Social Indicators Research (2026) 181:16
https://doi.org/10.1007/s11205-025-03745-0

ORIGINAL RESEARCH

Relative-importance Analysis of Material and Social Deprivation Across European Countries

Chiara Mussida[1,2] · **Maria Laura Parisi**[3] · **Nicola Pontarollo**[3]

Received: 20 March 2025 / Accepted: 4 November 2025 / Published online: 16 December 2025
© The Author(s) 2025

Abstract
We investigate the relative importance of the socioeconomic characteristics of households associated with the risk of material and social deprivation. The methodology is based on sequential R^2 decomposition and cluster analysis approaches, applied to 27 European countries in 2023. Household data come from the European Union Statistics on Income and Living Conditions survey. Our analysis of relative importance reveals that household disposable income accounts for approximately 20% of the variance in deprivation on average, meaning that the remaining 80% of the variability is explained by non-monetary factors. Among the key non-monetary factors, we identify household composition, education, and age. Finally, our cluster analysis suggests that while the Nordic welfare regime is relatively effective in reducing material and social deprivation, further efforts are needed across the rest of Europe. Governments should take the relative importance analysis into account when considering potential measures to decrease the number of factors associated with the risk of deprivation. This latter suggests the need for integrated interventions, encompassing housing, care services, education, and labor market participation.

Keywords Material and social deprivation · Relative importance · Cluster analysis · Europe

✉ Chiara Mussida
chiara.mussida@unicatt.it

Maria Laura Parisi
marialaura.parisi@unibs.it

Nicola Pontarollo
nicola.pontarollo@unibs.it

[1] Department of Economic and Social Sciences, Università Cattolica del Sacro Cuore, Via Emilia Parmense 84, Piacenza 29122, Italy

[2] GLO, Essen, Germany

[3] Department of Economics and Management, University of Brescia, Via San Faustino 74/b, Brescia 25122, Italy

1 Introduction

The 2030 Agenda for Sustainable Development, adopted by the United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and in the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize, by strengthening the previous Europe 2020 strategy, that ending poverty and deprivation must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests (United Nations, 2015). One of the indicators used by Eurostat to monitor social exclusion is severe material deprivation, together with at-risk-of poverty, and very low work intensity (European Commission, 2014). The literature on (individuals or) households' deprivations defines the phenomenon as having multidimensional aspects (see Ayala et al., 2011; Dudek & Szczesny, 2021; Fabrizi et al., 2023; Whelan & Maître, 2012) not only based on income or financial conditions, but more generally based on enforced lacks that keep the quality of life of each individual not acceptable (compared to national standards). In addition, a strand of this literature discusses the validity of the indicators that the European Commission approved to monitor deprivation, and which resulted in an update of collected information at the individual and household levels, in 2014 (see Fabrizi et al., 2023; Guio et al., 2012, 2017, 2016), producing a new indicator tracing additional social aspects of deprivation and standard of living, i.e. the material and social deprivation indicator (MSD). The material and social deprivation indicator is the variable of interest in our analyses. The present paper takes a comparative perspective on European countries with observable data on material and social deprivation; however, it offers some novelties. First, considering material and social deprivation as a multifaceted phenomenon, this work highlights the heterogeneous importance of socioeconomic household factors in explaining cross-country variability (for a discussion on integrating micro and macro-level factors on poverty see, e.g., Brady et al., 2009). In this respect, an OLS estimation of a linear-probability model provides evidence on the socioeconomic characteristics of the household connected with deprivation for each European country. This analysis enables us to calculate the relative importance of each regressor in explaining the model variance for each country. The reason why socio-economic factors have different importance at explaining material deprivation in each country may trace back to the sociological concept of social stratification within each country, as will be explained in the Literature section, as well as how sensitive and decisive are policies to reduce material deprivation and poverty. Second, for robustness check, we also apply a logit model to the dichotomous dependent variable, estimating the coefficients through a maximum likelihood approach. Third, a hierarchical clustering applied to the relative importance of the regressors of each country allows identifying two main clusters of countries, that is two large 'macro-regions' with clearly different patterns for socioeconomic characteristics related to material and social deprivation. These statistical results have important policy implications at the European level.

The paper is structured as follows. Section 2 offers a review of the literature. Section 3 describes the data and indicators. Section 4 sketches the methodology. In Section 5, we report our results: Section 5.1 comments on the findings for the relative importance analysis, Section 5.2 reports on the cluster analysis, while Section 5.3 discusses the findings. Section 6 offers some concluding remarks and policy implications.

2 Literature Review

There exists a strand of literature that is relatively policy oriented, by investigating the phenomenon of deprivation from a comparative perspective, especially after the great economic recession (see, e.g., Mussida et al., 2023) and related to the socioeconomic characteristics of individuals and households, under a deprivation condition (see Layte et al., 2001; Mussida & Parisi, 2021; Nolan & Whelan, 2010; Whelan et al., 2004). Many scholars concentrated on national solutions to deprivation, discussing social assistance programs, public health provision, and the setting of general welfare regimes that shape the consequences of long-term unemployment (see Israel & Spannagel, 2019; Layte et al., 2001). However, Nelson (2012) shows that about 29% of the variation in material deprivation can be explained by country differences. Verbunt and Guio (2019), as well, find a role for countries in explaining deprivation. They use the Shapley decomposition method to compare the relative contribution of independent variables at the household and country level to the variance within and between countries in income poverty and severe material deprivation in 2012. Their findings suggest that household-level socioeconomic characteristics explain 32% of the severe material deprivation within the country. They also find that one-third of the total unexplained variance in the risk of severe material deprivation is located at the country level.

Bárcena-Martín et al. (2014), instead, investigate to what extent differences in individual characteristics and country-specific factors can explain country differences with respect to material deprivation levels in 28 European countries in 2007 (before the great recession). Their results suggest that country-specific factors seem to be much more relevant than individual effects in explaining country differences in material deprivation.

There is also literature that elaborates on the determinants of the probability of falling into material deprivation (across countries). Among the main socioeconomic characteristics, the evidence suggest gender (Notten & Guio, 2021); age (see Bárcena-Martín et al., 2014; Dudek & Szczesny, 2021; Guio & Van den Bosch, 2020); age and number of children (Provencher & Carlton, 2018); health status, (Bedük, 2018); the disability of any household member (e.g., Dudek & Szczesny, 2021; Guio & Van den Bosch, 2020); education (see all above-cited papers, including Whelan et al., 2002); household's structure (Dudek & Szczesny, 2021; Papadopoulos & Tsakloglou, 2016); the presence and number of children in the household (Boarini & d'Ercole, 2006; Dewilde, 2008; Tsakloglou & Papadopoulos, 2002); home tenure status (Bárcena-Martín et al., 2014); country of birth (Busetta et al., 2016); labor market features, such as work intensity (de Graaf-Zijl & Nolan, 2011; Figari, 2012; Halleröd et al., 2006) or employment type (see, e.g., Bárcena-Martín et al., 2014); and macroeconomic factors, such as welfare regimes and labor market institutions (e.g., Alper et al., 2020; Nelson, 2012; Nolan & Whelan, 2010).

The theoretical framework at the base of social stratification posits that individuals and households are embedded in hierarchical structures based on income, education, occupation, and social capital. These structural positions influence access to resources, opportunities, and exposure to deprivation (see, e.g., Marquis et al., 2025). Lower socioeconomic status households are more vulnerable to both material hardship (e.g. inability to afford basic goods) and social exclusion (e.g. limited participation in social life). Socioeconomic household factors can trigger cycles of deprivation, leading to cumulative disadvantage and country heterogeneity (Budría et al., 2025). Moreover, social protection expenditure is very heterogeneous across European countries, being relatively higher than the EU average in

Northern countries, and lower in the rest of the countries (Leventi et al., 2021; Notten & Guio, 2021).[1]

Although our research relies on the suggestions of the existing literature, in terms of choice of main socioeconomic factors, it adds novelty in two ways. The first contribution is the assessment of the weight of monetary and non-monetary factors in explaining MSD through a sequential R^2 decomposition approach. The second novelty is that this analysis provides governments with a clear framework for policy interventions, prioritizing areas according to the established relative importance, in a recent period sufficiently distant from economic crises. At the European level, it is also clear that funds should be allocated to improve the condition according to the two emerging clusters, with the northern cluster suffering less on average from deprivation compared to the rest of Europe, but for different reasons, as discussed in Section 5.

