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Beyond Income: Social Protection Spending and Food Insecurity in Europe

Bartolucci F., Crippa A., Pieroni L.

Abstract

This paper investigates the effect of social protection spending on mitigating food insecurity across Europe between 2005 and 2023. Despite strong economic development, food insecurity remains a major challenge, reflecting persistent socio-economic vulnerabilities worsened by crises such as the Great Recession and the COVID-19 pandemic. Using longitudinal microdata from the Survey of Income and Living Conditions (EU-SILC), we estimate a logit model with random individual effects and fixed country effects to analyze its determinants, while accounting for cross-country heterogeneity in welfare systems. The results show that higher social protection spending is associated with a 0.30 percentage-point reduction in food insecurity, with effects that are robust and stronger during economic downturns. This improvement is mainly mediated through income. These findings highlight social protection as a central instrument of food-security policy in high-income countries, where food insecurity is driven less by aggregate food availability than by unequal access, affordability constraints, and household exposure to income shocks. The results suggest that food policy should not be limited to food aid or supply-side interventions but should also include income-support mechanisms capable of protecting vulnerable households from trade-offs between food and other essential expenditures.

Keywords: Food insecurity; social protection; food affordability; welfare regimes; EU-SILC; food policy

JEL code: H53, I38, I32, E62, O52

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1 Introduction

Food insecurity remains an enduring and multi-faceted challenge in various European nations, affecting a substantial proportion of the population despite the robust overall economic development of the continent and elevated living standards. This pervasive problem underscores profound socio-economic vulnerabilities present even within affluent societies, revealing significant disparities in access to fundamental necessities. The mere availability of commodities in retail environments does not translate into universal food security, as numerous households continue to struggle with insufficient access to adequate quantities of nutritious and safe food (Osberg and Sharpe, 2014). Consequently, a comprehensive context analysis of food insecurity in Europe is essential to formulate effective evidence-based policy responses and targeted intervention strategies that genuinely address its root causes. Furthermore, prolonged economic stagnation and the systemic disruptions associated with the COVID-19 pandemic have exacerbated pre-existing levels of food insecurity. These crises have increased the vulnerability of previously food-secure households, while further deepening deprivation among groups already exposed to severe socio-economic disadvantage.

In Europe, the paradigm of food insecurity transcends the mere absence of sufficient calories to include structural challenges regarding food access, economic affordability, and nutritional quality. From a food-policy perspective, this implies that food insecurity in Europe cannot be addressed only through food supply, emergency food aid, or nutrition education. When households face binding budget constraints, the ability to access adequate food depends on the interaction between food prices, disposable income, housing and energy costs, and the design of social protection systems. Thus, social transfers may operate as indirect food-security policies by relaxing households' budget constraints and reducing the need to substitute toward cheaper, less nutritious diets. This multidimensional approach acknowledges that sufficient caloric consumption can coexist with severe nutritional deficiencies, when economic constraints require sub-optimal diets (Penne and Goedemé, 2021). Therefore, the adoption of rigorous, standardized definitions is critical; such frameworks are essential for consistent empirical measurement, comparative cross-national analysis across the European Union, and the formulation of a unified policy response.

Empirical evidence regularly indicates varying, yet chronically concerning, rates of food insecurity among member states of the European Union. Prevalence rates have been shown to fluctuate significantly, ranging from a low of 3.1% to more than 20% in various countries over the past decade, highlighting substantial geographical disparities across the region (Loopstra, 2020). The persistence of food

insecurity in wealthy European contexts raises profound questions about how social support systems have been designed and whether they adequately address the needs of vulnerable populations. The relationship between social benefit receipt and food insecurity reveals an equivocal picture in which food insecurity was not significantly associated with pension or child benefit receipt, but was significantly prevalent among out-of-work and general social benefit recipients (Loopstra et al., 2016). Most importantly, higher value social benefits did not consistently correlate with lower risks of food insecurity among recipients, suggesting that benefit levels are insufficient to cover the costs of adequate nutrition or that structural factors prevent complete mitigation of food deprivation (Garratt, 2020). These findings point to a critical gap between intentions and outcomes of welfare policy, indicating that addressing food insecurity requires moving beyond income support alone to address the systemic and structural drivers of food access and nutritional inequality.

The prevalence of food insecurity shows clear stratification in specific demographic cohorts throughout the continent. Research highlights that women face greater vulnerability than men, a phenomenon rooted in the complex intersection of gendered economic disparities, unequal domestic burdens, and a skewed allocation of resources within the home (Penne and Goedemé, 2021). Empirical evidence also demonstrates that older adults, people with limited educational qualifications, and disabilities face an increased risk of food deprivation (Bernaschi and Leonardi, 2023). Furthermore, marginalized populations, most notably undocumented migrants and refugees, are particularly exposed to acute forms of food poverty, largely due to their structural exclusion from formal social protection systems. These patterns indicate that food insecurity in Europe is not randomly distributed but is concentrated among economically disadvantaged groups and reflects broader systemic inequalities.

In this paper, we estimate whether and to what extent several types and degrees of social security spending in European countries helped buffer populations from food insecurity. Our empirical investigation uses annual data collected from the Survey of Income and Living Conditions (EU-SILC) between 2005 and 2023. Based on responses to the annual comparative indicator of food insecurity in EU countries, we measure the magnitude of food poverty and food-related material deprivation in the EU (Eurostat, 2015). We model the relationship between social protection and food insecurity within a utility-maximizing framework, where both income-based and policy interventions are assumed to be associated with reductions in food insecurity. We also evaluate whether the association between social protection and food insecurity differs during periods of increasing economic hardship, particularly income declines linked to the Great Recession and the COVID-19 pandemic.

The primary empirical challenge in studying this relationship lies in the fact that there remain significant data gaps on the specific and granular links between different types of social protection benefits and their direct outcomes on food insecurity, using longitudinal microdata. We move from macro to individual panel data analysis using a logit model with random effects, which allows coefficients to vary across observations over time and reflects diverse responses to social protection interventions. For a general discussion on the panel data models, see Skrondal and Rabe-Hesketh (2004) and Hsiao (2022).[1] This is critically important in the European context, where the member states exhibit considerable diversity in their social protection systems, economic structures, and cultural factors, together with variations in the prevalence and characteristics of food insecurity (Marchetti and Luca, 2022). This cross-country heterogeneity can be further interpreted through the lens of welfare-regime theory. European welfare states differ not only in the amount of social protection expenditure, but also in their institutional design, coverage, accessibility, and reliance on family or market provision. As discussed in Hillier-Brown et al. (2019) social-democratic regimes are generally characterized by universal and generous transfers, conservative-corporatist regimes by status-based protection, liberal regimes by more selective and means-tested support, Southern European regimes by fragmented provision and stronger family reliance, and post-socialist regimes by distinct institutional legacies and often lower spending capacity. These institutional differences may affect the extent to which social protection expenditures are translated into effective protection against food insecurity.

Our baseline estimates show that social protection policies improve food security outcomes among the European population. This positive effect remains robust across regional subdivisions and amplifies significantly during severe macroeconomic shocks, specifically the Great Recession and the COVID-19 pandemic. Significantly, the results suggest that these improvements are mediated by shifts in income. Through an extended model using individual-level social protection data, we uncover substantial heterogeneity in the protective role of social protection. The findings suggest that heterogeneity in welfare design, benefit adequacy, and recipient characteristics can help explain differences in the protective role of social protection in Europe, while individual-level attributes, such as gender and educational attainment, provide additional insight into the underlying mechanisms.

This paper contributes to the food-policy literature by examining social protection spending as a structural determinant of food access in Europe. While many

[1] For other applications of the mixed logit model in the food context, see, for example, Caputo et al. (2018).

food-policy interventions focus on food assistance, price incentives, or nutritional guidance, our analysis evaluates whether welfare transfers reduce food-related material deprivation by improving households' economic capacity to obtain adequate meals. This perspective is important because, in affluent countries, food insecurity often reflects insufficient purchasing power rather than insufficient food availability. By combining longitudinal EU-SILC microdata with cross-country variation in welfare regimes, the paper provides evidence on the conditions under which and the populations for whom social protection may function as an effective buffer against food insecurity.

