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W.E. UPJOHN INSTITUTE FOR EMPLOYMENT RESEARCH
Researching the causes and consequences of unemployment

Partial Disability System and Labor Market Adjustment: The Case of Spain

Upjohn Institute Working Paper No. 13-201

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ABSTRACT

Although partially disabled individuals in Spain are allowed to combine the receipt of disability benefits with a job, the empirical evidence shows that employment rates for this group of individuals are very low. Therefore, in this paper we construct labor market model with search intensity and matching frictions in order to identify the incentives and disincentives to work provided by the partial disability system in Spain from the point of view of both disabled individuals and employers. According to the model, the high employment rate gap observed between nondisabled and disabled workers can be partially explained by the presence of a lower level of productivity and higher searching costs among disabled individuals that discourage them from looking for jobs. Moreover, the design of the Spanish Disability System also contributes in explaining this gap. We also analyze the role of business cycle conditions in shaping the labor market transitions of disabled individuals.

JEL Classification Codes: I18, J64, J68

Key Words: disability system, job search intensity, flow analysis.

Partial Disability System and Labor Market Adjustment: The Case of Spain

In recent years, disability policies have attracted particular attention in OECD countries because they represent an important source of public spending and also because societies are increasingly concerned about the need to strengthen the integration of people with disabilities. For these reasons, the possibility of increasing the number of disabled individuals who work is regarded as a good strategy to decrease the pressures on the financial stability of the social security systems as well as to achieve the social integration of people with disabilities. As the OECD notes, “Helping (disabled) people to work is potentially a ‘win-win’ policy: it helps people avoid exclusion and have higher incomes while raising the prospect of more effective labor supply and higher economic output in the long term” (OECD 2007).

The promotion of the employment of disabled individuals is particularly relevant in Spain, where partially disabled individuals are allowed to combine the receipt of (part) of the disability benefits with a job without any limit on the maximum wage or number of hours worked. Nonetheless, the country reported an average employment rate of just 11 percent for the group of people with partial disability from 2001 to 2011, which contrasts with the observed rate for nondisabled employees (79.9 percent). The employment rate falls to less than 6 percent when only considering people with disabilities in the age bracket 55–65 (which represents 45 percent of all the partially disabled individuals in Spain).

Therefore, in this paper we perform an analysis of the incentives and disincentives to work provided by the partial disability system in Spain from the point of view of both disabled individuals and employers. At the same time, we also identify the role of business cycle conditions in shaping the labor market transitions of disabled individuals using data for the period 2001–2011, which includes the last expansion and recession of the Spanish economy. The central goal of the study is to isolate the role of the disability system in explaining the low employment rates of partially disabled individuals in Spain vis-à-vis their nondisabled counterparts. The final aim is to reach some conclusions about the types of policy initiatives that could be more effective in increasing both individual incentives to work as well as employers' incentives to hire disabled workers.

To do this, we consider a search and matching model of individuals with disabilities and their interaction with nondisabled individuals in the search for jobs. Additionally, we also include in the model the hiring decisions made by companies and the incentives available in the legislation to hire disabled workers. We assume that, due to their disabling condition, disabled workers are, on average, less productive and incur higher job searching costs than nondisabled individuals. The presence of a productivity gap in our model is consistent with the recent empirical evidence presented by Malo and Pagan (2012).[1] They show that between 68 and 74 percent of the Spanish wage differential between nondisabled and disabled workers is due to the differences in workers characteristics, which generate a productivity gap of nondisabled workers with respect to their disabled counterparts.[2] In contrast, the authors show that less than 30 percent of the wage gap between these two groups of workers can be attributed to the presence of discrimination.[3]

[1] This paper uses the Oaxaca-Blinder wages decomposition method for Spain and other European countries.

[2] Because the authors use data from the ECHP survey, they define disabled workers as "individuals that are hampered in their daily activities."

[3] In their paper, Malo and Pagan (2012) show that Spanish workers with disabilities hampered in their daily activities earn between 1.71 and 1.44 euros per hour less than workers who are not disabled. They also find that most of this wage gap is related to workers' and jobs' characteristics that lead to a productivity gap. Moreover, the wage differences between nondisabled and disabled workers who are not hampered for their daily activities are not statistically significant, so that the presence of discrimination is not empirically proved. Similar results are found for most of the 11 European countries considered in their data.

We calibrate and simulate the structural model to match a number of stylized facts observed in the administrative data provided by the Spanish Social Security Administration (the Continuous Sample of Working Lives). Our simulated model helps to understand the differences between disabled and nondisabled workers. More in detail, it simulates an employment rate of 24.0 percent among disabled workers, which is much lower than the simulated one for nondisabled individuals (79.9 percent). The model also shows that the job finding rate for disabled workers is much lower and the job separation rate is higher than for nondisabled workers. These results are in line with the data presented in this paper.

The sensitivity analysis shows that both workers and firms are sensitive to the main policy parameters, especially for those remaining operative during the different labor market conditions. Thus, according to the model, part of the employment rate gap observed between nondisabled and disabled workers can be attributed to the design of the Spanish Disability System, which contributes to generate a 64 percent job search intensity gap between disabled and nondisabled individuals. Part of this lower search intensity can be explained by the presence of cost gaps in both productivity and job searching that discourage disabled workers from looking for jobs. However, our model also indicates the level of disability benefits for disabled workers increases their employment opportunity costs and, therefore, reduces their job search intensity.

This result is in line with the one reported by Silva and Vall-Castello (2012a), who focus on the employment effects of an increase in disability benefits that is granted to disabled individuals who turn 55. They design, calibrate, and simulate a structural labor supply model of job search with labor force participation decisions of individuals with disabilities. They show that the employment rate for disabled individuals is lower because the increase in the level of disability benefit generates the incentive to stay out of the labor force. However, this study only reproduces the behavior of disabled individuals without including the interactions between disabled and nondisabled workers, and it also neglects the role of employers.

Our simulated model also shows that 87.0 percent of the times the firm and the disabled worker meet, a new employment relationship is created. This result occurs because of the policy incentives in place for employers to hire disabled workers. In other words, the model suggests that although firms are willing to hire disabled individuals, these workers look for jobs with much less intensity than nondisabled individuals. Moreover, since disabled workers receive disability benefits, they have a higher adjusted employment opportunity cost and, therefore, are separated from their jobs with higher frequency than nondisabled ones.

In terms of policy interventions, the sensitivity analysis shows that the employment rate gap between disabled and nondisabled workers can be considerably reduced by decreasing the percentage of the regulatory base received by partially disabled individuals, by increasing the deduction to Social Security Contributions paid by the employer, or by increasing the tax deduction for disabled workers. In contrast, the model shows that transitory lump-sum subsidies have a much lower impact in the employment rate of disabled individuals.

In contrast to the strong incentive to hired disabled individuals from the unemployment status, employers do not tend to maintain their workers in the firm when they receive the negative health shock and become partially disabled. According to our model, less than 10 percent of the employees who become disabled are kept in the same firm. This result is in line with the low employment survival rate for new disabled employees observed in the data (17.3 percent). It is important to emphasize that, in this case, firms do not receive a lump-sum tax if they keep the new disabled employee in the firm.

Finally, the model shows that the employment rate, the job finding rate, and the job survival rate in the same firm are positively correlated with the gross domestic product (GDP). This result goes in line with the procyclical behavior of these rates shown by the data. Furthermore, the job destruction rate is negatively correlated with GDP, which is in line with its empirical countercyclical response.

Besides the aforementioned work by Silva and Vall-Castello (2012), we have found no literature that studies the job search process of disabled individuals. There is also no literature that analyzes the matching problems in the labor market for individuals with disabilities through the use of structural models. However, two studies analyze the labor supply behavior of individuals with disabilities using life-cycle models in the United States: Benitez-Silva, Buchinsky, and Rust (2010) and Yin and Benitez-Silva (2009). Both studies focus on the U.S. economy, where the disability system does not allow disabled individuals to combine the benefits with a job, which is very different from the Spanish system. Furthermore, these studies do not consider interactions with nondisabled workers or the role of employers. In our model, we include search intensity and matching frictions because we think that they play a central role in determining employment outcomes of disabled individuals. With respect to the empirical evidence on the labor market behavior of disabled individuals, there is an extensive literature analysing the U.S. system (see Autor and Duggan [2006, 2007, 2008]; Autor, Duggan, and Lyle [2011]; Burkhauser and Daly [2011], among others), but the literature is still very limited for the Spanish case (Cervini-Plá, Silva, and Vall-Castello 2012; Malo and Pagan 2012; Marie and Vall-Castello 2012; Vall-Castello 2012).

The paper proceeds as follows. The next two sections describe the specificities of the Spanish system of disability benefits and compare the Spanish labor market behavior for partially disabled and nondisabled individuals from 2001 until 2011. The following sections introduce the job search and matching model and present its calibration. The paper then presents the steady state benchmark simulation and compares it with the data, and after that presents the sensitivity analysis to the policy parameters. It then looks at the business cycle behavior of the disabled workers. Finally, some conclusions are derived in the last section.

MAIN FUTURES OF THE SPANISH SYSTEM OF DISABILITY BENEFITS

After the period of the Franco regime, the first comprehensive piece of legislation that was passed in Spain with respect to individuals with disabilities was the "Ley de Integración Social de los Minusvalidos" (LISMI), which was approved in 1982. The law included various aspects ranging from disability benefits as a way to economically protect disabled individuals to employment promotion measures to promote the labor market integration of disabled individuals. After this first important step, a number of small changes have been adopted during the 1990s and 2000s in terms of employment promotion measures to increase the incentive to work and hire disabled workers.