3 Data and Indicators

We use data from the cross-sectional sample of the European Union Statistics on Income and Living Conditions (EU-SILC) survey. The survey is carried out in all Member States of the European Union and some additional countries by the corresponding National Institute of Statistics using harmonized questionnaires and survey methodologies (Eurostat, 2010). We consider the year 2023 and explore all available twenty-seven European countries, that are: Austria, Belgium, Bulgaria, Cyprus, Czechia, Germany, Denmark, Estonia, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovenia, and Slovakia. Our sample includes all households, and the household is our unit of analysis. Our variable of interest is the indicator of material and social deprivation. This score is based on 13 selected deprivations (items) defined at the individual or 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 it cannot afford the specific good (and not for other reasons based on preferences; see Guio & Van den Bosch, 2020) or is not capable of the specific social activity/interaction (Guio et al., 2017, 2016). Given that material and social deprivation is measured at the household level, the indicator itself includes the household-level items and the sum of individual-level items of the household components. According to the Eurostat guidelines, an individual is defined as materially and socially deprived if she/he lives in a household which suffers from a lack of at least 5 (out of 13) items. The complete list of items is provided in Table 1.

Table 2 shows the weighted descriptive statistics of the variables used in our analyzes for all countries, while Table 1A in the Appendix reports the statistics by country. We consider household characteristics. The choice of variables was guided by the determinants of MSD mainly suggested in the available literature (discussed in Section 2). Our dependent variable is the material and social deprivation indicator, which is a dummy variable that

[1] Social protection expenditure includes benefits for disability, sickness/health care, old age, survivors, family/children, unemployment, housing and social exclusion. See Eurostat, 2025, https://ec.europa.eu/eurostat/databrowser/view/spr_exp_type/default/table?lang=en.

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

#	items	Var 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

Table 2 Weighted descriptive statistics

Variable	Mean	St. Dev.
material and social deprivation	13.0	34.0
head of household age	48	19
head of household female	37.4	42.4
head of household primary educated	21.8	40.8
head of household secondary educated	42	49.4
head of household tertiary educated	36.2	47.05
WI		
Low/medium *WI*	20.9	40.7
High *WI*	56.9	51.3
Out of age	22.2	41.5
home ownership	80.0	40.0
household size	2.88	1.45
# elderly in the household	0.78	1.03
# disabled in the household	0.72	0.95
# temporary workers in the household	0.15	0.42
(log) equivalized household income	9.76	0.79
household type		
one person	17.0	35.1
single parent	3.9	21.2
couple without children	28.7	45.1
couple with children	31.5	47.1
other household type	18.9	39.7
Observations	409,736	

Note: Values are expressed as % share of households, except for age (years), household size, #elderly, #disabled, #temporary (count), log income

Source: Authors' calculations on 2023 cross-sectional EU-SILC data

equals 1 for a materially and socially deprived household, 0 otherwise. From Table 2, we note that 13% of the total European population was materially and socially deprived in 2023. From Table 1A , we note that there is lot of heterogeneity in the MSD rates across countries, ranging from percentages around 2% in the Nordic countries to figures higher than 30% in Bulgaria and Greece (38% and 33%, respectively). Regarding household-level characteristics, we include the (log of) equivalized household disposable income (disposable household income divided by the equivalence scale).[2] 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. The scale coincides with the modified OECD scale. Then we consider home ownership, the number of elderly, disabled, and temporary workers in the household, the size of the household, and the type of household. As for home ownership, from Table 1A we see some countries' specificities, i.e. the share of homeowner ranges from 55% in Germany to 97% in Romania. For the type of household, we rely on five categories derived by merging the 13 categories in the EU-SILC for household type (HX060 code): one person household, single parent, couple without children, couple with children, and the residual category other households. From Table 2, we see that *couple with children* is the most common type of household in the dataset, 31.5% of the sample ranging from 15% in Romania to 44% in Finland, see Table 1A in the Appendix, while the least common are single parents (3.9%). We also include the total work intensity (WI) of the household in our set of covariates. Work intensity is calculated at the household level 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 by the household.[3] The indicator is calculated for adults aged 18 to 59, excluding students from the age of 18 to 24. In this study, we consider two categories (0 and 1, i.e. medium-low and high work intensity) and a third category represented by the out of age (the reference category in the models). The characteristics of the head of household considered are age, gender, and the level of educational attainment. The head is defined as the individual with relatively higher earnings in the household.[4] From Table 2, we see that the majority of households are headed by men (the female heads are 37.4%), have a head with secondary education (42% of the sample, followed by a head with tertiary education, 36.2%). Finally, we include the degree of urbanization and the regions (where available).

4 Empirical Strategy

Our empirical model is a straight linear probability model such as:

$$Y_i = \beta_0 + X_i^{'}\beta_i + \epsilon_i, Y_i \in \{0, 1\} \tag{1}$$

[2] That is the variable HX090 in the EU-SILC code.

[3] For a detailed explanation, see the Eurostat webpage: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Persons_living_in_households_with_low_work_intensity.

[4] As a robustness check, we consider also the alternative definition of the head of household, that is the individual responsible for the accommodation. The findings remain unchanged. For the sake of brevity, we do not report this check. The results are available upon request.

where Y_i is a dichotomous variable that takes the value 1 if a household falls into multidimensional deprivation and 0 otherwise. X_i is a vector of household characteristics, β_i is the vector of coefficients, and ϵ_i the regression error. Estimates are performed for each one of the 27 countries for which EU-SILC data are available using a linear probability model (LPM) via an ordinary least squares (OLS) estimator (Table 3) and, as a robustness check, using a logit model via the maximum likelihood (ML) estimator (Table 2A in the Appendix). The latter method is useful for solving some critical issues raised by the linear probability model, such as the assumption of normality of the distribution of the error term.[5]

LPM allows us to identify the proportion of the variance explained by the independent variables, namely R^2. In this way, we determine the relative importance of each explanatory variable as proposed by Lindeman et al. (1980), Budescu (1993), and Gromping (2006). The authors propose a method called simple unweighted averages (which we name LMG, from the names of the authors) that consists of a decomposition of the overall model R^2 into non-negative contributions for each predictor term. This approach is based on the sequential R^2, obtained accounting for the additional contribution of a variable to R^2. The additional contribution is calculated considering all possible degrees of contribution of a variable in all subset models nested in the original model.

The LMG removes the dependence on orderings that bias stepwise regression by averaging over orderings. Furthermore, Johnson and LeBreton (2004) recommend the LMG method over other methods because it is able to proportionate the contribution each predictor makes to R^2, considering both its direct effect (i.e., considered by itself) and its total effect (i.e., when combined with the other variables in the regression equation). The relative importance of the coefficients is then standardized, as they sum to 1 (or 100%).

The second step is to perform a cluster analysis of the 27 countries based on the main eigenvectors extracted from a principal component analysis (PCA) of the standardized relative importance measures. To achieve this aim, hierarchical (or agglomerative) clustering is applied to a distance matrix computed with a Euclidean criterion. The cluster analysis is performed in the spirit of the Ward squared ($Ward^2$) method proposed by Murtagh and Legendre (2014), which selects the quality of the hierarchical structure through the calculation of the correlation between distance values (i.e., the Cophenetic Correlation Coefficient, CPCC). The distance values are calculated through a dendrogram and the observed distance. A hierarchical agglomerative method of this kind begins the analysis with as many groups as there are units. Then fewer groups are formed ascendingly from these initial units. At each stage, according to the $Ward^2$ criterion, the two clusters are formed for which there is the smallest increment in the total value of the sum of the squares of the differences within each cluster. The goal of the $Ward^2$ method is to create homogeneous clusters, that is, with as little within-cluster variability as possible. This hierarchical agglomerative method results in a dendrogram, a visual tool that helps to identify the groups that best represent the data structure. A general rule of thumb is that clustering is performed where significant gaps exist within the dendrogram.

[5] Importantly, the findings of the logit model do not differ significantly from those of the LPM, especially for the most important factors influencing material and social deprivation, which appear in the two PC scores of Fig. 3.

