

The Evolution of Income Distribution and Disability in Europe

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Abstract

We investigate how disability affects income distribution and how this has evolved in Europe, using 2005–2008 and 2015–2018 European Union Statistics for Income and Living Conditions data. We model both income and disability processes in a dynamic way, allowing for the possible role of past income in determining disability.

Our findings suggest the decade explored has been characterized by a slight strengthening of income polarization and lower income mobility. However, income inequality evolved differently by disability group: it increased for non-disabled, and decreased for people with severe disabilities and their households. For this latter, our results suggest this evolution can be explained by a worsening of overall income conditions, with greater persistence in poverty, lower persistence in richness, and a higher probability of moving from high to low-income positions. In this respect, increasing social expenditure for disability may be important for the mitigation of such detrimental effects.

Keywords: income distribution; inequality; poverty; Europe; social policies

JEL classification: D31; I14; I32

Introduction

The decade after the Great Recession was characterized by a mixed pattern of poverty and income inequality in Europe. Poverty rates rose right after the Great Recession and in concomitance with austerity measures in many countries. However, poverty rates declined at the end of the '10s, while income inequality changed little over the period¹. While this is true in substance for the overall population, it's not necessarily right for some population subgroups. In this context, people with disabilities and related households, are those who have possibly worsened their income conditions during the last decade. This may result in a relocation along the income distribution, with consequences for poverty rates, within and between income inequality, income polarization, and mobility.

Since the turn of the century, many initiatives have been implemented to remove material and immaterial barriers and support the equality and integration of people with disabilities in society and the economy. These include anti-discriminatory legislations (such as ADA in the US, DDA in the UK, and Law 104/92 and Law 68/99 in Italy during the '90s), the conceptualization of the social model of disability due to the International Classification of Functioning, Disability, and Health (WHO 2001), the adoption of the Convention on the Rights of Persons with Disabilities (UN, 2006), and the European Disability Strategy 2010–2020.

However, the Great Recession and the consequent austerity and fiscal consolidation programs adopted in many European countries to reduce budget deficits and the public debt-to-GDP ratio undermined the potential socioeconomic gains for people with disabilities resulting from the adoption of such initiatives (e.g., Malli et al., 2018).

The employment fall determined by the Great Recession affected comparatively more people with disabilities than the general working-age population in many European countries. Analyzing EU countries, Reeves et al. (2014) emphasize that the employment of people with chronic illnesses and health limitations was disproportionately affected by the Great Recession, especially in countries that experienced a severe fall in income levels and with weak employment protection. Garrido-Cumbrera and Chacon-Garcia (2018) highlight how the 2008 financial crisis in Spain affected people with disabilities to a greater extent than those without disabilities. Evidence from the US (e.g., Livermore and Honeycutt, 2015) has confirmed that the decline in the employment rate among people with disabilities after the Great Recession was greater than that among people without disabilities, given the weaker attachment to the labor force of the former. In addition, most of the countries affected by the Great Recession adopted austerity measures (such as Southern countries and Ireland) that determined severe cuts in public spending especially on social, health, and education services, including

¹ Figures available from the Eurostat at <https://ec.europa.eu/eurostat/web/income-and-living-conditions/data/database>.

those targeted at people with disabilities². Other countries, such as UK and Hungary promoted reforms of their social security and social protection systems to consolidate their budget (Hauben et al. 2012).

These events impacted people with disabilities and their households by affecting employment levels of the former, the amount and the quality of public transfers, and even household members' labor supply (as a result of the increasing need to provide informal care within the family), with important consequences for related household income. This paper offers a novel analysis of how disability affects income conditions in Europe and whether and how this has changed over time, in light of events that shocked economies and public budgets in the last decade. We adopt a European perspective for at least two reasons. First, this goes in the direction of viewing the European Union as a social entity (Atkinson, 1998) and going beyond a national perspective (Fredriksen, 2012). More recently, the EU set out the 2017 European Pillar of Social Rights to design a strong social Europe. Several of the twenty principles are possibly related to the integration of people with disabilities in society, such as those related to equal opportunities, protection from being very poor, and long-term care. The seventeenth one, in particular, declares the right of people with disabilities of being supported to live with dignity and take part in the world around them. Moreover, for several years EU-wide social indicators on income inequality, poverty (and, more in general, social exclusion) have been analyzed. These EU-wide indicators can provide basic information in evaluating the process of the Union toward greater social cohesion. Second, it allows stressing country differences as well as the role of nationally-based social expenditure.

In contrast to other studies (e.g., Jenkins and Rigg, 2004, Parodi and Sciulli, 2008, Dávila-Quintana and Malo, 2012), we do not limit our investigation to poverty conditions; rather, we widen the analysis to the entire income distribution. This would enable us to understand how people with disabilities (and their households) performed not only at the bottom but also in the middle and upper levels of the income distribution. This is important for various reasons. First, employment loss associated with the Great Recession and review of public balances is likely to have affected middle- and high-income households with members with disabilities. Considering that employed disabled persons are less at risk of poverty than non-employed ones, the reduction of the employment rate for people with disabilities has potentially greatly affected not poor households. Similar effects may have risen from the non-indexation of invalidity benefits above a certain threshold. Finally, cuts to long-term care have potentially increased the need for informal care provided within households, particularly by women (e.g., Siegel, 2006, Parodi and Sciulli, 2019), with greater detrimental effects on the incomes of double-earner households. Second, focusing on the whole distribution may help to study the contribution of disability to persistence and mobility in low and high-income conditions and how this changed over time.

² In many countries, austerity measures provided for the temporary decline of disability benefits, the revision of indexation mechanisms for invalidity benefits, the decrease of public spending for the state financing of social care and assistance, the reduction or abolition of funds for the long-term care sector (Horstmann, 2011).

This may help to characterize the evolution of income inequality, including within and between groups inequality, and to identify possible polarization in income distribution in Europe, a phenomenon whose importance has been recently stressed by Wang et al. (2018).

The analysis exploits the 2005–2008 and 2015–2018 longitudinal sections of the European Union Statistics for Income and Living Conditions (EU-SILC) database. We explore fifteen European countries for which the information for the outcomes of interest is available. With the aim of identifying persistence and transitions across income positions, we split income distribution into four income groups (poor, lower-middle class, upper-middle class, and higher-income class) defined on the basis of the median equivalent income, in the spirit of the definition of poverty. The calculation of reference income accounts for the extra costs of disability by adopting the disability-adjusted equivalence scale proposed by Kuklys (2005).

When studying how disability affects income positions, one must consider that disability conditions might be predetermined by past income conditions (e.g., Jenkins and Rigg, 2004). We deal with the dynamic interrelated structure of the income–disability relationship by estimating a dynamic bivariate ordered probit model, which relaxes the assumption of the strict exogeneity of disability and models both income and disability processes by assuming disability may be determined by past income conditions. Definitively, our model accounts for genuine state dependence, correlated random effects, initial conditions, and feedback effects from past income to disability. We focus on two periods: before and after the Great Recession and the application of austerity measures. This enables us to uncover the sources of persistence and mobility across income positions and how these have changed over time and to evaluate the evolution of income inequality for relevant subgroups of the European population.

Our findings suggest an overall situation characterized by a slight strengthening of income polarization, lower mobility across the top and bottom income groups, and an increasing lock-in effect of poverty. In this context, we find that disability deteriorates income conditions, mostly for people with severe disabilities and their households, which was exacerbated in the post-recession period. They experienced a relatively greater increase in poverty state dependence, a decrease in the probability of remaining in high-income positions, and a higher risk of moving from high to low-income positions. The analysis at the country level substantially confirms these results. We note the detrimental effect of severe disabilities on the risk of poverty has increased strongly in several countries involved in severe cuts in public spending on social functions during the application of austerity measures or in reforms of social security systems. This includes Czechia, Greece, Italy, Hungary, the Netherlands, Portugal, and the UK. However, we stress that increasing the social expenditure for disability may be important for the mitigation of such detrimental effects.

This paper is organized as follows. Section 2 reviews the existing literature. Section 3 presents the dataset and provides a descriptive analysis. The empirical model is described in Section 4. Section 5 discusses the main findings, and Section 6 offers some concluding remarks.

2. Literature

The effects of the Great Recession on household income inequality and poverty in Europe have been widely debated in the literature (e.g., Jenkins et al., 2012; Medialdea-García and Sanabria-Martín, 2022). Some efforts have been made to explore the effects of such a shock on employment and living conditions/social exclusion of the disadvantaged population category of people with disabilities.

There is a strand of literature dealing with the effects of the Great Recession on the living conditions of disabled people (Malli et al., 2018; Maggini et al., 2021; Jones et al., 2021; Kaye, 2010).

Malli et al. (2018), for instance, suggest that equality and the integration of people with disabilities were weakened by the Great Recession and the consequent austerity and fiscal consolidation programs adopted in many European countries. Across European Union countries, the impact of the 2008 financial crisis and the subsequent austerity measures implemented by governments, especially in some countries, led to a drop in public services and further exacerbated growing inequalities, especially for the already disadvantaged category of disabled people (Maggini et al., 2021).

Jones et al. (2021) explore the experience of disabled employees in the UK during the Great Recession. The results suggest the cyclicity of the in-work experience of disabled employees, as they are more likely to report being affected by recession-induced change—particularly in relation to workload, work organization, wages, and training—compared to non-disabled employees.

Kaye (2010) finds strong evidence that the 2007–2009 downturn disproportionately affected workers with disabilities in the US, resulting in an important decline in the presence of disabled people in the employed labor force, and especially for men, those with low levels of education and, more generally, workers in low-skilled occupations.

More generally, the literature on disability and living standards both in developing and developed countries has stressed the disadvantage of people with disabilities. Within this literature, studies have mainly focused on the relationship between disability and income poverty (e.g., Jenkins and Rigg, 2004; Parodi and Sciulli, 2008; Dávila-Quintana and Malo, 2012), with some contributions widening their view to social exclusion and/or multidimensional measures of living standards and subjective well-being (i.e., Gannon and Nolan, 2007; Jones et al., 2018; Parodi and Sciulli, 2019). Few studies have focused on disability, or more generally health, and material deprivation (i.e., Mussida and Sciulli, 2022a).

