Transition Probabilities and Duration Analysis among Disability States: Some Evidence from Spanish Data

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Transition probabilities and duration analysis among disability states: some evidence from Spanish data*

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Abstract

In this paper we study the disability transition probabilities (as well as the mortality probabilities) due to concurrent factors to age such as income, gender and education. Although it is well known that ageing and socioeconomic status influence the probability of causing functional disorders, surprisingly little attention has been paid to the combined effect of those factors along the individuals' life and how this affects the transition from one degree of disability to another. The assumption that tomorrow's disability state is only a function of the today's state is very strong, since disability is a complex variable that depends on several other elements than time. This paper contributes into the field in two ways: (1) by attending the distinction between the initial disability level and the process that leads to his course (2) by addressing whether and how education, age and income differentially affect the disability transitions. Using a Markov chain discrete model and a survival analysis, we estimate the probability by year and individual characteristics that changes the state of disability and the duration that it takes its progression in each case. We find that people with an initial state of disability have a higher propensity to change and take less time to transit from different stages. Men do that more frequently than women. Education and income have negative effects on transition. Moreover, we consider the disability benefits associated to those changes along different stages of disability and therefore we offer some clues on the potential savings of preventive actions that may delay or avoid those transitions. On pure cost considerations, preventive programs for improvement show higher benefits than those for preventing deterioration, and in general terms, those focussing individuals below 65 should go first. Finally the trend of disability in Spain seems not to change among years and regional differences are not found.

JEL classification: *J11, I18, H55*

Keywords: *Markov transition, disability states, cost of disability, Spain, survival analysis*

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1 Introduction

Demographic changes in the last decades in most of OECD countries, as a result of increasing life expectancy and low fertility, have brought profound changes in the population pyramid. They have several effects. One of them is the likely increase in the number of people with disabilities since age is a determining factor in the emergence of this problem. Furthermore, increased longevity impel social and political institutions to adjust their objectives and programs to face the new challenges. In this context, changes in the prevalence of severe disability among elderly in most developed countries are likely to have important effects on demand, and therefore on expenditure in long-term care. Before to consider eventually policy strategies to tackle this and some other related problems, it is essential to understand the nature and characteristics of the disable population, and in particular how many are affected to, what limitations do they have and how severe disability is. It is also important to understand, which factors (age, education, income, gender...) may affect the appearance of disability for the first time and the transition mechanisms which lead disability from one state to another. The impact of those other factors on health status should not be overall underestimated. From a policy stand, they are risk factors and not exogenous unavoidable consequences. Not a surprise, disability and age are strongly related, displaying a rather similar pattern to mortality.

Disability prevalence rates tend to be lower at the youngest ages and higher for the elderly. This relationship is important because knowledge of a population structure, and how this might change, gives important information on the current number of people with a disability and how this may evolve in the future. However factors other than age also influence the disability status and its evolution. The assumption that tomorrow's disability state is only a function of today's disability is quite strong. Since disability is a confounding situation that depends on more factors than just age, it is important to condition the disability transition probabilities (as well as the mortality ones) on those additional factors such as income, gender, education, etc. Most of the projections on ageing done by researchers in a number of fields, including medicine, demography and actuarial studies, have helped governments and institutions to understand the likely scale of the side effects related to the disability problem. A particular focus of many of these studies has been to forecast prevalence and incidence of disability amongst the elderly with the aim of assessing the future costs of health care. Projections of the numbers of people with disability are important for planning in order to direct resources and services in an efficient and effective manner (Siegel, 2002). In particular, to know the trend of the disability and its evolution over time permits to plan the preventive programs that a country needs in order to better serve the welfare of its population. Although, it is clear that characteristics such as age, gender and socioeconomic status can influence the probability of having functional disorders

(Zimmer et al (2003), Strauss et al (2009)), surprisingly little attention has been paid to the combined effect of those in the transition from one degree of disability to other (Juergen (2009), Janus (2009)). This may be due in part to the relative lack of information on a panel data basis for a representative population sample that span sufficient years to allow for the analysis of changes in disability over time.

For the former purpose, it is common in the literature to distinguish between "health related disability", which arises from clearly diagnosed medical conditions, and some others sucha as "work disability", which may also have its roots in economic and social circumstances. Although, there is a link between work and health disability, other economic conditions and variations in labour situations may play an important role in explaining the dynamics of the disability (Benìtez-Silva et al, 2010). However, despite the recognized importance of using a classification of disabilities for service planning, very little is known today about the progression of people disabilities in such classifications (i.e. the transitions between profiles).

In this paper we want to contribute to the field by analyzing the trends of disability; tghis is the entrance into one state and from this the transition to others, and the factors that may affect these changes. We focus our analysis on Spain, a OECD country where very little is known about the trends in disability [1]. A small change on the prevalence of the actual disability rates can have substantial impact on future expenditure of health care and social services; particularly in a fast growing older population as the Spanish one, for which is projected that population over 65 years old will double in 2060. As seen in Figure 1, life expectancy has already increased greatly in the last 20 years, making the number of over 65 years a 16.9% of total population in 2008 in Spain. His projection (32.5% for 2060) implies increased public spending on health, long-term care and pensions. In order to face this impact, we need to understand in a better way the leading mechanisms that influence this transition.

Unfortunately there is not a panel data in Spain that might allow us to take the evolution of the health states of people. For doing this ourselves we would need to know a lot more on the effects of the health care system in functional day of living outcomes. Many of the studies so far published analyzing public expenditure on dependency care (Bolancé et al. (2012), D'amico et al. (2009)) used the probability of death at each age, but without considering the likelihood of moving from a state of disability to another, since this would require really complex models under different scenarios. They usually provide at best only a transition to a worse state, but not, for instance, its impact and the possibility ofimprovement. Fortunately, as it is commented in the next section, we have the possibility to explore a new dataset that solves the most of the former issues and allow us the possibility to put more light on transition among disability states

[1] Lafortune and Balestas (2007) show a study on trends of disability for 12 OECD countries, where Spain is excluded

and its consequences.

This paper seeks to advance in the general understanding of these questions in three ways: (1) by attending to the distinction between disability level and his course or progression; (2) by addressing whether and how education, age, and income differentially affect the disability transition process and some of the difference that can be observed at the regional level, and (3) by showing the advantages of preventive programs for avoiding deterioration of disability states and for those looking for improvements. Our study is structured in four Sections. In the first Section we offer a brief introduction about the data we have used in our research. In the second one we show the estimation strategy, and in the third present the main results. The final Section concludes and discuss these results.

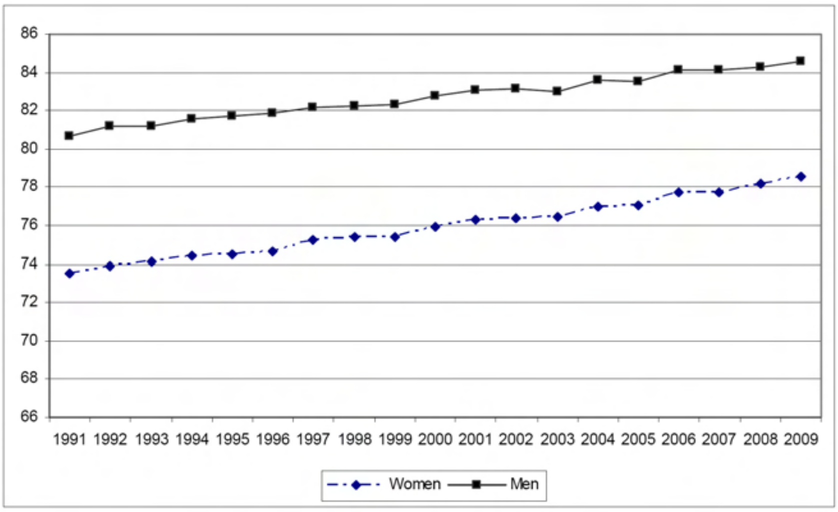

Figure 1: Trend of Life Expectancy by gender

2 Data

In 2008, 8.5% of the Spanish population had some disability, most of them were over 65's, a group of population that in Spain represents a 16.8% of the population (see INE 2010). Regarding the dependency ratio, defined as people with one or more limitations in basic activities of daily living (such as eating, washing/bathing, dressing, and getting in and out of bed), the figure amounted a 24.43%, however to estimate the real dependency ratio is not easy due to data limitation.

Most of the studies concentrate the analysis on the physical disability and in particular on the number of beneficiaries and the benefits that people receive. Disability benefits in many European countries are related to medical conditions, to economic-work related reasons and/or a combination of these factors. To analyse those disability benefits may be quite enriching for the purpose of preventing those cases and focussing on the most fragile population groups. In fact the disability Social Security programme in Spain is quite similar to that of most of EU countries. There are two basic types of permanent disability benefits: contributory, which are given to individuals who have contributed to the Social Security system before entering in the state of disability; and non-contributory, to individuals who are never contributed (or do not reach the minima requirements to access the contributory system).

The number of individuals with disability and not being social insurance contributors are relatively small compared to those benefiting from the contributory system (197,126 versus 920,860 in 2009). The amount of benefits received is smaller in the non-contributory case (417.09 Euros/month compared to an average contributory disability pension of 831.49 Euros/month). These two system are supposed to offer the possibility, to an individual that enters in the disability status, to maintain a certain amount of income during his life (see Jiménez et all, 2011 and Jiménez and Villaplana-Prieto, 2012).

The Spanish Social Security administration uses a classification of four main degrees of disability. They basically depend on the working capacity lost. A permanent limited disability for the current job requires the individual to losses at least 33% of the standard performance for his/her usual job but the individual is still able to develop the fundamental tasks of his/her usual job or professional activity. Individuals in this level of disability only receive a one-time lump sum payment.

In order to capture the different situations in which a person can be after suffering from a disabling condition, the Spanish Social Security administration uses a classification of several main degrees of disability that depend on the working capacity lost:

1. Severe disability
2. Total disability
3. Total incapacity for the usual occupation (55% of base)
4. Total disability for the usual occupation (75% of base)
5. Permanent partial disability
6. Other disability pensions.

