



# Material and social deprivation among one-person households: the role of gender

Enrico Fabrizi<sup>1</sup> · Chiara Mussida<sup>1,2</sup> · Maria Laura Parisi<sup>3</sup>

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## Abstract

We explore whether gender has a statistically significant impact on material and social deprivation of single adults after accounting for other characteristics. We use data from the 2022 European Union Statistics on Income and Living Conditions survey for six European countries. By assuming deprivation as an individual latent trait and by treating different deprivation levels as ranked categories, we estimate a proportional odds model separately by country. Our findings suggest a clear role for gender, i.e., the risk of being materially and socially deprived is relatively higher for women everywhere. The novelty is that facing “unexpected expenses” is the worst trouble for women, clearly coming from relative financial and economic fragility. Individual characteristics play a more important role than more aggregate indicators at explaining the risk of material and social deprivation. Finally, the estimated gender gap is robust to a large set of changes in model specification and assumptions.

**Keywords** Gender gap · Material and social deprivation · Proportional odds regression model · Financial fragility

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✉ Maria Laura Parisi  
marialaura.parisi@unibs.it

Enrico Fabrizi  
enrico.fabrizi@unicatt.it

Chiara Mussida  
chiara.mussida@unicatt.it

<sup>1</sup> Department of Economic and Social Sciences, Università Cattolica del Sacro Cuore, Via Emilia Parmense 84, 29122 Piacenza, Italy

<sup>2</sup> GLO, Essen, Germany

<sup>3</sup> Department of Economics and Management, University of Brescia, Via San Faustino 74/b, 25122 Brescia, Italy

## 1 Introduction

Unlike analysis of the labor market (Olivetti and Petrongolo 2008; Castellano and Rocca 2020), gender differentials in poverty and social exclusion are difficult to assess. Most, if not all, measures are household-based, thus implicitly assuming equity of resource sharing within the household, under a Beckerian, or unitary, conception of the household (Becker 1991). Despite the limited information usually available from large social surveys, a stream of literature has tried to shed light on within-household inequalities (Bennett 2013; Corsi et al. 2016; Guio and Van den Bosch 2020; Karagiannaki and Burchardt 2020).

We investigate gender differentials in material and social deprivation by focusing on single adult households, with the reference adult aged between 18 and 64 (working-age, non-retiree). The reason for considering this household type is twofold: first, it circumvents the problem of assessing intra-couple or within-household inequality; second, single-person households are on the rise (Karagiannaki and Burchardt 2020) in European societies and are particularly exposed to the risk of poverty (Chzhen and Bradshaw 2012; Treanor 2018). We restrict our attention to working-age, non-retired individuals as poverty and social exclusion of the elderly deserve to be treated as separate problems.

Among the numerous measures of poverty, we focus on material and social deprivation, which is routinely monitored in the EU (and other European) countries via the EU-SILC surveys. Material and social deprivation focuses on the extent to which the resources available to a household match the actual needs of its members (Notten and Guio 2019); this ability not only reflects the adequacy of income but also additional assets that can or cannot be available to the household, such as savings, gifts, inter-household transfers, or services useful to finance the living standard (Israel 2016). The measurement is based on a set of thirteen items, covering several domains both at the household and at the individual level (Guio et al. 2016, 2017) and lies on the idea of *enforced lack*: a living condition is labeled as *in deprivation* if it is enforced by lack of resources and not by choice.

Published rates of material and social deprivation are based on a threshold of 5 lacking items out of 13 (deprivation is *severe* when an individual lacks 7 items). Our analysis goes beyond that. By assuming material and social deprivation as an individual latent trait and by treating different deprivation levels as ranked categories, we estimate a proportional odds model. Our research objective is to assess whether single women are more exposed than single men to the risk of material and social deprivation. If this gap is observed, can we explain it in terms of observable heterogeneous characteristics (individual characteristics, household characteristics, and macro indicators)? What is the (data-driven) main explanation for which the risk is not gender-neutral?

As the answer to these questions may depend on the macroeconomic and social environment, we conduct our analysis separately for six EU countries: the five most populated countries in the EU (Germany, Spain, France, Italy, and Poland) plus Sweden, included as a representative of Northern countries whose societies stand out for their balance between gender roles and welfare regimes. The countries of choice correspond to different welfare regimes, labor markets, and institutions. A secondary aim

of our research is to assess whether there is a difference in the estimated gender gap among these countries.

The paper is organized as follows. After reviewing the relevant literature in Section 2, we introduce the model in Section 3 and the data and methodology in Section 4; Section 5 shows the table of results with a discussion; Section 6 reports several analyses of robustness; and Section 7 draws concluding remarks and policy implications.

## 2 A review of the literature

The issue of analyzing gender differences in poverty and social exclusion, as explained in the Introduction to this paper, is complex. For instance, Corsi et al. (2016) recognize that official measures of at-risk of poverty based on the assumption of equal sharing of households' resources incur a serious risk of underestimating the true gender gap in poverty. The existing household data and country heterogeneity, however, are not able to explain the availability and sharing of resources within the household, thus identifying the true difference in the risk of poverty or material deprivation between men and women. Nonetheless, a stream of literature has started shedding light on within-household inequalities (Bennett 2013; Corsi et al. 2016; Guio and Van den Bosch 2020; Karagiannaki and Burchardt 2020).

One way to solve for the identification issue is working on sample selection, e.g., selecting single heads of household of both sexes—i.e., not in a cohabiting couple,<sup>1</sup> and if necessary single parents (Christopher et al. 2002; Wiepking and Maas 2005).<sup>2</sup> This type of households is spreading out in Europe (see, for instance, Karagiannaki and Burchardt 2020), changing the average family structure, and it is particularly exposed to the risk of social exclusion (Chzhen and Bradshaw 2012; Treanor 2018).

We learn another way in Guio and Van den Bosch (2020), one of the few attempts to estimate the gender gap in material deprivation for married and cohabiting couples (who may live with other adults) in 23 European countries. The possibility to identify deprivation between female and male individuals in the couple is given by the interview mode.<sup>3</sup> In almost every country, women turn out to experience an enforced lack of pocket money and leisure, with some heterogeneity across items and countries.

A third loose attempt is found in Aisa et al. (2019)'s contribution on a sample of working men and working women in 25 EU countries; in general, the literature recognizes that female-headed households, especially if they are single parents, face an above-average risk of poverty and material deprivation (see, e.g., Chant 2003; 2004). Bárcena-Martín et al. (2014) suggest that individuals who live in households whose reference person is a woman, or single parent, have higher intensity of depriva-

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<sup>1</sup> *Lone* individuals live on one's own without other adults in the household; *single* individuals may live with other cohabiting non-partner adults (e.g., their own parents) with whom they may have (partially) common financial resources (Provencher and Carlton 2018).

<sup>2</sup> We follow part of Wiepking and Maas (2005) in the spirit, by using a sample of single adult households.

<sup>3</sup> In this study, run in 2015, the items subject to material deprivation are 6: clothes, a pair of new shoes, get together with friends, leisure time, pocket money, internet connection. See Section 4 and Table 1 for details about deprivation items.

tion. Papadopoulos and Tsakoglou (2016) analyze the long-term relationship between material deprivation and poverty in Europe before the crisis period: women formed a “medium-risk” group in chronic material deprivation in all countries, being 1 to 1.5 times at higher risk to accumulate material disadvantage than the population average. Mussida et al. (2023) use EU-SILC data for the period 2014–2018 to find that the risk of falling into (low and high intensity of) severe material deprivation for female heads of household is about 2.8 times higher than their male equivalent, across the Spanish communities.