Jenkins and Rigg (2004) investigate the economic disadvantage experienced by working-age disabled persons in the UK. Their findings suggest that employment rates fall with disability onset and continue to fall the longer a disability

spell lasts, whereas average income falls sharply with onset but then subsequently recovers. Parodi and Sciulli (2008) find evidence that Italian households with disabled members incur a higher risk of income poverty compared to households without disabled members and stress the role of disability benefits to mitigate this disadvantage. Adopting a dynamic approach, Dávila-Quintana and Malo (2012) investigate the impact of disability on income poverty in Spain and find that being disabled increases the probability of being poor and that the probability increases in the long term.

Turning to the literature on the relationship between disability and social exclusion, Gannon and Nolan (2007) studied differences in the dynamics of social inclusion between people with and without disabilities, focusing on Ireland. The authors find that both persistent disability and disability onset determine a lower chance of being socially included, in terms of poverty and social participation. Further, Jones et al. (2018) find a negative effect at disability onset on the probability of employment and life satisfaction in Australia. More recently, in line with studies that stress the use of multidimensional measures of living standards, Parodi and Sciulli (2019) investigate how the presence of disabled member(s) affects a household's risk of being socially excluded in Italy. The authors find that the presence of severely disabled member(s) increases the probability of being socially excluded. Mussida and Sciulli (2022a) offer a dynamic analysis of material deprivation in Italy, examining the indicators for material and social and material deprivation and looking extensively at the role of disability. The results indicate that disability tends to worsen the living conditions of households already disadvantaged in Italian society, such as those with low educated, older, and female heads of household, as well as singles and households characterized by low work intensity.

Examining the existing literature reveals a lack of studies specifically focused on disability and poverty persistence across the overall income distribution by exploring Europe as a whole. In this work, we aim to fill this gap in the literature by exploring the evolution of disability effects along the overall income distribution in Europe. This enables us to uncover the possible sources of persistence and mobility across income positions and how these have changed over time, as well as to evaluate the evolution of income inequality for relevant subgroups of the European population.

3. Data

We explore the periods 2005–2008 and 2015–2018 by using two short panels from the longitudinal sample of the European Union Statistics on Income and Living Conditions (EU-SILC) survey.

The survey is conducted in most countries across the European Union by the relevant National Institutes of Statistics using harmonized questionnaires and survey methodologies. The EU-SILC is a rotating panel survey with a 75% overlap of samples in successive years. Each panel is independent of the other and representative of the EU population. We explore fifteen European countries for which the information on income and disability is available and

with reasonable sample sizes. This selection leaves us with a total of 180,166 and 286,156 observations for the 2005-2008 and 2015-2018 periods, respectively.

We focus on the relationships between the phenomena of at-risk-of-poverty and disability, as measured by limitations in daily activities, and our units of analysis are the individuals. In our sample, we identify three groups of individuals: 1. those living in households without any person with a disability; 2. those living in households with at least a person with a moderate disability; 3. those living in households with at least a person with a severe disability.

The dependent variables used in our investigation, which includes two equations (see Section 4), are income groups obtained by considering the at-risk-of-poverty threshold and corrected for disability, and disability-level groups.

With the aim of carrying out a detailed analysis across the overall income distribution (by the level of disability), we identify four income groups, or income positions, with respect to the national median equivalized income. The equivalized income is the total disposable household income (after taxes and social transfers) divided by an equivalence scale that gives weight to each person in the household. For households without disabled members and with members with some disabilities, the scale coincides with the modified OECD scale, whereas for households with severely disabled members we use the disability-corrected equivalence scale suggested by Kuklys (2005).³ In this scale, the limitations on individuals' daily activities due to disability are taken into account by assigning a different weight to persons with a disability. Moreover, we correct the reference income for purchasing power parities and price level using the Harmonized Index of Consumer Prices (HICP) and take 2015 as the reference year. The four groups we consider are up to 60% of the national median equivalized income (poor), (60%; 100%] (lower-middle income), (100; 150] (upper-middle income), and 150% and over (higher-income).

As for disability, the EU-SILC survey provides information on individual disability status based on a question about limitations in daily activities that arise due to health problems (variable PH030 in the EU-SILC code). This information enables us to distinguish among different severity levels of disability, namely severe activity limitations, some limitations, and no limitations.

We now briefly describe the covariates used, keeping in mind that due to the frameworks employed, we also include lagged dependent variables and initial condition, as well as the average and initial values of time-varying covariates. Descriptive statistics of covariates by time period and disability group are reported in Table A1.

Our control variables can be classified into individual and household characteristics. Individual characteristics refer to the characteristics of the head of the household, which is considered as representative of the other household

³ Modified OECD scale: $1 + 0.5(N_A - 1) + 0.3 N_{CH}$; disability-corrected equivalence scale: $1.56[1 + 0.5(N_D - 1)] + 0.5(N_A - N_D) + 0.3N_{CH}$, where N_A , N_{CH} , and N_D are the number of adults, children, and disabled persons in the household. For households without disabled persons, a weight of 1.0 is assigned to the first adult, 0.5 to the second and each subsequent person aged 14 and over, and 0.3 to each child under 14. When there is one disabled adult in the household, the weight is 1.56.

members. The variables include age ranges from less than 25 years to more than 64 years of age, gender, education, and marital status. Notably, we have added some potentially relevant individual controls in the disability equation: a dummy variable for disabled individuals of working age (1 if the disabled person is aged 16–60, 0 otherwise), a dummy variable for disabled individuals with low education (1 if the disabled person is educated only to a primary level, 0 otherwise), and a dummy variable for the gender of the disabled individual (1 if female, 0 otherwise). Household characteristics include controls for the presence of children aged from 0 to 15 years, home ownership, and work intensity. Work intensity is calculated as “the number of months that all working-age household members have been working during the income reference year as a proportion of the total number of months that could theoretically be worked within the household.”⁴ In this study, we follow the EU-SILC survey and group work intensity into four categories (variable HX020 in the EU-SILC questionnaire): 0, (0, 0.5), [0.5, 1), and 1. We also extend the Eurostat definition of work intensity to account for part-time employment, which may represent an opportunity to reconcile work and the informal care of disabled household members. We assume that part-time employment is equivalent to 50% of full-time employment; therefore, months worked part-time are down-weighted by 50% when computing the total months worked.⁵ In addition, we also include the variable ‘pensioner’ which indicates the households only include individuals in retirement age. We control for some types of social expenditures at the country level which are expenditures for disability, sickness/health care, and social exclusion.⁶ Finally, we control for country dummy variables, and, as we work with panel data, for years.

3.1 Descriptive analysis

This section provides preliminary evidence regarding disability and income inequality in fifteen European countries, using various inequality indicators and investigating the evolution between the pre- and post-Great Recession periods.

First, we analyze income inequality by reporting results from alternative inequality indices in Table 1 (Gini, Theil, and Atkinson ($\epsilon=1$) indices). According to the Gini and Atkinson indices, income inequality for the overall population has slightly decreased from 2005-2008 to 2015-2018 periods, with the former index going from 0.337 to 0.329 and the latter from 0.187 to 0.182. The Theil index, instead, indicates that income inequality has increased after the Great Recession, being passed from 0.200 to 0.235. The different evolution described by mentioned indices is possibly guided by the sensitivity to income differences in the upper part of the distribution, which is particularly high for the Theil index. By

⁴ For details, see the Eurostat website: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Persons_living_in_households_with_low_work_intensity.

⁵ From Table A1, we note that there was a substantial increase in WI=0 for household with members with disabilities (from 35.5 to 44.6% for moderate disability, and from 48.5 to 57.2% for severe disability). This increase is relatively greater than the one observed for non-disabled group, a result which is consistent with the hypothesis that people with disabilities and their households experience a greater loss of employment opportunities in the post-recession period.

⁶ Figures are available from the Eurostat at https://ec.europa.eu/eurostat/databrowser/view/SPR_EXP_SUM_custom_3614451/default/table

exploiting the decomposability property of both Theil and Atkinson indices, we highlight the contribution of within and between inequality to the overall levels. First, the within component is predominant concerning the between one. In line with the overall inequality, within-inequality has increased according to the Theil index and slightly decreased according to the Atkinson index. The between-inequality instead has increased according to the Theil index and remained stable according to the Atkinson index.

When investigating differences at the disability level (bottom part of Table 2), the indices reveal consistent patterns and indicate that inequality has slightly increased for the non-disabled group and decreased for people with disabilities (especially for those with severe disabilities) and their household members.

	Gini index		Theil index		Atkinson index ($\epsilon=1$)	
	2005-2008	2015-2018	2005-2008	2015-2018	2005-2008	2015-2018
All	0.337	0.329	0.200	0.235	0.187	0.182
<i>Within</i>	-	-	0.192	0.225	0.179	0.175
<i>Between</i>	-	-	0.008	0.010	0.009	0.009
Non-disabled	0.326	0.327	0.189	0.252	0.177	0.183
Moderate	0.332	0.305	0.196	0.165	0.180	0.157
Severe	0.348	0.302	0.204	0.162	0.195	0.152

Table 1. Inequality indices by disability status

Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Note equivalent income adjusted for disability.

A further investigation based on the study of kernel density of within-group distributions at the country level may help us to interpret evidence established on inequality indices. Figure A1 compares, country by country, the kernel density of income distribution for non-disabled and severely disabled for the 2005-2008 and 2015-2018 periods⁷. First, we note that the severe disability group shows lower income than the non-disabled group in each country, for both pre and post-Great Recession periods. The detrimental effect associated with a disability varies across countries and has evolved differently over time. Despite this, we identify a predominant pattern in the analyzed data. In most cases, the income distribution moved to the right (especially in Eastern European countries) or remained substantially stable after the Great Recession for the non-disabled group, except Cyprus, Greece, Italy, and the UK. On the contrary, people with severe disabilities and their households have mainly experienced worsening (or stable) income conditions after the Great Recession. The exceptions are represented by some Eastern countries (Estonia, Lithuania, and Latvia), Belgium, and Ireland. Among countries that experienced worsening income conditions, Portugal and, especially, the UK stands out. Cyprus, France, Greece, Italy, and the Netherlands are other countries in this subgroup. People with disabilities and their households have generally experienced a loss of income in relative terms compared to non-disabled. In addition, higher-income people with disabilities (and their households) appear to have suffered a greater worsening of income levels than poor people

⁷ For better readability we plot incomes included in the [0, 75000] range. This excludes just 0.5% of observations.

with disabilities (and their households), possibly leading to a decline of within-group income inequality, as suggested by inequality indices.