To plan health strategies according to this settings (disability trends, quality of life and health care resources needed) is a major challenge. For this we need however information about the probability that a person with certain characteristics enter in an state of disability and move from one state to another. Most the papers use the health status to respond to this research question, and to simulate thereafter several alternative scenarios to predict those probabilities.

The lack of panel data is their major shortcoming. Thanks to a new longitudinal data-set recently available in Spain we can now estimate the probability to enter in a disability process and to analyse the evolution of this in transiting to sequential disability states.

To realize the analysis we use the Social Security Records data (Muestra Continua de Vidas Laborales (MCVL)). The MCVL started in 2004, and data come out from a random sample of workers and pensioners affiliated to the Social Security System in the year when the survey was conducted. It hence reproduces the labour history of the affiliated starting with their first job and/or when they enter in the retirement system. These data represent more than 1 million people in the Social Security System of Spain. The MCVL is however an appropriate database to proxy that since it contains the information that permit to analyze the disability, and factors that could influence it, such as age, gender, income, level of education, geographical residence, degree of disability, and number of family members. In particular, the MCVL allows us to identify a file on the fiscal declaration (Model 190) that a firm or government need to present to the Social Security agency for each worker or pensioner. In this model the firm fills information about the demographics characteristics of the workers, their earnings and the taxes paid. All the entities that pay salaries, pensions and unemployment benefits are required to present the model. Recipients in these files include all those who receive income subject to income tax even when this goes below the statutory minimum exemption (in order to assess personal income tax) having withheld salaries without or with exempt income. Data on inactive population such as unemployed without subsidy and civil servants are the more important omissions. We use for our purpose MCVL data from 2005 until 2010[2] in longitudinal form to estimate the probabilities of transitions among individuals that first reported disability.

In addition another information reported in the MCVL is the degree of disability. In particular this variable take four values:

i. If the recipient does not suffer from any disability or in case it has some limitations his degree of disability is less than 33%.

ii. If the degree of disability of the recipient is above 33% and below 65%.

iii. If the degree of disability of the recipient is less than 33 percent and below 65% but it needs support from other people.

iiii. If the degree of disability of the recipient is equal or greater than 65%.

We include also a fifth state which represents '*death*'.

In Tables 1 and 2 we report descriptive statistics about the sample and actual figures on the degree of disability by year. We have more than three million total observations, with a

[2]We have excluded 2004 because was the first wave and has some missing data important.

homogenous distribution across the years. By gender we can see how 88% of men have not disability while this percentage is a little bit higher for females (90%). In addition, 8% of men present a degree of disability of 33% of disability with respect to 6% of women, while regarding at the disability status "more than 65%" of women seem to suffer more than men do. The trend of disability in Spain seems not change across years. In table 2 we show the summary statistics of each variable included in the analysis. We distinguish individuals with and without disability. Those without disability are more frequently workers and younger (45 years old versus 65), with descendent, more educated and with an income higher than people with disability. At regional level the difference across regions are quite significant while among individuals with and without disability their percentages are quite similar. Andalusia and Catalonia are the regions with more disable people, this fact being in accordance with the registries of the Spanish Institute of Statistics (INE) for 2008.

This is a first evidence that people with disability usually are old, but also earn less income, and in addition their level education is lower too.

3 Empirical Model

We use two different approaches to estimate the transition probabilities from one state to other. The first one is a simple method that calculates the one-step transition probability; this is a simple counting procedure of the probability of transition from one state to another in a single step without consider in any explanatory variable. The transition probability matrix, P, is the matrix consisting of the one-step transition probabilities, p_{ij}.

$$p_{ij} = Pr\{X_n = j | X_{n-1} = i\}$$

The v-step transition probability is the probability of transition from state i to state j in v steps.

$$p_{ij}^{(v)} = Pr\{X_{n+v} = j | X_n = i\}$$

The v-step transition matrix whose elements are the $mv - step$ transition probabilities $p_{ij}^{(v)}$ is denoted as $P^{(v)}$.

The second method uses predictions from an ordered logit model. In particular, we use a Markov switching model. This is a natural approach to take when modelling the transitions of individuals between discrete disability states over time. It implies a parametric estimation and can be specified by a likelihood function, which contains the conditional probability distribution of the vector of all observations Y given the vector of all parameters Θ. We denote the probability $p_i(s|j)$ the probability that an individual i has the disability status s in period t, conditional on having a "j" disability status in $t-1$. We estimate this probability considering a vector of variables such as: age, age square, income, level of education, residence and if the individual is inactive or not.

To define the data probability distribution we first introduce an unobserved (latent) state variable st, which determines the state during time period t, and can assume only two values: $st=0$ corresponds to one state and $st=1$ corresponds to the other state ($t=1,2,...,T$) see Palumbo (1999). We can define $st_i(s|j)$ as:

$$st_i(s|j) = \begin{cases} exp(x_{it}\beta_{sj}), & \text{for } s=1,2,3... \\ exp(x_{it}0_{sj}), & \text{for } s=0 \end{cases}$$

Then the Markov transition probability for the disability status of individual i in time t is:

$$st_i(s|j) = \frac{st_i(s|j)}{\sum_{j=1}^{T} st_i(s|j)}$$

Assuming that the disability and the grade of disability it can be order from low (γ_1) to high (γ_s) we can consider the order logit Markov transition as define in Jung (2009):

$$Pr[y_i = j] = \frac{exp(\gamma_j - x_{it}\beta_{sj})}{1-exp(\gamma_j - x_{it}\beta_{sj})} - \frac{exp(\gamma_{j-1} - x_{it}\beta_{sj})}{1-exp(\gamma_{j-1} - x_{it}\beta_{sj})}$$

The state variable st is assumed to follow a stationary two-state Markov chain process in time, which can be specified by time-independent transition probabilities. We use this model to predict the probability to transit from one state to disability to other respectively.

Finally, we consider also a survival analysis using a semi-parametric estimation to calculate the risk or the hazard to transit in some state of disability. In particular we analyse the determinants of the transitions from observed for individual i in time $[0,t]$ from state $s \longrightarrow j$ (see Anderson, Hansen and Keiding, 1991) considering a multivariate survival analysis. This model allow us to take into account that a same individual could presents more than one "failure" events a long the years considered, i.e. a person could enter in a level of disability in one year and next years could change her state of disability.

Using a semi-parametric Cox model we can adjusted the covariance matrix of estimators for additional correlation, due to that the individual is observed more than once. Let X_{ki} and C_{ki} be the failure and censoring time of the kth failure type ($k=1,...,K$) in the ith cluster ($i=1,...,m$) and let Z_{ki} a p-vector of possible time-dependent covariates for ith cluster with respect to the kth failure type. The hazard function of the ith cluster for the kth failure type is:

$$\lambda_k(t, Z_{ki}) = \lambda_0(t)e^{Z_{ki}\beta}$$

4 Results

As we have described in the previous section, the model specified permits to study the transition from one status of disability to another. In table 3 we report the simple method of probability counting that allows us to analyse the disability transition by gender, without considering any of those expected influential explanatory variables. At a first look we see that most of individuals do not have any transition from one state of disability to other. Just 11% of them transit from one disability status to another and only around 3% of those with no disability enter in disability during any of the years we have considered; 5% of individuals with of 33% of disability have a transition, most of them towards a worst situation including death (2%) and just around 1.5% improve. Individuals with a severe disability (more than 65%), died (4,82% in the case of men and 5.49% of women) but also some of them (1.5%) improve among those with 33% of disability. We observe very few cases transiting from having 33% of disability and in need of help. However, their transition towards other states of disability is higher.

In Tables 4 and 5 we report the order logit used to predict the transition year by year taking into account the explanatory variables age, income, gender, region, number of family descendents and ascendents, level of education, and the fact that the individual is either a pensioner or a worker. We show in tables 4 and 5 the mean values of the predicted probabilities, conditioned on the previous disability states, in order to fill a $4 \otimes 4$ Markov transition matrix. We do the analysis separately by gender between age 40 and 90. We report the predicted probability, conditioned on the survival sample, in Table 4 and we consider the death states (in Table 5). If we compare these two tables we can see how the probability to transit among disability states is lower when we consider the death status, especially for the group with disability greater than 65%. This indicates that a high percentage of these individuals is predicted will transit towards the state *5* (death). If we compare the individual unconditional prediction (Table 3) with the conditional transition probability (Table 5), we show that the probabilities to transit for individuals with already some degree of disability are higher if we consider most of the above indicated explanatory variables, both for men and women. According to our data men are more likely to transit into disability than women; however we can observe that if women present a strong disability in the first place, have a higher propensity rate to die or to enter in a worst state.

In Table 6 we report the marginal effects of the order logit model by considering the transition with a Markov matrix $3 \otimes 4$, once we exclude the state "disability 33% plus help" due to the existence of very few observations in this category. We estimate the initial status and the probability to remain in the same state or to move to other conditions given the set of the regressed variables and commented in the previous sections. We report cluster robust estimation at the individual level. Most of the regressors considered are significant. Particular results per regions are not reported here but they are available on request. We observe that the gender variable has a negative effect for females in the transitions to the cases where the initial state of disability is '*no disability*' moving towards a state with 33% or more; similarly for an initial state of a disability of 33% towards '*no disability*', or from the initial state of *disability of 65%* towards to "remain in the same state". The signs confirm our previous result in the sense that women have less probability to enter in disability than men, and again if they suffer a disability are more likely to change. For those individuals with already some degree of disability or for people without disability to remain in the same state, the age shows a negative effect on the probability to transit; similarly for pensioners (an age related factor). The education level seems not to affect the transitions except for people with high degrees of disability. However, people with tertiary education have less probability to move from the state with strong disability: "*disability 65%*". Income does have a negative effect on transitions, and less income certainly increases the probability to enter into a more disable states. To have family ascendants increase the probability to transit among disability stages, while to be an immigrant reduce it.