Economic Incentives for Employers to Hire Disabled Workers

As shown in Table 1, currently there are three main economic incentives for employers that hire disabled workers. First, there is a lump-sum subsidy of 3,906.58 euros for each disabled worker hired (this amount is adjusted proportionally for part-time contracts). Second, employers can benefit from deductions to the Social Security contributions. These deductions are linked to the gender and the intensity of the disability of the worker. In general the deductions are 4,500 euros per year, but they increase to 5,350 for women, to 5,700 for women above age 45, to 5,100 for individuals with a severe disability, to 5,950 for women with a severe disability, and to 6,300 for women with a severe disability and age above 45. Finally, the third element that is included in the package of financial incentives for employers to hire disabled workers is another subsidy that aims to adapt the working space to the special needs that the disabled worker may have. The maximum amount of this subsidy is set at 902 euros and is only paid one time for each contract.

Furthermore, a new piece of legislation was passed in 2001 to stress the fact that all these measures would no longer be applied to certain contracts, such as those to family members, to workers who had worked in the firm in the past 24 months with a permanent contract, or to workers who had ended a permanent contract during the last three months.

Table 1 Summary of the Economic Incentives for Employers

Lump-sum subsidy (one for each contract)	Deductions to the Social Security contributions	Other subsidies
3,906.58 (open to part-time contracts; proportional)	4,500 euros/year 5,350 women 5,700 women > 45 5,100 severe disability 5,950 women severe disability 6,300 women severe disability>45[a]	Ask to INEM for subsidies to adapt the working space[b] up to a maximum of 902 euros

NOTE: [a] If it is a part-time contract the deductions will be 100 percent if 75 percent of full-time work, 75 percent if she works between 50 and 75 percent, 50 percent if she works between 25 and 50 percent, and 25 percent if she works less than 25 percent. This was changed in RD2/2009: the deductions will equal the percentage worked plus 30 percent (with a 100 percent limit).
[b] In 1994 the maximum amount of this subsidy was set at 901.5 euros.

Economic Incentives for Disabled Workers

The disability system in Spain distinguishes between two types of permanent disability benefits: 1) contributory, which are given to individuals who have generally contributed to the Social Security system before the onset of the disabling condition; 2) and noncontributory, which are given to individuals who are assessed to be disabled but have never contributed to the Social Security system (or do not reach the minimum contributory requirement to access the contributory system). Noncontributory disability benefits are means-tested and managed at the regional level. [4]

[4] Income is evaluated yearly. The income threshold in 2010 was set at 4,755.80 euros/year for an individual living alone. This amount is adjusted if the individual lives with other members.

The size of the noncontributory system is relatively small compared to the contributory system (197,126 individuals received noncontributory disability benefits in 2009, while 920,860 received contributory benefits during the same year). The amount of benefits received is also smaller in the noncontributory case (the average noncontributory pension is 417.09 euros/month compared to an average contributory disability pension of 831.49 euros/month). Because we want to assess the effect of disability on wages, in the remainder of the paper we focus only on the permanent contributory disability system in Spain.

The Spanish Social Security Administration defines the permanent contributive disability insurance as the economic benefits to compensate the individual for losing a certain amount of wages or professional earnings when affected by a permanent reduction or complete loss of his/her working ability due to the effects of a pathologic or a traumatic process derived from an illness or an accident.

In order to capture the different situations in which a person can be after suffering from a disabling condition, the Spanish Social Security A In 1994 the maximum amount of this subsidy was set at 901.5 euros. In 1994 the maximum amount of this subsidy was set at 901.5 euros. In 1994 the maximum amount of this subsidy was set at 901.5 euros. In 1994 the maximum amount of this subsidy was set at 901.5 euros. In 1994 the maximum amount of this subsidy was set at 901.5 euros. In 1994 the maximum amount of this subsidy was set at 901.5 euros. Administration uses a classification of three main degrees of disability that depend on the working capacity lost:[5]

[5] There is a fourth degree of disability benefits (permanent limited disability), but this type of benefit is already extinguished and it only consists of a one-time lump-sum payment.

1) Partial disability (57 percent of claimants): the individual is impaired to develop all or the fundamental tasks of his/her usual job or professional activity, but he/she is still capable of developing a different job or professional activity.

2) Total disability (40 percent of claimants): the individual is impaired for the development of any kind of job or professional activity.

3) Severe disability (3 percent of claimants): individuals who, as a result of anatomic or functional losses, need the assistance of a third person to develop essential activities of daily living, such as eating or moving.

The eligibility requirements and the pension amount depend on the source of the disability (ordinary illness, work-related or unrelated accident, or occupational illness); the level of the disability; and the age of the onset of the disabling condition. Table 2 summarizes the main parameters of both the eligibility criteria and the pension formula. With respect to eligibility, the number of years of contributions required depends on the age of the onset of the disabled condition for common illness, while there are no contributory requirements if the health impairment is due to either an accident or an occupational illness.

The total amount of the pension is obtained by multiplying a percentage, which varies depending on the type of pension and the degree of disability (as shown in the last rows of Table 2) to the regulatory base, which depends on the source of the disability and on previous salaries.[6] The percentage is 55 percent or 75 percent for partial disability beneficiaries, 100 percent for total disability and 150 percent for severe disability. Partial disability beneficiaries receive 55 percent of the regulatory base but this percentage can be increased to 75 percent for individuals who are older than 55 and have difficulties finding a job due to lack of education or characteristics of the social and labor market of the region where they live.

[6] Benefit = Regulatory base × Percentage.

The number of years included in the regulatory base depends on the source of the disability; for common illness the regulatory base is calculated by dividing by 112 the wage in the last 96 months (8 years) before becoming disabled. When the source of the disability is an accident unrelated to work, the regulatory base is calculated by dividing by 28 the wage in the last 24 months before becoming disabled. The individual can choose these 24 months from the last 7 years of work. For a work-related accident or professional illness, the regulatory base is calculated by dividing by 12 the wage in the last 365 days before becoming disabled.[7]

With respect to the taxes that disabled individuals have to pay, we can see in Table 3 that individuals with a total disability benefit are exempt from paying income taxes. On the contrary, partially disabled workers are required to pay income taxes (they are only exempt if the individual resides in the Basc country and the partially disabled worker does not have a job). However, there is a reduction in the employment income used to calculate the income tax for partially disabled workers. This reduction is 2,800 euros per year if the disability level is between 33 and 65 percent and 6,200 euros per year if the disability level is more than 65 percent (or if the individual has reduced mobility).

Because the aim of the paper is to analyze the incentives and disincentives to work provided by the disability system in Spain, we focus only on the group of partially disabled individuals, as they have been assessed to keep certain capacity to work by the Social Security medical team (in a professional activity that is different from the one developed before the onset of the disability). We do not include in our sample individuals with a total or a severe disability

[7] There was a reform in the calculation of the level of disability benefits for ordinary illness introduced in 2008. After the reform, there was a percentage that depended on the number of years contributed to the system that was multiplied by the regulatory base. We do not model this legislative change in this paper, and we include the pre-reform system in our model. However, to see the effect of this change on the inflow into the disability system, see Silva and Vall-Castello (2012b).

because they are supposed to be impaired for the development of any kind of job or professional activity.

Table 2 Summary of the Parameters to Calculate Permanent Disability Pensions

	Ordinary illness	Accident unrelated to work	Work-related accident or professional illness
Eligibility	Age >= 31: Contributed 1/4 time between 20 years old and disabling condition. Minimum of 5 years. Age < 30: Contributed 1/3 time between 16 years old and disabling condition. No minimum number of years required.	No minimum contributory period required.	No minimum contributory period required.
Regulatory base	Average wage last 8 years of work.	Average annual wage of 24 months within the last 7 years of work.	Average wage last year of work.
Percentage applied to the regulatory base	Partial disability: 55 percent. Individuals older than 55 with difficulties to find a job due to lack of education or characteristics of the social and labor market of the region where they live: 75 percent. Total disability: 100 percent. Severe disability: 100 percent + 50 percent.		

Table 3 Summary of the Fiscal Measures for Individuals Receiving Disability Benefits

	Partially disabled individuals	Totally disabled individuals
Income taxes	Pay normal income taxes. Exempt if Basc[a] country and no job.	Exempt from income taxes.
Reduction in employment income used to calculate the income tax	2,800 euros/year (if disability level between 33 percent and 65 percent) if working. 6,200 euros (if disability more than 65 percent or below that but disabled with reduced mobility) if working.	

NOTE: [a] Disabled individuals in the provinces of Vizcaya, Alava, and Guipuzcoa, which constitute the Basc country, are exempt from paying income taxes on total disability pensions if they don't work.

DATABASE

The study will use the Continuous Sample of Working Lives (*Muestra Continua de Vidas Laborales*, [MCVL]), which is a microeconomic data set based on administrative records provided by the Spanish Social Security Administration. It contains a random sample of 4 percent of all the individuals who, at some point during 2010, had contributed to the Social

Security system (either by working or being on an unemployment scheme) or had received a contributory benefit. The random sample selected contains over 1 million people.

There is information available on the entire employment and pension history of the workers, including the exact duration of employment, unemployment, and disability pension spells, and for each spell, several variables that describe the characteristics of the job or the unemployment/disability benefits. There is also some information on personal characteristics such as age, gender, nationality, and level of education. The macroeconomic variables used to capture the economic business cycle are derived from the Spanish "Instituto Nacional de Estadistica."