Table 3 Probability model (OLS) results

	AT	BE	BG	CY	CZ	DE	DK	EE	EL
Constant	0.730***	1.420***	2.031***	1.366***	1.717***	1.593***	0.815***	0.815***	2.766***
	(0.095)	(0.088)	(0.081)	(0.091)	(0.067)	(0.045)	(0.063)	(0.056)	(0.073)
head age	0.002***	−0.00003	0.006***	0.004***	0.004***	0.001***	−0.001*	0.003***	0.004***
	(0.0004)	(0.0004)	(0.001)	(0.001)	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0005)
head female	0.025***	0.033***	0.031***	0.029***	0.014***	0.009**	−0.004	0.024***	0.059***
	(0.008)	(0.006)	(0.009)	(0.009)	(0.005)	(0.004)	(0.004)	(0.006)	(0.008)
head secondary edu	−0.082***	−0.096***	−0.178***	−0.112***	−0.184***	−0.090***	−0.042***	−0.062***	−0.159***
	(0.019)	(0.012)	(0.012)	(0.015)	(0.013)	(0.006)	(0.008)	(0.010)	(0.010)
head tertiary edu	−0.097***	−0.118***	−0.269***	−0.126***	−0.195***	−0.104***	−0.050***	−0.090***	−0.177***
	(0.018)	(0.012)	(0.014)	(0.014)	(0.014)	(0.006)	(0.008)	(0.010)	(0.011)
WI= 1	−0.014	−0.066***	−0.070***	−0.018*	−0.054***	−0.022***	−0.050***	−0.064***	−0.028***
	(0.010)	(0.008)	(0.013)	(0.010)	(0.010)	(0.005)	(0.007)	(0.009)	(0.010)
WI= 0	−0.024	−0.032**	0.108***	−0.102***	0.045***	−0.009	−0.103***	0.033**	0.108***
	(0.017)	(0.014)	(0.020)	(0.021)	(0.012)	(0.008)	(0.013)	(0.016)	(0.015)
home ownership	−0.033***	−0.104***	−0.055***	−0.046***	−0.090***	−0.039***	−0.047***	−0.033***	−0.115***
	(0.008)	(0.008)	(0.014)	(0.011)	(0.007)	(0.004)	(0.005)	(0.009)	(0.009)
household size	0.011***	−0.017***	−0.004	−0.002	0.011***	−0.013***	0.007*	0.001	−0.017***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.002)	(0.003)	(0.002)	(0.005)
#elderly	−0.007**	−0.019***	−0.020***	−0.013***	−0.070***	−0.014***	0.012*	−0.053***	−0.030***
	(0.003)	(0.003)	(0.005)	(0.004)	(0.006)	(0.002)	(0.006)	(0.006)	(0.005)
#disabled	0.004	0.017***	0.012**	0.007**	0.040***	0.023***	0.046***	0.058***	0.023***
	(0.003)	(0.003)	(0.005)	(0.003)	(0.004)	(0.002)	(0.004)	(0.004)	(0.004)
#temporary workers	−0.003	−0.004	0.027*	−0.005	−0.011*	−0.007**	0.025**	0.010	0.010
	(0.006)	(0.007)	(0.014)	(0.007)	(0.006)	(0.003)	(0.013)	(0.008)	(0.007)
log_eqhhincome	-0.057***	-0.099***	-0.184***	-0.121***	-0.147***	-0.128***	-0.045***	-0.063***	-0.251***
	(0.009)	(0.008)	(0.008)	(0.009)	(0.007)	(0.004)	(0.006)	(0.005)	(0.008)
single parent	−0.125***	−0.150***	−0.139***	−0.079**	−0.061***	−0.093***	−0.181***	−0.098***	−0.109***
	(0.019)	(0.016)	(0.039)	(0.033)	(0.016)	(0.011)	(0.017)	(0.017)	(0.033)
couple without children	−0.122***	−0.067***	−0.104***	−0.130***	−0.154***	−0.091***	−0.198***	−0.153***	−0.144***

Table 3 (continued)

	(0.013)	(0.012)	(0.016)	(0.020)	(0.010)	(0.007)	(0.009)	(0.012)	(0.013)
couple with children	−0.108***	−0.070***	−0.154***	−0.080***	−0.141***	−0.105***	−0.225***	−0.141***	−0.185***
	(0.015)	(0.015)	(0.022)	(0.021)	(0.012)	(0.009)	(0.014)	(0.013)	(0.019)
other type	−0.150***	−0.055***	−0.193***	−0.126***	−0.162***	−0.090***	−0.226***	−0.174***	−0.172***
	(0.017)	(0.017)	(0.023)	(0.024)	(0.014)	(0.010)	(0.014)	(0.015)	(0.020)
Observations	4,242	8,709	7,541	4,240	17,440	34,742	11,740	11,338	11,233
R^2	0.174	0.213	0.445	0.234	0.279	0.163	0.199	0.228	0.425
Adjusted R^2	0.171	0.211	0.444	0.231	0.278	0.163	0.198	0.227	0.424
Residual Std. Error	0.212	0.252	0.361	0.249	0.289	0.296	0.218	0.265	0.357
	ES	FI	FR	HU	IE	IT	LT	LU	LV
Constant	1.351***	0.442***	1.396***	1.695***	0.845***	0.920***	1.468***	0.645***	1.414***
	(0.055)	(0.041)	(0.069)	(0.063)	(0.057)	(0.029)	(0.069)	(0.062)	(0.064)
head age	0.003***	0.0004**	0.002***	0.005***	0.002***	0.004***	0.006***	−0.0002	0.005***
	(0.0003)	(0.0002)	(0.0003)	(0.0004)	(0.0004)	(0.0002)	(0.0005)	(0.0003)	(0.0004)
head female	0.027***	0.010***	0.024***	0.014**	0.016***	0.036***	0.010	0.008	0.021***
	(0.005)	(0.003)	(0.005)	(0.006)	(0.005)	(0.003)	(0.007)	(0.005)	(0.007)
head secondary edu	−0.064***	−0.022***	−0.084***	−0.267***		−0.111***	−0.139***	−0.015	−0.134***
	(0.007)	(0.007)	(0.009)	(0.010)		(0.004)	(0.015)	(0.010)	(0.014)
head tertiary edu	−0.080***	−0.030***	−0.092***	−0.335***	0.030	−0.115***	−0.221***	−0.025***	−0.173***
	(0.006)	(0.007)	(0.009)	(0.011)	(0.033)	(0.004)	(0.016)	(0.009)	(0.015)
WI= 1	−0.029***	−0.014***	0.008	−0.076***	−0.051***	−0.046***	−0.075***	−0.004	−0.086***
	(0.006)	(0.004)	(0.007)	(0.010)	(0.009)	(0.004)	(0.012)	(0.008)	(0.010)
WI= 0	0.001	−0.001	−0.033***	−0.008	−0.039***	0.054***	0.028*	−0.015	0.022
	(0.011)	(0.007)	(0.011)	(0.015)	(0.014)	(0.007)	(0.017)	(0.011)	(0.016)
home ownership	−0.103***	−0.051***	−0.109***	−0.073***	−0.126***	−0.091***	−0.058***	−0.021***	−0.077***
	(0.007)	(0.006)	(0.007)	(0.012)	(0.010)	(0.004)	(0.013)	(0.006)	(0.010)
household size	−0.009***	0.001	−0.011***	0.033***	−0.006*	0.006***	0.015***	0.002	0.005
	(0.003)	(0.001)	(0.003)	(0.004)	(0.003)	(0.002)	(0.005)	(0.003)	(0.004)
#elderly	−0.022***	−0.008***	−0.009***	−0.063***	−0.026***	−0.042***	−0.057***	−0.010***	−0.055***

Table 3 (continued)

	(0.002)	(0.002)	(0.002)	(0.006)	(0.005)	(0.003)	(0.006)	(0.003)	(0.006)
#disabled	0.036***	0.005***	0.020***	0.074***	0.040***	0.058***	0.078***	0.017***	0.054***
	(0.002)	(0.001)	(0.002)	(0.005)	(0.004)	(0.002)	(0.006)	(0.003)	(0.004)
#temporary workers	0.018***	−0.007**	−0.002	0.056***	−0.027***	0.003	0.035**	−0.004	0.038***
	(0.004)	(0.003)	(0.005)	(0.007)	(0.006)	(0.003)	(0.015)	(0.005)	(0.014)
log_eqhhincome	−0.112***	−0.025***	−0.117***	−0.145***	−0.059***	−0.074***	−0.126***	−0.046***	−0.120***
	(0.006)	(0.004)	(0.007)	(0.007)	(0.005)	(0.003)	(0.007)	(0.005)	(0.006)
single parent	−0.065***	−0.096***	−0.061***	−0.068***	−0.095***	−0.104***	−0.100***	−0.092***	−0.098***
	(0.016)	(0.013)	(0.016)	(0.021)	(0.021)	(0.008)	(0.020)	(0.016)	(0.017)
couple without children	−0.083***	−0.120***	−0.074***	−0.168***	−0.119***	−0.133***	−0.183***	−0.062***	−0.152***
	(0.010)	(0.009)	(0.010)	(0.012)	(0.013)	(0.005)	(0.013)	(0.010)	(0.012)
couple with children	−0.108***	−0.105***	−0.046***	−0.232***	−0.098***	−0.120***	−0.174***	−0.097***	−0.129***
	(0.012)	(0.010)	(0.013)	(0.016)	(0.016)	(0.007)	(0.018)	(0.012)	(0.014)
other type	−0.108***	−0.107***	−0.063***	−0.290***	−0.133***	−0.152***	−0.270***	−0.103***	−0.206***
	(0.013)	(0.009)	(0.015)	(0.016)	(0.015)	(0.008)	(0.020)	(0.015)	(0.017)
Observations	22,763	13,311	12,151	14,259	9,168	55,993	10,516	6,878	11,013
R^2	0.185	0.121	0.192	0.359	0.185	0.232	0.355	0.070	0.334
Adjusted R^2	0.185	0.120	0.191	0.358	0.184	0.232	0.354	0.067	0.333
Residual Std. Error	0.314	0.148	0.263	0.351	0.222	0.314	0.343	0.187	0.309
	MT	NL	NO	PL	PT	RO	SE	SI	SK
Constant	0.835***	0.512***	0.344***	1.045***	1.690***	2.343***	0.476***	1.050***	2.347***
	(0.087)	(0.035)	(0.057)	(0.030)	(0.049)	(0.110)	(0.050)	(0.080)	(0.111)
head age	0.00003***	0.0003*	0.0003**	0.004***	0.004***	0.008***	0.001**	0.002***	0.005***
	(0.00002)	(0.0001)	(0.0002)	(0.0003)	(0.001)	(0.0002)	(0.0003)	(0.001)	(0.00002)
head female	0.025***	0.001	0.004	0.022***	0.032***	−0.013	0.012***	0.003	−0.027***
	(0.008)	(0.003)	(0.003)	(0.003)	(0.005)	(0.012)	(0.004)	(0.005)	(0.009)
head secondary edu	−0.034***	−0.026***	−0.001	−0.173***	−0.068***	−0.063***	−0.031***	−0.101***	−0.342***
	(0.009)	(0.005)	(0.007)	(0.008)	(0.006)	(0.014)	(0.009)	(0.012)	(0.019)
head tertiary edu	−0.042***	−0.030***	−0.008	−0.209***	−0.063***	−0.171***	−0.037***	−0.110***	−0.432***

