economics* 14, 245-276.

Appendix A

Table A. Ratio between number of permanent disability benefits and retirement benefits

	1985	1987	1989	1991	1993	1995	1997	1999	2001
Andalucía	91.9	93.6	92.4	88.6	86.1	84.1	76.5	27.2	26.5
Aragón	42.1	41.3	40.6	38.6	38.5	37.2	34.0	13.4	13.1
Asturias	56.4	54.8	53.6	51.6	51.2	50.0	45.7	18.6	18.6
Baleares	42.3	42.0	42.1	42.8	44.4	45.2	43.4	19.4	20.4
Canarias	74.6	75.1	74.1	73.2	69.5	65.4	58.5	22.9	21.9
Cantabria	43.9	43.7	43.9	43.7	43.6	42.5	39.3	14.9	14.9
C. Mancha	52.9	52.2	51.4	48.7	46.9	44.9	40.3	14.1	14.2
C. León	54.2	53.0	51.9	48.3	46.7	44.3	39.1	12.9	12.1
Cataluña	57.2	56.9	56.3	53.5	50.9	47.8	43.4	18.3	17.5
Extremadura	56.6	57.7	57.8	55.8	54.7	52.7	47.7	17.5	16.4
Galicia	55.2	55.9	55.5	54.3	53.2	50.9	45.1	13.9	13.5
Madrid	40.2	38.5	33.4	37.5	36.9	34.5	31.0	13.6	12.9
Murcia	150.4	153.6	157.0	152.0	148.5	138.1	116.4	28.1	25.8
Navarra	52.1	51.2	48.5	46.4	45.1	43.5	39.4	16.4	15.9
País Vasco	47.8	46.2	44.7	43.1	42.2	40.1	37.0	17.2	16.1
La Rioja	65.9	65.0	63.7	60.4	59.9	57.4	50.2	17.3	16.5
Comunidad Valenciana	52.7	50.6	49.2	45.7	43.5	41.6	38.9	16.6	16.6
Ceuta	83.3	73.7	66.7	63.6	54.2	48.1	44.8	19.4	19.4
Melilla	100	94.1	94.1	88.9	94.7	95.0	90.5	33.3	33.3
España	59.06	58.4	56.7	55.2	53.6	51.2	46.4	17.9	17.3

Source: Ministry of Labor and Social Issues. Note: Since 1997 (Law 24/1997) disability pensions for individuals aged 65+ are counted as retirement pensions.

Appendix B. Descriptive statistics

Table B.1. Disabilities

Nº of observations	Men with benefits		Women with benefits	
	Deserve	Not deserve	Deserve	Not deserve
Seeing any image	0.98	0	0.90	0
Global visual tasks	13.73	5.48	16.22	14.29
Detailed visual tasks	15.03	41.11	14.41	14.29
Other visual disabilities	4.58	9.59	8.11	7.14
Hearing any sound	1.63	0	0	0
Hearing strong sounds	1.31	2.74	1.80	0
Listening the speech	9.48	9.59	8.11	0
Communicating through speech	7.19	6.85	2.70	7.14
Communicating through alternative languages	0.65	0	0.90	0
Communicating through not sealed gestures	0.65	0	0.90	0
Communicating through reading-writing	9.80	0	9.01	0
Recognizing people	3.92	0	4.50	0
Remembering information	9.48	0	9.01	0
Executing simple orders	2.94	0	4.50	0
Executing complex orders	7.52	0	5.41	0
Maintaining body postures	23.53	12.33	32.43	0
Getting up and down	33.33	26.03	39.64	14.29
Moving inside home	19.93	12.33	23.42	7.14
Moving not heavy objects	36.93	26.03	39.64	42.86
Using utensils and tools	31.05	20.55	32.43	35.71
Manipulating small objects	17.65	19.18	25.23	21.43
Moving without transport	45.52	31.51	44.14	14.29
Moving in public transport	41.18	20.55	44.14	14.29
Driving own vehicle	49.67	24.66	48.65	21.43
Washing oneself	16.34	2.74	18.02	0
Controlling physical needs	5.23	1.37	4.50	0
Dressing and undressing	16.99	5.48	11.32	0
Eating and drinking	4.25	1.37	4.50	0
Do the shopping	20.26	8.22	35.14	21.43
Cooking	13.73	8.22	25.23	7.14
Washing and ironing clothes	18.63	10.96	37.84	28.57
Cleaning the house	24.18	19.18	51.35	28.57
Looking after the family	16.99	8.22	27.93	21.43
Relations with family	2.61	1.37	4.50	7.14
Making friends	7.84	1.37	9.91	7.14
Relating at work	11.11	2.74	16.61	7.14