For the sample of disabled workers we select an inflow sample of all individuals that started receiving partial disability benefits between 2001 and 2010, and we follow their labor market transitions until 2010 or until they reach age 65, and they are automatically transferred to the old-age pension system. For the sample of nondisabled individuals we select a 30 percent random sample of all individuals that have never received (and never will receive) a disability pension, and we follow their transitions in the labor market from 2001 to 2010. For both samples, we consider an individual as employed if they are observed as working on December 15th.[8]

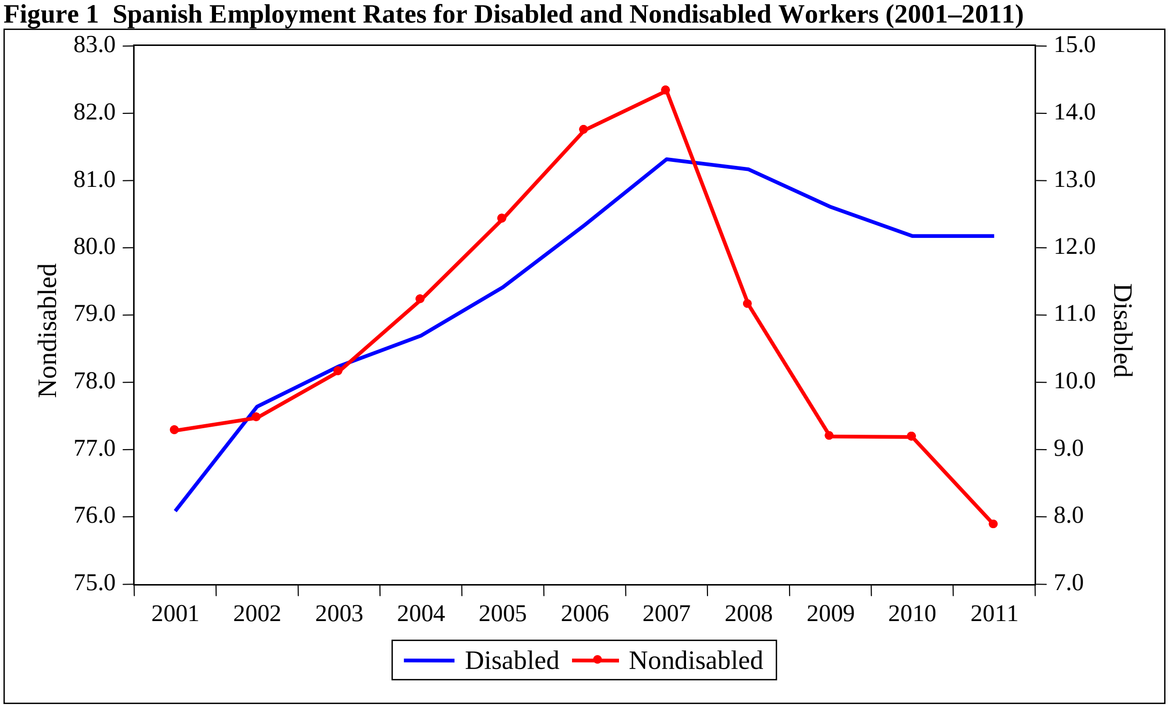
EMPLOYMENT AND TRANSITION RATES IN THE SPANISH LABOR MARKET FOR DISABLED AND NONDISABLED WORKERS

In this section we present a set of indicators that compare the Spanish labor market behavior for partially disabled (*d*) and nondisabled (*n*) individuals from 2001 until 2011. Figure

[8] We have also worked with a different definition of employment and the results do not change substantially. We have decided to use the December 15th definition because it proved to be the definition with a lower irregular component.

1 shows the annual employment rates of these two types of individuals, as a proportion of the working-age population. The first noteworthy result is the presence of an important employment gap between nondisabled and partially disabled workers during the whole period. More in detail, while the employment rate of nondisabled employees fluctuates between 78.2 percent and 82.3 percent, the corresponding rate of partially disabled employees moves between 8.1 percent and 13.3 percent. Both employment rates show a somewhat similar trend, increasing between 2001 and 2007 and decreasing during the current downturn.

Figure 1 Spanish Employment Rates for Disabled and Nondisabled Workers (2001–2011)

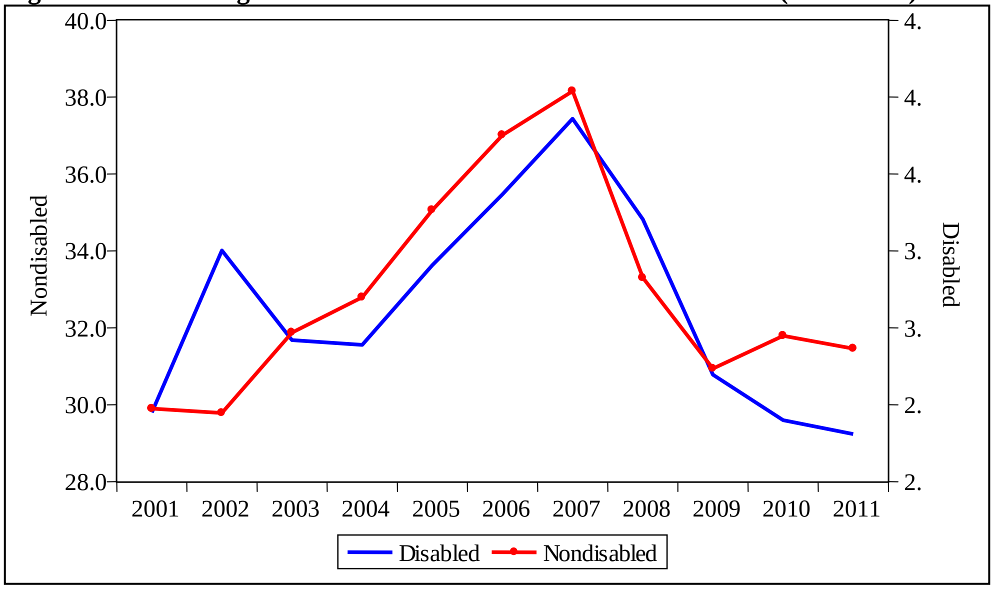


SOURCE: Authors' elaboration from the MCVL.

We also analyze the ins and outs of employment by considering measures of separation and job finding rates derived from the MCVL. Let eu_t^i and ue_t^i denote the gross flows from employment to nonemployment and from nonemployment to employment with i=d,n, respectively, and let e_{t-1}^i and u_{t-1}^i indicate the measured stocks of employed and nonemployed workers in year $t-1$, respectively. Then, the annual separation and job finding rates are determined by $\psi_t^i = \frac{eu_t^i}{e_{t-1}^i}$ and $f_t^i = \frac{ue_t^i}{u_{t-1}^i}$. Figures 2 and 3 show the evolution of the job finding and job separation rates for both disabled and nondisabled workers.

As can be observed in Figure 2, the job finding rate for the nondisabled is much higher than that for disabled people. On average, the job finding rate for the former is 10 times higher (0.329 and 0.033, respectively). In addition, both rates display similar behavior during the period, showing a correlation coefficient of 0.70. In turn, Figure 3 shows that the job separation rate of disabled workers is 2.5 times higher than that for nondisabled workers (0.215 vs. 0.092, on average). Moreover, both rates are positively correlated, displaying a correlation coefficient of 0.55.

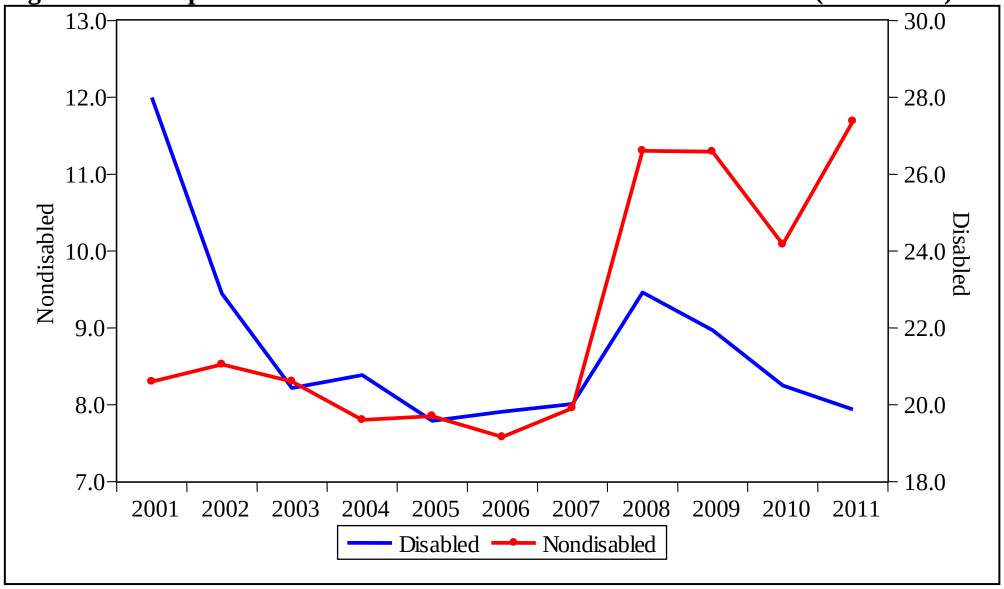
Figure 2 Job Finding Rates for Disabled and Nondisabled Workers (2001–2011)



SOURCE: Authors' elaboration from the MCVL.

Summarizing, we find that the job finding rate for disabled workers is much lower than for nondisabled workers, while the job separation rate is higher. These results imply that nonemployment spells for the disabled are much larger while, at the same time, these workers lose or separate from their jobs with higher frequency.

Figure 3 Job Separation Rates for Disabled and Nondisabled Workers (2001–2011)



SOURCE: Authors' elaboration from the MCVL.

As we have seen above, the Spanish system allows partially disabled individuals to work while receiving disability benefits. According to the law, however, partially disabled individuals cannot work in the same job position when becoming disabled, although they are still capable of doing a different activity. Therefore, once the individual becomes disabled, either the firm can reallocate these workers in a different job position inside the firm or the new disabled individual has to change his current job and search for a job in another firm. According to Figure 4, less than 20 percent of the nondisabled employees who become partially disabled continue working in the same firm just after the disabling condition (17.3 percent, in average). This survival rate, $\varrho_{e,t}^{d}$, is determined by the ratio between the new disabled individuals who remain employed in the same firm, $\mathrm{e}_{t-1}^{n}\mathrm{e}_{t}^{d}$, and the total flow of new disabled individuals, $\left(\mathrm{e}_{t-1}^{n}\mathrm{e}_{t}^{d} + \mathrm{e}_{t-1}^{n}u_{t}^{d}\right)$.