Table 3 (continued)

	(0.009)	(0.004)	(0.006)	(0.008)	(0.006)	(0.021)	(0.008)	(0.012)	(0.020)
WI= 1	−0.038***	−0.038***	−0.008*	−0.032***	−0.029***	−0.014	−0.018***	−0.0003	−0.092***
	(0.010)	(0.004)	(0.004)	(0.004)	(0.007)	(0.015)	(0.005)	(0.006)	(0.012)
WI= 0	0.086***	−0.016**	−0.016**	0.029***	0.037***	0.115***	−0.034***	0.025*	0.043**
	(0.019)	(0.006)	(0.008)	(0.007)	(0.012)	(0.025)	(0.009)	(0.014)	(0.019)
home ownership	−0.104***	−0.073***	−0.017**	−0.080***	−0.072***	−0.036	−0.035***	−0.030***	−0.107***
	(0.015)	(0.004)	(0.008)	(0.005)	(0.007)	(0.031)	(0.005)	(0.007)	(0.017)
household size	-0.001	0.003	0.002	0.006***	−0.011***	−0.035***	0.003	−0.0005	0.008
	(0.004)	(0.002)	(0.002)	(0.001)	(0.004)	(0.006)	(0.003)	(0.002)	(0.006)
#elderly	−0.021***	−0.024***	−0.003*	−0.032***	−0.029***	−0.008	−0.006***	−0.014***	−0.047***
	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)	(0.007)	(0.002)	(0.002)	(0.005)
#disabled	0.015***	0.027***	0.001	0.054***	0.051***	0.011**	0.006***	0.017***	0.044***
	(0.004)	(0.002)	(0.001)	(0.002)	(0.003)	(0.005)	(0.002)	(0.003)	(0.005)
#temporary workers	-0.002	0.003	−0.002	0.002	0.012**	0.032**	−0.008**	0.003	0.021*
	(0.007)	(0.005)	(0.002)	(0.002)	(0.006)	(0.015)	(0.003)	(0.005)	(0.011)
log eqhhincome	−0.050***	−0.027***	−0.026***	−0.077***	−0.165***	−0.243***	−0.031***	−0.089***	−0.199***
	(0.008)	(0.003)	(0.005)	(0.003)	(0.005)	(0.012)	(0.005)	(0.008)	(0.012)
single parent	−0.185***	−0.120***	−0.045***	−0.161***	−0.124***	0.080	−0.073***	−0.133***	−0.117***
	(0.031)	(0.010)	(0.014)	(0.011)	(0.017)	(0.080)	(0.015)	(0.023)	(0.030)
couple without children	−0.143***	−0.128***	−0.051***	−0.211***	−0.116***	−0.055***	−0.097***	−0.118***	−0.149***
	(0.021)	(0.006)	(0.009)	(0.007)	(0.011)	(0.019)	(0.009)	(0.018)	(0.017)
couple with children	−0.169***	−0.120***	−0.056***	−0.181***	−0.109***	−0.092***	−0.097***	−0.105***	−0.116***
	(0.023)	(0.007)	(0.010)	(0.008)	(0.014)	(0.027)	(0.011)	(0.017)	(0.022)
other type	−0.133***	−0.131***	−0.053***	−0.245***	−0.138***	−0.139***	−0.091***	−0.135***	−0.169***
	(0.023)	(0.007)	(0.009)	(0.009)	(0.015)	(0.029)	(0.012)	(0.018)	(0.024)
Observations	4,814	24,888	6,213	41,017	17,135	4,808	8,842	7,958	7,049
R^2	0.177	0.175	0.055	0.293	0.282	0.461	0.114	0.202	0.333
Adjusted R^2	0.174	0.174	0.052	0.292	0.281	0.459	0.112	0.200	0.331
Residual Std. Error	0.241	0.174	0.098	0.265	0.322	0.363	0.145	0.210	0.338

Note: *p<0.1;**p<0.05;***p<0.01

5 Results

Our analyses begin with an investigation of the relative importance of socioeconomic household factors in the risk of material and social deprivation (Section 5.1). We then offer a cluster analysis that enables us to merge European countries according to the similarity in the relative importance of factors that affect the risk of material and social deprivation (Section 5.2). Finally, we discuss our findings (Section 5.3).

5.1 Relative Importance Analysis

The relative importance of socioeconomic household factors in explaining the variability of material and social deprivation in European countries is reported in Table 4. The latter shows the percentages of the factors considered for the 27 countries. The countries are ordered according to the decreasing relevance of the log-income coefficient to the R^2 according to the LMG method. First, we notice that the relative importance of all factors is heterogeneous. Second, equivalized household income is an important factor (but with different degrees), yet explaining 20% of the within-country variance on average, and much less in the Netherlands, Denmark, Poland, Malta, Italy, and Finland. Income appears to be an above-average determinant in Luxembourg, Germany, Portugal, Cyprus, Spain, and France.

Clearly, other household features explain the rest of the variability. The type of household (and to a lesser extent the size of households) appears to be extremely relevant in explaining R^2 for all countries (Dudek & Szczesny, 2021; Papadopoulos & Tsakloglou, 2016). For example, household type explains almost 50% of the total variance in Finland, and about 40% of the total variance in Norway, Denmark, Sweden, and the Netherlands. Size relevance, instead, goes from 3.1% in Hungary to 12.9% in Romania.

The level of education of the head of household explains a significant portion of the variability in material deprivation. Its relative importance is relatively higher in Hungary and Slovakia, i.e. 28.6% and 28.8%, respectively, higher than 20% in Cyprus and Belgium, while its relevance is below 5% in Norway, Finland and Denmark.

The age of the head of the household explains a significant portion of the variance (Bárcena-Martín et al., 2014; Dudek & Szczesny, 2021; Guio & Van den Bosch, 2020) in some countries, like Romania (20.2%), Bulgaria (15.7%), Lithuania (14.4%), and Latvia (13.6%), while it is very low in the Northern European countries (below 2%). In fact, the relative importance of age is correlated with the presence of elderly individuals in the household. The relative importance of age exceeds 12% in Italy, Poland, Estonia, Latvia, Bulgaria, and Romania, while it is less than 2% in Luxembourg, Ireland, the Netherlands, and the Nordic countries.

In Belgium, the Netherlands, and Spain home ownership explains about 20% of material deprivation variability, between 10% and 20% in Greece, Sweden, Finland, and Denmark (Bárcena-Martín et al., 2014), while it is less significant in the other countries.

Elderly members in the household, on average, do not explain a significant share of MSD variability (it explains around 5% of MSD variability with the partial exception of Ireland, which shows 8.3%).