The remainder of the paper is structured as follows. Section 2 provides background on the empirical literature on food insecurity. Section 3 describes the conceptual framework, the empirical model, and the data utilized to estimate the effect of social protection on food insecurity. The results and their policy implications are presented and discussed in Section 4. Section 5 concludes.

2 Related literature

The European literature on food insecurity can be organized around three main conceptual and empirical strands: economic risk factors, the conceptualization of food insecurity beyond basic hunger, and the role and effectiveness of social protection systems.

Empirical investigations uniformly confirm that food insecurity in Europe is coupled with structural economic determinants and disproportionately affects specific demographic cohorts. The work of Loopstra et al. (2016) established that the increase in unemployment rates and the decline in real wages were strongly associated with the diminished capacity to provide essential food and indicated that the increased spending on social protection successfully mitigated these risks. This relationship was further reinforced by Garratt (2020) during the Great Recession (2007–2011), a period characterized by a significant surge in food insecurity, highlighting that social protection mechanisms are most impactful among economically vulnerable segments (i.e., low-income individuals, renters, and those detached from the formal labour market). Several groups face elevated and persistent risks, including: i) women and lone-parent households; ii) older people and those with disabilities; iii) individuals with low education and precarious employment.

The prevalence of food insecurity is skewed toward women in European regions (Grimaccia and Naccarato, 2022). This gender disparity is compounded by demo-

graphic factors, notably the presence and number of dependents within the household. As a result, lone-parent and single-occupancy households consistently emerge as the most vulnerable cohorts, a status driven by severe economic constraints and restricted opportunities for adequate food procurement (Garratt, 2020; Carrillo Álvarez et al., 2023). Older adults, as well as people with disabilities, face elevated risks, indicating that fixed incomes and the absence of social support can undermine stability (Garratt, 2020; Carrillo Álvarez et al., 2023). A recent systematic review by Dana et al. (2025) confirms these findings, demonstrating that intersecting social vulnerabilities amplify the risk of child food insecurity, even within the context of advanced nations. Finally, low educational attainment, unemployment, and low work intensity are structural conditions strongly associated with a higher risk of deprivation in all food dimensions (Pérez-Corral and Moreno-Mínguez, 2025; Carrillo Álvarez et al., 2023).

The second strand of literature emphasizes another specific issue concerning food insecurity in affluent Europe, which is a problem of affordability and access to a healthy diet. From a policy perspective, this literature suggests that food insecurity should be addressed through both food-sector and non-food-sector instruments. Food aid and targeted nutritional programs may provide short-term relief, but do not necessarily address the structural affordability gap faced by low-income households (Carrillo Álvarez et al., 2023). Penne and Goedemé (2021) used national food-based dietary guidelines and household income data to estimate affordability across a large number of countries and conclude that in many countries, particularly in Southern and Eastern Europe, low-income households, and especially those reliant on minimum income schemes, lack sufficient resources to afford a healthy diet. Consequently, Bernaschi and Leonardi (2023) suggest that this affordability gap forces vulnerable households into trade-offs, often resulting in diets that are energy-dense but nutrient-poor, contributes to poorer health outcomes and social exclusion.

Another empirical strand of the literature focuses on the role and effectiveness of social protection programs intended to act as the primary buffer against food insecurity. Loopstra et al. (2016) demonstrated that only if social protection spending approximately 10,000 dollars per capita made the effects of rising unemployment and falling wages on food insecurity statistically insignificant. Evidence from outside Europe reinforces this stylized fact. Li et al. (2016) demonstrated that the positive shift in social policies directly affected the prevalence of household food insecurity in British Columbia, underscoring the high sensitivity of vulnerable populations to the expansion or deployment of local social safety nets (Li et al., 2016). In contrast,

using individual-level data, Garratt (2020) identified an equivocal role for social benefits, in which food insecurity exhibited a significantly higher prevalence among recipients of out-of-work benefits and all recipients of social assistance, relative to non-recipients. This counterintuitive finding is theorized to stem from two factors. First, the highly targeted nature of these benefits, implying that recipients represent the most severely disadvantaged segment of the population; and second, the possibility that the monetary value of the benefits is insufficient to cover both adequate food provisioning and other essential fixed costs.

Welfare architecture fundamentally shapes how macroeconomic pressures translate into household access to adequate nutrition. Evidence from the welfare-and-health literature reinforces the importance of institutional context. Bambra (2011) finds that the protective association between social protection expenditure and poor self-perceived health varies between welfare regimes, with stronger effects in social-democratic and conservative systems and weaker effects in more fragmented or selective welfare arrangements. Since both health perception and food insecurity are affected by material deprivation and economic insecurity, this evidence suggests that welfare-regime characteristics may also shape the capacity of social protection to reduce food deprivation. Regime-sensitive analyses also reveal a persistent growing disconnect between food price movements and wage stagnation across European countries, with Social Democratic welfare systems demonstrating limited pass-through of food price increases to household deprivation relative to Eastern European contexts (Reeves et al., 2017). In countries with stronger social democratic protections, each one percent increase in food prices above wage growth was associated with minimal increases in reported inability to afford protein-rich foods, while Eastern European regimes experienced significantly pronounced vulnerability to the same price shocks.

Further research has disaggregated the effects of specific social spending functions at the household level. Pérez-Corral and Moreno-Mínguez (2025) analyzed the impact of three categories of social protection on child deprivation (including nutrition). Their findings suggest that increased social expenditure on sickness and disability benefits may be negatively correlated with child deprivation across all dimensions, likely because these provisions offer crucial income support or assistance particularly beneficial for vulnerable single-parent households. Conversely, the impact of family/children and housing/social exclusion benefits proved to be more limited, despite contributing to reduced inequalities in specific types of deprivation (e.g., leisure and social life) between single-parent and two-parent families. Reeves et al. (2017) also supported the ambiguity surrounding the efficacy and adequacy

of the specific benefit receipt, using individual-level data in European countries. A further implication is that aggregate welfare expenditure can conceal important compositional and institutional differences. As noted by Lanari et al. (2026) different social protection components may operate through distinct mechanisms, where unemployment benefits provide income replacement after labor-market shocks, old-age and survivor benefits stabilize income across the life course, family allowances support household needs, while sickness and disability benefits are closely linked to health limitations and impaired work capacity. Therefore, the same total level of social protection spending may have different implications depending on the allocation of resources across benefit categories and on the welfare regime within which these programs operate.

3 Empirical analysis

3.1 A stylized model

We model how social protection programs affect food insecurity within a utility-maximizing framework. A household derives the utility (U) from the consumption of food (F) and other goods and services (OGS). However, the income available to maximize this utility varies depending on the degree to which social protection serves to buffer households against food insecurity. Accordingly, the budget constraint is defined by the following equation:

$$Y = E_{INC} + O_{INC} + SP = p_F F + p_{OGS} OGS \tag{1}$$

where E_{INC} denotes current earned income, O_{INC} refers to other non-labor, non-transfer resources such as property income, private transfers, savings-based support, and other resources outside current earnings and social protection, SP represents social protection benefits. The prices of food and other goods and services are denoted by p_F and p_{OGS}, respectively.

Several mechanisms explain how social protection modifies the relationship between economic hardship and food insecurity. First, social protection provides income support during periods of low earnings or income loss. Since unemployment, wage reductions, and unstable attachment to the labor-market are the main drivers of food insufficiency, welfare transfers may protect households' ability to purchase adequate food by stabilizing disposable income (Loopstra and Tarasuk, 2013; Huang et al., 2016). Second, social protection may reduce ***trade-offs*** between food and other essential expenditures. Low-income households often allocate limited resources

to competing needs such as food, rent, utilities, transport, and healthcare (Heflin, 2006; Frank et al., 2006). By relaxing the household budget constraint, social protection can limit the extent to which non-food expenses crowd out food consumption. This mechanism is crucial because social protection directly alleviates these binding resource constraints, operating as an indirect buffer against food-price and cost of living pressures.