Therefore, using these transition rates that we have empirically obtained from the Spanish Social Security database, in the next sections we present and simulate a model with matching

Figure 4 Survival Employment Rate for New Disabled Employees (2001–2011)

SOURCE: Authors' elaboration from the MCVL.

frictions and search intensity that includes the main aspects of the Spanish Disability System in order to explain the labor market differences between disabled and nondisabled workers.

THE THEORETICAL MODEL

The economy consists of a continuum of risk-neutral, infinitely lived firms, and individuals who discount future payoffs at a common rate, β. We normalize the population to 1. Moreover, capital markets are perfect and time is discrete.

Individuals may be either nondisabled (*n*) or partially disabled (*d*). A partially disabled individual receives a pension equivalent to a proportion, α, of their average wage for the years previous to the accident or illness, $\mathrm{w}_0^{\mathrm{d}}$. A nondisabled individual can be converted into partially disabled with exogenous probability, π(the health shock). In turn, a partially disabled individual exits from the labor market with exogenous probability, ρ.

According to the Spanish disability system, an individual with partial disability cannot develop all of the fundamental tasks of his usual job, but he is still capable of developing a different job or professional activity. We assume that the firm can decide to offer him a reallocation in a different professional activity. If there is not reallocation inside the firm, the new disabled individual has to search for a new one.

Both partially disabled and nondisabled individuals can either be employed or unemployed. All workers compete in the labor market for the same jobs. Unemployed individuals enjoy an instantaneous utility b each period. This employment opportunity cost has to be given up when the worker finds a job. Following Pissarides (2000), unemployed workers have search intensity. Let s_t^j with $j = n,d$ be a variable measuring the intensity of search by each type of unemployed workers. Unemployed workers incur in convex job search costs, $b\left(s_t^j\right)^{\varpi}$, expressed in terms of the employment opportunity costs, b. It is more difficult for a person with a partial disability to look for jobs than it is for a person without one. Thus, we assume that the search costs for disabled individuals are proportional to the level of disability, dis.

Each period, any job position may be endogenously terminated. Exogenous separations may also occur with probability φ for any type of worker. When an employment relationship is broken, the worker becomes unemployed.

Each firm consists of one job that is either filled or vacant and uses only labor as input. Before a position is filled, the firm has to open a job vacancy with cost c per period. A firm's output depends on aggregate productivity A_t, a match-specific term z_t, and the worker's type. In particular, a job filled with nondisabled workers produces $A_t z_t$, whereas with a partial disability in continuing jobs produces $(1 - dis)A_t z_t$, where $(1 - dis)$ is the "permanent" productivity gap between disabled and nondisabled individuals.[9] Following Cervini-Plá, Silva, and Vall-Castello (2012), we also assume that the productivity gap in new job positions includes a temporary component, dis_t, which is related to the assimilation costs of working in a different job or professional activity. This temporary gap component disappears after a certain period spent working in the new job.

The match-specific productivity term z_t is assumed to be independent and identically distributed across firms and time, with a cumulative distribution function *G(z)* and support $[0, \bar{z}]$. We also assume that $log(A_t)$ follows a Markovian stochastic process, while the idiosyncratic productivity *z* is assumed to be log-normally distributed with normalized mean (μ) and standard deviation (σ).

Employers receive a one-time lump-sum subsidy ζ_e when they maintain a new disabled individual in the firm or ζ_u if they hire an unemployed disabled worker. Firms also receive an annual deduction of ξ to Social Security contributions for each disabled worker. In turn, firms incur extra hiring costs when they hire a new disabled worker. For example, they need to provide adapting working space costs so that workers with disabilities can do their jobs, and they have to take into account the extra time that supervisors or coworkers will need to spend to assist workers with disabilities. We assume that these net entry costs, τ, are incurred during the first year of the employment relationship. Finally, employed individuals earn a wage net of taxes, w_t^j, and disabled workers receive a net income tax deduction, p, when they are working.

There is a time-consuming and costly process of matching unemployed workers and job vacancies. As in den Haan, Ramey, and Watson (2000), we assume that the meeting function takes the following form:

[9] As we mentioned in the beginning of the paper, the presence of a productivity gap in our model is consistent with the recent empirical evidence presented by Malo and Pagan (2012).

(1) $m(s_t u_t, v_t) = \frac{s_t u_t v_t}{\left(s_t u_t^{\vartheta} + v_t^{\vartheta}\right)^{1/\vartheta}}$,

where u_t denotes the unemployment rate, v_t are vacancies, and s_t defines the average job searching intensity. Each period an unemployed individual meets a firm with probability Since $\lambda_t^j = s_t^j \frac{m(s_t u_t, v_t)}{s_t u_t}$. there is not search intensity for firms, they meet an unemployed worker with probability $q_t = \frac{m(s_t u_t, v_t)}{v_t}$.

We assume that there is free entry for firms. Hence firms open vacancies until the expected value of doing so becomes zero. Therefore, in equilibrium the value of a vacancy, V_t, is equal to zero:

(2) $V_t = 0$.

To describe the firms' behavior, let us define the Bellman equations characterizing the value of the filled position for a nondisabled worker, $J_t^n(z_t)$, the new job position for disabled worker remaining in the same firm, $J_{e,t}^d(z_t)$, the new disabled position for a worker coming from the unemployment status, $J_{u,t}^d(z_t)$, and the position for a disabled employee in a continuing job, $J_t^d(z_t)$.

(3) $J_t^n(z_t) = A_t z_t - w_t^n(z_t) + (1-\varphi)\beta E_t\left\{(1-\pi)\int_{\tilde{z}_{,t+1}^n}^{\bar{z}} J_{t+1}^n(z)\,dG(z) + \pi\int_{\tilde{z}_{e,t+1}^d}^{\bar{z}} J_{e,t+1}^d(z)\,dG(z)\right\}$

(4) $J_{u,t}^d(z_t) = (1 - dis - dis_t)A_t z_t - w_{u,t}^d(z_t) + \zeta_u + \xi - \tau + (1-\varphi)(1-\rho)\beta E_t\int_{\tilde{z}_{t+1}^d}^{\bar{z}} J_{t+1}^d(z)\,dG(z)$

(5) $J_{e,t}^d(z_t) = (1 - dis - dis_t)A_t z_t - w_{e,t}^d(z_t) + \zeta_e + \xi - \tau + (1-\varphi)(1-\rho)\beta E_t\left\{\left[\int_{\tilde{z}_{t+1}^d}^{\bar{z}} J_{t+1}^d(z)\,dG(z)\right]\right\}$

$$(6) \quad J_t^d(z_t) = (1-dis)A_t z_t - w_t^d(z_t) + \xi + (1-\varphi)(1-\rho)\beta E_t \int_{\tilde{z}_{t+1}^d}^{\bar{z}} J_{t+1}^d(z)\,dG(z)$$

where E_t is the expectation operators and $\tilde{z}^{\,n}, \tilde{z}_u^d, \tilde{z}_e^d$ and $\tilde{z}^{\,d}$ are productivity thresholds defined such that nonprofitable matches (i.e., with negative surplus) are severed.

According to Equation (3), each period, those nondisabled employees who receive a health shock, π, have the possibility of being reallocated to a different job position inside the firm. If the firm reallocates the worker it receives the lump-sum subsidy, ζ_e (see Equation [5]). In case of disagreement, the firm opens a new vacancy that may be filled by either a disabled or a nondisabled worker. If an unemployed disabled worker fills the new vacancy, the firms will receive a lump-sum subsidy, ζ_u (Equation [4]). In both cases, the firm only gets the subsidy during the first period of the new employment relationship and incurs adjustment costs, τ. As Equation (6) shows, continuing disabled job positions do not receive the lump-sum subsidy but still receive the deduction ξ to Social Security contributions.

New hires are determined according to the expected value of a contact with an unemployed worker. This value is the average of the expected hiring values of disabled and nondisabled unemployed workers. Thus, it depends on the effective searching share of disabled and nondisabled individuals looking for jobs, $\delta_t^j = \frac{s_t^j u_t^n}{s_t u_t}$. The average expected value of a new filled position is equal to

$$(7) \quad \frac{c}{q_t} = \beta E_t \left\{ \delta_t^n \int_{\tilde{z}_{t+1}^n}^{\bar{z}} J_{t+1}^n(z)\,dG(z) + \delta_t^d \int_{\tilde{z}_{u,t+1}^d}^{\bar{z}} J_{u,t+1}^d(z) dG(z) \right\}$$

According to Equation (7), in equilibrium the average expected value of a new filled position is equal to the hiring costs, $\frac{c}{q_t}$. The conditions defining the thresholds for job creation and destruction are

(8) $J_t^n(\tilde{z}_t^n) = 0,$

(9) $J_{e,t}^d(\tilde{z}_{e,t}^d) = 0,$

(10) $J_{u,t}^d(\tilde{z}_{u,t}^d) = 0,$

(11) $J_t^d(\tilde{z}_t^d) = 0.$

The first expression, (8), captures both the job creation and job destruction condition for a nondisabled individual. Expression (9) is the job reallocation condition for the disabled worker who remains in the same firm. In turn, expression (10) is the job creation condition for a disabled worker coming from the unemployment status, u. Finally, expression (11) is the job separation condition for each disabled employee in a continuing job position.