In order to explore with greater details these probabilities, in the figures that follow we consider how the predicted probabilities change with respect to some variables such as age, income or region of residence. From Figure 2 to **??** we represent the distribution of the predicted probability by age and considering the different disability status of men and women respectively. We can observe how the probability of not to enter in any type of disability, or remain in the same state, is negatively correlated to age, while the probability to enter in the state of disability increases with age. For those already having a disability of 33% is more likely to move towards a disability with 65% once we account for their age. We can also appreciate as the dead state moves obviously with age, being the probability higher particularly for individuals with a disability greater than 65%. We observe also differences at a gender level. These results confirm the previous ones: women are less likely to enter in disability, but if they have some degree of disability are more propense to move.

Figures **??** to **??** show the transition probabilities for different income quantiles. We can observe, first of all, that individuals with higher incomes are more likely to have less disability and remain in the same state without transiting, while people below the 5th quantile are more exposed to transit towards worse disability states if in their initial states they do not present disability. If individuals present a disability in their initial states, the income variable does not seem to have effect on the transition. In addition, men and women present different patterns: again women, if they do not have any initial disability, present less probability to enter in one; but if they suffer a degree of disability show a higher probability than men to enter in further disability stages, once we take into account income.

In Figures **??**-**??** we plot for men and women the predicted probability by age and region. In considering geographical effects, we analyse 5 regions with the highest resident population levels in Spain (this is, Andalusia, Catalonia, Galicia, Madrid and Valencia (Ine 2008). We detect some evidence on territorial differences, specially when we analyze the probability to transit from no disability to any of the disability states. We can observe in this sense that people that live in Madrid have less probability to transit in comparison to those who live in Andalusia. These results are not however confirmed when we look at the probability of transition for people with just 'some level of disability'. Differences across women and men at a regional level reflect similar results to those found earlier on, with no differences observed at the regional level.

Next we incorporate into the analysis the multivariate survival approach, where we look at the time (years) that takes for an individual to change his present state of disability, including -as before- death as another state. In Figure **??** we report the estimation of the hazard cumulative function of Nelson-Aalen for all the states considered in this study. As shown in Figure **??** the risk of transiting along the years here considered is greater for individuals with high disability or who are approaching death. In particular, individuals with a '*disability of 33%*' and need help and those with '*more than 65%*' of disability have higher hazard rates (less time in changing from an state to another), and in this process men seem more likely to make transitions among states than women.

In Table 7 we report estimates of the Cox proportional hazard model for men and women. We observe that the age increases the probability to exit (this is, reducing the time for transit) and the size of the impact associated to this is greater for men. The same effect appears for the case in which the individual is a pensioner, and if he has family responsibilities. Income and level of education have in this sense negative effects in reducing the hazards to transit.

In Figures **??** to **??** we present the hazard rates for the transitions from one state of disability to several others. We see that women have higher hazards to transition towards better states or stay in the same condition than men, as found before. Figure **??** refers the probability to exit from "no disability" to other states. The hazards rate to transit towards worse disability outcomes (Disability 65% or Dead) or remain in the same state increase with age. But the probability of not to enter in a disability states decrease with the age (ie. the hazard rate increases), being the fact of entering in a state of "disability 33%" is more likely for individuals between 40 and 60 years old. Looking at Figures **??** and **??**, we see that when people suffer an initial state of disability, the time needed to transit towards other states increase with age, while to remain in the same state is more likely for women than for men, as it is also for people below 60 years old than for the rest.

We want finally to analyze how much Spain could save in succeeding to reduce the disability degree either by an improvement in the current status or by avoiding a transit towards worse states. We classify changes in disability through a variable that takes three values as we did before: 0–No disability, 1–Disability at 33% and 2–Disability at 65%), and we study two consecutive years (2008 and 2009) for this purpose. Individuals that experimented an *improvement*, have 3 possible patterns: 1/0, 2/0 and 2/1; similarly, 3 for a *deterioration*: 0/1, 0/2 and 1/2. Of course the jump from 3 (more than 65but given its lowest likelihood is not considered here. The the jump from 1 to 0 is the most likely event for an improvement, while looking at the probability for a deterioration we do not observe a clear pattern in our data.

Considering the whole population (199,885 individuals), we observe that 501 have experimented an improvement between 2008 and 2009, while 1.299 have shown a degenerative process. In Table 8 we can see how most of the individuals which change status (80%) experiencing either a weak improvement or deterioration other trhan death. Around 12% of the individuals transited from 2 to 0, while 6% did from 0 to 2 in that single year. In Table 9 we report the improvement and the deterioration levels by intervals of age, and the observed patterns once we consider some characteristics (gender, education and the evolution of pensions over time) of those who transit. As we can see the two age groups are not much different despite the fact that women are less likely to transit in both directions. In addition people with higher levels of education had experienced improvements, particularly when they were young, while people with low skills usually show more propensities to transit towards some worse states of disability. Looking at the changes in the Social Security pensions when the transition happens, we can observe on average some rather important differences in the total costs with regard to the benefits associated at each status.

In brief, we see that in a single year just 1.0% of the total population transit, and two thirds do it towards a worse status. We do not observe any specific pattern with regard to age once we adjust for education. Given those observed transitions, we can see in Table 9 that the highest potential savings from preventive programs on disability (in terms of reducing the observed difference in pensions) may result from achieving improvements from states 2/0, 1/0 and 2/1, more than from avoiding deterioration. Indeed maximum lower differential pensions result from 2/0 with respect to 0/2 by an annual amount of 10.432 € (versus 6.021€). This is the case in all the states for those individuals below 65 years old. Out of these changes from the highest to the lowest state -this implies changes that are obviously difficult to achieve in a given year-, we observe still important savings (−7.349€) for those below 65 and 2.256,8 € for those above 65 years old, for changing states 2/1 and 1/0, respectively. By contrast, for preventive programs avoiding deterioration, people below 65 will show in both cases higher priority if we look again at the potential costs avoided, measured by the pension differences. Therefore on pure cost considerations, preventive programs for improvement show higher benefits than those for preventing deterioration, and in general terms, those aged below 65 should be focussed first.

5 Discussion and Conclusion

Disability benefits in many European countries are related to medical conditions, to economic-work related factors and/or to a combination of them. A correct understanding on the factors that influence the transition probabilities among the disability status of dependent beneficiaries of an increasingly ageing population is crucial in an aged society. An exhaustive analysis of the phenomena allows policies to focus on the preventive elements which may greatly influence those transitions. We then may link to some programs the costs and savings associated to lower those probabilities, in a sort of cost benefit analysis associated to the alternative required interventions. For this exercise, in Table 10 we report the monthly average disability benefits by years, gender and kind of disability. We calculate this cost from the pension file of the Social Security Pensions Record (MCVL) from 2005 to 2010. The imports of the annual benefits are in Euros and indexed by the Consumer Price deflator (base 2006, see INE 2011). As expected, the import is higher for total than for partial disability. Notice in addition that these amounts differ when the retired pension overlaps the disability one Since only one of the two pensions may prevail (the highest). This would then be, in principle, the benefit (avoided cost) from any preventive program.

Searching for the potential beneficiaries of those programs, we have found that in general only around 3% of people without disability enter into one state of disability during the years considered and that a 11% transit among disability states .This ratio is higher when we consider the disability status, specially for the group with disability greater than 65%. We find that men are more likely to transit into disability than women, and that age, as expected, has a positive effect on those transits, particularly for those with already some kind of disability. The education level seems not to affect the transitions, except for people with the highest degrees of disability. However people with a tertiary education level show a lower propensity to move towards a higher degree of disability. Income in turn has a clear negative effect: less income increases the probability to enter in a more disable status, especially if the initial state is a non disability one. For individuals with some kind of disability, income does not reduce the probability to transit. Women show a higher probability than men to enter in disability once we take income into account. From the multivariate survival analysis we also show that income and the level of education have a negative effect in reducing the hazard to transit, while age reduce the time for this transit to happen.

Finally, from a public policy point of view, these results may help to incorporate into the welfare programs some protection mechanisms in order to target the most fragile population groups on geographical or socioeconomic conditions. On pure cost avoiding considerations (reducing pensions differences), preventive programs for improving disability status show higher benefits than those which may prevent deterioration, and in general terms, those aged below 65 should be focussed first.

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Table 1: **Percentage of people by disability degree**

Male

Year	**No Disab**	**Disab 33%**	**Disab 33% plus help**	**Disab 65%**	**Dead**	Total
2005	244,505	22,986	158	2,406	2,602	272,657
	89.67	*8.43*	*0.06*	*0.88*	*0.95*	*100*
2006	241,066	22,364	179	2,214	5,654	271,477
	88.8	*8.24*	*0.07*	*0.82*	*2.08*	*100*
2007	261,628	24,390	193	2,564	6,419	295,194
	88.63	*8.26*	*0.07*	*0.87*	*2.17*	*100*
2008	269,412	25,074	215	2,537	5,652	302,890
	88.95	*8.28*	*0.07*	*0.84*	*1.87*	*100*
2009	275,789	25,422	213	2,508	6,432	310,364
	88.86	*8.19*	*0.07*	*0.81*	*2.07*	*100*
2010	281,725	25,933	197	2,477	5,305	315,637
	89.26	*8.22*	*0.06*	*0.78*	*1.68*	*100*
Total	1,574,125	146,169	1,155	14,706	32,064	1,768,219
	89.02	*8.27*	*0.07*	*0.83*	*1.81*	*100*

Female

Year	**No Disab**	**Disab 33%**	**Disab 33% plus help**	**Disab 65%**	**Dead**	Total
2005	195,607	14,144	85	3,342	2,315	215,493
	90.77	*6.56*	*0.04*	*1.55*	*1.07*	*100*
2006	192,628	14,028	86	3,298	5,396	215,436
	89.41	*6.51*	*0.04*	*1.53*	*2.5*	*100*
2007	217,268	15,335	137	3,877	5,780	242,397
	89.63	*6.33*	*0.06*	*1.6*	*2.38*	*100*
2008	227,730	15,937	151	3,887	5,593	253,298
	89.91	*6.29*	*0.06*	*1.53*	*2.21*	*100*
2009	235,641	16,356	151	3,807	5,924	261,879
	89.98	*6.25*	*0.06*	*1.45*	*2.26*	*100*
2010	244,440	16,977	127	3,731	4,850	270,125
	90.49	*6.28*	*0.05*	*1.38*	*1.8*	*100*
Total	1,313,314	92,777	737	21,942	29,858	458,628
	90.04	*6.36*	*0.05*	*1.5*	*2.05*	*100*