Finally, in an even more general setting, we reviewed articles which estimate the determinants of the probability of falling into material deprivation across countries; among the explanatory variables we find gender (Notten and Guio 2020); age (see Bárcena-Martín et al. 2014; Guio and Van den Bosch 2020; Dudek and Szczesny 2021); age and number of children (Provencher and Carlton 2018); family’s health status (Bedük 2018 for both women and men); the disability of any family member (e.g., Guio and Van den Bosch 2020; Dudek and Szczesny 2021); education (see all above-cited papers, including Christopher et al. 2002); household’s structure (Papadopoulos and Tsakoglou 2016; Dudek and Szczesny 2021); the presence and number of children, especially for single-headed households, is a converting factor (Tsakoglou and Papadopoulos 2002; Boarini and d’Ercole 2006; Dewilde 2008); home tenure status (Bárcena-Martín et al. 2014); country of birth (Busetta et al. 2016); labor market features, such as work intensity (Layte et al. 2001; Halleröd et al. 2006; de Graaf-Zijl and Nolan 2011; Figari 2012) or employment type (see, e.g., Bárcena-Martín et al. 2014); and macroeconomic factors, such as welfare regimes and labor market institutions (e.g., Nolan and Whelan 2010; Nelson 2012; Alper et al. 2020).

### 3 Model specification

In our modelling exercise, we target the deprivation score, defined as the number of items in deprivation in a multi-item scale. As anticipated, our target population is given by singles aged between 18 and 64 years and not yet retired. Our aim is to investigate whether gender has a statistically significant and relevant impact once other related observable characteristics are accounted for.

In previous literature, the deprivation score has been analyzed either using count (Notten 2016; Bedük 2018) or proportional odds (Guio et al. 2012; Notten and Guio 2020) regression methods. In the first case, the score is treated as an additive counting variable, while in the second, deprivation is read as an individual latent trait and different deprivation levels are treated as ranked categories instead of equidistant categories.

In line with Notten and Guio (2020), we assume a proportional odds model. Count regression models will also be considered, and their ability to fit the data is compared in terms of popular model selection criteria such as the Akaike information criterion; their results are compared to those we obtain with the proportional odds as a robustness check. Results related to partial proportional odds models (see, for instance, Peterson and Harrell Jr. 1990; Williams 2016) are not reported, since the evidence of their superior fit is not supported by Brant test results (Brant 1990) in all countries we

consider, and would not compensate the increased model complexity. In any case, results obtained relaxing the odds proportionality for the gender indicator and possibly a few other selected variables are discussed below.

The regression results cannot consider sampling weights and other survey design aspects, because published sampling weights account for the unequal inclusion probabilities plus corrections aimed at attenuating the effect of non-response. However, we use these weights when computing estimates of population descriptive quantities in Section 4. In that context, accounting for unequal inclusion probabilities is essential to obtain consistent results. In the regression problem, the opportunity of using weights depends on whether they are informative, given the covariates. We tested this hypothesis according to a procedure illustrated in Pfeffermann and Sverchkov (1999) and Long (2022), which led to the non-rejection of the null hypothesis in all cases.

As a further check, we also estimate survey-weighted ordinal regression models using the methodology illustrated in Lumley (2011) (chapter 6), obtaining point estimates largely consistent with those obtained without weights. A full consideration of the sampling design (stratification, clustering, varying inclusion probability, and post-stratification adjustment) can have an impact on the estimation of the standard errors. Unfortunately, we do not have access to all relevant sampling design information (stratum and cluster identifiers) because of disclosure constraints.

Let  $\eta_i$  be the latent unobserved deprivation of individual  $i$  in the sample. We assume that the material and social deprivation scale divides this continuous variable into  $K + 1 = 14$  intervals by means of (latent) increasing constants  $c_1 \leq \dots \leq c_k \leq \dots \leq c_K$ , so that the observed deprivation score  $Y_i$  with support  $\{0, \dots, K = 13\}$  is such that

$$Y_i = \begin{cases} 0 & \eta \leq c_1 \\ k & c_k \leq \eta_i < c_{k+1} \quad (k = 1, \dots, K - 1) \\ K & \eta_i \geq c_K \end{cases}$$

The proportional odds regression model is based on assuming the cumulative logit to be a linear function of the regressors. In this case,

$$\log \left( \frac{P(Y_i \geq k)}{P(Y_i < k)} \right) = \alpha_k + \mathbf{x}_i^T \beta \quad (1)$$

Moreover, it is specific to this model the assumption that, while we have a deprivation level-specific intercept  $\alpha_k$ , the slopes are assumed common. This parsimonious specification entails that regressors impact the odds of moving from deprivation level  $k$  to  $k + 1$  in the same way, regardless of  $k$ . This somewhat restrictive assumption is implied by assuming that regressors have an impact on the latent variable  $\eta_i$  only through its location (Fullerton and Anderson 2021).

## 4 Data and samples

We use data from the EU-SILC survey, that is based on a methodology and definitions that are standardized across most members of the European Union (Eurostat 2010). The

**Table 1** Items in the material and social deprivation indicator (EU-SILC)

#	Items	Variable code
1	Face unexpected expenses	HS060
2	Afford one week annual holiday away from home	HS040
3	Avoid arrears (in mortgage rent, utility bills and/or hire purchase instalments)	HS011 HS031
4	Afford a meal with meat, chicken, fish or vegetarian equivalent every second day	HS050
5	Afford keeping their home adequately warm	HH050
6	Have access to a car/van for personal use	HS110
7	Replace worn-out furniture	HD080
8	Replace worn-out clothes with some new ones	PD020
9	Have two pairs of properly fitting shoes	PD030
10	Spend a small amount of money each week on him/herself (“pocket money”)	PD070
11	Have regular leisure activities	PD060
12	Get together with friends/family for a drink/meal at least once a month	PD050
13	Have an internet connection	PD080

topics covered by the survey are living conditions, income, social exclusion, housing, work, demographics, and education of individuals. We select cross-sectional data for six European countries in 2022, corresponding to the income year 2021.<sup>4</sup> In detail, we settle on Germany, Spain, France, Italy, and Poland, which are the most heavily populated countries in the EU, with the addition of Sweden. We decided to explore the phenomenon in these countries as they are representative of different welfare regimes, labor markets, and institutions. Nelson (2012), for instance, shows that a meaningful part of the cross-country variation in the levels of material deprivation comes from different social assistance and benefits provided by governments. According to the 2030 Agenda of the United Nations, as well as to the previous Europe 2020 strategy of the European Commission, measuring non-financial poverty, and deprivation in particular, is very important for monitoring social exclusion (Guio et al. 2012). Our variable of interest is therefore the material and social deprivation score (Guio et al. 2016). This score is based on 13 selected deprivations (items) defined either at the individual or the household level. Individual items come from a questionnaire filled out by each adult in the household; questions on household items are included in the household questionnaire (filled out by a reference person for each household). Each item is based on the idea of an enforced lack, so an individual/household is deprived with respect to an item if she/he cannot afford the specific good (and not for other reasons based on preferences, see Guio and Van den Bosch 2020) or is not capable of the specific social activity/interaction (Guio et al. 2016, 2017). According to the Eurostat guidelines, an individual is defined as materially and socially deprived if she/he suffers from a lack of at least 5 out of 13 items. The full list of items is provided in Table 1.

