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Relationships between disability and labour market outcomes in Europe

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Relationships Between Disability and Labour Market Outcomes in Europe

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Résumé

L'objectif de cette thèse est d'explorer la relation croisée entre le handicap et le marché du travail en Europe en utilisant les données de l'enquête sur la santé, le vieillissement et la retraite en Europe (SHARE), qui offre un vaste échantillon d'individus suivis au cours du temps (panel) dans 28 pays européens.

Le premier chapitre se concentre sur l'impact de l'apparition d'un handicap sur le revenu personnel, défini comme la somme des salaires et des revenus de compensation. Cet impact est mesuré en appariant les individus avant l'apparition du handicap puis en mettant en place une double différence pondérée. Les résultats montrent une baisse du revenu personnel due à une forte perte de salaires qui n'est pas compensée par les revenus de compensation. Des analyses d'hétérogénéité révèlent qu'au sein des pays mettant en œuvre des mesures d'intégration fortes pour les personnes handicapées sur le marché du travail et/ou offrant des revenus de compensation élevés, l'apparition du handicap n'a pas d'impact sur le revenu personnel.

Le deuxième chapitre examine la modification de l'offre de travail résultant de l'apparition du handicap chez le conjoint. Ce choc affectant le partenaire entraîne des changements dans le revenu et la consommation du ménage, incitant potentiellement l'individu à augmenter son offre de travail. Parallèlement, l'individu peut devenir un aidant informel, nécessitant ainsi une disponibilité accrue. En utilisant les données rétrospectives de SHARE et une méthode de différence-de-différences robuste à l'hétérogénéité du choc, ce chapitre révèle une diminution de l'offre de travail du conjoint qui s'accroit au fil des années suivant la survenue du handicap du conjoint. Les disparités entre les pays soulignent à nouveau le rôle protecteur des systèmes de sécurité sociale. Dans les pays offrant des mesures d'intégration solides sur le marché du travail pour les personnes en situation de handicap et un accès aisé aux revenus de compensation, l'apparition du handicap du conjoint n'a pas d'impact sur l'offre de travail.

Enfin, dans le troisième chapitre, nous explorons la causalité inverse en mesurant les conséquences d'une période de chômage sur la probabilité de déclarer une maladie invalidante. Les premières investigations, utilisant des modèles Logit, révèlent une relation positive entre ces deux variables à l'âge de 45 et 50 ans. En considérant un indicateur de maladies invalidantes mentales, les analyses indiquent qu'une période de chômage précoce (entre 15 et 24 ans) est associée à une probabilité accrue de déclarer des maladies invalidantes dès l'âge de 30 ans.

Mots clés: Handicap, Marché du Travail, Revenus, Participation au Marché du Travail, Chômage, Différence de Différences, Données de Panel, Logit

Summary

The aim of this thesis is to explore the relationships between disability and labour market outcomes in Europe, utilising data from the Survey of Health, Ageing and Retirement in Europe (SHARE), which provides a large sample of individuals followed over time (panel) from 28 European countries.

The first chapter focuses on the impact of the onset of a disability on personal income, defined as the sum of wages and compensation incomes. The impact of disability is measured by implementing a matching before the onset of disability and then computing a weighted difference-in-differences. The results show a decrease in personal income due to a significant loss of wages that is not compensated by compensation incomes. Heterogeneity analyses reveal that in countries implementing strong integration measures for disabled individuals in the labour market and/or offering high compensation incomes, the onset of disability has no impact on personal income.

The second chapter examines the modification of labour supply resulting from the onset of the partner's disability. This shock affecting the partner leads to changes in household income and consumption, potentially prompting the individual to increase their labour supply. Simultaneously, the individual may become an informal caregiver, requiring higher availability. Using retrospective SHARE data and a heterogeneity-robust difference-in-differences method, this chapter reveals a decrease in the labour supply of the partner that increases over the years following the onset of the partner's disability. Disparities between countries again highlight the protective role of social security systems. In countries with strong integration measures in the labour market for individuals with disabilities and easy access to compensation incomes, the onset of the partner's disability has no impact on labour supply.

Finally, in the third chapter, we explore reverse causality by measuring the consequences of an unemployment spell on the probability of declaring a disabling disease. Initial investigations, using Logit models, reveal a positive relationship between these two variables at ages 45 and 50. When considering mental disabling diseases, the analyses indicate that a period of youth unemployment (between 15 and 24 years) is associated with an increased probability of reporting disabling diseases by the age of 30.

Keywords: Disability, Labour Market Outcomes, Incomes, Labour Force Participation, Unemployment, Difference-in-Differences, Panel Data, Logit

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[1] Source: La thèse de Christophe Loussouarn

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À mes grands parents,
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Introduction

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1 Frame

1.1 Disability definition

Before the First World War, individuals with disabilities were not included in the society. Indeed, at first, disability was seen as a divine curse [Bussière, 2016]. Individuals with disabilities were considered as not normal, fool, whatever the types of limitations they had. As a result, there was a prevailing belief that it was "necessary" to segregate them from society, often in almshouses or similar institutions. During the Age of Enlightenment, disability was one of the research subject in various areas such as education, medicine, philosophy among others. For example, in 1749, with his *"Lettre sur les aveugles à l'usage de ceux qui voyent"*, Diderot [1749] has tried to demonstrate that individuals with disabilities (here blindness, in particular), thanks to sensorial education and training, can understand and perceive the world as well as individuals without disabilities [Genel, 2003]. Assistance to individuals with disabilities became the norm at this time, especially with the diverse works/realisations of Thomas Braidwood, the Abbé de l'Épée (who creates in Paris the world's first public school for deaf individuals), Valentin Haüy, Philippe Pinel, Dugal Stewart, among others. Unfortunately, it was not until the end of the First World War to observe an evolution regarding individuals with disabilities. Indeed, at the end of the fight, the number of individuals with disabilities was considerable: nearly eight million men in Europe [Cohen, 2001]. Partial or total, temporary or permanent, all kinds of disability existed. The needs of these people were essential: healthcare, financial support, and especially return to work. At this time, disability was becoming one of the priorities in Europe. Governments multiplied laws to provide pensions, health services, and return to work opportunities. For example, in 1920, Germany introduced free health care, work retraining, and physical rehabilitation [Pironti, 2017]. Since 1921, Italy has compelled private sector companies to hire one veteran with disabilities for every 20 employees [Pironti, 2020].

With all these measures for veterans, the way disability is viewed has changed. Thus, a definition and a frame were needed to include all individuals with disabilities, not only soldiers.

1.1.1 A long-term health deterioration

In the 1970s, confronted with the limitations of the International Classification of Diseases (ICD)[2] in addressing all the consequences of a disease, the World Health Organization (WHO) commissioned rheumatologist Philip Wood to create a new classification outlining the consequences of illness. Wood introduced a four-step model to define disability. The starting point is the disease or disorder. Subsequently, disability emerges as the outcome of this illness, encompassing three distinct levels of consequences. The first level is impairment, which Wood characterized as the loss or alteration of anatomical function resulting from the disease. For example, it represents a lost arm, an organ removal. The second level is the one of disability. The impairment (or the initial disease) generates an inability or a restriction in performing daily activities. For example, the individual is not able to extend their arm. The third and last level is the handicap one. Due to disability or impairment, the individual has some disadvantages in the achievement of "normal" social roles considering their age, sex, etc. (see figure A.1.1 in Appendix A.1). Thus, the WHO published the International Classification of Impairments, Disabilities and Handicaps (ICIDH) [WHO, 1980].

1.1.2 A non-medical-centred definition of disability

The ICIDH faced significant criticism, primarily for being perceived as excessively medical. It focused on the individual's health decline, neglecting the crucial role of the environment [Simeonsson et al., 2000]. In the 1960s already, a social model appeared. It takes into account the social disadvantages due to the social environment. This model considers that disability results from society's difficulties in integrating individuals with disabilities

[2]The ICD allows to classify diseases and types of death around the world.

and meeting their needs. Consequently, disability is only due to the barriers created by society, and the differences between persons with impairments and the "normality" result from this society.

The biopsychosocial model was developed to reconcile these two models and take account of their interactions. The central concept of this model is to consider the integration of individuals with disabilities into society. The disability is then due to the interaction between the individuals, their own characteristics and facilities, or difficulties created by their environment conditions (see details in figure A.1.2 in Appendix A.1). In 2001, the International Classification of Functioning, Disability and Health (ICF) was introduced [WHO, 2001] and received approval from 191 countries. In 2006, the Convention on the Rights of Persons with Disabilities, adopted by the United Nations (UN), defines people with disabilities as follows: *"Persons with disabilities include those who have long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others."* [UN, 2006].

With this definition, we integrate three new components of the disability, considering that the life environment creates disability due to impossible interactions with the individual and not only because of the impairment. The first component is the "Body Functions and Structures", the second is the "Activities and Participation" and the last is the "Environmental Factors". The first one, at the body level, regroups all the physiological and anatomical limitations, while the "Activities and Participation" level is at the individual and describes the difficulties experimented by this individual in performing activities or involving in life areas. In particular, work and employment are part of "Activities and Participation". ICF considers all the learning process (informal, preschool, school and higher education; vocational training; apprenticeship) and the working life (seeking, finding, choosing, keeping employment; quitting a job). Finally, the "Environmental Factors" considers external factors in the environment where individuals live. This section also

mentions employment but not at the individual level. The labour market characteristics, such as equipment, workstation and social protection, are classified to identify the level of protection or barriers created by these environmental factors. Examples of applications of ICF on individuals are provided in A.1.3 in Appendix A.1.

Consequently, in this thesis, we will mainly use the expressions "individuals with disabilities" or "persons with disabilities" rather than "disabled individuals". These formulations highlight that it is not only the individual's characteristics that put them in a situation of disability.

1.1.3 Different types of disability

Disability is a wide and versatile concept arising from different causes and generating different types.

The onset of disability can occur at various stages throughout the life cycle. Disabilities may manifest at any age, whether at birth, during childhood, following an accident, or even during one's working years. Additionally, disabilities may vary in duration, ranging from temporary conditions to permanent impairments.

We also can classify the disabilities according to the following categories: motor disability; sensory disability; mental disability; psychic disability, and disabling illness. Motor disability corresponds to inability (partial or total) to move around or their limbs, to perform actions. The sensory one represents difficulties related to the senses. The two most well-known are vision and hearing problems. Individuals with mental disability have mental or intellectual impairments leading to understanding, thinking, expressing, and communicating issues. It differs from psychic disability, which does not lead to problems with intellectual functions. Psychic disability is more related to a disturbance in personality or mental, or emotional troubles. Finally, disabling illnesses are long-term illnesses that may cause disability and evolve over time.

Among all these categories, one last classification could appear regarding the level of disability in terms of severity. There is no actual definition for disability severity. Most of the time, this severity is assessed through the ability to work. Each level enables individuals with disabilities to receive (or not) compensations.

1.2 Disability and employment

When focusing on the bound between disability and labour market outcomes, two main dimensions appear. First, disability can affect labour market outcomes (see part 1.2.1). Second, reverse causality can also exists: work may impact disability (see part 1.2.2).

1.2.1 How may disability affect labour market outcomes?

The literature on the impact of disability on labour market outcomes can be divided in three parts. The first one is related to the papers highlighting the direct impact of disability on labour market outcomes. The second one refers to the indirect effect of disability on working through receiving disability benefits. The last one is about evaluations of public policies regarding disability.

Direct impact of disability on labour market outcomes

Disability is well-known as being negatively correlated with labour market outcomes. In particular, previous researches have shown the negative impact of disability on labour force participation [Mussida and Sciulli, 2016; Silva and Vall-Castelló, 2017], working hours [Müller and Boes, 2020] and earnings [Angelov and Eliason, 2016; Kidd et al., 2000]. In the meantime, disability is associated with early retirement [Denton et al., 2010]. Those adverse effects primarily arise because disability impedes entry into the labor market, given limitations that are incompatible with certain jobs. Moreover, the disutility of work can be generated by various disincentives, including the challenges posed by the disability or the productivity gap between individuals with and without disabilities [Silva and Vall-Castelló, 2017].

This relationship between disability and employment can be mitigated or amplified by individuals or disability characteristics. For example, the severity of the disability or the type could generate a higher negative impact. Lindeboom et al. [2016] highlight higher consequences as the degree of disability increases and French and Song [2014] show that individuals receiving disability benefits for mental illness have a lower decrease in employment probability than other benefits recipients. Regarding individuals' characteristics, being female, being older, or being less educated amplifies the negative effect of disability [Barnay, 2010; Lindeboom et al., 2016].

Indirect impact of disability on labour market participation through the receipt of disability benefits

As mentioned earlier, disability has a negative impact on earnings [Angelov and Eliason, 2016; Kidd et al., 2000]. First, the decrease in productivity generates lower access to the labour market, and, in the meantime, expenses in medical goods and services are growing. Disability insurance (DI) has been implemented (see details in part 2.2) to compensate for decreased incomes for individuals with disabilities.[3] Nonetheless, some literature shows that receiving DI can discourage individuals with disabilities from working. After controlling for the health characteristics of the disability, Frutos and Castello [2015] show that compared to individuals with low disability levels who do not receive DI, the ones with low disability level who receive DI have 19 percentage points (pp) lower probability of being in the labour market. At the intensive margins in Switzerland, Müller and Boes [2020] find that receiving DI leads to an increase of 32pp in the probability of working part-time. This result comes from a sample of older workers (at least 56). Regarding the older workers, several papers demonstrate that DI is used as a pathway to early retirement [Aranki and Macchiarelli, 2013; Bernal and Vermeulen, 2014; Lammers et al., 2013; Li, 2018].

[3]Other disability pensions exist but DI is the major one.

Evaluations of public policies to promote the work of individuals with disabilities[4]

The large part of individuals with disabilities out of the labour market (see part 2.1) highlights difficulties of the labour market on the supply side (disability impacts negatively the labour market outcomes as mentioned earlier) but also on the demand side. Indeed, when people with disabilities want to offer their labour force, their offer could be not satisfied because of a lack of integration. Employers could apply discrimination against them. According to Heckman [1998], discrimination appears if a firm treats differently (e.g., does not offer the same job opportunities, the same earnings) two individuals with different personal characteristics (such as gender, race, or health status) which do not impact their productivity. Discrimination can be of several types. For example, working conditions could mismatch with the limitations of the individual with disabilities, and employers do not want to the adapt their workstation to fit with this individual. Moreover, if we do not look at the entry to the labour market but at keeping people with disabilities in work, Silva and Vall-Castelló [2017] observe that, in Spain, employers have few incentives to keep individuals with disabilities in their firms. Governments have implemented policies regarding the demand side of the labour market to limit these discriminations (especially at the entry of the labour market). For example, in France, since 1987, each firm with more than 20 workers has to hire disabled workers, in a proportion of 6% of the total workforce. In Italy, a similar measure was established in 1999 regarding companies with at least 15 employees. These coercive measures have been evaluated. Indeed, Barnay et al. [2019] are interested in the 1987 French law. They find a negative impact of the quota on the employment rate of individuals with disabilities in the private sector, while no effect in the public sector is found. In Italy, we can mention the diverse works of Agovino and his co-authors. The authors have tried to assess the effectiveness of the 1999 law at the level of Italian provinces. Using administrative data [Agovino and Rapposelli,

[4]Regarding governments actions for the supply side of labour market, we provide details about welfare systems in part 2.2.

2014] or survey data [Agovino et al., 2018], both papers have shown that the effectiveness of the law depends on the provinces and the positive effect of the law is very low.

1.2.2 What about the role of work and work conditions on disability status?

For now, we only consider the impact of disability on labour market outcomes. However, it's important to note that work itself could potentially have consequences on one's disability status.

Labour characteristics such as lack of autonomy or working conditions could negatively impact health. For example, Bassanini and Caroli [2015], in a literature economic review, show that working long hours negatively impacts health, especially when it is not a choice. Conversely, a part-time job is associated with lower physical health [Carrieri et al., 2012; Waenerlund et al., 2011]. Working conditions such as night work, heavy workload, and manual job can also negatively impact health [Case and Deaton, 2005; Robone et al., 2011].

Globally, job strain and effort-reward imbalance models [Karasek Jr, 1979; Siegrist, 1996] have been mainly used in empirical literature to demonstrate that stress models are associated with poor health and predict disability pension [Canivet et al., 2013; Laine et al., 2009].

At the extensive margin, the adage "work is health" seems to indicate that being out the labour market is not good for health. In particular, unemployment impacts negatively health (see Paul and Moser [2009]); especially self-rated health [Voßemer et al., 2018], and men's mental health [Artazcoz et al., 2004; Backhans and Hemmingsson, 2012; Schröder, 2013]. Retirement has an adverse impact on cognitive functions, mental and physical health [Mazzonna and Peracchi, 2017], and on men's weight [Feng et al., 2020; Godard, 2016]. Nonetheless, as mentioned earlier, working conditions can mitigate the results.

Specifically, concerning the effects of retirement on health, the literature demonstrates that considering factors like arduousness at work or educational level, retirement can have a positive effect on health. [Barnay and Defebvre, 2021; Gorry et al., 2018].

2 Disability and Employment in Europe: an overview

The whole thesis studies the relationship between disability and labour market in Europe. Consequently, we provide here an overview of the situation regarding disability and employment in Europe. We also present the main properties and differences between European social welfare systems.

2.1 Disability in Europe: a few elements of context

Definition and legal framework

In 2010, all EU members except Finland, Ireland, and Netherlands adopted the 2006 definition of the UN [UN, 2006].[5] Despite this convergence, European countries have adopted different legal approaches to disability, some setting up a proper regulatory framework (Germany, Spain, France). In contrast, others refuse to stigmatise individuals with disabilities (the Nordic countries) and then do not set up any framework.

The disability in Europe in figures

In 2021, one-quarter of the 16 and over European Union (27 countries) population have reported some or severe long-standing limitations in usual activities due to health problems [Eurostat, 2023]. This rate was about 31% for the 55 to 64 years population. With the ageing population, the number of people reporting disability is supposed to increase.

In the last decades, protecting the rights of people with disabilities has become a challenge

[5] "Persons with disabilities include those who have long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others"

in Europe. Indeed, those individuals face challenges, especially in the labour market: differences in employment rate between working-age people with and without disabilities are important. In 2011, the employment rate for the without-disability European population aged 15−64 was around 67%, and this rate was only 47% for people with disabilities. While this rate has increased in the last years, reaching 50.6% in 2017, the gap between individuals with and without disability is still high (+14.2pp). In 2022, according to Eurostat, 50% of working-age individuals with disabilities are unemployed, while only 25% of those without disabilities. Those gaps are heterogeneous among countries.

2.2 Disability and employment through welfare systems[6]

two distinct systems coexist to provide optimal protection for individuals encountering these challenges: the insurance system and the assistance system.[7] The first one is generally related to a usual insurance system where individuals give contributions -voluntary or not- to receive financial compensation if they face the risk for what they are insured. The second one is often for individuals with insufficient contributions to be integrated into the first. The aim is to maintain a minimum means of subsistence.

In the case of disability, insurance is the predominated system. In Europe, this system is most of the time mandatory. OECD has implemented indicators to compare disability policies regarding employment by separating compensation and integration.

Compensation component

The compensation component of OECD indicators is based on 10 items: the covered population (from employed individuals to the total population of the country); the minimal level of incapacity which enables to receive benefits; the level of incapacity which provides full benefits levels (from 100% to less than 50%); the level of replacement rate (from

[6]This section has been inspired by [OECD, 2010, 2019; MISSOC, 2019].

[7]These two systems refer to the initial Bismarck and Beveridge systems. The first one was introduced in Germany at the end of the XIX century for the workers who contributed to the system. The second one comes from England at the end of World War II and offers protection regardless of the working situation.

less than 50% to more than 75%); the continuity of benefits (from temporary for each disability level to permanence); the examination of work capacities; the replacement rate of sickness benefits; the duration of sickness benefits (from less than 6 months to more than one year) and the tracking of sick leave [OECD, 2010]. These different items are in place to help individuals with disabilities who cannot (partially or completely) work. Consequently, the compensation indicator measures the welfare systems' role in removing barriers to the labour supply side due to disability.

Regarding disability benefits, European countries predominantly link them to income. However, Estonia stands out as it provides fixed benefits irrespective of a reference earning. Similarly, self-employed individuals with disabilities in Belgium receive a fixed amount, unlike their employed counterparts who receive benefits based on earnings. In most European countries, disability benefits transition into old-age pensions once the retirement age is reached. Notably, Hungary, Malta, and Slovenia allow individuals to choose between disability pensions and old-age pensions. Furthermore, Nordic countries (specifically Sweden and Denmark) and Germany do not have minimum levels for disability pensions. Italy has eliminated its minimum level for individuals entering the labor market after 1996.

The combination of disability benefits with other social security benefits is partially authorized. In Estonia, Hungary, Ireland, and Malta, no such combination is permitted. In Denmark, combinations are allowed only if other benefits do not address the same needs. In countries where such combinations are possible, the following characteristics apply. First, disability pensions transform into old-age pensions at retirement age, and the combination is generally not allowed. Second, combining disability benefits with unemployment benefits is subject to conditions; for instance, in the Czech Republic and France, it is allowed only for certain levels of disability. In Spain, accumulation is possible only in case of total permanent incapacity for the current occupation. Conditions are also applied when individuals wish to combine disability and sickness benefits. A combination of earnings from employment and disability pensions is allowed. However, in most

countries, if the cumulative amount exceeds a certain threshold, disability benefits are reduced. The Czech Republic, Spain, and Sweden are exceptions where no reduction is applied.

Integration component

OECD indicator of integration relies on ten items: the consistency of the covering; the programs evaluation; the anti-discrimination legislation; supported employment programs; subsided employment programs; sheltered jobs; the professional rehabilitation; the moment of this rehabilitation; the regulation on benefits suppression; the incentive to work [OECD, 2010]. The integration part of OECD indicators measures the ability of countries to remove labour demand side barriers regarding individuals with disability.

Regarding integration, in the last decades, countries have implemented policies to compensate for the adverse effects of disability on the labour market. Again, countries' disparities also arise. Indeed, coercive measures have been established in France, Italy, Spain, Germany, Austria, and the Czech Republic. These measures impose on firms to hire a proportion of individuals with disabilities. In order to constrain firms to respect quotas, different strategies have been adopted. For example, Austrian firms with 25 to 100 employees have to pay 251€/month if they do not hire people with disabilities; Italian firms have reduced contributions if they hire individuals with disabilities; subsidies are given to firms in the Czech Republic. In contrast, countries with no quotas are focusing on working conditions (appropriate workstations in Sweden, for example; special facilities; etc.) and have implemented measures to reduce discrimination against workers with disabilities and to push integration. For example, Denmark and Sweden have decided to "freeze" compensation incomes if an individual with disabilities decides to go back to work, meaning that if, in the end, they lose their job, they will receive compensation incomes without a new application.

If we look at OECD indicators, Nordic countries and Switzerland were the most generous

in the early 2000's. While the indicator is still valid, the country's score is slightly old. Nonetheless, if we look at the part of GDP devoting to disability benefits in the late 2010's, we see that this trend is still valid.

3 Theoretical and methodological background

3.1 Theoretical background

This thesis is at the intersection of three economics fields: health, labour and family economics.

Chapters 1 and 2 focus on studying the impact of disability situation. This situation will have an impact on individuals' utility by modifying their choices in terms of :

(i) consumption: disability situation will modify revenues (see especially Chapter 1) and generates higher expenses in medical goods;

(ii) work-leisure trade-off (see especially Chapter 1)

We are also interested in the consequences of disability at the household model. Family consequences arise by modifying bargaining power of household individuals (see especially Chapter 2). Due to the above-mentioned modifications in the revenue and consumption structure of the individual with disabilities, disability will play a role in labour supply, consumption, household tasks and leisure of each household member, and then affect theirs utilities.

Finally, to study the full link between disability and work, we are also looking at the reverse causality, i.e. the impact of work on disability (see especially Chapter 3).

Although this work is empirical, it is necessary to explain in details theses insights by integrate them into a theoretical framework. This work is based on four main models.

3.1.1 Demand for Health Capital

The Demand For Health model of Grossman [1972] is the pioneer model in this thesis. It can be considered as a specific application of the Human Capital Theory of Becker [1964] where the Health Capital is introduced. In this theory, the demand for health is considered as endogenous and can be both demanded and produced by the consumers. On the demand side, health is viewed as a expense post (healthcare consumption) while on the production side, it becomes a part of the revenue (investing in health increases the productivity level). As in any micro-economic model, individual is looking for the optimal health capital HC^*. It is defined as the one which maximise their utility $U(.)$ under production, time and revenue. This model goes further by adding an intertemporal dimension. Indeed, health is seen as a capital and, thus, is subject to depreciation:

$$HC_{t+1} - HC_t = I_t - \delta_t HC_t$$

with I_t the gross investment in HC and δ_t the depreciation rate which can vary with age but not only. Health investment, healthcare consumption, labour market outcomes impact the depreciation rate.[8] Especially, work can be a source of health degradation or, on the contrary, of protection. Good health allows one to work and working allows one to have an income to invest in one's health capital. At reverse, poor conditions and job insecurity are factors that can degrade health [Barnay and Jusot, 2018].

Incorporating the disability shock into this model induces modifications. It is reasonable to expect that health capital depreciation will be more pronounced in cases of disability compared to other health shocks. This is especially true because disability has long-term effects on an individual's life. Furthermore, disability is likely to impact not only the rate of health capital depreciation but also another critical component of the budget constraint: income (as explored in Chapter 1). Individuals with disabilities often face

[8] More precisely, in the original Grossman model, depreciation was treated as exogenous and constant over time. Several extensions of this model relax this assumption.

higher chances of exiting the labour market, leading to reduced income levels. This reduction in income is compounded by the increased healthcare consumption due to the intensive and long-term care needs associated with disability, further exacerbating the financial strain. Additionally, the time constraint will also be affected by the additional caregiving responsibilities necessitated by the disability. These factors will inevitably lead to changes at the household level. The loss of income and the shift in consumption patterns, particularly towards healthcare and informal caregiving, will compel the healthy partner to reassess their labor supply (as explored in Chapter 2).

3.1.2 Theoretical background in family economics - *Chapter 2*

Joint labour supply models

Joint labour supply theories explain the intra-household bargaining leading to the choice of labour supply for each member of the couple.

Joint labour supply models can be classified into two groups: unitary models and non-unitary ones [Chiappori, 1992].

The first group consider the household as one single agent, one unit. Analytically, this agent is represented by one unique utility function for all the members in the household $U(L_A, L_B, C)$ with L_i the labour supply of the household member $i (i = A, B)$ and C a composite good. This utility function is then maximised under one unique budget constraint depending on the wages of both members, their available time and their other revenue. It is simply a generalisation of the single individual model [Chiappori, 1992; Donni, 2006]. These models have been largely criticised because they do not take into account the various preferences of each member in the household.

The second group goes further by considering preferences of each individual in the household. The utility function will depend on the behaviour of each member. If they are egoistic, their utility function will depend only on their own leisure and consumption:

$U^i(L_i, C_i)$. At reverse, the partner's leisure and consumption could be directly integrated in the utility function depending on the type of consumption and the degree of altruism of individuals. If the consumption is public, utility functions of each members will depend on both C_1 and C_2 while the utility of individual i will depend only on C_i if the consumption is private. Finally, if people are altruistic, their own utility will depend on their leisure and the one of their partner while it will depend only on L_i if individual i is selfish. Cooperative models and non-cooperative ones are two categories of non-unitary models. In the cooperative models, the household maximises a weighted sum of members' utilities: $\mu U_A + (1-\mu)U_B$ where μ is defined as the bargaining power of individual A in the household [Chiappori, 1988, 1992]. This program can be also viewed as follows: each member maximises their own utility under the constraint that the partner's utility is higher than a lower utility threshold $\overline{u}_B$ [Chiappori, 1992]. It results in a Pareto Optimal equilibrium. In non-cooperative models, each member maximises their utility taking for granted the actions of their partner [Leuthold, 1968; Lundberg and Pollak, 1993, 1994, 1996]. This model is comparable to a Cournot one. Consequently, the equilibrium is a Nash one.

Consequently, when we study labour supply of one individual it is important to take into account the job situation of their partner. With the added worker effect theory, we will explain how disability onset affect the labour supplies of the household members.

Added worker effect

Initially designed for household where a married men become unemployed, the added worker effect (AWE) theory suggests that women will increase their labour supply. The idea is to maintain the level of household income to smooth the consumption [Mincer, 1962].

This theory could be extended to any negative shock regarding labour market in a household. Especially, if we consider disability onset. Disability reduces labour market produc-

tivity but not only. It can also imply decrease in household productivity and/or in ability to perform personal daily activities (e.g., dressing, washing, etc.). Moreover, healthcare consumption is increasing. In the case the healthy partner wants to provide for all these needs, they may be tempted to work more.

Empirically, some papers have investigated the added worker effect. The main finding is that the strength of the AWE depends on the age of the healthy partner [Acuña et al., 2019]; the health measure [Acuña et al., 2019; Fadlon and Nielsen, 2021] and the gender [Charles, 1999; Coile, 2004].

3.1.3 Theoretical background in labour economics - *Chapter 3*

Latent deprivation model

As highlighted in the demand for health and the AWE theories, employment enables to make a living resulting in some well-being/ good health (see Grossman [1972]). Nonetheless, work fulfils other essential needs for well-being, in particular mental well-being. Jahoda [1982] proposes a deprivation model of joblessness. She postulates that employment, after providing obvious function allowing access to material and financial goods, offers access to five latent functions. The first one is the time structure: work provides a rhythm to our daily life. The second one is social contact: at work, you create social relationship with people outside the family circle. Colleagues give new social contacts with mutual aid and support. This link is not only professional. Daily informal conversations could appear. The third latent function is related to purpose: having a job allows to develop new skills to achieve goals. The fourth one is activity: employment pushes people to have regular activity. Finally, the last latent function provided by employment is status: job allows to have society recognition by giving to people a status.

All these latent functions participate to mental well being. Consequently, work contributes to good health while unemployment deprives individuals from these functions. It generates changes in daily life, especially in time use. It also changes activities participation, and

in particular, decrease in the ones with a fee. The link with people outside the family circle is reduced and the society's view is changing. Thus, well being is clearly decreasing. Health decrease is the first component of disability. We assume that, in the long run, this decrease can evolve into a disability (see chapter 3).

3.2 Empirical framework

3.2.1 Challenges

Measurement issues

Disability measures Due to the complexity of disability, measuring it is neither straightforward nor unequivocal. Two types of disability measures can be used: self-reported and objective assessments.

The most common self-reported indicators of disability are, on the one hand, Activity of Daily Living (ADL) and instrumental ADL (iADL), and, on the other hand, the Global Activity Limitation Indicator (GALI). ADL and iADL are thought to be relatively more indicative of irreversible impairments and more specific to age-related dependency [Cambois et al., 2013; Millán-Calenti et al., 2010] rather than to all-cause disability. GALI, which measures functional disability, is one of the most used and standardised indicators for national statistics. Recently, several studies have assessed the validity of GALI for measuring disability compared to other health measures. The literature underlines that GALI sums up participation restrictions, thus making it a globally valid and reliable measure [Van Oyen et al., 2018]. Moreover, GALI correctly reports limitations captured by both subjective and objective measures that is consistent across European countries in the Survey of Health, Ageing and Retirement in Europe [Jagger et al., 2010]. Indicators of long-term health problems can also measure disability. Indeed, even if diseases do not always lead to disability, the medical model defines disability as a direct consequence of illness or other health problems [WHO, 1980]. Furthermore, disabling illnesses are a type

of disability. Some studies have used this indicator of long-term health problems. For instance, Kidd et al. [2000] have studied the impact of disability (defined as long-term health problems) on earnings and labour force participation. Nonetheless, to account for all types of disability and for barriers and/or factors that limit individuals, a mix of GALI and long-term illness is more often used. Gannon [2005] uses this mix to study the effect of disability on labour force participation and earnings, while Pagan [2011] relies on it to explore the job satisfaction of older individuals with and without disabilities.

The literature employs objective indicators to mitigate self-declaration bias and the interpersonal comparison issues associated with self-reported indicators. The aim is to obtain a more accurate measure. Physical health measures, such as grip strength and the ability to rise from a chair, are commonly utilized. For instance, Boissonneault and Vilotitch [2017] rely on these indicators, among others, to examine the relationship between early retirement and poor health. Objective measures can also be obtained through administrative data, allowing the identification of individuals receiving Disability Insurance (DI).

According to Bound, both types of measures present pros and cons while also leading to different biases [Bound, 1991]. This pioneering article provides an analysis of what kind of measures are the most efficient from the econometric point of view. By estimating a statistical model which contains both measures of health and using the Retirement History Survey (a database with men aged 58-63 observed during ten years), Bound [1991] shows that objective measures of health, just as self-reported measures, can result in a bias leading to econometrics issues.

Justification bias In the relationship between disability and labour market outcomes, declaration biases can appear due to justification biases. The idea of these latter biases is that individuals overstate their disability situation to justify their non-participation in the labour market. Overstate disability situation means to report a higher level of disability than the latent disability (the actual value, unobserved by researchers). Even

if this endogeneity has been studied in the literature for a long time (first papers in the 1980s [Anderson and Burkhauser, 1985; Stern, 1989]), there has yet to be a consensus. While some papers demonstrate a justification bias [Baker et al., 2004; Gannon, 2009; Lindeboom and Kerkhofs, 2009] leading to wrong estimations [Lindeboom and Kerkhofs, 2009], others assert no evidence that self-reported disability has been driven by justification bias [Benítez-Silva et al., 2004; Cai, 2009]. More recently, Black et al. [2017] rely on a panel database where disability is declared twice in face-to-face interviews. The database is the *Household, income and labour dynamics in Australia* survey which consists of three parts: household form, household questionnaire and person questionnaire. The first measure is reported in the household form, meaning that one respondent declares for all the household the disability situation. The second measure is stated at the end of the person questionnaire. Both of them are available in a panel dimension. By implementing a fixed-effects model, they estimate the probability of declaring disability at the second question conditionally on the answer to the first one and the labour market situation. They find a justification bias higher for men than women. The probability of declaring a disability situation is 3.3pp higher for unemployed men than working men, with constant first self-reported disability. For women, this amount is about 2.2pp.

Selection issues

If study sample is not random, estimators could be biased. For example, if we rely on a survey, investigated individuals can have particular characteristics, such as interests for the study, leading to investigating only those who want to be and have specific features. For example, some authors focus their work on sample selection regarding health surveys [Holle et al., 2006; Mindell et al., 2015]. They show that non-responding individuals are more likely to be women [Mindell et al., 2015], young [Holle et al., 2006; Mindell et al., 2015], less healthy [Holle et al., 2006]. Consequently, if some characteristics are over-represented in the survey, the results based on them will be biased and unrepresentative of the general population. In particular, if we look at the disability-labour market

relationship, selection biases could result from the fact that current health or disability may be determined by past employment characteristics or initial health capital. Moreover, to answer a survey, individuals with disabilities need to be in a sufficiently good health, meaning that those with the worse health status are excluded from the estimations. Same if we look at the career path of individuals with disabilities. Those still in the labour force are the healthier ones (see the Healthy Worker Effect theory). At the same time, when people choose their job, they do it considering their own characteristics such as their health status and, *a fortiori* their disability. In this thesis, we rely on one database randomly selecting individuals (see Database description in part 3.2.2). This survey is compulsory in Europe, meaning that if individuals are selected, they have to answer it.

Finally, when researchers are evaluating public policies, they are used to create treated and control groups. The treated group represents individuals who have experienced something we want to evaluate (here, in this thesis, it can be a disability situation or unemployment). Control groups are those who did not experiment the treatment. When those two groups are constructed, it might be the case that the distribution of individuals between groups is not random. For example, those who will be unemployed can initially have predisposing factors leading to biases in the estimations. In this case, researchers must implement an adequate methodology to get closer to a randomised experiment where treatment has been assigned randomly to individuals.

Two-way relationship

The relationship between disability and labour market outcomes can be understood as a two-way causal relationship [Barnay, 2016; Grossman, 1972]. Indeed, in this relationship it can be hard to define which variable is the consequence of this other one. Both can be determined simultaneously. Disability can influence labour market outcomes by reducing productivity. In the meantime, labour market caracteristics can potentially create disability situation or labour market structure can not be adapted to the health situation of

the individual and, thus, created a disability situation.

A lot of empirical studies try to eliminate this potential biases by studying the impact of exogenous disability shock on labour market outcomes. Measuring an exogenous shock to disability involves choosing a disability measure that could not be predicted such as accidents [Cervini-Plá et al., 2016; Dano, 2005]. Same could be done if we look at the reverse causality. Exogenous labour market shocks like unemployment due to plant closure have been often used [Browning et al., 2006; Gallo et al., 2009; Schaller and Stevens, 2015; Schmitz, 2011; Schröder, 2013; Strandh et al., 2014].

Omitted variables

Omitted variables is also one source of endogeneity leading to bias in the estimation. This unobserved heterogeneity is often related to variables that we do not have in the database or we do not observe. It relates to confounding factors that can simultaneously influence both disability and socio-economic statuses. In other words, if those variables are correlated with the explanatory ones and explain partly the dependent variable, estimations are biased.

In the disability-labour market relationship, these variables could be, among others, risk aversion, risk behaviours, personal characteristics (e.g., initial skills), level of disability [Jones, 2011] or desutility at work [Eibich, 2015].

3.2.2 Database

Description

Due to the abovementioned issues, studying the relationship between disability and labour market outcomes necessitates panel databases or, at least, temporal information. Moreover, we focus our work on Europe and not only on one country. Consequently, in this work, we rely on the The Survey of Health, Ageing and Retirement in Europe (SHARE). This survey is a panel database which is carried out every two years since 2004 in 27

European countries and Israel [Börsch-Supan et al., 2013]. Treated topics are various: health care, cognitive function, employment and pensions, mental health, demographics, physical health, etc. Interviews are realised in face-to-face. Concerning the target population, SHARE is focused on individuals aged 50+ years (at the time of the first interview) living in private households. It also includes the partners of the respondents, regardless of their age.

In 2004, when SHARE began, 30,434 individuals have been interviewed for the 1st wave in 12 different countries: Austria, Belgium, Denmark, France, Germany, Greece, Israel, Italy, Netherlands, Spain, Sweden, Switzerland. Other countries were added to the survey as they came in (see figure A.2.4 in Appendix A.2). Overall, more than 140,000 individuals have been investigated since the beginning.

SHARE can be divided in two panel database: a regular one and a SHARELIFE one. The regular one correspond to the initial questionnaire (the one in wave 1) which have been used again in other waves to see the evolution of individuals. Nonetheless, when the wave 3 has been done, organisers have decided to implement a special questionnaire called SHARELIFE. It refers to past events in the life of the individual. As new countries have joined the study, all the participants, who did not participate to the wave 3, have answered to the SHARELIFE questionnaire in wave 7. These two questionnaires (regular one and SHARELIFE) need to be used separately.

The strengths of this survey are numerous. First, it is a longitudinal study. Second, the retrospective panel enables to reconstruct a complete biography for each individual from birth to the interview. All the information regarding partners, jobs, major health events, children, etc. are provided. Third, the regular panel allows us to create homogeneous framework. Finally, the European dimension of the database is a major interest. Heterogeneity in welfare systems, in familial models can be explored.

Why using it for this thesis?

When studying disability, two types of databases can be used: the ones focusing only on individuals with disabilities or the ones that are more generalist, which include some questions that measure disability situations. Evaluating the impact of a "treatment" (e.g. disability in two parts of this thesis) requires comparing individuals who received the treatment and those who did not. Consequently, we decided to look at databases not only focused on people with disabilities.