Having members with disabilities or sickness places a household at a significantly higher risk of deprivation in every country (e.g., Dudek & Szczesny, 2021; Guio & Van den Bosch,

Table 4 Relative importance of coefficients to R^2

	LU	DE	PT	CY	ES	FR	EL	NO	IE
head age	0.017	0.072	0.122	0.107	0.096	0.055	0.111	0.018	0.018
head female	0.012	0.022	0.011	0.028	0.016	0.030	0.030	0.018	0.001
head education	0.072	0.147	0.139	0.236	0.152	0.168	0.173	0.049	0.101
work intensity	0.017	0.073	0.105	0.062	0.078	0.034	0.128	0.036	0.191
home ownership	0.089	0.066	0.037	0.055	0.087	0.196	0.020	0.109	0.020
household size	0.083	0.095	0.066	0.063	0.066	0.065	0.088	0.061	0.055
#elderly in the household	0.030	0.010	0.018	0.009	0.016	0.007	0.017	0.012	0.083
#disabled in the household	0.051	0.034	0.072	0.007	0.066	0.027	0.016	0.003	0.082
#temporary workers in the household	0.001	0.002	0.002	0.001	0.003	0.000	0.002	0.002	0.006
(log) equivalized household income	0.334	0.305	0.299	0.288	0.287	0.286	0.268	0.257	0.229
household type	0.294	0.175	0.129	0.145	0.133	0.132	0.148	0.435	0.213
	BG	LV	BE	HU	SI	SK	RO	CZ	LT
head age	0.157	0.136	0.028	0.080	0.125	0.091	0.202	0.084	0.144
head female	0.013	0.018	0.020	0.013	0.006	0.008	0.008	0.033	0.010
head education	0.160	0.101	0.210	0.286	0.190	0.288	0.093	0.133	0.133
work intensity	0.188	0.153	0.095	0.108	0.108	0.153	0.169	0.129	0.145
home ownership	0.005	0.032	0.225	0.008	0.015	0.017	0.001	0.081	0.005
household size	0.059	0.082	0.041	0.031	0.076	0.034	0.129	0.063	0.089
#elderly	0.012	0.030	0.016	0.024	0.015	0.022	0.009	0.038	0.033
#disabled	0.004	0.052	0.017	0.074	0.023	0.041	0.007	0.039	0.078
#temporary	0.001	0.001	0.000	0.014	0.001	0.002	0.001	0.002	0.001
log eq. income	0.227	0.226	0.220	0.218	0.218	0.218	0.213	0.208	0.192
household type	0.174	0.169	0.128	0.144	0.223	0.126	0.168	0.191	0.171

Table 4 (continued)

	SE	AT	EE	FI	IT	MT	PL	DK	NL
head age	0.018	0.093	0.129	0.016	0.121	0.128	0.120	0.019	0.016
head female	0.035	0.054	0.027	0.022	0.023	0.024	0.017	0.008	0.019
head education	0.086	0.159	0.070	0.045	0.185	0.088	0.162	0.045	0.050
work intensity	0.047	0.081	0.141	0.049	0.131	0.188	0.119	0.081	0.063
home ownership	0.160	0.070	0.020	0.172	0.056	0.091	0.036	0.128	0.234
household size	0.048	0.077	0.088	0.049	0.081	0.086	0.085	0.095	0.065
#elderly	0.015	0.008	0.041	0.017	0.034	0.019	0.028	0.041	0.041
#disabled	0.015	0.003	0.094	0.005	0.059	0.016	0.068	0.063	0.047
#temporary	0.003	0.001	0.001	0.001	0.003	0.001	0.004	0.003	0.001
log eq. income	0.184	0.179	0.161	0.138	0.137	0.128	0.121	0.112	0.096
household type	0.389	0.274	0.228	0.485	0.160	0.232	0.241	0.405	0.368

Note: *p<0.1;**p<0.05;***p<0.01

2020, in European countries). However, its relative importance is almost null in Austria, Cyprus, and Norway. This factor contributes about 9.4% to explaining the variability of MSD in Estonia (the highest in the group), around 7% in Portugal, Hungary, Lithuania, Poland, and Denmark.

Finally, the relative importance of work intensity ranges from 1.7% in Luxembourg to 19.1% in Ireland. Temporary work, measured by the number of temporary workers in the household, is almost completely irrelevant in this analysis. The gender of the head of household explains very little variance, ranging from 0.1% in Ireland to 5.4% in Austria.

5.2 Cluster Analysis

Figure 1 reports a dendrogram to identify clusters of countries, on which we previously applied a principal components analysis that allowed us to identify two main components that account for around 77% of total variance.[6] $Ward^2$ has a value CPCC of 0.856, close to 1, indicating a good fit of hierarchy to the data. Figure 1A in the Appendix offers a visual geographical inspection of the two main components of the PCA. Regarding the first, which accounts for most of the variance (57%), countries with higher values are characterized by higher education, age, high work intensity, and household income. On the other hand, countries with high values of the second component (17% of the variance) have larger households with a relatively high share of over 65, very high work intensity and low household income.[7] One cluster includes Denmark, Finland, Ireland, the Netherlands, Norway, and Sweden. A second, larger cluster encompasses the rest of Europe. Within the latter, it is possible to (albeit weakly) identify two sub-clusters that separate the East and Baltic republics from the rest of Europe, with the exception of Italy and Switzerland, which fall into the Eastern cluster. Using the information from this general dendrogram, we created a geographical map of the two main clusters in Fig. 2. The green countries in the North (Cluster 2 in Fig. 2) differ significantly from the red countries in the East, Core, and Southern Europe (Cluster 1 in Fig. 2). The former are characterized by relatively lower material and social deprivation rates compared to the latter. Why do these macro-regions differ according to MSD? One way to explore these differences is to let the data "speak": Figure 3 presents the relative importance of the determinants of MSD based on our regression results, which contributed to the construction of the two clusters. Cluster 1 in this figure shows the relative importance of determinants for Eastern, core, and Southern European countries. It is evident that these determinants contribute to explaining R^2 in a balanced way, with a more significant role for the equivalised household income, household type, education, and household work intensity (in this order). Cluster 2 refers to Northern European countries, where the main determinants are household type, home ownership, and income (in this order).

[6] Table 5 shows the correlation between the principal component scores (PCA scores) and the relative importance components, in order to understand which variables contribute most to the variability captured by each component.

[7] The CPCC for single linkage is 0.127, for complete linkage is 0.476, average linkage is 0.313, McQuitty linkage is 0.301, median linkage is 0.222 and for centroid linkage is 0.219.

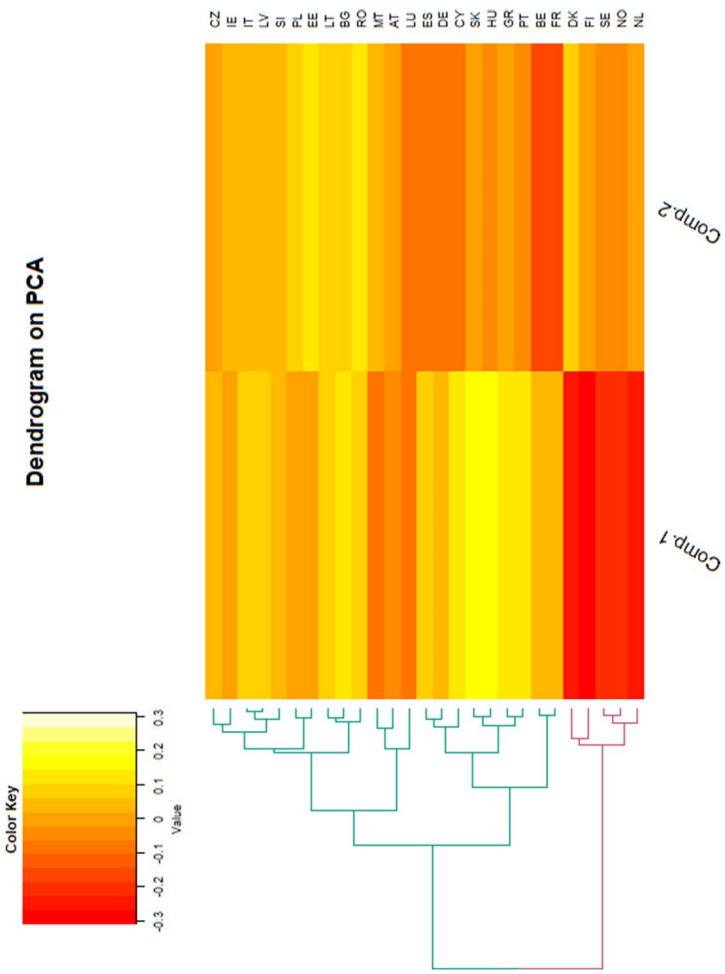


Fig. 1 Clusters of countries according to PCA. Countries are more homogeneous in terms of relative factors with similar colour in the graph. Two big clusters emerge

Table 5 Correlation between PCA scores and relative importance components

	Comp.1	Comp.2	Comp.3	Comp.4	Comp.5	Comp.6	Comp.7	Comp.8	Comp.9	Comp.10	Comp.11
age	0.720	0.470	−0.140	−0.010	−0.470	−0.070	0.110	0.020	−0.010	0	0.080
head female	−0.170	−0.250	0.130	−0.090	−0.430	0.030	−0.140	−0.810	0.150	0.020	−0.050
factor(head edu)	0.760	−0.300	0.380	−0.440	0.030	0.010	−0.030	0.020	0	0	0.010
factor(WI)	0.500	0.660	0.230	0.230	0.240	0.380	0.030	0.020	0.030	0	−0.220
home ownership	−0.680	−0.560	0.350	0.280	−0.130	0.040	0.030	0.020	0	0	−0.100
household size	0.040	0.460	−0.360	0.400	−0.380	−0.060	−0.580	0.100	−0.010	0.010	0.020
# elderly	−0.120	0.390	0.130	0.310	0.700	−0.270	0.040	−0.110	−0.370	0.010	−0.120
# disabled	0.220	0.280	0.070	0.260	0.490	−0.740	0.060	0.050	0.090	0.010	0.070
# temporary workers	0.180	0.050	0.12	−0.410	0.480	−0.250	0.080	0.010	0.130	−0.680	0.710
log_eqhhincome	0.470	−0.580	−0.650	0.010	0.090	0.100	0.030	0.010	0.010	0	0.080
factor(household type)	−0.960	0.160	−0.100	−0.200	0.010	0.030	0.010	0.010	0	0	0.060
Standard deviation	0.132	0.0729	0.0568	0.0437	0.0360	0.0295	0.0142	0.0098	0.0069	0.0018	0.000
Proportion of Variance	0.573	0.174	0.105	0.062	0.042	0.028	0.006	0.003	0.001	0	0
Cumulative Proportion	0.573	0.748	0.854	0.917	0.959	0.988	0.995	0.998	0.999	1	1