<sup>4</sup> COVID-19 is not an issue for our analyses for at least two reasons. First, given that we explore deprivation and not income, our main reference year is the survey year, i.e., 2022. Second, the negligible impact of the pandemic on the deprivation rate was already recovered in 2022 (see Eurostat statistics).

Our sample includes single adult households, i.e., one-person households (single with no children), in which the adult is 18–64 years old and not retired. We use the same age limit for retirement in each country, that is 64 years, i.e., the threshold considered by Eurostat in its publications. In any case, we exclude retired workers even if aged less than 64. This solves the identification issue discussed in Section 2, because we are able to distinguish between female and male heads of household, their resources, and their enforced lacks. The selection leaves us with 19,886 observations for one-person households.

Table 2 shows the (weighted) material and social deprivation rates estimated by country and gender, as well as the gender gap, for our target population computed on the 2022 EU-SILC sample, and for the general population aged between 18 and 64 (Eurostat). As for the gender gap, we calculate *t*-tests for its statistical difference, and when statistically significant at least at 5% level, it is in italics. In Table 2, it is evident that the gender differences are statistically significant in the general population, with the only exception of Italy and Sweden. We find a disadvantage for women, i.e., a negative gender gap in Spain, France, and Poland and a positive one in Germany. With respect to the target population, however, the gap is significant, and negative, only in Spain (−8.2 p.p.).

We selected a sample (by country) of one-person households because this type of household is the only one that enables to really understand if there is a “genuine” gender gap in material and social deprivation. This indicator, in fact, is usually calculated by considering items both at the household and at the individual level (for the list, see Table 1). In the selected household type, consisting of one person only, there is no problem of sharing the inability to afford items with other household members. Starting from this consideration, we now explore the raw gender gap (and its statistical significance) in the deprivation items by country. The calculations are reported in Table 3. On the one hand, we see that the items with a (significant) gender gap to the disadvantage of women are (i) facing unexpected expenses, (ii) affording to keep their home adequately warm, (iii) replacing worn-out furniture, (iv) pocket money, and (v) leisure. On the other hand, “arrears” is the item with a relatively higher disadvantage for men. By looking at the country columns, Spain has the highest number of negative and

**Table 2** Weighted material and social deprivation prevalence (in percentage) by gender in 2022

	Target households			General population		
	M	F	Gap	M	F	Gap
Germany	17.8	17.1	0.7	16.9	14.1	2.8
Spain	15.8	24	−8.2	14.9	17.8	−2.9
France	17	19.2	−2.2	15.2	17.3	−2.1
Italy	11.9	13.6	−1.7	11.1	11.5	−0.4
Poland	12.3	11.7	0.6	11.7	13.8	−2.1
Sweden	7.8	7.7	0.1	6.8	6.6	0.2

Note: Gender gaps among target sample and general population. Italics indicate a statistical significant difference in (male–female) means at least at 5% level. Target households are one-person households, age 18–64. Source: 2022 EU-SILC and Eurostat data

**Table 3** Gender gap in mean deprivation of the items by country, target sample

	DE	ES	FR	IT	PL	SE
1. Unexpected expenses (gap)	-2.20	-6.11	-5.93	-2.25	-6.74	-3.34
%male	42.9	37.8	34.3	37.3	30.7	24.1
%female	45.1	43.9	40.2	39.5	37.5	27.5
2. One week holidays away	3.33	-5.34	-0.73	-2.30	5.28	-1.99
%male	29.0	32.1	25.5	33.9	25.8	11.0
%female	25.7	37.5	26.3	36.2	20.5	13.0
3. Arrears	1.80	-0.94	2.94	1.17	3.79	0.75
%male	8.0	13.6	12.4	6.3	13.7	9.7
%female	6.2	14.6	9.5	5.2	9.9	9.0
4. Meal with meat/fish/vegetables	-1.19	-3.46	-4.10	0.87	3.05	-1.85
%male	15.2	6.1	12.9	10.9	9.8	2.8
%female	16.4	9.6	17.0	10.0	6.8	4.7
5. Warm home	-0.39	-4.78	-6.14	-1.00	3.13	-2.94
%male	8.1	20.0	12.0	14.1	9.1	2.3
%female	8.5	24.8	18.1	15.1	6.0	5.2
6. Access to a car	1.35	-5.26	-0.09	-0.05	-1.51	-2.04
%male	15.5	7.1	7.8	4.6	8.6	8.5
%female	14.2	12.4	7.8	4.6	10.2	10.6
7. Worn-out furniture	-0.34	-7.74	-4.78	-4.20	2.32	-0.10
%male	21.6	27.1	29.1	19.7	17.9	9.7
%female	21.9	34.8	33.8	23.8	15.5	9.8
8. Worn-out clothes	1.62	-4.85	-2.75	-2.19	2.30	-0.53
%male	11.9	9.6	11.7	7.2	9.6	5.3
%female	10.3	14.5	14.5	9.4	7.3	5.8
9. Two pairs of shoes	2.35	-0.41	1.36	0.52	2.12	0.37
%male	5.5	3.6	5.3	4.6	3.3	0.9
%female	3.2	4.0	4.0	4.1	1.1	0.5
10. Pocket money	0.94	-9.41	-5.87	-3.27	-2.28	-2.29
%male	13.6	13.2	10.8	5.9	9.9	8.8
%female	12.7	22.6	16.7	9.2	12.2	11.0
11. Leisure	0.59	-5.10	-4.45	-3.03	-3.89	-3.28
%male	17.2	13.9	16.8	10.8	10.2	7.0
%female	16.6	19.0	21.3	13.9	14.1	10.3
12. Get with friends/family	0.28	-2.74	-0.33	-1.15	1.50	-1.58
%male	10.0	7.4	6.9	5.4	8.8	1.3
%female	9.7	10.1	7.2	6.6	7.4	2.9

**Table 3** continued

	DE	ES	FR	IT	PL	SE
13. Internet connection	<i>0.96</i>	-0.84	<i>2.34</i>	-1.98	<i>3.50</i>	<i>-1.17</i>
%male	4.6	3.6	4.0	3.8	5.0	0.2
%female	3.7	4.5	1.7	5.8	1.5	1.4

Note: Negative values are associated with more women in deprivation of that item. Values in percentages. Italics indicate a statistical significant difference in (male–female) means at least at 5% level. Mean percentages of men/women flagging the item in the survey. See Table 1 for a complete description of items

significant gaps (basically all the 13 items, 10 of them significant), followed by France (all items other than arrears, internet connection, and two pairs of shoes). Furthermore, we see three negative significant gaps in Italy and Sweden, two in Poland, and only one—in unexpected expenses—in Germany. These differences across countries in the gender gap in the overall indicator, Table 2, as well as in each item, Table 3, stimulated our econometric investigation.