Moreover, in this thesis, we are interested in the interactions between labour market and disability. Consequently, we also need labour market information. Since SHARE is a survey about Health, Ageing and Retirement, it provides detailed information regarding the health status and, in the meantime, the career path. Although this is not the only study on health and career paths, SHARE is still ongoing, meaning that data are still young. The longitudinal dimension is long enough to study our research problems, which have long-term consequences (disability is a long-term process and can vary with time). The European dimension is also advantageous in suggesting policy recommendations based on what has been done in some neighbouring countries.

Regarding disability, SHARE provides different measures, objective or subjective. The former are grip strength, chair stand test, walking speed, expiratory lung force and administrative recognition of disability situation. Grip strength and administrative recognition are the only ones available from wave 3 to wave 7 (the waves we are using). While grip strength is a good predictor of disability [Ishizaki et al., 2000; Wang et al., 2019], it is often related to the ageing process (studies on grip strength as a predictor of disability mostly integrate people aged 50 at least). Furthermore, it refers to a physical measure based on a single body part of the individual. This thesis tries to rely on a comprehensive definition of disability. Regarding administrative recognition, differences between countries are essential (see parts 2.2), making country comparisons all the more important. The subjective measures of disability in SHARE are ADL, iADL, mobility, long-term illness

and the GALI (see explanations in part 3.2.1). SHARELIFE provides only three measures of disability: administrative recognition, disabling diseases and physical injury leading to permanent disability. This thesis relies on the GALI, long-term illness/disabling illness and administrative recognition. In each chapter, capturing as best we could all types of dimensions of disability definition [UN, 2006] and making countries comparisons were our first goals, explaining mainly our choices of disability measures.

4 Outline

Chapters 1 and 2 of this thesis examine the impact of disability on labour market outcomes. Chapter 1 focuses on the individual with disabilities, while Chapter 2 explores this relationship at the household level. In the Chapter 3, we investigate the reverse causality by examining the effects of unemployment spells on the later probability of declaring disabling diseases

Specifically, Chapter 1 aims to assess the causal impact of the onset of a disability situation on personal income, defined as the sum of wages and compensation incomes. Disability is defined using two main indicators: the GALI and a binary variable of long-term illness. Using a balanced panel from SHARE, we compare the incomes changes of those experiencing a disability situation (159 individuals) and those without a disability (2,375 individuals). To address selection issues, a propensity score matching (PSM) is performed before the onset of disability. A difference-in-differences (DiD) model is then implemented. The results show that the onset of disability leads to a strong negative impact on wages (-60.15%), which is not compensated by the increase in compensation incomes (no significant effect), resulting in a 16.47% decline in personal income. Heterogeneity tests according to gender and the generosity of social welfare systems are performed. While no differences between women and men are found, the generosity of social welfare systems plays a protective role. In countries with easy access to disability benefits, generous compensation incomes, and strong employment integration measures for individuals with

disabilities, there is no drop in personal income following the disability onset

Chapter 2 considers the causal impact of partner's disability situation onset on labour supply. Using the Life Histories waves of SHARE (SHARELIFE), a retrospective panel is reconstructed to observe each member of the couple from birth to at least age 50. Then, relying on an administrative measure of disability, the labour supply of healthy individuals with a partner's with disabilities, considered as a treatment, is studied. The administrative measure of disability allows to consider the compensation incomes received by the partner's with disabilities. Taking into account the characteristics of this treatment - irreversibly, heterogeneous timing among individuals - a robust heterogeneity DiD is implementing. Findings highlight a decline in the probability of working following the partner's disability onset, ranging between -1.9pp in the year following the receipt of Disability Insurance (DI) and -4.8pp after five years. These results are applicable to both women and men and are primarily driven by individuals aged 41 to 55 when their partner's disability occurs and those with partner who stop working in the two years following the onset of disability. Similar to Chapter 1, when countries implement strong integration measures for individuals with disabilities, no effect is observed on the partner's labor supply.

Looking at the reverse causality, Chapter 3 proposes a first analysis of the role of experiencing unemployment spells on the probability of declaring later disabling diseases. This early work, based on logit models, highlights a positive association between experiencing unemployment between 15 and 44 years and the probability of declaring disabling diseases at ages 45 and 50. This relationship emerges even earlier when examining a specific indicator of mental disabling diseases. Individuals facing unemployment between 15 and 24 years have a higher probability of declaring mental disabling diseases from age 30. While country heterogeneity and robust methodologies still need implementation, this chapter provides insight into a hidden societal cost generated by unemployment. It raises questions about the necessity of compensating unemployed individuals for this potential

adverse effect and the effectiveness of back-to-work measures.

Chapter 1

How Does Disability Affect Incomes? An Empirical Study on Older European Workers

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Table of contents

Abstract

This paper studies the impact on personal income resulting from the onset of disability. Using the Survey of Health, Ageing and Retirement in Europe, we compare the income trajectories of individuals experiencing disabilities and of those remaining in healthy conditions during the same period. Assuming that a disability shock may result in a loss of overall income due to the negative effect on wages being much higher than the positive effect on compensation incomes, we strive to identify a causal impact by combining a difference-in-differences approach with kernel propensity score matching, allowing us to account for observable and time-invariant unobservable individual characteristics. Our findings suggest a strong negative impact on wages that is not compensated by compensation incomes, leading to a decrease in personal income. We also perform heterogeneity tests according to gender and the generosity of social welfare systems, demonstrating that the most generous countries play a protective role.

1 Introduction

One-quarter of the European Union (EU) population reported long-standing limitations in 2018 (see Figure B.1.5 in Appendix B.1), which reflects several social disadvantages, including the prevalence of chronic diseases, accidents, and harsh working conditions. Due to losses in productivity, treatment time when care is needed, and discrimination effects, people with disabilities would experience changes at both intensive and extensive margins of labour supply, which may lead to permanent exclusion from the labour market.

While the 2011 employment rate for the European population without disabilities aged 15–64 is approximately 67%, this rate is only 47% for the population with disabilities.[1] The gap in employment rates between people with and without disabilities ranges from 2.4 percentage points (pp) in Luxembourg to 37.4 pp in both Hungary and the Netherlands (see Figure B.1.6, Appendix B.1). This relationship is exacerbated for people aged 50 and over due to associated comorbidities, employability issues and increasing retirement age. Unsurprisingly, the proportion of people with disabilities reaches 31% of the 55-64 population against 12% for the 16-44 population (see Figure B.1.7 Appendix B.1). However, extensive margin analysis, e.g., the study of the influence of disability on employment rates, does not seem sufficient to analyse the entire income movement resulting from disability onset. Specifically, the occurrence of disability can dramatically affect income composition, with significant diversity being observed among European countries due to differences in welfare generosity. Actually, principle 17 of the European Pillar of Social Rights states that *"People with disabilities have the right to income support that ensures living in dignity, services that enable them to participate in the labour market and in society, and a work environment adapted to their needs"*. Depending on the profes-

[1]The year 2011 is the first year of our study. While this rate has increased since 2011, reaching 50.6% in 2017, the gap between individuals with disabilities and the ones without is still high (+14.2 percentage points).

sional path consecutive to the disability onset, this income support may originate from wages, compensation incomes or a mix of the two types.[2] Regarding both wages and compensation components of income, disability may lead to opposite mechanisms.

First, disability may result in a decrease in wage level. While bad health can prevent entry into the labour market due to limitations that are not compatible with some jobs, the disutility of work may also be generated by various disincentives to work, such as the arduousness of the disability or the productivity gap between individuals with disabilities and healthy individuals [Silva and Vall-Castelló, 2017]. Workers with disabilities can have lower productivity levels and thus weaker marginal productivity than the healthy population [Malo and Pagán, 2012]. In both cases, wages seem to be negatively correlated with disability.

The second mechanism refers to compensation incomes. Most European countries have implemented social welfare systems to provide insurance against financial losses due to social risks.[3] In 2017, European countries dedicated 7.5% of their total social benefits to disability benefits, representing approximately 2.0% of the GDP (see Figures B.3.8 and B.3.9, Appendix B.3). This proportion varied from 0.5% in Malta to 5.0% in Denmark. However, these mechanisms are put in place for a certain level of disabilities.[4] For people with disabilities, benefits from social welfare systems represent one-third of their individual income, while this rate reaches 50% for those with the highest levels of disability [OECD, 2022].

Our objective is to investigate the impact of a "severe" and long-term disability on income by distinguishing between these two mechanisms. In the literature, income has been

[2]In Denmark, for example, you can be entitled to a flexi-job when your work ability is reduced and then granted a disability pension.

[3]We provide detailed information regarding social welfare systems of the European countries included in our study in Appendix B.2.

[4]For instance, in Germany, workers with disabilities are eligible for disability benefits (DB) if they are unable to work at least six hours (partial disability) or at least three hours a day (total disability) in a paid activity. In Finland, the person's functional capacity must be reduced for at least one year with a loss of autonomy to be eligible for a disability allowance, although one can claim partial disability pension if one's ability to work has decreased by 2/5. (European commission and Table B.2.2 in Appendix B.2).

mainly studied in levels. Few studies decompose income by sources, and most of them highlight the fact that public transfer incomes (e.g., disability benefits) compensate for income losses [Cervini-Plá et al., 2016; Dano, 2005; Lechner and Vazquez-Alvarez, 2011].

From a methodological point of view, we attempt to address the two following issues: measurement biases and reverse causality.

Regarding disability, we define disability using the Global Activity Limitations Indicator (GALI) combined with the prevalence of long-term health problems (see Section 2.1).

The interaction between disability and income can be understood as a two-way causal relationship [Barnay, 2016; Cai, 2010; Lindeboom and Kerkhofs, 2009]. On the one hand, a high income plays a protective role against health shocks, especially disability, by allowing investment in health capital (through health care and preventive actions), thanks to having access to private health insurance, reducing out-of-pocket payments, and protecting from painful jobs and deleterious working conditions. On the other hand, disability can depreciate wage levels due to loss of both employability and productivity, while also generating replacement income that can partially offset disability's adverse consequences on well-being. In a labour market model, disability may indeed be endogenous in both a structural and a statistical sense. Structurally, disability and labour market outcomes are determined simultaneously, and the causality is potentially bidirectional. Statistically, unobserved heterogeneity may result from some confounding factors that can simultaneously influence both disability and socioeconomic statuses, such as a present-biased preference or risk aversion. To raise this methodological issue, we perform panel data analysis by comparing individuals who experience disabilities and those who remain healthy during the same period. We also impose a temporal gap between the onset of the disability and the income measurement (see details in Section 3.2).

Our first contribution is to disentangle changes in personal income (sum of wages and compensation incomes) following the onset of a disability. To our knowledge, only few

paper proposes a decomposition on income (see Section 2.2). Our second contribution lies in dealing with this issue at the European level, which enables us to compare countries with different social welfare systems and highlight the role played by compensation earnings. While García-Gómez [2011] already addresses this heterogeneity, she does so in regard to the impact of chronic illness or disability onset on labour market transitions. She finds that the onset of a chronic condition has no impact on the probability of staying employed in France and Italy, where quotas for individuals with disabilities are high. In the meantime, she highlights that most of the exits of the labour market are due to transition into inactivity rather than unemployment. Nonetheless, in Denmark and the Netherlands, transitions to unemployment are higher than in other countries. She explains this outcome by the high unemployment replacement rates in these countries [García-Gómez, 2011].

We study individuals aged 50 and over from twelve countries based on the Survey of Health, Ageing and Retirement in Europe (SHARE) [Bergmann et al., 2019; Börsch-Supan et al., 2013]. We first perform propensity score kernel matching on our two groups (individuals with disabilities and those without disabilities). We then implement a weighted difference-in-differences (DiD) model to control for time-invariant unobserved heterogeneity. We show that the onset of disability leads to a negative impact on personal income mainly due to a loss of wages, which can be compensated by replacement incomes if the social welfare system is sufficiently "generous" (high level of compensation and/or integration of the individuals with disabilities).

2 Background

2.1 Defining and measuring disability

Disability is a wide-ranging concept that refers to either physical, mental, or cognitive impairments arising from a congenital disorder, accident, disease, or the ageing process.

Disability refers to a long process resulting from the interaction between an individual's health and various factors, including gender, age, habits, and work. Thus, disability can be seen as the result of a progressive health capital depreciation, an impairment or a nonintegration of the individual in the society [WHO, 2001].

In 2006, the Convention on the Rights of Persons with Disabilities, adopted by the United Nations (UN), defined people with disabilities as follows: *"Persons with disabilities include those who have long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others"* [UN, 2006]. In 2010, all EU members except for Finland, Ireland, and the Netherlands adopted this definition [European Parliament. Directorate General for Parliamentary Research Services., 2017]. Despite this convergence, European countries have adopted different legal approaches to disability, with some setting up a proper regulatory framework (Germany, Spain, France) and others refusing to stigmatize the population with disabilities (the Nordic countries).

Measuring disability is neither straightforwards nor unequivocal. Two types of disability measures can be used, namely, self-reported and objective assessments.

The most common self-reported indicators of disability are, on the one hand, Activities of Daily Living (ADL) and instrumental ADL (iADL) and, on the other hand, the GALI. ADL and iADL are thought to be relatively more indicative of irreversible impairments and more specific to age-related dependency [Cambois et al., 2013; Millán-Calenti et al., 2010]. The GALI, which measures functional disability, is one of the most used and standardized indicators for national statistics. Recently, several studies have assessed the validity of the GALI for measuring disability compared to other health measures. The literature underlines that the GALI sums up participation restrictions, thus making it a globally valid and reliable measure [Van Oyen et al., 2018]. Moreover, it correctly reports limitations captured by both subjective and objective measures that are consistent across European countries in the SHARE [Jagger et al., 2010]. In addition, indicators of long-

term health problems can be combined with some of the abovementioned indicators to measure disability. Indeed, even if diseases do not always lead to disability, the medical model defines disability as a direct consequence of diseases or other health problems [WHO, 2001]. Several studies have used this indicator of long-term health problems. For instance, Kidd et al. [2000] study the impact of disability (defined as long-term health problems) on earnings and labour force participation [Kidd et al., 2000]. Gannon combines this indicator with the GALI to study the same problem [Gannon, 2005]. Finally, this mix is also used by Pagan [2011] to explore the job satisfaction of older individuals with and without disabilities [Pagan, 2011]. The combination of both approaches enables us to have a long-term disability indicator that accounts for the individuals' health state as a whole, in line with the definitions of both the WHO and the UN.

Objective indicators, such as physical measures or administrative data, are often used to avoid self-declaration bias and the interpersonal comparison of self-perception problems of self-reported indicators by aiming to have a more accurate measure. Physical health measures can be used, such as grip strength and the ability to get up from a chair. Objective measures can also be gathered through administrative data.

Most studies focusing on the link between disability and incomes use a clear-cut measure of disability, such as administrative recognition [Angelov and Eliason, 2016; Bhattacharya et al., 2010; Cervini-Plá and Vall Castelló, 2018; Kidd et al., 2000; Lechner and Vazquez-Alvarez, 2011], accidents and road injuries [Cervini-Plá et al., 2016; Dano, 2005] or self-reported limitations in daily activities/restrictions [Mete et al., 2008; Mitra et al., 2009; Polidano and Vu, 2015]. These differences may result in distinct findings, population sizes, and different issues in terms of econometrics. As briefly explained above, self-reported measures of disability can depend on respondents' feelings and knowledge. Thus, individuals can overestimate their response. While several studies have examined this issue without determining any clear consensus, most find no evidence of overreported disability. For example, Benítez-Silva et al. [2004] show that self-reported disability reports the

same health status as the Social Security Administration (SSA) decision concerning entry into disability insurance [Benítez-Silva et al., 2004]. In Ireland, Gannon [2009] uses a generalized ordered response model to show that limitations in daily activities are over-reported. Nonetheless, this measurement error decreases after accounting for unobserved heterogeneity [Gannon, 2009]. The findings of these studies confirm that self-reported disability is no more likely than administrative data to lead to more econometric issues.

In summary, according to Bound [1991], both types of measures present pros and cons, while also leading to different biases [Bound, 1991] and thus to issues in terms of econometrics. However, in reference to the literature, we consider a mix of the GALI and long-term illness. First, both harmonized indicators allow international comparisons. Second, the UN definition accounts for all types of disability (physical, mental, etc.), which can be captured by long-term health problems, and it relates them to barriers and/or factors that limit individuals, which in turn can be captured by the GALI.

2.2 Relationship between disability and income

A large literature based on longitudinal data stresses the impact of disability onset on both extensive and intensive margins. For instance, Jones and McVicar [2020] study the impact of disability—measured through work limitations—on employment probability, while Müller and Boes [2020] assess the role of receiving disability insurance benefits on working full-time. Regardless of the definition of disability used, the literature generally underlines the adverse impact of a disability shock on labour market outcomes, such as labour force participation [Jones and McVicar, 2020; Mussida and Sciulli, 2016; Polidano and Vu, 2015; Silva and Vall-Castelló, 2017], working hours [Jones et al., 2018; Müller and Boes, 2020; Polidano and Vu, 2015], exit from the labour market [Wubulihasimu et al., 2015], and income [Cervini-Plá et al., 2016; Dano, 2005; García-Gómez et al., 2013; Lechner and Vazquez-Alvarez, 2011], especially earnings [Angelov and Eliason, 2016; Bhattacharya et al., 2010; Cervini-Plá and Vall Castelló, 2018; Kidd et al., 2000]. For

example, Kidd et al. [2000] use a human capital-based model of earnings determination to model labour force participation decisions based on a sample of 16–64-years-old British men. By defining disability as a long-term health problem, they find that individuals with disabilities earn 14.1% less than those without disabilities [Kidd et al., 2000]. The negative impact of disability on earnings appears even before the onset of disability, demonstrating the nonrandom onset of disability in the population [Angelov and Eliason, 2016; Cervini-Plá and Vall Castelló, 2018; Meyer and Mok, 2019]. In fact, Cervini-Plá and Vall Castelló [2018] show that recipients of disability benefits earn less than healthy people even four years before receiving disability benefits. In particular, one year before, the wage gap between these two groups represents a benefit of 8.3% for people without disabilities. Finally, regarding overall income and the combination of wages and replacement incomes, only a few papers examine both dimensions, with most of them finding a nonsignificant impact [Cervini-Plá and Vall Castelló, 2018].

The findings may differ by type of disability. Angelov and Eliason [2016] compare people with disabilities and those without disabilities to study the impact of job loss on earnings and incomes. By estimating a fixed effect estimator for a matched sample, they show that the earnings gap between the two groups, one year prior to job loss, varies according to disability type. Healthy people earned approximately 8,000€ more than mentally disabled people one year before the onset of disability, while they earned approximately 7,300€ more than those with a motor disability [Angelov and Eliason, 2016]. Bhattacharya et al. [2010] highlight that losses in earnings correspond to which part of the body is injured. Derived from California administrative data, their results suggest that psychiatric and hearing impairments lead to higher earnings losses than back injuries [Bhattacharya et al., 2010]. Finally, only a few studies investigate the impact relative to the degree of disability. This phenomenon could rely on the difficulty in defining disability severity [Charles, 2003].

Nonetheless, only a few papers propose a decomposition of income between wages and compensation revenues. Lechner and Vazquez-Alvarez [2011] quantify the loss in pro-

ductivity and the evolution in labour market outcomes for individuals whose disabilities appeared in West Germany between 1984 and 2002. Using matching methods, these authors underline that disability has a nonsignificant result on income. They conclude that the German social welfare system has been successful in mitigating the negative economic impacts of disability [Lechner and Vazquez-Alvarez, 2011]. Other authors, using different definitions of disability (accidents [Cervini-Plá et al., 2016; Dano, 2005] or hospital admissions [García-Gómez et al., 2013; Lundborg et al., 2011]), reach the same conclusions. The unanticipated nature of the event ensures the exogeneity of the shock. By using claims data from the Spanish Social Security Administration and combining matching algorithms with DiD, Cervini-Plá et al. [2016] estimate a theoretical wage gap model. The results suggest that after one year, a disability shock leads to an average monthly salary decrease of approximately 20%, although this decrease is essentially compensated by the disability benefits received [Cervini-Plá et al., 2016]. Dano [2005] investigates the causal effect of road injuries in Denmark on disposable income, earnings, employment status, and public transfers. She implements a DiD matching method on a follow-up administrative registers. She shows that public transfers compensate injured individuals for their losses in disposable income and in earnings [Dano, 2005].

3 Database, variables and sample selection

3.1 Database

We use the SHARE, a European panel survey that is focused on people aged at least 50 years old and their partners [Börsch-Supan et al., 2013]. Carried out every two years, this survey began in 2004 with 30,424 individuals participating from 12 European countries. It currently includes participants from 27 European countries and Israel, with 139,556 individuals having been interviewed over the course of eight waves (2004; 2006; 2008; 2011; 2013; 2015; 2017 and 2019/20). It covers various topics in face-to-face interviews, including health, social and family networks, employment and pensions, and other key

areas of life.

3.1.1 Income

We rely on three different outcome variables: personal income, wages and compensation income. The SHARE provides a comprehensive measure of varying income types measured at the household and individual level, such as employment and self-employment earnings, unemployment benefits, pensions, and property incomes, among others. Such information allows the production of both an accurate estimate of total income and a decomposition of the main sources of revenue. Because of the high rates of missing values, the SHARE offers imputations for all these variables (see imputation methodologies in Appendix B.4).

In this study, personal income is defined as the sum of earnings from employment, earnings from self-employment, pension plans, occupational pensions, disability insurance pension and sickness benefits, unemployment benefits, and payment from social assistance. Wages are defined as the sum of the first two components of personal income, i.e., earnings from employment and earnings from self-employment. Finally, compensation incomes relate to all other elements of personal incomes: pension plans, occupational pensions, disability insurance pensions and sickness benefits, unemployment benefits, and payment from social assistance. We do not divide compensation incomes between those related to health and disability from the other ones. Actually, people with disabilities mainly receive one income replacement, which can be, for example, unemployment benefits or social assistance benefits [OECD, 2022].

3.1.2 Measuring disability onset through the GALI and long-term health problems

As mentioned earlier, we can measure disability through different indicators. We retain the GALI as the primary disability measure. The measurement corresponds to the following question: *"For at least the past six months, to what extent have you been limited because*

of a health problem in activities people usually do?". Three answers are offered: *"Severely limited"*, *"Limited, but not severely"*, and *"Not limited"*. We consider the GALI as a binary variable that takes a value 1 if the individual declares being limited, whether severely or not. The choice to use this GALI question is made for several reasons. First, compared to physical health measures such as grip strength or the ability to get up from a chair, the question captures all severities and types (i.e., mental, physical, and cognitive limitations) of disability. Moreover, most of these physical measures are not available in all waves of the SHARE and therefore cannot be compared from a longitudinal perspective. Finally, this approach allows us to achieve comparability across countries and waves.

However, as mentioned before, the GALI may be subject to self-declaration biases, by which it lacks the strength to properly identify individuals with disabilities. Furthermore, only a few individuals report themselves as severely limited for one year. In addition, among them, in 2013, 38% declared no GALI in 2015, highlighting the nonpermanent nature of this indicator. To limit these drawbacks, we also combine the combined the GALI with an indicator of long-term illness. This last indicator is defined as the answer to the following question: *"Some people suffer from chronic or long-term health problems. By long-term, we mean it has troubled you over a period of time or is likely to affect you over a period of time. Do you have any long-term health problems, illness, disability or infirmity? (Including mental health problems)"*.

3.2 Sample selection

To use a homogeneous sample, we select all individuals who participated in three consecutive waves of the SHARE, namely, waves 4 (2011), 5 (2013), and 6 (2015).[5] Ultimately, we keep 30,747 individuals who all participated in these three consecutive waves.

At baseline (in 2011), we include employed (or self-employed) individuals and those without disability. Thus, we target people aged at least 50 who are still employed and have

[5]Waves 3 and 7 are based on the individual's past life events questionnaire (SHARELIFE), which does not contain routine follow-up information, leading to higher duration between the two "routine" waves.

earnings. Consequently, individuals who reported 0€ wages in 2011 are excluded. We also exclude those who at one point (at least) reported a personal income equal to 0€. We focus on people who declared no activity limitation and no long-term health problems in 2011. We drop individuals with missing GALI or long-term health problem indicators in 2013 or 2015. Finally, we select only individuals who answered the routine questionnaire in the last wave (2015).[6] After selection, our sample includes 4,072 individuals from 12 different European countries, namely, Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, Slovenia, Spain, Sweden, and Switzerland.

We divide this sample into two groups: treatment and control. The treatment group includes people who experienced a disability shock, i.e., those who reported "GALI > 0" and long-term health problems in waves 5 and 6. It consists of 159 people whose disability was declared in 2013 and maintained in 2015, while the control group contains 2,375 individuals who declared no limitations and no long-term health problems, neither in 2013 or 2015 nor during the follow-up. Consequently, we do not consider individuals who reported a disability in only 2013 or in only 2015 (see details in Figure B.5.10, Appendix B.5). This design is similar to the one used by García-Gómez [2011] and Jones and McVicar [2020] to estimate the effect of a health shock on employment.

4 Empirical strategy

To estimate the causal impact of the onset of disability on incomes (personal income, wages, compensation incomes), we combine propensity score matching (PSM) with a DiD approach.

Formally, we rely on the causal model of Rubin [1974] and thus consider the disability shock as a treatment. If we denote T as the treatment variable, we have $T = 1$ if the

[6] In addition to the main questionnaire and retrospective SHARELIFE survey, an end-of-life interview was developed for respondents who died between the two waves; this interview was conducted after the individual's death. In these interviews, a previously designated proxy for the individual answered end-of-life questions about the individual (death, health care, estate, etc.). Here, we only want to include individuals who were alive during the three studied waves.

individual suffers a disability shock and zero otherwise. Let I_i^1 and I_i^0 be the income of individual i when $T = 1$ and $T = 0$, respectively. Consequently, we do not observe I_i^1 for control individuals, and I_i^0 is not observed for individuals with disabilities. Nonetheless, our aim is to calculate the average treatment effect on the treated (ATET), defined as follows:

$$\Delta^{ATET} = \mathbb{E}(I_i^1 - I_i^0 | T = 1) = \mathbb{E}(I_i^1 | X, T = 1) - \mathbb{E}(I_i^0 | X, T = 1) \tag{1}$$

where X is the set of observed characteristics of the individuals.

We cannot directly calculate the ATET from the data. Thus, we construct a counterfactual group that becomes our control group. Nonetheless, if we simply compare treated and nontreated groups, our estimation may result in a potential bias related to differences in the compositions of both groups. As already explained before (see mostly Section 2.2), the onset of disability is not a random process (not an exogenous shock).

To control for this endogenous selection process, we rely on a PSM model. We implement a logit model to estimate the individual probability of being treated on a set of observed individual characteristics X: age, gender, education level, being in a couple, having at least one child, being in the private or public sector, and being self-employed. The negative impact of disability on labour market outcomes is amplified by being older, being female, and being less educated [Lindeboom et al., 2016; Polidano and Vu, 2015]. Moreover, these characteristics increase the probability of being in bad health [da Silva Alexandre et al., 2012]. Regarding the private/public sector, Barnay and his coauthors highlighted a stronger negative impact of disability on private employment than on public employment in the French case. Public employment protects individuals from employment losses [Barnay et al., 2015].

To alleviate selection, we carry out PSM at baseline before the onset of disability, i.e., in wave 4 (2011). Then, we match future individuals with disabilities and those without by

using a kernel matching algorithm with a bandwidth equal to 0.01, by which all control individuals are used to construct a counterfactual [Caliendo and Kopeinig, 2008]. The ambition is to determine, by means of the Epanechnikov kernel function, the distance between the controls and their matched treated counterparts. Then, weights are given to the control persons according to this distance and to the number of times they are used as a counterfactual. The individuals with disabilities have a weight equal to one. This algorithm is also used by García-Gómez [2011] and García-Gómez et al. [2013].

The main advantage of PSM is that it does not require making a structural hypothesis on the specification of the model because kernel matching is a nonparametric method [Härdle and Linton, 1994]. Moreover, this first step of estimating the propensity score enables us to explain what characteristics influence the probability of experiencing a disability shock.

However, one drawback is that PSM relies on the conditional independence assumption that there are no unobservable characteristics that can explain the difference in income between individuals with and without disabilities: $(I_i^1, I_i^0) \perp T|X$. If this assumption does not hold, the impact of disability onset on income is not causal. To control for unobserved characteristics, we implement DiD with only individuals who are on the common support of the PSM.[7] We perform the DiD using 2011 and 2015 data and estimate the following fixed effects panel model:

$$\begin{aligned} ln((income+1)_{it}) =& \beta_0 + \beta_1 * treated_i + \beta_2 * after_t + \beta_3 * (treated * after)_{it} \\ &+ \beta_4 * job\_situation_{it} + \delta_i + u_{it} \end{aligned} \tag{2}$$

where $income_{it}$ is either the personal income, the wages or the compensation incomes of individual i in time t; $treated_i$ takes the value 1 if individual i is in the treatment

[7] In the treated group, we can have individuals who have a propensity score very close to one or zero. When we engage in the matching, these individuals are excluded because we cannot find individuals in the other group who are similar. Thus, a control individual will not have a propensity score near one and, conversely, a treated one will not have a propensity score very close to zero.

group; $after_t$ takes the value 1 if we consider the year 2015; and $job\_situation_{it}$ is a four-category variable consisting of employed or self-employed, retired, unemployed, and other situation (which groups together permanently sick or disabled individuals, homemakers, etc.). δ_i is an unobserved time-invariant individual effect, and u_{it} is an error term. To smooth the distribution of incomes, we consider the logarithm of these variables, to which we add one upstream variable. Regarding personal income, this is not an issue since 0 does not exist. Regarding wages, we do not have any 0 values in 2011. In 2015, there is no inflation of zero since those with zero value are individuals outside the labour market.

The variable $job\_situation_{it}$ enables controlling the effect of a change in job situation that can affect our dependent variable. In particular, we differentiate the effect of the onset of disability and that of retirement or unemployment.

In the linear-dependent variable model, the effect of interest would be given by the differences between these two waves and the two groups of individuals, i.e.,

$$[\mathbb{E}(I_i|X, T = 1, t = 1) - \mathbb{E}(I_i|X, T = 1, t = 0)] - [\mathbb{E}(I_i|X, T = 0, t = 1) - \mathbb{E}(I_i|X, T = 0, t = 0)] \tag{3}$$

where t describes the period such that $t = 0$ describes the period before the treatment (i.e., 2011 in this study) and $t = 1$ corresponds to after the treatment period (i.e., 2015 in our case).

However, in our model, we rely on a log-linear dependent variable. Consequently, regarding our coefficient of interest β_3, we have the following:

$$\exp(\beta_3) = \frac{\dfrac{\mathbb{E}(I_i|X, T = 1, t = 1)}{\mathbb{E}(I_i|X, T = 1, t = 0)}}{\dfrac{\mathbb{E}(I_i|X, T = 0, t = 1)}{\mathbb{E}(I_i|X, T = 0, t = 0)}} \Leftrightarrow \exp(\beta_3) - 1 = \frac{g_T - g_C}{g_C} \tag{4}$$

where g_T is the temporal evolution in income for the treated group and g_C is the one for

the control group. Using the $ln(1+x) \approx x$ approximation, we see that β_3 is equivalent to the proportional difference in growth rates between the two groups over the two waves.

We implement the abovementioned DiD using the weights obtained by the PSM procedure. The combination of PSM and DiD allows us to account for observed and unobserved time-constant differences. This method is also used in Cervini-Plá et al. [2016] and García-Gómez et al. [2013]. The objective is to reach comparability between treated and nontreated groups with PSM and then control for unobserved characteristics with DiD.

Thus, DiD implies that there are no unobservable (fixed in time) characteristics that can explain the differences in incomes between treated and control individuals (the CIA is partly checked). However, DiD relies on the parallel-trend assumption, which assumes that, in the absence of treatment, individuals who experienced disabilities would have the same trend in income as those in the control group. Nonetheless, we can verify this hypothesis more easily than the conditional independence hypothesis. In the end, we assume that we are able to remove a large part of the endogeneity issues related to not only selection effect but also reverse causality, according to which work can have a negative impact on health [Barnay, 2016; Bassanini and Caroli, 2015; Robone et al., 2011].

5 Results

5.1 Descriptive statistics

We document descriptive statistics regarding the link between our two disability indicators in Table B.6.3 (Appendix B.6). This Table provides the crossed percentages of the GALI and the long-term health problems in 2013 for employed individuals in 2011 without restriction on disability (see Figure B.5.10, Appendix B.5). Regarding our treatment group, by imposing a shock on both indicators, we select 90% of individuals who declared being severely limited and 61% of those who declared having long-term health problems. If we look at our control group, it is composed of 79% of people without limitations in the

sense of the GALI and 91% of individuals without long-term health problems (see Table B.6.3 in Appendix B.6). These percentages enforce our idea that the combination of both indicators enables us to rely on a strong disability shock.

The proportion of new people with disabilities in 2013 who still had disabilities in 2015 was 6.8% (see Table B.6.4, Appendix B.6). At baseline (in 2011), future individuals with disabilities are selected and appear slightly older and less educated than those without disabilities. For example, those who will experience disabilities are more likely to have an education level lower than secondary school (24% compared to 17%) and less likely to have a higher education level than their counterparts. Concerning financial issues, the overall income of persons without disabilities is 46% higher than that of individuals with disabilities. The details show the gap to be less pronounced when considering wages, with a 42% higher average income for people without disabilities (see Table 1). While this difference is consistent with the assumption of lost productivity for individuals with disabilities, it also potentially implies a selection effect in employment (lower-paying jobs for people with disabilities). We also notice a slight difference in marital status; i.e., individuals with disabilities are less likely (74%) to be in a couple than their nondisabled counterparts (80%).

In summary, those who will experience disabilities later in life exhibit more frailty than those without disabilities in terms of initial socioeconomic conditions at baseline. These disparities seem to highlight the nonrandom nature of the onset of disability. As a result, matching individuals appears to be a relevant process for making comparable groups.

Regarding income, we first observe that between 2011 and 2015, new individuals with disabilities experienced a decrease in personal income of approximately 1,666€. This represents a 9.2% loss of their initial personal income. During the same period, individuals without disabilities gained almost 2,200€ in income (see Figure 1 and Table B.6.5 in Appendix B.6). Let us now decompose personal income into two subgroups of income: wages

Table 1: Descriptive statistics of treatment and control groups in Wave 4

Individual characteristics (measured at baseline)	**Individuals with disabilities N = 159** Mean	SD	**Individuals without disabilities N = 2,375** Mean	SD	***t-test diff. in means***
Incomes					
Annual personal income	18,174	1,537	26,538	516	-8,364***
Earnings from employment	14,727	1,363	20,859	430	-6,132***
Earnings from self-employment	2,817	719	4,555	337	-1,737
Old age, early retirement, survivor and war pensions	524	165	723	93	-198
Private occupational pensions	0	0	226	57	-226
Disability/sickness pension and benefits	20	18	19	6	0.5
Unemployment benefits and insurance	85	54	152	58	-67
Payment from social assistance	0	0	4	3	-4
PSM Variables					
Age	56.66	0.41	56.19	0.11	0.48
Female	0.48	0.04	0.52	0.01	-0.04
Education Level					
Lower secondary school	0.24	0.03	0.17	0.01	0.07**
Upper secondary school	0.49	0.04	0.46	0.01	0.03
Higher education	0.26	0.04	0.37	0.01	-0.11***
In couple	0.74	0.04	0.8	0.01	-0.06**
One or more children	0.93	0.02	0.91	0.01	0.03
Occupational Sector					
Private sector	0.74	0.04	0.71	0.01	0.03
Public sector	0.1	0.02	0.14	0.01	-0.04
Self-employment	0.16	0.03	0.15	0.01	0.01

Note: In 2011, future treated individuals have 8,364€ less than future control in personal income.

Population: Employed individuals without disability in 2011

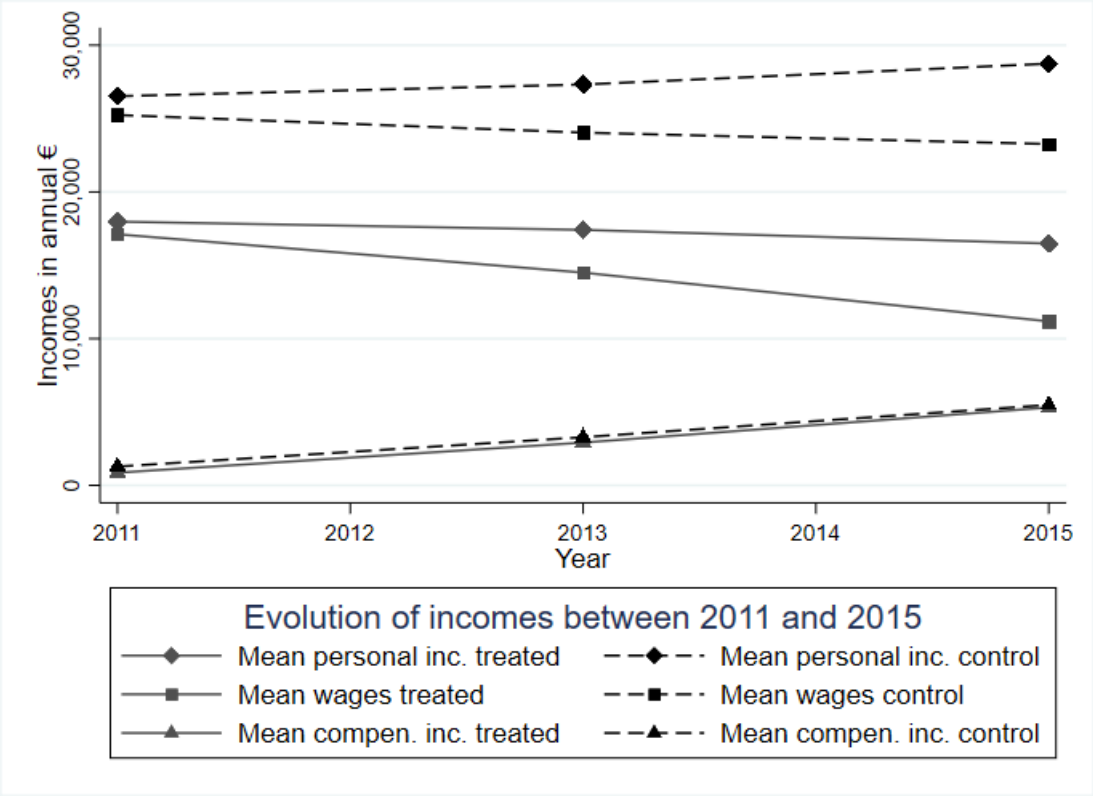
Source: SHARE; Waves 2011, 2013, 2015

"t-test diff. in means" corresponds to the p-value of the t-test between the individuals with disabilities and those without. Significance at 1% (***), 5% (**), and 10% (*).

All numbers are given to the nearest hundredth (except for incomes).

and compensation revenue.[8] In the control group, wages decreased between 2011 and 2015 (approximately -2,000€), but the increase in retirement pensions overcompensated for this decline (approximately +3,000€ for old-age pensions). In the group of people with disabilities, wages decreased between 2011 and 2015 (approximately -6,000€). These decreases are partly compensated by the increase in compensation earnings, especially with the rise of disability/sickness benefits.