Thus, we model the disutility associated with food insufficiency by *D(FI)*, where *FI* represents food insufficiency. Let F_{min} denote the minimum level of food consumption required for food sufficiency, which varies by household size. A household is classified as insufficient food *(FI = 1)* if its food consumption falls below F_{min}, and sufficient food *(FI = 0)* otherwise. The disutility D(FI) is strictly positive when *FI = 1* and zero when *FI = 0*. This disutility may include the physical discomfort of hunger experienced by some or all household members, the adverse consequences of inadequate nutrition (e.g., reduced academic performance among children, lower workplace productivity among adults), and the psychological toll—such as the shame felt by parents over their inability to adequately feed their children.[2] The household's goal is to select a consumption bundle that maximizes its utility. This involves solving the utility maximization problem, *U(F,OGS)*, subject to budget constraint, Y $= p_F$F $+ p_{OGS}$OGS. Solving this problem yields the reduced-form demand equation for food:

$$F^* = f(p_F, p_{OGS}, E_{INC}, O_{INC}, SP) \tag{2}$$

Given that F_{min} represents the minimum threshold for food sufficiency, an individual is sufficient food if $F^* - F_{min} \geq 0$, and food insufficient if $F^* - F_{min} < 0$, which are indicated by *FI = 0* and *FI = 1*, respectively.

While an increase in earned income (E_{INC}) as well as other income (O_{INC}) is expected to increase total consumption and, in turn, food consumption, this analytical framework underscores the vital role of social protection mechanisms in mitigating the risk of food insufficiency among lower-income households. The effect of changes in food prices may differ from that of changes in the prices of other goods and services, as households may substitute between food and non-food consumption when relative prices change.

To address the limitations inherent in this restrictive specification, we assume

[2]The disutility associated with participating in social protection programs may also be captured through "transaction costs." These include the time and effort required to visit government offices, waiting times, childcare costs incurred during appointments, and transportation expenses. Nevertheless, high take-up among eligible populations in Europe may mitigate the deterrent effects of these transaction costs, particularly where information costs are low.

that the relative price of food, measured with respect to other goods, remains constant across households and over time, since unobserved variation in relative prices could introduce potential estimation bias. The role of income distribution in shaping food insecurity also indicates that food security is not determined solely by extreme poverty or subsistence-level earnings. Consequently, an econometric approach accounting for these distributional and structural dimensions is required to capture the underlying economic dynamics.

3.2 Econometric estimation

The available data are clustered and longitudinal, with units corresponding to individuals and clusters corresponding to countries. To account for this data structure, and considering that the response variable is binary, we rely on a logit model with random effects at the individual level and fixed effects at the cluster level. For theoretical aspects of models of this type, see Skrondal and Rabe-Hesketh (2004) and Hsiao (2022). In this way, we suitably account for the dependence among the time-specific response variables for the same individual and for the unobserved heterogeneity between countries. It is also worth considering that, although the data have a large number of units, the number of clusters is limited, and using a fixed rather than a random effect for each of these clusters gives the model a high degree of flexibility and avoids specific computational problems.

Let y_{hit} denote the binary response variable, corresponding to food insecurity, for unit i in cluster h for year t, where $h = 1, ..., H$, $i = 1, ..., n_h$, and $t = 1, ..., T$, and $\boldsymbol{x}_{hit}$ be the corresponding vector of covariates, mainly social protection expenditure (SP), but also economic drivers of food insecurity like labor (E_{INC}) and non-labor income resources (O_{INC}). Given the rotational panel structure, for every individual, observations are available for a reduced number of time occasions. In particular, we denote by $\mathcal{T}_{hi}$ the set of time occasions for which observations are available for individual i in country h. For the data at hand, we formulate a model of type:

$$\text{logit}[p_{hit}(\alpha_{hit})] = \alpha_{hi} + \boldsymbol{x}'_{hit}\boldsymbol{\beta} + \gamma_h + \theta_{ht}, \quad t \in \mathcal{T}_{hi}, \tag{3}$$

for $h = 1, \ldots, H$ and $i = 1, \ldots, n_h$, where $p_{hit}(\alpha_{it})$ corresponds to the probability the response variable is equal to 1 and $\text{logit}(p) = \log[p/(1-p)]$ for a probability p. Moreover, the α_{hi} are individual random effects with normal distribution having mean 0 and variance σ^2_α, $\boldsymbol{\beta}$ is a vector of regression coefficients for the covariates, and the γ_h are fixed effects for every cluster (country). The latter parameters are collected in the vector $\boldsymbol{\gamma}$ for $h = 1, \ldots, H$. Finally, θ_{ht} represents the interaction for

every cluster (country) and time.

The assumed model is estimated by the maximum likelihood approach. This method is based on maximizing the model likelihood with respect to the fixed parameters ($\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, and σ_α^2), which may be written as:

$$L(\boldsymbol{\beta}, \boldsymbol{\gamma}, \sigma_\alpha^2) = \prod_{h=1}^{H} \prod_{i=1}^{n_h} \int \prod_{t \in \mathcal{T}_{hi}} p_{hit}(\alpha_{hi})^{y_{hit}} [1 - p_{hit}(\alpha_{hi})]^{1-y_{hit}} \phi(\alpha_{hi}; \sigma_\alpha^2) d\alpha_{hi},$$

where $\phi(\alpha_{hi}; \sigma_\alpha^2)$ is the density of a normal distribution with mean 0 and variance σ_α^2 at α_{hi}.

Parameter estimation is in practice based on the maximization, by a Newton-type algorithm, of $L(\boldsymbol{\beta}, \boldsymbol{\gamma}, \sigma_\alpha^2)$, which is computed because of a reliable approximation of the integral involved in this function with respect to the normal distribution. See, Skrondal and Rabe-Hesketh (2004) for details.[3]

3.3 Data and descriptive analysis

The European Union Statistics on Income and Living Conditions (EU-SILC) collect multidimensional microdata on income distribution, poverty, and social exclusion for people aged 16 and over. The longitudinal data for EU-SILC follow a rotational design, which refers to the sample selection based on subsamples or replications, each similar in size and design and representative of the entire population. Specifically, households and individuals are interviewed in four consecutive years, although some countries have longer panel durations (Eurostat, 2015). We exploit the longitudinal component to collect primarily information on food insecurity, social protection spending, as well as on time-varying and time-unvarying variables as income, gender, and education.

Food insecurity is captured by a variable that records whether a household cannot afford a meal every second day, according to dietary guidelines that recommend at least 1–2 servings of meat, chicken, or fish (or alternative protein sources) every day. Our dichotomous outcome variable assigns a value equal to one for all those who exhibit food insecurity, and zero otherwise. Although this measure does not capture all dimensions of food insecurity, it identifies a severe affordability constraint related to access to protein-rich meals, capturing the inability to afford a basic component of a nutritionally adequate diet. This makes this measure suitable for evaluating whether social protection improves economic access to food, even if it does not allow

[3]We use Stata xtlogit command for this estimation and to obtain the corresponding standard errors.

us to examine dietary diversity, food quality, or the duration of food insecurity episodes (Loopstra et al., 2016).

Enhancements in social protection programs are assumed to be associated with a reduction in food insecurity, and the identification of beneficiaries is of crucial importance. We use the recorded expenditures of welfare programs considering respondents who stated that they received (a) unemployment benefits, (b) old-age benefits, (c) survivor's benefits, (d) sickness benefits, (e) disability, (f) child/family allowances, and (g) social exclusion not elsewhere classified in the past 12 months net of taxes at the individual.[4] Employee and self-employment cash income at net of taxes constitutes the labor income variable. As for other types of income, we recorded respondents who stated that they received (a) income from rental of a property or land, (b) regular inter-household cash transfer received, (c) interest, dividends, and profit from capital investments at net of taxes. As for the gender variable, we construct a dichotomous variable where the value 1 is assigned to female and 0 otherwise. Education variable consists of primary, secondary, and tertiary education, according to ISCED criteria. The expenditures on social protection and income are expressed in euros and adjusted for the Harmonized Index of Consumer Prices for each country. In addition, the values have been divided by the number of household members converted into equivalized adults.[5]

The sample we will use in our empirical estimation consists of 595,730 individual records on 16 countries covering the years from 2005 to 2023. Descriptive statistics and frequency distribution for the entire period related to food insecurity, along with those of other covariates included in the model 3, are reported in Appendix B. Individuals who are food insecure account for 9.9% of respondents. The average value of social protection is €2709, while the mean labor income amounts to €4292 and other sources of income average €539. Additionally, 48.4% of the respondents are female (Appendix B - Panel A). Finally, as shown in Appendix B - Panel B, with regard to the education variable, 41% of respondents hold a secondary level of education, while 30.9 and 28.1% have primary and tertiary education, respectively.