From the worker's perspective, the values of being unemployed U_t^j, employed and $W_t^j(z_t)$ are

(12) $$U_t^n = b - b\left(s_t^n\right)^{\varpi} + (1-\pi)\beta E_t \left\{ \begin{array}{l} \lambda_t^n \left[\int_{\tilde{z}_{t+1}^n}^{\bar{z}} W_{t+1}^n(z)\, dG(z) + G\left(\tilde{z}_{t+1}^n\right) U_{t+1}^n \right] \\ +\left(1-\lambda_t^n\right) U_{t+1}^n + \pi\beta E_t U_{t+1}^d \end{array} \right\}$$

(13) $$U_t^d = b - b(1+dis)\left(s_t^d\right)^{\varpi} + \alpha_u w_0^d + (1-\rho)\beta E_t \left\{ \begin{array}{l} \lambda_t^d \left[\int_{\tilde{z}_{t+1}^{du}}^{\bar{z}} W_{u,t+1}^d(z)\, dG(z) + G\left(\tilde{z}_{u,t+1}^d\right) U_{t+1}^d \right] \\ +\left(1-\lambda_t^d\right) U_{t+1}^d \end{array} \right\}$$

$$(14)\quad \begin{aligned} W_t^n(z_t) &= w_t^n(z_t) + (1-\pi)\beta E_t\left\{(1-\varphi)\left(\int_{\tilde{z}_{t+1}^n}^{\overline{z}} W_{t+1}^n(z)\,dG(z) + G\left(\tilde{z}_{t+1}^n\right)U_{t+1}^n\right) + \varphi U_{t+1}^n\right\} \\ &+ \pi\beta E_t\left[\left(\int_{\tilde{z}_{e,t+1}^d}^{\overline{z}} W_{e,t+1}^d(z)\,dG(z)\right) + G\left(\tilde{z}_{e,t+1}^d\right)U_{t+1}^d\right] \end{aligned}$$

$$(15)\quad W_{u,t}^d(z_t) = \alpha_d w_0^d + w_{u,t}^d(z_t) + p + (1-\rho)\beta E_t\left\{\begin{aligned}&(1-\varphi)\left(\int_{\tilde{z}_{t+1}^d}^{\overline{z}} W_{t+1}^d(z)\,dG(z) + G\left(\tilde{z}_{t+1}^d\right)U_{t+1}^d\right)\\ &+\varphi U_{t+1}^d\end{aligned}\right\}$$

$$(16)\quad W_{e,t}^d(z_t) = \alpha_d w_0^d + w_{e,t}^d(z_t) + p + (1-\rho)\beta E_t\left\{\begin{aligned}&(1-\varphi)\left(\int_{\tilde{z}_{t+1}^d}^{\overline{z}} W_{t+1}^d(z)\,dG(z) + G\left(\tilde{z}_{t+1}^d\right)U_{t+1}^d\right)\\ &+\varphi U_{t+1}^d\end{aligned}\right\}$$

$$(17)\quad W_t^d(z_t) = \left(\alpha_d w_0^d + w_t^d(z_t)\right) + p + (1-\rho)\beta E_t\left\{\begin{aligned}&(1-\varphi)\left(\int_{\tilde{z}_{t+1}^d}^{\overline{z}} W_{t+1}^d(z)\,dG(z) + G\left(\tilde{z}_{t+1}^d\right)U_{t+1}^d\right)\\ &+\varphi U_{t+1}^d\end{aligned}\right\}.$$

When a health shock hits a nondisabled worker, he receives disability benefits, $\alpha_j \mathrm{w}_0^{\mathrm{d}}$, regardless of the labor market status. However, according to Equations (13) and (15)−(17), the disability scheme for an unemployed worker, α_u, can be different with respect to the one for the employment status, α_d. More in detail, according to the Spanish Disability System, the amount of pension received varies according to the disability degree in which the individual is classified. Individuals in the partial disability scheme receive, in general, 55 percent of the regulatory base (which is an average of the last salaries). This 55 percent can be increased to 75 percent for individuals aged 55 conditionally of being unemployed. Moreover, Equations (15)–(17) show that if the partially disabled individual works, he receives a net reduction of p in the employment income used to calculate the income tax.

Unemployed nondisabled and disabled workers find jobs with the following probabilities:

(18) $$f_t^n = (1-\pi)\lambda_t^n\left[1-G\left(\tilde{z}_{t+1}^n\right)\right]$$

(19) $$f_t^d = \left(1-\rho\right)\lambda_t^d\left[1-G\left(\tilde{z}_{u,t+1}^d\right)\right]$$

Moreover, it follows that nondisabled and disabled workers separate from employment to unemployment with probabilities

(20) $$\psi_t^n = \left(1-\pi\right)\left[\varphi+\left(1-\varphi\right)G\left(\tilde{z}_{t+1}^n\right)\right]$$

(20) $$\psi_t^d = \left(1-\rho\right)\left[\varphi+\left(1-\varphi\right)G\left(\tilde{z}_{t+1}^d\right)\right]$$

In turn, the reallocation and nonreallocation rates for new disabled employees are

(22) $$\chi_{e,t}^d = \left(1-\rho\right)\pi\left[1-G\left(\tilde{z}_{e,t+1}^d\right)\right]$$

(23) $$\chi_{u,t}^d = \left(1-\rho\right)\pi G\left(\tilde{z}_{e,t+1}^d\right)$$

Notice that the survival rate inside the firm for new disabled workers is just $\varrho_{e,t}^d = \left[1 - G\left(\tilde{z}_{e,t+1}^d\right)\right]$.

Neither workers nor employers can instantaneously find an alternative match partner in the labor market, and because hiring and firing decisions are costly, a match surplus exists. To divide this surplus we assume wages to be the result of bilateral Nash bargaining between workers and firms. They are revised every period upon the occurrence of new shocks, and the Nash solution is the wage that maximizes the weighted product of the workers' and the firms' net return from the job matches. The first-order conditions for the disabled and nondisabled employees yield the following four equations:

(24) $$(1-\eta)\left[W_t^n(z_t)-U_t^n\right]=\eta J_t^n(z_t)$$

(25) $$(1-\eta)\left[W_{u,t}^d(z_t)-U_t^d\right]=\eta J_{u,t}^d(z_t)$$

(26) $$(1-\eta)\left[W_{e,t}^d(z_t)-U_t^d\right]=\eta J_{e,t}^d(z_t)$$

(27) $$(1-\eta)\left[W_t^d(z_t)-U_t^d\right]=\eta J_t^d(z_t)$$

where $\eta \in (0,1)$ denotes workers' bargaining power relative to firms.

Finally, each type of unemployed worker chooses search intensity s_t^j to maximize the present-discounted value of their expected income U_t^j during the search process, taking the other market variables as given. Each optimal s_t^j satisfies

(28) $$(1-\pi)\frac{m(s_t u_t, v_t)}{s_t u_t}\beta E_t\left[\int_{\tilde{z}_{t+1}^n}^{\bar{z}} W_{t+1}^n(z)\,dG(z)-\left(1-G\left(\tilde{z}_{t+1}^n\right)\right)U_{t+1}^n\right]=b\varpi\left(s_t^n\right)^{\varpi-1}$$

(29) $$(1-\rho)\frac{m(s_t u_t, v_t)}{s_t u_t}\beta E_t\left[\int_{\tilde{z}_{t+1}^{du}}^{\bar{z}} W_{u,t+1}^d(z)\,dG(z)-\left(1-G\left(\tilde{z}_{u,t+1}^d\right)\right)U_{t+1}^d\right]=b\varpi(1+dis)\left(s_t^d\right)^{\varpi-1}$$

To fully characterize the dynamics of this economy, we need to define the law of motion for unemployment and employed workers (u_t^j and e_t^j). These evolve according to the following difference equations:

(30) $$e_t^n = e_{t-1}^n + f_t^n u_{t-1}^n - \psi_t^n e_{t-1}^n - \chi_{e,t}^d e_{t-1}^n - \chi_{u,t}^d e_{t-1}^n$$

(31) $e_t^d = e_{t-1}^d + f_t^d u_{t-1}^d - \psi_t^d e_{t-1}^d + \chi_{e,t}^d e_{t-1}^n - \rho e_{t-1}^d$

(32) $u_t^n = u_{t-1}^n - f_t^n u_{t-1}^n + \psi_t^n e_{t-1}^n - \pi u_{t-1}^n$

(33) $u_t^d = u_{t-1}^d - f_t^d u_{t-1}^d + \psi_t^d e_{t-1}^d + \pi u_{t-1}^n + \chi_{u,t}^d e_{t-1}^n - \rho u_{t-1}^d$

(34) $e_t^n + e_t^d + u_t^n + u_t^d = 1$

(35) $u_t^n + u_t^d = u_t$

(36) $e_t^n + e_t^d = e_t$ (36)

CALIBRATION

We calibrate the model in the steady state at annual frequency to be consistent with certain empirical Spanish labor market facts. In particular, the parameterization must match the main labor market characteristics of nondisabled individuals between 2001 and 2011:

1) A job separation rate of 9.2 percent, so $\psi^n = 0.092$.

2) A job finding rate of 28.4 percent, $f^n = 0.284$.

3) the 93.2 percent average proportion of nondisabled workers in the labor force, $\frac{e^n + u^n}{u + e} = 0.932$

4) A relative number of nondisabled workers looking for jobs of $\frac{u^n}{u} = 0.783$.

5) Following Silva and Vázquez-Grenno (2011), the hiring costs parameter is calibrated to match a quarterly hiring costs equivalent to 3 percent of nondisabled wages, $\frac{c}{w^n} = \frac{0.12}{4}$.

6) Cervini-Plá, Silva, and Vall-Castello (2012) estimate an average wage gap of 21 percent between a disabled and nondisabled individual, $\frac{w^n}{w^d} = 1.21$.

7) Based on Castillo, Jimeno, and Licandro (1998), the calibration also must match our target elasticity, ε_u, of 0.80 in the matching function with respect to unemployment.