Descriptive statistics by country for the variables used as covariates in our models are reported in Table 4. The predictor variables can be classified into individual characteristics, household characteristics, and macroeconomic indicators. Individual characteristics include gender, age, past marital status, work intensity, social class, citizenship (EU, non-EU, extra EU), limitation in activities because of health problems (no activity limitations, some limitations, and severe limitations), home tenure status (by considering five states, see Table 4), and degree of urbanization (densely populated area, intermediate, and thinly populated).

In particular, work intensity enables us to control for labor market attainment (Verbunt and Guio 2019; Fabrizi and Mussida 2020). It is officially defined by Eurostat as the number of worked months by all household members of working age (18–64 years of age) divided by the number of workable months in 1 year by the same household members. The work intensity should take values between 0 and 1, and we group them into three classes, defined as  $[0, 0.2]$ ,  $(0.2, 1)$ , and 1. The first class enables us to identify the very low work intensity indicator, defined by Eurostat as the number of individuals working less than 20% of the total working time potential during the previous year. This is one of the three indicators, together with the at-risk-of poverty or social exclusion and severe material deprivation, used by the European Commission to monitor social exclusion (Atkinson et al. 2017). In Table 4, we notice that while the shares of very low work intensity range from 14% in Sweden to 21% in Spain, there are important differences across the countries explored for the other WI classes. For intermediate WI, we see that the share for our target households ranges from 8% in Poland to 20% in Sweden. As regards full WI, the shares range from 66% in Spain to 74% in Poland. These differences are primarily due to the different labor market commitment of the the household type investigated across countries.

Social class definition is based on the ISCO-88 job classification of occupations (following ESec, by Rose and Harrison 2007 and, among others, Whelan et al. 2007), that includes six categories by considering the occupation for workers, the occupation

**Table 4** Weighted descriptive statistics of the regressors by country

	DE	ES	FR	IT	PL	SE
Female	0.430 (0.496)	0.450 (0.498)	0.480 (0.500)	0.440 (0.496)	0.480 (0.500)	0.430 (0.495)
Age	44.97 (12.841)	49.54 (10.138)	46.54 (12.284)	48.44 (10.693)	49.24 (11.491)	42.44 (13.664)
Past marital status (never married)	0.694 (0.461)	0.634 (0.482)	0.727 (0.446)	0.718 (0.450)	0.509 (0.500)	0.727 (0.446)
Very low WI [0; 0.2]	0.180 (0.384)	0.210 (0.405)	0.150 (0.356)	0.160 (0.371)	0.180 (0.384)	0.140 (0.342)
Intermediate WI (0.2; 0.99]	0.140 (0.346)	0.140 (0.342)	0.180 (0.384)	0.130 (0.338)	0.080 (0.265)	0.200 (0.397)
Full WI (WI=1)	0.68 (0.466)	0.66 (0.475)	0.67 (0.469)	0.700 (0.457)	0.74 (0.436)	0.67 (0.471)
<i>Social class:</i>						
Professionals	0.250 (0.431)	0.22 (0.411)	0.29 (0.453)	0.22 (0.416)	0.32 (0.465)	0.31 (0.462)
Technicians	0.190 (0.392)	0.140 (0.346)	0.180 (0.384)	0.190 (0.394)	0.130 (0.334)	0.170 (0.377)
Clerks	0.270 (0.445)	0.290 (0.456)	0.230 (0.418)	0.260 (0.436)	0.200 (0.402)	0.250 (0.435)
Craftsmen	0.120 (0.325)	0.120 (0.323)	0.110 (0.311)	0.100 (0.306)	0.170 (0.378)	0.110 (0.312)
Operators	0.150 (0.356)	0.200 (0.398)	0.160 (0.365)	0.160 (0.364)	0.160 (0.367)	0.140 (0.342)
Never worked	0.020 (0.148)	0.030 (0.183)	0.040 (0.195)	0.070 (0.250)	0.020 (0.140)	0.020 (0.147)
National citizenship	0.90 (0.302)	0.93 (0.256)	0.93 (0.252)	0.88 (0.327)	0.99 (0.116)	0.91 (0.291)
European citizenship	0.040 (0.191)	0.030 (0.175)	0.020 (0.130)	0.040 (0.204)	0.00 (0.035)	0.030 (0.161)
Non-European citizenship	0.060 (0.245)	0.040 (0.193)	0.050 (0.221)	0.080 (0.268)	0.010 (0.111)	0.060 (0.250)
<i>Limitation in activities because of health problems:</i>						
No activity limitations	0.81 (0.391)	0.69 (0.463)	0.780 (0.416)	0.82 (0.385)	0.760 (0.425)	0.810 (0.396)
Some activity limitations	0.13 (0.335)	0.250 (0.433)	0.140 (0.347)	0.160 (0.362)	0.170 (0.380)	0.150 (0.359)
Severe activity limitations	0.060 (0.237)	0.060 (0.242)	0.080 (0.275)	0.030 (0.159)	0.060 (0.239)	0.040 (0.203)

**Table 4** continued

	DE	ES	FR	IT	PL	SE
<i>Tenure status:</i>						
Outright owner	0.12 (0.321)	0.35 (0.476)	0.18 (0.386)	0.48 (0.50)	0.64 (0.479)	0.10 (0.307)
Owner paying mortgage	0.08 (0.272)	0.29 (0.455)	0.25 (0.431)	0.11 (0.311)	0.12 (0.326)	0.38 (0.484)
Tenant paying rent	0.73 (0.444)	0.22 (0.414)	0.30 (0.460)	0.25 (0.434)	0.07 (0.263)	0.510 (0.050)
Accommodation at reduced fee	0.03 (0.18)	0.40 (0.187)	0.230 (0.418)	0.020 (0.153)	0.020 (0.142)	0.000 (0.000)
Accommodation provided free	0.04 (0.192)	0.11 (0.309)	0.40 (0.200)	0.130 (0.341)	0.14 (0.346)	0.10 (0.087)
<i>Degree of urbanisation:</i>						
Densely populated	0.85 (0.358)	0.55 (0.497)	0.47 (0.499)	0.39 (0.487)	0.50 (0.50)	0.45 (0.498)
Intermediate	0.00 (0.00)	0.29 (0.455)	0.28 (0.450)	0.41 (0.493)	0.27 (0.445)	0.37 (0.483)
Thinly populated	0.015 (0.358)	0.160 (0.362)	0.25 (0.435)	0.200 (0.400)	0.23 (0.419)	0.18 (0.381)
Labor income component	1.627 (1.310)	1.471 (1.351)	1.582 (1.298)	1.531 (1.334)	0.945 (0.813)	1.922 (1.260)
Non-labor income component	0.316 (0.604)	0.368 (0.687)	0.434 (0.731)	0.371 (0.769)	0.146 (0.328)	0.421 (0.848)
Local unemployment rate	3.54	13.89	n.a.	9.20	3.00	7.33
Observations	7104	3230	2634	4270	1600	1048

Note: Standard deviations in parentheses. Source: 2022 EU-SILC data

in the previous job for retired, other inactive, and more recently unemployed,<sup>5</sup> and a residual category for those who never worked or are long-term unemployed: (1) professionals (ISCO codes 1 and 2); (2) technicians (ISCO code 3); (3) clerks (ISCO codes 4 and 5); (4) craftsman (ISCO codes 6 and 7); (5) operators (ISCO codes 8 and 9); (6) never worked. As for household characteristics, we separate the total disposable household income (variable HY020 in the EU-SILC code) in labor and non-labor income components (i.e., benefits, transfers, other non-labor income aspects at the household level), as they may affect differently the poverty indicator. Labor and non-labor income variables are divided by the income poverty threshold, in each country, and the ratios are used in the regression analyses. In terms of macroeconomic indicators, we control for local unemployment rates (NUTS1 level), as our aim is to adjust for the difficulty of obtaining jobs.