These findings are reflected by evidence that emerges from the analysis of the distribution of disability status in the income groups (Table 2)⁸. The share of people with severe disabilities and related household members within the poor group increased from 33.7% to 38.4% after the Great Recession, while the share of higher-income people with severe disabilities and related household members declined from 8.8% to 6.5%. Looking at the middle of the income distribution, the disabled group increased in the lower part, while decreased in the upper-middle (by almost 5% in absolute terms). The share of people without disabilities in the lowest and lower-middle parts of the income distribution declined from 2005-2008 to 2015-2018, while those in the upper-middle and highest part increased. At the overall level, these patterns resulted in a slight income polarization.

	Poor		Lower-middle		Upper-middle		Higher-income	
	2005-2008	2015-2018	2005-2008	2015-2018	2005-2008	2015-2018	2005-2008	2015-2018
All	16.76	17.19	33.28	32.85	28.99	29.24	20.96	20.72
No disability	14.27	13.33	30.20	29.84	30.94	31.95	24.59	24.88
Disability	15.97	15.24	35.75	35.51	28.75	30.84	19.53	18.40
Severe disability	33.72	38.40	38.24	40.68	19.24	14.41	8.80	6.51

Table 2. Income conditions by disability group: 2005-2008 vs 2015-2018

Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Note equivalent income adjusted for disability.

4. The econometric approach

We provide a quantitative analysis of how disability affects income distribution using a dynamic bivariate random effects ordered probit model. This allows us to model both the income and disability processes, accounting for genuine state dependence, correlated random effects, and endogenous initial conditions. Our approach also takes into account that the income–disability link may be driven by potential feedback effects from income to future disability status, that is, the possibility that income shocks may affect the onset of the disability and its duration (e.g., Jenkins and Rigg, 2004), thus enabling us to relax the assumption of strict exogeneity of disability in the income equation. Our model extends a methodology previously proposed by Biewen (2009) and Ayllón (2015) to study poverty dynamics in the presence of feedback effects to the study of the income distribution and its dynamics. Moreover, part of this dynamic specification is based on the one established by Contoyannis et al. (2004) for self-perceived health, which has been applied to health limitations also by Hernández-Quevedo et al. (2007).

⁸ The cut-off points to identify the four income groups are the following ones: 7668 euros, 12780 euros (the median) and 19170 euros in the 2005-2008 period; 7760 euros, 12932 euros (the median) and 19398 euros in the 2015-2018 period. These values originates from equalized country-level income distribution, once PPP and disability-adjustment scale were accounted for.

We assess how disability-related effects have evolved over time by applying the model to two different timespans, the 2005–2008 pre-Great Recession period and the 2015–2018 post-Great Recession one.

Let us define y_{it} as the (disability-adjusted) income status and d_{it} as the disability status, where $i=1 \dots N$ are the individuals and $t=1 \dots T$ refers to the years analyzed. We define the latent propensity of income and disability in equations 1 and 2, respectively. Specifically, the latent income propensity y_{it}^* reads as:

$$y_{it}^* = \alpha_1 y_{it-1} + \alpha_2 d_{it} + \alpha_3 d_{it-1} + \alpha_4 x_{it} + \alpha_5 z_i + h_i + u_{it}, \quad (1)$$

while the latent disability propensity d_{it}^* reads as

$$d_{it}^* = \beta_1 d_{it-1} + \beta_2 y_{it-1} + \beta_3 x_{it} + \beta_4 z_i + \beta_5 r_{it} + g_i + v_{it}. \quad (2)$$

For each unobserved latent propensity variable, we can identify a corresponding observable ordinal variable that identifies the income and disability outcomes. The former is expressed in equation 3, while the latter is reported in equation 4:

$$y_{it} = \begin{cases} 1 & \text{if } y_{it}^* \leq c_1, \\ 2 & \text{if } c_1 < y_{it}^* \leq c_2, \\ 3 & \text{if } c_2 < y_{it}^* \leq c_3, \\ 4 & \text{if } y_{it}^* > c_3, \end{cases} \quad (3)$$

$$d_{it} = \begin{cases} 0 & \text{if } d_{it}^* \leq k_1, \\ 1 & \text{if } k_1 < d_{it}^* \leq k_2, \\ 2 & \text{if } d_{it}^* > k_2, \end{cases} \quad (4)$$

where y_{it-1} is the lagged (disability-adjusted) income status and d_{it-1} is the lagged disability status, while x_{it} and z_i are vectors of strictly exogenous time-variant and time-invariant (respectively) individual and household characteristics. r_{it} is a vector of strictly exogenous characteristics of household members with a disability. α_1 and β_1 are vectors of state dependence parameters for income and disability, respectively. The vectors of parameters α_2 and α_3 identify the effect of current and past disability on income positions, respectively, while the vector of parameters β_2 identifies the presence of feedback effects from past income to disability. $\alpha_4, \alpha_5, \beta_3, \beta_4$ and β_5 , are sets of parameters to be estimated. The terms h_i and g_i represent the unobserved time-invariant individual effects for the analyzed processes, while u_{it} and v_{it} are the idiosyncratic error terms for income and disability processes, which we assume to be normally distributed with zero mean and unit variance and not serially correlated.⁹ Finally, c_1, c_2, c_3, k_1 , and k_2 are threshold parameters to be estimated.

Because of the dynamic structure of the model and the possibility the start of the observed data does not coincide with the start of the analyzed process, an initial conditions problem arises (Heckman, 1981). We deal with this by adopting the Wooldridge method (2005), according to the version proposed by Rabe-Hesketh and Skrondal (2013), which involves the use of an alternative conditional maximum likelihood (CML) estimator that considers the distribution conditional on

⁹ Assuming error terms are not serially correlated is necessary to avoid excessive computational burdens (see Biewen, 2009).

the value in the initial period. In addition, we incorporate the Mundlak method (1978) to relax the assumption that individual-specific random effects are independent of other covariates, and we assume correlated random effects. Thus the auxiliary models definitively read as:

$$h_i = \gamma_0 + \gamma_1 y_{i1} + \gamma_2 d_{i1} + \gamma_3 \bar{x}_i + \gamma_4 x_{i1} + \mu_i, \quad (5)$$

$$g_i = \delta_0 + \delta_1 y_{i1} + \delta_2 d_{i1} + \delta_3 \bar{x}_i + \delta_4 x_{i1} + \delta_5 \bar{r}_i + \delta_6 r_{i1} + \varepsilon_i, \quad (6)$$

where y_{i1} is the initial (disability-adjusted) income status and d_{i1} is the disability status at time 1. \bar{x}_i is a set of time-averaged time-variant control variables calculated from periods 2 to T, and x_{i1} is a set of initial values of time-varying covariates. $\gamma_1, \gamma_2, \gamma_3, \gamma_4, \delta_1, \delta_2, \delta_3, \delta_4, \delta_5,$ and δ_6 are sets of parameters to be estimated. Finally, the terms μ_i and ε_i are the residual unobserved heterogeneity, which is assumed to be independent of observed characteristics.

Because unobserved individual characteristics that make it more likely to be disabled might also make people more likely to be poor, it may be important to model the correlation between unobserved heterogeneity terms to avoid this correlation determining a bias of disability status on income conditions. Thus, we assume that income and disability equations are linked via random effects and that they are drawn from a bivariate normal distribution with zero mean and variance σ^2 . Their association is captured by the correlation term $\rho = \text{corr}(\mu_i, \varepsilon_i)$, which represents the correlation between unobservable factors of the outcomes considered. The significance of the correlation term would be suggestive of the importance of using a joint estimation approach to avoid inconsistent estimates (e.g., Ayllón, 2015).

Finally, because the estimated coefficients describe the sign of the relationship but are inappropriate for determining the magnitude of the impact between outcome and explanatory variables, we compute and report the average marginal effects (AMEs).

5. Results

In this section, we present the results (AMEs) of the quantitative analysis. Section 5.1 describes the dynamic across income groups and how disability affects income conditions. Section 5.2 examines evidence from the interaction analysis between past income conditions and disability, while Section 5.3 describes the disability effect along the income distribution at the country level. For each aspect, we stress the possible changes over time during the decade explored which includes the Great Recession and the implementation of austerity measures.

5.1 Income dynamics and the role of disability for income distribution

Tables 3a-3d reports the main results from the income equation for each income class. The upper part of each table illustrates the role of genuine state dependence/mobility and initial conditions in the income groups, while the bottom part reports AMEs related to the effect of disability on income positions. We find evidence of genuine state dependence

in poverty—that is, being currently poor increases the probability of experiencing poverty in the future (Table 3a). This suggests that experiencing poverty may determine poverty-trap effects, possibly because of individual disincentives to escape poverty in an effort to retain public support measures or because of detrimental phenomena such as demoralization, the obsolescence of human capital, and unhealthy behaviors associated with low-income conditions. Interestingly, we note that the mentioned poverty-trap effect increased after the Great Recession, with the genuine state dependence parameters for the poor income group going from 0.098 to 0.141. This is in line with the results of Mussida and Sciulli (2022b), which stressed the importance of public policies to contrast such an increasing poverty-trap effect. Additionally, our analysis shows that genuine state dependence for higher-income has also increased (from 0.070 to 0.092, Table 3d), as it is in the lower-middle group, although the increase is moderate for the latter (from 0.030 to 0.040, Table 3b). In the same time period, year-by-year mobility across the top and bottom groups have declined. Considering that the base category is the upper-middle class, the probability of moving from richness to poverty decreased from -0.041 in 2005–2008 to -0.049 in 2015–2018 (Table 3a), while the probability of moving from poverty to richness decreased from -0.086 in 2005–2008 to -0.109 in 2015–2018 (Table 3d). Looking at the middle of the income distribution, we note an increase in the probability of moving from richness to upper-middle income class (from 0.024 in 2005–2008 to 0.033 in 2015–2018, Table 3c). All in all, these findings suggest that the period after the Great Recession and the application of austerity measures has been characterized in general by a worsening of income condition, with a strengthening of income polarization and the crystallization of income positions.