Table 1 presents the values of each social protection measure for the subsample of beneficiaries. The largest component of social protection spending concerns old-age benefits, with €5867 per capita. The average social protection spending is around 4018 per-capita euros among beneficiaries.

[4]Appendix A further describes these categories.

[5]Household members are equivalized or made equivalent by the following so-called modified OECD (Organization for Economic Co-operation and Development) equivalence scale where: (a) the first household member aged 14 years or over counts as one person; (b) each other household member aged 14 years or over counts as 0.5 person; (c) each household member aged 13 years or less counts as 0.3 person (Eurostat, 2023).

Table 1: Beneficiaries of social protection categories

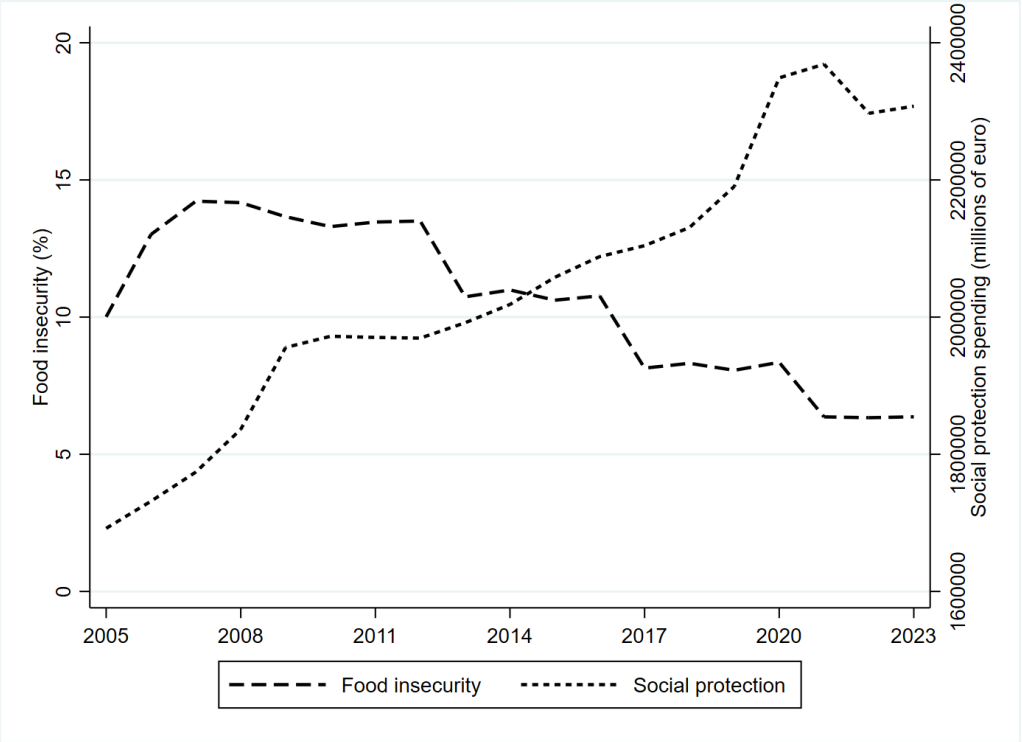
Social protection measures	Beneficiaries (number)	Percentage of total sample (%)	Average amount (€)
Unemployed	40,751	6.9	2383
Old-age	204,578	34.6	5867
Survivor's	17,260	2.9	4168
Sickness	27,583	4.7	620
Disability	30,830	5.2	2666
Child/family	136,149	23.0	773
Social exclusion	42,358	7.2	661
Total beneficiaries	398,267	67.4	4018

Notes: Each measure of social protection is expressed in euros and adjusted for the Harmonized Index of Consumer Prices for each country. In addition, the values have been divided by the number of household members converted into equivalized adults. The total number of beneficiaries may differ from the arithmetic sum of the individual items as everyone may receive multiple benefits.

Figure 1 shows the patterns of food insecurity and social protection expenditure spanning two decades. The figure shows that the share of individuals reporting food insecurity declined markedly after 2012, while social protection spending increased, suggesting an inverse trend between the two variables, except during the COVID-19 pandemic period. Quantitatively, it shows that over the years social protection expenditure has progressively increased, rising from 1.7 trillion in 2005 to 2.3 trillion in 2023. Parallel to this increase, average food insecurity declined from 12.9% in 2005–2008 to about 6.7% in 2020–2023, suggesting that initial increases in social spending were insufficient to immediately offset the negative effects of the monetary crisis and potential surges in global food commodity prices.

Figure 2 presents a dynamic view of two key socioeconomic drivers of food insecurity, in which income is measured by labor income (black line) or other sources of income (blue line) and the unemployment rate in percentage (grey line) over the period 2005–2023. Labor income represents the largest economic component throughout the entire period, although it shows considerable volatility. After increasing until 2009, it experienced a marked decline between 2012 and 2014, followed by a phase of relative stagnation and a new upward trend starting in 2020. Since labor income constitutes the main source of household income, its reductions can increase economic vulnerability and consequently the risk of food insecurity. Income from other sources appears to be more stable over time, despite the presence of fluctuations. The peak recorded in 2019 may reflect a greater reliance on other forms of economic support. The unemployment rate shows an inverse trend compared with labor income. The unemployment rate shows a characteristic cyclical pattern, fluctuating between 5% and 10%. It peaks near 10% around 2013, a delayed but clear consequence of the 2008 financial crisis and the subsequent sovereign debt cri-

Figure 1: Food insecurity and social protection trend (2005–2023)

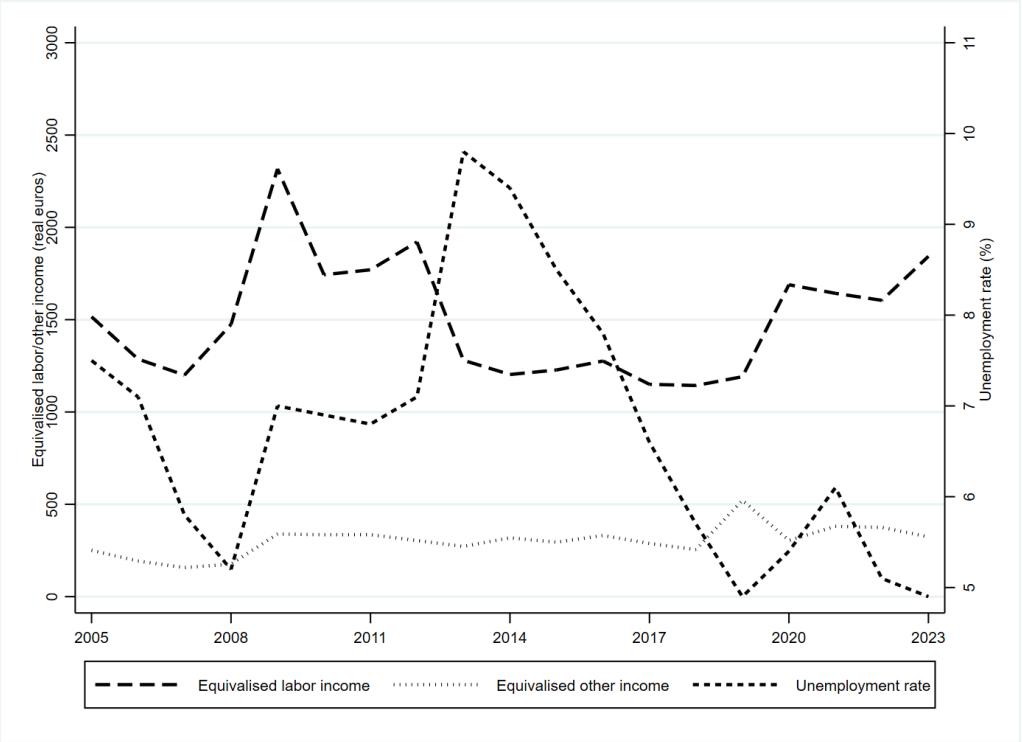


Notes: Social protection is taken for countries involved in our study. Values for 2023 are provisional.

sis, while it remains low because of the 2020-2021 pandemic shock. It is plausible that the social protection addressed to unemployment should have contributed to alleviating food insecurity in Europe.