<sup>5</sup> We use the information on the International Standard Classification of Occupations (ISCO) available in the EU-SILC survey, that is the two digits ISCO-88.

**Table 5** Akaike information criteria for hurdle-negative binomial, zero-inflated negative binomial, and proportional odds estimations

Country	hurdle-NB	zi-NB	prop-odds
Germany	22,766.5	22,802.0	22,422.9
Italy	13,157.4	13,141.2	13,107.8
France	8134.5	8133.5	8032.8
Spain	10,900.3	10,917.7	10,758.0
Poland	4855.0	4877.2	4805.3
Sweden	2168.6	2178.2	2139.3

Overall, large heterogeneity across countries in the gender gap in material and social deprivation and in the characteristics is taken care of by separating the analyses for each country. In this way, we can reconcile our work with the literature on country differences in welfare regimes, fiscal transfers and alleviation measures discussed in Bedük (2018) and Guio and Van den Bosch (2020).

## 5 Results

In this section, we comment on the results from the proportional odds model for the risk of material and social deprivation. Table 6 reports the estimated coefficients of Eq. 1, applied to each country. As commented in Section 3, we also estimated other models of risk such as the negative binomial hurdle model, Poisson hurdle (that does not allow for overdispersion), and ordinary zero-inflated negative binomial model (Feng 2021), calculating the Akaike information criteria to check for the best-fitting specification.

Criteria in Table 5 show how the predictive abilities of hurdle-negative binomial and zero-inflated negative binomial are very close and which one prevails changes from country to country. In all cases, the proportional odds models present lower AIC and are therefore preferable. We do not consider other information criteria such as the Bayes information criterion, but results would go in the same direction: for this criterion, the penalization complexity is more severe, and this would go in favor of the proportional odds models that are more parsimonious.

Table 6 shows that there is a clear role for gender, i.e., the risk of being deprived is relatively higher (and significant) for single women than for men in all the countries explored, with the exception of Italy. These findings confirm the existing literature discussed in Section 2. Bedük (2018) and Nelson (2012), for instance, found that women are generally more deprived than men. Indeed, most studies find similar results, although the gender gap remains largely unexplained, even when controlling for individual demographic characteristics, socio-economic status, and macroeconomic factors (e.g., Muffels and Fouarge 2004; Halleröd et al. 2006; Papadopoulos and Tsakloglou 2016; Provencher and Carlton 2018). However, differently from most of the existing literature, we have evidence of a non-monotonic relationship between the gender gap and the cumulative risk of material and social deprivation. The gender impact is much higher when individuals are exposed to a few material deprivation items. Women are at maximum risk differential at their disadvantage when stepping

**Table 6** Proportional odds model for the probability of being deprived in at least one item

	DE	ES	FR	IT	PL	SE
Female	0.113** (0.051)	0.366*** (0.074)	0.335*** (0.085)	0.094 (0.065)	0.309*** (0.111)	0.327** (0.158)
Age	-0.013*** (0.002)	-0.007 (0.004)	-0.010** (0.004)	0.003 (0.004)	0.012* (0.006)	0.005 (0.007)
Age squared	-0.001*** (0.000)	-0.001** (0.000)	-0.002*** (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.002*** (0.001)
Past marital status	0.214*** (0.061)	0.351*** (0.078)	0.375*** (0.098)	-0.091 (0.073)	0.084 (0.115)	0.536*** (0.194)
<i>Work intensity - reference: intermediate</i>						
Full WI [=1]	-0.181** (0.075)	-0.646*** (0.104)	-0.615*** (0.115)	-0.467*** (0.091)	-0.806*** (0.194)	-0.372* (0.197)
Very low WI [0; 0.2]	0.711*** (0.090)	0.485*** (0.127)	0.641*** (0.147)	0.716*** (0.121)	1.060*** (0.230)	0.581** (0.252)
<i>Social class - reference: clerks</i>						
Professionals	-0.556*** (0.079)	-0.510*** (0.121)	-0.460*** (0.131)	0.004 (0.094)	-0.700*** (0.172)	-0.643*** (0.230)
Technicians	-0.320*** (0.071)	-0.168 (0.113)	-0.290** (0.126)	-0.059 (0.094)	-0.249 (0.184)	-0.455* (0.234)
Craftsmen	0.018 (0.081)	-0.043 (0.122)	-0.140 (0.144)	0.017 (0.114)	-0.072 (0.167)	-0.451* (0.271)
Operators	0.230*** (0.072)	0.119 (0.099)	0.195 (0.125)	0.278*** (0.098)	0.031 (0.162)	-0.164 (0.220)
Never worked	-0.237 (0.156)	0.075 (0.213)	-0.050 (0.218)	0.190 (0.146)	-0.622* (0.361)	-0.352 (0.513)
<i>Citizenship - reference: European</i>						
National citizenship	-0.112 (0.119)	-0.072 (0.185)	0.172 (0.305)	-0.420*** (0.152)	7.538*** (0.218)	-0.489 (0.452)
Non-European citizenship	0.338*** (0.143)	0.306 (0.242)	0.684* (0.357)	0.343** (0.179)	7.723*** (0.323)	0.640 (0.501)
<i>Educational attainment level - reference: secondary education</i>						
Primary education	0.559*** (0.065)	0.260*** (0.091)	0.501*** (0.115)	0.360*** (0.075)	0.751*** (0.186)	0.471** (0.215)
Tertiary education	-0.514*** (0.066)	-0.433*** (0.097)	-0.429*** (0.107)	-0.313*** (0.084)	-0.524*** (0.148)	-0.242 (0.191)
<i>Limitation in activities because of health problems - reference: no limitations</i>						
Some activity limitations	0.561*** (0.070)	0.672*** (0.082)	0.515*** (0.114)	0.935*** (0.084)	0.623*** (0.135)	0.870*** (0.199)
Severe limitations	1.133*** (0.102)	1.323*** (0.144)	0.780*** (0.145)	0.789*** (0.187)	1.137*** (0.218)	1.353*** (0.341)