Table B.2. Socioeconomic characteristics

	Without disability benefit	With disability benefit		Without disability benefit	With disability benefit	
		Deserve	Not deserve		Deserve	Not deserve
Working	27.66	22.66	13.11	58.19	48.75	25
Working but temporally absent	0.58	1.17		1.74		
Looking for first job	0.39	0.78	1.64	0.35		
Unemployed (has worked before)	5.61	7.42	6.56	13.59	13.75	
Unable for working	0.77	1.95	3.28	3.83	6.25	
Contributive Disability Benefit	1.74	3.91	6.56	9.06	15	37.5
Not Contributive Disability Benefit	2.9	2.34	3.28	0.7		
Retirement Benefit	0.77	1.17		11.15	16.25	12.5
Studying	0.39	0.78				
Houseworking	58.41	57.42	63.93			
Other situations	0.77	0.39	1.64	1.39		25

Men: (N=984) 82.43% of the sample is married
Women: (N=552) 65.28% of the sample is married

Table B.3. Spouse labor force status

	Men		Women	
	Receive Deserve	Receive Not deserve	Receive Deserve	Receive Not deserve
Age between 55-59	47.06	35.62	47.75	28.57
Needs caretaker	7.30	0	18.11	0
Rehabilitation treatment	30.25	28.38	35.43	35.29
Change of house	7.62	6.76	10.24	11.76
Married	80.72	83.56	64.86	50
Main sustainer	84.97	90.41	27.03	35.71

Studies				
Without studies	31.05	32.77	35.13	28.57
Elementary	46.73	43.94	40.54	35.71
High school	18.63	20.55	15.32	21.43
College	3.59	2.74	9.01	14.29
Profesional occupation (before)				
Unskilled	22.14	18.84	52.25	42.87
Skilled	65.44	72.46	40.54	35.71
White collar	12.42	8.70	7.21	21.42