Figure 1: Trends in personal income, wages, and compensation incomes during the follow-up period, before matching



Source: SHARE; Waves 2011, 2013, 2015, graphic by authors
Abbreviations: inc., income; compen., compensation

Finally, we focus on the job situation two years after disability onset (see Table B.6.6, Appendix B.6). Individuals without disabilities are more likely to remain employed, with approximately 70% of them still being employed in 2015. We see that 56% of individuals with disabilities were still employed in 2015, while 6% were unemployed.

[8] In Table B.6.5 (Appendix B.6), we indicate the amounts of retirement pension and disability/sickness benefits. Those two items are the most interesting for our study.

5.2 Naïve model

We first perform an unmatched DiD regression (Table B.7.7 in Appendix B.7). These results control for unobserved time-constant heterogeneity. The results suggest a positive time effect on the three different income types: wages, compensation income and personal income (the latter being the sum of the first two). This means that between 2011 and 2015, incomes became higher in the control group, regardless of the intensity of disability. Regarding our coefficient of interest, this naïve model suggests differences between individuals with disabilities and those without in the pretreatment versus posttreatment periods. Indeed, the onset of disability decreases wages and increases compensation incomes. We observe an increase in compensation incomes, a loss in wages and a decrease in personal income. Finally, compared to being employed, the positive impacts on compensation incomes from being retired, unemployed, or in another situation are highlighted. Conversely, being retired or unemployed has a negative impact on personal income and wages, as expected.

5.3 Main results

Here, we present the results based on DiD weighted by the matching weights. After the matching process, the sample size is approximately 99.8% of the initial size of our sample. This matching enables us to eliminate all the initial differences between individuals with disabilities and those without regarding explanatory variables. Differences regarding wages and personal income remain even after matching (see Appendix B.8).[9]

We run two models, namely, one without the job situation (Table 2) and the other with it (Table 3). The first model reveals a significant positive effect on compensation incomes after the onset of disability and a negative impact on personal income and wages. How-

[9]We also perform tests on the bandwidth by running the same regression with the bandwidth equal to 0.001 and then to 0.1. The selection of bandwidth is related to the continuing debate between bias and precision. On the one hand, a large bandwidth allows diminishing the variance and thus increasing the precision. On the other hand, the higher the bandwidth is, the more biased the estimations can be [Caliendo and Kopeinig, 2008]. Our results are not sensitive to changes in the bandwidth.

ever, this model does not account for differences in employment trajectories, particularly the transition to retirement or nonemployment, which affects individuals with disabilities more than those without. We probably overestimate the effects in Table 2. Consequently, we want to purge the effect of disability onset on employment changes, as well as the negative impact of nonemployment status on overall income. Therefore, after controlling for job situation, our findings underline the same trends as before but with a lower magnitude. Disability results in a 16.47%[10] decrease in personal income. If we look at the composition of personal income, we see two opposite results. On the one hand, disability leads to a 60.15% decline in wages. On the other hand, disability leads an individual to receive benefits or pensions, which explains a 66.52% increase in compensation incomes. Nonetheless, the effect of disability onset on compensation incomes is significant at only the 10% level, meaning that we do not have sufficient evidence of an increase in compensation incomes. One potential explanation is that it is likely that having a disability does not automatically entitle one to a disability pension and/or replacement rates are not strong enough.

Table 2: Weighted DiD results without controlling for the job situation

		Log personal income	**Log wage**	**Log compen. incomes**
After	Coefficient	0.10***	-1.48***	2.42***
	SE (robust)	0.02	0.08	0.1
Treated*After	Coefficient	-0.23***	-1.54***	1.12***
	SE (robust)	0.09	0.36	0.37
No. of clusters (individuals)		2,532	2,532	2,532

Note: On average, the onset of disability leads to a 21% decrease in personal income.
Population: Employed individuals without disability in 2011
Source: SHARE; Waves 2011, 2013, 2015
Abbreviation: compen., compensation
***p <0.01; **p <0.05; *p <0.1.

Becoming unemployed or retired or being in another situation in 2015 (compared to remaining employed) leads to a loss in wages and an increase in compensation incomes.

[10] $[\exp(-0.18 - 1)] * 100$

Table 3: Weighted DiD controlling for the job situation

		Log personal income	Log wages	Log compen. incomes
After	Coefficient	0.16***	0.25**	0.68***
	SE (robust)	0.04	0.1	0.12
Treated*After	Coefficient	-0.18**	-0.92***	0.51*
	SE (robust)	0.09	0.25	0.3
Job situation in 2015 (ref: employed or self-employed)				
Retired	Coefficient	-0.15	-5.77***	5.84***
	SE (robust)	0.1	0.34	0.35
Unemployed	Coefficient	-0.66***	-3.74***	3.11***
	SE (robust)	0.22	1.1	1.05
Other†	Coefficient	-0.38	-4.82***	5.02***
	SE (robust)	0.29	1.12	0.93
No. of clusters (individuals)		2,528	2,528	2,528

Note: On average, the onset of disability leads to 16% decrease in personal income.
Population: Employed individuals without disability in 2011
Source: SHARE; Waves 2011, 2013, 2015
Abbreviation: compen., compensation
***p <0.01; **p <0.05; *p <0.1.
† This category gathers together individuals who can be permanently sick or disabled, homemakers, students, rentiers, and voluntary workers, among others

We observe a decrease in personal income only for unemployed individuals.

By and large, it seems that the onset of disability has a negative impact on personal income. This is mainly driven by the loss in wages, which is not compensated by an increase in compensation incomes. Several mechanisms may explain these findings. First, as mentioned before, our disability indicator is strong (a combination of two measures); thus, the more limited one becomes, the less the individual is able to work and the larger the loss in wages becomes. At the same time, the need for care increases, thus making the disutility of work higher. In the end, these two factors point towards the probability of leaving the labour market.

6 Heterogenous effects

The influence of disability on incomes could be different according to individual characteristics, such as gender [Dano, 2005; Lindeboom et al., 2016] or country. Consequently, we test for gender and the heterogeneity of social welfare systems.

6.1 Gender

Gender inequality in the labour market has been greatly documented in the literature. For example, Lindeboom et al. [2016] studied the causal effect of disability on employment; they define disability by means of an indicator for long-term illness, disability, or infirmity. They find that the onset of disability has a negative impact on the employment rates of males but has no impact for females [Lindeboom et al., 2016]. Dano [2005] uses a Danish sample to show that earnings decrease after a disability shock, as measured by road injuries, and only for men. Table B.9.9 (Appendix B.9.1) provides results according to gender. For men, we find a negative impact of 57.68% on wages following the onset of disability. In the meantime, while the increase in compensation incomes is approximately 77.88%, the significance is not as strong, perhaps due to the poor level of treated individuals. In the end, no impact on personal income is highlighted. Women suffer from a 62.84% decrease in wages, while their compensation incomes are not impacted. Regarding personal income for women, we find insufficient evidence of a decrease (significant effect at the 10% level). Because we are dealing with two different subgroups, we are not able to directly compare these effects. Consequently, we perform a Chow test to see if the coefficient of interest in the female sample (men/women) is significantly different from that in the male sample [Chow, 1960]. We are not able to reject the hypothesis of equality between the two coefficients for personal incomes (p value=0.67) and wages (p value=0.20). This means that there are no significant differences in the treatment between men and women. Regarding compensation incomes, the Chow test highlights the differences between women and men (p value=0.05).

6.2 Social welfare systems

Next, social welfare systems partially allow individuals to be protected against the financial consequences of disability risk. Figure B.3.8 (Appendix B.3) shows the differences among EU countries regarding the portions of their GDPs devoted to disability benefits. The Nordic countries (Denmark, Finland, and Sweden) dedicate a higher proportion of their GDP (5.0%, 2.9%, and 2.8%, respectively) to disability benefits than the EU-28 mean proportion (2.0% of the EU-28 GDP). In contrast, the share of the GDP devoted to disability benefits in Eastern countries such as Hungary, Romania, and Slovenia is weaker (1.1%, 0.9%, 1.1%, respectively) than the EU-28 mean share. The same conclusions can be made after looking at the amount of social benefits devoted to disability (see Figure B.3.9 Appendix B.3). Consequently, we choose to divide our sample into two groups. The first group represents countries whose percentages of GDP dedicated to disability benefits are greater than the EU-28 mean; Germany, Sweden, France, Denmark, Switzerland, and Belgium comprise this group. The second group consists of Austria, Spain, Italy, Czech Republic, Slovenia, and Estonia, all of whom have percentages that fall below the EU-28 mean. The results are provided in Table B.9.10 (Appendix B.9.2). In the most generous countries, disability does not translate into a lower income. Conversely, in countries that offer lower disability compensation, such a health shock leads to a 22.89% drop in overall income and a 57.26% decrease in wages. There is no impact on compensation incomes. The results of the Chow tests highlight significant differences in terms of personal income (p value=0.07), while no significant differences in terms of wages are found (p value=0.18).

Among others in the group of most generous countries, we have the Nordic countries of Sweden and Denmark, as well as Germany and Switzerland. These four countries are part of the social democratic model described by the OECD. They are characterized by easy access to disability benefits, strong employment integration measures, anti-discrimination legislation, and generous compensation incomes [OECD, 2010]. For example, Denmark and Sweden have decided to freeze compensation income if an individual with disabilities

decides to go back to work, meaning that if this person ultimately loses his or her job, then he or she will begin to receive compensation income anew without having to reapply for it. In contrast, employment integration for people with disabilities in the second group is weakly developed, and the received compensation is less substantial [OECD, 2010]. For example, countries such as the Czech Republic and Spain impose strict conditions for receiving a combination of disability pension and other social security benefits, such as unemployment benefits [MISSOC, 2019]. Estonia does not allow such a combination at all (see Table B.2.1 in Appendix B.2). The OECD classification adequately corresponds to our results; countries in the more generous group exhibit no impact on personal income, which could be explained by their promoting the integration of individuals with disabilities into the workforce and providing higher compensation incomes. These two mechanisms act as protection for people who experience a disability shock. Conversely, countries in the less generous group lack integration policies, thus leading to lost wages that is not compensated by their low levels of replacement income.

7 Discussion and conclusion

Our study uses European panel data to measure the impact on personal income due to the onset of disability measured through the GALI and an indicator of long-term health problems, assuming that this mix evaluates a long-term and severe disability. We also take the novel approach of decomposing this personal income into wages and replacement incomes. Our assumption is that the onset of disability leads to a decrease in productivity and, consequently, a loss in potential wages, while individuals with disabilities simultaneously receive a disability pension. Using combined PSM and DiD, we are able to control not only for observed characteristics but also for unobserved heterogeneity. We contribute to the literature by decomposing overall income into two parts, which are impacted by our treatment in a presumably inverse way. Our findings indicate that disability leads to a 60.15% loss in wages and has no impact on replacement income, resulting in a 16.47%

decrease in personal income. This drop in wages is more than four times higher than the one find by Kidd et al. [2000]. Moreover, the works of Dano [2005] and Lechner and Vazquez-Alvarez [2011] show that public transfer compensates for losses in wages, while in our study, the drop in personal income shows that compensation incomes do not increase sufficiently to compensate for the drop in wages. Nonetheless, to our knowledge, ours is the first paper to take this approach using data from several countries. Consequently, we employ our method by splitting countries according to generosity of their social welfare system. Our results highlight that the onset of disability has no impact at all in more generous countries. Thus, we assume that disability is not as discriminatory in these countries compared to in less generous countries. For the less generous group, we find a decrease in wages and personal income but no impact on compensation incomes. This higher negative impact of disability on labour market outcomes in less integrative countries has also been found by García-Gómez [2011] during her examination of employment probability. Her results suggest that a health shock has higher consequences on activity in countries such as Denmark, where integration policies are important [García-Gómez, 2011]. Finally, we also account for gender. In the female population, wages decrease with no effect on compensation incomes. For men, we show a negative impact on wages. Nonetheless, the differences between women and men are not significant.

Nevertheless, our paper suffers from limitations. First, we rely on a database that targets individuals aged 50 years or more. Thus, our results should not be extended to younger people since they do not have the same health status or labour market situation (e.g., higher probability of retirement process). Health problems and early retirement are likely to be positively associated with each other [Aranki and Macchiarelli, 2013], which is a result that has also been found in the Netherlands [Bernal and Vermeulen, 2014], particularly in the case of disability among European countries [Wubulihasimu et al., 2015]. We partly control for this association by including the change in job situation in our weighted DiD. Second, our follow-up period is short. Therefore, we can only guess that the long-term effects become greater as disability perseveres and the intensity potentially

increases. Nonetheless, the literature on disability's long-term effects on labour market outcomes shows the impact to be lower in the long term relative to the short term [Dano, 2005; García-Gómez et al., 2013; Mussida and Sciulli, 2016]. Third, our disability measure relies only on self-reported indicators, for which declaration bias can exist and questions can be interpreted differently. However, we use homogenous indicators across countries that have been reported as valid and reliable. Moreover, we try to cover all dimensions contained within the UN definition. Fourth, to ensure that the results obtained with DiD are robust, we must rely on the parallel-trend assumption, which, in the absence of treatment, requires a parallel trend of incomes between individuals with disabilities and those without. In Figure 1, we see that personal income, wages, and compensation incomes follow the same trend between 2011 and 2013 as they do for the treated and the control groups. Indeed, while personal and compensation incomes increase in the two groups, wages also decrease for both. Fifth, by defining a strict measure of disability, we select a small, treated group. We perform an additional sensitivity test by considering a broader definition of disability. We find no impact on personal income, potentially because the disability shock is not strong enough. Sixth, we may imagine that the transitions in the labour market could include part-time accommodations. We compute a model by adding a part-time position (in job situation variables) but without any effects. Finally, potential bias could remain in the heterogeneity tests. Regarding the estimates for women versus men, we know that women are more likely to leave the labour market earlier than men [Lammers et al., 2013] and to more frequently have part-time contracts than men [Barnay, 2016]. While our model controls for exit from the labour market, these two points could explain the noneffect of disability on compensation incomes. Concerning heterogeneity in the social welfare system, we are perfectly aware that our two groups do not depend on all available compensation incomes, among which disability, unemployment, and old-age pension are the three most important factors. If we look at Eurostat's data on old-age pensions as a part of GDP during 2011–2015, we can see that the proportions dedicated to old-age pensions by Denmark, France, Italy, Austria, and Sweden are greater than the

EU-28 mean proportion. Regarding unemployment during this same period, the generous countries are Belgium, Denmark, Spain, France, Italy, and Austria. If we were to look at all these compensation incomes independently, we would have created group that differ from those used in our robustness checks. Nonetheless, in looking at the three compensation incomes all together, the groups that we created are quite valid. In our generous group, Denmark and France have devoted more than the EU mean to all three items, while Belgium and Austria are above the mean for two of the items. Finally, we can make two comments about Austria and Italy. First, the proportions of the GDP devoted by these two countries to unemployment benefits are, respectively, only 0.1 and 0.2 pp higher than the EU-28 mean proportion during the 2011–2015 period. The second comment concerns old-age pensions. Because Italy and Austria are characterized by a notable level of early retirement [OECD, 2010], they incur higher expenditures in this regard.

Our results suggest that while disability continues to have a negative impact on labour market outcomes, this impact could be mitigated by social welfare system heterogeneity.

Chapter 2

What is the impact of my partner's disability on my labour force participation? A European study.

co-authored with Sandrine Juin

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Table of contents

Abstract

This paper investigates the effect of partner's disability on an individual's labour supply at the extensive margin. The Retrospective part of the *Survey of Health, Ageing and Retirement in Europe* (SHARELIFE) allows us to follow individuals between the ages of 20 and 55 in 28 European countries. Using an heterogeneity-robust difference-in-differences estimator, we estimate the effect of partner's disability on an individual's labour force participation up to five years after the onset of disability. Our results show that having a partner who receives public disability benefits significantly decreases the probability of working for both men (-5.8pp) and women (-4.2pp). These effects seem to be driven by individuals aged 40 and over and by those whose partner has stopped working. When separating the European countries in two groups according to disability policies, we find no effect of partner's disability in "social-democratic" countries that provide generous compensation benefits and implement strong integration measures. The negative effect on the labour supply is found in "corporatist" countries that are characterised by intermediate levels of benefits and integration policies.

1 Introduction

In 2021, Belgium decided to cancel the "love tax" on one of its disability allowances. The "love tax" means that an individual with disabilities loses some allowances if they[1] are in couple. This was also a debate in recent years in France regarding the allowance for adults with disabilities. Indeed, this allowance was only granted if the annual household income is below a certain threshold. As a result, an individual with disabilities could be doubly disadvantaged due to both their incapacity and their financial dependence on their partner. After multiple discussions at the French National Assembly, the individualisation of this social benefit was voted on in 2022. These two examples illustrate that the financial situation of a couple facing disability, and thus the labour supply of both partners, should be studied at the couple level.

In this paper, we investigate the following research question: what is the impact of partner's disability on an individual's labour force participation? This question is of particular interest because several economic mechanisms (see Section 2.1) are likely to increase or decrease the individual's labour supply (e.g., income and substitution effects, informal care provision, access to public disability benefits, changes in the relative productivities at home and on the labour market within the couple, etc.) but their overall effect is unclear and complex to predict. This question is also relevant from the perspective of public policies. On the one hand, if we find that the partner without disabilities works more, it may have an impact on their own physical and mental health. This can also shed light on the fact that public disability benefits may be insufficient to compensate for the loss of income following disability. On the other hand, if we find a decrease in the labour force participation of the partner without disabilities, this raises concerns about the consequences on the household income and the risk of precariousness. In addition, if a partner's

[1]For generic individuals whose gender is unknown, we use the singular "they" as a third-person singular pronoun to avoid she/he and we use "their" to replace possessive determiners her/his.

disability negatively impacts the career path, it may have long-term consequences, such as reducing pension benefits.

This paper contributes to the literature in several ways. First, existing studies have mainly focused on the negative effects of disability on the labour supply of individuals with disabilities [García-Gómez, 2011; Jones and McVicar, 2020; Mussida and Sciulli, 2016; Silva and Vall-Castelló, 2017; Müller and Boes, 2020; Polidano and Vu, 2015]. We extend this area of the literature by investigating the effects on the partner's labour supply. Second, this paper fits into the literature on the effects of family events on labour market outcomes. While there is a strong consensus on the child penalty faced by mothers [Angelov et al., 2016; Ishizuka, 2021; Kleven et al., 2019] and on the negative effects of informal care provision to elderly parents on the labour supply [Bauer and Sousa-Poza, 2015; Schmitz and Westphal, 2017; Simard-Duplain, 2022; Van Houtven et al., 2013], less is known about other types of family events such as disability. Thus, we fill this gap by studying the impact of disability within couples.

Our paper is part of the more general literature on the effect of a health shock on a spouse's labour supply (see Section 2.2.1). While disability is also a health shock, it is important to bear in mind that disability onset can have different implications compared to other health shocks. It refers to a long process that can occur at any age and, most of the time, without reversibility (see our disability measure in Section 3.2.2). These differences probably lead to different intertemporal trade-offs than those made after others health shocks. In addition, disability compensation benefits are different from those perceived with others health shocks. Existing works focusing especially on partner's disability (see Section 2.2.2), as well as those on health shocks, stress out that the direction and the magnitude of the effects strongly depend on the type of shock considered, on gender and on age. There is no consensus regarding the impact of partner's health on an individual's labour supply. In addition, existing papers often study the case of the US and/or focus on people aged 50 and older. Their career paths and decisions will likely differ from those

of younger individuals or individuals living in other countries and cannot be generalised.

Our study brings additional evidence in the European context. We rely on the retrospective waves of the *Survey of Health, Ageing and retirement in Europe* (SHARE). We measure disability through administrative recognition: our treatment variable equals one if the partner declares receiving public disability benefits. These data allow us to follow a large sample of individuals between the ages 20 and 55 in 28 European countries. This longitudinal dimension enables us to control for individual fixed effects, capturing all the country-specific differences. Using a new heterogeneity-robust difference-in-difference estimator [De Chaisemartin and d'Haultfoeuille, 2022a], we estimate the effect of a partner's disability on an individual's employment up to five years after the onset of disability. Our results show that having a partner who receives public disability benefits significantly decreases the probability of working for both men (-5.8pp) and women (-4.2pp). These effects remain significant five years after the onset of disability and seem to be driven by individuals aged 40 and over; by those whose partner has stopped working and by individuals living in countries where the generosity of the welfare system regarding disability is less developed in terms of compensation incomes but also in terms of integration measures of individual with disabilities on the labour market.

This paper is organised as follows. The next section presents the mechanisms through which partner's disability may impact an individual's labour supply and summarises the existing empirical literature. We present the database, variables and sample selection in Section 3. Section 4 introduces the empirical strategy, and our results are reported in Section 5. Finally, Section 6 is devoted to discussion and conclusion.

2 Background

2.1 Mechanisms through which partner's disability may impact an individual's labour supply

Several mechanisms at work can lead to either an increase or a decrease in the labour supply of the partner of the individual with disabilities leading to a overall effect that is unclear.

First, the onset of disability may directly and indirectly affect household consumption. The potential decrease in the labour supply of the individual with disabilities may generate a loss of household income. There is also a substitution effect that leads to a drop in general consumption in favour of a rise in health expenditures. Consequently, if the household wants to maintain its initial consumption level and pay for extra health expenditures and professional care at home, the healthy partner will increase their labour supply. This result is the well-known "Added Worker Effect" (AWE) [Lundberg, 1985; Mincer, 1962]. This theory is usually associated with unemployment, where one spouse (the woman most frequently) temporarily increases their labour supply in response to the unemployment of the other one.

Secondly, informal care provision to the partner with disabilities may lead to a decrease in labour market participation or in working hours. Studies have shown that providing informal care to an elderly parent has generally little or no effect on labour force participation to the labour market but is negatively associated with working hours, especially for women [Bauer and Sousa-Poza, 2015; Schmitz and Westphal, 2017; Simard-Duplain, 2022; Van Houtven et al., 2013]. Regarding informal care provision to the spouse, only a few papers exist. While McLanahan and Monson [1990] show that male caregivers of spouses work fewer hours, Butrica and Karamcheva [2018] find no impact of spouse caregiving on working hours, but men who care for their wives are less likely to be in the

labour market.

Thirdly, if the partner with disabilities is eligible for compensation benefits, it mitigates the income loss and the AWE. At the same time, if eligibility for compensation incomes is not met due to the partner's revenue, the partner must earn sufficient income to meet the needs of the couple.

Fourthly, the complementarity in spousal leisure time can be modified with the onset of bad health or disability [Coile, 2004].

Finally, disability may change the relative productivities of family members in household production and on the labour market, but it is difficult to predict in what direction. In that case, following Becker's comparative advantages theory, the labour supply of both partners is likely to change [Becker, 1991]. It is also possible that couples renegotiate their division of domestic and labour market work after a disability shock.

We sum up all these mechanisms in Table C.1.11 in Appendix C.1.

2.2 Empirical studies on the effects of health shocks or disability on the partner's labour market outcomes

The literature has mainly focused on the labour market outcomes of individuals with disabilities. Previous researches have shown the negative impact of disability on labour force participation [García-Gómez, 2011; Jones and McVicar, 2020; Mussida and Sciulli, 2016; Silva and Vall-Castelló, 2017], working hours [Müller and Boes, 2020; Polidano and Vu, 2015] and earnings [Angelov and Eliason, 2016; Kidd et al., 2000]. In contrast, the consequences of disability at the couple level have been less studied even though joint labour supply models have shown the importance of integrating the partner's decisions in labour supply choices [Leuthold, 1968; Chiappori, 1988, 1992; Lundberg and Pollak, 1993, 1994, 1996; Donni, 2006].

2.2.1 Effects of diverse health shocks

Empirically, existing works focused on the impact of health shocks on the partner's labour market outcomes measure health shocks through the onset of diverse health conditions such as arthritis [Acuña et al., 2019; Coile, 2004; McGeary, 2009], asthma [Acuña et al., 2019]; cancer [Coile, 2004; Riekhoff and Vaalavuo, 2021]; diabetes [Coile, 2004; Giaquinto et al., 2022; McGeary, 2009]; high blood pressure [McGeary, 2009]; heart attack, disease or failure [Coile, 2004; Fadlon and Nielsen, 2021; Giaquinto et al., 2022; McGeary, 2009; Riekhoff and Vaalavuo, 2021; Siegel, 2006]; hypertension [Acuña et al., 2019]; stroke [Coile, 2004; Fadlon and Nielsen, 2021; Giaquinto et al., 2022; McGeary, 2009; Riekhoff and Vaalavuo, 2021; Siegel, 2006]. García-Gómez et al. [2013] is the only one to consider unscheduled and urgent hospitalisations. This literature studies various labour market outcomes such as participation to the labour market or entry in the labour market [Fadlon and Nielsen, 2021; García-Gómez et al., 2013; Giaquinto et al., 2022; Siegel, 2006; Acuña et al., 2019]; working hours [Charles, 1999; Coile, 2004; Fadlon and Nielsen, 2021]; income [Fadlon and Nielsen, 2021; García-Gómez et al., 2013; Siegel, 2006] and retirement [Coile, 2004; McGeary, 2009; Riekhoff and Vaalavuo, 2021].

While some papers find no significant impact of the spouse's health deterioration [Fadlon and Nielsen, 2021; Giaquinto et al., 2022], most of the literature stresses that the direction and the magnitude of the effects strongly depend on the type of health shock considered, gender and age [Acuña et al., 2019; Coile, 2004; McGeary, 2009; Riekhoff and Vaalavuo, 2021; Siegel, 2006; García-Gómez et al., 2013]. It should be stressed that the works of Coile [2004], McGeary [2009], and Siegel [2006] are based on US data focusing on individuals aged 50 and older. Their career paths and decisions are likely to be different from those of younger individuals or of individuals living in other countries. The other studies mentioned in this session consider individuals of all working ages in Chile [Acuña et al., 2019], in Europe [Riekhoff and Vaalavuo, 2021], in the UK [Giaquinto et al., 2022], in Denmark [Fadlon and Nielsen, 2021] and in the Netherlands [García-Gómez et al., 2013].

In the end, the paper of [Riekhoff and Vaalavuo, 2021] will be the closest to ours in terms of studying area. Dealing with countries like the USA or Chile can generate different findings due to different labour markets, disability insurance schemes and/or family structures. Studying the whole Europe instead of one country will enable to perform heterogeneity tests according to welfare systems.

2.2.2 Specific effects of disability and work limitations

We identify only a few papers that study the specific impact of disability on partner's labour supply [Berger, 1983; Braakmann, 2014; Giovanis and Ozdamar, 2019].

Consequently, the three following papers are of particular interest to us.[2] First, in the early 1980's, Berger [1983] studies the onset of disability on family labour market adjustments. Solving his theoretical model of labour supply, he finds two effects: a "full income effect" and a "household production effect". The first one drives healthy family members to increase their working time in response to the onset of disability of one family member. The second one reflects the potential decrease in working hours due to an increase in housework. The author shows on US data that women with a spouse with disabilities have a lower probability to work, but the ones who stay in the labour market seem to react to the "full income effect" by increasing their working hours. By contrast, following the onset of female disability, men tend to react to the "household production effect". However, this first study uses an imprecise disability measure (individuals with disabilities are those who declare not working the whole 1977 year because of poor health) and relies on non-longitudinal data. Few decades later, Braakmann [2014] and Giovanis and Ozdamar [2019] add to this literature new disability measures, data and methods. Using the German Socio Economic Panel from 1984 to 2006, Braakmann [2014] defines disability with a medical indicator. He finds no effect of the partner's disability on the probability of being on the labour market, the working hours or the monthly wages. Finally, Giovanis and Ozdamar [2019] use the woman's disability as a distribution factor [Bourguignon et al.,

[2] A sum up of these three papers is provided in table C.2.12 in Appendix C.2

2009], meaning they consider that disability influences the household behaviour (via the bargaining power for the sharing rule of the household income) but has no direct effect on household's preferences. They use Iraqi data to estimate a non-unitary cooperative model of labour supply and find that men with a spouse with disabilities work more and participate more to the household production than those with a healthy spouse.

Inside this literature, we also find papers relying on limitation indicators such as work-limiting health conditions [Anand et al., 2022; Berger and Fleisher, 1984; Charles, 1999; Jolly and Theodoropoulos, 2023; Parsons, 1977; Siegel, 2006]; ADL [Coile, 2004; McGeary, 2009] or functional impairment [Johnson and Favreault, 2001; Siegel, 2006]. They study the effects of partner's disability on employment [Anand et al., 2022; Charles, 1999; Jolly and Theodoropoulos, 2023; Siegel, 2006; Johnson and Favreault, 2001], working hours [Anand et al., 2022; Berger and Fleisher, 1984; Charles, 1999; Jolly and Theodoropoulos, 2023; Parsons, 1977; Coile, 2004], and retirement [Jolly and Theodoropoulos, 2023; Coile, 2004; McGeary, 2009; Johnson and Favreault, 2001].

The direction and the size of the effects differ across studies and depend on gender and on limitation indicators, so that no consensus emerges. These studies rely on US data (with the exception of Jolly and Theodoropoulos [2023] that use European data) and mainly focus on individuals aged at least 45 (except Anand et al. [2022]; Berger and Fleisher [1984]; Parsons [1977]). Their career paths and decisions are likely to be different from those of younger individuals or of individuals living in other countries. In addition, work-limiting indicators capture both health problems and disability. They also imply, by definition, that the spouse with disabilities is very likely to reduce their labour supply. This prevents us from studying differentiated effects according to the labour supply of the partner with disabilities.

2.2.3 Contribution to the literature

To sum up, there is no consensus in the literature regarding the impact of partner's health or disability shock on labour supply. In addition, existing papers often study the case of the US or focus on people aged 50 and older and their results cannot be generalised to other contexts or populations.

Our study brings additional evidence by using a permanent disability measure (see section 3.2.2). We rely on retrospective European data - the SHARELIFE part of the *Survey of Health, Ageing and retirement in Europe* (SHARE) - that allow us to follow a large sample of individuals between the ages of 20 and 55 in 28 European countries. This longitudinal dimension enables us to control for individual fixed effects, capturing all the country-specific differences. Using an heterogeneity-robust difference-in-difference estimator, we are also able to estimate the effect of partner's disability on an individual's employment up to five years after the onset of disability.

In addition, the use of European data enables us to test the sensitivity of the effects to social welfare systems. While SHARE has been used twice to measure the impact of a health shock on the partner's career path [Jolly and Theodoropoulos, 2023; Riekhoff and Vaalavuo, 2021], we think our study contributes to the literature differently. As we do, Riekhoff and Vaalavuo [2021] rely on retrospective waves of SHARE. Nonetheless, they focus only on female responses to male health shocks while we take into account women and men. Their measure of health shock differs from our and can implies different trade off as explained before. Finally, Jolly and Theodoropoulos [2023] use the usual waves of SHARE meaning they focus on individuals aged at least 50 while we look at individuals between aged 20 and 55. Their indicator of health is related to the capacity of work. In our study, we provide evidences of the differences generated by the job situation of the individuals suffering from disability shock.

3 Data

3.1 *The Survey of Health, Ageing and Retirement in Europe*

In order to investigate our research question, we need to gather data with information on the partner's disability and with a longitudinal dimension to study career paths. We then rely on the *Survey of Health, Ageing and Retirement in Europe* (SHARE) [Bergmann et al., 2019; Börsch-Supan et al., 2013].

This European survey is carried out every two years since 2004 and includes now 28 European countries.[3] The regular waves of SHARE interviews people aged 50 and older and their partner regardless of their age. Various topics are covered such as children, health, employment and pensions, behavioural risks, social networks.

In this work, we use the two retrospective waves of SHARE named SHARELIFE [Börsch-Supan, 2022a,b]. They have been conducted in 2009 and 2017 (waves 3 and 7). SHARELIFE surveys focus on people's life histories, thus providing information on health, work and family situations from birth to the interview date. It makes it possible to study the effect of the partner's disability on work at all ages, in both the short and medium term. We combine raw SHARELIFE data with the Job Episodes Panel (JEP), an annual database built by SHARE teams based on SHARELIFE information [Brugiavini et al., 2019, 2022]. Consequently, we benefit from an unbalanced panel where we observe each individual from birth to at least age 50, which is the minimum age to participate in the survey.[4]

[3] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and Switzerland.

[4] Because of the participation of partners regardless of their age, some individuals are less than 50 during their SHARELIFE interview. It represents 2% of our final sample, of which 1.5% are over 44 years old.

3.2 Main variables

3.2.1 Employment

In this work, our dependent variable is a binary variable Y_{it} taking the value 1 if the individual i is employed or self-employed at year t and 0 otherwise. We thus focus on the labour force supply at the extensive margin. We restrict our analyses to this outcome due to data limitations. SHARELIFE retrospective surveys provide only partial information on working hours[5] and wages[6].

3.2.2 Measuring the partner's disability

Disability is a vast concept referring to physical, mental or cognitive impairments. It can be the result of various causes. Hence, multiple indicators can be used to measure it. The most common are functional limitations, restrictions in basic and instrumental activities of daily living (ADL and iADL), the Global Activity Limitation Indicator (GALI) and administrative recognition of disability.

While the first two are mainly related to ageing process, the GALI indicator has the advantage of being comparable across countries and covers all dimensions of disabilities.Nonetheless, it is not available in SHARE retrospective data (SHARELIFE). Furthermore, it may capture a reversible disability given that it is based on limitations of at least six months. It would have been difficult for individuals to remember the exact year of disability defined through this indicator. The same problems arise with functional limitations and restrictions in activities of daily living.

In this paper, we measure partner's disability through administrative recognition of dis-

[5]When individuals switch from a part-time to a full-time contract (and vice versa) but remain in the same job, we know the year of the switch only for one change in SHARELIFE 2009 data. In 2017 data, the switch year is not provided at all.

[6]Individuals provide their wages only when they start a job. If they stay in the same job, we do not have information regarding wages evolution. Moreover, even for the first wage, it could be too difficult for individuals to remember this information throughout their lives.

ability. Our explanatory variable of interest takes the value 1 if the partner receives public disability benefits and 0 otherwise. This kind of indicator is commonly used in the literature and has several advantages. First, it covers all dimensions of disability. Second, it refers to strong and, in most cases, permanent limitations. The OECD stresses that *"exits from disability benefits are rare, and when they occur, often result in transitions to other social protection programmes"* [OECD, 2022]. This kind of permanent disability is more likely to affect the time trade-offs of couples and their labour supply decisions. It is thus particularly relevant for our research question.[7] Finally, even if we use a declarative measure, our disability indicator is less subject to self-declaration biases than other ones since administrative recognition is based on an assessment by social workers or healthcare professionals. However, it should be kept in mind that our disability measure may not be comparable across countries due to different eligibility criteria and to the potential non take-up of disability benefits. In addition, it captures not only a pure disability effect but also the effect of compensation incomes received by individuals.

For information, we compare our disability indicator to other common disability indicators. In our sample, we initially have 3,797 individuals who declare receiving disability pension (see detailed information in subsection 3.3 and Figure C.3.12 in Appendix C.3). Among them, 2,404 have participated in the 2017 wave of SHARELIFE. In 2017, besides retrospective information, some usual variables have been collected.[8] 85.9% of individuals who receive disability pensions have limitations in activities because of health problems in 2017, of which 43.8% declare severe limitations. Among those receiving disability pensions, 36.0% (resp. 26.7%) report iADL (resp. ADL) while for those who do not receive disability pensions, this rate falls in 12.9% (resp. 8.4%).

[7] In fact, in SHARELIFE data, we know when the application for disability benefits has been accepted but we have no information on the potential cessation of benefits. In this work, we consider the partner's disability as a staggered treatment and we study its effect on labour supply up to 5 years after the onset of disability.

[8] This was not the case in 2008.

3.3 Sample selection

We combine the two SHARELIFE retrospective waves (wave 3, conducted in 2008 and the wave 7, conducted in 2017) with the JEP, leading to a sample of almost 92,000 individuals. We keep only the 29,010 European couples where both individuals have participated to the survey (number of individuals = 58,020).[9]

Among the 58,020 individuals in our database, we exclude couples composed of two disabled people. Consequently, we focus on couples where both individuals are "healthy" or where only one of them is in situation of disability. Empirically, for the first type of couples, the two individuals can be used (with equal probabilities) in our models while in the second type of couples we study only the career path of the "healthy" partner. Thus, we remove the 3,115 individuals with disabilities and keep only their spouse. For couples with one individual with disabilities we impose that they were living together before the onset of disability. For this, we need non-missing values for the year of disability and the year of the beginning of their cohabitation. We consequently drop 289 individuals. Finally, since we are interested in the career path of the healthy partner, we decide to drop individuals for whom their spouse's disability occurred before age 20 or after age 55. Consequently, our final sample is about 53,128 individuals: 2,020 are the partners of individuals with disabilities while 51,108 are healthy individuals with a healthy partner.

In the empirical strategy, we use only the years where individuals are 20-55 years old in order to avoid, as much as possible, transitions from school to working life and (pre-)retirement decisions.

A detailed flowchart is in Figure C.3.12 in Appendix C.3.

[9] In case of relationship breakdown, we have no information on the health status of the partner. We thus restrict our sample to couples that have remained together. The reader should keep in mind that it may generate a selection bias.

4 Empirical strategy

To investigate the impact of partner's disability on the individual labour supply we rely on a difference-in-differences framework.

Based on the causal model of Rubin [1974], this approach considers a quasi-experimental framework where some individuals are "treated" and others are not. These later individuals, the controls, are representing the counterfactual meaning the evolution in the dependant variable if the treated units were not treated. In our paper we will denote D the treatment variable. It is equal to one if the individual has a partner with disabilities and zero otherwise. The objective is to estimate the causal impact of the treatment (the onset of the partner's disability) on the outcome (the labour supply).

The difference-in-differences model compares the outcome variables of the treated and the control groups before and after the onset of the treatment. The central assumption is the parallel trend one, assuming that, in the absence of treatment, treated individuals would have the same trend in the outcome as the ones in the control group. Then, in a two-periods framework with a treatment appearing in t, the estimator is the following:

$$[\mathbb{E}(Y_i|X_i, D_i = 1, t+1) - \mathbb{E}(Y_i|X_i, D_i = 1, t)] - [\mathbb{E}(Y_i|X_i, D_i = 0, t+1) - \mathbb{E}(Y_i|X_i, D_i = 0, t)] \tag{1}$$

with Y the dependent variable and X a set of control variables.

In the case of panel data with more than two periods, difference-in-differences are commonly estimated through a two-way fixed effects (TWFE) model. In our design, it can be written as follows:

$$\text{Labour supply}_{it} = \alpha_i + \gamma_t + \beta \text{Treated}_i \text{Post}_t + X'_{it}\omega + u_{it} \tag{2}$$

where α_i and γ_t represent the individual and temporal fixed effects, $\text{Treated}_i\text{Post}_t$ is the

interaction term of the two binary variables defining the treatment (Treated_i takes the value of 1 if the individual i is part of the treated group, and the variable Post$t$ takes the value of 1 if we are in the period after the occurrence of the shock) and X'_{it} is a set of covariables.

In this panel framework, the TWFE is a weighted average of every possible 2x2 (two-groups/two-periods) estimators [Goodman-Bacon, 2021]. This design suggests that treatment effects are constant between groups and over time. This model will be our "naive" model. Indeed, the recent literature on difference-in-differences has highlighted several biases regarding TWFE whenever the number of periods is higher than two (see De Chaisemartin and d'Haultfoeuille [2022b] for a review) due to the challenges of meeting identifying assumptions. First, whenever the treatment is not implemented on the same date for every treated unit (i.e., heterogeneous treatments), the treatment effects can not be constant over time and in groups. Second, if the parallel trend assumption is not satisfied, TWFE are biased. Third, in TWFE, the control group includes already treated individuals, leading to "forbidden comparisons".