The analysis of initial income status offers some additional insights. The statistical significance of that variable suggests that initial conditions and unobserved heterogeneity are correlated and indicates the importance of accounting for the initial conditions problem (Heckman, 1981). Interestingly, jointly evaluating the AMEs associated with past and initial income status allows us to uncover how lock-in effects in poverty and richness evolve over time. In particular, if the AME associated with past income status is smaller than that associated with initial income status, this should be indicative that the lock-in effect of previous income status increases over time (e.g., Ayllón, 2015). Since we noted that AMEs associated with past poverty were 0.098 for the 2005–2008 period and 0.141 for 2015–2018 one, and being those associated with initial low-income status equal to 0.318 in 2005–2008 and 0.302 in 2015–2018, we can conclude that the lock-in effect strengthened over time at the bottom of the income distribution in both time periods. This strengthening, however, was a little more relevant in the pre-crisis period. An increase in lock-in effects emerges also at the top of the income distribution, as the AMEs associated with an initial higher-income status are 0.243 in 2005–2008 and 0.305 in 2015–2018 (being those associated with past higher-income status equal to 0.070 and 0.092, respectively).

Focusing on disability effects, we find evidence of a sharp deterioration of the income conditions of people with severe disabilities and their households after the Great Recession. Being or living with a person with a severe disability

increased one's probability of being poor by 13.7% in 2005–2008, and the detrimental effect increased to 18.7% in 2015–2018. Similarly, being or living with a person with a severe disability decreased the probability of being in the high-income group by 10.8% in 2005–2008, and the detrimental effect increased to –13% in 2015–2018. In addition, the probability of being in the lower-middle income group increased slightly, while the probability of being in the upper-middle group decreased. Interestingly, for the moderate disability group there was only a slightly worsening, and of the same magnitude, of income conditions in the 2015–2018 (+0.3% for poor, and -0.3% for higher-income). Finally, the analysis of previous disability conditions (i.e., disability at time $t-1$ and time 0) reveals that the association between disability and income positions sees its sign reversed in the medium/long term. This result recalls evidence by Meyer and Mok (2019), which indicated that economic outcomes such as working hours, earnings, and consumption decline before the onset of the disability and may or may not recover some years later, depending on the nature of the disability. In particular, they noted the decline is sharp and long-lasting for chronic-severe disability while it is short-term for temporary disability.

Outcome: POOR	2005-2008		2015-2018			
	AME	s.e.	AME	s.e.		
<i>Income time t-1</i>						
Poor	0.098	0.004 ***	0.141	0.004 ***		
Lower-middle	0.039	0.002 ***	0.056	0.002 ***		
Upper-middle			(base category)			
Higher-income	-0.041	0.002 ***	-0.049	0.001 ***		
<i>Income time 0</i>						
Poor	0.318	0.006 ***	0.302	0.004 ***		
Lower-middle	0.093	0.002 ***	0.096	0.002 ***		
Upper-middle			(base category)			
Higher-income	-0.029	0.001 ***	-0.033	0.001 ***		
<i>Disability</i>						
None			(base category)			
Moderate	-0.003	0.001 *	0.003	0.001 *		
Severe	0.137	0.005 ***	0.187	0.003 ***		
<i>Disability time t-1</i>						
None			(base category)			
Moderate	0.010	0.002 ***	0.001	0.002		
Severe	-0.017	0.003 ***	-0.032	0.003 ***		
<i>Disability time 0</i>						
None			(base category)			
Moderate	0.003	0.002	0.004	0.002 **		
Severe	-0.045	0.003 ***	-0.059	0.002 ***		

Table 3a. Income equation for poor income class. Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Notes: countries explored: Belgium, Cyprus, Czechia, Estonia, Spain, France, Greece, Hungary, Ireland, Italy, Lithuania, Latvia, Netherlands, Portugal, and the UK; equivalent income adjusted for disability; control variables are accounted for.

Outcome: LOWER-MIDDLE	2015-2018		2005-2008			
	AME	s.e.	AME	s.e.		
<i>Income time t-1</i>						
Poor	0.056	0.003	***	0.060	0.002	***
Lower-middle	0.030	0.002	***	0.040	0.002	***
Upper-middle	(base category)					
Higher-income	-0.053	0.003	***	-0.076	0.003	***
<i>Income time 0</i>						
Poor	0.178	0.004	***	0.182	0.003	***
Lower-middle	0.174	0.005	***	0.171	0.004	***
Upper-middle	(base category)					
Higher-income	-0.208	0.004	***	-0.239	0.003	***
<i>Disability</i>						
None	(base category)					
Moderate	-0.002	0.001	*	0.001	0.001	*
Severe	0.038	0.001	***	0.013	0.001	***
<i>Disability time t-1</i>						
None	(base category)					
Moderate	0.004	0.001	***	0.000	0.001	
Severe	-0.009	0.002	***	-0.011	0.001	***
<i>Disability time 0</i>						
None	(base category)					
Moderate	0.001	0.001		0.001	0.000	**
Severe	-0.025	0.002	***	-0.024	0.001	***

Table 3b. Income equation for lower-middle income class. Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Notes: countries considered: Belgium, Cyprus, Czechia, Estonia, Spain, France, Greece, Hungary, Ireland, Italy, Lithuania, Latvia, Netherlands, Portugal, and the UK; equivalent income adjusted for disability; control variables are accounted for.

Outcome: UPPER-MIDDLE	2005-2008		2015-2018			
	AME	s.e.	AME	s.e.		
<i>Income time t-1</i>						
Poor	-0.068	0.004	***	-0.092	0.004	***
Lower-middle	-0.027	0.002	***	-0.038	0.002	***
Upper-middle	(base category)					
Higher-income	0.024	0.001	***	0.033	0.001	***
<i>Income time 0</i>						
Poor	-0.358	0.007	***	-0.359	0.007	***
Lower-middle	-0.161	0.005	***	-0.169	0.005	***
Upper-middle	(base category)					
Higher-income	-0.006	0.003	***	-0.032	0.004	***
<i>Disability</i>						
None	(base category)					
Moderate	0.001	0.001	*	-0.001	0.001	**
Severe	-0.067	0.003	***	-0.070	0.002	***
<i>Disability time t-1</i>						
None	(base category)					
Moderate	-0.004	0.001	***	0.000	0.001	
Severe	0.007	0.001	***	0.013	0.001	***
<i>Disability time 0</i>						
None	(base category)					
Moderate	-0.001	0.001		-0.002	0.001	**
Severe	0.017	0.001	***	0.023	0.001	***

Table 3c. Income equation for upper-middle income class. Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Notes: countries explored: Belgium, Cyprus, Czechia, Estonia, Spain, France, Greece, Hungary, Ireland, Italy,

Lithuania, Latvia, Netherlands, Portugal, and the UK; equivalent income adjusted for disability; control variables are accounted for.

Outcome: HIGHER-INCOME	2005-2008			2015-2018		
	AME	s.e.		AME	s.e.	
<i>Income time t-1</i>						
Poor	-0.086	0.003	***	-0.109	0.002	***
Lower-middle	-0.043	0.002	***	-0.058	0.002	***
Upper-middle	(base category)					
Higher-income	0.070	0.004	***	0.092	0.003	***
<i>Income time 0</i>						
Poor	-0.139	0.002	***	-0.125	0.002	***
Lower-middle	-0.105	0.002	***	-0.098	0.002	***
Upper-middle	(base category)					
Higher-income	0.243	0.007	***	0.305	0.006	***
<i>Disability</i>						
None	(base category)					
Moderate	0.003	0.002	*	-0.003	0.001	**
Severe	-0.108	0.003	***	-0.130	0.002	***
<i>Disability time t-1</i>						
None	(base category)					
Moderate	-0.010	0.002	***	-0.001	0.001	
Severe	0.019	0.003	***	0.030	0.002	***
<i>Disability time 0</i>						
None	(base category)					
Moderate	-0.003	0.002		-0.004	0.001	**
Severe	0.054	0.004	***	0.060	0.003	***

Table 3d. Income equation for higher-income class. Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Notes: countries explored: Belgium, Cyprus, Czechia, Estonia, Spain, France, Greece, Hungary, Ireland, Italy, Lithuania, Latvia, Netherlands, Portugal, and the UK; equivalent income adjusted for disability; control variables are accounted for.

The main results for the disability equation are reported in Table A3. At the top, we report both lagged and initial income, while at the bottom we show lagged and initial disability conditions. We note that being poor in the previous period does not exert a role on either degree of disability (moderate or severe) and does not change with the Great Recession, while if we move to the initial values, we find some significant associations (for both moderate and severe disability), especially for poor income condition. In particular, we note that being poor at time 0 increases by 1.6 p.p. the probability of being severely disabled in the 2005-2008 period and by 0.8 p.p. in the 2015-2018 one. This suggests the existence of feedback effects from poverty to disability in medium-term which, however, has weakened in the post Great Recession period. We also find the presence of state dependence for severe disability that does not change with the Great Recession. Moreover, severe disability is mutually reinforcing, as a lagged status of severe (moderate) disability is positively associated with current severe disability. Additional insights emerge if we consider the initial disability status. Here, we note that the AME associated with initial severe disability status is higher than that associated with lagged severe disability status. This

should be indicative of the fact that the lock-in effect of previous severe disability condition status decreases over time. Table A4 reports the AMEs of covariates of disability equation for severe disability outcome. As for household characteristics, we see that all the age range of the head of household other than the oldest (age over 64) lose significance with the Great Recession. Being in a household with a female head, instead, is negatively associated with severe disability in both periods. Notably, looking at the individual characteristics of the disabled individual, we see that being a low educated female in working age increase the probability of being severely disabled. Notably, the most relevant effect is the one of a double discrimination collected by disabled female individual both before and during the recession (0.508 pp. and 0.466 pp., before and after the recession, respectively). From the bottom of Table A4, we see that the effect of all the kind of social expenditures considered is relatively low in magnitude.

Finally, we stress the term ρ which measure the correlation between unobservable factors of both equations is negative both in pre and post Great Recession periods. This is possibly indicative that confounding factors which tend to increase the probability of being severely disabled also decreases the probability of being higher-income.