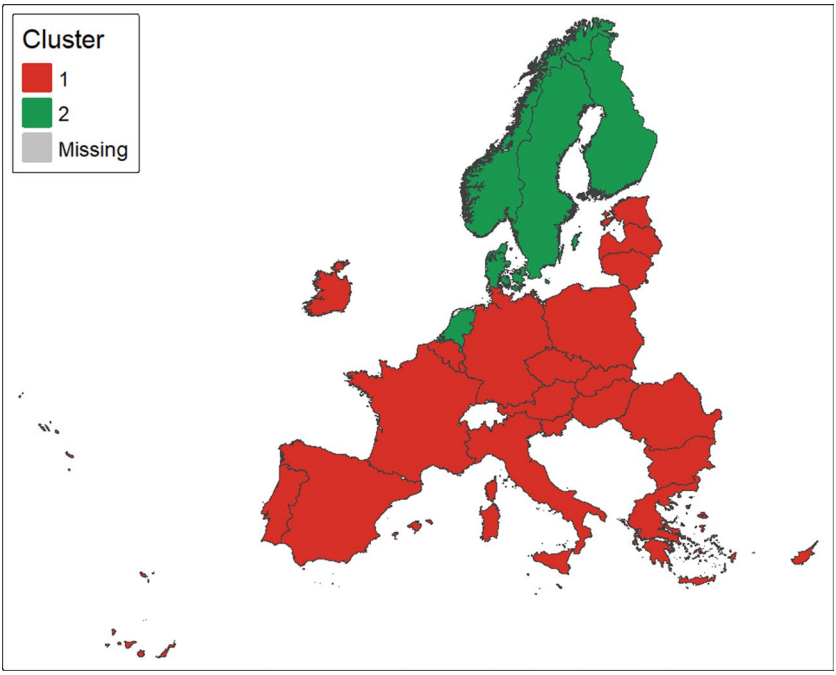


Fig. 2 Visual clusters in Europe according to PCA, which identifies two principal components

5.3 Discussion

This paper analyzes the relative importance of household characteristics in determining the risk of material and social deprivation in Europe. Specifically, we estimate the relative contribution of each socioeconomic feature of a household to the variability of this indicator.

Our analysis suggests that household characteristics, as well as some attributes of the head of household, play an important yet heterogeneous role. Since equivalised household income explains about 20% of the variance on average, this result reinforces the concept of deprivation based on non-monetary aspects of living standards, that account for the other 80%. In other words, it supports the concept of household deprivation based on non-monetary enforced lack, or a more general concept of "permanent income" rather than current income (Ayala et al., 2011; Fabrizi & Mussida, 2020; Whelan & Maître, 2009).

Moreover, it demonstrates that statistics on relative income positions may not capture essential disparities in living standards across the Member States, even more so with the enlargement of the EU (Atkinson et al., 2004).

Third, such variability might be due to the fact that even if in low-income households, people still get along and consume basic goods due to savings or support from relatives and friends, or receive in kind benefits from public services or are employed in the informal sector (Nelson, 2012).

The type (and size of) household also have a significant, though varying, role across countries. Their relative importance is higher in Northern European countries and lower in countries like Italy, Cyprus, Hungary, and Slovakia. These figures are consistent, for exam-

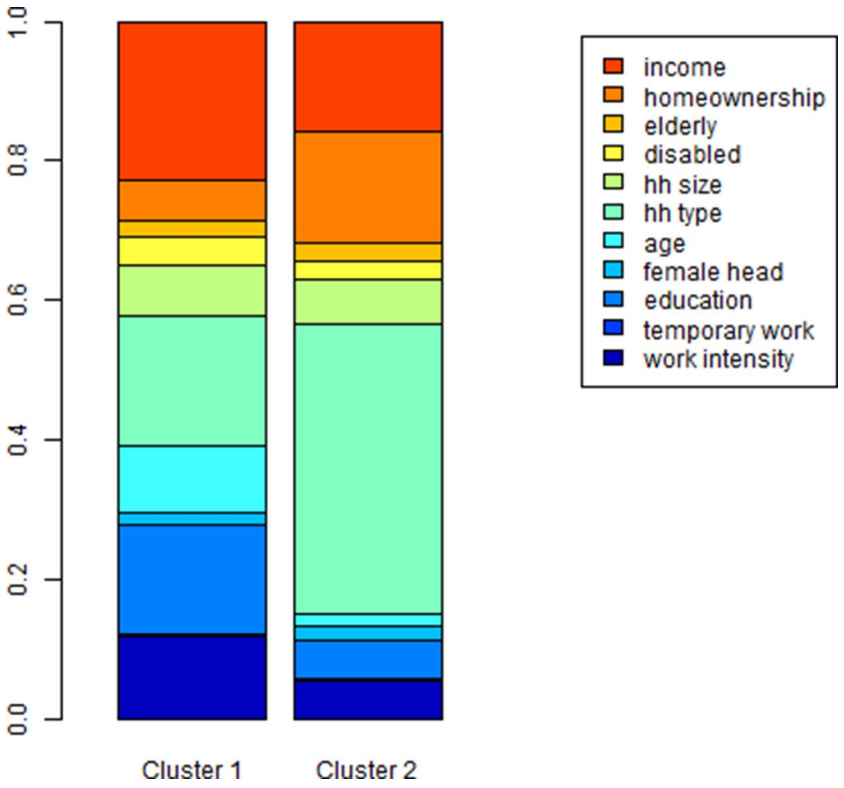


Fig. 3 Relative importance in the two main PC scores. Cluster 1 and 2 are those highlighted in Fig. 2

ple, with evidence on child poverty and material deprivation among lone parents in Nordic countries compared to other European countries (Chzhen & Bradshaw, 2012).

Education plays a role as well, but with less relative importance in the Nordic countries, which is in line with the existing literature. These results provide valuable insights for policymakers to understand which household factors are key to explaining both within-country and between-country differences in material and social deprivation (as evident from the results on each country in Table 4 and subsequents and Tables 1A and 2A in Appendix).

Home ownership has an impact of around 20% of MSD variability in Belgium, the Netherlands, and Spain, countries where housing affordability has been low even before the recent pandemic and energy crises. In the other European countries, home ownership does not play a relevant role (with the partial exception of Greece, Sweden, Finland, and Hungary, where it stands between 10% and 20%). In fact, home ownership is typical of the elderly population and reduces the risk of poverty among the elderly (Bedük, 2018; Dudek & Szczesny, 2021), but there is country heterogeneity.

Interestingly, the presence of elderly household members does not, on average, account for a significant share of MSD variability. The European Commission in the 2017 recommendation of European Pillar of Social Rights stated that, to reach social rights, EU workers have the right to social protection (art.12) and a pension: citing art.15 “Everyone in old age has the right to resources that ensure living in dignity” (European Commission, 2017).

Social protection and revenues to feed pension schemes go therefore hand in hand, and yet the presence of elderly individuals in our data does not play a relatively important role in explaining the variance in material deprivation in most European countries. The reason might be due to a "composition" effect. On the one hand, the South includes countries with rapidly aging populations. Italy and Greece in 2023 were the countries with the highest old-age dependency ratios (DR)[8] equal to 37.8% and 36.2%, respectively, well above the EU-27 average (33.4%). However, Northern countries, such as Ireland, have a relatively young population overall (Irish DR was 23.2% in 2023), so areas with higher concentrations of elderly people show a sharper contrast in deprivation indicators. Looking at the ratio between the median relative income of the elderly and that of the individuals aged 0-64 in these countries, Italy has a ratio of 1.01, Poland 0.91, Estonia 0.57, Latvia 0.58, Bulgaria 0.75, and Romania 0.90. Interestingly, although Finland has a very small fraction of its population experiencing material deprivation, some age-related disparities are found in relation to specific items - considered necessities or desirable, such as the ability to save or having an Internet connection. Ilmakunnas and Mäkinen (2021), for instance, observe that preferences or consensus for specific items may change over the life cycle, thus altering the values of the deprivation index across age groups. The variability of spending on social protection and social contributions across different welfare regimes in Europe (Fenger, 2007; Ferrera, 2005; Leventi et al., 2021), and the subsequent heterogeneous economic conditions also help explain this apparently insignificant role of the elderly in the variability of MSD. Finally, at least part of the reason for the almost null effect of having members with disabilities or sickness is the generosity of welfare systems, which include protection against sickness, disability, and unemployment (Saltkjel & Malmberg-Heimonen, 2017).