In our case, based on the growing new literature on heterogeneity-robust DiD estimators and on our disability measure, we need an estimator that meets four criteria. First, our treatment is binary. Second, the partner's disability does not appear in the same year for every individual. Third, our treatment (having a partner with disabilities) is staggered, meaning that once an individual is treated, they stay treated. In other words, there is no recovery regarding the disability of the partner. Finally, we consider that past treatments can affect the outcome, meaning that the labour supply of the individual can be impacted by the partner's disability even several years after the onset of the shock. The underlying hypothesis is that job market adjustments are not instantaneous. Consequently, according to De Chaisemartin and d'Haultfoeuille [2022b], four estimators could be suitable for our framework (with a binary and staggered treatment): Borusyak et al. [2021]; Callaway and Sant'Anna [2021]; De Chaisemartin and d'Haultfoeuille [2022a]; Sun and Abraham [2021].

Because our sample covers a significant number of years, with some of them containing only a few treated individuals, the estimators of Callaway and Sant'Anna [2021] and Sun and Abraham [2021] are not suitable for this paper. Regarding the estimator of Borusyak et al. [2021], it relies on a strong parallel trend assumption. Thus, we finally decide to use the De Chaisemartin and d'Haultfoeuille [2022a] estimator.

Since the estimator of De Chaisemartin and d'Haultfoeuille [2022a] allows for control variables, we include the following set of covariables: age, sex, final number of schooling years, number of children (three binary variables: having zero child, having 1 child, having at least 2 children); having at least one child under three years old, having at least one child above sixteen; being in good health during childhood and having illness(es) in year t. The inclusion of these control variables is grounded in existing literature. Gender serves as a crucial determinant of labour supply (see details information in Section 5.3). As previously mentioned, the presence of children also exerts an influence on labour supply, particularly for mothers [Angelov et al., 2016; Ishizuka, 2021; Kleven et al., 2019]. Controlling for children above the age of 16 allows us to approximate the presence of informal caregivers in the household, in addition to the partner. Indeed, the prevalence of young caregivers in Europe has been more extensively documented recently, notably in Austria [Nagl-Cupal et al., 2014], France [Untas et al., 2022], Germany [Metzing et al., 2020], Italy [Landi et al., 2022] and Switzerland [Leu et al., 2019]. Finally, existing literature has demonstrated that adverse childhood health experiences have detrimental impacts on labour market outcomes in adulthood [Smith, 2009; Viinikainen et al., 2020].

In this estimator, control variables are introduced to account for time-varying covariates, distinguishing it from Callaway and Sant'Anna [2021] that primarily handle time-invariant variables. When control variables are incorporated into this estimator, the parallel trend assumption becomes conditional. Consequently, the control and treated groups may exhibit different trends in outcomes before the treatment, but under the condition that disparities in trends between the two groups can be explained by a linear model involving

these variables.

Regarding the control group, following the recent literature [Fadlon and Nielsen, 2021; Jones and McVicar, 2020], we consider individuals with a partner who will experience disability in the future. These not-yet-treated individuals are supposed to be better counterfactuals than the never-treated ones. They are more likely to have characteristics similar to those of the treated individuals.[10]

We first estimate our model on the whole sample and then separately for men and women. Standard errors are clustered at the household level in analyses based on the total sample while we only use an individual level cluster for analyses on men and women.

5 Results

5.1 Descriptive statistics

Descriptive statistics are provided in Table 1. As the onset of disability occurs at the age of 45 on average, we present statistics at age 45 for the control group.

Regarding our dependent variable, we observe that treated individuals seem to be less in employment than their counterpart. The employment rate of individuals whose partner has no disability is 82% at age 45. If we focus on individuals with a partner with disabilities, the employment rate is 77% one year before the onset of disability (in $t-1$) and decreases to 72% three years after (in $t+2$). At age 20, the total sample is composed of 51% women. This rate is much higher among treated individuals (65%), reflecting the fact that disability is more frequent among males in our sample. Treated individuals are slightly less educated than individuals in the control group and are more likely to have a child under three years old. Finally, individuals facing partner's disability seem

[10]Nonetheless, we also provide results including never-treated individuals in the control group in Appendix. In this paper, never treated individuals are those that have never had a partner with disabilities up to the survey date.

Table 1: Descriptive statistics

Individual characteristics	Total sample		Individuals with a partner without	Individuals with a partner with disabilities			
	at age 20	at age 55	disabilities - age 45	t-1	t+1	t+2	t+3
Dependent variable							
Percentage of employed (or self-employed) individuals	62.81	72.86	82.06	76.83	74.66	73.47	71.80
Independent variables							
Percentage of individuals with a partner with disabilities	0.00	3.72	0.00	0.00	100.00	100.00	100.00
Female	50.56	48.09	49.77	64.80	64.66	64.70	64.53
Mean age				44.31	46.27	47.18	48.07
Mean years of schooling (after 6 years old)	11.34	11.22	11.36	10.73	10.73	10.71	10.70
Number of children							
0	0.90	0.08	0.09	0.07	0.07	0.07	0.07
1	0.09	0.17	0.17	0.18	0.17	0.16	0.17
2 and +	0.02	0.75	0.74	0.75	0.76	0.77	0.77
Having at least one child under 3 years old	9.96	0.27	3.33	8.86	6.42	5.60	4.30
Having at least one child above 16 years old	0.01	89.33	72.57	68.32	74.17	76.00	77.69
Percentage of individuals in good health during childhood	16.66	16.84	16.81	15.64	15.63	15.68	15.81
Percentage of individuals in illness period	1.38	6.19	3.57	4.01	4.88	5.24	5.37
Number of individuals	53,128	47,428	50,831	2,020	2,009	1,983	1,954

Note: At the age of 20, 63% of individuals in our sample are employed.

Population: SHARELIFE individuals without disabilities with responding partner to SHARELIFE

Source: SHARELIFE and JEP

to be more likely to report an illness period (5% one year after the onset of disability as compared to 3.5% in the control group).

Individuals in our sample come from 28 European countries. The most represented countries are Spain (7.35% of the sample), Italy (7.13%), Belgium (6.38%), Estonia (5.73%) and Germany (5.62%) while the less represented are Malta (1.70%), Latvia (1.49%), Cyprus (1.41%), Luxembourg (1.20%) and Ireland (0.91%).

5.2 Naive results: Event-Study design

As mentioned above, we rely on TWFE as a naive estimator. In order to study the evolution of the treatment effect over time, we implement an Event-Study design using a fixed effects model. This kind of design requires never treated groups for identification reasons. Figure C.4.13 in Appendix C.4 presents the results.

We observe a decrease in the labour supply following the onset of the partner's disability. While the decline is not significant over the first three years, we observe a 2pp drop in the probability of being on the labour market four years after the shock and a 3pp drop five years after the shock.

When looking at the pre-shock effects, we observe significant effects. For example, in $t-3$ (with t the treatment year), the estimated coefficient is around -1pp. Considering that those lag effects compare a previous year to the reference year $(t-1)$, these negative pre-shock effects mean that, before the treatment, future treated individuals had a higher probability of being in the labour market. The parallel trend assumption it thus violated with the Event-study design. When looking at the graph, we observe that between $t-5$ and $t-3$ confidence intervals and estimates vary widely. We may assume that when individuals with disabilities apply for compensation incomes, they already are in a situation of disability. Their partner may increase their labour force participation before the receipt of compensation benefits in order to limit the decrease of household income and to cover extra health and care expenditures. Just as a reminder, we measure the DI at the moment of the demand and not at the moment of the receipt, meaning that we minimize the anticipation effect as much as possible.

In any cases, implementing the heterogeneity-robust DiD estimator of De Chaisemartin and d'Haultfoeuille [2022a], enables to overcome those issues. First, with this estimator we can work only on treated individuals. Using future treated individuals as a control group makes the parallel trend assumption more credible. Second, the Event-Study results are very likely to be biased due to the different treatment years leading to forbidden comparisons. The estimator of De Chaisemartin and d'Haultfoeuille [2022a] presented in the next session also addresses this problem.

5.3 Main results: heterogeneity-robust DiD estimator

Following the recent paper by Fadlon and Nielsen [2021], we rely on a control group which contains only not-yet treated individuals. Those individuals are the ones who will have a partner with a disability but later in the timeline. They are supposed to be more similar to the treated individuals. More specifically, the parallel trend hypothesis seems more realistic.[11]

We first present the results on the whole sample and then separately for men and women.

Looking at the whole sample, we find a decrease in the probability of working following the onset of partner's disability (see figure 1). The effect ranges between -1.9pp the year following the receipt of DI and -4.8pp after five years. Consequently, the negative effect on the labour supply persists and even increases over time. Regarding pre-trends, the joint test placebo confirms the plausibility of the parallel trend hypothesis (p-value=0.3996).

Most papers in the literature on labour supply study men and women separately. More specifically, the literature on the effects of partner's health/disability shock either provides a gendered analysis [Berger, 1983; Braakmann, 2014; Charles, 1999; Coile, 2004; García-Gómez et al., 2013; Giaquinto et al., 2022; Jolly and Theodoropoulos, 2023; McGeary, 2009; Parsons, 1977] or focuses on women only [Acuña et al., 2019; Berger and Fleisher, 1984; Siegel, 2006] or men only [Giovanis and Ozdamar, 2019]. This is particularly relevant because men and women have different career paths, professional opportunities and family-work-leisure trade-offs which are not captured by analyses on the whole sample. Even if their labour force participation has increased since 1900 [Olivetti and Petrongolo, 2016], women are still leaving the labour market earlier than men [Lammers et al., 2013] and more likely to have part-time contracts. Moreover, occupational segregation still exists. Women tend to be over-represented in sectors with relatively low wages (*horizontal segregation*) and, when considering the same sector, they are less likely to have higher-paid

[11] We also provide the analyses with the never treated in the Appendix C.5

jobs (*vertical segregation*). The literature focusing only on men's health shock provides two reasons to justify this choice: men are the main breadwinners [Riekhoff and Vaalavuo, 2021] and women are more likely to be out of the labour force [Acuña et al., 2019]. Gender differences regarding disability shocks can also justify this separation in the analyses. For instance, severely disabled men suffer more frequently from heart problems such as heart attacks, coronary thrombosis, myocardial infarction, etc. Suffering from heart problems is more likely than other diseases to result in a low probability of participating in the labour force [Stern, 1989]. This may lead to different adjustments regarding the partner's labour supply and informal care provision. More generally, an extensive literature has shown that women provide more intensive informal care (to children, to parents, to their partner) than men [Cortés and Pan, 2023; Haberkern et al., 2015].

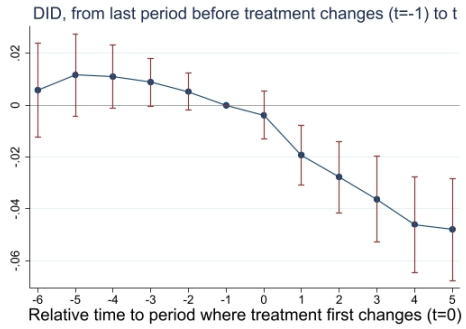
Looking at the results, we do not observe any added worker effect. In fact, we observe the opposite effect: following the onset of partner's disability, both men and women reduce their labour supply. For women (see Figure 2), the effects goes from -2pp one year after the shock to -4.2pp. For men (see Figure 3), the drop in labour supply reaches -5.8pp five years after the onset of partner's disability.

We report all details in columns (4), (5) and (6) of Table C.5.13 in Appendix C.5. The reader must be aware that the joint-test placebo is significant at 10% for men, which raises some doubt about the parallel-trend assumption. This is not the case when never-treated are included in the control group (column(3)), which leads us to think of a statistical power issue rather than parallel trend violation.

5.4 Heterogeneity analyses

In this section, we provide different heterogeneity analyses according to age, to the evolution of the labour supply of individuals with disabilities, and to countries.

Figure 1: Main results - On the whole sample



Gender heterogeneity

Figure 2: Main results - Women

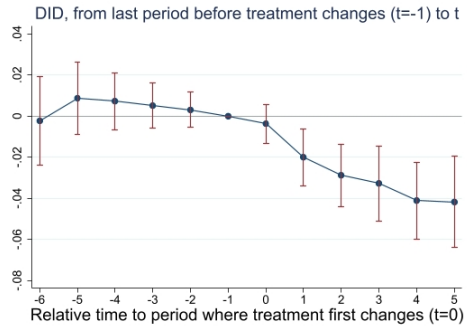
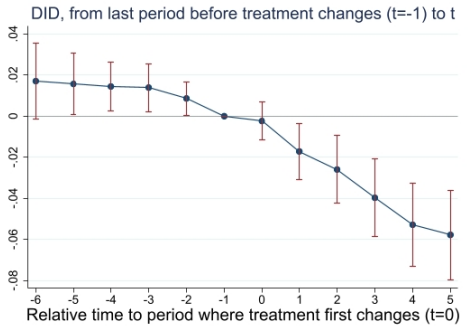


Figure 3: Main results - Men



5.4.1 Results by age

Individuals at the end of their working life and younger ones may not have the same opportunities to adjust their labour force. While younger workers can potentially adjust their labour supply by adjusting their working hours or changing job (which would have no effect on our labour force participation indicator), we can imagine that switching job is more difficult for older workers, but in the meantime they may decide to retire early.

Consequently, we split our initial sample into two sub-samples. In order to have groups as balanced as possible we split our sample at age 40 (which is very close to the mean age of treated individuals at the onset of their partner's disability). The first group contains individuals aged 20 to 40 and the second one individuals aged 41 to 55. In this second group, we exclude individuals who were treated before age 41.

We do not find any impact of partner's disability on the probability of being employed for individuals under 40 years old (see Figure 4). In the older sample, we observe a decrease in labour supply following the partner's receipt of DI that reaches -6.2pp five years after the shock (see Figure 5). Nonetheless, we must be cautious because placebo effects seem to invalidate the hypothesis of a pre-treatment parallel trend between individuals with a partner with disabilities and those with a healthy partner (joint test placebo significant at 10%).[12]

Age heterogeneity with not yet treated individuals as control group

Figure 4: 20-40 years old individuals

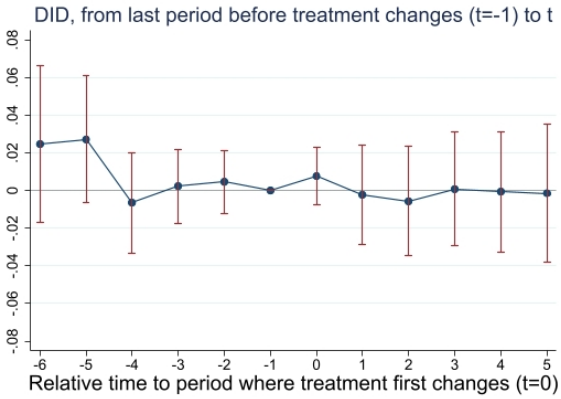
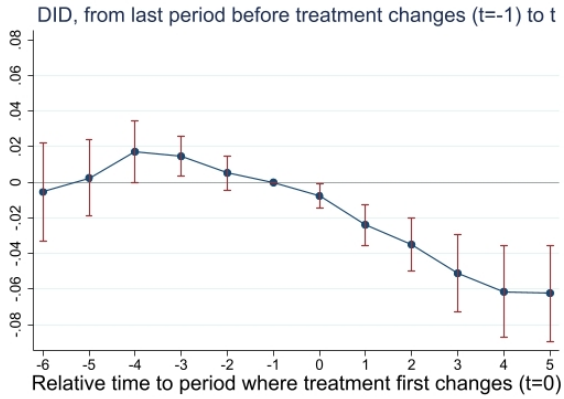


Figure 5: 41-55 years old individuals



To go deeper, we compute the analyses on age separately for men and women. Despite the small number of individuals in each category, our results confirm the heterogeneity according to age. Indeed, old women and men decrease their labour supply following the onset of their partner's disability. For women (respectively men), the effects ranges between -3pp (resp. -1.5pp) the year following the shock and -6.1pp (resp. -6.5pp) five years later. Regarding young individuals, we do not observe any effect on women's labour force participation. The trend seems to be decreasing for men, but the pre-trend is not satisfying.[13]

Results on 41-55 years old individuals are in line with the previous literature. In particular, Jolly and Theodoropoulos [2023] perform an age heterogeneity analysis by splitting

[12]Details are provided in Table C.5.14 in Appendix C.5

[13]Graphics are provided in Figures C.5.17, C.5.18, C.5.19 and C.5.20 in Appendix C.5.

their sample according to the median age when the partner experiences a health shock. Their results also support the idea that men between 50 and 65 years old have a higher probability of retiring (so, being out of the labour force) after the shock. Riekhoff and Vaalavuo [2021] also find that men are more likely to retire following the shock. Nonetheless, the evidence we find for women is different from previous results highlighted by Riekhoff and Vaalavuo [2021]. They do not observe any evidence of a change in women's career path. For those initially outside the labour market, they suggest that, the more their human capital depreciated, leading to a weaker probability of being able to take financial responsibility for their relationship [Riekhoff and Vaalavuo, 2021]. Nonetheless, Riekhoff and Vaalavuo [2021] use an health measure that is less similar to ours than the one used by Jolly and Theodoropoulos [2023].

5.4.2 Results according to the job situation of the partner with disabilities

So far, the results suggest a decline in the probability of working when the partner experiences disability. These results invalidate the added worker effect hypothesis. This might be related to the job situation of the partner with disabilities. Indeed, if the partner was already out of the labour market before receiving DI, the shock on the household's income is less important as the one expected if the partner was in the labour force. The intuition is the same for an individual who would have remained employed after the receipt of DI.

We conduct analyses of heterogeneity based on the job situation of the partner with disabilities. Focusing on individuals whose partner was working one year before receiving DI, we run separate estimations depending on whether the partner remains employed the two years following the start of DI receipts or not.

When the partner stops working in $t+1$ or in $t+2$, we still observe a decline in labour supply (see Figure 6). It goes from -2.3pp one year after the partner starts receiving DI to -5.8pp after five years. One possible explanation is that individuals reduce their labour

Heterogeneity according to the labour supply of the partner with disabilities

Figure 6: Stop work

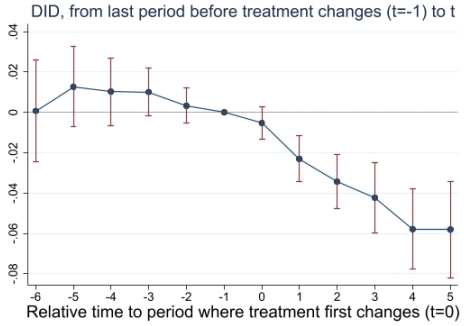
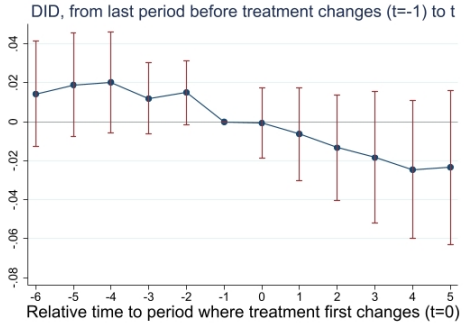


Figure 7: Stay in labour force



supply to provide informal care at home. Indeed, partners who stop working likely have a high level of disability. By contrast, the effect is no longer significant when the partner with disabilities stays in the labour force (see Figure 7). Nonetheless, it is important to bear in mind the sample size of partner's with disability staying in the labour force is very low.[14] This is quite reasonable considering our measure of disability. Again, we do not find any evidence of a positive AWE. This result is in line with the one found by Giaquinto et al. [2022] in the case of an health shock (heart attack, stroke or cancer) on the partner. Indeed, when considering a subgroup where the partner was working one year before the shock, the authors do not find any positive AWE.

5.4.3 Country heterogeneity

As mentioned previously, there is no consensus in the literature regarding the effect of partner's health on the labour supply. If differences in health indicators and methods partly explain these discrepancies, the heterogeneity across countries can also play a role. The European dimension of the data allows us to conduct separate analyses according to the disability policies in the different countries.

We create country groups based on disability policies models following a typology from the OECD [OECD, 2010]. According to the OECD, the level of generosity of disability

[14] More details in columns (3) and (4) in Table C.5.14 in Appendix C.5).

policies in a country can be measured through two synthetic indicators: a compensation indicator and an integration one. Based on these scores, the OECD suggests two main European models. The first one is the "Social-democratic" model, characterised by an important generosity in terms of both compensation incomes and integration measures. Countries in this cluster provide easy access to compensation benefits, incentives for vocational training and high levels of benefits. It includes Denmark, Finland, Germany, the Netherlands, Sweden and Switzerland. The second model is the "Corporatist" one, characterised by intermediate levels of access to compensation benefits and of integration measures. It includes Austria, Belgium, Czech Republic, France, Greece, Hungary, Ireland, Italy, Luxembourg, Poland, Portugal and Spain.

We find no evidence of a change in labour supply following the onset of partner disability in the "Social-democratic" group (see Figure 8). On the contrary, in "Corporatist" countries the trend is decreasing following the shock (see Figure 9), but there may be doubts regarding the parallel trend assumption. To go deeper, following the OECD classification, we divide the "Social-Democratic" group into two subgroups[15] and the "Corporatist" one into three subgroups[16]. It confirms the previous results (see Figures 10, 11, 12, 13 and 14). In "Social-democratic" subgroups, it seems that partner's disability does not have any consequences on an individual's labour supply. In the meantime, for each subgroup of the "Corporatist" model, we find a negative impact of partner's disability on the probability of being in the labour market. In subgroup 1, the effects range between -4.4pp one year after the shock and -9pp four years after the partner's disability onset. In subgroup 2, we observe a small decrease in the probability of being in the labour market in the first two years following the shock. Finally, in subgroup 3, the decline ranges between -1.7pp following the shock and -4.6pp four years later.[17]

Consequently, it seems that the most generous countries succeed in mitigating the adverse

[15]Subgroup 1: Denmark, the Netherlands, Switzerland ; subgroup 2: Germany, Finland, Sweden.
[16]Subgroup 1: Austria, Belgium, Hungary ; subgroup 2: France, Greece, Luxembourg, Poland ; subgroup 3: the Czech Republic, Ireland, Italy, Portugal, Spain.
[17]All the details are provided in Table C.5.15 in Appendix C.5.

effects of a partner's disability, thanks to compensation incomes and to integration policies for people with disabilities. Subgroup 2 of "Social-democratic" countries is the one that has the most stringent measures towards firms in favour of individuals with disabilities.

5.5 Sensitivity analyses

Exclusion of Poland

When looking at our sample, we observe that 19.9% of our treated individuals live in Poland. This represents an important proportion and the results could be driven only by this country.

In order to check the robustness of our results, we re-estimate our main analysis by excluding Poland (see Figures 15, 16 and 17). For the whole sample and the men subsample, it does not change our effects. Regarding women, the effects seem slightly smaller than in the main analysis but given the size of standard errors we can conclude that this difference is not significant.

Year of treatment

We work on a large panel with a very long observation period. The treatment is heterogeneous, meaning that individuals do not experience the shock at the same time. In this subsection, we investigate if our results depend on the year of treatment.

Descriptive statistics show that 90% of our treated individuals are confronted to their partner's disability between 1976 and 2011. Consequently, we looked at major changes regarding disability policies in Europe during this period. During the 1990's, European countries have shifted from a model focused on compensation incomes to a model putting more emphasis on the integration of people with disabilities on the labour market [Böheim and Leoni, 2018; Hemmings and Prinz, 2020; Hvinden and Halvorsen, 2003; OECD, 2010]. Access to compensation benefits has become more restrictive, prompting countries to develop employment incentives and reintegration policies. For example, the Netherlands

raised the minimum work capacity reduction required to be entitled to compensation benefits [Hemmings and Prinz, 2020], and Italy implemented its first hiring quotas for disabled workers [Böheim and Leoni, 2018]. The Figure C.5.21 produced by Böheim and Leoni [2018] provides a clear picture of this shift towards the so-called "active policies". Consequently, we implement our methodology by distinguishing individuals treated before 1995 and after 1995.[18]

In the whole sample, the results are consistent with those of the main analysis: following the onset of partner's disability, we observe a decline in the labour market participation that intensifies over time. When separating men and women, results are less precise than in the main analysis due to smaller sample sizes. Overall, the trends are downwards, confirming our main findings.[19]

[18] More generally, during the first years of this period, Europe faced the 1973 Oil Crisis, and during the last few years, Europe experienced the debt crisis. During this period, one major event was the European Monetary System crisis, which started in 1992. Consequently, the evolution of disability policies is well representative of economic problems during the period. The sensitivity analysis also takes into account these different economic and financial crises.

[19] Using the year 1990 or the year 2000 as the threshold gives similar results.

Country heterogeneity

Figure 8: "Social-democratic" group

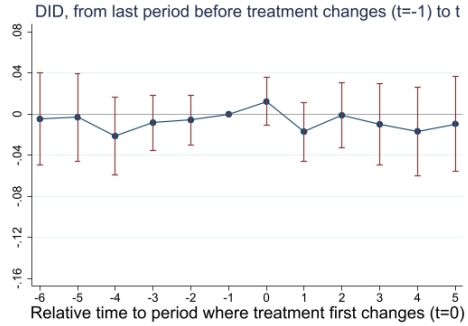


Figure 9: "Corporatist" group

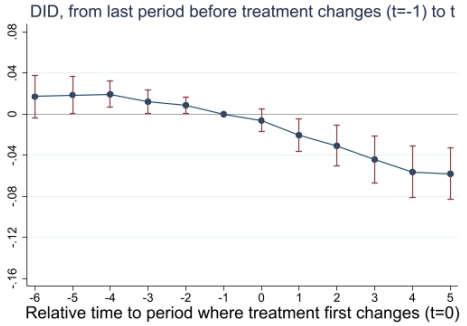


Figure 10: Subgroup 1 - "Social-democratic"

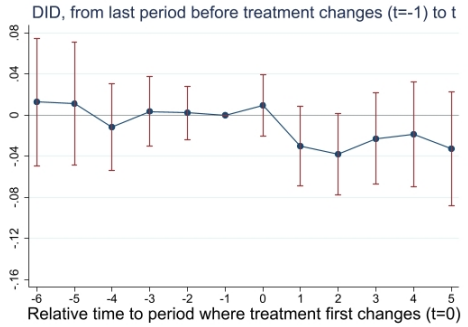


Figure 11: Subgroup 2 - "Social-democratic"

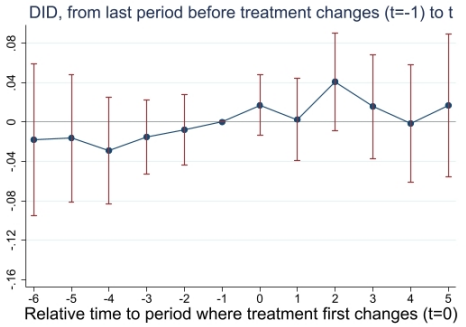


Figure 12: Subgroup 1 - "Corporatist"

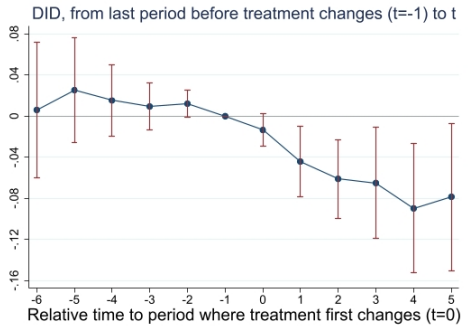


Figure 13: Subgroup 2 - "Corporatist"

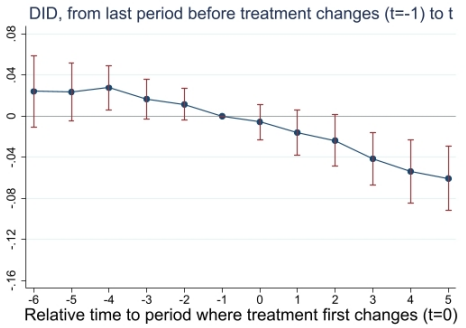
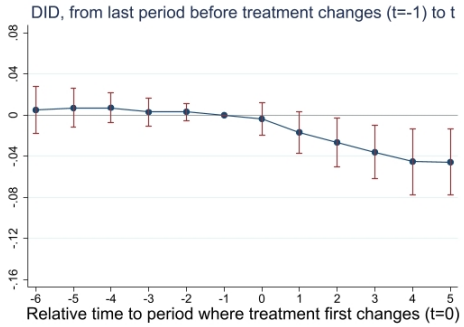


Figure 14: Subgroup 3 - "Corporatist"



Exclusion of Poland

Figure 15: All sample without Poland

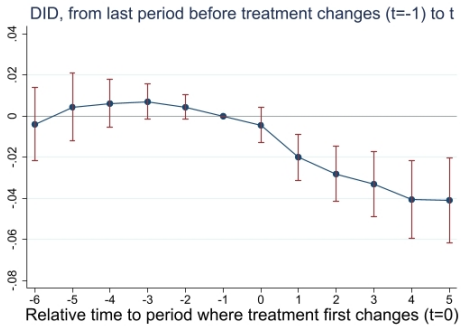


Figure 16: Women without Poland

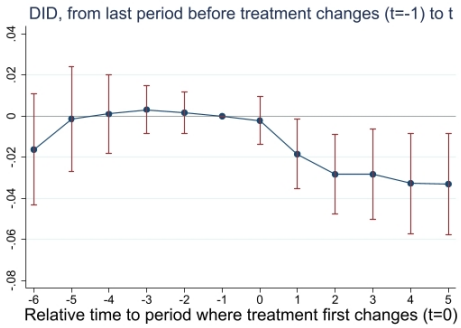
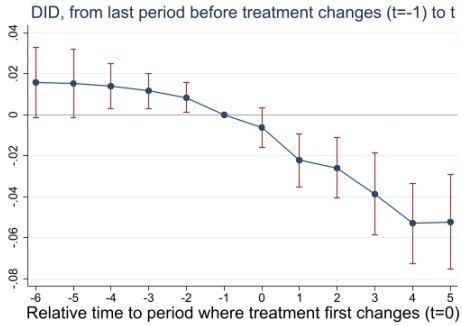


Figure 17: Men without Poland



Sensitivity to treatment year

Figure 18: Whole sample - Before 1995

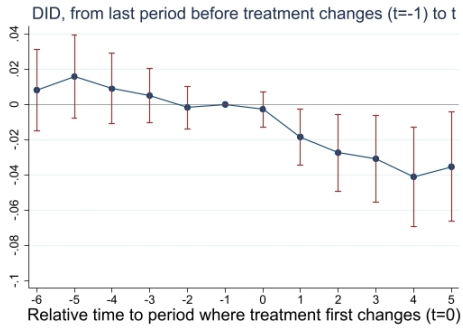


Figure 19: Whole sample - After 1995

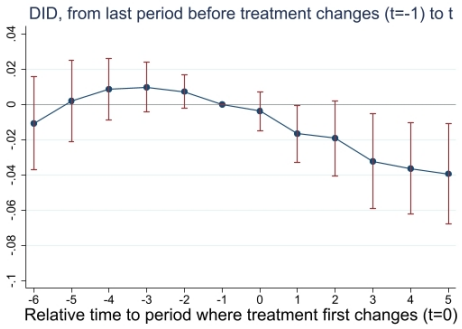


Figure 20: Women - Before 1995

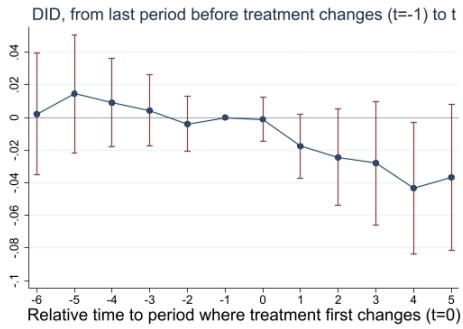


Figure 21: Women - After 1995

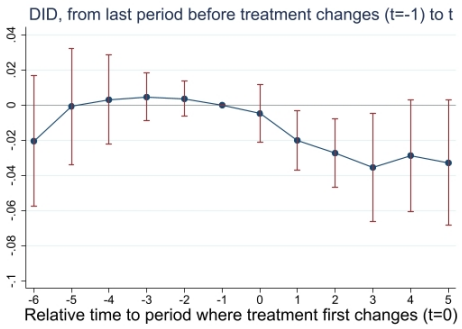


Figure 22: Men - Before 1995

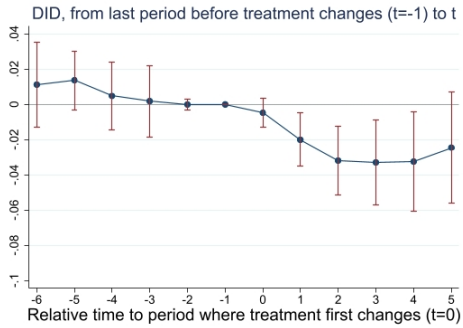
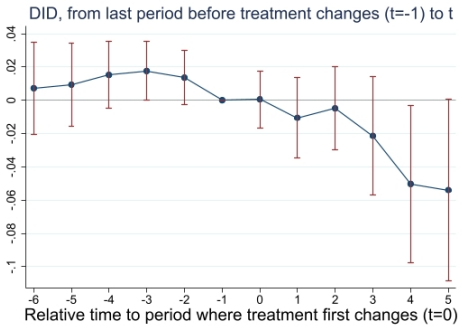


Figure 23: Men - After 1995



6 Conclusion and discussion

This paper proposes an analysis of the relationship between the disability of one individual and the career path of their partner. Using a large sample of European individuals and heterogeneity-robust DiD estimators, we show that the partner's disability is negatively linked with the probability of being employed. Those results are valid among men and women. They are in line with the results find by Berger [1983] but not with the ones find by Braakmann [2014].

We also show that our results particularly hold for older individuals (41-55 years) and for those with a partner initially employed. Heterogeneity across countries reveals that the generosity of welfare systems can offset the adverse effects of partner's disability on the labour supply. In particular, when countries implement strong integration measures for individuals with disability, no effect is found on the partner's labour supply.

In the end, we do not find any positive AWE. Our results support the idea that individuals having a partner with disabilities free up time for two potential things. First, they might become informal caregivers. Second, as uncertainty about their partner's health increases, they might want to spend more leisure time with their partner. Nonetheless, our study brings back only a overall effect. We cannot distinguish those mechanisms; these are simply avenues for interpretation. We potentially may have descriptive intuitions about some of these channels. For example, in the wave 8 of SHARE, every individual describes their typical day by explaining how much time they spend at work, at home, at leisure, etc. Looking at this qualitative indicator could help us to explain our results. Nonetheless, in the end, we will not be able to go deeper into the interpretation because we do not have precise information on working hours or job adjustment following the onset of the partner's disability in our database.

In the current version of the paper, we do not consider heterogeneity according to the probability of being employed before the partner's disability onset. In the next few weeks,

following the paper of García-Gómez et al. [2013] we should implement heterogeneity tests considering the labour supply of our individuals one year before the partner's disability. García-Gómez et al. [2013] show that the ones who were not working did not change their labour supply while those who were employed reduced it (by 1.5pp for men and 1.1pp for women). Moreover, considering the results of Riekhoff and Vaalavuo [2021] on women who were initially the labour market (see Section 5.4.2), this test could help us to verify their hypothesis of excessively degraded human capital.

Finally, our study might lack external validity. Indeed, to have information about both individuals in the couple, we need to ensure that individuals do not break up. Nonetheless, existing literature shows that first disabling illnesses inside a couple do not lead to a higher probability of divorce [Charles and Stephens, 2004]. Bünnings et al. [2021] also support this result when looking at deterioration in physical health. However, a decrease in mental health is associated with a higher probability of breaking up.

Chapter 3

Are disabling diseases resulting from unemployment spells?

co-authored with Thomas Barnay and Tom Buchmueller

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Abstract

This work proposes a first analysis of the effect of unemployment on disability. Using European data, we implement logit models to measure the impact of having experienced diverse unemployment spells on the probability of declaring disabling illnesses at ages 25, 30, 35, 40, 45 and 50. While these first results give an insight into the relationship between the two variables, interpretations of the results must be carried out with caution. We observe a positive association between the experience of unemployment and the probability of declaring later disabling diseases. Considering a specific indicator of mental disabling diseases, we observe that the association can start at age 30 when looking at those with youth unemployment spells. These effects are mainly driven by men.

1 Introduction

While the unemployment rate in Europe has been declining since 2014, according to Eurostat, it stood at 6.2% in 2022, with approximately 6.7 million unemployed men and 6.5 million unemployed women.

Unemployment represents a significant disruption that can affect an individual's entire working life, leading to increased uncertainty regarding career prospects and a decrease in human capital [Pollak, 2013] and wage rates [Arulampalam, 2001; Barnette and Michaud, 2017]. Especially, literature has shown the major role played by youth unemployment on later labour market outcomes such as wages [Gregg and Tominey, 2005; Mroz and Savage, 2006], labour force participation [Gregg, 2001]. Nevertheless, unemployment can also yield effects beyond labour market outcomes. During unemployment, individuals experience a decline in income, which has ripple effects throughout the household. The adverse effects of unemployment on personal or household outcomes have been well-documented. For instance, unemployment increases the likelihood of relationship breakups [Charles and Stephens, 2004; Hansen, 2005; Solaz et al., 2020] and leads to delays in fertility decisions [Pailhé and Régnier-Loilier, 2015].

Looking at more personal outcomes, unemployment can impact health. We identify two main effects of unemployment on health: a direct one and an indirect one. First, unemployment may result in a health deterioration due to an increase in stress levels and anxiety. Unemployment modifies the individual's life: new rhythm, fewer social contacts, etc. (see deprivation model of Jahoda [1982]). In the end, this feeling of isolation can lead to increased risky behaviours such as smoking [Falba et al., 2005], alcohol consumption [Deb et al., 2011], and suicide behaviour [Blakely et al., 2003].

This increase in stress levels is reinforced by the indirect effect of unemployment on health:

the financial effect. The financial effect results from two losses: a decrease in earnings and a loss of health insurance in case of based-employment and not portable insurance. Both lead to decreased demand for health care. The Welfare System, which provides insurance against financial losses due to social risks like unemployment, can amplify or mitigate these effects. Indeed, household savings and debts regarding supplementary health insurance can amplify or attenuate the adverse effect. Moreover, the economic context can also play a part. If the individual is in a context of high unemployment, the harmful effects of unemployment on health can be mitigated [Blasco and Brodaty, 2016].

In the end, unemployment incurs a social cost that justifies investigating its consequences to better understand the short and long-term impacts of unemployment. This understanding can then inform policies by accounting for these consequences when measuring the overall cost of unemployment. Public policies should consider this additional cost of unemployment in compensation schemes or preventive measures aimed at reducing the occurrence of unemployment spells.

While the literature on the effects of unemployment on health has shown adverse impacts, it is also worth examining whether unemployment can lead to a specific health outcome: disability. Given that disability often becomes a persistent condition, the social cost of unemployment would likely be further exacerbated.

The negative correlation between unemployment and disability has been mainly studied in the literature. Nonetheless, most of the time, the reverse causality is investigated (i.e. the impact of disability on labour market outcomes) highlighting adverse effects of disability on labour force participation [García-Gómez, 2011; Jones and McVicar, 2020; Mussida and Sciulli, 2016; Silva and Vall-Castelló, 2017], working hours [Müller and Boes, 2020; Polidano and Vu, 2015], income [Cervini-Plá et al., 2016; Dano, 2005; García-Gómez et al., 2013; Lechner and Vazquez-Alvarez, 2011] and earnings [Angelov and Eliason, 2016; Kidd et al., 2000]. Less is known about the potential disability situations stemming from unemployment.