5.2 Income state dependence and mobility by disability group

In a supplementary analysis, we investigate the joint effect of past income conditions and disability on income poverty. We estimate a model including the interaction between past income status (considering the income groups defined in Section 3) and disability level before and after the Great Recession. The aim of this exercise is to see whether and how the dynamic of income conditions of the non-disabled group and those with different degrees of disability changed with the crisis. For the sake of brevity, we focus only on the interactions for the poor and lower-middle income groups. The results for persistence (in poor and lower-middle) and mobility (from poor to lower-middle and vice versa) by disability status are reported in Figure 1. Here, we find the four combinations/graphs of past and current income condition/status (poor and/or lower-middle) associated with the three disability group considered, that are not disabled, disabled, and severely disabled before (pre-) and after (post-) the Great Recession for the poor and the lower-middle income. At the top left, we find the interactions for the persistently poor in both periods, meaning no change in income status. We note changes in the same direction for the disability categories investigated. Nonetheless, while we see a negligible increase in persistence for both non-disabled and disabled from the pre- to post-Great Recession period (from 0.164 pp. to 0.187 pp. and from 0.177 to 0.211, respectively), the increase was relatively higher in magnitude for disabled with severe activity limitations (from 0.387 pp. before the recession to 0.462 pp. after).

If we consider income mobility, and specifically a movement from lower-middle to poor, is there a change in the interaction with disability with the Great Recession? From the graph on the top right (of Figure 1), we see that if there is a worsening of income condition (from lower-middle to poor), there are changes of different sign the groups of non-

disabled and (especially) severely disabled. While the change between the pre- and post- periods for the non-disabled remained almost unchanged with a slight reduction (declining from 0.119 pp. to 0.116 pp.), for severely disabled there was an increase (from 0.268 pp. to 0.331 pp.). These changes signal that with the Great Recession there was a slight improvement of the income conditions of non-disabled group, and a worsening of the conditions of people with severe disability. At the bottom left, instead, we note that for an improvement in income status from poor to lower-middle, the changes from the pre- to the post-Great Recession period are negligible.

At the bottom right, we find the results for the persistently lower-middle income who remain lower-middle income in both periods. Notably, with the Great Recession we see that while there is an improvement in income conditions for non-disabled (and moderately disabled) individuals (from 0.401 pp. to 0.410 pp.), there is a worsening for severely disabled individuals which decrease their persistence in the status of lower-middle (from 0.451 pp to 0.435 pp).

All in all, this exercise helps clarify possible changes in the dynamics of income conditions with the Great Recession for the different disability groups¹⁰. By pinpointing persistence and mobility from poor to lower-middle income and vice versa, we see that income helps disabled individuals and their relatives. With the Great Recession, being in poverty as well as a transition from lower-middle income to poor somehow deteriorated the conditions of severely disabled individuals and related households and improved the conditions of the group of non-disabled, while the changes for the other groups considered were negligible.¹¹

¹⁰ In order to assess the statistical significance of the changes in the estimated coefficients, we estimate a full interaction model, where each covariates is interacted with a dummy variable taking value one for the period 2015-2018. Findings suggest that changes in most relevant variables were statically significant. Estimates are available upon request

¹¹ We also explored the persistence and mobility from poor to higher-income and vice versa. Figure A2 in the Appendix shows the graphs for persistence and mobility in these income statuses. We note that, with the Great Recession, being in poverty and moving from poverty to higher-income deteriorated the income conditions of severely disabled individuals and improved the conditions of non-disabled individuals. These somehow confirm the findings discussed in the text for poor and lower-middle income status.

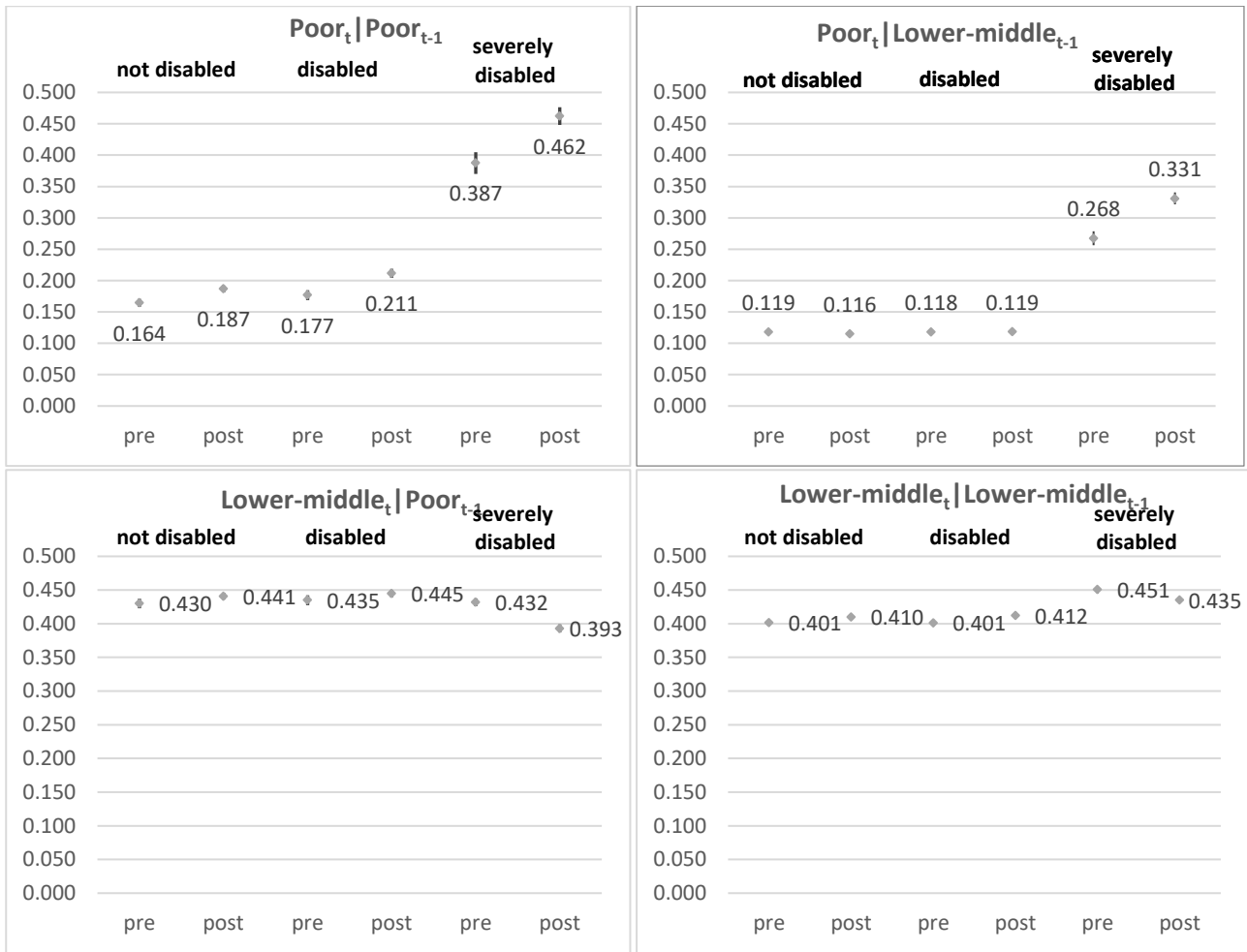


Figure 1. Income state dependence and mobility by disability group

Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Note: equivalent income adjusted for disability.

5.3 Disability effect along the income distribution at the country level

We offer a supplementary analysis by focusing on how income conditions of people with severe disabilities and related household members have evolved over time at the country level, by comparing predicted probabilities of being poor and being higher-income, respectively, calculated over the 2005-2008 and the 2015-2018 periods (Figures A3 and A4).

Focusing on Figure A3, we note an increase in the predicted probability of being poor for the severe disability-group in all countries, except Lithuania and Latvia, for which the reduction in the risk of poverty is not statistically significant. Countries that show a statistically significant increase in the risk of poverty are Czechia, Spain, France, Greece, Hungary, Ireland, Italy, the Netherlands, Portugal, and the UK. The increase was particularly strong for Greece (from 5% to 22%), France (from 17% to 40%), and Portugal (from 10% to 32%).

Looking at Figure A4, we note the predicted probability of being higher-income for the severe disability-group has substantially decreased or remained stable in all countries. In this respect, Lithuania and Latvia represent the usual exception, being the predicted probabilities of being higher-income increased between the two periods. For Czechia,

France, Greece, and Portugal, we find a statistically significant decrease in the predicted probabilities of being higher-income.

In sum, analysis at the country level confirms evidence that emerged from the European analysis, i.e. a worsening of income conditions of people with disabilities and their household members. This has taken place through an increase in the risk of poverty and sometimes through a decrease in the probability of being higher-income. The only exceptions are represented by Baltic countries (i.e. Lithuania and Latvia), where the disabled-group having experienced a relative improvement in their income conditions. In other countries, income conditions substantially worsened, especially in those countries, such as France, Greece, and Portugal, where in the pre-Great Recession period people with disabilities and their households were in relatively good income conditions. Other Mediterranean countries (i.e. Italy and Spain), as well as Ireland, Hungary and the UK, showed a deterioration in income conditions associated with disability. All these countries experienced severe cuts in public spending on social, health, and disability services or significant reforms of their social security and social protection systems.

With the aim of providing a more comprehensive interpretation of the evolution of disability effect on income conditions, we finally investigate the possible correlation between the change in poverty risk of the severely-disabled group (corresponding to the differences of estimates between pre and post-Great Recession periods displayed in Figure A5) at the country level and the change in the expenditure on social protection between the 2005-2008 and 2015-2018 periods. Here we focus on poverty because much of the social protection measures are usually targeted at low-income levels.

Thus, Figure A5 displays the association between change (from 2005-2008 to 2015-2018) in predicted probabilities of being poor for such group and change in social protection expenditure (expressed in purchasing power standard per inhabitant) in the periods 2004-2007 and 2014-2017. In addition, we explore the role of specific functions of social protection, such as disability, sickness, and social exclusion, and look for such associations as well. We don't find evidence that an increase in (overall) social protection expenditure has worked against the increase of probabilities of being poor of people with disabilities and their household member. Sickness and, particularly, social exclusion, were also ineffective to protect people with disabilities and their relatives from the risk of poverty in the decade analyzed here. On the contrary, we find a negative association, between the increasing risk of being poor for the severely-disabled group and an increase in social expenditure in the disability function. This stresses the importance of having financed targeted measures for disability to prevent or mitigate detrimental effects on income conditions, during the decade across the Great Recession and austerity measures.

6 Conclusions

This paper studies how disability affects income distribution in Europe and whether and how this has changed in the decade characterized by the Great Recession and the application of austerity measures. We offer both a descriptive analysis and an econometric investigation of the entire income distribution by disability group for two periods: 2005-2008 and 2015-2018.