Appendix C. Estimations and forecasts

Table C.1. Bivariate probit. Sample with disabilities

	Men				Women			
	Deserve		Receive		Deserve		Receive	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t
Constant	-0.8056	3.50	-0.6*9	-3.20	-0.8503	-2.20	-0.9293	-2.68
Disability:								
Vertebral column	0.4186	2.14	0.3044	2.02	0.7184	3.48	0.1936	2.08
Upper and low extremities	0.0552	2.27	0.2642	2.50	0.4462	1.82	0.0813	2.39
Seeing	0.3658	2.27	0.0253	2.17	0.9053	4.01	0.0346	2.20
Hearing	0.3194	1.93	0.3654	3.54	0.4573	2.13	0.6298	2.84
Communicating	0.2465	2.00	0.4685	2.01	0.7546	2.75	0.8165	2.45
Remembering	0.2852	2.37	0.3842	2.95	0.3427	2.59	0.2613	2.59
Executing orders	0.3134	1.90	0.2885	2.80	0.1950	2.19	1.1224	1.93
Maintaining body postures	0.2282	2.05	0.0316	2.16	0.0706	3.30	0.2068	1.99
Moving inside home	0.4744	2.41	0.0295	2.17	0.0291	3.13	0.1602	2.80
Using hands and fingers	0.2162	2.49	0.2821	2.19	0.3649	2.14	0.1926	2.24
Moving outside home	0.4109	2.87	0.3889	3.63	0.6666	3.72	0.1091	2.65
Taking care of oneself	0.5355	2.19	0.1974	3.10	0.0938	2.31	0.1865	2.36
Houseworking	0.0405	2.18	0.5447	2.95	0.3401	1.83	0.4302	2.48
Relating	0.8202	2.38	0.5579	2.93	0.5068	2.30	0.1732	3.05
Socioeconomic characteristics								
Age between 55-59	0.0733	2.64	0.1379	2.21	0.2069	2.35	0.1332	2.90
Change of house	0.3917	2.11	0.6247	2.18	0.0516	2.15	0.5162	1.91
Impairment certificate	0.1240	2.91	0.7150	5.77	0.2575	2.41	0.5962	3.76
Needs caretaker	0.7702	2.38	0.1811	2.60	0.2694	2.93	0.3602	2.20
Rehabilitation treatment	0.1286	2.81	0.2731	1.92	0.0582	2.34	0.0366	2.24
Spouse working	-0.0191	1.52	-0.4148	-2.82	0.0038	1.18	-0.1079	-2.13
Spouse disability benefit	0.0189	1.75	0.3089	2.67	0.0058	1.69	0.1699	2.55
Married	0.0249	0.63	0.0988	2.01	0.0105	0.71	0.0141	1.98
Elementary	0.8045	2.09	1.6779	1.96	0.3394	2.63	0.9641	2.51
High school	0.5977	2.23	0.6317	2.05	0.0300	2.39	-0.1359	-2.88
College	0.2952	2.05	0.3559	2.42	-0.0893	-2.27	-0.6535	-2.02
Active	0.1841	2.01	0.3195	-1.90	-0.0569	-2.24	0.2020	2.03
Unemployed	0.4425	-2.93	-0.2975	-2.14	0.1578	2.62	-1.4187	-3.09
Main sustainer	-0.1978	-0.96	0.0860	2.43	0.0243	1.11	0.1554	2.67
White collar occupation	-0.1316	-2.60	0.1696	3.43	0.1917	2.77	0.8429	3.42
Skilled occupation	-0.0175	3.34	0.7779	5.13	0.3394	1.94	0.9641	4.00
Autonomous Communities								
Andalucía-Ceuta-Melilla	0.7624	1.39	-0.0073	-1.99	0.5326	1.17	-0.1275	-2.08
Aragón-Navarra-Rioja	0.7546	1.60	-0.2636	-1.99	0.5235	1.21	-0.4570	-1.89
Asturias-Cantabria	1.0826	1.18	-1.0627	-2.22	0.2898	0.76	-0.5114	-2.46
Baleares	0.7349	1.12	-1.0076	-2.02	0.2621	0.61	-1.1546	-2.54
Canarias	0.4906	0.96	-1.0566	-1.91	0.5562	1.32	-0.6078	-2.31
Castilla La Mancha	0.9363	0.86	-0.9415	-3.19	0.2946	0.80	-0.3446	-1.97
Castilla León	0.5839	1.35	-0.8752	-2.04	0.3379	1.16	-0.5008	-1.84
Cataluña	0.6279	1.41	-0.2638	-2.29	0.5208	1.35	-0.4553	-2.06
Extremadura	1.1119	1.01	-0.0242	-1.90	0.8071	1.38	-0.2529	-1.87
Galicia	0.4978	1.13	-0.3957	-1.99	0.2577	0.49	-0.4569	-2.26
Madrid	1.0609	1.06	-0.9277	-2.08	0.4127	1.18	-0.6261	-2.78
País Vasco	0.5818	1.24	-0.8396	-2.87	0.0953	0.23	-0.7922	-2.46
Comunidad Valenciana	0.3563	0.75	-0.5315	-1.84	0.3380	1.11	-0.4381	-2.54
Number of observations				984				552
Rho				0.3690				0.3161
Log likelihood				-702.3350				-460.4645