We normalized the aggregate labor productivity to one, $A = 1$. We fix the discount factor at β = 0.96, which implies a reasonable interest rate of nearly 4 percent. We also set the bargaining parameter η to 0.5. Using the definition of partial disability, we assume that partial disability represents a reduction of between 33 percent and 65 percent of the working ability and set the permanent disability gap at dis = 0.50. From the Spanish database, the transition rate from nondisability to partial disability is set at 0.14 percent, $\pi = 0.0014$. In turn, Cervini-Plá, Silva, and Vall-Castello (2012) calculate that the transitory component of the wage gap represents 6 percent of the wage of a disabled worker. Thus, we set the transitory disability gap, dis_t, to match this target, $\frac{w^d}{w^d_u} = 1.06$.

Individuals above 55 years of age in the partial disability scheme receive 75 percent of the regulatory base if they do not work and 55 percent if they work (which is an average of the last eight years of salaries). As in Silva and Vall-Castello (2012a), we assume that individuals are below 55 years old. Thus, we set $\alpha_u = \alpha_d = 0.55$.

The average wage net of tax for a partially disabled worker is 14,168 euros/year.[10] If the individual works, he receives an income deduction net of taxes of 420 euros/year in the employment income if the disability level is between 33 percent and 65 percent.[11] This amount represents around 3 percent of the average wage for disabled workers. In turn, the average regulatory base is 10,716 euros/year, which represents 0.76 times the average net wage of a partially disabled worker. Thus, we calibrate w^d_0 and p to match these two targets.

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[10]According to Cervini-Plá, Silva, and Vall-Castello (2012), the gross average wage is 16,668. Using the OECD Tax Database, we calculate an average income tax of 15 percent.

[11]Multiplying the income tax deduction of 2,800 by the tax rate of 0.15 we obtain 420 euros/year.

In turn, firms receive a lump-sum subsidy of 3,900 euros when hiring an unemployed disabled individual, which represents around 28 percent of the average annual net wage of a disabled worker. Thus, we set ζ_u to match this target. Since 2001, this subsidy cannot be applied to workers that had worked in the firm in the past 24 months or to workers that had ended a contract during the last 3 months. We assume that $\zeta_e = 0$.

Firms also receive 4,500 euros/year, which accounts for reduction to the Social Security contributions. This magnitude represents 32 percent of the net wage for a disabled individual. As before, we set ξ to match this target. The logarithm of the idiosyncratic productivity *z* is assumed to be N ($\mu=0$, $\sigma=0.2$).

Finally, the parameter of the searching costs, ϖ, the matching function parameter, ϑ, the exogenous separation probability, φ, the transitory disability gap, dis_t, the employment opportunity cost, b, the vacancy costs parameter, c, income deduction, p, the exit rate from the labor market for disabled individuals, ρ, the lump-sum subsidy for hiring a disabled worker ζ_u, the firm's deduction to the Social Security contributions, ξ, the firm's adjustment costs, τ,and the regulatory base parameter, w_0^d, are calibrated to match our 12 targets. Table 4 resumes the targets and the calibrated parameters in the economy.

Table 4 Annual Calibrated Parameters for the Average Spanish Labor Market, 2001–2011

Parameters	Value	Definition
A	1	Normalization of aggregate labor productivity
β	0.96	Discount factor
σ_w	0.20	Standard deviation for the distribution of *log(A)*
μ	0.00	Mean of the distribution of *log(A)*
b	0.779	The employment opportunity cost
ϑ	0.630	Matching function elasticity
φ	0.083	Exogenous job exit probability.
ρ	0.019	Exit rate from the labor market for disabled individuals
c	0.029	Vacancy costs
p	0.023	The income deduction for disabled workers
ζ_u	0.22	The firm's lump-sum subsidy for hiring an unemployed worker with disability

Table 4 (Continued)

Parameters	Value	Definition
ζ_e	0.0	The firm's lump-sum subsidy for hiring an employed worker with disability
α_u	0.55	Partial disability scheme for unemployment
α_d	0.55	Partial disability scheme for employment
$\mathrm{w}_0^{\mathrm{d}}$	0.61	Regulatory base for disability
dis	0.50	Permanant degree of disability
dis_t	0.076	Transitory degree of disability
ϖ	3.7	Searching costs
η	0.552	Workers' bargaining power
π	0.0014	Transition from nondisability to partial disability
ξ	0.25	Firm's deduction to Social Security contribution
τ	0.120	Creation costs for new disabled positions
Targets		
f^n	0.329	Nondisabled job finding rate
ψ_t^d	0.083	Nondisabled job separation rate
$\frac{u^n}{u}$	0.783	The relative number of nondisabled unemployed workers
$\frac{e^n+u^n}{u+e}$	0.932	Average proportion of nondisabled workers in the labor force
$\frac{c}{w^n}$	0.03	Vacancy costs ratio
$\frac{w^n}{w^d}$	1.21	Average wage gap between disabled and nondisabled workers
$\frac{p}{w^d}$	0.030	Worker's subsidy ratio for disabled individuals
$\frac{\mathrm{w}_0^{\mathrm{d}}}{w^d}$	1.35	Regulatory base ratio for disabled individuals
$\frac{\zeta_u}{w^d}$	0.28	The firms lump-sum subsidy ratio
$\frac{\xi}{w^d}$	0.32	Firm's ratio of deduction to Social Security contribution
ε_u	0.81	Elasticity of the matching function
$\frac{w^d}{w_u^d}$	1.06	Transitory disability gap

STEADY STATE SIMULATED RESULTS

Table 5 shows the benchmark simulation of the model in the steady state and compares it with average values observed in the Spanish labor market between 2001 and 2011. The simulation shows an employment rate of 24.0 percent among disabled workers, which is much lower than the observed one for nondisabled individuals (79.9 percent). It also shows that the job finding rate for disabled workers (0.101) is significantly lower than the observed one for nondisabled individuals (0.329). The lower average job finding rate of disabled workers is due to their search intensity rate of 0.167, which is much lower than the job search intensity rate of nondisabled workers (0.465).

The simulation also shows that 87.0 percent of the times the firm and the disabled unemployed worker meet, a new employed relationship is created [$G\left(\tilde{z}_{u,t+1}^{d}\right) = 0.130$]. In other words, the model suggests that although firms are willing to hire disabled unemployed individuals, these workers look for jobs with much less intensity than nondisabled individuals. While part of this behavior is related to the presence of both a productivity gap and higher job searching costs that discourage these types of workers from looking for jobs, our model also indicates that the receipt of the disability benefits increase the employment opportunity cost and therefore reduce their job search intensity.

With respect to the firms' side, although the lump-sum subsidy generates the incentive to hire new disabled workers this incentive is reduced once the subsidy disappears in the next period. More in detail, Table 5 shows that the simulated job destruction rate for continuing job disability contracts, ψ^{d}, amounts to 0.311, which is higher than the job destruction rate of nondisabled employees (0.083). Similarly, the model shows that less than 10 percent of the employees who become disabled are kept in the same firm after the disabling condition. That is, the employment survival rate for new disabled employees is $\varrho_{e,t}^{d} = 0.085$. As explained above, this low survival rate can be explained by the fact that firms do not receive a lump-sum subsidy if they decide to keep the new disabled employee working in the firm.

Finally, although the model can help to explain the differences between disabled and nondisabled workers, notice that it overestimates most of the average transition rates for the latest group of workers observed in the data, except for the case of the job survival rate for new disabled individuals, which is lower than the observed one, $\varrho^{d}_{e,t}$.

Table 5 Steady State Simulated Results for the Spanish Labor Market Average (2001–2011)

Simulated results		Simulated results	Data
Nondisabled employment rate	e^n_r	0.799	0.799
Disabled employment rate	e^d_r	0.240	0.114
Nondisabled Job separation rate	ψ^n	0.083	0.083
Disabled job separation rate	ψ^d	0.311	0.215
Unsuccessful job meeting rate	$G(\tilde{z}^d_u)$	0.130	—
Nondisabled job finding rate	f^n	0.329	0.329
Disabled job finding rate	f^d	0.101	0.033
Employment survival rate for new disabled	ϱ^d_e	0.085	0.173
Job search intensity for nondisabled	s^n	0.465	—
Job search intensity for disabled	s^d	0.167	—
Wage ratio	$\frac{w^n}{w^d}$	1.211	1.210

SENSITIVITY ANALYSIS FOR THE LEVEL OF DISABILITY AND POLICY PARAMETERS

In this section, we present the results of a sensitivity analysis with respect to the main parameters related to the Spanish Disability System. We modify some of the relevant parameters and compare the simulated results with the benchmark simulation in Table 5. In each exercise, we only modify one of the model's parameters and keep the rest unchanged. We believe that this exercise allows us to compare the sensitivity of each of the parameters included in the model and to assess the relative importance of each of them in explaining the labor market behavior of disabled workers.

The first row of Table 6 shows that when the degree of the permanent disability increases one percentage point from 50 percent to 51 percent, the employment rates falls from 24.0 percent to 17.4 percent. According to the model, a higher level of disability reduces the worker's productivity and increases the job search costs for disabled individuals. As a result, the job destruction rate increases from 0.311 to 0.392, while the job finding rate falls from 0.101 to

0.085. In the latest case, the decrease in f^d is due in part to a reduction in the job search intensity of disabled workers—from 0.167 to 0.155. Moreover, the model shows that 21.0 percent of the meetings between the firm and the worker do not finish in a new employment relationship. This simulated scenario also shows that the job survival rate in the firm for new disabled individuals falls from 8.5 percent to 5.3 percent.

With respect to the policy parameters that involve the worker's side of the model, we observe that when the proportion of the disability benefits for unemployed workers, α_u, is increased from 55 percent to 56 percent, the employment rate falls to 19.9 percent, increasing the employment rate gap. In this case, the model says that workers have less incentive to look for jobs and decide to reduce their search intensity, which in turn reduces the job finding rate to 0.093. The lower search intensity also increases their adjusted employment opportunity costs and, therefore, the job meeting rejection rate from 13.0 percent to 17.8 percent, $G(\tilde{z}_u^d) = 0.178$. Moreover, with higher employment opportunity costs, firms have less incentive to maintain these types of workers, so the job destruction rate jumps to 0.359.