This work focuses on the role of experiencing unemployment spells on disability. Disability is a long-term and broad concept that is difficult to grasp in terms of definition and measurement. It refers to physical, mental or cognitive impairments due to the ageing process, an accident or a disease and, in the first place, can be seen as the consequence of a progressive health deterioration. While its proper definition has evolved with the different classifications of the World Health Organization (WHO), in 2006, the United Nations proposed a definition that has been adopted by consensus in most European countries. It is defined as follows: *"Persons with disabilities include those who have long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others."* [UN, 2006]. This definition highlights that disability results from the interaction between an individual's health and internal factors such as gender, age, and habits or external ones like social integration. Then, disability is instead a "situation of disability", not only due to a long-term health condition. It is also the result of an interaction with the individual's environment generally not adapted to the individual with a disability, leading to activity limitations and/or participation restrictions (see Figure D.1.22 in Appendix D.1).

More specifically, this preliminary version examines the association between experiencing one unemployment spell at different age periods and the probability of declaring disabling diseases. We rely on logit models computing at different fixed ages. Our first findings highlight a positive link between the experience of unemployment (between 15 and 44 years) and the later probability of declaring disabling disease (at ages 45 and 50 years). When looking at an indicator of mental disabling diseases, this association becomes significant since age 30 following a youth unemployment spell (i.e. between ages 15 and 24).

Ultimately, this paper aims to extend the literature by two means. First, while existing literature has mainly focused on the adverse effects of unemployment on mental health, we go further by exploring disability situation, relying on indicators capturing the main

aspects of disability situation: chronicity, medical sources, consequences on activities in a specific context (see Section 3.3.1). Second, we rely on multi-country panel data, allowing us to consider countries (in a later version) and economic differences.

This paper presents a review of the existing literature (Section 2). We then introduce the data (Section 3) and the empirical strategy (Section 4). We present the first results (Section 5) and discuss them (Section 6).

2 Literature review

2.1 The effect of unemployment on health and disability

A large part of the literature regarding the effect of unemployment on health has studied mental health [Artazcoz et al., 2004; Backhans and Hemmingsson, 2012; Blasco and Brodaty, 2016; Breslin and Mustard, 2003; Schmitz, 2011] or (psychological) well-being [Booker and Sacker, 2012; Flint et al., 2013; Mousteri et al., 2018]. All these empirical studies are based on Jahoda's latent deprivation model [Jahoda, 1981, 1982]. For Jahoda, employment provides five latent functions: time function, social contact, activities, purpose and status. These functions are mandatory for psychological well-being. Based on that, empirical papers have tested the hypothesis that unemployment leads to decreased mental health. While a negative impact seems to be mainly highlighted (for a meta-analyse, see Paul and Moser [2009]), results are heterogeneous among several factors such as gender, age, and country. Blakely et al. [2003] find an adverse impact of unemployment on French men's mental health while no impact on women. Significantly, men more than 40 years old suffer more from unemployment. A higher impact on men's health has also been found in Sweden [Backhans and Hemmingsson, 2012], Spain [Artazcoz et al., 2004] and Europe in general [Schröder, 2013]. Regarding countries' heterogeneity, it seems that the effect of unemployment on health is higher in the US [Schaller and Stevens, 2015], while this effect does not exist in Denmark [Browning et al., 2006]. Nonetheless, Mousteri

et al. [2018] show that, in the long run, in Europe, the psychological consequences of unemployment are not due to country-specific characteristics.

Regarding the effect of unemployment on overall health (measured through self-assessed health, life satisfaction or well-being, for example), previous literature has mainly found a negative impact [Clark et al., 2001; Schaller and Stevens, 2015; Voßemer et al., 2018]. Using the first retrospective wave of the Survey of Health, Ageing and Retirement in Europe (SHARE), Voßemer et al. [2018] estimate the role of early-career (within the first ten years after entry into the labour market) involuntary job loss. They find a six percentage point increase (pp) in the probability of declaring fair or poor self-rated health in late life. Finally, we identify fewer papers on overall physical health [Gallo et al., 2009; Schröder, 2013]. The main result, which is not in line with the literature on mental health, is that the physical health of men is less affected by unemployment. Indeed, using the first four waves of the Health and Retirement Survey (HRS), Gallo et al. [2009] measure the impact of unemployment on the sum of fourteen binary physical health variables (e.g. climbing flights of stairs, getting up from a chair, walking, etc.). They find no impact for men, while unmarried women are at risk for bad health. Schröder [2013] shows the same intuition: women who have experienced a job loss at least 25 years ago are more likely to be obese or overweight and to declare limitations in their instrumental activities of daily living (results for men are found only for mental health).

Consequently, unemployment seems to have a detrimental effect on health, with different results depending on which health measures are considered and which kind of individuals (see Picchio and Ubaldi [2022] for a detailed meta-analysis). Nonetheless, as usual, this relationship is subject to biases like measurement error, omitted variables, etc. Among them, the most important is reverse causality (for details on the relationship between work and health, see Barnay [2016]). Health impacts the career path, and the relationship between unemployment and health is subject to selection effect at the entry and exit of unemployment [Blasco and Brodaty, 2016]. Indeed, bad health (a fortiori, disability)

negatively affects most of the considered outcomes of the labour market, and bad health decreases the opportunity to quit unemployment. Consequently, to avoid this reverse causality, most papers consider involuntary job loss due to plant closures or layoffs to measure unemployment [Browning et al., 2006; Gallo et al., 2009; Schaller and Stevens, 2015; Schmitz, 2011; Schröder, 2013; Strandh et al., 2014]. Nonetheless, panel data could be also a solution. Implementing the panel data model goes further by enabling it to take into account inobservable (at least fixed in the time) and observable individual characteristics, which could be latent factors influencing health but also on unemployment. This is the strategy pursued, in particular, by Böckerman and Ilmakunnas [2009] and Schmitz [2011]. Böckerman and Ilmakunnas [2009] rely on difference-in-differences (DiD) models combined with matching methods. At the same time, Schmitz [2011] uses the conditional logit model to estimate the impact of plant closures on different health outcomes. These papers finally find no evidence of a negative impact of unemployment on health. The authors mentioned the fact that it could be due to panel considerations.

Regarding the specific case of disability, impairment or limitations, we do not find any paper exclusively working on it. Schröder [2013] uses the first retrospective wave of SHARE to quantify the impact of unemployment on various health indicators and, especially: application for disability insurance payments, granted disability insurance; activities of daily living (ADL) and instrumental ADL (iADL). By implementing a logistic regression, he finds that women (only) who experienced an unemployment spell at least 25 years ago have a higher probability of reporting limitations in their ADL and iADL. Gallo et al. [2009] consider their physical health indicators as physical disability measures.

2.2 What about the role of unemployment duration or timing?

In the relationship between unemployment and health, the duration of unemployment could play a significant role. The longer the duration of unemployment, the more the factors mentioned above may be exacerbated. Strandh et al. [2014] use Swedish data

to assess the impact of various exposure periods to unemployment on a Psychological Problems Index. Examining periods of 18-21 years, 21-30 years, and 30-42 years and employing a repeated-measures linear mixed-models method, they demonstrated that individuals exposed to unemployment in all three periods exhibited worse mental health compared to those not exposed. The same result is found for exposition to two periods compared to one or zero. Nonetheless, the hypothesis of a linear impact is sometimes questioned [Blakely et al., 2003; Clark et al., 2001]. Using the German Socioeconomic Panel from 1984 to 1994, Clark et al. [2001] test the habituation hypothesis, meaning that unemployed people become used to their non-working situation. They show that the relationship between unemployment and well-being is subject to habituation. Unemployed individuals with a higher unemployment rate in the past are less affected, especially for men.

The timing of the unemployment spell is essential. Indeed, Strandh et al. [2014] show that youth unemployment is the only one to impact later psychological problems significantly. More specifically, they highlight that individuals exposed to unemployment between 18 and 21 years have significantly higher nervous and depressive symptoms, but also sleep problems at age 42 (compared to those who do not experience unemployment). Moreover, those exposed at unemployment between 21-30 years or between 30-42 years do not have higher mental disorders at age 42. This result reinforces our aim to investigate the consequences of youth unemployment.

Our study aims to provide further evidence of the association between unemployment and disability situations. By examining an indicator of disabling diseases (refer to Section 3.3.1) and focusing on the initial (and singular) unemployment spell, we compare various unemployment spells based on the age at which they occur.

3 Framework and methodology

3.1 Database

We rely on the *Survey of Health, Ageing and Retirement in Europe* (SHARE) and especially on the Life Histories waves (SHARELIFE) [Brugiavini et al., 2019]. SHARE is a panel realised every two years since 2004 in Europe and has investigated around 156,000 individuals. It targets individuals who are 50 years and older and their partner regardless of their age. It now includes 28 European countries and Israël and covers various topics such as health, employment, family, etc.

SHARELIFE corresponds to two retrospective waves conducted in 2009 and 2017 (waves 3 and 7 of SHARE) [Börsch-Supan, 2022a,b]. The retrospective waves give information from the birth of the individual to their[1] SHARELIFE interviews, meaning that we have all the evolution of health, working spells, relationships, etc., from age 0 to age 50 at least.[2] In order to have annual records, we combine raw SHARELIFE data with the Job Episodes Panel (JEP), an annual database built by SHARE teams based on SHARELIFE information [Brugiavini et al., 2019, 2022].

3.2 Sample

Starting from the 91,743 individuals in SHARELIFE, we proceed to some selection. First of all, looking at education level, only 88,225 individuals provide the final year of their full time education. Taking that into account, we then drop the 1% individuals declaring finishing their full time education after 33 years old. Among the 87,304 individuals left in our sample, in this first analysis, we decide to focus only on those having at most one

[1] In this paper, we rely on "they" to avoid personal pronouns (e.g., she/he) and on "their" to replace possessive determiners (e.g., her/his) by their.

[2] Because of the participation of partners regardless of their age, some individuals are less than 50 during their SHARELIFE interview. It represents sample, of which 1.5% are over 44 years old.

spell of unemployment.[3] Consequently, we keep the 80,572 individuals with zero spell during the observation period and the 5,535 individuals with exactly one spell.

Among those with one spell, we are interested of the ones who experienced it between ages 15 and 44. Indeed, our aim is to capture the impact of different timing of unemployment spell, especially of youth unemployment. Considering OECD definition of youth unemployment rate, we select individuals with unemployment spell starting from age 15. In the meantime, because our individuals are mainly observed until 50 years, we decide to cut off before this age. Also, the probability of declaring disability problems increase with age, especially after 50. At the end, we do not consider the 2,029 individuals with spell before 15 years-old or after 44.

Moreover, because we look at different period over the life course and, in order to keep only non aberrant values, we restrict our sample to those who experiment a spell during at most 10 years. It represents less than 0.3% of the total sample and around 6.2% of those experiencing one unemployment spell (216 individuals).

Finally, if we only take into account unemployment among the worker cycle of individuals, we can have individuals with only unemployment and inactivity along their whole career path. In this case, effects on mental DD could be overestimated due to the bad health status of these individuals. Consequently, to focus on a more homogeneous sample, we restrict our analyses to those who, during their whole career, will have at least five years of employment. This allows us to consider individuals with a non-zero probability of experiencing unemployment spells.

Our final sample is about 77,783 individuals including 74,569 with no spell of unemployment and 3,214 individuals with exactly one spell lasting at most 10 years between their 15 and 44 years (see Flowchart D.2.23 in Appendix D.2).

[3]The first unemployment spell is the one who have the higher long-term consequences on wages [Arulampalam, 2001].

3.3 Variables

3.3.1 Disability situation

As mentioned earlier, disability is a wide concept referring to various situations. WHO proposes five categories of disability situations: motor disability, sensory disability, mental disability, psychic disability and disabling illness. In this paper, we will focus on the later ones. Disabling diseases are long-term illnesses that may cause a disability situation and involve with time.

In this work, disability situation being our dependent variable, we consider as much as possible a large definition, capturing by self-declared and subjective indicators which can capture all the "feelings" (physical, mental, cognitive) emerging following unemployment situation.[4]

Consequently, our main indicator is the disabling diseases (DD). We rely on the following question *"[When you were 16 up until now] How many periods of ill health or disability have you had that lasted for more than a year?"*. One interviewer note is also specified: *"This include serious illnesses that lasted less than one year, but influenced the respondent's daily life for more than a year."*. We retain this indicator for several reasons. First, this binary indicator regroups several dimensions of a disability situation: the problem has to i) be chronic (*"lasted for more than a year"*); and ii) coming from medical problems (*"ill health or disability"*) who iii) have consequences on daily life (*"influenced the respondent's daily life"*). Second, the negative effect of unemployment on health has been mainly documented, and the fact that chronic diseases caused disability situations also [Hoeymans et al., 2012; Klijs et al., 2011; Nusselder et al., 2019].

[4]We decide to not consider, for now, more objective indicators such as disability insurance receipt. It captures high levels of disabilities and it is mostly permanent, meaning that individuals have low chances to recover and be back on the labour market.

3.3.2 Unemployment

SHARELIFE provides year by year the job situation of each individual. Nonetheless, for practical reasons, this variable contains drawbacks. Indeed, working and retirement are two dominant situations. It means that whenever an individual declares being working (resp. retired) and not working during the same year will be considered as working (resp. retired) the whole year (see more details in Brugiavini et al. [2019]).

To overcome this issue, we modify this variable by using raw data, allowing us to detect every spell of unemployment that lasted at least six months during a year. In this version, speaking of spells during ten years means that we observe an "at least six months" period of unemployment for ten consecutive years.

In this work, we construct several dependent variables measuring unemployment. First, we compare individuals experiencing unemployment between 15 and 44 years with those with zero unemployment spells. Second, we divide our 15-44-year period into three to understand the impact of unemployment spell timing. We then compare individuals with a spell between 15 and 24 years old to those with no spell. The same analyses are realised considering spells between 25 and 34 years and spells between 35 and 44 years. Third, when looking at only those with one spell, we create five binary indicators comparing the experiment of spells between two age periods.

4 Empirical strategy

In this first analysis, we do not rely on panel data models. As we deal with binary outcome, we implement logit regressions. As a first step, to get an idea of the link between unemployment and DD, we decided to estimate our model at a defined age beforehand. Depending on the specifications, we perform our analysis at ages 25, 30, 35, 40, 45 and 50 to see the evolution of the effect.

Basically, we want to estimate the following model:

$$DD_i = \begin{cases} 1 & \text{if } DD_i^* \geq 0 \\ 0 & \text{if } DD_i^* < 0 \end{cases} \tag{1}$$

$$DD_i^* = \beta_0 + U_i^{'}\beta_1 + \beta_2 SAH\_Child_i + \beta_3 Female_i + Educ_i^{'}\beta_4 + u_i \tag{2}$$

where U_i is one indicator of unemployment spells; SAH_Child_i is the binary variable representing the self-assessed health (SAH) of the individual between 0 and 15 years old and taking the value 1 if the SAH was excellent, very good or good; $Educ_i$ is categorical variable representing the number of schooling years[5]; $Female_i$ is taking the value 1 if the individual is a women and u_i an error term following a logistic distribution.

We integrate SAH_Child in our model to have a health status before the shock of unemployment. This measure is interesting for two reasons. First, if individuals are initially in bad health, it increases their likelihood to experience unemployment (non random shock). Second, following Grossman's model, DD at time t depends on DD at time $t-1$ [Grossman, 1972]. This health status control is a proxy of DD_{t-1}.

Lastly, we also incorporate educational level as a control variable, given that higher education levels are associated with better health outcomes [Raghupathi and Raghupathi, 2020]. Firstly, higher education facilitates easier access to healthcare due to higher incomes. Secondly, it leads to better awareness and understanding of healthcare programs. Thirdly, educational attainment can also predict the likelihood of experiencing unemployment spells. Since disability situations represent a specific aspect of health, not accounting for educational level would introduce omitted variable bias.

[5]This variable takes the value 0 if the individual has less than six years of school, 1 for 7 to 10 years of education, 2 if more than 10 years

This model is computed for every unemployment spell indicator mentioned in Section 3.2. We can perform analyses from 25 to 50 years old depending on our dependent variable. Especially when our reference group is individuals with no unemployment spell, we evaluate the effect just after the end of the unemployment spell experienced by the other ones. Each specification is also computed taking into account countries dummies.

With the aim of having an idea of the magnitude of the relationship between unemployment and DD, we compute odd-ratios (OR). It gives the relative probability increase (or decrease) of DD associated to unemployment.

5 Results

5.1 Descriptive statistics

Tables 1 and 2 provide descriptive statistics.

At age 45, we observe that individuals who have experienced a youth unemployment spell (between 15-24 years) are 1.16 percentage points (pp) more likely to report DD than those with no unemployment spell. This differential is about +0.94pp for those who have experienced unemployment spells between 25 and 34 years.

Moreover, females are more represented in the group of individuals experiencing a youth unemployment spell compared to those without unemployment, while they suffer less from unemployment between 25-34 and 35-44 years.

Regarding education, individuals with no unemployment spells seem less educated than those who were unemployed between 25 and 34 or 35 and 44 years old. For those experiencing a youth unemployment spell, the proportion of individuals finishing full-time education before 12 years old is lower than in other categories.

With regard to health during childhood, we observe that individuals who experienced

unemployment at a young age or later in life have a slightly higher probability of reporting good health between the ages of 0 and 15 years.

Finally, we observe that individuals with unemployment have mostly a higher probability of declaring DD five years after the end of their spell period. 2.51% (resp. 4.35%; 8.26%) of those with an unemployment spell between 15 and 24 years (resp. 25 and 34 years; 35 and 44 years) report DD at age 30 (resp. at age 40; at age 50) compared to 2.43% (resp. 3.74%; 6.24%) of their counterparts without unemployment. This differential is growing until age 50 (7.68% compared to 6.31%). Regarding the ones with an unemployment spell between 25 and 34 years, we observe a lower probability of declaring DD during the spell period (at ages 25 and 30). The trend is reversing from the age of 40 years until 50 years, where 8.53% of them declare DD (compared to 6.31% for those without an unemployment spell). The same trend is found for those with an unemployment spell between 35 and 44 years.

Table 1: Descriptive statistics at age 45

Individual characteristics (age= 45 years)	**1 spell**			**0 spell**	**Total sample**
	15-24 years	**25-34 years**	**35-44 years**		
Disabling disease	5.87%	5.65%	3.99%	4.71%	4.74%
Female	48.10%	39.69	40.46	46.77	46.60
Nbr. of schooling years (starting from age 6)					
Less than 6	2.90%	4.38	4.12	7.02	6.89
Between 7 and 10	50.19%	24.29	27.06	30.12	30.35
More than 10	46.91%	71.33	68.81	62.86	61.76
SAH between 0 and 15 years old	91.90	90.64	91.47	90.46	90.49
Nbr. of individuals	1,345	708	776	74,362	77,552

Note: At age 45, 48% (resp. 40%; 40%) of individuals who have experienced one spell of unemployment between 15 and 24 years (resp. 25 and 34 years; 35 and 44 years) are women.
Source: SHARELIFE and JEP

Table 2: Evolution of disabling diseases over age

	25 years	**30 years**	**35 years**	**40 years**	**45 years**	**50 years**
Nbr. of individuals - Total sample	77,783	77,781	77,771	77,717	77,552	76,798
Nbr. of individuals - 0 spell	74,569	74,567	74,558	74,510	74,362	73,683
Nbr. of individuals - 1 spell	3,214	3,214	3,213	3,207	3,190	3,115
Nbr. of individuals - 1 spell between 15 and 24 years	1,354	1,354	1,354	1,351	1,345	1,321
Nbr. of individuals - 1 spell between 25 and 34 years	714	714	713	712	708	685
Nbr. of individuals - 1 spell between 35 and 44 years	779	779	779	779	776	763
Disabling diseases - Total sample	1.98%	2.43%	2.90%	3.76%	4.74%	6.31%
Disabling diseases - 1 spell between 15 and 24 years	1.99%	2.51	2.88	4.22	5.87	7.42
Disabling diseases - 1 spell between 25 and 34 years	1.68%	2.10	2.95	4.35	5.65	8.32
Disabling diseases - 1 spell between 35 and 44 years	1.54%	2.05	2.44	3.21	3.99	8.26
Disabling diseases - 0 spell	1.98%	2.43	2.90	3.74	4.71	6.24

Note: At age 25, 1.98% of our total sample declare disabling diseases. This rate is about 1.99% for those who have experienced an unemployment spell between 15 and 24 years, 1.68% (resp 1.54%) for those who will experience an unemployment spell between 25 and 34 years (resp. 35 and 44 years) and 1.98% for those without unemployment spell.
Source: SHARELIFE and JEP

5.2 First econometric results

Disabling diseases

We observe a positive link between unemployment spell between 15 and 44 years (compared to zero spell) and the probability of declaring DD at ages 45 and 50. It seems that, this event multiplies the probability of declaring DD by 1.18 at age 45 and by 1.32 at age 50. We do not find effects on the age at which unemployment occurred before age 50. At this age, we observe that, having a spell between ages 25 and 34 (respectively, 35 and 44) multiplies the probability of declaring DD by 1.39 (respectively, 1.39).

When considering country dummies, the magnitude of the effects slightly increases.

Table 3: Main results on the probability of declaring DD conditioning on at least 5 years of employment over the life course

DD		25 years	25 years	30 years	30 years	35 years	35 years	40 years	40 years	45 years	45 years	50 years	50 years
Spell 15-24 years VS no spell	OR	0.95	1.02	0.99	1.03	0.93	0.97	1.11	1.12	1.24*	1.23*	1.19	1.19
	s.e	(0.19)	(0.21)	(0.18)	(0.19)	(0.16)	(0.17)	(0.16)	(0.16)	(0.15)	(0.15)	(0.13)	(0.13)
	Obs	75,469	75,469	75,467	75,467	75,458	75,458	75,407	75,407	75,253	75,253	74,551	74,551
Spell 25-34 years VS no spell	OR					1.04	1.06	1.19	1.22	1.23	1.26	1.39**	1.43**
	s.e					(0.23)	(0.24)	(0.22)	(0.23)	(0.20)	(0.21)	(0.20)	(0.20)
	Obs					74,825	74,825	74,776	74,776	74,624	74,624	73,923	73,923
Spell 35-44 years VS no spell	OR									0.86	0.86	1.39**	1.40**
	s.e									(0.16)	(0.16)	(0.19)	(0.19)
	Obs									74,693	74,693	74,002	74,002
Spell 15-44 years VS no spell	OR									1.18**	1.19**	1.32***	1.34***
	s.e									(0.09)	(0.10)	(0.09)	(0.09)
	Obs									77,093	77,093	76,340	76,340
Spell 15-24 years VS 25-44 years	OR									1.09	1.02	0.79	0.79
	s.e									(0.18)	(0.19)	(0.11)	(0.12)
	Obs									2,966	2,953	2,902	2,890
Spell 15-24 years VS 25-34 years	OR									0.96	0.93	0.83	0.81
	s.e									(0.20)	(0.20)	(0.15)	(0.15)
	Obs									2,039	1,992	1,992	1,955
Spell 15-24 years VS 35-44 years	OR									1.35	1.16	0.80	0.74
	s.e									(0.30)	(0.28)	(0.14)	(0.14)
	Obs									2,108	2,038	2,071	2,045
Spell 15-34 years VS 35-44 years	OR									1.43*	1.35	0.89	0.92
	s.e									(0.30)	(0.31)	(0.14)	(0.16)
	Obs									3,021	3,008	2,950	2,938
Spell 25-34 years VS 35-44 years	OR									1.43	1.36	1.01	1.08
	s.e									(0.35)	(0.37)	(0.19)	(0.22)
	Obs									1,479	1,380	1,443	1,412
15-24 years spell (ref) VS 25-34 VS 35-44	OR									1.05	1.07	1.25	1.24
	s.e									(0.22)	(0.23)	(0.22)	(0.23)
	OR									0.73	0.80	1.24	1.22
	s.e									(0.16)	(0.19)	(0.22)	(0.23)
	Obs									2,813	2,800	2,753	2,741
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Experiencing an unemployment spell lasting at most 10 years between the ages of 15 and 44 multiplies the probability of declaring DD at age 45 by 1.18 compared to individuals without unemployment during that period.
Source: SHARELIFE and JEP
Robust se in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Mental versus physical disability situation

Considering the results provided by the literature on the effects of unemployment on health, we decide dig deeper. Our indicator of DD regroups all types of illness or disability. Nonetheless, literature has mainly underlined that adverse effects of unemployment are mainly verified on mental health. Consequently, to be more precise in our results, we decide to create indicators separating mental and physical disability situation.

We first rely on a disabling diseases list available in SHARE to capture mental disabling disease. Among this list we keep two items *"Emotional, nervous, or psychiatric problem"* and *"fatigue, e.g. with multiple sclerosis or myalgic encephalomyelitis"*, regardless of other items. Among individuals declaring at least one DD over their life course, 12.7% declare at least one of the two items (1,740 individuals).

To capture physical disability, we first rely on another indicator available in SHARELIFE.

It is based on the following question *"[When you were 16 up until now] Have you ever received a physical injury that has led to any permanent handicap, disability or limitations in what you can do in daily life?"*. In our sample, 8,747 individuals experience a physical injury, representing 11.2% of our final sample.[6]

Table 4: Main results on the probability of declaring mental DD conditioning on at least 5 years of employment over the life course

Mental DD		25 years	25 years	30 years	30 years	35 years	35 years	40 years	40 years	45 years	45 years	50 years	50 years
Spell 15-24 years VS no spell	OR	1.66	2.09	2.46**	2.42**	1.78	1.77	2.44***	2.26***	2.47***	2.48***	2.00***	2.16***
	s.e	(0.96)	(1.19)	(0.95)	(0.96)	(0.68)	(0.69)	(0.64)	(0.61)	(0.56)	(0.58)	(0.44)	(0.48)
	Obs	75,469	63,459	75,467	71,970	75,458	74,343	75,407	75,407	75,253	75,253	74,551	74,551
Spell 25-34 years VS no spell	OR					0.92	0.92	1.17	1.12	1.33	1.32	1.33	1.35
	s.e					(0.66)	(0.66)	(0.59)	(0.57)	(0.55)	(0.55)	(0.48)	(0.49)
	Obs					74,825	73,711	74,776	74,776	74,624	74,624	73,923	73,923
Spell 35-44 years VS no spell	OR									1.03	1.01	1.99**	1.99**
	s.e									(0.47)	(0.46)	(0.57)	(0.57)
	Obs									74,693	74,693	74,002	74,002
Spell 15-44 years VS no spell	OR									1.72***	1.71***	1.88***	1.97***
	s.e									(0.31)	(0.31)	(0.28)	(0.30)
	Obs									77,093	77,093	76,340	76,340
Spell 15-24 years VS 25-44 years	OR									2.06**	1.93*	0.96	1.12
	s.e									(0.75)	(0.72)	(0.29)	(0.32)
	Obs									2,966	1,752	2,902	2,117
Spell 15-24 years VS 25-34 years	OR									1.57	1.55	1.27	1.34
	s.e									(0.72)	(0.74)	(0.54)	(0.57)
	Obs									2,039	1,143	1,992	1,291
Spell 15-24 years VS 35-44 years	OR									1.98	1.45	0.84	0.86
	s.e									(0.96)	(0.69)	(0.30)	(0.28)
	Obs									2,108	1,067	2,071	1,356
Spell 15-34 years VS 35-44 years	OR									1.90	1.85	0.82	0.89
	s.e									(0.92)	(0.97)	(0.27)	(0.30)
	Obs									3,021	1,981	2,950	2,143
Spell 25-34 years VS 35-44 years	OR									1.30	1.46	0.68	0.77
	s.e									(0.79)	(0.97)	(0.31)	(0.35)
	Obs									1,479	584	1,443	876
15-24 years spell (ref) VS 25-34 VS 35-44	OR									0.61	0.64	0.78	0.69
	s.e									(0.28)	(0.30)	(0.33)	(0.29)
	OR									0.48	0.51	1.16	1.03
	s.e									(0.23)	(0.27)	(0.42)	(0.36)
	Obs									2,813	1,650	2,753	2,003
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Experiencing an unemployment spell lasting at most 10 years between the ages of 15 and 44 multiplies the probability of declaring mental DD at age 45 by 1.72 compared to individuals without unemployment during that period.
Source: SHARELIFE and JEP
Robust se in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Looking at mental DD, when controlling for employment throughout the career path, having an unemployment spell between 15 and 24 years multiplied by 2.46 (respectively, 2.44; 2.47; 2.00) the probability of declaring mental at age 30 (respectively at age 40; 45; 50). Concerning individuals with one spell between 15 and 44 years, we also observe a positive association with the report of mental DD but, magnitudes are lower. The probability of declaring mental DD is multiplied by 1.72 at age 45 and by 1.88 at age 50.

If we compare, at age 45 individuals with an unemployment spell between 15-24 years

[6] See Figure D.2.23 in Appendix D.2.

Table 5: Main results on the probability of physical injury conditioning on at least 5 years of employment over the life course

Physical injury		25 years	25 years	30 years	30 years	35 years	35 years	40 years	40 years	45 years	45 years	50 years	50 years
Spell 15-24 years VS no spell	OR	1.14	1.28	1.08	1.17	0.95	1.01	0.99	1.05	1.03	1.08	1.01	1.08
	s.e	(0.22)	(0.25)	(0.18)	(0.20)	(0.15)	(0.16)	(0.14)	(0.15)	(0.13)	(0.14)	(0.12)	(0.13)
	Obs	75,238	75,238	75,236	75,236	75,227	75,227	75,176	75,176	75,022	75,022	74,322	74,322
Spell 25-34 years VS no spell	OR					1.28	1.24	1.37*	1.33*	1.40**	1.35*	1.26	1.22
	s.e					(0.25)	(0.25)	(0.24)	(0.23)	(0.22)	(0.21)	(0.19)	(0.18)
	Obs					74,593	74,593	74,544	74,544	74,392	74,392	73,693	73,693
Spell 35-44 years VS no spell	OR									1.15	1.17	1.28*	1.30*
	s.e									(0.18)	(0.19)	(0.18)	(0.18)
	Obs									74,461	74,461	73,772	73,772
Spell 15-44 years VS no spell	OR									1.21**	1.22**	1.18**	1.21***
	s.e									(0.09)	(0.10)	(0.09)	(0.09)
	Obs									76,858	76,858	76,107	76,107
Spell 15-24 years VS 25-44 years	OR									0.77	0.85	0.79	0.87
	s.e									(0.13)	(0.16)	(0.12)	(0.15)
	Obs									2,961	2,835	2,897	2,823
Spell 15-24 years VS 25-34 years	OR									0.81	0.91	0.90	1.01
	s.e									(0.17)	(0.19)	(0.18)	(0.21)
	Obs									2,036	1,962	1,989	1,947
Spell 15-24 years VS 35-44 years	OR									0.95	1.08	0.87	1.00
	s.e									(0.20)	(0.27)	(0.17)	(0.22)
	Obs									2,105	1,935	2,068	2,005
Spell 15-34 years VS 35-44 years	OR									1.01	1.11	0.88	0.94
	s.e									(0.19)	(0.23)	(0.15)	(0.17)
	Obs									3,016	2,888	2,945	2,872
Spell 25-34 years VS 35-44 years	OR									1.22	1.19	1.00	0.94
	s.e									(0.27)	(0.28)	(0.20)	(0.20)
	Obs									1,475	1,268	1,439	1,295
15-24 years spell (ref) VS 25-34 VS 35-44	OR									1.30	1.17	1.16	1.02
	s.e									(0.27)	(0.25)	(0.23)	(0.21)
	OR									1.07	0.94	1.17	1.04
	s.e									(0.23)	(0.22)	(0.22)	(0.22)
	Obs									2,808	2,689	2,748	2,679
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Experiencing an unemployment spell lasting at most 10 years between the ages of 15 and 44 multiplies the probability of declaring physical injury at age 45 by 1.21 compared to individuals without unemployment during that period.
Source: SHARELIFE and JEP
Robust se in parentheses
*** p<0.01, ** p<0.05, * p<0.1

and those who experience unemployment between 25 and 44 years, we observe that youth unemployment multiplies by 2.06 the probability of declaring DD compared to unemployment between 25 and 34 years.[7]

As concerns the probability of declaring physical injury that has led to any permanent disability, results are more mitigated (see Table 5). The only association which is find is the following one: having an unemployment spell, lasting at most 10 years, between 15 and 44 years old seems to multiply the probability of declaring physical injury by 1.21 at age 45 and by 1.18 at age 50.

In Appendix D.3, we relax the assumption of five years of continuous employment across the entire career path. We find that controlling for employment prevents overestimation of the results.

[7]See all details in Table 4.

In the meantime, in order to convince the reader regarding our indicator of mental disabling disease, we exclude the item "fatigue" which can be associated with physical disabling disease.[8] Consequently, we restrict our analysis to those who only have the "Emotional, nervous, or psychiatric problem". While, the effect at age 30 disappears, we observe higher magnitudes regarding the positive association between experiencing an unemployment spell between 15 and 24 years and declaring emotional DD. Magnitudes of the effects on emotional DD regarding those with an unemployment spell between 15 and 44 years are also higher than the ones find with mental DD.[9]

5.3 Heterogeneity analyses

Regarding our first analyses and considering technical issues, we perform robustness without controlling for country dummies.

What about the time period of the spell?

We are dealing with a huge panel database containing an important time period. Regarding time period, two main results in the literature must be mentioned. First, as mentioned earlier (see Section 1), Blasco and Brodaty [2016] show that a context of high unemployment can mitigate the adverse effects of unemployment on health. The idea is the following: the higher the unemployment rate is in the country, the less unemployed individuals feel different and "excluded", and the lower the negative impact on mental health is.

Consequently, we decide to perform analyses among time period. Looking at our sample, we observe that 96% of our individuals are between 15 years (first age for unemployment spell) and 50 years (last observation age for DD) between 1950 and 2008. We select this time period because it excludes the specific situation of Second World War II and we do not have sufficient individuals after 2008 to isolate the effects of the Europe's debt crisis.

[8] In the item "fatigue", they mention "e.g. with multiple sclerosis or myalgic encephalomyelitis"
[9] See Table D.4.19 in Appendix D.4

Inside this time frame, two major events occurred in Europe: the 1973 Oil Crisis and the European Monetary System crisis, which started at the end of 1992/93. Thus, we compute our estimations by exploring these three periods of time on individuals having a less than 10 years spell of unemployment between 15 and 44 years.[10]

Regarding mental DD at age 45, we observe a positive correlation between unemployment spell between 1950 and 1973 and the probability to declare mental DD. Nonetheless, when focusing only on individuals with unemployment spell, this unemployment time period seems not to increase the probability of declaring mental DD. The idea is shown at age 50 for the period 1974-1993.

As concerns physical injury, we observe that individuals with unemployment spell between 1974 and 1993 (respectively 1994 and 2008) are more likely to have physical injury than those who experience disability between 1950 and 1973. Magnitudes of the odd ratios are about 1.70 at age 45 and 1.85 at age 50 for the time period 1974-1993. The odd ratios on the last time period (1994-2008) are about 1.63 and 1.85.

Gender heterogeneity

Gender differences and norms are highly determining when studying career paths. Moreover, previous literature has highlighted differences according to gender in terms of unemployment's impact on health [Artazcoz et al., 2004; Backhans and Hemmingsson, 2012; Blakely et al., 2003; Schröder, 2013].

Consequently, we perform analyses by separating men and women.

When examining women, the only significant association we find is a positive correlation between experiencing an unemployment spell between the ages of 15 and 44 and the probability of reporting mental DD at age 50.[11] No other significant results are observed

[10] See results in Table D.5.20 in Appendix D.5.1.

[11] When considering mental DD among women, sample sizes are very small and some observations are dropped to lack of variation in the control variables.

for this indicator or for the likelihood of reporting physical injury.[12]

As for men, several findings emerge. Firstly, similar to the overall sample, we observe that experiencing an unemployment spell between the ages of 15 and 24 multiplies the likelihood of reporting mental DD by 2.49 at age 30. This effect increases from age 40 to 45 and further decreases at age 50. Moreover, the impact of this early unemployment spell on mental DD at age 45 is more pronounced compared to unemployment spells occurring between the ages of 25 and 34. Additionally, experiencing one unemployment spell between the ages of 15 and 44 multiplies the probability of reporting mental DD by 1.74 at age 45 and by 1.91 at age 50 (see Table D.5.23). These results are consistent with those observed for the overall sample, albeit with higher magnitudes.

Of particular interest is the observation that, while no effect was found on the probability of reporting physical injury overall, among men, experiencing an unemployment spell between the ages of 25 and 34 multiplies the probability of reporting physical injury by 1.55 at age 45. Although positive correlations are observed at ages 35, 40, and 55, the effects are significant only at the 10% level. Moreover, experiencing an unemployment spell between the ages of 15 and 44 is also associated with a higher probability of reporting physical injury among men (see Table D.5.24).

5.4 Sensitivity analyses

Balanced sample

In this work, sample sizes are varying a lot depending on the considering fixed age and the independent variable of interest.

To address this issue, we opted to conduct sensitivity analyses on a balanced sample. This entails selecting individuals from the database aged between 15 and 50, covering the period from the first age of unemployment observation to the last age of DD observation.

[12] See details in Tables D.5.21 and D.5.22 in Appendix D.5.2.

Overall, the results remain largely consistent with our main findings. However, we did notice a few differences. At age 30, individuals who experienced an unemployment spell between 15 and 24 years no longer reported mental DD. Additionally, the magnitudes of the other significant effects were slightly smaller (see Tables D.6.25, D.6.26, D.6.27 in Appendix D.6.1).

It is important to note that imposing a balanced panel can introduce potential selection bias because we only retain individuals who are in sufficiently good health to be included in the database. However, since SHARE primarily targets individuals aged 50 and above, we were supposed to observe all individuals from age 15 to 50. The only individuals who can be investigated before age 50 are the partners. Balancing the panel entails excluding younger partners. Since the differences in magnitude between our sample and the balanced sample are not significant, it suggests that young partners do not necessarily have a higher probability of being in poor health. Therefore, we conclude that there is no significant issue of selection bias when considering the cylindrical panel exclusively.

Threshold regarding number of working years

We conducted a final sensitivity analysis by adjusting the minimum number of years individuals must have worked over their entire career path. Previously, individuals were included in the sample if they had been employed for at least 5 years during their life course. Here, we raised the threshold to 10 years.

The findings still indicate that experiencing an unemployment spell between the ages of 15 and 44 is associated with a higher probability of reporting mental DD at ages 45 and 50. Similarly, the same association holds for individuals with unemployment spells between the ages of 15 and 24. However, while we observed significant effects at age 30 when considering only five years of employment over the entire career, here, the effect is not significant at age 30 (see Table D.6.28).

Similar interpretations can be made when considering physical injury (see Table D.6.29).

We do not observe any major changes.

6 Discussion and work remaining to be done

This chapter proposes a first analysis of the impact of unemployment on the probability of declaring DD. Considering our basic methodology, we only highlight associations between the two variables at this stage.

Using a sample of European individuals and logit models, we find that experiencing unemployment spells between ages 15 and 44 is associated with a higher probability of declaring disability disease at age 50. When looking at an indicator of mental DD, we observe that youth unemployment (between 15 and 24) is more detrimental than later unemployment spells. Looking at mental DD, we observe a strong negative correlation between youth unemployment and the probability of declaring DD from age 30 to 50. We also show that those effects are driven essentially by men since no effect are found on women. We do not find a clear impact of recessions on the association between unemployment and declaring mental at ages 45 and 50.