Table 2: **Descriptive statistics**

	No disability		**Disability**	
	Mean	Std. Dev.	Mean	Std. Dev.
Female	0.45	0.50	0.41	0.49
Age	59.21	14.50	65.53	12.93
Pensioner	0.40	0.49	0.84	0.36
Family descendent	0.43	0.81	0.18	0.54
Family ascendent	0.01	0.10	0.00	0.07
Immigrants	0.13	0.34	0.11	0.31
Level of education				
Primary	0.44	0.50	0.65	0.48
Secondary	0.49	0.50	0.33	0.47
Tertiary	0.06	0.24	0.02	0.13
Region				
Catalonia	0.18	0.38	0.17	0.38
Andalusia	0.17	0.37	0.20	0.40
Galicia	0.07	0.25	0.10	0.30
Leon	0.06	0.24	0.05	0.22
Cantabria	0.01	0.12	0.02	0.13
Valencia	0.11	0.31	0.10	0.29
Castilla la Mancha	0.05	0.21	0.04	0.20
Madrid	0.14	0.35	0.08	0.27
Asturia	0.03	0.16	0.04	0.21
Aragon	0.03	0.18	0.02	0.15
Exstremadura	0.03	0.16	0.02	0.15
Rioja	0.01	0.09	0.01	0.08
Canaries Island	0.04	0.20	0.03	0.17
Balearic Island	0.02	0.15	0.02	0.14
Murcia	0.03	0.16	0.04	0.20
Earning	15511.98	16297.51	11775.98	9674.51
Tot. Obs.	**3057725**		**248340**	

Table 3: **Transition Probability by gender**

	No Disab	**Disab 33%**	**Disab 33% plus help**	**Disab 65%**	**Dead**	Tot obs
			Female			
No Disab	993,481	4,878	84	773	14,691	1,013,907
	97.99	*0.48*	*0.01*	*0.08*	*1.45*	*100*
Disab 33%	1,091	70,712	86	360	1,506	73,755
	1.48	*95.87*	*0.12*	*0.49*	*2.04*	*100*
Disab 33% plus help	43	83	428	32	4	590
	7.29	*14.07*	*72.54*	*5.42*	*0.68*	*100*
Disab 65%	171	143	10	15,323	793	16,440
	1.04	*0.87*	*0.06*	*93.21*	*4.82*	*100*
			Male			
No Disab	1,224,263	7,393	150	820	18,628	1,251,254
	97.84	*0.59*	*0.01*	*0.07*	*1.49*	*100*
Disab 33%	1,827	112,043	136	384	3,179	117,569
	1.55	*95.30*	*0.12*	*0.33*	*2.70*	*100*
Disab 33% plus help	74	136	636	50	1	897
	8.25	*15.16*	*70.90*	*5.57*	*0.11*	*100*
Disab 65%	265	284	21	10,162	623	11,355
	2.33	*2.50*	*0.18*	*89.49*	*5.49*	*100*

Table 4: **Transition Probability by gender from Order Logit Model**

Female

	No Disab	**Disab 33%**	**Disab 33% plus help**	**Disab 65%**	**N**
No Disab	0.9943	0.0049	0.0001	0.0007	1031193
Disab 33%	0.0141	0.9799	0.0011	0.0049	72347
Disab 33% plus help	0.0759	0.1465	0.7181	0.0594	601
Disab 65%	0.0089	0.0095	0.0008	0.9808	16802

Male

	No Disab	**Disab 33%**	**Disab 33% plus help**	**Disab 65%**	**N**
No Disab	0.9935	0.0056	0.0001	0.0008	1245430
Disab 33%	0.0162	0.9785	0.0010	0.0043	113580
Disab 33% plus help	0.0794	0.1507	0.7153	0.0546	905
Disab 65%	0.0269	0.0235	0.0018	0.9478	11061

Table 5: **Transition Probability by gender from Order Logit Model including Death**

Female

	No Disab	**Disab 33%**	**Disab 33% plus help**	**Disab 65%**	**Dead**	**N**
No Disab	0.9922	0.0052	0.0001	0.0007	0.0019	1067720
Disab 33%	0.0153	0.9758	0.0011	0.0044	0.0034	72629
Disab 33% plus help	0.0750	0.1432	0.7148	0.0625	0.0045	631
Disab 65%	0.0103	0.0109	0.0009	0.9672	0.0107	16682

Male

	No Disab	**Disab 33%**	**Disab 33% plus help**	**Disab 65%**	**Dead**	**N**
No Disab	0.9917	0.0055	0.0001	0.0007	0.0020	1291760
Disab 33%	0.0156	0.9760	0.0010	0.0042	0.0031	114249
Disab 33% plus help	0.0817	0.1501	0.7101	0.0550	0.0032	950
Disab 65%	0.0248	0.0223	0.0017	0.9465	0.0047	11083

Table 6: **Marginal Effects Order Logit Model**

Initial State: No Disab	**No Disab**	**Disab 33%**	**Disab 65%**
Female	0.00067***	-0.00058***	-0.00008***
	-0.00007	*-0.00006*	*-0.00001*
Age	-0.00152***	0.00132***	0.00017***
	-0.00005	*-0.00004*	*-0.00001*
Age square	0.00002***	-0.00001***	-0.00000***
	-0.00002	*-0.00005*	*0.0000*
Pensioner	-0.01147***	0.00975***	0.00152***
	-0.00022	*-0.00019*	*-0.00005*
Family descendent	0.00001	0.00001	0.00001
	-0.00005	*0.00004*	*0.00003*
Family ascendent	-0.00159***	0.00138***	0.00018***
	-0.00026	*-0.00023*	*-0.00003*
Immigrants	0.00163***	-0.00143***	-0.00018***
	-0.00012	*-0.00011*	*-0.00001*
Level of education*			
Primary Ref. cat.			
Secondary	0.00095	-0.00115	-0.00015
	-0.00278	*-0.00246*	*-0.00033*
Tertiary	0.00132	-0.00199	-0.00024*
	-0.00283	*-0.00128*	*-0.00014*
Earning	0.00011***	-0.00010***	-0.00001***
	-0.00004	*-0.00004*	*-0.0001*

Initial State: Disab 33%	**No Disab**	**Disab 33%**	**Disab 65%**
Female	-0.00286***	0.00168***	0.00168***
	-0.0004	*-0.00024*	*-0.00024*
Age	0.00093***	-0.00055***	-0.00032***
	-0.00017	*-0.0001*	*-0.00006*
Age square	-0.00001***	0.00001***	0.00000***
	0.0000	*0.0000*	*0*
Pensioner	-0.03892***	0.03408***	0.00394***
	-0.00217	*-0.00215*	*-0.00015*
Family descendent	-0.00215***	0.00127***	0.00127***
	-0.00049	*-0.00029*	*-0.00029*
Family ascendent	-0.00651**	0.00383**	0.00383**
	-0.00321	*-0.00189*	*-0.00189*
Immigrants	0.00648***	-0.00475**	-0.00142***
	-0.0023	*-0.00191*	*-0.00033*
Level of education*			
Primary Ref. cat.			
Secondary	0.00013	-0.00008	-0.00004
	-0.00104	*-0.00062*	*-0.00035*
Tertiary	0.00449*	-0.00315	-0.00110**
	-0.00273	*-0.00214*	*-0.00048*
Income	-0.01146***	0.00674***	0.00388***
	-0.0004	*-0.00032*	*-0.00017*

Initial State: Disab 65%	**No Disab**	**Disab 33%**	**Disab 65%**
Female	-0.00298***	-0.00410***	-0.00410***
	-0.00059	*-0.00068*	*-0.00068*
Age	0.00127***	0.00175***	-0.00316***
	-0.00015	*-0.00021*	*-0.00034*
Age square	-0.00001***	-0.00002***	0.00003***
	0.0000	*0.0000*	*0.0000*
Pensioner	-0.00324***	-0.00421***	0.00778***
	-0.00096	*-0.00104*	*-0.00206*
Family descendent	-0.00081**	-0.00112**	-0.00112**
	-0.00034	*-0.00045*	*-0.00045*
Family ascendent	0.00149	0.00204	0.00204
	-0.00222	*-0.00304*	*-0.00304*
Immigrants	0.0033	0.00421*	-0.00783*
	-0.0021	*-0.00248*	*-0.00475*
Level of education*			
Primary Ref. cat.			
Secondary	-0.00169***	-0.00018***	0.00414***
	-0.00057	*-0.00006*	*-0.00132*
Tertiary	-0.00345	0.00505	0.0026
	-0.01486	*-0.02179*	*-0.01107*
Income	-0.00242***	-0.00333***	0.00601***
	-0.0004	*-0.00041*	*-0.00081*

The reference categories for education is: primary education.