Figure 3 comprises two bar charts and scatter plots comparing the EU member states at three relevant points: 2005 (pre-Global Financial Crisis), 2019 (pre-COVID-19 pandemic), and 2023 (post-pandemic/recent period). Subfigure (a) illustrates the percentage of the population experiencing food insecurity. There is a clear and persistent dichotomy in food insecurity rates across the EU. Countries like Bulgaria, Romania, and Hungary consistently exhibit the highest prevalence of food insecurity, often reaching or exceeding 20-30% in 2005 and 2019, although with some reported decline by 2023. Conversely, Austria, Estonia, and Sweden maintain low rates, below 10%. The trend analysis between 2005 and 2019 shows that in Central and Eastern Europe (CEE) countries, such as Romania, there is a significant decline in food insecurity, reflecting general economic convergence and reduction of poverty in the EU during that period. Focusing on the post-pandemic change between 2019 (red dot) and 2023 (black triangle) reveals heterogeneous impacts. Countries, including those with historically low food insecurity (e.g., Belgium), show a moderate increase, attributable to the combined effects of the COVID-19 pandemic and the

Figure 2: Labor income, other type of income and unemployment rate (2005–2023)

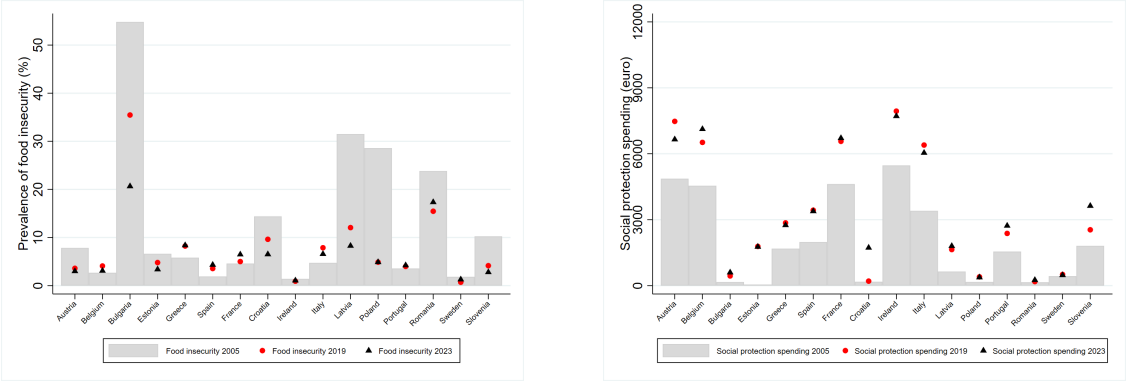


subsequent cost-of-living crisis driven by inflation (energy, food prices). Subfigure (b) of Figure 3 reports social protection spending, expressed in millions of euros, as an indicator of welfare effort across countries. The figure reveals substantial cross-country variation in the absolute scale of spending. Larger and wealthier countries, such as Austria, Belgium, France, Ireland, and Italy, generally record higher levels of per-capita social protection expenditure, often exceeding €6,000 in 2023, whereas smaller or less affluent countries, such as Bulgaria and Romania, display considerably lower levels. Consistent with the aggregate pattern shown in Figure 1, social protection spending increases in most countries over the period considered, with 2023 values generally exceeding both 2005 and 2019 levels. The largest increases are observed between 2019 and 2023, reflecting the substantial fiscal responses adopted during the COVID-19 pandemic and the subsequent economic crises.

4 Estimates

Tables 2 reports marginal effects from logit models of the probability of being food insecure, estimated at the individual level. Across all specifications, the effect of social protection is negative and highly statistically significant, indicating that higher social protection spending is associated with a lower probability of experiencing food

Figure 3: Prevalence of food insecurity and social protection spending in 2005, 2019, and 2023 in EU countries



(a) Prevalence of food insecurity

(b) Social protection spending

Notes: The values of food security and social protection spending are taken at year 2006, 2013, 2009 and 2007 for Bulgaria, Croatia, Portugal, and Romania, respectively. Social protection values are adjusted for the Harmonized Index of Consumer Prices and subsequently divided by the number of household members converted into equivalized adults.

insecurity. The estimated effect of social protection on food insecurity is –0.0040 in the baseline random-effect specifications (column 1), and –0.0012 once country fixed effects are introduced (column 2), remaining close –0.0011, when additionally controlling for country×year effects (column 3). The reduction in coefficient magnitude across specifications suggests that part of the raw correlation reflects time-invariant cross-country differences. For example, countries with more generous welfare systems also differ structurally in ways related to food insecurity, although the association remains clearly negative even after controlling for these confounders. We translate the "impact on average" of food insecurity using the estimate of column (3) and considering that the average per-capita social protection spending in the sample is €2709. An increase in social protection equal to this mean is associated with a reduction in food insecurity of approximately –0.30 percentage points, corresponding to a decline in prevalence from about 9.9% to 9.6%.[6] Income, regardless of whether it is classified as labor income or income from other sources, functions as the primary mechanism for reducing food insecurity. Specifically, an increase in labor income is associated with a decline in the probability of experiencing food insecurity equal to -0.98 percentage points (-0.0023*4.293), corresponding to a decrease in prevalence from about 9.9% to 9.0%. The impact of other sources of income is equal to -0.26 percentage points (-0.0049*0.54). Looking to the other covariates, holding all other variables included in the model constant, women exhibit a probability approximately 0.21 percentage points higher of experiencing food

[6]This is: –0.0011 * 2.709 ≈ –0.0030, which is translated in percentage points by multiplying for 100.

insecurity compared to men. Regarding educational attainment, individuals with primary education show a probability of about 8.01 percentage points higher than those experiencing food insecurity relative to individuals with tertiary education. Similarly, individuals with secondary education exhibit a probability approximately 3.20 percentage points higher compared to those with tertiary education.

Table 2: Probability of being food insecure across Europe over the period 2005–2023, (average marginal effects)

	(1)	(2)	(3)
Social protection	-0.0040***	-0.0012***	-0.0011***
	(0.0001)	(0.0001)	(0.0001)
Labor income	-0.0054***	-0.0026***	-0.0023***
	(0.0001)	(0.0001)	(0.0001)
Other income	-0.0066***	-0.0052***	-0.0049***
	(0.0004)	(0.0004)	(0.0004)
Gender			
Female	0.0066***	0.0022**	0.0021**
	(0.0009)	(0.0009)	(0.0009)
Male (ref.)			
Education			
Primary	0.0770***	0.0886***	0.0801***
	(0.0012)	(0.0013)	(0.0013)
Secondary	0.0428***	0.0363***	0.0320***
	(0.0011)	(0.0010)	(0.0010)
Tertiary (ref.)			
Observations	582,957	582,957	582,957
Country (FE)	No	Yes	Yes
Country * Year	No	No	Yes
ρ	0.8505	0.8372	0.8434
LR test	0.0000	0.0000	0.0000

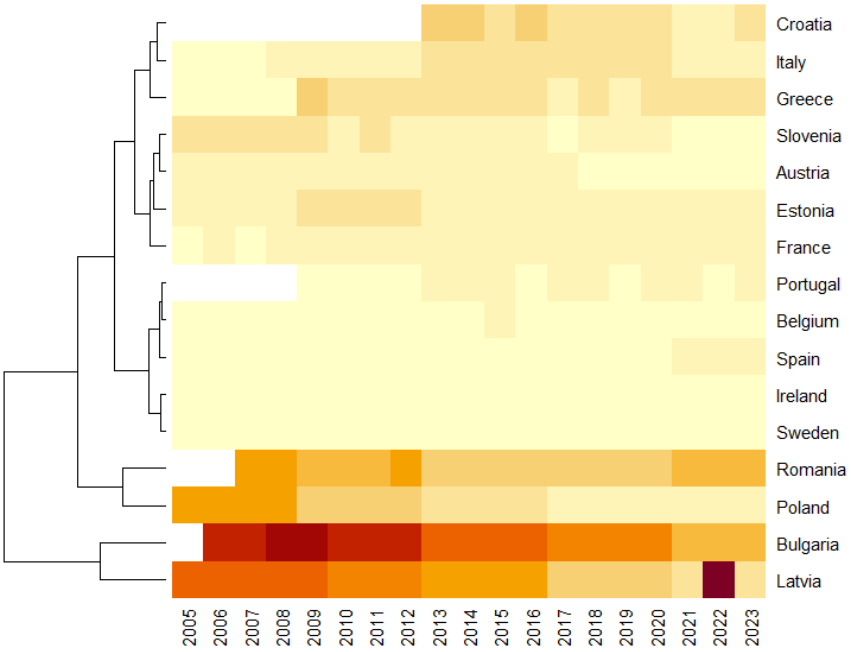
Notes: significant levels are reported with the following notation: ***p-value<0.01, **p-value<0.05, *p-value<0.1. Standard errors are in round brackets.