Table C.2. Marginal probabilities. Men with disabilities

	Men				
	(1)	(2)	(3)	(4)	(5)
Baseline (BL)	0.3235		0.4539		-0.4031
Disability:					
Vertebral column	0.4843	47.91	0.5748	26.63	-0.1868
Upper and low extremities	0.3437	6.24	0.5589	23.13	-1.5261
Seeing	0.4633	43.21	0.4639	2.20	-0.0013
Hearing	0.4449	37.53	0.5985	31.86	-0.3446
Communicating	0.4163	28.69	0.6378	40.52	-0.5321
Remembering	0.4314	33.35	0.6058	33.47	-0.4043
Executing orders	0.4426	31.68	0.5685	25.25	-0.2845
Maintaining body postures	0.4092	26.49	0.4664	2.75	-0.1398
Moving inside home	0.5066	56.60	0.4656	2.58	0.0809
Using hands and fingers	0.4045	25.04	0.5660	24.70	-0.3993
Moving outside home	0.4813	48.78	0.6076	33.86	-0.2624
Taking care of oneself	0.5309	64.11	0.5325	17.31	-0.0030
Houseworking	0.3382	4.54	0.6659	46.71	-0.9689
Relating	0.6414	98.26	0.6708	47.79	-0.0458
Socioeconomic characteristics					
Age between 55-59	0.3503	8.28	0.5088	12.09	-0.4502
Change of house	0.4736	46.40	0.6946	53.03	-0.4666
Impairment certificate	0.3692	14.12	0.7255	59.84	-0.9643
Needs caretaker	0.6226	92.46	0.5259	15.82	0.1552
Rehabilitation treatment	0.3710	14.68	0.5518	25.57	-0.4873
Spouse working	0.3256	0.65	0.3329	-28.87	0.0083
Spouse disability benefit	0.3394	4.91	0.6148	35.46	-0.8114
Married	0.3325	2.79	0.4932	8.65	-0.4833
Elementary and unskilled	0.6244	93.01	0.8829	94.51	-0.4139
High school and skilled	0.4838	49.55	0.7951	75.24	-0.6434
High school and white collar	0.4832	49.36	0.7847	72.92	-0.6239
College and skilled	0.3654	12.95	0.6958	53.29	-0.9042
Main sustainer	0.2560	-20.86	0.4881	7.53	-0.9066
Unemployed	0.4933	52.49	0.3396	-25.18	0.3116
Autonomous Communities					
Andalucía-Ceuta-Melilla	0.6197	91.56	0.4509	-0.66	0.2724
Aragón-Navarra-Rioja	0.6167	96.63	0.3521	-24.43	0.4298
Asturias-Cantabria	0.7339	126.86	0.1193	-73.72	0.8374
Baleares	0.6091	88.28	0.1306	-71.23	0.7856
Canarias	0.5528	70.88	0.1205	-73.45	0.7828
Castilla La Mancha	0.6838	111.37	0.1452	-68.01	0.7145
Castilla León	0.5502	70.07	0.1608	-64.57	0.7077
Cataluña	0.5675	66.15	0.3521	-22.43	0.3796
Extremadura	0.7434	129.79	0.4443	-2.11	0.4023
Galicia	0.5160	59.50	0.3044	-32.94	0.4185
Madrid	0.7267	124.64	0.1483	-67.33	0.7959
País Vasco	0.5493	69.79	0.1697	-62.61	0.6911
Comunidad Valenciana	0.4595	42.04	0.2586	-43.03	0.4372

(1): marginal probability of deserving; (3): marginal probability of receiving
(2) and (4): rate of change with respect to baseline; (5)=[(1)-(3)]/(1)
BL: man, younger than 55 years old, single, college, white collar, living in Murcia, suffering only disabilities with moderate severity, without rehabilitation treatment, impairment certificate, caretaker and has not changed of house because of a disability.

Table C.3. Marginal probabilities. Sample without disabilities

	Men		Women		[(1)-(2)]/(1)
	(1)	(3)	(2)	(3)	
BASELINE (BL)	0.0130		0.0036		
Age between 55-59	0.0283	117.69	0.0096	166.66	0.6608
Main sustainer	0.0149	14.62	0.0044	22.22	0.7047
Married	0.0113	-13.08	0.0020	-44.44	0.8230
Elementary	0.0123	-5.39	0.0036	0	0.7073
College	0.0137	5.38	0.0038	5.55	0.7226
White collar	0.0101	-22.31	0.0010	-72.22	0.9009

(1) and (2): marginal probability of receiving; (3)=rate of change with respect to BL.
BL: individual younger than 55 years old, single, not main sustainer, high school, skilled occupation and living in Murcia.