This work is in progress, and we still have to work on it. First, future design must solve endogenous issues regarding the link between unemployment and health. When studying this relationship, reverse causality is one of the most challenging endogeneity sources. Looking at ages following the unemployment spell and controlling for self-assessed health before age 15 was the first approach to limit this problem. We are perfectly aware that more is needed. As we have already mentioned, one of the ways the literature approaches this question is to consider the exogenous reasons for the period of unemployment. SHARELIFE offers the possibility of knowing the reason for each unemployment spell. We are currently investigating these variables. More vigorous investigations should determine if a robust methodology can be implemented for this kind of unemployment spell. Regarding the overall method, we want to find a robust and appropriate one. Con-

sidering the longitudinal dimension of our database, we should consider how to implement a panel model. This could help us consider endogeneity and the dynamic evolution of unemployment effects. Especially if we consider unemployment spells as a treatment variable, the new literature on heterogeneity robust DiD estimator, we can imagine an estimator considering that the treatment can switch in and out and have different intensities (especially with different duration for each spell). The one proposed by De Chaisemartin and d'Haultfoeuille [2022a] offers those possibilities.

Third, we should perform heterogeneity tests according to the type of unemployment spell and individual characteristics. Indeed, as mentioned earlier, long-term unemployment spells have higher adverse effects than short-term ones [Picchio and Ubaldi, 2022]. In the meantime, in this preliminary version we restrict our sample to individuals experiencing at most one spell. Investigations on the impact of spells number should be performed. Nonetheless, those with more than one spell represents 1.4% of our initial sample, i.e. 17.8% of those experiencing at least one spell. Countries heterogeneity seems also important, especially regarding the generosity of social welfare systems, with a specific focus on unemployment benefits. A large literature has investigated the link between unemployment insurance (UI) and disability insurance (DI) benefits. Especially, authors estimate the level of substitution between the two [Koning and Van Vuuren, 2010; Koning and Lindeboom, 2015; Lindner, 2016; Maestas et al., 2021]. Results are quite diverse across countries: hidden unemployment in DI varies across studies from 3% to 50% depending on the period and the region (see specifically the Dutch disease in the Netherlands [Koning and Van Vuuren, 2007]) and hidden disability in UI is not always found depending on the period and the region.

Finally, considering our physical injury we are aware that this indicator is specific and strong. As mentioned earlier, for now, we decide to not consider disability insurance receipt thinking that it captures high levels of disabilities and it is mostly permanent. The same remark can be done with this first indicator of physical disability. Considering

that and our wish to compare a physical indicator with the mental DD one, it should be more appropriate to construct a measure of physical DD referencing to items in the list of DD (on which we based our mental indicator).

While the implementation of a proper methodology is necessary, preliminary policy recommendations can be drawn from the initial findings. The social costs associated with unemployment appear to be greater than initially perceived when considering its impact on health. Indeed, the preliminary results suggest that unemployment raises the likelihood of experiencing a disability situation in the long term. Building upon existing literature, unemployment benefits should incorporate considerations for health deterioration, as corroborated by these findings. Moreover, it becomes evident that such considerations should extend to long-term perspectives.

Additionally, the findings underscore the heightened adverse consequences of youth unemployment. This underscores the urgency of implementing preventive policies to shield young individuals from unemployment, particularly at such a formative stage of their lives. It is imperative to ensure that the transition from education to the workforce does not culminate in unemployment. Achieving this necessitates the development of tailored educational programs that align with individual skills and personal constraints.

Conclusion

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1 Main results and contributions

This thesis explores the relationships between labour market outcomes and disability in Europe. This work addresses both methodological and institutional challenges.

From a methodological standpoint, there are two key hurdles to overcome. Firstly, defining and measuring disability poses inherent difficulties due to its broad and multifaceted nature. Disability encompasses a wide range of conditions, making it challenging to develop a comprehensive definition. In this work, we address this challenge by employing various measures of disability, consistently considering four dimensions: its underlying health causes, its chronicity as a long-term process, its impact on daily activities, and its interaction with specific environments. This approach allows us to navigate the complexity of disability while maintaining a clear framework. Second, the relationship between disability and labour market outcomes is inherently complex and bidirectional. Disability may lead to adverse effects on labour market outcomes, but conversely, labour market conditions can also contribute to the development of disability situations. This bidirectional causality necessitates the use of robust methodologies to accurately capture and analyse the interactions between disability and labour market outcomes.

From an institutional perspective, disability represents one of the risks for which social welfare systems are designed to provide protection. These systems aim to mitigate financial losses resulting from life's uncertainty, such as unemployment or declining health status. Therefore, investigating the relationship between disability and labour market outcomes raises important questions about the role played by social welfare. This is particularly relevant in the context of Europe, where expenditures on social protection vary across countries (see Figure E.1.24 in Appendix E.1), and social welfare systems exhibit considerable diversity.

In a European perspective, this work sheds light on the adverse effects of disability at both the individual and couple levels. Specifically, it reveals a decline in personal income

following the onset of disability. Within households, the study demonstrates that a partner's disability leads to a reduction in labour supply. Simultaneously, the research brings attention to a positive correlation between unemployment and the likelihood of declaring disabling diseases in the long run.

Chapter 1 is grounded in the hypothesis that disability exerts two opposing effects on personal income. Firstly, disability tends to decrease an individual's productivity, leading to a decline in wages. Secondly, it introduces the individual into the compensation income system. Utilising a weighted difference-in-differences estimator, the results reveal a 16% decrease in personal income following the onset of disability, driven by a significant drop in wages that is not offset by compensation incomes. When considering gender differences, no significant differences are observed.

This chapter introduces a novel decomposition of personal income, a method that has been seldom utilised in previous studies and has never been applied simultaneously across multiple countries. This approach enables a robust empirical testing of the two theoretical hypotheses.

Chapter 2 posits that, after the onset of a partner's disability, an individual may either increase their labour supply to offset income losses or decrease it primarily to provide informal care to their partner. Drawing on retrospective data and employing a heterogeneity-robust difference-in-differences estimator, this chapter offers new insights to the literature by utilising a strong disability indicator and conducting numerous heterogeneity tests. Results highlight a decrease in the probability of working after the partner's disability onset, with this decline increasing over time: -1.9pp in the year following the partner's disability onset, rising to -4.8pp after five years. These results hold true for both women and men, with slightly higher magnitudes for men. For women, the effects range from -2pp one year after the shock to -4.2pp, and the drop reaches -5.8pp five years after the onset of the partner's disability. Examining heterogeneity according to age, individuals aged 41 to 55 when their partner's disability occurs drive these results, while no signifi-

cant effects are observed in younger individuals (20 to 40 years old). Controlling for the job situation of the partner with disabilities reveals that when the partner stops working one or two years after the disability onset, the decline is about -2.3pp one year after the shock, increasing to -5.8pp after five years. Results are not significant when the partner continues to work, likely due to the low number of cases.

Chapter 2 possesses several notable strengths. It makes a distinctive contribution to the literature by examining the effects of disability in a novel manner, focusing on its impact on partners' labour supply. The utilisation of a comprehensive database provides access to detailed information on both individuals within a couple, while the inclusion of retrospective data enables the tracking of disability occurrences across various life stages. Heterogeneity tests further enhance the analysis by allowing for the dissection of the overall effect according to diverse characteristics such as gender, age, job situation of individuals with disabilities, and country of residence. The extensive time period covered in the study also facilitates insights into the impact of political changes regarding disability insurance schemes spanning from 1976 to 2011.

Since this work explores the relationships between disability and labour market in Europe, an additional contribution of this thesis lies in providing insights into variations across European countries. In Chapters 1 and 2, analyses are conducted based on the generosity of social welfare systems. Chapter 1 elucidates that nations allocating a higher proportion of their GDP to disability benefits compared to the EU-28 mean empower citizens with disabilities to maintain a larger share of their incomes. We posit that these countries are also the ones actively promoting the integration of individuals with disabilities into the labour market. Chapter 2 underscores that these same countries, with robust integration measures and easy access to benefits, mitigate the negative impact of disability on the partner's labour supply.

Finally, Chapter 3 investigates whether unemployment, through wage loss and increased stress levels, can lead to disability situations. While adverse effects of unemployment on

health has been already shown, investigating disability is the next level. Using logit models, this chapter provides preliminary insights into the association between unemployment spells and disabling diseases. Interpretations must be approached with caution, but it is observed that experiencing unemployment spells between 15 and 44 years is associated with an increased probability of declaring disabling diseases at ages 45 and 50. For mental disabling diseases, this relationship is observed from age 30 for those who face unemployment between 15 and 24 years. Upon examining gender heterogeneity, we find that the effects of youth unemployment spells on the likelihood of reporting mental disabling diseases are predominantly driven by men. Additionally, significant results emerge when comparing unemployment spells between the ages of 15 and 24 years to those between 25 and 34 years. Furthermore, men exhibit a positive association between unemployment experienced between the ages of 25 and 34 years and the likelihood of reporting physical injury. While further improvements are necessary, this final chapter offers novel insights to the existing literature. Specifically, it provides analyses based on the time period of experiencing unemployment spells, suggesting a higher probability of declaring physical disability following unemployment after the "30 Glorious Years". Moreover, it underscores numerous challenges in terms of shaping effective public policies, as discussed in the subsequent section.

2 Policy recommendations

Firstly, regarding Chapter 1, we observe that promoting policies to integrate individuals with disabilities into the labour market can alleviate the adverse effects of disability. However, we believe that the integration of individuals with disabilities does not necessarily require the implementation of quotas but can be addressed through workplace adjustments, as seen in Sweden, or subsidies for firms hiring individuals with disabilities, as seen in Denmark.

Secondly, with the findings from Chapter 2, we can posit two scenarios: individuals with

a partner with disabilities either become caregivers or seek to spend more time with their loved ones, ultimately requiring more free time. Our paper reveals that this increased free time often translates to exiting the labour market. In addition to the findings in the first Chapter, household income appears to be significantly reduced. With greater labour market flexibility, the healthy partner could potentially remain in the workforce and adjust their job status and working hours.[13] Furthermore, the heterogeneity among countries once again underscores the significance of integration measures for individuals with disabilities (the more integration measures a country provides, the less impact we observe on the labour supply of partners).

Thirdly, while the Chapter 3 requires further consolidation, we observe that unemployment can incur a higher societal cost than currently acknowledged. If unemployment elevates the probability of acquiring a disability, it challenges the calculation of compensation incomes related to unemployment and, particularly, the cost-effectiveness of back-to-work measures. If unemployment leads to disability, compensation incomes may need to be higher. This unveils a trade-off between encouraging a return to work and ensuring fair compensation. This chapter offers implications that extend beyond those regarding the effects of unemployment on health outcomes. It appears that disability often arises long after the end of an unemployment spell, indicating that the consequences manifest in the long term. Additionally, initial findings on youth unemployment underscore the importance of preventing young individuals from experiencing spells of unemployment, particularly after completing their education. To achieve this goal, it is essential to develop tailored educational programs that are aligned with individual skills and preferences. Lastly, in a broader sense, preventing unemployment spells may involve mitigating accidents and professional risks, which can be accomplished through various policies implemented within organisations.

[13] This hypothesis still needs validation, as this chapter is only concerned with the extensive margin.

3 Limitations and research perspectives

In this dissertation, we rely on the European Survey of Health, Ageing and Retirement. Moreover, Chapters 2 and 3 rely on retrospective information, meaning that each individual has to remember events in their lives from birth to their interview (mainly at a minimum age of 50). Declarative data may be subject to different biases as mentioned in general introduction of this work. First, feelings of the respondent at the moment of the interview can play a role. Understanding the question, questions that reflect happy or sad moments in life are so many reasons which can affect the answers from one day to the next. Second, justifications biases could emerge and generate measurement errors [Gannon, 2009; Lindeboom and Kerkhofs, 2009]. Third, especially regarding Chapters 2 and 3, memory biases could also create measurement errors. Finally, regarding our main variables of interest, Chapters 1 and 3 use subjective disability situation measures. Nonetheless, Bound [1991] shows that subjective and objective both can lead to biases. As concerns, job situation or incomes, they are also based on self-declaration measures.

More specifically, each chapter of this thesis highlights certain drawbacks and introduces research perspectives. In Chapter 1, the treated group is relatively small, potentially resulting in a lack of statistical power. To address this, future research could explore introducing some heterogeneity in treatment timing by utilising unbalanced panels with additional waves of SHARE data. This approach may provide valuable insights and enhance the robustness of the analysis, especially thanks to the recent advancements in Difference-in-Differences (DiD) methods.

As for Chapter 2, the current analysis provides only a overall effect. First of all, we were not able to investigate intensive margins of labour supply which could be relevant. Second, a more comprehensive exploration of the theoretical mechanisms mentioned would be a worthwhile objective. Utilising the new module called Time Expenditure in SHARE, we aim to offer insights into these theoretical mechanisms through descriptive statistics.

However, for more in-depth econometric analyses, a country-specific database (such as the Time Use Survey in France) would be essential. In connection with this, modifying theoretical joint labour supply models to observe the dynamics when disability arises within a couple could provide valuable insights. It's important to note that our results are specific to couples who remain together following the onset of disability due to the survey design. An analysis of the impact of disability on divorce or break-up could complement this chapter. Continuing the focus of Chapter 2, evaluating the recent individualisation of disability benefits in Belgium and France would be insightful.

Finally, regarding Chapter 3, there is a need for a more suitable methodology, particularly one that considers the longitudinal dimension and addresses endogeneity issues. At present, logit models do not fully capture all the dynamics between unemployment and disability. Additionally, imposing fixed ages to measure the probability of reporting disabling diseases overlooks the fact that unemployment spells may have ended several years prior. Moreover, other significant shocks, such as relationship breakups or the death of a relative, may occur in the interim period. Therefore, a more nuanced approach is required to capture these complexities accurately.

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Appendices

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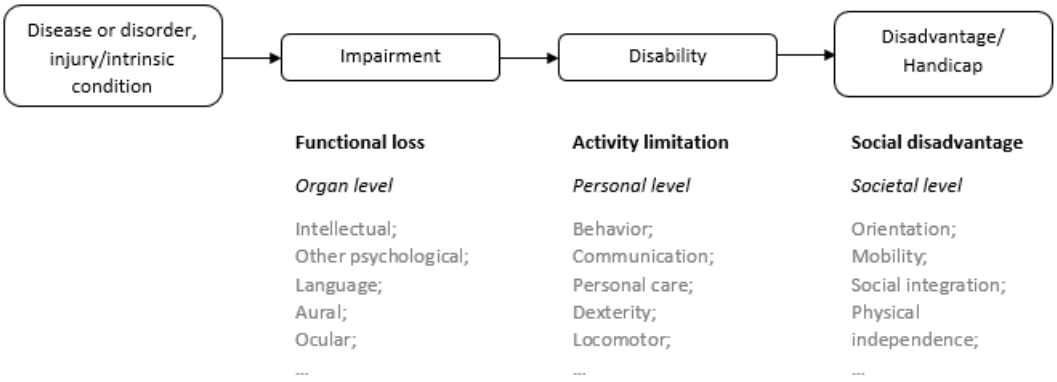
A. Appendices - Introduction

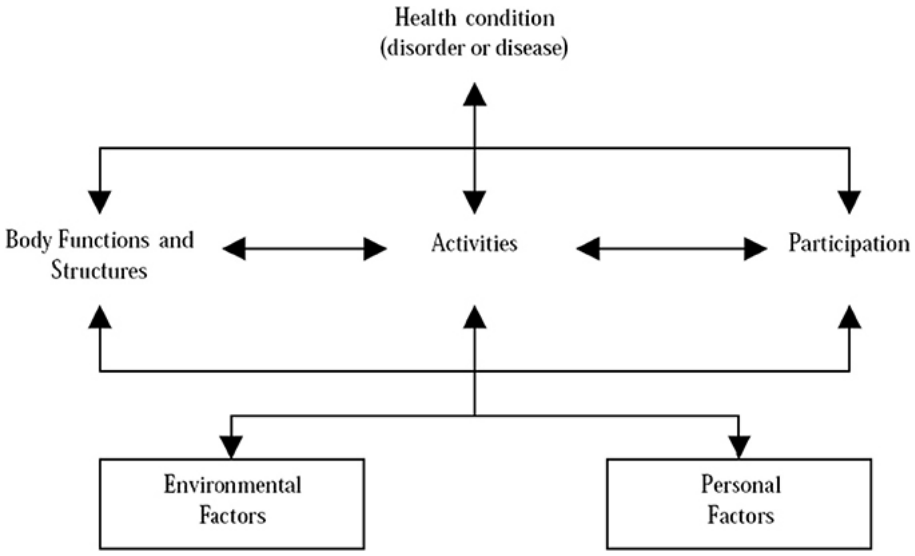
A.1 International classifications graphics

Figure A.1.1: ICIDH graphic



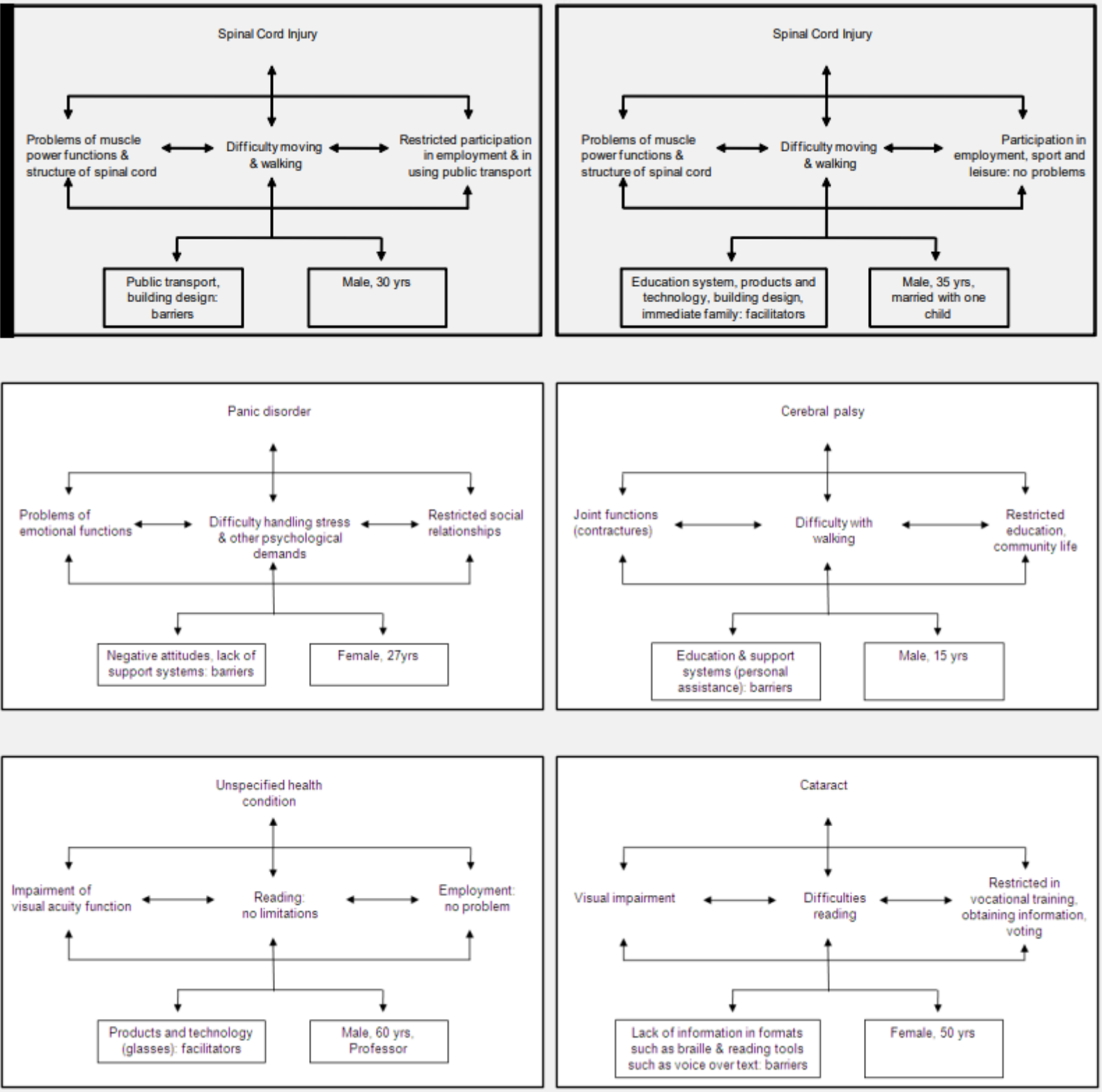
Source: Simeonsson et al. [2000]; Rimmerman [2013]

Figure A.1.2: ICF graphic



Source: WHO [2001]

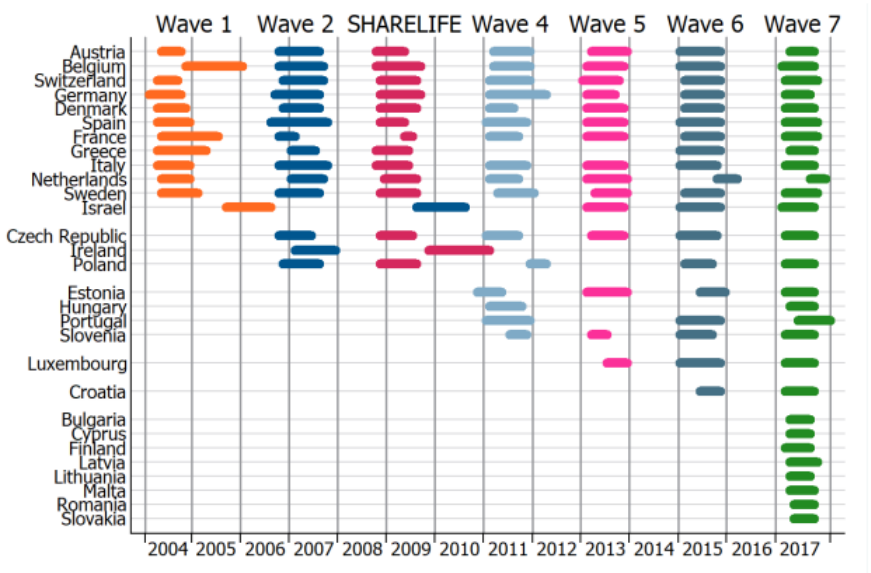
Figure A.1.3: Applications of the ICF to practical cases



Source: Üstün [2006]

A.2 Evolution of countries participation in SHARE

Figure A.2.4: Countries participation among waves - SHARE

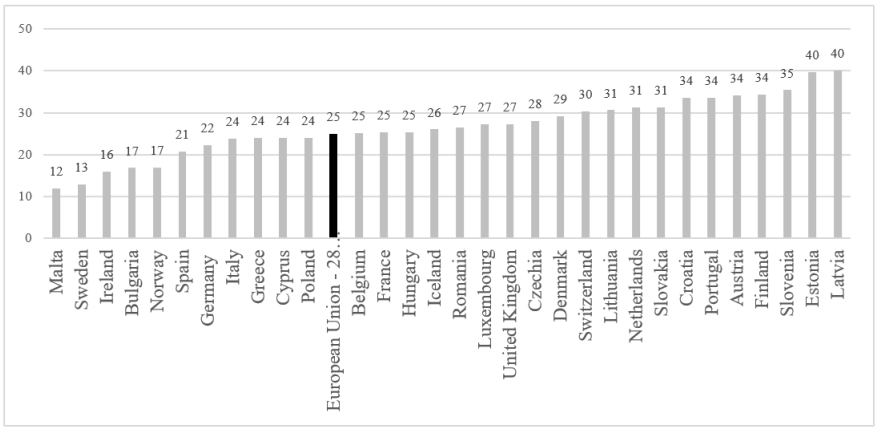


Source: Bergmann et al. [2019]

B. Appendices - Chapter 1

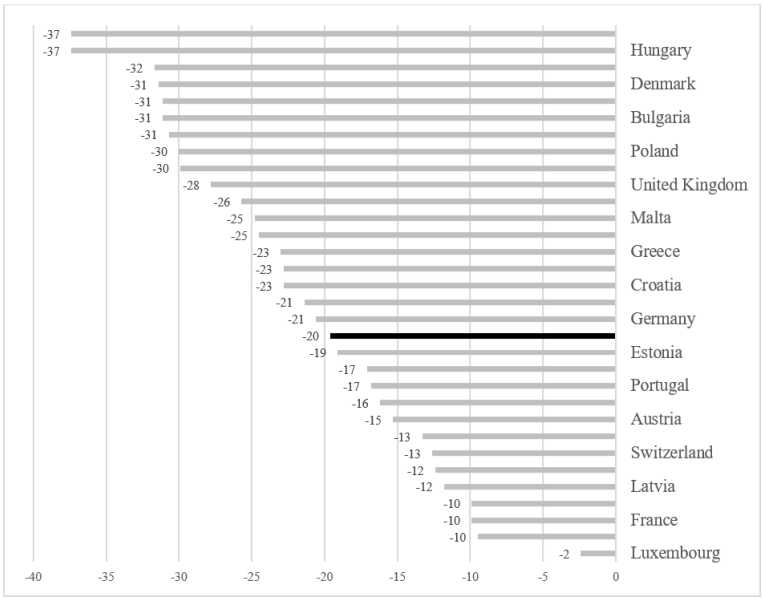
B.1 Disability in Europe

Figure B.1.5: Percentage of the population over 16 years reporting long-standing limitations in 2018



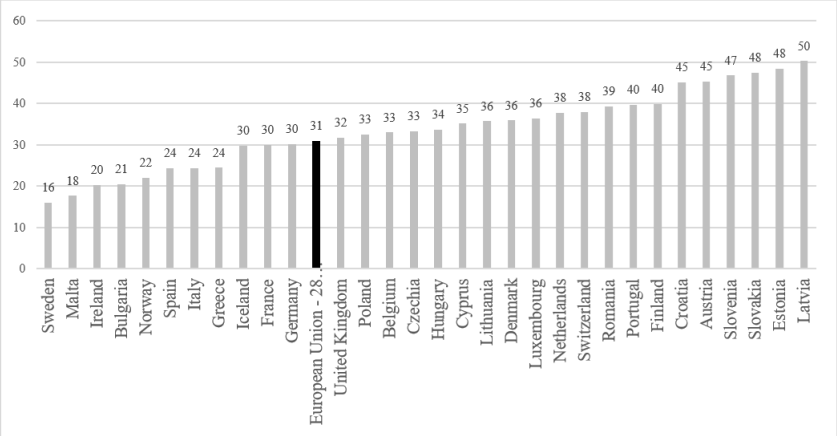
Source: 2018 Eurostat/EU-SILC data, graphic by authors

Figure B.1.6: EU differences in employment rates for people with disabilities and without disabilities aged 15-64 in 2011 (in percentage points)



Source: Eurostat News Release, 2014
Abbreviations: inc., income; compen., compensation

Figure B.1.7: Percentage of the population from 55 to 64 years reporting long-standing limitations in 2018



Source: 2018 Eurostat/EU-SILC data, graphic by authors

B.2 European Social Welfare Systems regarding disability

Table B.2.1: Institutional details on Welfare Systems in our sample - 1

	Austria	Belgium	Czech Republic	Denmark	Estonia	France
Mandatory social insurance or universal system	Mandatory insurance system	Mandatory system insurance. No assistance system in parallel	Mandatory insurance system.	Universal system + assistance system	Universal system. No assistance system in parallel	Mandatory insurance system. Assistance system in parallel
Min level of incapacity for work to be entitled to disability benefits	50% reduction in work capacity	66% reduction in earning capacity	35% reduction in work capacity	Between 18 and 39 years: the individual must never be able to work. After 40 years and before retirement age: the individual is unable to earn a living even with a flexi-job	No min level	66% reduction in work or earning capacity
Min/max level of disability pensions	Min: yes, depending on the marital status and	Min: yes, depending on the labour market	Min: no. Max: no	Min: yes, depending on the marital status	Yes (lump-sum benefit)	Min: yes (312€/month). Max: yes,
Quotas of individuals with disabilities in the firms	Yes, 1 for 25 employees. Subvention if a firm employs individuals with disabilities	No	Yes, 4% of the total number of employees in all the firms with at least 25 employees. Subvention if a firm employs individuals with disabilities	No but subvention if a firm employs individuals with disabilities	No but subvention if a firm employs individuals with disabilities	Yes, 6% of the total number of employees in all the firms with at least 20 employees.
Disability pensions become old age pensions	Yes	Yes	Yes	Yes	No	Yes
Accumulation with unemployment benefits	Yes	Yes	Only for the lowest levels of disability	Only if not related to the same need	No	Only for some disability levels
Accumulation with earnings from employment	Yes but disability benefits are reduced if the earnings are under a certain threshold	Yes but disability benefits are reduced if the working time exceeds 20%.	Yes with no limit	Yes but disability benefits are reduced	Yes but disability benefits are reduced if the earnings income exceeds 90 times the daily benefit rate	Yes but disability benefits are reduced by 50% if the new earnings exceeds the wages before invalidity

Source: MISSOC (Mutual Information System on Social Protection) Tables

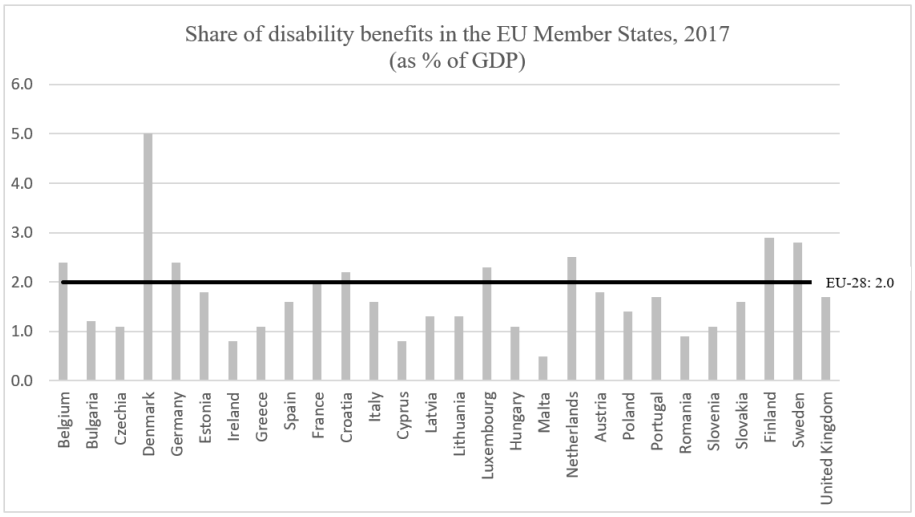
Table B.2.2: Institutional details on Welfare Systems in our sample - 2

	Germany	Italy	Slovenia	Spain	Sweden	Switzerland
Mandatory social insurance or universal system	Mandatory insurance system. No assistance system in parallel	Mandatory	National system. No assistance system in parallel	Mandatory insurance system. Assistance system in parallel	Mandatory public system.	Universal insurance (1st pilar) and mandatory insurance (2nd pilar)
Min level of incapacity for work to be entitled to disability benefits	Individual must not be able to work more than 6 hours a day (partial incapacity) or 3 hours a day (total incapacity)	66% reduction in work capacity	50% reduction in work capacity	33% reduction in work capacity	25% reduction in work capacity	40% reduction in work capacity
Min/max level of disability pensions	No	Min: yes but only for individuals entering the labour market before 1996 (around 7,300€/year). Max: no.	Min: yes. The level depends on which benefits you receive. Max: no	Min: yes depending on the disability level, the age and the marital status (lowest min: 572€/mois). Max: around 3,000€/month	Min: no. Max: no.	Min: yes, but only for the 1st pilar (1,245€/month). Max: yes, but only for the 1st pilar, depending on the marital status.
Quotas of individuals with disabilities in the firms	Yes, 5% of the total number of employees in all the firms with at least 20 employees.	Yes, 7% of the total number of employees in all the firms with at least 50 employees (1 or 2 individual with disabilities under 50 employees)	Yes, in all the firms with at least 20 employees. Quota depending on the sector of activity.	Yes, 2% of the total number of employees in all the firms with at least 50 employees. Subvention if a firm employs individuals with disabilities.	No. Working places adjusted.	No.
Disability pensions become old age pensions	Yes	Yes	Individuals can choose between the two	Yes	Yes	Yes
Accumulation with unemployment benefits	Yes	Yes	Yes	Only in case of total permanent incapacity for the current position	Yes	Yes
Accumulation with earnings from employment	Yes but disability benefits are reduced or removed if the earnings are above a certain threshold based on the work income before incapacity	Yes but disability benefits are reduced by 25 to 50% if the earnings are above 4 times the minimum wage	Yes but only part-time job leading to partial benefits	Yes	Yes. For the sickness/activity benefits, the recipients can freeze benefits (during max 2 years) if they go back to work	Yes but disability benefits are reduced if the earnings are under a certain threshold

Source: MISSOC (Mutual Information System on Social Protection) Tables

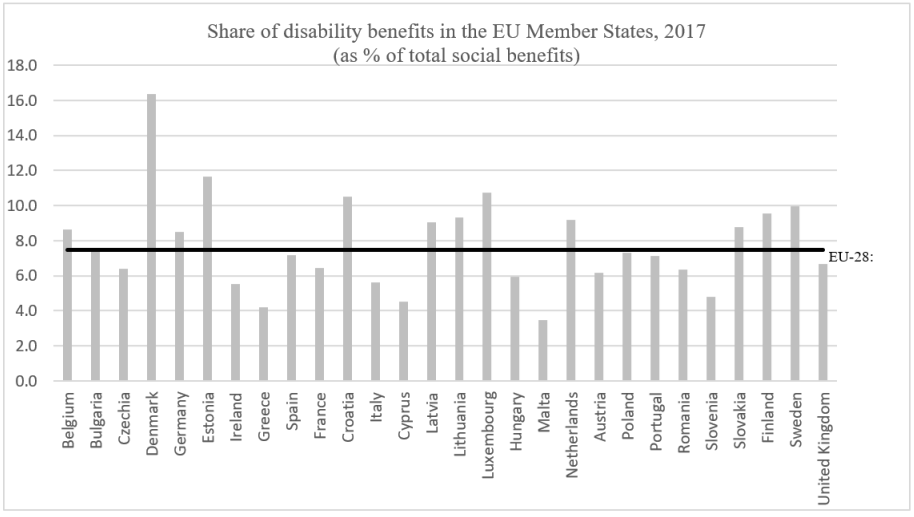
B.3 Share of disability benefits in EU Member States, 2017

Figure B.3.8: As percentage of GDP



Note: Hungary dedicated 1.1% of its GDP to disability benefits in 2017.
Source: 2017 Eurostat data, graphic by authors
Abbreviation: EU, European Union

Figure B.3.9: As percentage of total social benefits



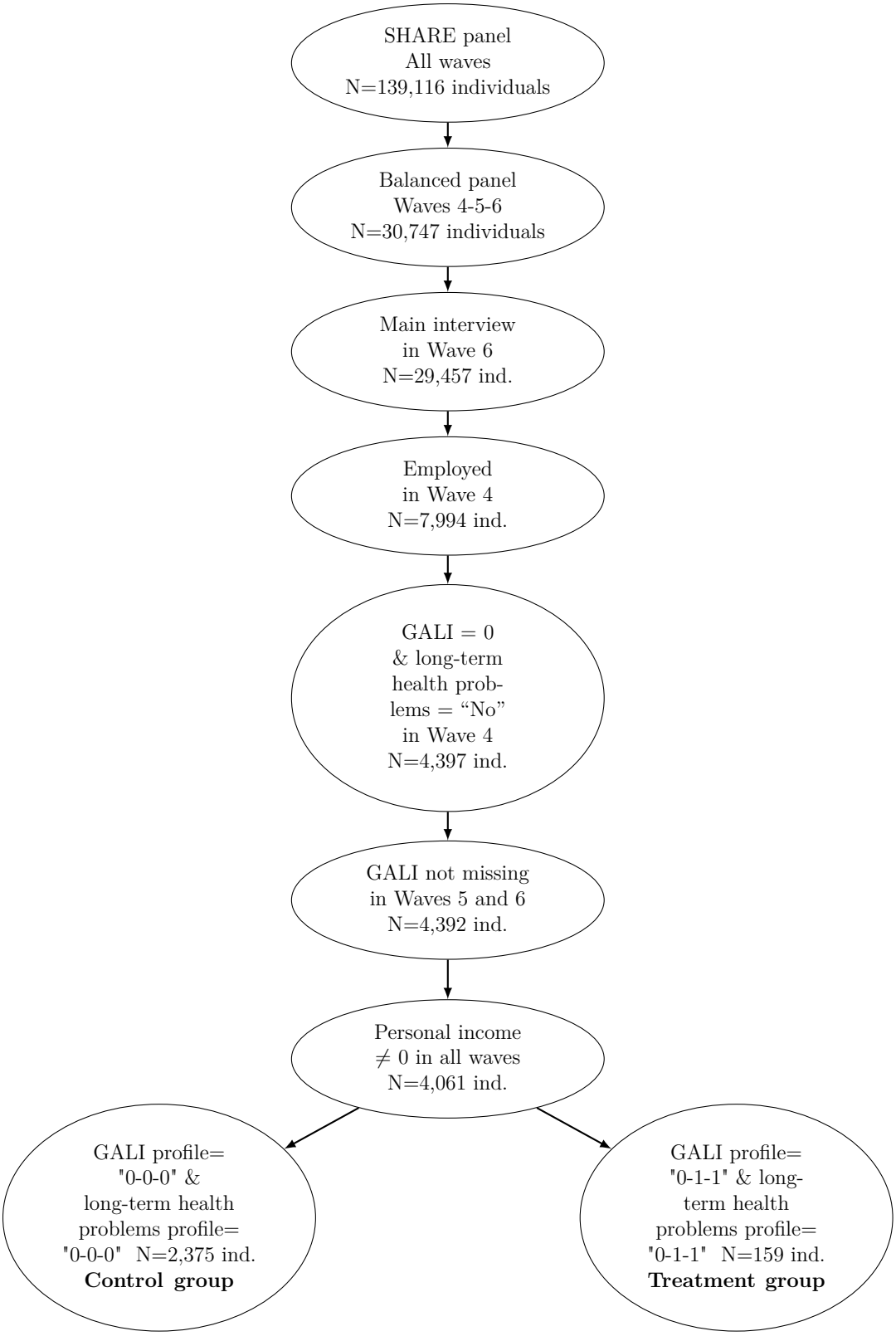
Note: Hungary dedicated 6% of its social benefits to disability benefits in 2017.
Source: 2017 Eurostat data, graphic by authors
Abbreviation: EU, European Union

B.4 Imputation of income variables

The SHARE database was compiled using two distinct methodologies to impute missing values, depending on the missing percentage contained in the variable. A hot deck method is applied for variables with a small fraction of missing values (less than 5%). For other variables, the implementers of SHARE use a fully conditional specification (FCS) method. Here, we are interested in monetary variables and will thus explain only the FCS method. This method uses an algorithm that imputes several values to the same variable to consider the variability generated by the imputation. Technically, the j-th variable is imputed at each step by means of the model's estimation. The predictors used are the most updated imputed values of the other variables. See the SHARE release guide [SHARE, 2019].