From a food-policy perspective, the magnitude of the estimated association suggests that social protection contributes to improved food security, although it is unlikely to eliminate food deprivation on its own. The average reduction associated with social protection is modest, whereas income and education gradients remain substantial. This indicates that food insecurity in Europe is embedded within broader inequalities in purchasing power, labor-market attachment, and social vulnerability. Accordingly, effective food policy requires coordination between income-support measures and interventions aimed at reducing cost-of-living pressures, improving food affordability, and ensuring access to healthy diets.

Figure 4 illustrates a pronounced tripartite structure, characterized by internally cohesive clusters that agglomerate at linkage distances far exceeding their within-

group variance. This clustering effectively stratifies the sample by prevalence intensity, in which the uppermost cluster aggregates countries with lower-medium level of food-insecurity risk over the last two decades. Conversely, the lower cluster, denoted by darker shading and encompassing Romania, Poland, Bulgaria, and Latvia, indicates a persistently higher probability of food insecurity throughout the period 2005–2023.

Figure 4: Food-insecurity risk over time by countries



4.1 Robustness

Table 3 presents a robustness check by re-estimating the model separately for the Great Recession (2007–2011) and the more recent COVID–19 crisis period (2019–2023). The effect of social protection spending remains negative and statistically significant. This indicates that higher spending is systematically associated with a lower probability of food insecurity during both economic downturns, with point estimates ranging from -0.32 to -0.46 percentage points at the sample means.[7] Therefore, social protection can operate as a countercyclical food-security instrument by preserving purchasing power when food access becomes more fragile. The estimates also confirm that income continues to dominate the risk profile. A higher income,

[7]During the Great Recession, average social protection spending was €2,460, whereas in 2019–2023 this amount reached €3,046.

whether from labor or other sources, is associated with a substantial reduction in food-insecurity risk in both sub-periods. A noteworthy temporal pattern is the reduction in income between the two periods. This is consistent with evidence showing that food insecurity remains socially stratified, even as its prevalence has declined in several European countries over time (Garratt, 2020). As for the other covariates, they are consistent with the benchmark estimates: women exhibit a slightly higher risk of food insecurity compared to men. Finally, individuals with primary education show a probability of food insecurity that is approximately 11.5 percentage points higher during the Great Recession period and 7.0 percentage points higher in 2019–2023, relative to individuals with tertiary education.

Table 3: Robustness: probability of food being insecure across Europe, subsamples (average marginal effects)

	2007–2011 (1)	2019–2023 (2)
Social protection	-0.0013***	-0.0015***
	(0.0004)	(0.0002)
Labor income	-0.0038***	-0.0026***
	(0.0003)	(0.0002)
Other income	-0.0068***	-0.0041***
	(0.0010)	(0.0005)
Gender		
Female	0.0008	0.0024*
	(0.0023)	(0.0014)
Male (ref.)		
Education		
Primary	0.1148***	0.0703***
	(0.0032)	(0.0021)
Secondary	0.0503***	0.0258***
	(0.0025)	(0.0015)
Tertiary (ref.)		
Observations	122,369	209,967
Country (FE)	Yes	Yes
Country * Year	Yes	Yes
ρ	0.8384	0.8111
LR test	0.0000	0.0000

Notes: significant levels are reported with the following notation: ***p-value<0.01, **p-value<0.05, *p-value<0.1. Standard errors are in round brackets.

Table 4 refines this interpretation by focusing on "beneficiaries" that are defined as those reporting receipt of social protection benefits. The social protection impact is larger within this policy-relevant subpopulation. The marginal effect of social protection is -0.0055 in the baseline specification, which decreases after controlling for country fixed effects and country-by-year effects (-0.0021 and -0.0019, respectively).

Table 4: Probability of food being insecure across Europe over the period 2005–2023 among beneficiaries (average marginal effects)

	(1)	(2)	(3)
Social protection	-0.0055***	-0.0021***	-0.0019***
	(0.0001)	(0.0002)	(0.0002)
Labor income	-0.0065***	-0.0036***	-0.0033***
	(0.0002)	(0.0002)	(0.0002)
Other income	-0.0065***	-0.0057***	-0.0056***
	(0.0005)	(0.0005)	(0.0005)
Gender			
Female	0.0087***	0.0038**	0.0040**
	(0.0012)	(0.0013)	(0.0012)
Male (ref.)			
Education			
Primary	0.0786***	0.0930***	0.0828***
	(0.0016)	(0.0017)	(0.0017)
Secondary	0.0445***	0.0404***	0.0348***
	(0.0015)	(0.0014)	(0.0014)
Tertiary (ref.)			
Observations	391,814	391,814	391,814
Country (FE)	No	Yes	Yes
Country * Year	No	No	Yes
ρ	0.8517	0.8331	0.8285
LR test	0.0000	0.0000	0.0000

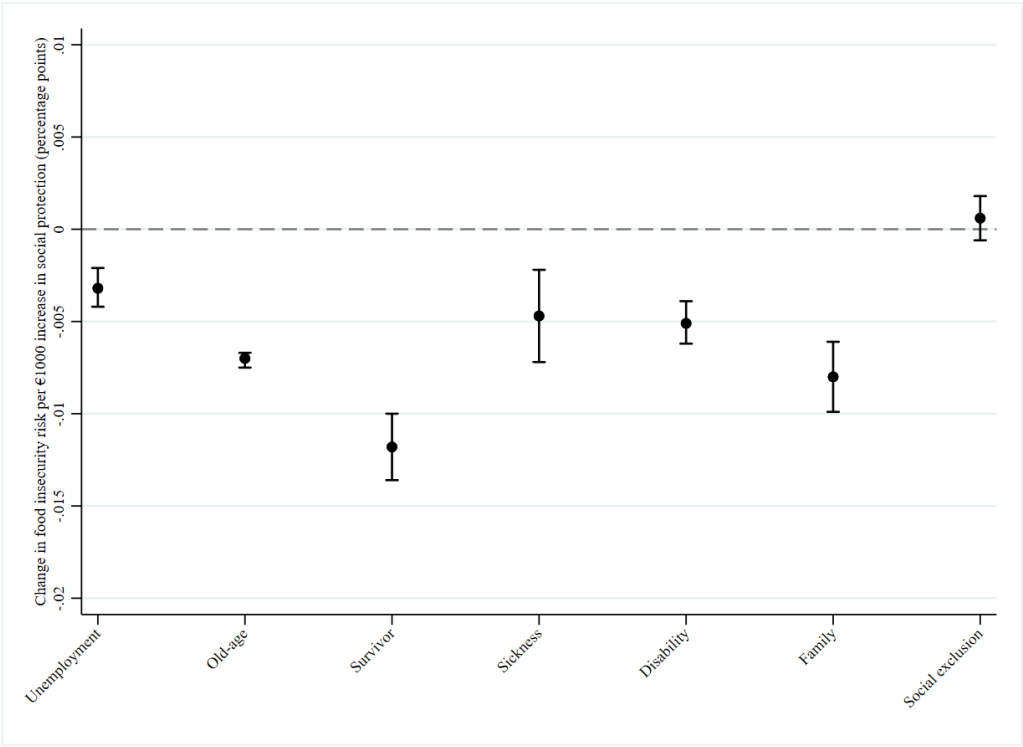
Notes: significant levels are reported with the following notation: ***p-value<0.01, **p-value<0.05, *p-value<0.1. Standard errors are in round brackets.