In the second part of our analysis we identify two macro-regions of countries: the first composed by Eastern, core, and Southern European countries, and the second by Northern European countries. These two clusters reflect the degree of variation in material and social deprivation across countries, which arises from a combination of different welfare regimes and institutions. These, in turn, shape individuals' capacity to earn and save over a lifetime, the extent of social transfers and income redistribution, as well as country-specific household socioeconomic characteristics and composition. In this way, macro-level factors alter the relative importance of micro-level factors in determining the risk of material and social deprivation: it depends on where you live.

Another way to address these differences between clusters is to examine the characteristics of the prevailing welfare regimes and institutions (Israel & Spannagel, 2019), at least for Cluster 2, which appears more homogeneous due to the prevalence of Nordic countries. Denmark, Finland, Norway, and Sweden fit into the Nordic regime, while Ireland align more closely with a liberal welfare model. The Netherlands is often classified as continental, but shares some features with the liberal regime. The relatively lower deprivation rates observed in Nordic countries might be partly explained by their generous welfare policies and flexible labor markets. Countries in the "Nordic dual-earner regime," such as Denmark, have generally invested heavily in in-kind benefits and transfers to families (Murphy & Turner, 2017). These countries also display higher levels of female labor force participation (Del Rey et al., 2021; Mahon, 2002).The Netherlands, in the Continental regime, is characterized by social transfers linked to previous earnings (Di Carlo et al., 2024).

[8] The *dependency ratio* is the number of old people - above 65 - compared to the number of people of working age - 15-64.

As for Cluster 1, the countries are more heterogeneous. In Mediterranean countries, for instance, where the norm for male providers has historically been strong, family benefits have generally been modest, and *de-familializing* services have been almost non-existent, resulting in low levels of female employment (Nygård et al., 2019). In contrast, Eastern European countries share a legacy of broad public social services from the communist era (Pop-Eleches, 2015).

Overall, in Cluster 1, the role of welfare regimes and institutions is less clear. Other factors, such as micro-level characteristics, likely carry more weight than country-level characteristics in explaining material and social deprivation.

6 Concluding Remarks

This analysis shows that household socioeconomic characteristics contribute significantly to the variability of material and social deprivation in Europe, although their impact is highly heterogeneous across countries. Equivalised income accounts for only a limited share of the variance, reinforcing the notion that deprivation cannot be reduced to a purely monetary dimension, but reflects structural aspects of well-being and forms of "permanent income."

Factors such as household composition, education, and age play an important role - albeit context dependent, while the presence of elderly members or individuals with disabilities appears to have a more limited effect than suggested by the existing literature and applications of social policies. These findings highlight the crucial role of welfare regimes and national institutions in mitigating the impact of households vulnerabilities. The identification of two country clusters underscores the interplay between micro- and macro-level factors: Nordic countries, characterized by more homogeneous institutions and generous welfare systems, show relatively lower deprivation means and standard deviations, while Mediterranean and Eastern European countries exhibit wide disparities, shaped by a weaker redistributive capacity and more traditional family and labor market structures.

From a policy perspective, this suggests that strategies to tackle material and social deprivation should be tailored to institutional and demographic contexts, focusing on the most effective instruments within each welfare regime. Since deprivation extends beyond disposable income, integrated interventions would be required, concerning housing, care services, education, and labor market participation.

Finally, we recognize that this study is subject to some limitations. First, the analysis relies on cross-sectional data, which inherently restricts the ability to draw causal inference. Although associations between variables can be identified, the temporal ordering necessary to establish causality cannot be determined within this framework. Second, the data structure does not allow for the consideration of within-country heterogeneity. Socio-economic conditions can vary substantially across regions within the same country, and such intra-national disparities may influence the outcomes under investigation. However, given the aggregate nature of the data, these variations remain unobserved, potentially limiting the inference of general principles from our findings.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11205-025-03745-0.

Author Contributions All authors contributed to the conception and design of the study. Material preparation was performed by Chiara Mussida, Maria Laura Parisi and Nicola Pontarollo; data collection was performed

by Chiara Mussida and data analysis was performed by Nicola Pontarollo. The first draft of the manuscript was written by Chiara Mussida and Maria Laura Parisi.

Funding Open access funding provided by Università Cattolica del Sacro Cuore within the CRUI-CARE Agreement. The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

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 licence 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.

Code Availability The R code for all analyses reported in the manuscript is available.

Declarations

Competing Interests The authors have no financial or proprietary interests in any material discussed in this article.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

References

Alper, K., Huber, E., & Stephens, J. D. (2020). Poverty and social rights among the working age population in post-industrial democracies. *Social Forces,99*(4), 1710–1744. https://doi.org/10.1093/sf/soaa073. https://academic.oup.com/sf/articlepdf/99/4/1710/36892860/file003_soaa073.pdf

Atkinson, A. B., Marlier, E., & Nolan, B. (2004). Indicators and targets for social inclusion in the European Union. *Journal of Common Market Studies, 42*(1), 47–75. https://doi.org/10.1111/j.0021-9886.2004

Ayala, L., Jurado, A., & Pérez-Mayo, J. (2011). Income poverty and multidimensional deprivation: Lessons from cross-regional analysis. *Review of Income and Wealth, 57*(1), 40–60. https://doi.org/10.1111/j.1475-4991.2010.00393.x

Bárcena-Martín, E., Lacomba, B., Moro-Egido, A. I., & Pérez-Moreno, S. (2014). Country differences in material deprivation in Europe. *Review of Income and Wealth,60*(4), 802–820. https://doi.org/10.1111/roiw.12030. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/roiw.12030. https://onlinelibrary.wiley.com/doi/pdf/10.1111/roiw.12030

Bedük, S. (2018). Understanding material deprivation for 25 EU countries: Risk and level perspectives, and distinctiveness of zeros. *European Sociological Review,34*(2), 121–137. https://doi.org/10.1093/esr/jcx089. https://academic.oup.com/esr/article-pdf/34/2/121/24659421/jcx089.pdf

Boarini, R., & d'Ercole, M. M. (2006). *Measures of material deprivation in OECD countries* (OECD Social, employment and migration working papers No. 37). OECD Publishing. Retrieved from https://ideas.repec.org/p/oec/elsaab/37-en.html

Brady, D., Fullerton, A. S., & Cross, J. M. (2009). Putting poverty in political context: A multi-level analysis of adult poverty across 18 affluent democracies. *Social Forces, 88*(1), 271–299. https://doi.org/10.1353/sof.0.0221

Budescu, D. (1993). Dominance analysis: A new approach to the problem of relative importance of predictors in multiple regression. *Psychological Bulletin, 114*, 542–551.

Budría, S., & García-Gómez, C. (2025). *Persisting disadvantages: A study of the dynamics of cumulative deprivation* (IZA Discussion Papers No. 17908). Bonn. Retrieved from https://hdl.handle.net/10419/320502

Busetta, A., Milito, A. M., & Oliveri, A. M. (2016). The material deprivation of foreigners: Measurement and determinants. G. Alleva & A. Giommi (Eds.), *Topics in theoretical and applied statistics* (pp. 181–191). Cham: Springer International Publishing.