Region dummy are included. Standard errors in italics. Significance levels: *** 1%; ** 5%; * 10%

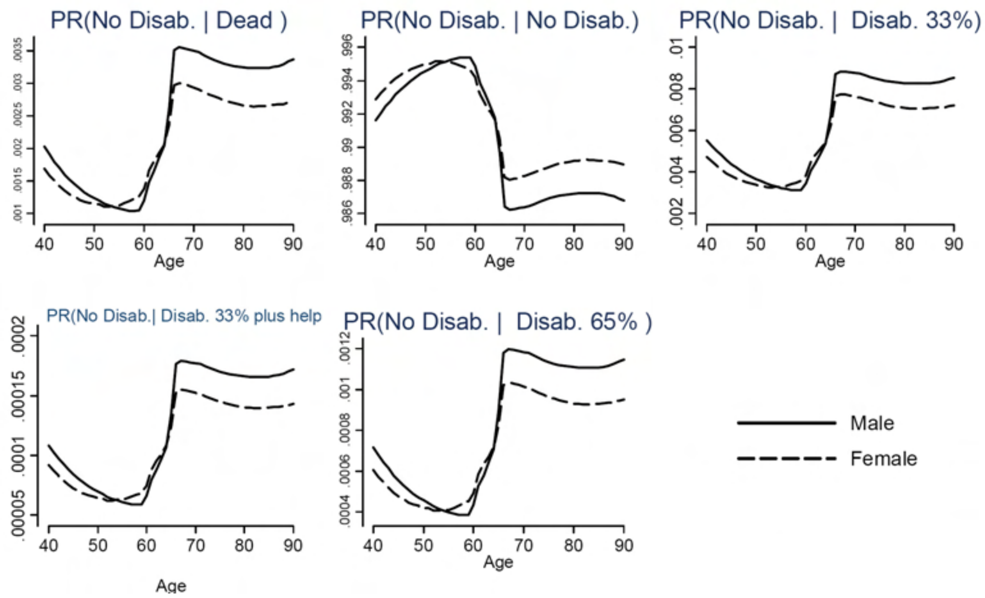

Figure 2: Transition Probability from No Disability: by age

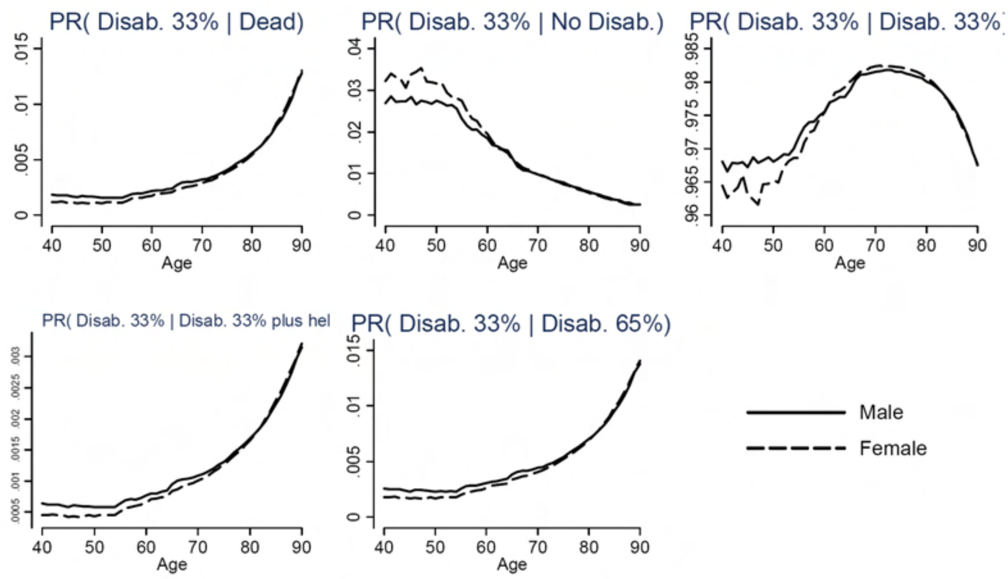

Figure 3: Transition Probability from Disability 33%: by age

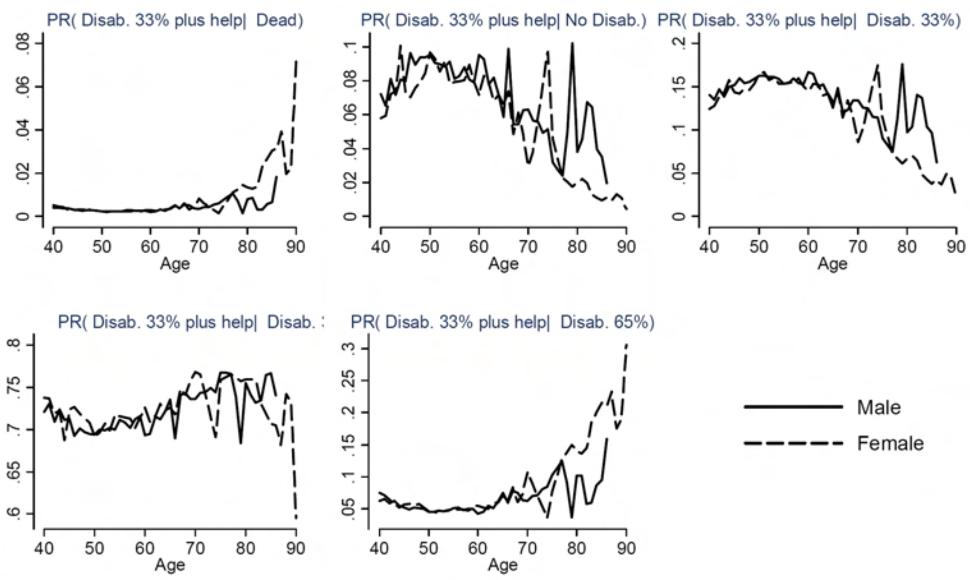

Figure 4: Transition Probability from Disability 33% plus help: by age

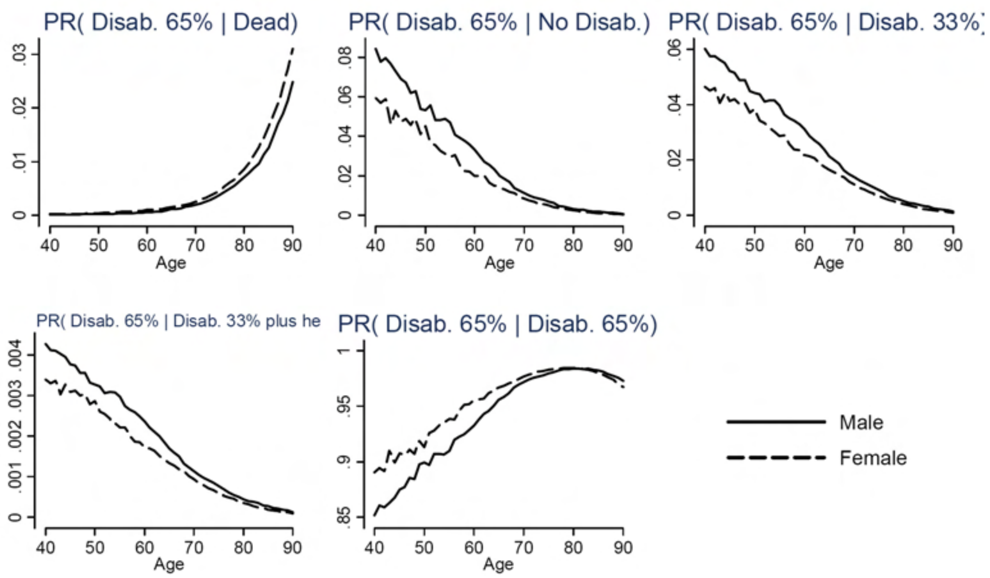

Figure 5: Transition Probability from Disability 65%: by age

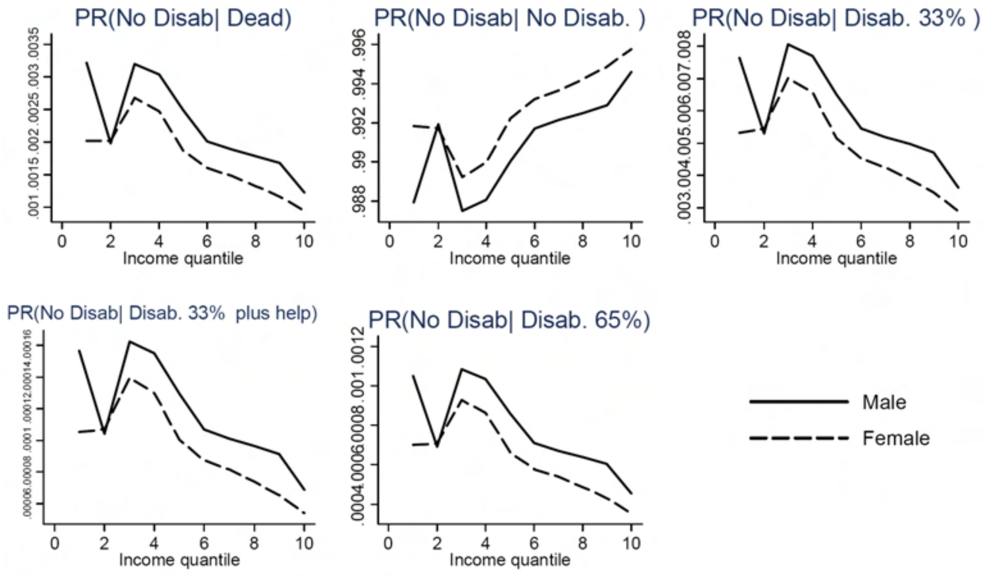

Figure 6: Transition Probability from No Disability: by income quantile

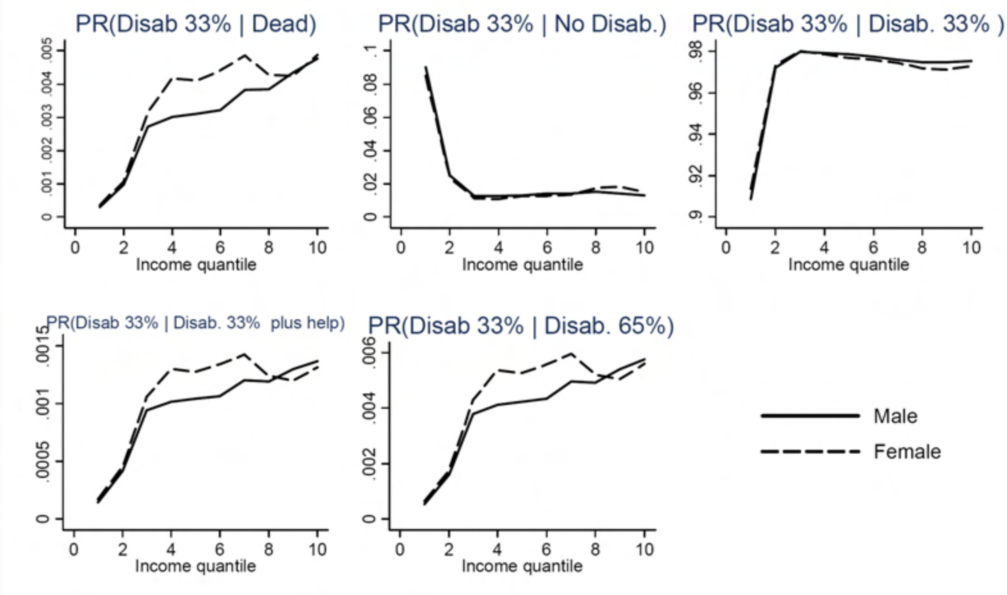

Figure 7: Transition Probability from Disability 33%: by income quantile

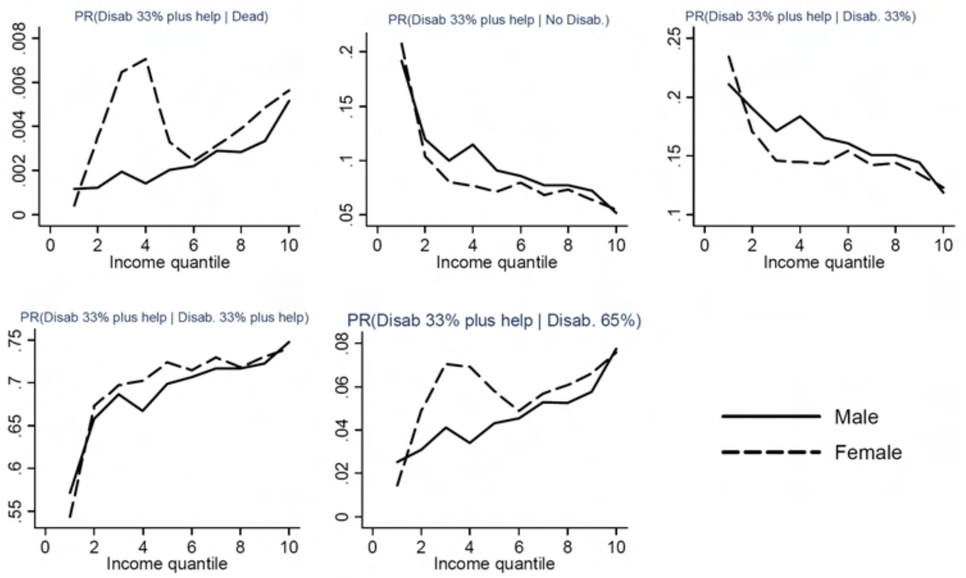

Figure 8: Transition Probability from Disability 33% plus help: by income quantile