Two main implications emerge from these results. First, the attenuation of the coefficient upon the inclusion of richer fixed-effects structures confirms that, while part of the raw association reflects persistent cross-country differences and common shocks, the remaining within-country, within-period relationship is estimated and negative. Second, the larger magnitudes observed among beneficiaries support a "marginal stabilization" mechanism, where additional resources delivered through the welfare system are more important for households already interacting with it, as they are closer to the food insecurity threshold. We cannot exclude selection concerns, since benefit receipt identifies groups with greater underlying disadvantage. The larger marginal effects should be interpreted as evidence of responsiveness within a high-risk population, rather than as evidence that benefits eliminate the structural drivers of food insecurity.

Figure 5 disaggregates the beneficiary analysis according to the function of social protection spending, including unemployment, old-age, sickness, survivor, disability, family-related support, and social exclusion not elsewhere classified. The results indicate that not all components of social spending yield equivalent returns for food

security. While some categories exhibit pronounced point reductions, others display wider intervals, suggesting lower precision in estimation. In summary, robustness reinforces the central interpretive claim that while welfare spending functions as a protective buffer, which is particularly evident during crisis windows and among recipients, the persistence of steep socioeconomic gradients implies that social protection, as currently structured, is more effective in mitigating risk at the margin than in fully compensating the underlying distributional and labor-market determinants of food insecurity.

Figure 5: Probability of food being insecure among beneficiaries, by social protection component (average marginal effects)

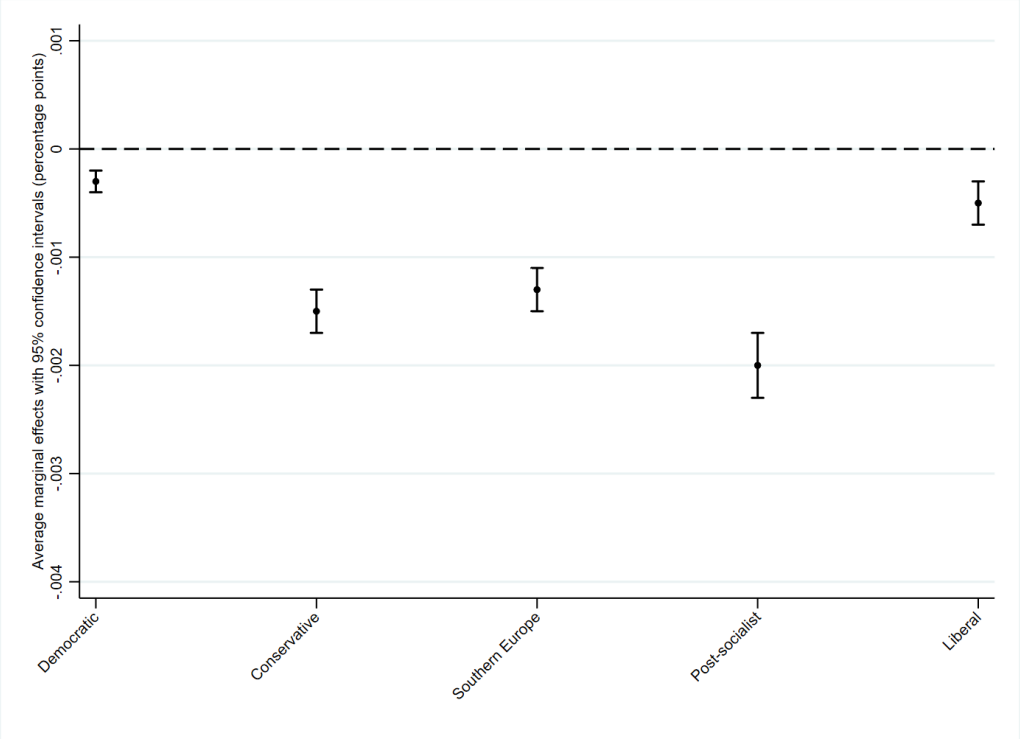


Notes: When the individual components of social protection are considered separately, these variables exhibit limited variability within countries over the observed period. Consequently, the simultaneous inclusion of country fixed effects and country-by-year interactions generates substantial collinearity and drastically reduces the amount of information available to identify the coefficients associated with the specific social protection components. To assess the effect of each social protection component on the probability of food insecurity, more parsimonious models excluding country fixed effects and country-by-year interactions are presented.

4.2 Heterogeneity

Figure 6 extends the analysis by examining whether the association between social protection expenditure and food insecurity differs across welfare regimes. The estimated marginal effects are negative across all regime types, indicating that higher social protection spending is associated with a lower probability of experiencing food

Figure 6: Estimates of social protection expenditure on food insecurity according to different welfare regimes (average marginal effects)



insecurity. However, the magnitude of this association varies across institutional contexts. The largest protective effect is observed in the post-socialist regime, followed by conservative and Southern European welfare systems, whereas the estimated reductions are smaller in social-democratic and liberal regimes. This heterogeneity suggests that the effectiveness of social protection expenditure cannot be interpreted solely in terms of aggregate spending levels but should also be understood in relation to welfare-state architecture, benefit adequacy, targeting mechanisms, and the socio-economic profile of recipient populations.

The comparatively stronger effect observed in post-socialist countries is consistent with the higher baseline exposure to food insecurity documented in the descriptive analysis, where Romania, Poland, Bulgaria, and Latvia form a cluster characterized by persistently higher food-insecurity risk over the period 2005–2023. In these contexts, additional social protection expenditure may generate larger marginal gains because a greater share of the population lies close to the food insecurity threshold. The estimated effect should be interpreted as evidence of stronger marginal responsiveness rather than necessarily greater institutional efficiency. In other words, social protection appears to have a larger measured impact where underlying deprivation is more widespread and where transfers can more directly relax binding budget constraints.

The sizeable effects estimated for conservative and Southern European regimes also suggest that social protection may play an important stabilizing role in welfare systems, where income maintenance and family-based support remain central components of protection against social risks. In Southern Europe, where food insecurity is often associated to labor-market segmentation, household income instability, and stronger reliance on family networks, welfare spending may reduce food deprivation by cushioning income shocks and limiting trade-offs between food and other essential expenditures. In conservative regimes, the protective association may reflect the role of social insurance schemes in stabilizing household resources across unemployment, sickness, disability, and old-age risks.

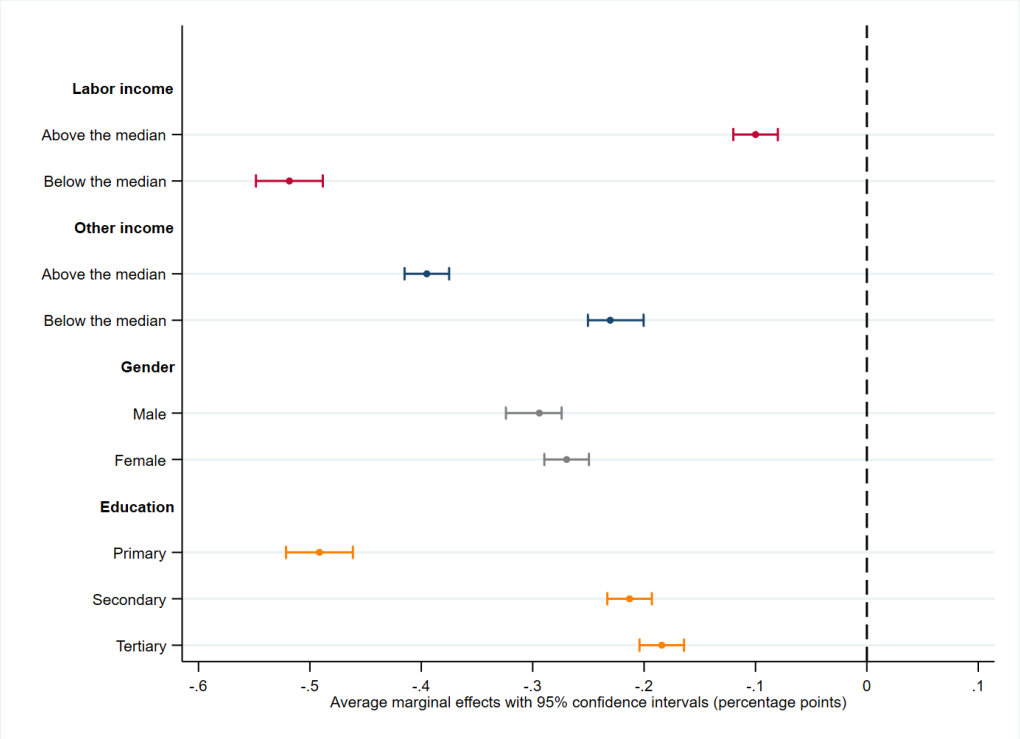
By contrast, the smaller estimated effects in social-democratic and liberal regimes should not be interpreted as evidence that social protection is irrelevant in these contexts. Rather, they may reflect lower baseline levels of food insecurity, more mature welfare provision, and a smaller share of individuals located near the food insecurity threshold. In such regimes, additional spending may generate more limited marginal reductions because food insecurity is already comparatively contained or concentrated among harder-to-reach groups. This interpretation is consistent with the broader results of the paper, which show that social protection acts as a protective buffer but does not fully offset the structural determinants of food insecurity, particularly low income, weak labor-market attachment, and lower educational attainment.