The use of different inequality indices reveals not-unique evidence about the evolution of overall income inequality in Europe. On the contrary, the within-group analysis leads to consistent results, for which income inequality has increased for people without disabilities and has decreased for people with disabilities and their relatives. This has possibly resulted from a slight income polarization for the former group and a slide to the left of the income distribution of the latter. This was particularly evident for people with severe disabilities and their households and especially in some European countries, such as the UK, Italy, France, Portugal, the Netherlands, and Greece

Econometric investigation confirms that disability contributes to deteriorating income conditions, mostly for the severely-disabled group. The detrimental effect of disability was exacerbated in the post-recession period, as it has increased the probability of being poor and has decreased that of being higher-income. People with severe disabilities and their relatives have also seen increased poverty state dependence. Unlike other population sub-groups, it has decreased the probability of remaining in high-income positions and it has increased the probability of moving from high to low-income positions, confirming the hypothesis of a slide to the left of the income distribution in case of severe disability. This happened in an overall situation characterized by a slight income crystallization, lower mobility across the top and bottom income groups, and an increasing lock-in effect of poverty.

Country analysis substantially confirms the above-mentioned evidence, with few exceptions in Eastern Europe. The risk of poverty of people with severe disabilities and their households, instead, has increased significantly in many countries, including Southern ones, France, the UK, Ireland, and the Netherlands, most of them involved in severe cuts in public spending on social functions during the application of austerity measures or in reforms of social security systems. An additional correlation analysis suggests that increasing social expenditure on disability during the analyzed decade contributed to mitigating the increasing detrimental effect of disability on income conditions. Overall expenditure for social protection or that for sickness and social exclusion functions, instead, resulted quite ineffective in this sense.

We remark on the importance of considering income and disability as interrelated phenomena with possible feedback effects and of investigating the overall income distribution to rise a clear picture of detrimental effects associated with disability and its evolution over time.

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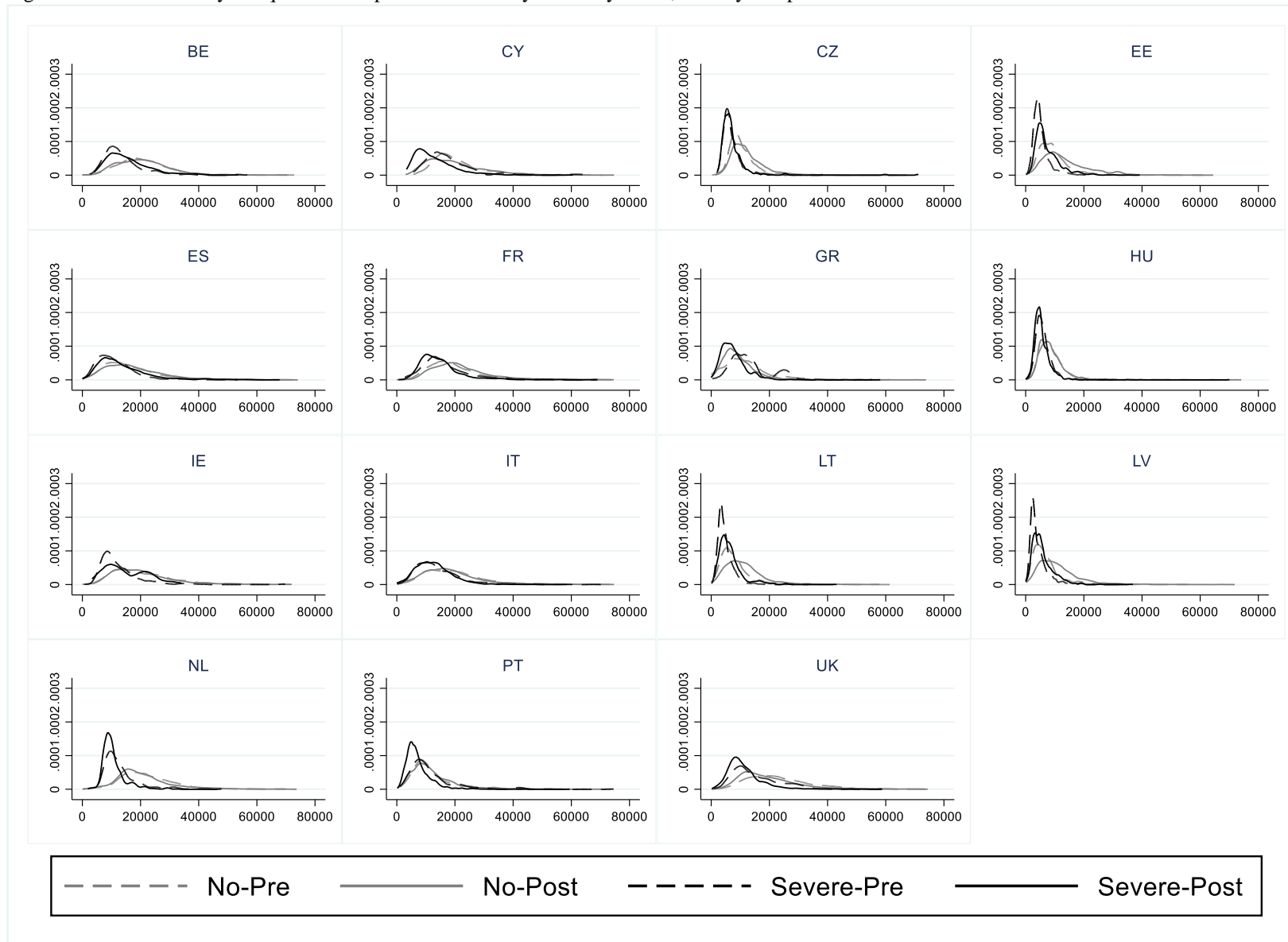
Appendix

Table A1. Descriptive statistics of covariates

	No disability				Moderate disability				Severe disability			
	2005-2008		2015-2018		2005-2008		2015-2018		2005-2008		2015-2018	
	Mean	Std dev.	Mean	Std dev.	Mean	Std dev.	Mean	Std dev.	Mean	Std dev.	Mean	Std dev.
HH age below 25	0.107	0.309	0.067	0.251	0.044	0.206	0.026	0.160	0.043	0.203	0.030	0.170
HH age 25–34	0.181	0.385	0.143	0.350	0.119	0.324	0.086	0.280	0.107	0.310	0.075	0.264
HH age 35–44	0.286	0.452	0.262	0.440	0.190	0.392	0.161	0.368	0.135	0.341	0.121	0.326
HH age 45–54	0.221	0.415	0.244	0.429	0.208	0.406	0.203	0.402	0.172	0.377	0.165	0.371
HH age 55–64	0.111	0.314	0.149	0.357	0.162	0.368	0.194	0.395	0.158	0.365	0.182	0.386
HH age over 64	0.095	0.294	0.135	0.342	0.277	0.447	0.329	0.470	0.385	0.486	0.427	0.495
HH female	0.378	0.485	0.411	0.492	0.399	0.490	0.436	0.496	0.432	0.495	0.433	0.496
HH low educated	0.314	0.464	0.273	0.445	0.400	0.490	0.402	0.490	0.500	0.500	0.479	0.500
HH middle educated	0.464	0.499	0.410	0.492	0.437	0.496	0.376	0.484	0.382	0.486	0.355	0.479
HH highly educated	0.222	0.416	0.317	0.465	0.163	0.369	0.222	0.415	0.118	0.323	0.166	0.372
HH married	0.663	0.473	0.657	0.475	0.646	0.478	0.618	0.486	0.592	0.491	0.603	0.489
Presence of children 0-15	0.481	0.500	0.437	0.496	0.292	0.455	0.251	0.434	0.221	0.415	0.181	0.385
Homeowner	0.887	0.316	0.769	0.421	0.903	0.296	0.801	0.399	0.902	0.297	0.779	0.415
WI = 0	0.230	0.421	0.267	0.442	0.355	0.478	0.446	0.497	0.485	0.500	0.572	0.495
0 < WI ≤ 0.5	0.085	0.280	0.080	0.271	0.105	0.307	0.091	0.288	0.120	0.325	0.097	0.297
0.5 < WI < 1	0.356	0.479	0.319	0.466	0.332	0.471	0.258	0.438	0.256	0.436	0.208	0.406
WI = 1	0.328	0.470	0.334	0.472	0.208	0.406	0.205	0.403	0.139	0.346	0.123	0.329
Only pensioners	0.068	0.251	0.112	0.315	0.194	0.395	0.275	0.446	0.247	0.431	0.334	0.472
Expenditure for disability	324.9	117.7	403.4	151.9	290.5	114.5	392.3	143.2	292.9	106.9	388.7	142.7
Expenditure for sickness/health care	1358.0	532.8	1614.4	678.5	1183.5	548.0	1495.9	660.4	1150.8	517.6	1522.0	687.5
Expenditure for social exclusion	68.2	75.5	137.6	109.8	50.9	62.0	118.0	110.2	47.2	58.7	117.5	106.4
Disabled individual of working age					0.499	0.500	0.569	0.495	0.665	0.472	0.703	0.457
Disabled individual with low education					0.777	0.417	0.719	0.450	0.821	0.383	0.767	0.422
Disabled female individual					0.951	0.216	0.929	0.257	0.956	0.204	0.937	0.242
Observations	109794		172257		44456		76523		25916		37376	
Percentage	60.94%		60.20%		24.68%		26.74%		14.38%		13.06%	

Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data.

Figure A1. Kernel density of equivalent disposable income by disability status, country and periods



Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data.