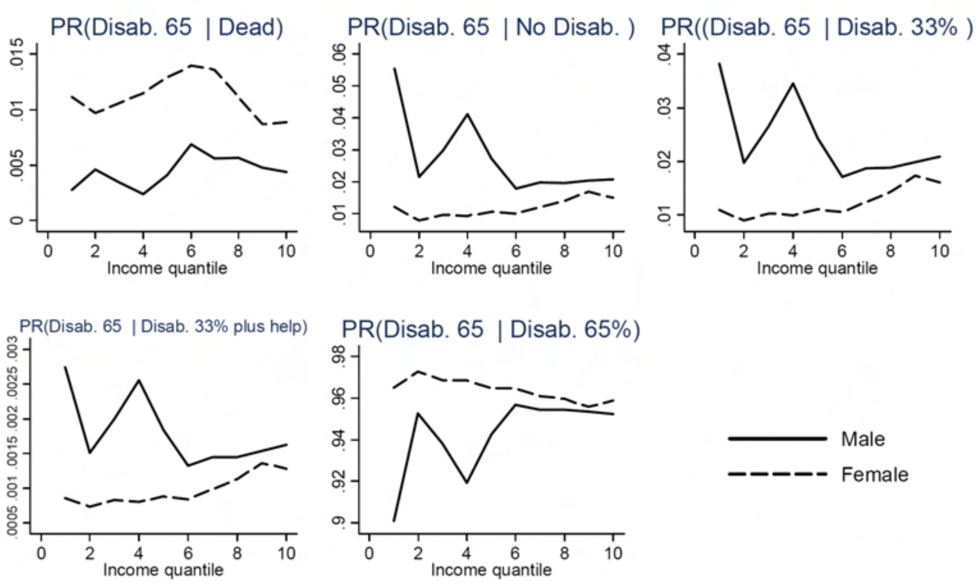

Figure 9: Transition Probability from Disability 65%: by income quantile

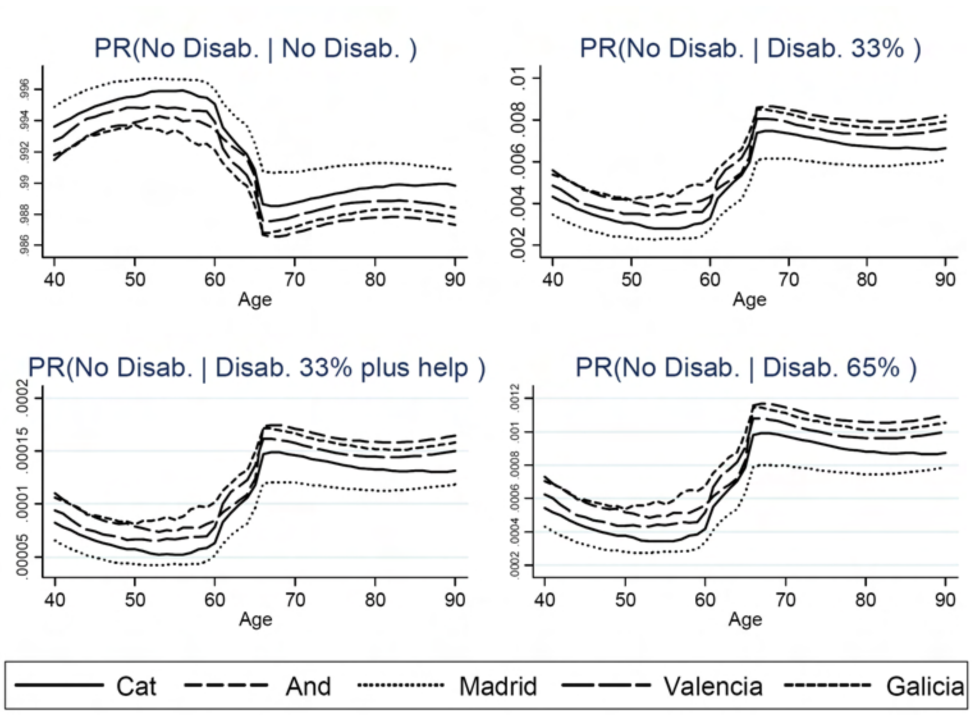

Figure 10: Female Transition Probability from No Disability: by region

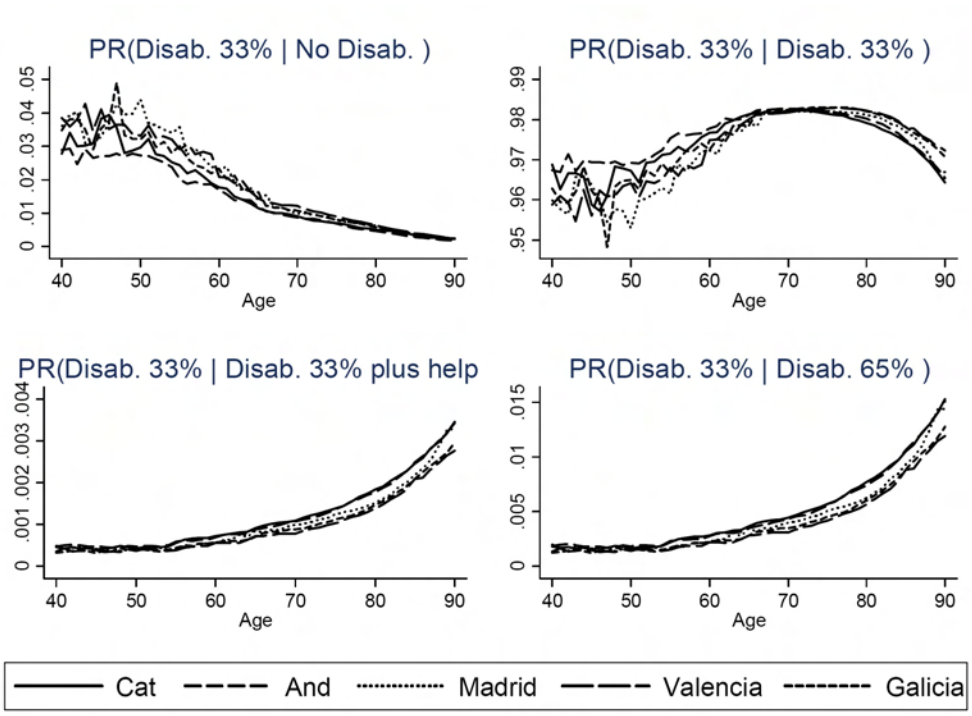

Figure 11: Female Transition Probability from Disability 33%: by region

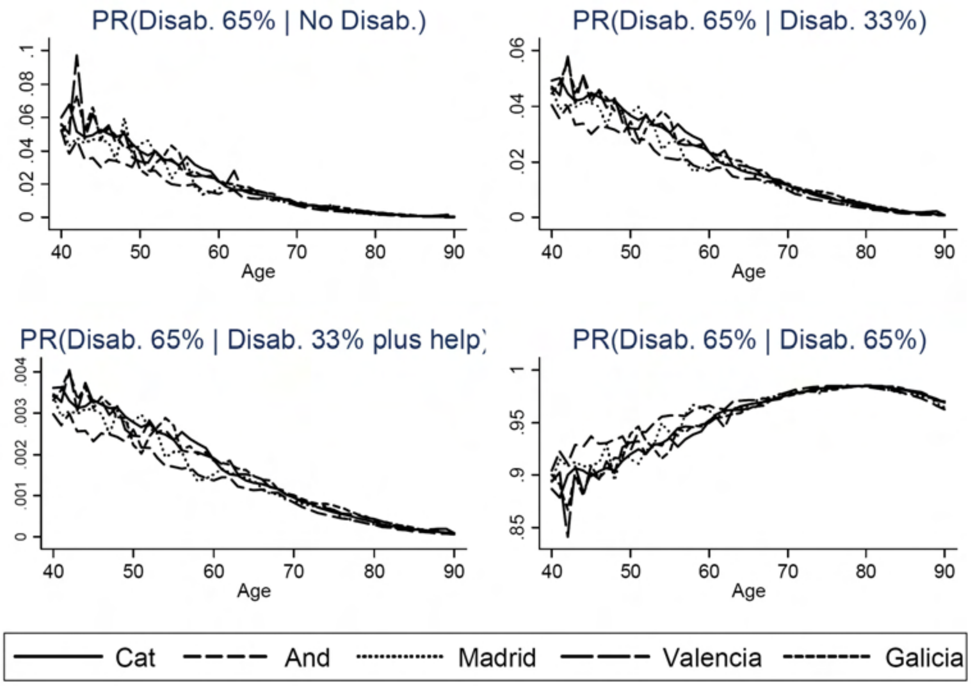

Figure 12: Female Transition Probability from Disability 65%: by region

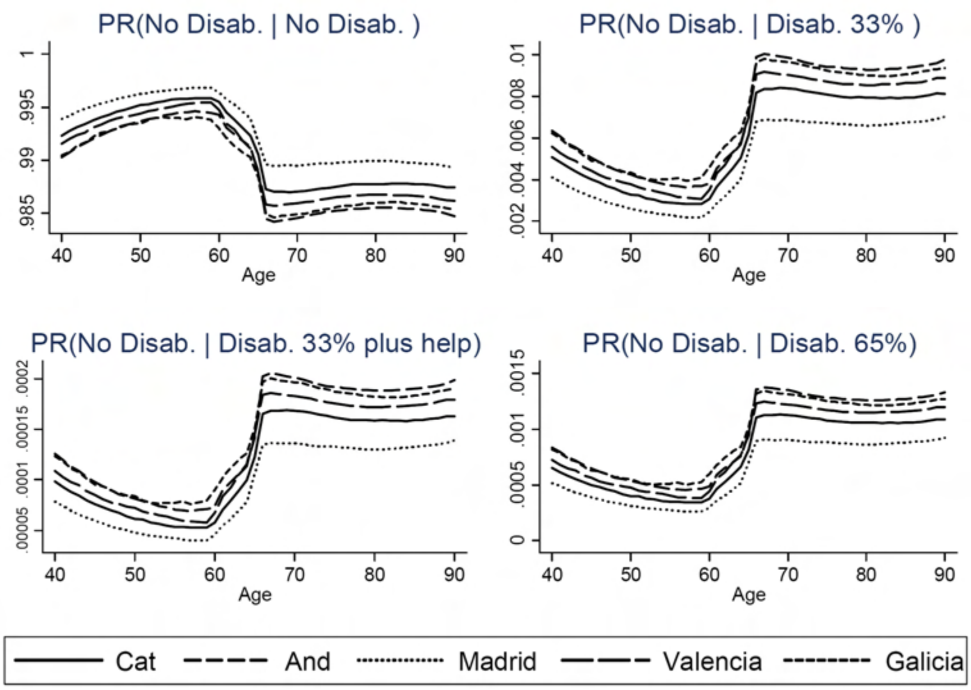

Figure 13: Male Transition Probability from No Disability: by region

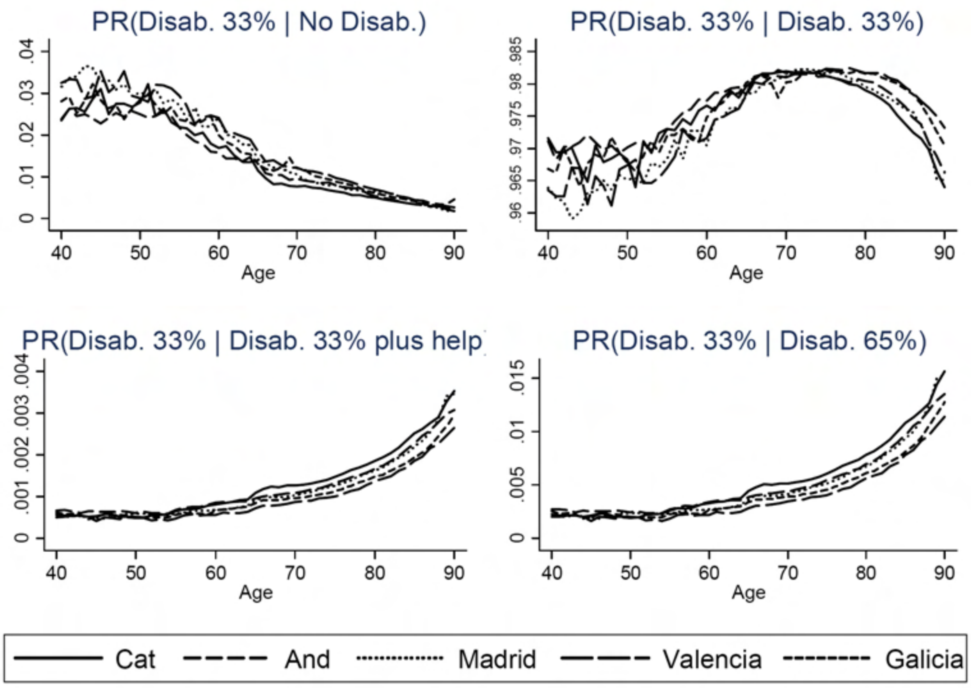

Figure 14: Male Transition Probability from Disability 33%: by region

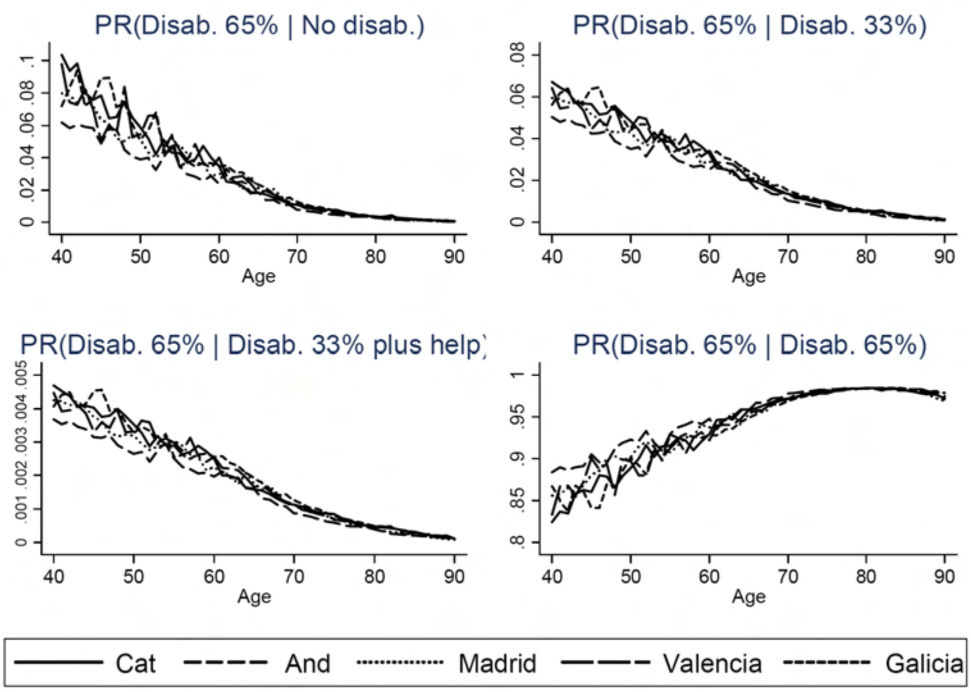

Figure 15: Male Transition Probability from Disability 65%: by region

Table 7: **Cox Proportional Hazard Model: Transition in a different disability state**

	Men	Women
Age	0.18601***	0.02148**
	-0.00905	-0.00916
Age square	-0.00191***	-0.00009
	-0.00007	-0.00007
Family ascendent	0.36294***	0.31783***
	-0.07427	-0.09983
Family descendent	0.02728*	0.00578
	-0.01401	-0.01977
Pensioner	1.46315***	1.30874***
	-0.02739	-0.0356
Level of education*		
Secondary	0.24963	-1.64452
	-1.00033	-1.00048
Tertiary	-0.17243	-2.01406**
	-1.00189	-1.0024
Earning	-0.16511***	-0.06422**
	-0.01261	-0.01695
N	1604043	1293768

* The reference categories for education is: primary education. Region dummy are included.

Standard errors in italics.