Table 6 continued

	DE	ES	FR	IT	PL	SE
<i>Tenure status - reference: tenant paying rent</i>						
Outright owner	-1.053*** (0.090)	-1.041*** (0.104)	-0.894*** (0.135)	-0.909*** (0.080)	-0.622*** (0.208)	-0.824*** (0.278)
Owner paying mortgage	-0.277*** (0.099)	-0.271*** (0.099)	-0.272** (0.115)	-0.615*** (0.116)	-0.084 (0.246)	-0.828*** (0.183)
Accommodation at reduced fee	0.217* (0.120)	0.174 (0.189)	0.071 (0.108)	0.195 (0.184)	-0.183 (0.385)	n.a.
Accommodation provided free	-0.703*** (0.130)	-0.502*** (0.127)	-0.510** (0.209)	-0.440*** (0.101)	-0.143 (0.232)	-1.242 (1.135)
Labor income component	-0.646*** (0.038)	-0.526*** (0.046)	-0.746*** (0.066)	-0.226*** (0.034)	-0.655*** (0.114)	-0.529*** (0.102)
Non-labor income component	-0.257*** (0.053)	-0.611*** (0.073)	-0.804*** (0.098)	-0.061 (0.042)	-1.817*** (0.252)	-0.524*** (0.149)
<i>Degree of urbanization - reference: intermediate</i>						
Densely populated	n.a.	0.077 (0.079)	0.200** (0.096)	0.063 (0.069)	0.262** (0.123)	-0.094 (0.177)
Thinly populated (rural)	0.037 (0.069)	-0.178* (0.102)	0.258** (0.104)	0.036 (0.085)	0.589*** (0.138)	-0.101 (0.222)
Local unemployment rate	0.015 (0.034)	0.031*** (0.009)	n.a.	0.109*** (0.008)	-0.020 (0.068)	0.078 (0.163)
<i>Intercepts</i>						
0 1	-1.599*** (0.188)	-1.708*** (0.253)	-1.988*** (0.352)	-0.535*** (0.204)	5.764*** (0.284)	-1.079 (1.380)
1 2	-0.804*** (0.188)	-0.935*** (0.251)	-1.258*** (0.350)	0.293 (0.204)	6.743*** (0.284)	0.010 (1.380)
2 3	-0.216 (0.187)	-0.363 (0.251)	-0.713** (0.349)	1.063*** (0.205)	7.414*** (0.285)	0.644 (1.381)
3 4	0.242 (0.188)	0.144 (0.251)	-0.207 (0.350)	1.594*** (0.206)	8.006*** (0.287)	1.137 (1.382)
4 5	0.672*** (0.188)	0.614** (0.252)	0.248 (0.350)	2.087*** (0.208)	8.476*** (0.290)	1.487 (1.384)
5 6	1.119*** (0.189)	1.074*** (0.253)	0.714** (0.352)	2.490*** (0.210)	8.835*** (0.293)	1.898 (1.386)
6 7	1.513*** (0.191)	1.527*** (0.255)	1.173*** (0.354)	2.904*** (0.213)	9.226*** (0.298)	2.426* (1.390)
7 8	1.962*** (0.193)	2.062*** (0.258)	1.661*** (0.357)	3.206*** (0.216)	9.579*** (0.302)	3.414** (1.405)

**Table 6** continued

	DE	ES	FR	IT	PL	SE
8 9	2.538*** (0.196)	2.640*** (0.264)	2.270*** (0.364)	3.664*** (0.221)	9.969*** (0.309)	3.588** (1.410)
9 10	3.244*** (0.204)	3.248*** (0.273)	2.866*** (0.373)	4.175*** (0.230)	10.538*** (0.322)	4.917*** (1.493)
10 11	3.981*** (0.219)	3.931*** (0.292)	3.668*** (0.396)	4.598*** (0.241)	11.169*** (0.346)	17.341*** (1.493)
11 12	5.111*** (0.269)	5.281*** (0.383)	5.282*** (0.538)	5.869*** (0.309)	11.763*** (0.382)	17.834*** (1.493)
12 13	6.810*** (0.485)	6.681*** (0.630)	32.764*** (0.538)	8.136*** (0.737)	13.891*** (0.764)	18.607*** (1.493)
Observations	7104	3230	2634	4270	1600	1048

Note: Standard errors in parentheses. \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ . Source: authors' estimations based on EU-SILC 2022 data

into deprivation from zero, while the gender difference at higher levels of deprivation is smaller. In fact, when we use logistic regressions for either being materially and socially deprived or severely deprived (i.e., the official indicators of the probability of being deprived if lacking 5 or 7 items, respectively), we observe a decrease in magnitude and significance of the gender effect (controlling for explanatory variables and a constant term). Results are reported in Table 3 in the Appendix and discussed in Section 6.<sup>6</sup> This conclusion is confirmed by the application of the partial proportional odds model to our data, relaxing the proportionality assumption only for the gender variable. For all countries, the signs of the estimated gender coefficient are positive, but their magnitude decreases as the threshold increases (i.e., there is a weaker and weaker difference between men and women), and they turn non-significant for high deprivation levels. Detailed results about these models are available upon request. This evidence is in favor of the “zero” threshold proposed by Bedük (2018).

A possible explanation for these results resides in the relative economic fragility of women. Table 3 in Section 4 highlights a strong disadvantage for women in facing unexpected expenses, everywhere, which is the item with the largest prevalence of deprivation for women in our samples across countries. Moreover, if we consider the subset of individuals with exactly one item in deprivation, in more than 50% of the cases, it has to do with the inability to face unexpected expenses. Lack of pocket money and leisure activities play a similar role, that recurs very often among the deprivation of individuals with a few (one or two) items in deprivation. We note that the availability of pocket money and leisure (social deprivations) is related to financial distress, and they appear to go at a strong disadvantage to female heads of household—except in Germany (see also Guio and Van den Bosch 2020). Spanish and French women seem

<sup>6</sup> We also estimated probit models on the two official indicators. Again, we note a decrease in the magnitude and significance of the gender effects when moving from a threshold of 5 items to 7 items. For the sake of brevity, we do not report the results, which are available upon request.

particularly vulnerable on these dimensions, followed by Italian women (in line with Mussida et al. 2023).

Financial fragility arises for several reasons. Individuals may have low financial literacy, they may overestimate or underestimate personal competencies, experience unexpected large income declines, and suffer from wrong financial choices. Aristei and Gallo (2022), for example, show that there is a gender gap in all these dimensions, detrimental to women. They argue that behavioral and psychological traits play a big role in financial decision-making; combined with social norms, they shape the perception of gender roles and contribute to expose women more to financial and poverty risks (see also Sholevar and Harris 2019; Zhou and Gan 2023). Lusardi and Mitchell (2017) show that women have more difficulty coping with financial troubles. Moreover, the fact that women earn less in their life-cycle and have low tolerance towards risk (Dawson 2023) decreases their saving behavior in the short and in the long run; this fact on average reduces their well-being relative to men (Fisher 2010).

In our results, people's condition about past marital status has a positive association with the risk of deprivation in all countries but Italy and Poland. Marital status is a dummy variable equal to 1 if the individual in the past had been married/cohabiting or is widowed; it is zero for never married/cohabiting people. Our findings are in line with England (2002), who explores the issue by gender. Italy and Poland represent an exception in our sample, no matter what "past life" individuals had, and it does not affect the probability of material and social deprivation. The unclear role of marital dissolution on deprivation in Italy might be partly due to the presence of strong family/intergenerational ties, that is proximity and parental support (Dalla Zuanna 2001). As for Poland, it is defined as one of the EU countries with the lowest level of family support (Szikra and Szelewa 2010).

Although our findings contrast with Bárcena-Martín et al. (2014) in the fact that, overall, individual characteristics play a more important role with respect to macro indicators at explaining the probability of deprivation, some gender differences across countries may arise because of existing gender norms, attitudes towards gender roles, welfare regimes, and transfer programs—more or less favorable to women, and other institutional differences, in the labor market and active labor market policies. According to OECD (2023), for example, in 2021, Italy had the highest employment gender gap among the six countries, and Sweden and France had the lowest. Nelson (2012) finds that about 16% variation of material deprivation can be explained by country differences in the levels of social benefits. Social assistance is divided into a system of contributory benefits (e.g., social insurance, parental leaves, minimum wage schemes, house benefits, child benefits, tax credits) and public services (e.g., provision of care for dependents). Social assistance levels are fairly low in Eastern European countries (such as Poland) relatively to other European regions; it is relatively high in Germany, Italy, and Sweden, although in the former two—plus Spain—large regional heterogeneity exists in the implementation of the benefits. Furthermore, the Italian welfare model is getting far from the European social system, because it is based more heavily on family network support (Addabbo et al. 2015).