B.5 Sample selection

Figure B.5.10: Sample selection



B.6 Descriptive statistics

Table B.6.3: GALI and long-term health problems distributions in 2013 before selection

		Long term health problems		
		Yes	**No**	**Total**
GALI	**Severely limited**	454	48	502
		90.44	9.56	100
		14.97	0.98	6.28
	Limited, but not severely	1,385	406	1,791
		77.33	22.67	100
		45.66	8.19	22.42
	Not limited	1,194	4,502	5,696
		20.96	79.04	100
		39.37	90.84	71.3
Total		3,033	4,956	7,989
		37.96	62.04	100
		100	100	100

Population: Employed individuals in 2011
Source: SHARE; Waves 2011, 2013, 2015

Table B.6.4: Distribution of individuals with and without disabilities in the sample

	Frequency	**Percent**
Individuals with disabilities	159	6.75
Individuals without disabilities	2,375	93.54
Total	2,534	100

Population: Employed individuals and without disability in 2011
Source: SHARE; Waves 2011, 2013, 2015

Table B.6.5: Incomes across waves

Group	Statistics	Personal income	Wages	Compensation in general	
				Retirement pensions	Disability / sickness benefits
Individuals with disabilities	N	159	159	159	
	Mean in	18,174	17,544	629	
				524	20
	Mean in 2013	17,302	14,518	2,783	
				1,191	632
	Mean in 2015	16,508	11,349	5,158	
				2,664	969
Individuals without disabilities	N	2,375	2,375	2,375	
	Mean in 2011	26,538	25,413	1,125	
				723	19
	Mean in 2013	27,318	24,066	3,253	
				1,890	87
	Mean in 2015	28,720	23,340	5,380	
				3,888	48

Note: Statistics are the annual mean in €. On average, the individuals with disabilities had a personal income of 18,174€ in 2011
Population: Employed individuals without disability in 2011
Source: SHARE; Waves 2011, 2013, 2015

Table B.6.6: Job situation after the disability shock - 2015

Group	Job situation	Freq.	Percent
Individuals without disabilities	N miss	4	0.17
	Employed or self-employed	1,676	70.57
	Retired	601	25.31
	Unemployed	56	2.36
	Other	38	1.6
Individuals with disabilities	N miss	0	0
	Employed or self-employed	89	55.97
	Retired	48	30.19
	Unemployed	9	5.66
	Other	13	8.18

Note: In our sample, 55.97% of individuals with disabilities stayed employed or self-employed after their disability shock.
Population: Employed individuals without disability in 2011
Source: SHARE; Waves 2011, 2013, 2015
Abbreviation: Freq., Frequencies

B.7 Naive results

Table B.7.7: DiD without matching

		Log personal income	Log wages	Log compen. incomes
After	Coefficient	0.15***	0.09***	0.57***
	SE (robust)	0.02	0.03	0.07
Treated*After	Coefficient	-0.20**	-1.13***	0.69*
	SE (robust)	0.09	0.28	0.20
Job situation in 2015 (ref: employed or self-employed)				
Retired	Coefficient	-0.15***	-5.31***	6.18***
	SE (robust)	0.13	0.19	0.19
Unemployed	Coefficient	-0.35***	-3.04***	3.76***
	SE (robust)	0.13	0.53	0.55
Other†	Coefficient	-0.19	-2.57***	2.56***
	SE (robust)	0.15	0.58	0.58
No. of clusters (individuals)		2,530	2,530	2,530

Note: On average, according to the fixed effect model, the personal income of the individuals without disabilities increased by 15% between 2011 and 2015, in our sample.
Population: Employed individuals without disability in 2011
Source: SHARE; Waves 2011, 2013, 2015
Abbreviation: compen., compensation
***p <0.01; **p <0.05; *p <0.1.
† This category gathers together individuals who can be permanently sick or disabled, homemakers, students, rentiers, and voluntary workers, among others

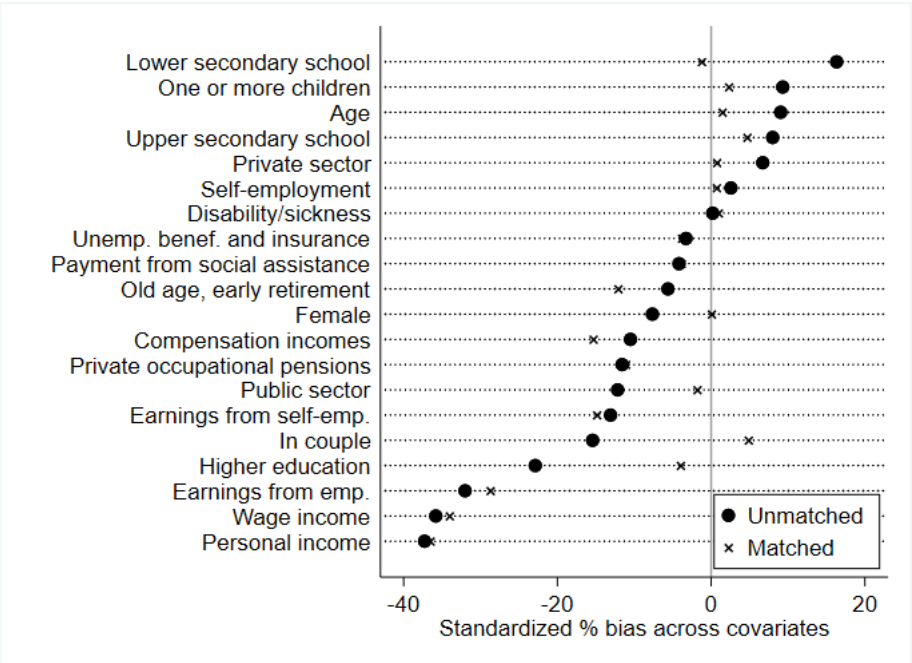
B.8 Matching results

Table B.8.8: Descriptive statistics before and after matching

Individual characteristics (measured at baseline)	Individuals with disabilities N = 159	Individuals without disabilities N = 2,375		t-test diff. in means	
	Mean	Before matching	After matching	Before matching	After matching
Incomes					
Annual personal income	18,174	26,538	26,372	-8,364***	-8,198***
Earnings from employment	14,727	20,859	20,229	-6,132***	-5,502***
Earnings from self-employment	2,817	4,555	4,790	-1,737	-1,973
Old age, early retirement, survivor and war pensions	524	723	952	-198	-428
Private occupational pensions	0	226	216	-226	-216
Disability/sickness pension and benefits	20	19	18	0.5	1.5
Unemployment benefits and insurance	85	152	163	-67	-78
Payment from social assistance	0	4	4	-4	-4
PSM Variables					
Age	56.66	56.19	56.59	0.48	0.07
Female	0.48	0.52	0.48	-0.04	0
Education Level					
Lower secondary school	0.24	0.17	0.24	0.07**	0
Upper secondary school	0.49	0.46	0.47	0.03	0.02
Higher education	0.26	0.37	0.28	-0.11***	-0.02
In couple	0.74	0.8	0.72	-0.06**	0.02
One or more children	0.93	0.91	0.92	0.03	0.01
Occupational Sector					
Private sector	0.74	0.71	0.73	0.03	0.01
Public sector	0.1	0.14	0.11	-0.04	-0.01
Self-employment	0.16	0.15	0.16	0.01	0.00

Note: "t-test diff. in means" corresponds to the p-value of the t-test between the individuals with disabilities and the ones without.
Significance at 1% (***), 5% (**), and 10% (*).
All numbers are given to the nearest hundredth (except for incomes).
Population: Employed individuals without disability in 2011
Source: SHARE; Waves 2011, 2013, 2015

Figure B.8.11: Graphical evidences of matching results



B.9 Robustness checks results

B.9.1 Gender heterogeneity

Table B.9.9: Weighted DiD for women vs. men

		Women			Men		
		Log personal income	**Log wages**	**Log compen. incomes**	**Log personal income**	**Log wages**	**Log compen. incomes**
After treatment	Coefficient	0.19***	0.33**	0.76***	0.14***	0.17	0.61***
	SE (robust)	0.05	0.13	0.17	0.04	0.15	0.18
Treatment*After treatment	Coefficient	-0.31*	-0.99**	0.27	-0.06	-0.86**	0.75*
	SE (robust)	0.16	0.35	0.42	0.1	0.37	0.43
Job situation in 2015 (ref: employed or self-employed)							
Retired	Coefficient	-0.10	-5.63***	5.33***	-0.21*	-5.89***	6.28***
	SE (robust)	0.17	0.48	0.52	0.11	0.49	0.47
Unemployed	Coefficient	-0.65*	-2.91**	2.28*	-0.59***	-5.04***	4.41***
	SE (robust)	0.35	1.33	1.27	0.22	1.71	1.57
Other†	Coefficient	-0.47	-4.14**	3.27**	-0.29	-5.50***	6.73***
	SE (robust)	0.52	1.67	1.49	0.26	1.46	0.61
No. of clusters (i.e., individuals)		1,314	1,314	1,314	1,212	1,211	1,211

Note: On average, the personal income of the woman without disabilities increased by 21% between 2011 and 2015.
Population: Employed individuals without disabilities in 2011
Source: SHARE; Waves 2011, 2013, 2015
Abbreviation: compen., compensation
***p <0.01; **p <0.05; *p <0.1.
† This category gathers together individuals who can be permanently sick or disabled, homemakers, students, rentiers, and voluntary workers, among others.

B.9.2 Heterogeneity of Social Welfare Systems

Table B.9.10: Weighted DiD for more vs. less generous countries

		More generous countries			Less generous countries		
		Log personal income	**Log wages**	**Log compen. incomes**	**Log personal income**	**Log wages**	**Log compen. incomes**
After treatment	Coefficient	0.11**	0.2	0.51***	0.24***	0.25*	0.79***
	SE (robust)	0.05	0.17	0.19	0.06	0.14	0.18
Treatment*After treatment	Coefficient	-0.19	-0.95*	0.55	-0.26**	-0.85***	0.5
	SE (robust)	0.18	0.48	0.53	0.12	0.3	0.37
Job situation in 2015 (ref: employed or self-employed)							
Retired	Coefficient	-0.15	-5.57***	6.80***	-0.08	-5.92***	5.33***
	SE (robust)	0.15	0.65	0.59	0.14	0.38	0.42
Unemployed	Coefficient	-0.16	-0.48	0.64	-0.82***	-4.80***	3.64***
	SE (robust)	0.16	0.64	1.02	0.27	1.24	1.19
Other†	Coefficient	0.01	-4.65**	5.33***	-0.70*	-4.99***	4.78***
	SE (robust)	0.43	1.89	1.55	0.37	1.24	1.08
No. of clusters (i.e., individuals)		1,415	1,415	1,415	1,110	1,110	1,110

Note: On average, the personal income of the individuals without disabilities increased by 12% between 2011 and 2015 in the more generous countries.
Population: Employed individuals without disabilities in 2011
Source: SHARE; Waves 2011, 2013, 2015
Abbreviation: compen., compensation
***p <0.01; **p <0.05; *p <0.1.
† This category gathers together individuals who can be permanently sick or disabled, homemakers, students, rentiers, and voluntary workers, among others.

C. Appendices - Chapter 2

C.1 Theoretical mechanisms

Table C.1.11: Overview of the theoretical mechanisms through which a partner's disability can impact labour supply

↗ of LS		↘ **of LS**	↗ **or** ↘ **of LS**
Direct effect on the hhld consumption → Income effect Indirect effect on the hhld consumption → Substitution effect	= Added Worker Effect	Partner becomes an informal caregiver	Start of compensation incomes Change in the complemen--tarity of leisure times Change in relative producti--vities (labour and hhld tasks)

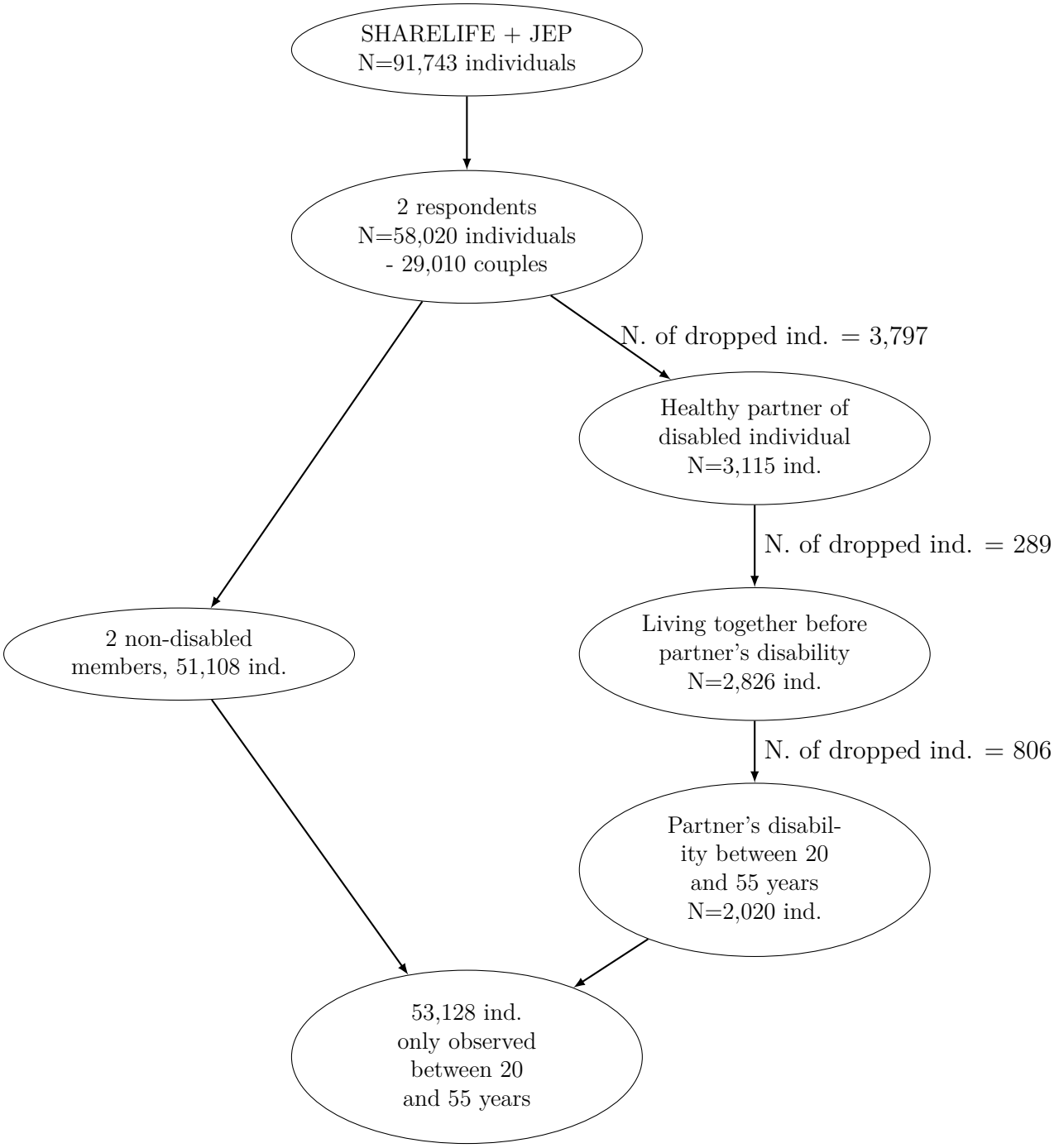
C.2 Summary of the literature

Table C.2.12: Overview of the literature on partner's disability and labour supply

	Data	Disability measure	Outcomes studied	Empirical strategy	Results
Berger (1983)	Current Population Survey (USA), 1978	Individuals who did not work in 1977 due to poor health	Probability of working; Annual hours of work	Heckman model	The probability of working **decreases** for men and women. No significant effect on hours of work when the selection bias is taken into account.
Braakman (2014)	German Socio Economic Panel, 1984-2006	1) Administrative recognition of a severe disability; 2) Disability degree between 0 and 100 (medical examination)	Pobability to be employed; Weekly working hours; Log of monthly gross labour income	Within estimator; Mundlak corrected RE model; LPM with FE; Mundlak corrected RE probit model; Chamberlain's conditional logit (depending on the outcome)	The partner's disability has **no effect** on the probability of being employed, the working hours and labour incomes (for men and women).
Giovanis & Ozdamar (2018)	Iraq Household Socio Economic Survey, 2012-2013	Disability registration	Labour supply hours	GMM estimations	Men with spouses with disabilities **work more** and increase their household production

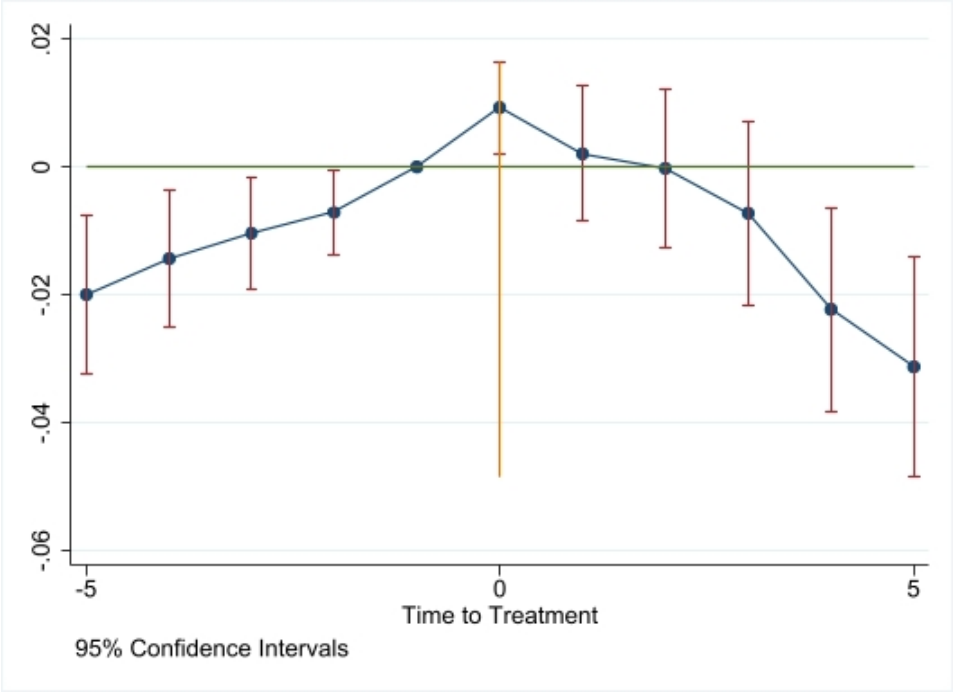
C.3 Sample selection

Figure C.3.12: Sample selection



C.4 Naive results: Event-Study design

Figure C.4.13: Event-Study design

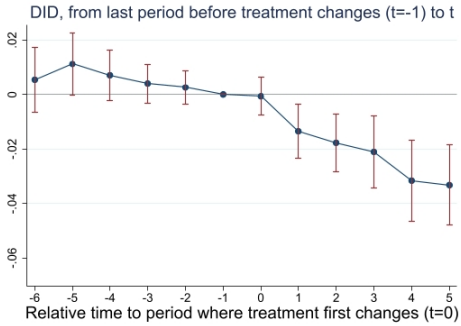


C.5 Heterogeneity-robust DiD estimator

C.5.1 Inclusion of never treated in the control group

We replicate our analyses with a larger control group including never treated individuals. We find a decrease in the probability of being employed one year after the onset of the partner's disability and this effect remains significant after five years. The drop goes from -1.4pp to -3.3pp (see Figure C.5.14. For women, there is no clear decrease in the labour supply following the onset of partner's disability in the first years. But after 4/5 years, we find a 2.7pp drop in the labour supply (see Figure C.5.15). For men, the decline in the labour supply intensifies over time. One year after partner's disability, the drop is around -1.4pp and it reaches -4.4pp five years after the shock (see Figure C.5.16). Those results confirm the ones we find using the not-yet treated only in the control group.

Figure C.5.14: On the whole sample



Gender heterogeneity - inclusion of never treated

Figure C.5.15: Women

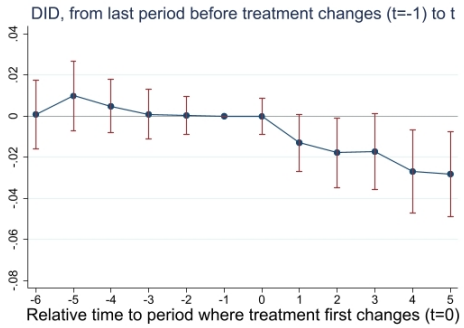
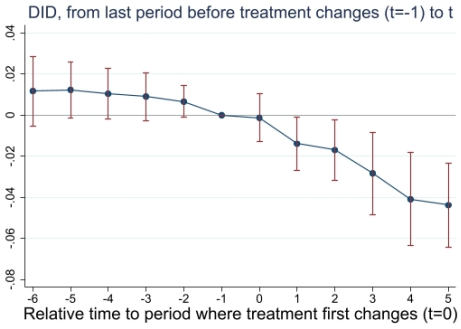


Figure C.5.16: Men



C.5.2 Detailed results

Table C.5.13: Main results: heterogeneity-robust DiD estimator

	Never treated included in control group			Control group: not-yet treated		
	(1)	(2)	(3)	(4)	(5)	(6)
	Total sample	**Women**	**Men**	**Total sample**	**Women**	**Men**
Effect 0	-0.0006	-0.0002	-0.0013	-0.0039	-0.0038	-0.0025
(s.e)	(0.0035)	(0.0045)	(0.0059)	(0.0047)	(0.0048)	(0.0047)
Nbr switchers	2,019	1,308	711	2,013	1,302	709
Effect 1	-0.0135	-0.0131	-0.0140	-0.0191	-0.0201	-0.0172
(s.e)	(0.0051)	(0.0070)	(0.0066)	(0.0059)	(0.0071)	(0.0070)
Nbr switchers	1,895	1,233	662	1,886	1,225	659
Effect 2	-0.0176	-0.0178	-0.0171	-0.0277	-0.0329	-0.0259
(s.e)	(0.0054)	(0.0086)	(0.0076)	(0.0070)	(0.0078)	(0.0084)
Nbr switchers	1,771	1,166	605	1,766	1,162	599
Effect 3	-0.0210	-0.0173	-0.0284	-0.0362	-0.0329	-0.0399
(s.e)	(0.0068)	(0.0095)	(0.0102)	(0.0085)	(0.0093)	(0.0096)
Nbr switchers	1,643	1,096	547	1,629	1,085	539
Effect 4	-0.0315	-0.0271	-0.0409	-0.0459	-0.0412	-0.0523
(s.e)	(0.0076)	(0.0103)	(0.0115)	(0.0094)	(0.0095)	(0.0102)
Nbr switchers	1,499	1,006	493	1,484	995	489
Effect 5	-0.0332	-0.0282	-0.0439	-0.0479	-0.0417	-0.0579
(s.e)	(0.0075)	(0.0105)	(0.0105)	(0.0100)	(0.0113)	(0.0112)
Nbr switchers	1,371	923	448	1,362	914	444
Average	-0.0182	-0.0163	-0.0219	-0.0281	-0.0266	-0.0296
(s.e)	(0.0045)	(0.0068)	(0.0065)	(0.0064)	(0.0067)	(0.0067)
Nbr switchers	10,198	6,732	3,466	10,140	6,683	3,439
Placebo 1	0.0026	0.0003	0.0066	0.0052	0.0030	-0.0085
(s.e)	(0.0031)	(0.0047)	(0.0039)	(0.0037)	(0.0044)	(0.0041)
Nbr switchers	2,018	1,307	711	2,012	1,301	709
Placebo 2	0.0040	0.0009	0.0089	0.0089	0.0050	0.0138
(s.e)	(0.0036)	(0.0062)	(0.0059)	(0.0047)	(0.0056)	(0.0059)
Nbr switchers	1,889	1,227	662	1,880	1,219	659
Placebo 3	0.0071	0.0048	0.0103	0.0110	0.0072	0.0144
(s.e)	(0.0047)	(0.0066)	(0.0063)	(0.0062)	(0.0071)	(0.0060)
Nbr switchers	1,756	1,153	603	1,751	1,149	597
Placebo 4	0.0112	0.0097	0.0123	0.0116	0.0087	0.0156
(s.e)	(0.0059)	(0.0086)	(0.0069)	(0.0081)	(0.0089)	(0.0076)
Nbr switchers	1,623	1,078	545	1,609	1,067	537
Placebo 5	0.0055	0.0008	0.0116	0.0058	-0.0023	0.0170
(s.e)	(0.0059)	(0.0086)	(0.0087)	(0.0093)	(0.0109)	(0.0094)
Nbr switchers	1,473	984	489	1,458	973	485
Joint test placebo						
p-value	0.4914	0.7124	0.3654	0.3996	0.6898	0.0751

C.5.3 Heterogeneity analyses

Table C.5.14: Age heterogeneity and heterogeneity according to the job situation of the partner with disabilities

	(1) **Young**	(2) **Old**	(3) **Partner stops working**	(4) **Partner remains employed**
Effect 0	0.0077	-0.0077	-0.0053	-0.0007
(s.e)	(0.0079)	(0.0035)	(0.0041)	(0.0092)
Nbr switchers	488	1,463	1,275	453
Effect 1	-0.0022	-0.0240	-0.0230	-0.0064
(s.e)	(0.0135)	(0.0059)	(0.0058)	(0.0122)
Nbr switchers	436	1,336	1,190	433
Effect 2	-0.0056	-0.0351	-0.0343	-0.0134
(s.e)	(0.0147)	(0.0077)	(0.0069)	(0.0137)
Nbr switchers	387	1,216	1,108	415
Effect 3	0.0008	-0.0512	-0.0423	-0.0184
(s.e)	(0.0154)	(0.0112)	(0.0088)	(0.0172)
Nbr switchers	340	1,080	1,014	401
Effect 4	-0.0006	-0.0614	-0.0578	-0.0245
(s.e)	(0.0163)	(0.0132)	(0.0102)	(0.0181)
Nbr switchers	293	937	920	371
Effect 5	-0.0014	-0.0623	-0.0581	-0.0234
(s.e)	(0.0187)	(0.0138)	(0.0121)	(0.0201)
Nbr switchers	264	816	837	343
Average	0.0002	-0.0365	-0.0342	-0.0137
(s.e)	(0.0121)	(0.0071)	(0.0063)	(0.0132)
Nbr switchers	2,208	6,848	6,344	2,416
Placebo 1	0.0045	0.0052	0.0033	0.0150
(s.e)	(0.0086)	(0.0049)	(0.0044)	(0.0084)
Nbr switchers	487	1,397	1,274	453
Placebo 2	0.0023	0.0145	0.0101	0.0119
(s.e)	(0.0100)	(0.0058)	(0.0061)	(0.0093)
Nbr switchers	430	1,195	1,189	429
Placebo 3	-0.0065	0.0172	0.0103	0.0203
(s.e)	(0.0136)	(0.0088)	(0.0085)	(0.0132)
Nbr switchers	372	1,005	1,103	407
Placebo 4	0.0271	0.0025	0.0127	0.0189
(s.e)	(0.0172)	(0.0109)	(0.0102)	(0.0135)
Nbr switchers	320	779	1,007	390
Placebo 5	0.0246	-0.0055	0.0008	0.0148
(s.e)	(0.0212)	(0.0140)	(0.0128)	(0.0138)
Nbr switchers	267	555	911	357
Joint test placebo p-value	0.1665	0.0777	0.1064	0.4433

Figure C.5.17: Women - 20-40 years old

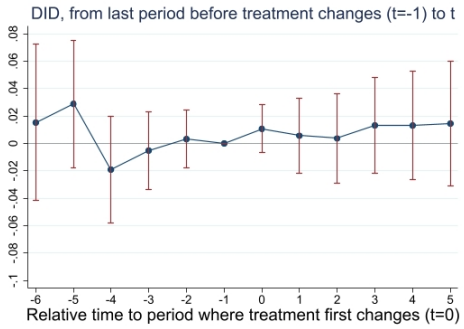


Figure C.5.18: Women - 41-55 years old

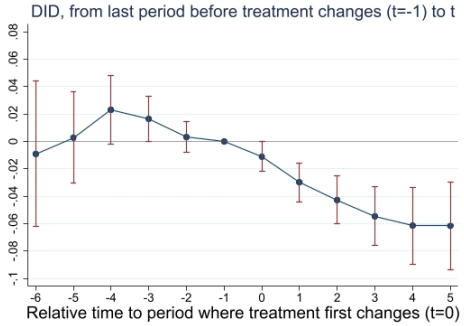


Figure C.5.19: Men - 20-40 years old

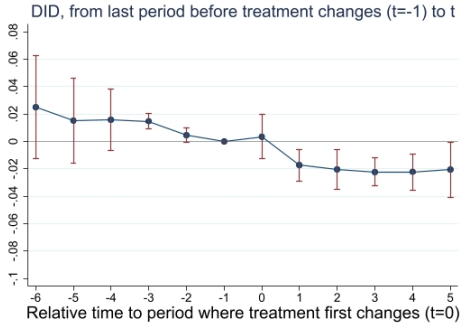


Figure C.5.20: Men - 41-55 years old

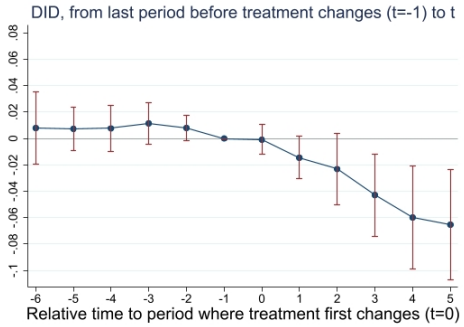
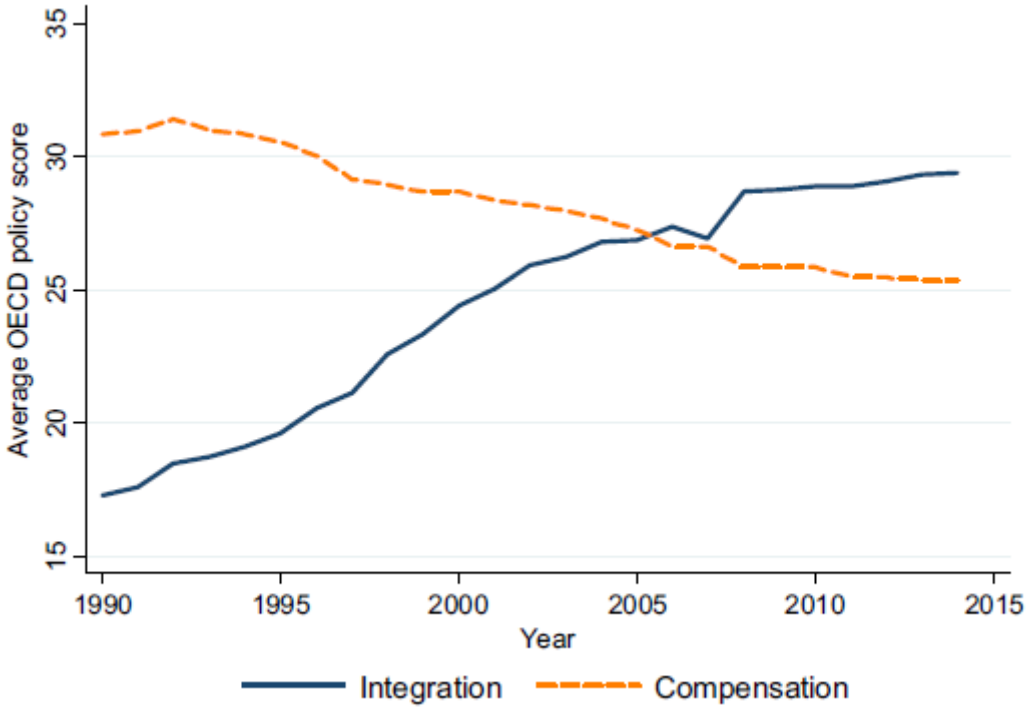


Table C.5.15: Country heterogeneity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Groups		**Subgroups**				
	Social-Democratic	**Corporatist**	**Subgroup 1 Social-Democratic**	**Subgroup 2 Social-Democratic**	**Subgroup 1 Corporatist**	**Subgroup 2 Corporatist**	**Subgroup 3 Corporatist**
Effect 0	0.0123	-0.0062	0.0095	0.0171	-0.0137	-0.0059	-0.0037
(s.e)	0.0118	0.0055	0.0154	0.0157	0.0080	0.0087	0.0081
Nbr switchers	325	1266	170	153	212	578	473
Effect 1	-0.0172	-0.0207	-0.0304	0.0027	-0.0443	-0.0161	-0.0167
(s.e)	0.0145	0.0081	0.0196	0.0214	0.0174	0.0114	0.0103
Nbr switchers	304	1181	159	142	195	541	442
Effect 2	-0.0013	-0.0308	-0.0381	0.0412	-0.0613	-0.0237	-0.0266
(s.e)	0.0162	0.0102	0.0203	0.0253	0.0194	0.0126	0.0120
Nbr switchers	277	1113	141	132	177	522	411
Effect 3	-0.0100	-0.0442	-0.0231	0.0158	-0.0650	-0.0415	-0.0360
(s.e)	0.0200	0.0117	0.0227	0.0270	0.0274	0.0130	0.0133
Nbr switchers	263	1014	134	126	154	488	368
Effect 4	-0.0166	-0.0563	-0.0186	-0.0015	-0.0897	-0.0539	-0.0455
(s.e)	0.0220	0.0129	0.0259	0.0304	0.0321	0.0155	0.0164
Nbr switchers	234	931	121	110	139	455	336
Effect 5	-0.0095	-0.0581	-0.0327	0.0170	-0.0787	-0.0606	-0.0455
(s.e)	0.0234	0.0127	0.0282	0.0371	0.0365	0.0158	0.0165
Nbr switchers	211	856	111	99	121	419	312
Average	-0.0063	-0.0336	-0.0210	0.0157	-0.0545	-0.0315	-0.0268
(s.e)	0.0149	0.0087	0.0187	0.0214	0.0184	0.0102	0.0111
Nbr switchers	1614	6361	836	762	998	3003	2342
Placebo 1	-0.0059	0.0087	0.0022	-0.0077	0.0120	0.0115	0.0031
(s.e)	0.0123	0.0041	0.0132	0.0183	0.0066	0.0078	0.0043
Nbr switchers	325	1265	170	153	212	577	473
Placebo 2	-0.0085	0.0120	0.0036	-0.0150	0.0092	0.0167	0.0028
(s.e)	0.0138	0.0059	0.0173	0.0192	0.0116	0.0099	0.0068
Nbr switchers	304	1177	159	142	194	538	442
Placebo 3	-0.0214	0.0194	-0.0118	-0.0289	0.0151	0.0274	0.0071
(s.e)	0.0193	0.0066	0.0217	0.0277	0.0179	0.0112	0.0073
Nbr switchers	274	1104	140	130	175	517	409
Placebo 4	-0.0033	0.0186	0.0110	-0.0162	0.0252	0.0233	0.0068
(s.e)	0.0217	0.0091	0.0305	0.0331	0.0260	0.0142	0.0096
Nbr switchers	260	1001	133	124	152	481	364
Placebo 5	-0.0049	0.0169	0.0127	-0.0179	0.0060	0.0239	0.0048
(s.e)	0.0230	0.0106	0.0316	0.0392	0.0337	0.0175	0.0118
Nbr switchers	229	915	119	107	137	446	331
Joint test placebo p-value	0.536	0.0841	0.6946	0.9283	0.1998	0.2711	0.9008

C.5.4 Evolution of disability policies in Europe since 1990

Figure C.5.21: Evolution of disability policies in Europe since 1990

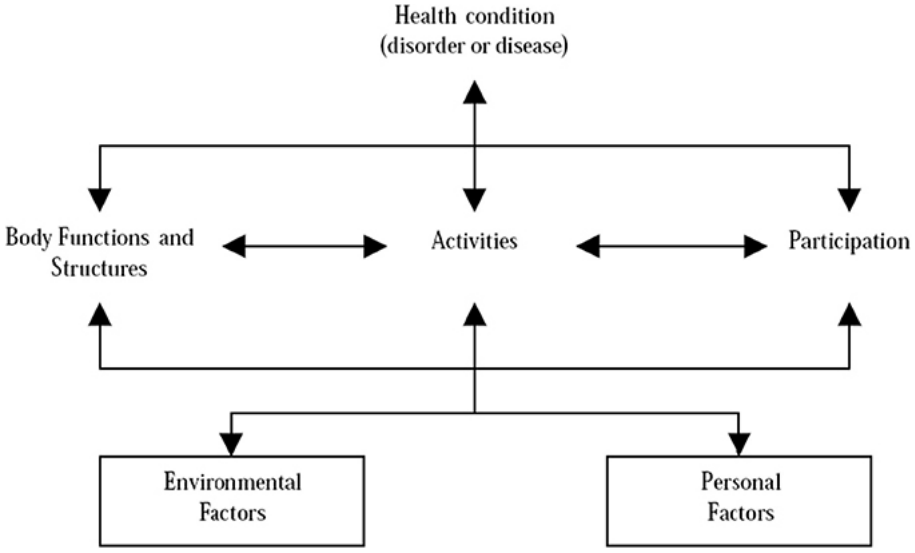


Source: Böheim and Leoni [2018]
Graphic based on OECD data

D. Appendices - Chapter 3

D.1 Disability classification

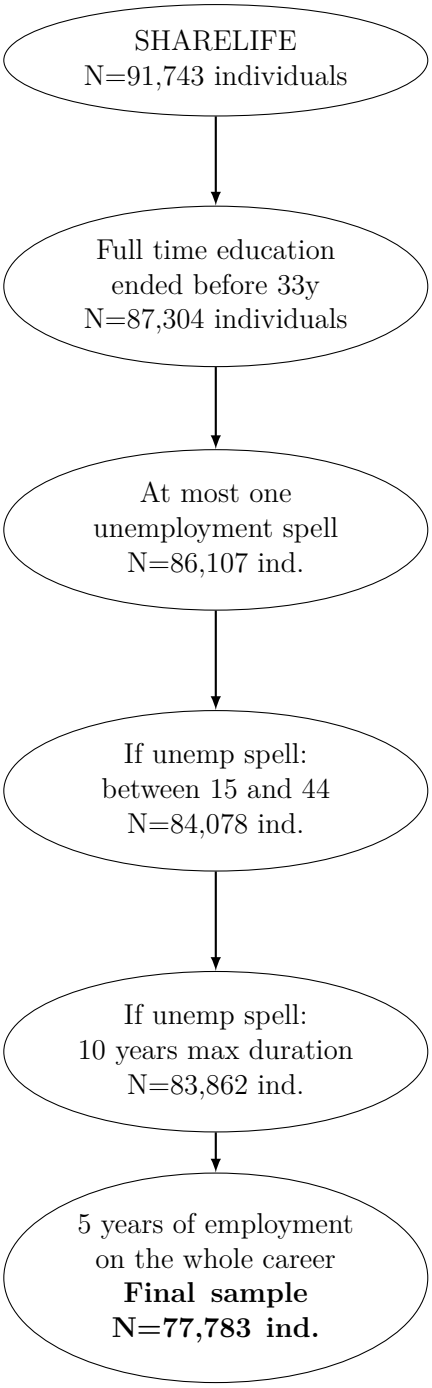
Figure D.1.22: International Classification of Functioning, Disability and Health



Source: WHO [2001]

D.2 Sample selection

Figure D.2.23: Sample selection



D.3 Without restriction on the number of employment years during the whole career path

Here, we relax the assumption of a five-year employment period to provide more justifications to this restriction.

When examining the probability of reporting DD, we observe similar trends as in the main specification but with higher magnitudes (see Table D.3.16). A new effect emerges at age 50 when focusing on individuals with a history of unemployment during their youth.