Table 6 Simulated Results for the Sensitivity Analysis

Scenario	e_r^d	$e_r^n - e_r^d$ Employment gap	f^d	$f^n - f^d$ Job finding gap	ψ^d	$\psi^n - \psi^d$ Job destruction gap	ϱ_e^d	$G(\tilde{z}_u^d)$	s^d	$s^n - s^d$ Search intensity gap
Benchmark scenario:										
	0.240	0.559	0.101	0.226	0.311	−0.228	0.085	0.130	0.167	0.295
Level of disability (*dis*=0.51)										
	0.174	0.625	0.085	0.243	0.392	−0.309	0.053	0.210	0.155	0.309
Workers' policy parameters										
$\alpha_u = 0.56$	0.199	0.600	0.093	0.236	0.359	−0.276	0.067	0.178	0.162	0.303
$p = 0.031$	0.310	0.489	0.117	0.212	0.247	−0.164	0.118	0.074	0.181	0.283
Firms'policy parameters										
ζ_e=0.22	0.268	0.531	0.103	0.226	0.311	−0.228	0.130	0.870	0.170	0.295
ζ_u= 0.228	0.247	0.552	0.108	0.221	0.315	−0.232	0.083	0.109	0.174	−0.291
$\xi = 0.26$	0.331	0.469	0.120	0.209	0.231	−0.149	0.129	0.062	0.184	−0.280

NOTE: The gaps measure the difference between nondisabled (*n*) and disabled individuals (*d*).

The other workers' policy parameters correspond to the income deduction for disabled workers, p. We next increase the net income deduction in one percentage point as a share of the disability wage (from 3 percent to 4 percent), which in monetary terms implies an increase from 2,800 to 3,773 euros/year in the employment income used to calculate the income tax (the net tax deduction is equivalent to 146 euros/year). As a result, the disability employment rate increases from 24.0 percent to 31.0 percent, reducing the employment gap to 48.9 percentage points. Moreover, the job separation is reduced to 24.7 percent. Thus, with this extra tax deduction, disabled workers have the incentive to look for jobs with more intensity, which also reduces their reservation wage and therefore their productivity threshold, so fewer job positions are destroyed.

From the firms' side, we first simulate what would happen if the lump-sum subsidy becomes operative not only when a firm hires a new disabled worker but also when it reallocates an employee that becomes partially disabled, $\frac{\zeta_e}{w^d}$=0.28. In fact, this subsidy was operative until 2001, when the law restricts it to certain contracts.[12] Table 6 shows that this policy increases the job survival rate of newly disabled individuals from 0.085 to 0.087. However, the policy has a relatively small impact on the employment rate, increasing from 24.0 percent to 26.8 percent.

We next simulate the effects of an increase in the government's lump-sum subsidy for newly hired disabled workers, ζ_u, from 3,900 to 4,041 euros, which represents an increase from 28 percent to 29 percent of the average wage of disabled workers. In this case, the employment rate of disabled workers changes from 24 percent to 24.7 percent, due only to an increase in the job finding rate from 0.101 to 0.108. Thus, it becomes more attractive to hired disabled workers, although the effects are relatively small. At the same time, the job destruction rate increases from

[12] In 2001 this lump-sum subsidy was not available for employment contracts to family membres, workers who had worked in the firm in the past 24 months with a permanent contract, and workers who had ended a permanent contract during the last 3 months.

31.1 percent to 31.5 percent, and the job survival rate inside the firm falls from 8.5 percent to 8.3 percent.

When a firm's deduction to Social Security contribution, ξ, increases one percentage point as a proportion of disability wages, which means an increase from 4,500 to 4,680 euros in this deduction, the employment rate of disabled workers jumps from 24 percent to almost 33 percent, due to both an increase in the job finding rate (from 0.101 to 0.120) and a reduction in the job separation rate (from 0.311 to 0.231). Notice that both lump-sum subsidies ζ_u and ζ_e generate a relatively much lower impact in the employment rate than the Social Security contribution, ξ, suggesting that firms are much more sensitive to the hiring incentives with permanent duration than to the transitory ones.

Overall, the simulated results show that both workers and firms are sensitive to the main policy parameters, especially when they remain operative under the different employment or job conditions. Thus, according to the model, the high employment gap observed between nondisabled and disabled workers can be explained in part by the design of the Spanish Disability System, which helps to generate a gap in the job search intensity as well as in the productivity thresholds between disabled and nondisabled workers.

Finally, in order to better understand the results obtained with our model, Table 7 shows how much three of the most sensitive policy parameters would need to change in order to close the employment gap between disabled and nondisabled individuals. We begin by asking how much the proportion of disability benefits would need to be reduced in order to get an almost negligible employment gap (six percentage points). Our model shows that benefits would need to be reduced from 55 percent to 35 percent of the regulatory base in order to achieve the objective of a six percentage point employment gap. In this case, the disabled employment rate increases to 74 percent.

Similar results are obtained if we equalize the employment income used to calculate the income tax to the average gross wage earned by a disabled worker (16,668 euros/year), which implies an effective tax deduction of 2,500 euros/year in contrast to the actual 420 euros/year (p increases from 0.023 to 0.137). Finally, the last row of Table 7 shows that by granting this extra tax deduction to the employer instead of the worker (extra tax deduction of 2,000 euros/year to the employer's Social Security contribution), the employment gap would also be reduced to the minimal six percentage point level.

Table 7 Modifying the Disability System to Close the Employment Rate Gap

Scenario	e_r^d	$e_r^n - e_r^d$	f^d	$f^n - f^d$	ψ^d	$\psi^n - \psi^d$	ϱ_e^d	$G(\tilde{z}_u^d)$	s^d	$s^n - s^d$
Benchmark scenario:	0.240	0.559	0.101	0.226	0.311	−0.228	0.085	0.130	0.167	0.295
Workers' policy parameters										
$\alpha_u = 0.35$	0.742	0.059	0.230	0.103	0.082	0.000	1.000	0.000	0.328	0.139
$p = 0.137$	0.739	0.063	0.226	0.108	0.082	0.000	1.000	0.000	0.320	0.145
Firms policy parameters										
$\xi = 0.361$	0.737	0.064	0.224	0.110	0.082	0.000	1.000	0.000	0.318	0.147

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To capture the business cycle response of disabled workers, we simulate the model presented above with an aggregate productivity shock, A_t, around the benchmark steady state of the model. Along this line, the logarithm of this variable follows an *AR*(1) process such that $\log(A_t) = \iota \log(A_{t-1}) + \epsilon_t$. The values of the autoregressive parameter and the standard deviation of the white noise process, $\iota = 0.85$ and $\sigma_\epsilon = 0.026$, have been calibrated to match the volatility (2.8 percent) and persistence (0.70) of the HP detrended Spanish GDP, $y_t = A_t e_t^n + (1 - dis) A_t e_t^d - c v_t$.

Figure 4 shows the response of the conditional mean of the labor market variables for disabled workers in response to the aggregate labor productivity shock. The disabled employment rate, e_r^d, is procyclical, increasing together with the GDP. This increase in e_r^d takes place because both the job finding rate increases and the job separation rate falls after the positive productivity shock. The procyclical behavior of f^d is due to the higher search intensity, s^d. Thus, disabled workers are more willing to look for jobs during economic expansions. In turn, the increase in the aggregate labor productivity affects positively the firm's surplus and, therefore, reduces the incentive to destroy job positions, reducing ψ_t^d. Finally firms are also more willing to reallocate new disabled workers in a different job position, which in turn increases ϱ_e^d.

Looking at the data, Table 8 shows that the employment rate, the job finding rate, and the job reallocation rate inside the firm are all positively correlated with the GDP. This result goes in line with the procyclical behavior of these rates shown by the simulated impulse response functions (Figure 4). Finally, we also observe in the data that the job destruction rate is negatively correlated with the GDP, which is in line with the countercyclical response observed in our simulated impulse response function.

In order to analyze whether business cycle conditions have a greater effect on disabled or nondisabled workers, in Figure 5 we simulate the effect of a business cycle shock on the relative employment rate of nondisabled and disabled workers, $\frac{e_{r,t}^n}{e_{r,t}^d}$. A negative response indicates a relatively higher impact of the shock in the employment of the latest group of workers, suggesting that disabled employees are more sensitive to labor market fluctuations than nondisabled ones. Comparing Figures 1 and 5, it is not clear that a similar behavior can be observed in the data. More in detail, as Figure 1 shows, the employment rate of nondisabled workers increases by relatively more between 2001 and 2007, and decreases by much more during the current economic downturn (2008–2011). Thus, the data suggest that $e_{r,t}^{n}$ seems to be more volatile than $e_{r,t}^{d}$ during labor market fluctuations.

We believe that an important part of the higher response observed in the employment rates of nondisabled workers in Spain can be explained by the higher incidence of the construction sector for nondisabled workers, which is a sector characterized by a higher share of temporary jobs. Therefore, as disabled workers do not have an important presence in the construction sector, their employment rates should be more stable. As we are unable to calculate employment rates by sector of activity with the administrative data, we cannot take this into account. Therefore, once the construction sector is omitted from data we should expect a relative increase in the business cycle response of the disabled employment rate as it is shown in the model's simulations.

Table 8 Labor Market Disability: Correlation with GDP (Spanish data 2001–2011)

Variables	Correlation with GDP
e_r^d	0.859
f^d	0.878
ψ^d	−0.533
ϱ_e^d	0.578

SOURCE: The Spanish Institute of Statistics and authors' elaboration from the MCVL.