Material and social deprivation has a non-linear relationship with age for Germany, Spain, France, and Sweden. The association we find is in line with the existing literature

(see, for instance, Bárcena-Martín and Moro-Egido 2013, Guio and Van den Bosch 2020; Dudek and Szczesny 2021). It suggests that the youth are particularly exposed to the risk of material and social deprivation (Whelan and Maître 2010; Fabrizi et al. 2023). Overall, both labor and non-labor income components are negatively associated with the risk of material and social deprivation. However, the effect of the former is relatively stronger (in magnitude and significance, see Table 6) than the latter, which is even non-significant in Italy. Notably, these findings should reflect the relative higher importance of the labor income share of total income in all countries. As far as Italy is concerned, there is a signal of the presence of non-labor income and/or transfers, which should not be effective in reducing the risk of deprivation (Bonanno et al. 2023). Likewise, full work intensity is negatively associated with material and social deprivation in all samples. However, work intensity estimates reveal that when individuals work less than 20% of the workable months in a year, they have very low work intensity and are exposed to a higher risk of material and social deprivation, in every country (after controlling for those who never worked and for income components of the household income). People with a low wage need to work a relevant number of hours, ending up with strong social and financial constraints. Likewise, people working few hours/months face difficulties to cope with expenses to conduct a decent way of life. Our results show that this may be true in every country, independently on the wage level or the gender wage differentials (Layte et al. 2001; Whelan et al. 2004; Halleröd et al. 2006; de Graaf-Zijl and Nolan 2011; Figari 2012). Job uncertainty (such as that spurred by the COVID-19 crisis) and the expectations of future employment and income decrease household financial resources and increase the risk of material deprivation (Crettaz 2015; Friedrich and Teichler 2024; Pérez-Corral et al. 2024). As regards social class, we observe that only pertaining to the professional occupations' category is negatively associated with the risk of deprivation in the investigated countries, with the exception of Italy. This finding is in line with Bedük (2018) who argues and finds a role for social class in the risk of deprivation (when zero items are taken as a threshold). Non-European citizens have a higher risk of deprivation in Germany, Italy, Poland, and slightly in France (as regards the disadvantage of foreigners, see, for instance, Bárcena-Martín et al. 2014; Busetta et al. 2016). Tertiary education is negatively associated with the probability of being deprived in at least one item, with the exception of Sweden (where the estimate is negative and non-significant). This result is in line with the evidence discussed in the literature section. There is a very large consensus among scholars about the protective role of high (secondary and mainly tertiary) education. Disability, that is limitation in daily activities, is positively associated with the risk of material deprivation in all countries. These findings are strictly linked to the indirect (long-term or permanent) impact of disability and caring activities on one's own or other household members' labor market participation, as found by, among others, Fabrizi and Mussida (2020). Finally, among the individual characteristics, outright ownership provides a relatively (compared with tenant paying for rent, our base category) lower risk of being materially and socially deprived, though not in Poland.

Among the macro-level variables, we do not find a clear role for the degree of urbanization. There is only a significant positive association for both densely and

thinly populated areas (with respect to our base category, i.e., intermediate) in Poland and France. Deprivation is not a monetary indicator, and the presence/absence of items should be less strongly associated with the degree of urbanization, since it is a more complex phenomenon. For instance, social deprivation may arise both in a densely populated area and in a rural area, if people experience a reduction of employment, financial constraints, or a scanty social environment without friends/family support.

The local—macro-regional—unemployment rate does not exert a clear role on the risk of material and social deprivation. When significant (in Spain and Italy), it has a positive sign. More checks on the role of the unemployment rate are conducted in the next section.

Finally, as shown in the bottom part of Table 6, we see that intercepts are in most cases equally spaced or close to this condition, which corroborates the good fit of our models. Marked variable spacing only seldom happens in our analysis, and when it does, it is only for very high levels of deprivation which are infrequent in the data and for which the ability of the models to discriminate is limited.

## 6 Robustness checks

In this section, we offer some robustness checks for the findings of our benchmark model, in which we change methods, specifications, and/or samples. The additional analyses can be summarized as follows: (1) separation of the material and social deprivation indicator in the “material” and “social” part, to understand their contribution to the overall indicator; (2) separate risk regressions for 13 deprivation items to inspect which deprivation contributes more to the gender difference; (3) logit of the standard material deprivation indicator and the standard severe material indicator, i.e., the lack of 5 or more items and 7 or more items, respectively, set by Eurostat; (4) models with interactions between gender and education (low/primary and high/tertiary educational attainment level); models estimated on separate sub-samples identified by median age; (5) (three) different model specifications on pooled data. All the attempts are reported in Tables 1 to 5 in the Appendix file. For the sake of brevity, in all these tables, we only report the main coefficients of interest.

In the first check, we separate the “material and social deprivation” indicator into its “material” and “social” part. The former includes nine items of the European standard indicator for material deprivation (HS040, HS060, HS011, HS031, HS050, HH050, HS110, HS100, HS080, HS070 in the EU-SILC code), while the latter includes the “new” items, i.e., the items added to obtain the “material and social deprivation” indicator after 2013 (PD050, PD060, PD070, HD080, PD020, PD030, PD080 in the EU-SILC code). Table 1 in the Appendix reports the estimated coefficients of gender for the material part, the social part, and the overall material and social indicator (which is our benchmark, see Table 6 above). The decomposition of the total indicator in the social and material components suggests interesting reflections. First, where the gender was significant for the overall material and social deprivation indicator, i.e., a relatively higher risk of being deprived for single women than for men, theseparate

social and material parts are both significant. Germany provides a partial exception, because gender is significantly associated only with material deprivation. In Italy, for which the coefficient associated with gender is not different from zero overall, significance arises for the social component. The responsible items of explaining the disadvantage of single women in those components are “unexpected expenses” for Germany and “leisure” and “pocket money” for Italy (as stylized in the descriptive statistics, Table 3).

The second check deals with the relevance of each item. The gender impact is relatively higher when individuals are exposed to few deprivation items, i.e., women are at maximum of their disadvantage when they move from zero to one deprivation item. This observation requires to run separate regressions—one for each deprivation item. The estimated gender coefficients for each item and country are reported in Table 2 of the Appendix. On the one hand, we see that women are highly penalized when it comes to “unexpected expenses” (positive and significant estimate for all countries, with the partial exception of Italy), “pocket money,” and “leisure.” On the other hand, being female reduces the risk of having “arrears” and, though to a lesser extent, “two pairs of fitting shoes.” In the former case, i.e., a significant disadvantage for females in “unexpected expenses,” “pocket money,” and “leisure,” we find a confirmation of the hypothesis of relative financial fragility of women; in the latter case, we find a confirmation of the relative lower tolerance of women towards risk, as discussed in Section 5 for the main results (Table 6). This exercise, therefore, verifies that our main findings in the benchmark model are robust. In fact, the heterogeneity across countries is confirmed (Italian and Swedish women appear not to be different from their male counterparts in terms of “unexpected expenses”).