Regarding the probability of reporting mental DD, Table D.3.17 reveals a strong positive correlation between experiencing unemployment between the ages of 15 and 24 compared to having no unemployment between 15 and 44. This positive effect is evident from age 30 to 50. At age 30, the likelihood of reporting mental DD appears to increase by a factor of 2.52 for individuals who experienced unemployment between 15 and 24. At age 45, those who experienced youth unemployment (15-24 years) also exhibit a higher probability of reporting mental DD compared to those with later unemployment (25-44 years).

A similar pattern in Table D.3.18 emerges when considering physical injury. The few significant results show higher magnitudes when no restrictions on the career path are applied.

Overall, when comparing the effect of unemployment to individuals with no unemployment experience, we observe an overestimation compared to results with a 5-year employment restriction. Considering that, when conditioning on the number of employment years, we exclude individuals with worse health status, this result suggests that youth unemployment has more harmful consequences than later unemployment. This finding is consistent with the results of Strandh et al. [2014].

It is important for the reader to note that specifications with country dummies sometimes drop several observations due to insufficient sample sizes in certain countries.

Table D.3.16: Results on the probability of declaring DD without restriction on the number of employment years

Disabling diseases		25 years		30 years		35 years		40 years		45 years		50 years	
Spell 15-24 years VS no spell	OR	1.06	1.10	1.07	1.10	1.02	1.06	1.19	1.21	1.31**	1.32**	1.23**	1.24**
	s.e	(0.20)	(0.20)	(0.18)	(0.19)	(0.16)	(0.17)	(0.16)	(0.16)	(0.15)	(0.15)	(0.13)	(0.13)
	Obs	81,464	81,464	81,462	81,462	81,451	81,451	81,390	81,390	81,202	81,202	80,395	80,395
Spell 25-34 years VS no spell	OR					1.04	1.05	1.19	1.21	1.27	1.29	1.43**	1.46***
	s.e					(0.23)	(0.23)	(0.22)	(0.22)	(0.20)	(0.21)	(0.20)	(0.20)
	Obs					80,766	80,766	80,707	80,707	80,521	80,521	79,716	79,716
Spell 35-44 years VS no spell	OR									0.88	0.87	1.41***	1.41**
	s.e									(0.16)	(0.16)	(0.19)	(0.19)
	Obs									80,586	80,586	79,791	79,791
Spell 15-44 years VS no spell	OR									1.23***	1.24***	1.36***	1.38***
	s.e									(0.10)	(0.10)	(0.09)	(0.09)
	Obs									83,058	83,058	82,200	82,200
Spell 15-24 years VS 25-44 years	OR									1.16	1.12	0.82	0.83
	s.e									(0.19)	(0.20)	(0.12)	(0.13)
	Obs									3,035	3,022	2,970	2,958
Spell 15-24 years VS 25-34 years	OR									1.01	1.02	0.84	0.84
	s.e									(0.20)	(0.22)	(0.15)	(0.15)
	Obs									2,105	2,058	2,057	2,020
Spell 15-24 years VS 35-44 years	OR									1.44*	1.26	0.82	0.77
	s.e									(0.31)	(0.30)	(0.14)	(0.15)
	Obs									2,170	2,098	2,132	2,104
Spell 15-34 years VS 35-44 years	OR									1.50**	1.43	0.92	0.95
	s.e									(0.30)	(0.32)	(0.14)	(0.16)
	Obs									3,096	3,083	3,024	3,012
Spell 25-34 years VS 35-44 years	OR									1.45	1.36	1.02	1.08
	s.e									(0.35)	(0.36)	(0.19)	(0.22)
	Obs									1,489	1,390	1,453	1,422
15-24 years spell (ref) VS 25-34 VS 35-44	OR									1.00	0.98	1.22	1.19
	s.e									(0.20)	(0.20)	(0.21)	(0.21)
	OR									0.69*	0.73	1.20	1.16
	s.e									(0.15)	(0.17)	(0.21)	(0.22)
	Obs									2,882	2,869	2,821	2,809
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Having an unemployment spell lasting at most 10 years between 15 and 44yo multiply by 1.23 the probability of declaring DD at age 45 compared to individuals with no unemployment spell.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.3.17: Results on the probability of declaring mental DD without restriction on the number of employment years

Mental DD		25 years		30 years		35 years		40 years		45 years		50 years	
Spell 15-24 years VS no spell	OR	1.94	2.36*	2.52**	2.51**	1.86*	1.89*	2.47***	2.34***	2.73***	2.81***	2.22***	2.45***
	s.e	(0.98)	(1.18)	(0.91)	(0.92)	(0.67)	(0.69)	(0.63)	(0.61)	(0.59)	(0.61)	(0.46)	(0.51)
	Obs	81,464	75,825	81,462	78,768	81,451	80,255	81,390	81,390	81,202	81,202	80,395	80,395
Spell 25-34 years VS no spell	OR					0.89	0.88	1.15	1.11	1.56	1.55	1.52	1.54
	s.e					(0.64)	(0.63)	(0.58)	(0.57)	(0.60)	(0.59)	(0.52)	(0.53)
	Obs					80,766	79,571	80,707	80,707	80,521	80,521	79,716	79,716
Spell 35-44 years VS no spell	OR									1.25	1.21	2.19***	2.17***
	s.e									(0.52)	(0.50)	(0.60)	(0.60)
	Obs									80,586	80,586	79,791	79,791
Spell 15-44 years VS no spell	OR									1.95***	1.94***	2.07***	2.18***
	s.e									(0.33)	(0.33)	(0.29)	(0.32)
	Obs									83,058	83,058	82,200	82,200
Spell 15-24 years VS 25-44 years	OR									1.99**	1.95**	1.00	1.18
	s.e									(0.67)	(0.67)	(0.28)	(0.32)
	Obs									3,035	1,858	2,970	2,235
Spell 15-24 years VS 25-34 years	OR									1.54	1.58	1.27	1.37
	s.e									(0.65)	(0.67)	(0.51)	(0.53)
	Obs									2,105	1,280	2,057	1,386
Spell 15-24 years VS 35-44 years	OR									1.91	1.41	0.88	0.90
	s.e									(0.85)	(0.63)	(0.30)	(0.29)
	Obs									2,170	1,150	2,132	1,447
Spell 15-34 years VS 35-44 years	OR									1.78	1.74	0.84	0.92
	s.e									(0.79)	(0.85)	(0.27)	(0.31)
	Obs									3,096	2,097	3,024	2,264
Spell 25-34 years VS 35-44 years	OR									1.24	1.32	0.71	0.78
	s.e									(0.69)	(0.85)	(0.31)	(0.35)
	Obs									1,489	591	1,453	885
15-24 years spell (ref) VS 25-34 VS 35-44	OR									0.62	0.62	0.78	0.67
	s.e									(0.27)	(0.26)	(0.31)	(0.26)
	OR									0.50	0.52	1.11	0.97
	s.e									(0.22)	(0.25)	(0.38)	(0.33)
	Obs									2,882	1,754	2,821	2,119
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Having an unemployment spell lasting at most 10 years between 15 and 24 years multiply by 1.99 the probability of declaring mental DD at age 45 compared to individuals with an unemployment spell between 25 and 44 years.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.3.18: Results on the probability of declaring physical disability without restriction on the number of employment years

Physical injury		25 years		30 years		35 years		40 years		45 years		50 years	
Spell 15-24 years VS no spell	OR	1.16	1.27	1.09	1.17	0.97	1.01	1.00	1.04	1.05	1.09	1.04	1.10
	s.e	(0.22)	(0.24)	(0.18)	(0.20)	(0.15)	(0.16)	(0.14)	(0.14)	(0.13)	(0.13)	(0.12)	(0.12)
	Obs	81,195	81,195	81,193	81,193	81,182	81,182	81,121	81,121	80,933	80,933	80,128	80,128
Spell 25-34 years VS no spell	OR					1.26	1.20	1.36*	1.30	1.39**	1.32*	1.26	1.20
	s.e					(0.25)	(0.24)	(0.23)	(0.22)	(0.21)	(0.21)	(0.19)	(0.18)
	Obs					80,497	80,497	80,438	80,438	80,252	80,252	79,449	79,449
Spell 35-44 years VS no spell	OR									1.18	1.19	1.31*	1.32**
	s.e									(0.19)	(0.19)	(0.18)	(0.19)
	Obs									80,317	80,317	79,524	79,524
Spell 15-44 years VS no spell	OR									1.22***	1.22***	1.21***	1.22***
	s.e									(0.09)	(0.10)	(0.09)	(0.09)
	Obs									82,785	82,785	81,929	81,929
Spell 15-24 years VS 25-44 years	OR									0.77	0.87	0.79	0.89
	s.e									(0.13)	(0.16)	(0.12)	(0.15)
	Obs									3,029	2,902	2,964	2,890
Spell 15-24 years VS 25-34 years	OR									0.79	0.73	0.95	0.79
	s.e									(0.23)	(0.26)	(0.29)	(0.30)
	Obs									230	218	225	217
Spell 15-24 years VS 35-44 years	OR									0.94	1.07	0.86	0.99
	s.e									(0.20)	(0.27)	(0.16)	(0.21)
	Obs									2,166	1,995	2,128	2,065
Spell 15-34 years VS 35-44 years	OR									1.00	1.09	0.87	0.93
	s.e									(0.19)	(0.22)	(0.14)	(0.17)
	Obs									3,090	2,961	3,018	2,945
Spell 25-34 years VS 35-44 years	OR									1.18	1.14	0.97	0.90
	s.e									(0.26)	(0.27)	(0.20)	(0.20)
	Obs									1,485	1,277	1,449	1,304
15-24 years spell (ref)VS 25-34 VS 35-44	OR									1.26	1.12	1.13	0.98
	s.e									(0.26)	(0.24)	(0.22)	(0.20)
	OR									1.08	0.94	1.18	1.05
	s.e									(0.22)	(0.22)	(0.22)	(0.22)
	Obs									2,876	2,756	2,815	2,746
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Having an unemployment spell lasting at most 10 years between 15 and 44 yo multiply by 1.22 the probability of declaring physical disability at age 50.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

D.4 Emotional DD

Table D.4.19: Main results on the probability of declaring only emotional DD

Emotional DD		**25 years**	**25 years**	**30 years**	**30 years**	**35 years**	**35 years**	**40 years**	**40 years**	**45 years**	**45 years**	**50 years**	**50 years**
Spell 15-24 years VS no spell	OR	2.32	2.57*	2.40*	2.13	1.70	1.54	2.70***	2.35***	2.86***	2.71***	2.32***	2.30***
	s.e	(1.35)	(1.46)	(1.09)	(0.99)	(0.77)	(0.71)	(0.80)	(0.71)	(0.71)	(0.69)	(0.56)	(0.56)
	Obs	75,410	60,290	75,393	68,783	75,363	71,958	75,274	74,370	75,062	74,160	74,249	73,371
Spell 25-34 years VS no spell	OR					1.29	1.21	1.67	1.54	1.57	1.52	1.67	1.65
	s.e					(0.92)	(0.86)	(0.85)	(0.79)	(0.71)	(0.69)	(0.65)	(0.64)
	Obs					74,732	71,344	74,645	73,751	74,436	73,544	73,623	72,755
Spell 35-44 years VS no spell	OR									1.16	1.12	2.21**	2.16**
	s.e									(0.59)	(0.57)	(0.71)	(0.70)
	Obs									74,505	73,612	73,700	72,831
Spell 15-44 years VS no spell	OR									1.98***	1.88***	2.21***	2.21***
	s.e									(0.39)	(0.38)	(0.36)	(0.37)
	Obs									76,897	75,975	76,023	75,126
Spell 15-24 years VS 25-44 years	OR									2.05*	1.94	0.90	1.01
	s.e									(0.80)	(0.79)	(0.29)	(0.31)
	Obs									2,958	1,698	2,882	2,051
Spell 15-24 years VS 25-34 years	OR									1.48	1.52	1.07	1.15
	s.e									(0.75)	(0.78)	(0.50)	(0.51)
	Obs									1,965	1,082	1,913	1,218
Spell 15-24 years VS 35-44 years	OR									2.09	1.52	0.87	0.84
	s.e									(1.08)	(0.80)	(0.34)	(0.31)
	Obs									2,103	1,066	2,059	1,346
Spell 15-34 years VS 35-44 years	OR									1.93	1.90	0.85	0.91
	s.e									(1.02)	(1.12)	(0.31)	(0.36)
	Obs									3,014	1,924	2,933	2,077
Spell 25-34 years VS 35-44 years	OR									1.35	1.44	0.79	0.81
	s.e									(0.92)	(1.04)	(0.40)	(0.41)
	Obs									1,347	516	1,433	844
15-24 years spell (ref) VS 25-34 VS 35-44	OR									0.63	0.64	0.88	0.79
	s.e									(0.32)	(0.32)	(0.40)	(0.35)
	OR									0.46	0.50	1.13	1.06
	s.e									(0.24)	(0.29)	(0.44)	(0.42)
	Obs									2,807	1,598	2,737	1,941
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Having an unemployment spell lasting at most 10 years between 15 and 44 yo multiply by 1.98 the probability of declaring emotional DD at age 45 compared to individuals without unemployment
Source: SHARELIFE and JEP
Robust se in parentheses
*** p<0.01, ** p<0.05, * p<0.1

D.5 Heterogeneity analyses

D.5.1 Influence of the time period when experiencing unemployment spells

Table D.5.20: Probability of declaring mental DD and physical injury depending on the time period of unemployment spell that occurred between ages 15 and 44

		Mental DD		Physical injury	
		45 years	**50 years**	**45 years**	**50 years**
Spell between	OR	2.03**	1.60	0.83	0.79
1950 and 1973	s.e	(0.62)	(0.47)	(0.14)	(0.12)
VS no spell	Obs	74,790	74,112	74,559	73,883
Spell between	OR	1.58*	1.84***	1.36***	1.38***
1974 and 1993	s.e	(0.43)	(0.40)	(0.15)	(0.14)
VS no spell	Obs	75,355	74,643	75,123	74,413
Spell between	OR	1.21	1.86*	1.27	1.47**
1994 and 2008	s.e	(0.62)	(0.68)	(0.25)	(0.25)
VS no spell	Obs	74,411	73,711	74,180	73,482
	OR	0.92	1.38	1.70**	1.73***
Spell betwen 1950-73 (ref)	s.e	(0.36)	(0.50)	(0.35)	(0.33)
VS 1974-1993	OR	0.76	1.54	1.63*	1.85**
VS 1994-2008	s.e	(0.43)	(0.72)	(0.44)	(0.45)
	Obs	2,799	2,743	2,795	2,739
5 years of employment control		Yes	Yes	Yes	Yes

Note: Having an unemployment spell lasting at most 10 years between 15 and 44 years during the period 1950-1973 increases the probability of declaring mental DD at age 45.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

D.5.2 Gender heterogeneity

Table D.5.21: Probability of declaring mental DD among women

Mental DD - Women		**25 years**	**30 years**	**35 years**	**40 years**	**45 years**	**50 years**
Spell 15-24 years VS no spell	OR	3.15	2.58	1.42	1.85	1.71	1.74
	s.e	(2.26)	(1.83)	(1.01)	(0.93)	(0.78)	(0.67)
	Obs	35,207	35,207	35,207	35,203	35,186	35,098
Spell 25-34 years VS no spell	OR			1.63	2.19	1.66	1.18
	s.e			(1.65)	(1.58)	(1.19)	(0.84)
	Obs			34,843	34,841	34,824	34,739
Spell 35-44 years VS no spell	OR					1.53	2.18
	s.e					(1.09)	(1.11)
	Obs					34,858	34,772
Spell 15-44 years VS no spell	OR					1.67	1.80**
	s.e					(0.55)	(0.48)
	Obs					35,901	35,808
Spell 15-24 years VS 25-44 years	OR					0.92	0.74
	s.e					(0.54)	(0.35)
	Obs					1,157	1,147
Spell 15-24 years VS 25-34 years	OR					0.63	0.86
	s.e					(0.49)	(0.64)
	Obs					827	820
Spell 15-24 years VS 35-44 years	OR					0.88	0.59
	s.e					(0.60)	(0.32)
	Obs					858	850
Spell 15-34 years VS 35-44 years	OR					1.10	0.65
	s.e					(0.82)	(0.37)
	Obs					1,153	1,143
Spell 25-34 years VS 35-44 years	OR					1.13	0.56
	s.e					(1.14)	(0.49)
	Obs					525	520
15-24 years spell (ref) VS 25-34	OR					1.28	0.95
	s.e					(1.05)	(0.75)
VS 35-44	OR					1.13	1.69
	s.e					(0.82)	(0.96)
	Obs					1,105	1,095
5 years of employment control		Yes	Yes	Yes	Yes	Yes	Yes

Note: Among women, experiencing an unemployment spell lasting no more than 10 years between the ages of 15 and 44 increases the probability of reporting mental DD at age 50 by 1.80 compared to women aged 50 without an unemployment spell.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.5.22: Probability of declaring physical injury among women

Physical injury - Women		**25 years**	**30 years**	**35 years**	**40 years**	**45 years**	**50 years**
Spell 15-24 years VS no spell	OR	1.09	1.06	0.94	0.92	1.00	0.92
	s.e	(0.27)	(0.23)	(0.19)	(0.17)	(0.16)	(0.14)
	Obs	35,085	35,085	35,085	35,081	35,064	34,976
Spell 25-34 years VS no spell	OR			1.01	1.15	1.25	1.09
	s.e			(0.30)	(0.29)	(0.28)	(0.24)
	Obs			34,722	34,720	34,703	34,618
Spell 35-44 years VS no spell	OR					1.24	1.31
	s.e					(0.26)	(0.25)
	Obs					34,736	34,650
Spell 15-44 years VS no spell	OR					1.14	1.07
	s.e					(0.12)	(0.11)
	Obs					35,778	35,685
Spell 15-24 years VS 25-44 years	OR					0.84	0.79
	s.e					(0.20)	(0.18)
	Obs					1,294	1,284
Spell 15-24 years VS 25-34 years	OR					0.93	0.96
	s.e					(0.28)	(0.28)
	Obs					921	914
Spell 15-24 years VS 35-44 years	OR					0.90	0.78
	s.e					(0.27)	(0.21)
	Obs					954	946
Spell 15-34 years VS 35-44 years	OR					0.91	0.76
	s.e					(0.23)	(0.18)
	Obs					1,295	1,285
Spell 25-34 years VS 35-44 years	OR					1.00	0.82
	s.e					(0.31)	(0.24)
	Obs					593	588
15-24 years spell (ref) VS 25-34 VS 35-44	OR					1.18	1.12
	s.e					(0.35)	(0.32)
	OR					1.16	1.35
	s.e					(0.34)	(0.36)
	Obs					1,234	1,224
5 years of employment control		Yes	Yes	Yes	Yes	Yes	Yes

Note: Among women, experiencing an unemployment spell lasting no more than 10 years between the ages of 15 and 44 has no effect on the probability of reporting physical injury.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.5.23: Probability of declaring mental DD among men

Mental DD - Men		**25 years**	**30 years**	**35 years**	**40 years**	**45 years**	**50 years**
Spell 15-24 years VS no spell	OR	0.85	2.49**	1.99	2.76***	2.88***	2.14***
	s.e	(0.86)	(1.14)	(0.90)	(0.85)	(0.76)	(0.57)
	Obs	40,262	40,260	40,251	40,204	40,067	39,453
Spell 25-34 years VS no spell	OR			0.64	0.79	1.21	1.39
	s.e			(0.65)	(0.57)	(0.61)	(0.58)
	Obs			39,982	39,935	39,800	39,184
Spell 35-44 years VS no spell	OR					0.85	1.92*
	s.e					(0.49)	(0.66)
	Obs					39,835	39,230
Spell 15-44 years VS no spell	OR					1.74***	1.91***
	s.e					(0.37)	(0.34)
	Obs					41,192	40,532
Spell 15-24 years VS 25-44 years	OR					3.02**	1.09
	s.e					(1.33)	(0.40)
	Obs					1,670	1,616
Spell 15-24 years VS 25-34 years	OR					2.23	1.47
	s.e					(1.20)	(0.75)
	Obs					1,117	1,077
Spell 15-24 years VS 35-44 years	OR					2.96*	1.00
	s.e					(1.83)	(0.44)
	Obs					1,152	1,123
Spell 15-34 years VS 35-44 years	OR					2.58	0.91
	s.e					(1.61)	(0.37)
	Obs					1,724	1,663
Spell 25-34 years VS 35-44 years	OR					1.39	0.73
	s.e					(1.07)	(0.39)
	Obs					885	854
15-24 years spell (ref) VS 25-34 VS 35-44	OR					0.44	0.70
	s.e					(0.24)	(0.35)
	OR					0.31*	0.98
	s.e					(0.19)	(0.43)
	Obs					1,577	1,527
5 years of employment control		Yes	Yes	Yes	Yes	Yes	Yes

Note: Among men, experiencing an unemployment spell lasting no more than 10 years between the ages of 15 and 44 increases the probability of reporting mental DD at age 45 by 1.74 compared to men aged 45 with no history of unemployment spell.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.5.24: Probability of declaring physical injury among men

Physical injury - Men		**25 years**	**30 years**	**35 years**	**40 years**	**45 years**	**50 years**
Spell 15-24 years VS no spell	OR	1.24	1.11	0.97	1.12	1.07	1.15
	s.e	(0.38)	(0.32)	(0.26)	(0.24)	(0.21)	(0.20)
	Obs	40,153	40,151	40,142	40,095	39,958	39,346
Spell 25-34 years VS no spell	OR			1.62*	1.64**	1.55**	1.45*
	s.e			(0.43)	(0.38)	(0.33)	(0.29)
	Obs			39,871	39,824	39,689	39,075
Spell 35-44 years VS no spell	OR					1.06	1.24
	s.e					(0.26)	(0.25)
	Obs					39,725	39,122
Spell 15-44 years VS no spell	OR					1.28**	1.32***
	s.e					(0.15)	(0.14)
	Obs					41,080	40,422
Spell 15-24 years VS 25-44 years	OR					0.70	0.78
	s.e					(0.17)	(0.17)
	Obs					1,667	1,613
Spell 15-24 years VS 25-34 years	OR					0.72	0.87
	s.e					(0.21)	(0.24)
	Obs					1,115	1,075
Spell 15-24 years VS 35-44 years	OR					1.02	0.97
	s.e					(0.32)	(0.27)
	Obs					1,151	1,122
Spell 15-34 years VS 35-44 years	OR					1.15	1.00
	s.e					(0.32)	(0.24)
	Obs					1,721	1,660
Spell 25-34 years VS 35-44 years	OR					1.46	1.17
	s.e					(0.47)	(0.33)
	Obs					882	851
15-24 years spell (ref) VS 25-34 VS 35-44	OR					1.41	1.19
	s.e					(0.41)	(0.32)
	OR					0.96	1.03
	s.e					(0.30)	(0.28)
	Obs					1,574	1,524
5 years of employment control		Yes	Yes	Yes	Yes	Yes	Yes

Note: Among men, experiencing an unemployment spell lasting no more than 10 years between the ages of 15 and 44 increases the probability of reporting physical injury at age 45 by 1.28 compared to men aged 45 without an unemployment spell.
Source: SHARELIFE and JEP
*** p<0.01, ** p<0.05, * p<0.1

D.6 Sensitivity analyses

D.6.1 Balanced sample

Table D.6.25: Probability of declaring DD - Balanced sample

DD - Balanced sample		25 years	25 years	30 years	30 years	35 years	35 years	40 years	40 years	45 years	45 years	50 years	50 years
Spell 15-24 years VS no spell	OR	0.98	1.05	0.99	1.03	0.93	0.97	1.10	1.11	1.27**	1.26*	1.19	1.19
	s.e	(0.20)	(0.21)	(0.18)	(0.19)	(0.16)	(0.17)	(0.16)	(0.16)	(0.15)	(0.15)	(0.13)	(0.13)
	Obs	74,551	74,551	74,551	74,551	74,551	74,551	74,551	74,551	74,551	74,551	74,551	74,551
Spell 25-34 years VS no spell	OR					1.03	1.05	1.21	1.23	1.21	1.24	1.39**	1.43**
	s.e					(0.24)	(0.24)	(0.23)	(0.23)	(0.20)	(0.21)	(0.20)	(0.20)
	Obs					73,923	73,923	73,923	73,923	73,923	73,923	73,923	73,923
Spell 35-44 years VS no spell	OR									0.88	0.89	1.39**	1.40**
	s.e									(0.16)	(0.17)	(0.19)	(0.19)
	Obs									74,002	74,002	74,002	74,002
Spell 15-44 years VS no spell	OR									1.20**	1.21**	1.32***	1.34***
	s.e									(0.10)	(0.10)	(0.09)	(0.09)
	Obs									76,340	76,340	76,340	76,340
Spell 15-24 years VS 25-44 years	OR									1.12	1.03	0.79	0.79
	s.e									(0.19)	(0.19)	(0.11)	(0.12)
	Obs									2,902	2,890	2,902	2,890
Spell 15-24 years VS 25-34 years	OR									1.00	0.96	0.83	0.81
	s.e									(0.21)	(0.21)	(0.15)	(0.15)
	Obs									1,992	1,931	1,992	1,955
Spell 15-24 years VS 35-44 years	OR									1.36	1.16	0.80	0.74
	s.e									(0.31)	(0.28)	(0.14)	(0.14)
	Obs									2,071	2,003	2,071	2,045
Spell 15-34 years VS 35-44 years	OR									1.41*	1.32	0.89	0.92
	s.e									(0.29)	(0.30)	(0.14)	(0.16)
	Obs									2,950	2,938	2,950	2,938
Spell 25-34 years VS 35-44 years	OR									1.37	1.31	1.01	1.08
	s.e									(0.34)	(0.36)	(0.19)	(0.22)
	Obs									1,443	1,348	1,443	1,412
15-24 years spell (ref) VS 25-34 VS 35-44	OR									1.01	1.03	1.25	1.24
	s.e									(0.21)	(0.23)	(0.22)	(0.23)
	OR									0.73	0.81	1.24	1.22
	s.e									(0.16)	(0.20)	(0.22)	(0.23)
	Obs									2,753	2,741	2,753	2,741
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Experiencing an unemployment spell lasting at most 10 years between the ages of 15 and 44 multiplies the probability of declaring DD at age 50 by 1.32 compared to individuals without unemployment during that period.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.6.26: Probability of declaring mental DD - balanced sample

Mental DD - Balanced sample		25 years	25 years	30 years	30 years	35 years	35 years	40 years	40 years	45 years	45 years	50 years	50 years
Spell 15-24 years VS no spell	OR	1.69	2.13	2.19*	2.12*	1.57	1.54	2.35***	2.18***	2.53***	2.53***	2.00***	2.16***
	s.e	(0.98)	(1.21)	(0.90)	(0.90)	(0.64)	(0.64)	(0.64)	(0.61)	(0.58)	(0.59)	(0.44)	(0.48)
	Obs	74,551	62,756	74,551	71,120	74,551	73,447	74,551	74,551	74,551	74,551	74,551	74,551
Spell 25-34 years VS no spell	OR					0.96	0.96	1.23	1.19	1.15	1.14	1.33	1.35
	s.e					(0.69)	(0.69)	(0.62)	(0.61)	(0.52)	(0.52)	(0.48)	(0.49)
	Obs					73,923	72,819	73,923	73,923	73,923	73,923	73,923	73,923
Spell 35-44 years VS no spell	OR									1.06	1.04	1.99**	1.99**
	s.e									(0.48)	(0.47)	(0.57)	(0.57)
	Obs									74,002	74,002	74,002	74,002
Spell 15-44 years VS no spell	OR									1.72***	1.70***	1.88***	1.97***
	s.e									(0.31)	(0.31)	(0.28)	(0.30)
	Obs									76,340	76,340	76,340	76,340
Spell 15-24 years VS 25-44 years	OR									2.23**	2.04*	0.96	1.12
	s.e									(0.85)	(0.80)	(0.29)	(0.32)
	Obs									2,902	1,716	2,902	2,117
Spell 15-24 years VS 25-34 years	OR									1.85	1.88	1.27	1.34
	s.e									(0.92)	(0.99)	(0.54)	(0.57)
	Obs									1,992	1,091	1,992	1,291
Spell 15-24 years VS 35-44 years	OR									1.99	1.45	0.84	0.86
	s.e									(0.97)	(0.69)	(0.30)	(0.28)
	Obs									2,071	1,049	2,071	1,356
Spell 15-34 years VS 35-44 years	OR									1.83	1.70	0.82	0.89
	s.e									(0.89)	(0.89)	(0.27)	(0.30)
	Obs									2,950	1,935	2,950	2,143
Spell 25-34 years VS 35-44 years	OR									1.09	1.20	0.68	0.77
	s.e									(0.70)	(0.83)	(0.31)	(0.35)
	Obs									1,443	572	1,443	876
15-24 years spell (ref) VS 25-34 VS 35-44	OR									0.52	0.55	0.78	0.69
	s.e									(0.26)	(0.28)	(0.33)	(0.29)
	OR									0.48	0.54	1.16	1.03
	s.e									(0.24)	(0.29)	(0.42)	(0.36)
	Obs									2,753	1,617	2,753	2,003
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Experiencing an unemployment spell lasting at most 10 years between the ages of 15 and 44 multiplies the probability of declaring mental DD at age 45 by 1.72 compared to individuals without unemployment during that period.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.6.27: Probability of declaring physical injury - Balanced sample

DD - Balanced sample		25 years	25 years	30 years	30 years	35 years	35 years	40 years	40 years	45 years	45 years	50 years	50 years
Spell 15-24 years VS no spell	OR	1.17	1.32	1.11	1.20	0.98	1.04	1.00	1.06	1.04	1.09	1.01	1.08
	s.e	(0.22)	(0.26)	(0.19)	(0.21)	(0.16)	(0.17)	(0.14)	(0.15)	(0.13)	(0.14)	(0.12)	(0.13)
	Obs	74,321	74,321	74,321	74,321	74,321	74,321	74,321	74,321	74,321	74,321	74,322	74,322
Spell 25-34 years VS no spell	OR					1.23	1.19	1.31	1.27	1.35*	1.30	1.26	1.22
	s.e					(0.25)	(0.25)	(0.23)	(0.23)	(0.21)	(0.21)	(0.19)	(0.18)
	Obs					73,692	73,692	73,692	73,692	73,692	73,692	73,693	73,693
Spell 35-44 years VS no spell	OR									1.09	1.10	1.28*	1.30*
	s.e									(0.18)	(0.18)	(0.18)	(0.18)
	Obs									73,771	73,771	73,772	73,772
Spell 15-44 years VS no spell	OR									1.18**	1.20**	1.18**	1.21***
	s.e									(0.09)	(0.10)	(0.09)	(0.09)
	Obs									76,106	76,106	76,107	76,107
Spell 15-24 years VS 25-44 years	OR									0.81	0.89	0.79	0.87
	s.e									(0.14)	(0.17)	(0.12)	(0.15)
	Obs									2,897	2,774	2,897	2,823
Spell 15-24 years VS 25-34 years	OR									0.85	0.94	0.90	1.01
	s.e									(0.18)	(0.21)	(0.18)	(0.21)
	Obs									1,989	1,918	1,989	1,947
Spell 15-24 years VS 35-44 years	OR									1.02	1.17	0.87	1.00
	s.e									(0.23)	(0.30)	(0.17)	(0.22)
	Obs									2,068	1,900	2,068	2,005
Spell 15-34 years VS 35-44 years	OR									1.06	1.16	0.88	0.94
	s.e									(0.21)	(0.25)	(0.15)	(0.17)
	Obs									2,945	2,820	2,945	2,872
Spell 25-34 years VS 35-44 years	OR									1.24	1.22	1.00	0.94
	s.e									(0.28)	(0.30)	(0.20)	(0.20)
	Obs									1,439	1,237	1,439	1,295
15-24 years spell (ref) VS 25-34 VS 35-44	OR									1.23	1.13	1.16	1.02
	s.e									(0.26)	(0.25)	(0.23)	(0.21)
	OR									0.99	0.88	1.17	1.04
	s.e									(0.22)	(0.22)	(0.22)	(0.22)
	Obs									2,748	2,632	2,748	2,679
Country dummies		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: Experiencing an unemployment spell lasting at most 10 years between the ages of 15 and 44 multiplies the probability of declaring physical injury at age 45 by 1.18 compared to individuals without unemployment during that period.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

D.6.2 Ten years of employment on the whole career path

Table D.6.28: Probability of declaring mental DD conditioning on at least 10 years of employment over the life course

Mental DD		25 years	30 years	35 years	40 years	45 years	50 years
Spell 15-24 years VS no spell	OR	0.60	1.62	1.13	2.12**	2.41***	2.04***
	s.e	(0.61)	(0.82)	(0.57)	(0.62)	(0.58)	(0.45)
	Obs	72,824	72,823	72,815	72,774	72,635	71,980
Spell 25-34 years VS no spell	OR			1.00	1.22	1.39	1.36
	s.e			(0.71)	(0.62)	(0.58)	(0.49)
	Obs			72,250	72,211	72,072	71,415
Spell 35-44 years VS no spell	OR					1.04	1.99**
	s.e					(0.47)	(0.57)
	Obs					72,151	71,504
Spell 15-44 years VS no spell	OR					1.70***	1.90***
	s.e					(0.31)	(0.29)
	Obs					74,461	73,755
Spell 15-24 years VS 25-44 years	OR					2.07*	1.00
	s.e					(0.78)	(0.31)
	Obs					2,879	2,818
Spell 15-24 years VS 25-34 years	OR					1.57	1.31
	s.e					(0.74)	(0.57)
	Obs					1,953	1,909
Spell 15-24 years VS 35-44 years	OR					2.02	0.89
	s.e					(1.01)	(0.32)
	Obs					2,032	1,998
Spell 15-34 years VS 35-44 years	OR					1.91	0.85
	s.e					(0.94)	(0.28)
	Obs					2,932	2,864
Spell 25-34 years VS 35-44 years	OR					1.32	0.70
	s.e					(0.80)	(0.32)
	Obs					1,469	1,433
15-24 years spell (ref) VS 25-34 VS 35-44	OR					0.62	0.76
	s.e					(0.29)	(0.32)
	OR					0.47	1.11
	s.e					(0.24)	(0.40)
	Obs					2,727	2,670
10 years of employment control		Yes	Yes	Yes	Yes	Yes	Yes

Note: Having an unemployment spell lasting at most 10 years between the ages of 15 and 44 multiplies the probability of reporting mental DD at age 45 by 1.70 when imposing 10 years of employment over the entire career path.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.6.29: Probability of declaring physical injury conditioning on at least 10 years of employment over the life course

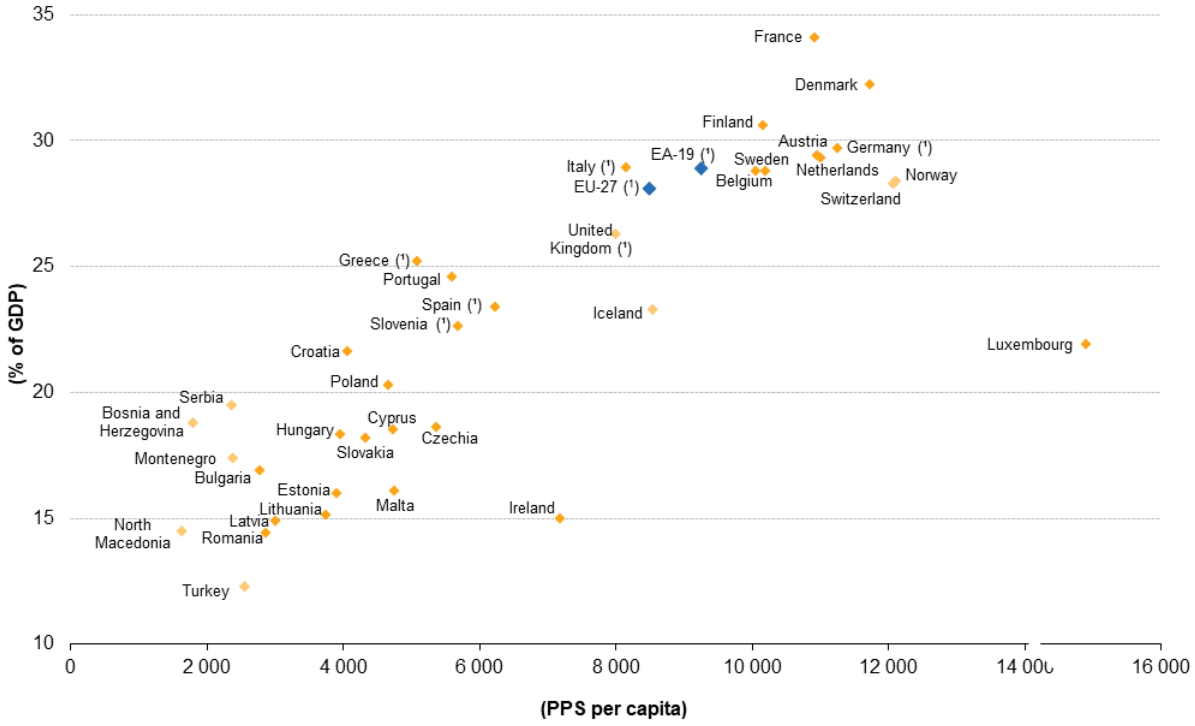
Physical injury		**25 years**	**30 years**	**35 years**	**40 years**	**45 years**	**50 years**
Spell 15-24 years VS no spell	OR	1.18	1.13	0.94	1.00	1.01	1.01
	s.e	(0.23)	(0.19)	(0.16)	(0.14)	(0.13)	(0.12)
	Obs	72,601	72,600	72,592	72,551	72,412	71,759
Spell 25-34 years VS no spell	OR			1.28	1.34*	1.34*	1.21
	s.e			(0.26)	(0.24)	(0.21)	(0.19)
	Obs			72,026	71,987	71,848	71,193
Spell 35-44 years VS no spell	OR					1.17	1.29*
	s.e					(0.19)	(0.18)
	Obs					71,927	71,282
Spell 15-44 years VS no spell	OR					1.19**	1.18**
	s.e					(0.10)	(0.09)
	Obs					74,234	73,530
Spell 15-24 years VS 25-44 years	OR					0.78	0.80
	s.e					(0.14)	(0.13)
	Obs					2,874	2,813
Spell 15-24 years VS 25-34 years	OR					0.85	0.96
	s.e					(0.18)	(0.19)
	Obs					1,950	1,906
Spell 15-24 years VS 35-44 years	OR					0.92	0.86
	s.e					(0.20)	(0.17)
	Obs					2,029	1,995
Spell 15-34 years VS 35-44 years	OR					0.98	0.86
	s.e					(0.19)	(0.15)
	Obs					2,927	2,859
Spell 25-34 years VS 35-44 years	OR					1.15	0.95
	s.e					(0.26)	(0.19)
	Obs					1,465	1,429
15-24 years spell (ref)	OR					1.24	1.10
	s.e					(0.26)	(0.22)
VS 25-34	OR					1.08	1.17
VS 35-44	s.e					(0.23)	(0.23)
	Obs					2,722	2,665
10 years of employment control		Yes	Yes	Yes	Yes	Yes	Yes

Note: Having an unemployment spell lasting at most 10 years between the ages of 15 and 44 multiplies the probability of reporting physical injury at age 45 by 1.19 when imposing 10 years of employment over the entire career path.
Source: SHARELIFE and JEP
Robust s.e in parentheses
*** p<0.01, ** p<0.05, * p<0.1

E. Appendices - Conclusion

E.1 Social protection expenditures

Figure E.1.24: Social protection expenditures in Europe



Source: Eurostat, 2017 data

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