Table A2. AMEs of covariates of the income equation: Poor and Higher-income outcomes

	Poor						Higher-income					
	2005-2008			2015-2018			2005-2008			2015-2018		
	AME	s.e.		AME	s.e.		AME	s.e.		AME	s.e.	
HH age below 25	base-category											
HH age 25–34	0.036	0.005	***	0.022	0.007	***	-0.038	0.005	***	-0.020	0.004	***
HH age 35–44	0.037	0.005	***	0.026	0.007	***	-0.039	0.006	***	-0.023	0.005	***
HH age 45–54	0.034	0.006	***	0.020	0.007	***	-0.036	0.006	***	-0.018	0.005	***
HH age 55–64	0.029	0.006	***	0.022	0.008	***	-0.031	0.007	***	-0.020	0.005	***
HH age over 64	0.027	0.007	***	0.034	0.009	***	-0.029	0.007	***	-0.030	0.006	***
HH female	0.021	0.001	***	0.021	0.001	***	-0.022	0.001	***	-0.019	0.001	***
HH low educated	base-category											
HH middle educated	-0.036	0.002	***	-0.028	0.001	***	0.038	0.002	***	0.025	0.001	***
HH highly educated	-0.090	0.002	***	-0.080	0.002	***	0.094	0.002	***	0.072	0.001	***
HH married	-0.014	0.004	***	-0.018	0.005	***	0.014	0.004	***	0.016	0.003	***
Presence of children 0-15	0.022	0.005	***	0.023	0.006	***	-0.023	0.005	***	-0.020	0.004	***
Homeowner	-0.009	0.004	**	-0.026	0.006	***	0.009	0.004	**	0.024	0.004	***
WI = 0	base-category											
0 < WI ≤ 0.5	-0.025	0.005	***	-0.024	0.006	***	0.027	0.005	***	0.022	0.003	***
0.5 < WI < 1	-0.077	0.004	***	-0.077	0.005	***	0.080	0.004	***	0.069	0.003	***
WI = 1	-0.121	0.004	***	-0.117	0.005	***	0.126	0.004	***	0.105	0.003	***
Only pensioners	0.005	0.009		0.008	0.010		-0.006	0.009		-0.008	0.006	
Expenditure for disability	0.00006	0.00005		-0.00005	0.00006		-0.00006	0.00005		0.00004	0.00004	
Expenditure for sickness/health care	0.00002	0.00001		-0.00005	0.00002	***	-0.00002	0.00001		0.00005	0.00002	***
Expenditure for social exclusion	-0.00015	0.00004	***	0.00023	0.00007	***	0.00016	0.00004	***	-0.00020	0.00004	***

Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Note: equivalent income adjusted for disability and corrected for 2015 current price index

Table A3. Disability equation

	Moderate disability						Severe disability					
	2005-2008			2015-2018			2005-2008			2015-2018		
	AME	s.e.		AME	s.e.		AME	s.e.		AME	s.e.	
<i>Income time t-1</i>												
Poor	0.006	0.004		0.003	0.003		-0.006	0.004		-0.004	0.003	
Lower-middle	0.003	0.003		-0.001	0.002		-0.003	0.003		0.001	0.002	
Upper-middle						(base category)						
Higher-income	-0.003	0.003		-0.003	0.003		0.004	0.004		0.003	0.003	
<i>Income time 0</i>												
Poor	-0.015	0.004	***	-0.007	0.003	**	0.016	0.005	***	0.008	0.004	**
Lower-middle	-0.008	0.003	***	0.002	0.002		0.009	0.003	***	-0.002	0.003	
Upper-middle						(base category)						
Higher-income	-0.005	0.004		0.007	0.003	**	0.006	0.004		-0.008	0.003	**
<i>Disability time t-1</i>												
None						(base category)						
Moderate	-0.020	0.002	***	-0.021	0.002	***	0.021	0.003	***	0.024	0.002	***
Severe	-0.030	0.003	***	-0.030	0.003	***	0.033	0.004	***	0.034	0.003	***
<i>Disability time 0</i>												
None						(base category)						
Moderate	0.401	0.015	***	0.446	0.010	***	0.153	0.002	***	0.142	0.001	***
Severe	0.423	0.007	***	0.441	0.004	***	0.271	0.003	***	0.274	0.002	***

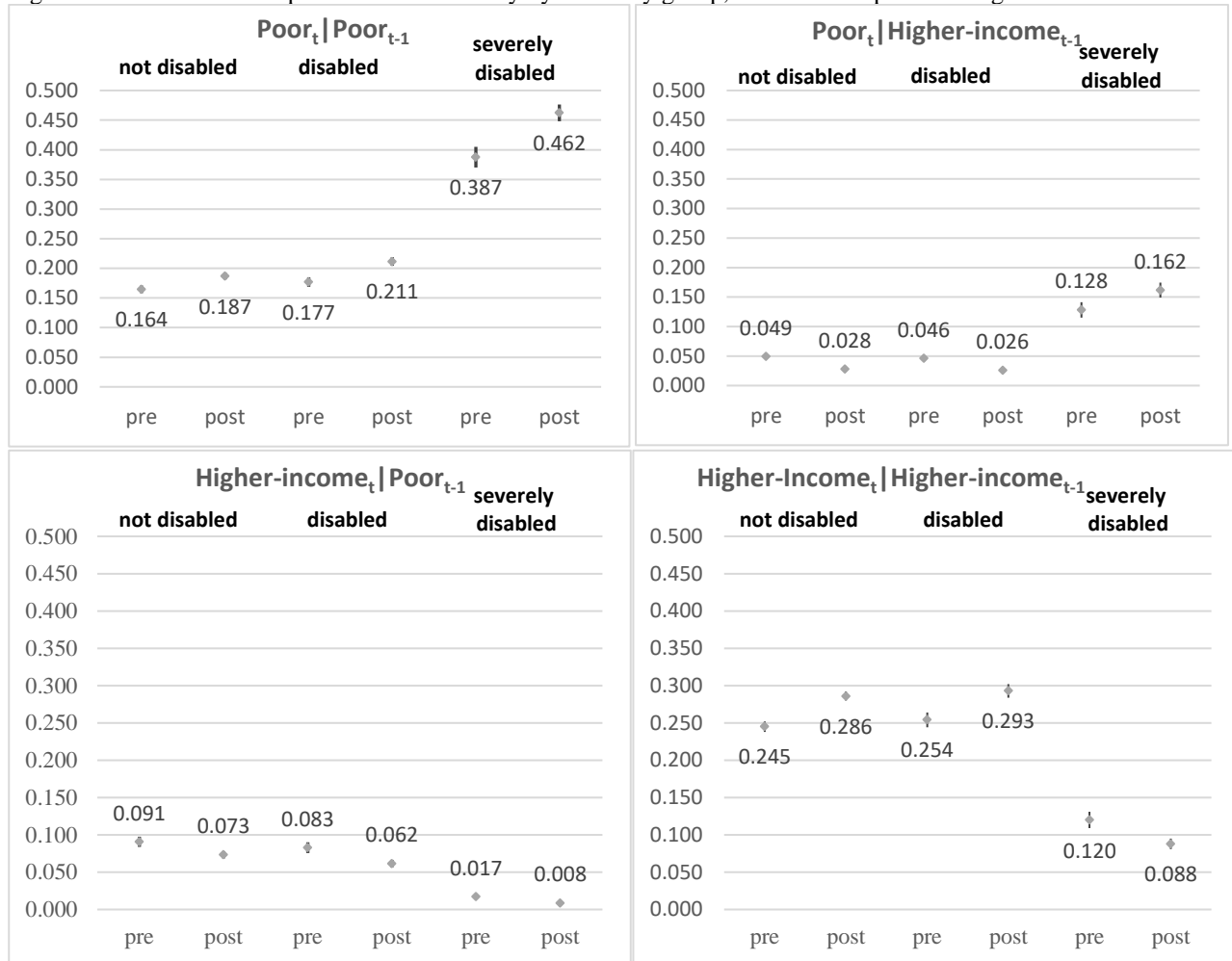
Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Note: equivalent income adjusted for disability.

Table A4. AMEs of covariates of the disability equation: Severe disability outcomes

	2005-2008		2015-2018			
	AME	s.e.	AME	s.e.		
HH age below 25			base-category			
HH age 25–34	0.013	0.008	*	-0.005	0.007	
HH age 35–44	0.023	0.008	***	-0.001	0.007	
HH age 45–54	0.027	0.008	***	-0.010	0.007	
HH age 55–64	0.019	0.009	**	0.007	0.007	
HH age over 64	0.026	0.009	***	0.023	0.008	***
HH female	-0.026	0.002	***	-0.031	0.001	***
HH low educated			base-category			
HH middle educated	0.011	0.002	***	0.024	0.002	***
HH highly educated	0.003	0.003		0.021	0.002	***
HH married	-0.015	0.005	***	-0.008	0.005	*
Presence of children 0-15	0.021	0.008	***	-0.005	0.007	
Homeowner	-0.014	0.006	**	-0.005	0.006	
WI = 0			base-category			
0 < WI ≤ 0.5	0.012	0.007	*	-0.014	0.005	***
0.5 < WI < 1	0.001	0.006		0.003	0.004	
WI = 1	0.005	0.006		0.004	0.005	
Only pensioners	0.017	0.010	*	0.004	0.008	
Disabled individual of working age	0.071	0.005	***	0.086	0.004	***
Disabled individual with low education	0.115	0.005	***	0.155	0.004	***
Disabled female individual	0.508	0.007	***	0.466	0.005	***
Expenditure for disability	0.00023	0.00008	***	0.00021	0.00006	***
Expenditure for sickness/health care	0.00009	0.00002	***	-0.00003	0.00002	
Expenditure for social exclusion	-0.00027	0.00006	***	-0.00006	0.00006	