Significance levels: *** 1%; ** 5%; * 10%

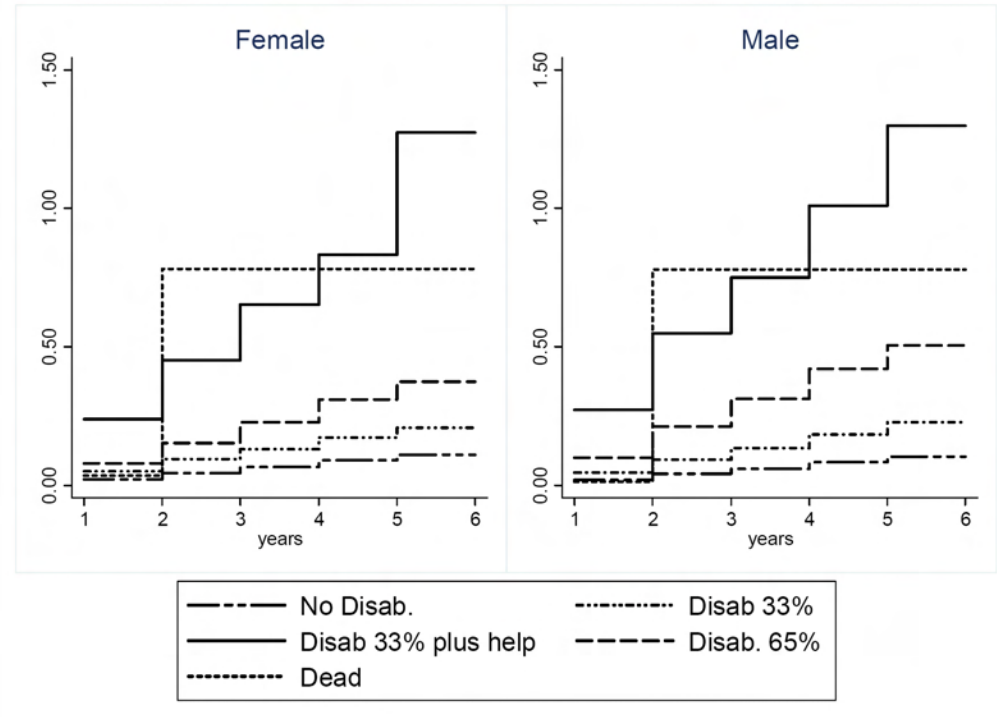

Figure 16: Cumulative Hazard Rates by disability degree

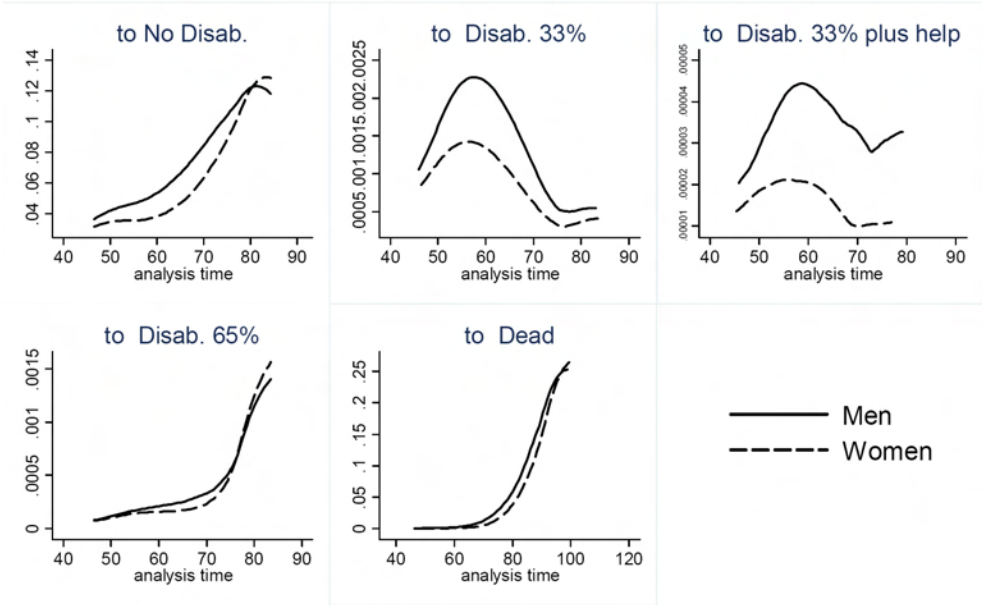

Figure 17: Hazard Rates out of No Disab.

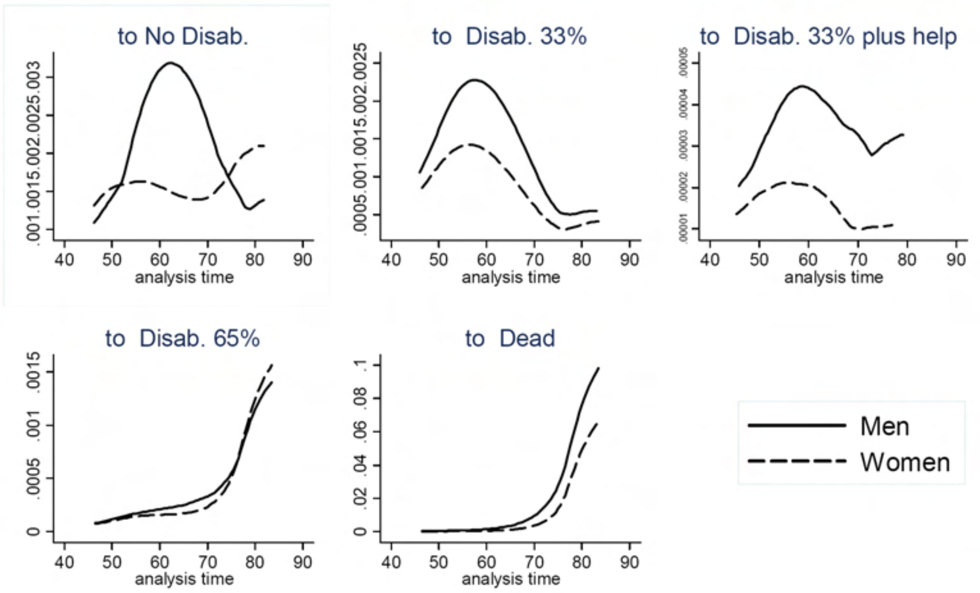

Figure 18: Hazard Rates out of Disab. 33%

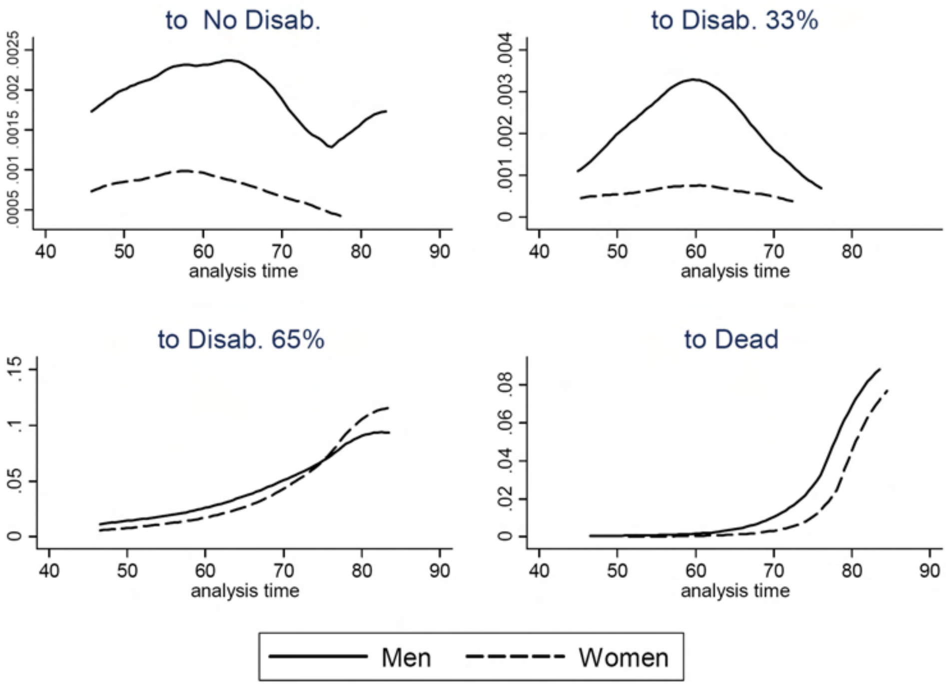

Figure 19: Hazard Rates out of Disab. 65%

Table 8: **Disability description among two years**

	Improvement		Deterioration
20	11.98	02	5.16
10	80.44	01	82.6
21	7.58	12	12.24
N	**501**		**1299**

Table 9: **Disability description among two years**

	Improvement					
		Age 16-65			**Age +65**	
	from 2 to 0	**from 2 to 1**	**from 1 to 0**	**from 2 to 0**	**from 2 to 1**	**from 1 to 0**
Gender	1.39	1.41	1.41	1.50	1.38	1.44
Primary	0.22	0.32	0.20	0.73	0.82	0.74
Secondary	0.68	0.67	0.72	0.23	0.12	0.23
Tertiary	0.11	0.02	0.08	0.04	0.04	0.03
Difference in Pension	-10432.64	-7349.22	-1215.40	-4083.60	-3682.90	-2256.82
N	38	22	267	22	16	136
	Deterioration					
		Age 16-65			**Age +65**	
	from 0 to 2	**from 2 to 1**	**from 0 to1**	**from 0 to 2**	**from 2 to 1**	**from 0 to1**
Gender	1.33	1.43	1.40	1.37	1.25	1.41
Primary	0.26	0.09	0.17	0.73	0.72	0.78
Secondary	0.68	0.80	0.75	0.25	0.27	0.21
Tertiary	0.06	0.11	0.08	0.02	0.01	0.01
Difference in Pension	6021.55	4333.50	2953.89	3433.86	2739.20	1821.47
N	100	47	705	59	20	368
	No transition					
			Age 16-65	**Age +65**		
Gender			1.41	1.36		
Primary			0.19	0.79		
Secondary			0.72	0.20		
Tertiary			0.09	0.01		
Difference in Pension			194.57	150.04		
N			131800	66255		

Table 10: **Monthly Disability Benefits by year and type of disability in euro**

Men				
	Total disability	**Disab. 55%**	**Disab.75%**	**Partial Disab.**
2005	521.31	298.01	448.72	87.17
2006	584.17	320.25	477.45	96.50
2007	639.39	352.13	523.59	104.52
2008	703.68	382.70	565.69	109.58
2009	739.57	401.18	589.05	113.22
2010	799.26	428.60	627.64	116.19
Women				
	Total disability	**Disab. 55%**	**Disab.75%**	**Partial Disab.**
2005	369.07	202.08	292.03	63.83
2006	398.05	219.66	309.54	70.14
2007	446.46	241.90	339.37	77.68
2008	502.26	263.48	366.88	86.06
2009	531.55	271.33	380.72	85.81
2010	580.21	290.07	401.02	83.73