Chzhen, Y., & Bradshaw, J. (2012). Lone parents, poverty and policy in the European Union. *Journal of European Social Policy, 22*(5), 487–506. https://doi.org/10.1177/0958928712456578
Commission, E. (2014). *An indicator for measuring regional progress towards the Europe 2020 targets*. Brussels: EC, Committee of the Regions.
de Graaf-Zijl, M., & Nolan, B. (2011). Household joblessness and its impact on poverty and deprivation in Europe. *Journal of European Social Policy, 21*(5), 413–431. https://doi.org/10.1177/0958928711418854
Del Rey, E., Kyriacou, A., & Silva, J. (2021). Maternity leave and female labor force participation: Evidence from 159 countries. *Journal of Population Economics, 34*, 803–824.
Dewilde, C. (2008). Individual and institutional determinants of multidimensional poverty: A European comparison. *Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement,86*(2), 233–256. Retrieved from https://EconPapers.repec.org/RePEc:spr:soinre:v:86:y:2008:i:2:p:233-256
Di Carlo, D., Hemerijck, A., & Karremans, J. (2024). The continental social investment turn: Sequencing corrective and transformative welfare state change in The Netherlands, Germany, and Italy. *Politics & Society, 53*, 29–56.
Dudek, H., & Szczesny, W. (2021). Multidimensional material deprivation in Poland: A focus on changes in 2015–2017. *Quality & Quantity,55*(2), 741–763. https://doi.org/10.1007/s11135-020-01024-3. Retrieved from https://link.springer.com/10.1007/s11135-020-01024-3
European Commission (2017). Commission recommendation of 26.4.2017 on the European Pillar of Social Rights (Vol. C(2017) 2600 final; Tech. Rep.). European Commission.
Eurostat,. (2010). *Description of target variables: Cross-sectional and longitudinal, EU-SILC 065/2010*. Luxembourg: Eurostat.
Fabrizi, E., & Mussida, C. (2020). Assessing poverty persistence in households with children. *The Journal of Economic Inequality, 18*(4), 551–569.
Fabrizi, E., Mussida, C., & Parisi, M. L. (2023). Comparing material and social deprivation indicators: Identification of deprived populations. *Social Indicators Research, 165*(3), 999–1020. https://doi.org/10.1007/s11205-022-03058-6
Fenger, M. (2007). Welfare regimes in Central and Eastern Europe: Incorporating post-communist countries in a welfare regime typology. *Contemporary Issues and Ideas in Social Sciences,3*(2), 1–30. Retrieved from http://hdl.handle.net/1765/34876
Ferrera, M. (Ed.). (2005). *Welfare state reform in Southern Europe: Fighting poverty and social exclusion in Greece, Italy, Spain and Portugal* (1st ed.). Routledge.
Figari, F. (2012). Cross-national differences in determinants of multiple deprivation in Europe. *The Journal of Economic Inequality, 10*(3), 397–418. https://doi.org/10.1007/s10888-010-9157-9
Gromping, U. (2006). Relative importance for linear regression in R: The package relaimpo. *Journal of Statistical Softwares, 17*, 1–27.
Guio, A.-C., & Van den Bosch, K. (2020). Deprivation of women and men living in a couple: Sharing or unequal division? *Review of Income and Wealth,66*(4), 958–984. https://doi.org/10.1111/roiw.12449. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/roiw.12449. https://onlinelibrary.wiley.com/doi/pdf/10.1111/roiw.12449
Guio, A. -C., Gordon, D., & Marlier, E. (2012). Measuring material deprivation in the EU: Indicators for the whole population and child-specific indicators. *Eurostat Methodologies and working papers*, Publications office of the European Union, Luxembourg.
Guio, A. -C., Gordon, D., Najera, H., & Pomati, M. (2017). Revising the EU material deprivation variables (analysis of the final 2014 EU-SILC data). *Final report of the Eurostat Grant 'Action Plan for EU-SILC improvements*.
Guio, A.-C., Marlier, E., Gordon, D., Fahmy, E., Nandy, S., & Pomati, M. (2016). Improving the measurement of material deprivation at the European Union level. *Journal of European Social Policy, 26*(3), 219–333.
Halleröd, B., Larsson, D., Gordon, D., & Ritakallio, V.-M. (2006). Relative deprivation: A comparative analysis of Britain, Finland and Sweden. *Journal of European Social Policy, 16*(4), 328–345. https://doi.org/10.1177/0958928706068272
Ilmakunnas, I., & Mäkinen, L. (2021). Age differences in material deprivation in Finland: How do consensus and prevalence-based weighting approaches change the picture? *Social Indicators Research, 154*(2), 393–412. https://doi.org/10.1007/s11205-020-02571-w
Israel, S., & Spannagel, D. (2019). Material deprivation in the EU: A multi-level analysis on the influence of decommodification and defamilisation policies. *Acta Sociologica, 62*(2), 152–173. https://doi.org/10.1177/0001699318778735
Johnson, J. W., & LeBreton, J. M. (2004). History and use of relative importance indices in organizational research. *Organization and Research Methods, 7*, 238–257.
Layte, R., Whelan, C. T., Maître, B., & Nolan, B. (2001). Explaining levels of deprivation in the European Union. *Acta Sociologica,44*(2), 105–121. Retrieved from http://www.jstor.org/stable/4194872

Leventi, C., Papini, A., & Sutherland, H. (2021). Assessing the anti-poverty effects of social transfers: Net or gross? and does it really matter? *Improving the understanding of poverty and social exclusion in Europe*, 123.

Lindeman, R. H., Merenda, P. F., & Gold, R. Z. (1980). *Introduction to bivariate and multivariate analysis*. Glenview, IL: Scott, Foresman and Company.

Mahon, R. (2002). Child care: Toward what kind of 'Social Europe'? *Social Politics, 9*, 343–379.

Marquis, L., Kuhn, U., & Tillmann, R. (2025). Causal attributions of poverty: A social stratification analysis. *Frontiers in Sociology,* 10–2025. https://doi.org/10.3389/fsoc.2025.1591235. Retrieved from https://www.frontiersin.org/journals/sociology/articles/10.3389/fsoc.2025.1591235

Murphy, C., & Turner, T. (2017). Formal and informal long term care work: Policy conflict in a liberal welfare state. *International Journal of Sociology and Social Policy, 37*, 134–147.

Murtagh, F., & Legendre, P. (2014). Ward's hierarchical agglomerative clustering method: Which algorithms implement Ward's criterion? *Journal of Classification, 31*, 274–295.

Mussida, C., & Parisi, M. L. (2021). Social exclusion and financial distress: Evidence from Italy and Spain. *Economia Politica, 38*, 995–1024. https://doi.org/10.1007/s40888-021-00228-6

Mussida, C., Parisi, M. L., & Pontarollo, N. (2023). Severity of material deprivation in Spanish regions and the role of the European Structural Funds. *Socio-Economic Planning Sciences, 88*, Article 101651. https://doi.org/10.1016/j.seps.2023.101651

Nelson, K. (2012). Counteracting material deprivation: The role of social assistance in Europe. *Journal of European Social Policy, 22*(2), 148–163. https://doi.org/10.1177/0958928711433658

Nolan, B., & Whelan, C. T. (2010). Using non-monetary deprivation indicators to analyze poverty and social exclusion: Lessons from Europe? *Journal of Policy Analysis and Management,29*(2), 305–325. https://doi.org/10.1002/pam.20493. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/pam.20493. https://onlinelibrary.wiley.com/doi/pdf/10.1002/pam.20493

Notten, G., & Guio, A. -C. (2021). By how much do social transfers reduce material deprivation in Europe? *Improving the understanding of poverty and social exclusion in Europe*, 139.

Nygård, M., Lindberg, M., Nyqvist, F., & Härtull, C. (2019). The role of cash benefit and in-kind benefit spending for child poverty in times of austerity: An analysis of 22 European countries 2006–2015. *Social Indicators Research, 146*, 533–552. https://doi.org/10.1007/s11205-019-02126-8

Papadopoulos, F., & Tsakloglou, P. (2016). *Chronic material deprivation and long-term poverty in europe in the pre-crisis period* (IZA Discussion Papers No. 9751). Bonn: Institute for the Study of Labor (IZA). Retrieved from http://hdl.handle.net/10419/141510

Pop-Eleches, G. (2015). Pre-communist and communist developmental legacies. *East European Politics and Societies, 29*, 391–408.

Provencher, A., & Carlton, A. (2018). The poverty experience of lone mothers and their children. *Applied Economics Letters, 25*(6), 401–404. https://doi.org/10.1080/13504851.2017.1327115

Saltkjel, T., & Malmberg-Heimonen, I. (2017). Welfare generosity in Europe: A multi-level study of material deprivation and income poverty among disadvantaged groups. *Social Policy & Administration,51*(7), 1287–1310. https://doi.org/10.1111/spol.12217. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/spol.12217. https://onlinelibrary.wiley.com/doi/pdf/10.1111/spol.12217

Tsakloglou, P., & Papadopoulos, F. (2002). Aggregate level and determining factors of social exclusion in twelve European countries. *Journal of European Social Policy, 12*(3), 211–225. https://doi.org/10.1177/0952872002012003394

United Nations (2015). T*ransforming our world: The 2030 agenda for sustainable development*. Habitat. Retrieved from https://sustainabledevelopment.un.org/post2015/transformingourworld

Verbunt, P., & Guio, A.-C. (2019). Explaining differences within and between countries in the risk of income poverty and severe material deprivation: Comparing single and multilevel analyses. *Social Indicators Research, 144*, 827–868. https://doi.org/10.1007/s11205-018-2021-1

Whelan, C. T., & Maître, B. (2012). Understanding material deprivation: A comparative European analysis. *Research in Social Stratification and Mobility,30*(4), 489–503. https://doi.org/10.1016/j.rssm.2012.05.001. (Consequences of Economic Inequality)

Whelan, C. T., Layte, R., & Maître, B. (2004). Understanding the mismatch between income poverty and deprivation: A dynamic comparative analysis. *European Sociological Review,20*(4), 287–302. Retrieved from http://www.jstor.org/stable/3559562

Whelan, C. T., Layte, R., & Maître, B. (2002). Multiple deprivation and persistent poverty in the European Union. *Journal of European Social Policy, 12*(2), 91–105. https://doi.org/10.1177/0952872002012002101

Whelan, C. T., & Maître, B. (2009). Comparing Poverty Indicators in an enlarged European Union. *European Sociological Review, 26*(6), 713–730. https://doi.org/10.1093/esr/jcp047

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.