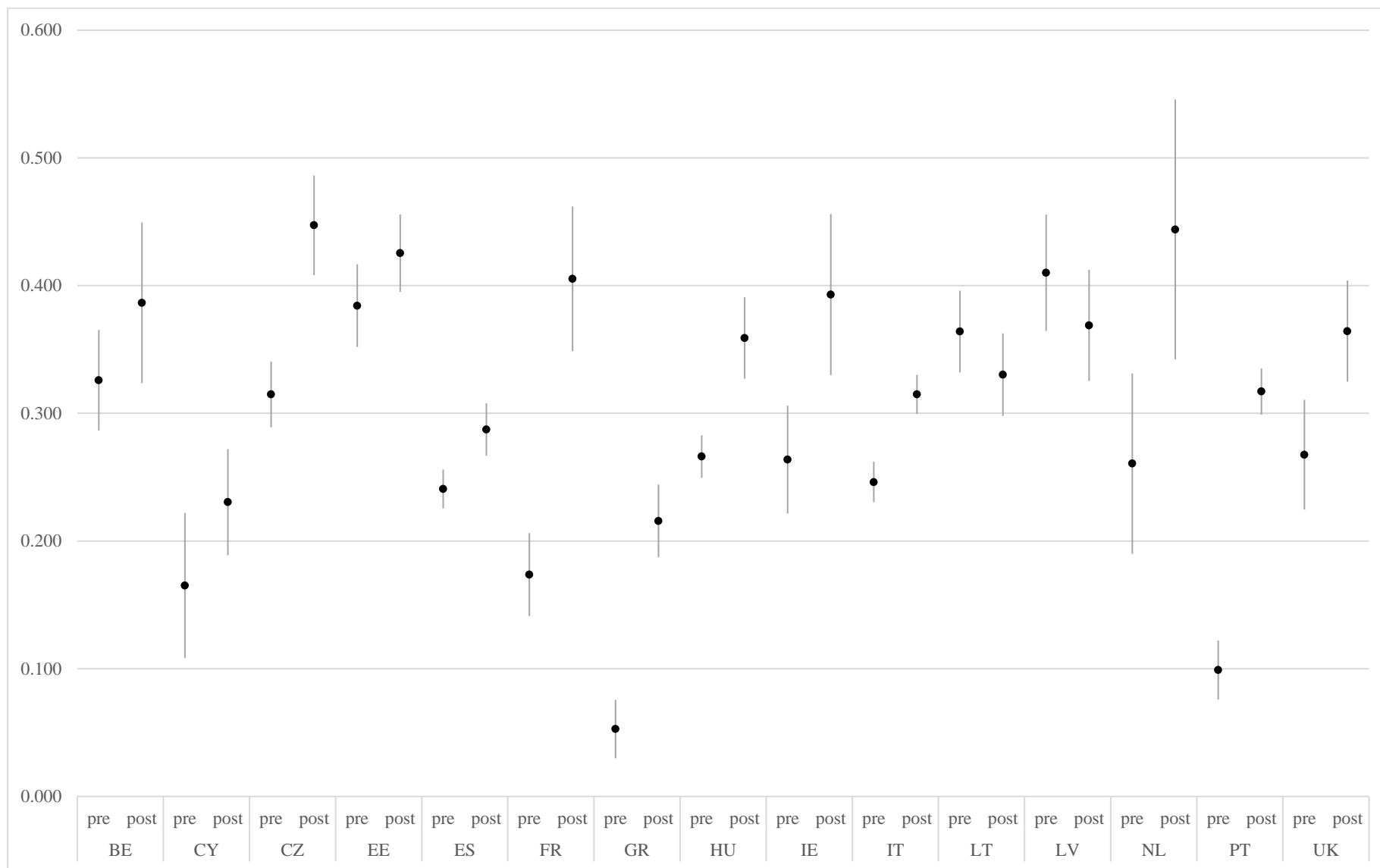
Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data. Note: equivalent income adjusted for disability.

Figure A2. Income state dependence and mobility by disability group, income class poor and higher-income



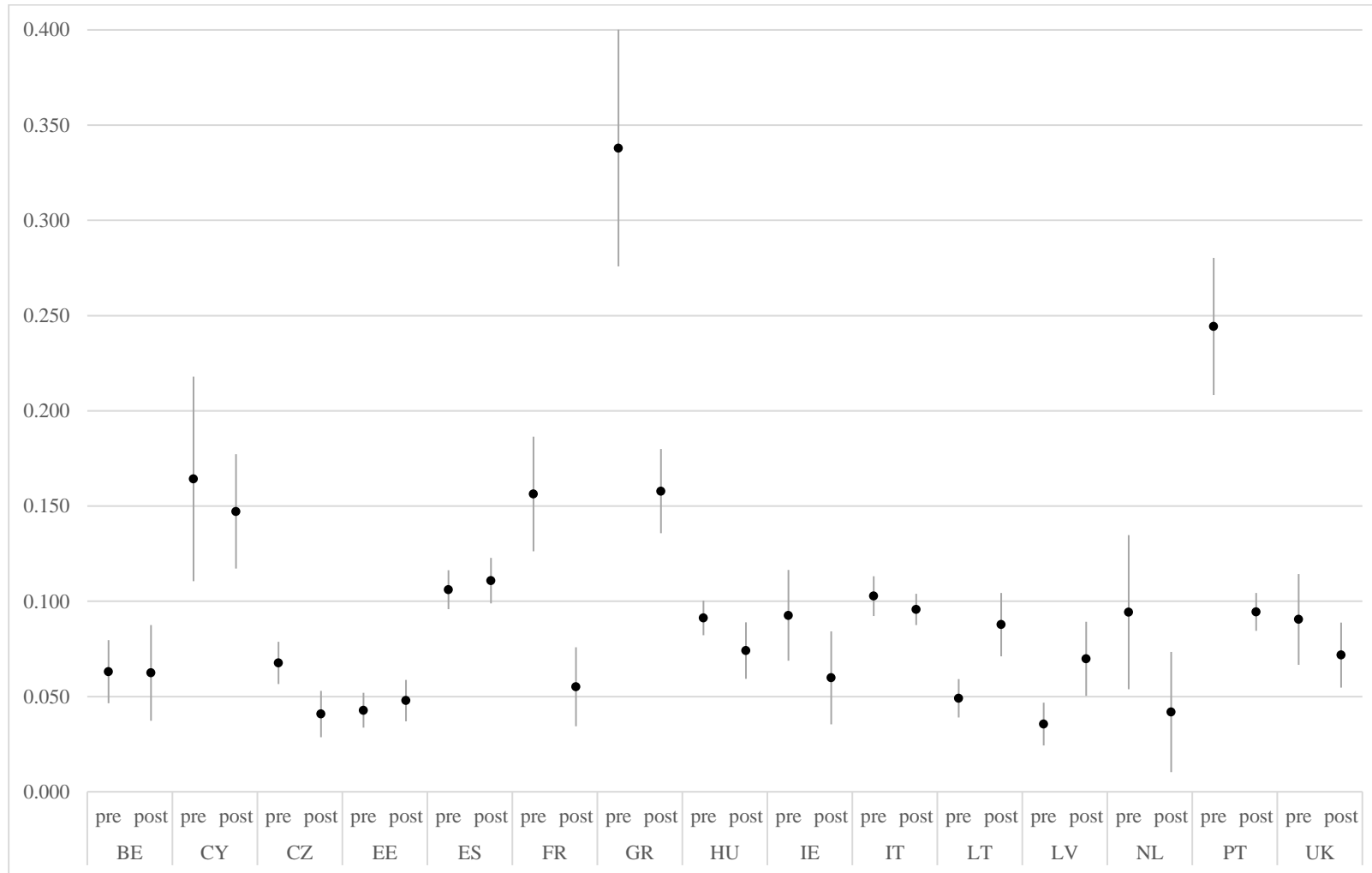
Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data.

Figure A3. Predicted probabilities of being poor for people with severe disability: 2005-2008 vs 2015-2018



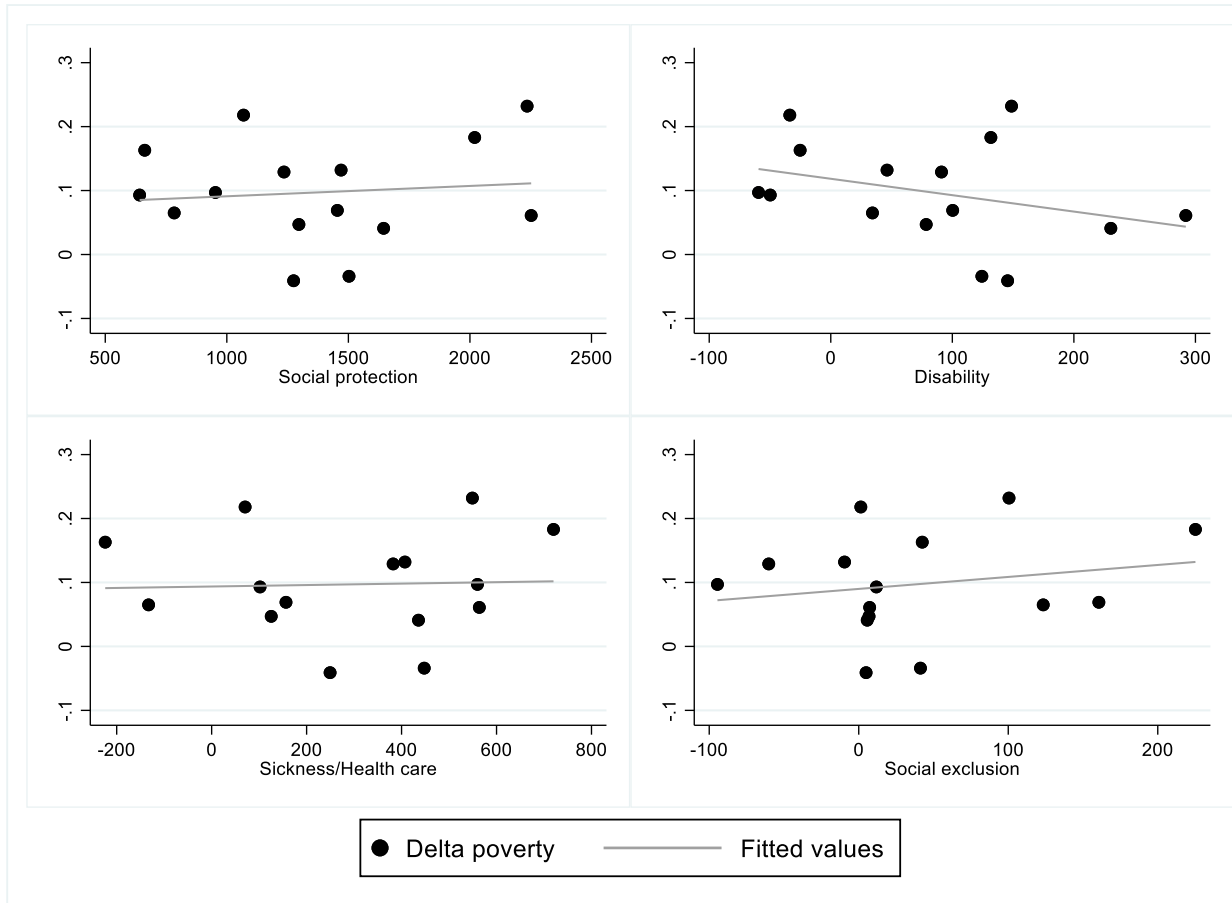
Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data.

Figure A4. Predicted probabilities of being higher-income for people with severe disability: 2005-2008 vs 2015-2018



Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data.

Figure A5. Correlation between change in predicted probabilities of being poor and change in social expenditure



Source: own elaboration on 2005-2008 and 2015-2018 EU-SILC data.