To conduct our analysis within an official framework of material deprivation measures, in the third check, we estimate the probability of material deprivation and severe material deprivation (that is the lack of 5 items and 7 items, respectively) by using simple logit models (as mentioned in Section 5). Results for the estimated gender coefficients are reported in Table 3 in the Appendix. There is evidence that the coefficient associated with gender in material deprivation logit is strongly positively significant only for Spain and moderately significant for Poland. As far as severe material deprivation, the coefficient is positive and statistically significant for Spain and negative and significant for Germany. The rest of the estimates are non-significant. Two conclusions from this evidence emerge: (i) the vast majority of individuals in all countries report up to one or two items of deprivation, with only a few deprived with respect to many items. Females are significantly more at risk when we consider no threshold, while this effect disappears when dichotomizing the deprivation status based on high thresholds; (ii) the probability of severe material deprivation even reverses at the expense of men in Germany, i.e., the probability to be deprived of seven or more items becomes higher for men than women (with a significance at 5% level). Detailed results about these models are available upon request. This provides evidence in favor of the “zero” threshold proposed by Bedük (2018), and to the fact that what we propose with a proportional odds model brings to light otherwise hidden/insignificant relationships. As an additional check, we also run probit models and the findings are in linewith

those just discussed. For the sake of brevity, we do not report probit estimates, which are available from the authors upon request.

The fourth check explores whether education and age interacted with gender lead to different findings or interpretations. Specification (i) includes interactions between gender and education classes (low/primary and high/tertiary educational attainment level), and specification (ii) separates samples below and above the country's median age, to estimate the impact of gender and education. Table 4 in the Appendix reports the estimated coefficients for the main variables of interest. In model specification (i), we observe that low-educated women are not different from highly educated women, in general. In Germany and Poland, low-educated women are at a bit less risk of deprivation than low-educated men. In model specification (ii), on age-split samples, old women appear to be at a significantly higher risk of deprivation than old men, except in Poland (against the common intuition that older women, especially when educated, face equal risks as men), while young women appear to be at a significantly higher risk than young men in France, Spain, and Poland, even if tertiary education protects them. We also calculated *t*-tests for statistically significant differences between old and young: only Italy, Poland, and Sweden have slightly different gender estimates by age. These analyses, therefore, support the results of our benchmark model.<sup>7</sup>

Finally, the last robustness analysis concerns pooling the data. We estimate three model specifications by pooling countries together to elaborate more on country differences: (1) pooled data with country dummies; (2) pooled data with the interaction between gender and country dummies; (3) pooled data with the interaction between gender and the local unemployment rate. Table 5 in the Appendix reports the results for the three specifications. Gender disparities remain in place, after controlling for country dummies or the interactions. In particular, the coefficient for the main gender variable is positive and significant, i.e., there exists a positive association between being female and the risk of material and social deprivation. However, we cannot speculate on countries' differences for gender here. It appears that country dummies are statistically significant (i.e., different from the reference category, Germany, the country with only one deprivation item against women, "unexpected expenses," see Table 3). Only Poland shows a relatively higher risk of deprivation (all other countries show negative signs, that is a relatively lower risk than Germany). This should be due, as we explain in Section 5, to the fact that the social assistance level is fairly low in Eastern European countries relatively to other European regions. It is relatively high in Germany, Italy, and Sweden, although for the former two—plus Spain—large heterogeneity exists in the implementation of the benefits among regions within countries (Nelson 2012).

Column 2 shows that the gender gap per se becomes non-significant when interactions are included, because of country heterogeneity. A female disadvantage with respect to German females can be detected in Spain, France, and Sweden (not in Italy and Poland). Country dummies—Germany as the reference category—give very

<sup>7</sup> As an additional exercise, we estimated models separately by median age including the interactions between gender and education. As for models (i) and (ii) above, we do not find important differences across population sub-groups. For the sake of brevity, we do not report these estimates here. Results are available upon request.

similar results as in column 1, again with Poland showing a slightly higher risk of deprivation.

Column 3 includes the interaction between gender and the local unemployment rate. While the estimated gender coefficient loses significance, the interaction with the unemployment rate is positive and significant. Country dummies give similar evidence as in column 1. Therefore, country differences remain even if we adjust for the difficulty of obtaining jobs, i.e., the local unemployment rates. There is a gender gap, and, of course, this is particularly true for unemployed single women.

Overall, these additional analyses corroborate the results of our benchmark model, which seems to be robust to alternative assumptions.

## 7 Conclusions

We investigate gender differentials in material and social deprivation by focusing on single adult heads of household, aged between 18 and 64, in six European countries. The sample selection circumvents the problem of assessing intra-couple or within-household inequality to better identify individual command over resources. Moreover, single-person households are on the rise (Karagiannaki and Burchardt 2020) in European societies and are particularly exposed to the risk of poverty (Chzhen and Bradshaw 2012; Treanor 2018). We estimate proportional odds models separately by country, to capture the intensity of deprivation and heterogeneity in the gender gap. Our findings suggest a clear role for gender, i.e., the risk of (cumulative) material and social deprivation for singles is relatively higher for women than for men in all the explored countries. The impact of gender is evident especially at low levels of deprivation, as women are more likely to experience deprivation in the items of financial distress, such as facing unexpected expenses or lack of pocket money, when the deprivation level is low. The effect tends to be less evident if we work with thresholds like 5 or 7, that identify more severely but clearly a much smaller set of deprived individuals. It is highest when women step into deprivation from zero. In other words, it is riskier to fall into deprivation of at least one item for women with respect to men (here, we do not intend that men are not at risk themselves). At higher levels of deprivation, the gap is more difficult to identify from a statistical point of view, because of the small number of individuals with those levels of deprivation. Moreover, while it is plausible that the COVID-19 pandemic has spread financial concerns among households, especially if their main earners lost part of her/his income, the difficulty to face “unexpected expenses” and financial constraints are not exclusively related to the pandemic period. Unfortunately, we do not have information about the extent of unexpected expenses for individuals and households (whether large or small).

The other individual characteristics play a role in line with expectations. We find a relatively less important role for macro indicators than individual features. Nonetheless, the answer to our research question is that the gender gap in material and social deprivation remains in place everywhere, after controlling for individual, macro variable and a set of robustness analyses. If we look at single items of deprivation, the most important one for women is “facing unexpected expenses,” i.e., the item showing

the relatively higher gap at the disadvantage of women. The main explanation for this finding stands in the relative financial and economic fragility of women (even if controlling for protecting factors such as tertiary education, outright home ownership, full work intensity, and labor/non-labor income). Overall, our findings offer important policy implications to reduce the fragility of women. With respect to financial fragility, interventions aimed at increasing financial literacy would be desirable. As for economic fragility, more general interventions should aim at improving the labor market conditions of women, especially reducing the pay gap which is strongly and positively associated with the risk of deprivation.

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**Data availability** The data that support the findings of this study are available from Eurostat, but restrictions apply to the availability of these data, which were used under license for the current study and so are not publicly available. The data are, however, available from the authors upon reasonable request and with the permission of Eurostat.

## Declarations

**Conflict of interest** The authors declare no competing interests.

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