Figure 4 Labor market Disability and Impulse Response to a Labor Productivity Shock

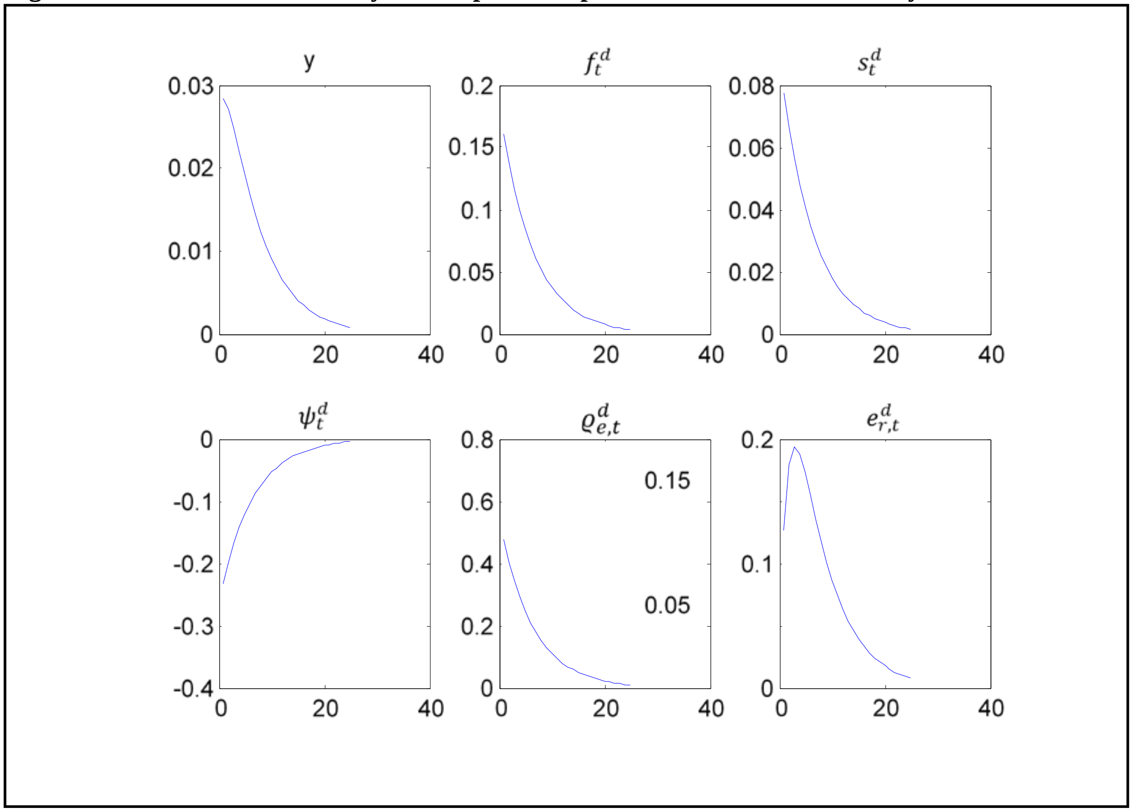
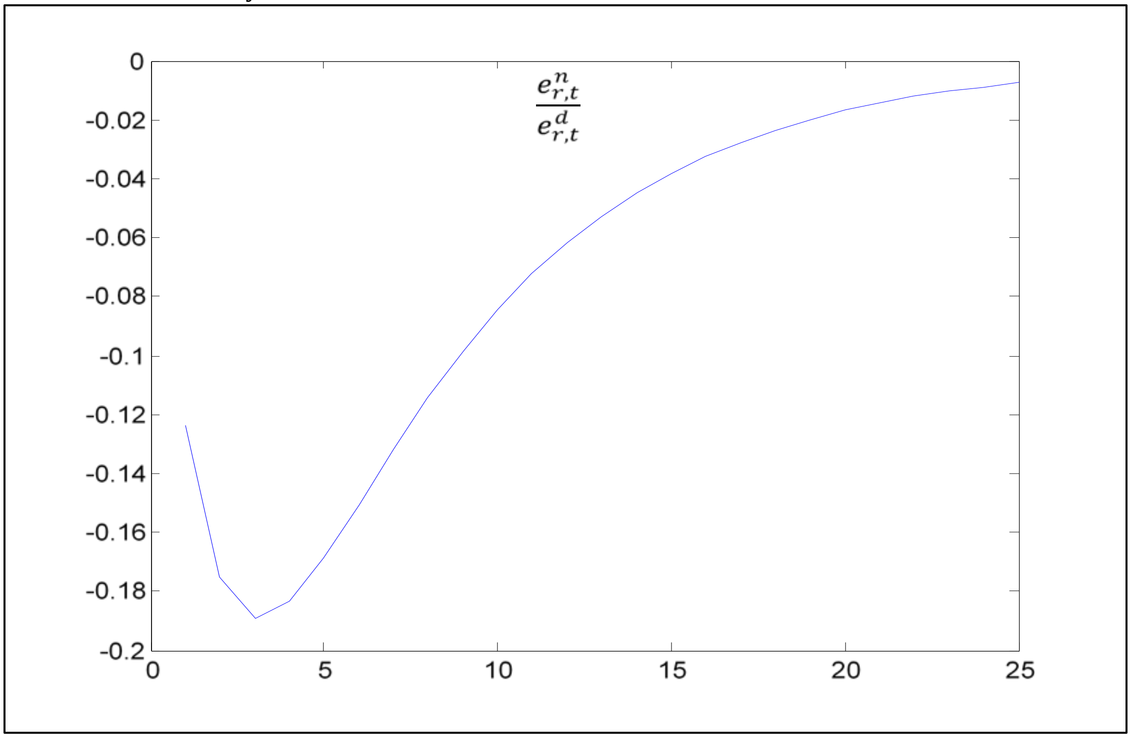


Figure 5 Impulse Response of the Ratio of Nondisabled and Disabled Employment Rate to a Labor Productivity Shock



CONCLUSIONS

In Spain there are approximately 1 million disabled individuals receiving disability benefits; around half of them are partially disabled individuals who are allowed to combine the receipt of disability benefits with a job. The country reports, however, an average employment rate of just 11 percent for this group of people from 2001 to 2011, which is much lower than the employment rate of 80 percent observed for nondisabled employees.

In this paper we analyze the incentives and disincentives to work provided by the partial disability system in Spain. We first present a set of indicators that compare the Spanish labor market behavior for partially disabled and nondisabled individuals from 2001 to 2011. We find that for disabled workers the job finding rate is much lower than for non-disabled workers, while the job separation rate is higher. We also find that less than 20 percent of the employees who become partially disabled continue working in the same firm after the disabling condition.

In order to understand these labor market differences observed in the data, we construct a labor market model with search intensity and matching frictions that includes the interaction between disabled and nondisabled individuals in the labor market. Additionally, we also include in the model the hiring decisions made by companies and the incentives available in the legislation to hire disabled workers. We calibrate the model to match a number of stylized facts observed in the Spanish labor market.

In line with the data, our benchmark simulation shows the presence of an employment rate gap of 56 percentage points between nondisabled and disabled workers. The model also shows that the job finding rate for disabled workers is much lower while the job separation rate is higher than for nondisabled workers. An important part of the employment rate gap observed between nondisabled and disabled workers can be explained by the presence of a job search intensity gap of 64 percent. These differences in the search intensity are due, in part, to the presence of a lower level of productivity, which, in turn, induces higher searching costs for disabled individuals discouraging them from looking for jobs. Moreover, our results show that the generosity of the Spanish Disability System also contributes to the presence of this search intensity gap between disabled and nondisabled individuals. More in detail, our model indicates that the level of disability benefits increases the employment opportunity costs for disabled workers and, therefore, reduces their job search intensity.

Our benchmark simulation shows that 87.0 percent of the times that the firm and the disabled worker meet, a new employment relationship is created. This result takes place due to presence of policy incentives for employers to hire disabled workers. In other words, the model suggests that firms are willing to hire disabled individuals. However, since disabled workers have a relatively high adjusted employment opportunity cost (due to both a lower level of productivity and the receipt of the benefits), they look for jobs with much less intensity and are separated from the job positions with higher frequency than nondisabled individuals.

In contrast to the strong motivation to hire disabled individuals because of the presence of incentives for employers, the model shows a much lower employer incentive to maintain their workers in the firm when they become disabled. According to the benchmark simulation, less than 10 percent of the employees who suffer a disabling condition are kept in the same firm. In this case, firms do not receive a lump-sum subsidy if they decide to keep the new disabled employee in the firm.

With respect to the type of policy initiatives that could be more effective in increasing both individual incentives to work as well as employer's incentives to hire disabled workers, the sensitivity analysis shows that the employment rate gap can be considerably reduced to a six percentage point level by modifying one of the following three parameters: 1) reducing the percentage of the regulatory base received by partially disabled individuals (from 55 to 35 percent); 2) increasing the deductions to the Social Security contributions paid by the employer (by an extra deduction of 2,000 euros/year); or 3) increasing the tax deductions for disabled workers (by 2,500 euros/year). In contrast, the model shows that transitory lump-sum subsidies have a much lower impact in increasing the employment rate of disabled individuals.

Overall, the simulated results show that both workers and firms are sensitive to the main policy parameters, especially when they remain operative under the different employment or job conditions. Thus, according to the model, the high employment gap observed between disabled and nondisabled workers can be partly explained by the design of the Spanish Disability System, which helps to generate a gap in the job search behavior of disabled and nondisabled workers.

We believe these results to be important because, to the best of our knowledge, they are the first ones that provide a quantitative analysis of the explanations of the observed employment gap between disabled and nondisabled workers as well as an estimation of the potential costs that would be needed in order to achieve a reduction of this employment gap to a very low level.

Finally, we analyse the role of business cycle conditions in shaping the labor market transitions of disabled individuals and find that the employment rate, the job finding rate and the job survival rate in the same firm are positively correlated with the GDP. This result goes in line with the procyclical behavior of these rates shown by the data. Finally, the job destruction rate is negatively correlated with GDP, which is also in line with its empirical countercyclical response.

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