After examining heterogeneity across welfare regimes, Figure 7 turns to individual-level heterogeneity by reporting subgroup-specific reductions in the predicted probability of food insecurity. Specifically, the coefficients are constructed as the product of the average marginal effect of social protection on the probability of food insecurity and the subgroup's "corresponding value" of social protection, scaled by one hundred to express the result in percentage points.

Income-related variables are dichotomized at the sample median and coded as 1 for observations below the median and 0 otherwise. This specification is adopted to facilitate the interpretation of average marginal effects. Moreover, the binary classification allows us to directly assess whether the effect of social protection expenditure differs across poor and more advantaged individuals. Social protection is associated with a reduction in the probability of food insecurity in both labor income categories; however, the effect is stronger among individuals with labor income below the median (-0.52 percentage points). This suggests that social protection has a greater impact on economically more vulnerable groups. A negative and statistically significant effect is also observed for other sources of income in both categories.

However, the reduction in food insecurity appears to be stronger among individuals with "other income" above the median. This may indicate that having an additional source of income enhances the effectiveness of social protection in translating into improved food security outcomes. Differences between men and women are limited. Both groups show a similar reduction in the probability of food insecurity, suggesting that the effect of social protection is homogeneous across gender (-0.29 and -0.28 percentage points for male and female, respectively). Finally, regarding to education, individuals with lower levels of education (primary) appear to benefit more substantially in terms of reductions in food insecurity. This benefit gradually declines as the level of education increases.

Figure 7: Social protection spending and food insecurity by covariate group across EU countries, 2005–2023 (average marginal effects)



Notes: the coefficients were obtained by multiplying the average marginal effect by the corresponding value of social protection for each category and subsequently multiplying the results by 100, so that they can be interpreted in percentage points (i.e., Labor income, below the median (second red line): (-0.0012*4.32)*100 ≈ -0.52)

5 Conclusions

This paper examined whether social protection spending mitigates food insecurity across Europe between 2005 and 2023, using longitudinal EU-SILC microdata and a random-effects logit framework that accounts for unobserved country heterogeneity and common shocks. The results show a robust negative association between social protection spending and the probability of food insecurity. In the preferred specification, an increase in social protection spending equal to the sample mean, about €2,709 per capita, is associated with a reduction of approximately 0.30 percentage points, lowering food-insecurity prevalence from about 9.9% to 9.6%. Although modest in average terms, the estimates remain statistically significant after controlling for country fixed effects and country-year shocks. The results also show that labor income and other components of household income reduce food insecurity. Conditionally to education level, individuals with primary education face a probability of food insecurity, about 8.0 percentage points higher than those with tertiary education. Overall, social protection appears to operate as a stabilizing instrument, especially during downturns and among vulnerable groups, but reducing food insecurity more substantially requires broader policies that improve income capacity, employment stability, educational opportunities, and the affordability of essential goods.

Robustness checks focusing on the Great Recession and the subsequent pandemic and cost-of-living crises support the main interpretation. In both downturn periods, social protection is negatively and statistically significantly associated with food insecurity, highlighting the countercyclical role of welfare systems when households experience income shocks and tighter budget constraints. More specifically, social protection is associated with lower food insecurity across welfare regimes, although its marginal association is stronger in contexts where deprivation is more severe, and transfers are more likely to relax immediate resource constraints.

The main food-policy implication of this study is that social protection should be considered part of the policy architecture for reducing food insecurity in Europe. Our empirical findings confirm that food policy in high-income contexts must look beyond aggregate supply. Because the problem is fundamentally rooted in household purchasing power, effective interventions must combine food-specific measures with broader income-support instruments. This pattern aligns with a "marginal stabilization" mechanism in which social protection dampens risk and smooths shocks, although it does not eliminate the underlying gradients produced by low earnings capacity, unstable employment, and constrained access to opportunities. A further implication concerns heterogeneity in the protective role of social protection across

countries and program functions. The welfare-regime perspective further clarifies this heterogeneity. Countries do not differ only in how much they spend, but also in how social protection is organized, targeted, and delivered. Evidence from related European research on self-perceived health shows that the protective role of welfare spending varies across social-democratic, conservative, Southern European, post-socialist, and liberal welfare regimes. Our findings suggest that a similar logic applies to food insecurity, in which welfare spending is more likely to reduce deprivation when it is embedded in institutional systems characterized by broad coverage, adequate benefits, effective implementation, and limited administrative barriers.

The observed variation in effect sizes also reflects heterogeneity across population subgroups. Although higher social protection spending may reduce food insecurity, the returns to such spending depend on whether benefits are timely, accessible, and sufficient relative to essential living costs, including housing and energy, and whether they effectively reach households facing the most binding constraints. This implies two complementary priorities for policy-makers. First, automatic stabilizers should be maintained and, where necessary, strengthened to protect households during adverse macroeconomic conditions. Second, the effectiveness of social protection should be improved by reducing administrative frictions, closing coverage gaps among marginalized groups, and calibrating benefit levels to local cost-of-living pressures (Zorbas et al., 2025). The persistence of steep socioeconomic gradients further indicates that substantial reductions in food insecurity require policies that go beyond transfer payments, including measures to improve labor-market opportunities, stabilize earnings trajectories, and address the broader distribution of economic resources.

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Appendix

A Description of social protection categories

Social protection categories (net of taxes)	Description
Unemployment benefits	Cash benefits which replace, in whole or in part, income lost by a worker due to the loss of gainful employment. Also includes early retirement for labor-market reasons, vocational training, mobility and resettlement.
Old-age benefits	Old-age benefits cover benefits that provide a replacement income when the aged person retires from the labor market, or guarantee a certain income, when a person has reached a prescribed age. Also includes partial retirement pensions, care allowances.
Survivor benefits	A survivors' benefit is normally granted on the basis of a derived right, that is, a right originally belonging to another person whose death is a condition for granting the benefit. It includes survivors' pensions and death grant.
Sickness benefits	Cash benefits that replace in whole or in part loss of earnings during temporary inability to work due to sickness or injury received during income reference period.
Disability benefits	Refer to benefits received during income reference period that provide an income to persons below the standard retirement age whose ability to work and earn is impaired beyond a minimum level laid down by legislation by a physical or mental disability. It includes disability pensions, early retirement in the event of reduced ability to work, care allowances.
Family/children allowances	Family/children allowances include income maintenance benefit in the event of childbirth, birth grant, parental leave benefit, and any other cash benefits to support households and help them meet specific costs.
Social exclusion not elsewhere classified	Social benefits in the function social exclusion not elsewhere classified, refer to the socially excluded or to those at risk of social exclusion. In general, target groups may be identified (among others) as destitute people, migrants, refugees, drug addicts, alcoholics, or victims of criminal violence.

Notes: description of social protection categories is taken from Eurostat (2023).

B Descriptive statistics and frequency distribution

	Observations	Mean	Std.dev.	Min	Max
Panel A - Descriptive statistics					
Food insecurity	595,595	0.0994	0.2992	0	1
Social protection	590,696	2709.2	5969.3	0	978850
Labor income	595,716	4292.8	8417.9	0	1751068
Other income	587,377	539.9	4446.1	0	1203063
Gender	595,706	0.4842	0.4997	0	1
Education	591,406	2.0284	0.7673	1	3
Panel B - Frequency distribution					
	Frequency	Percentage	Cumulate		
Food insecurity					
Food insecure	59,234	10.0	10.0		
Food secure	536,361	90.0	100.0		
Gender					
Male	307,214	51.6	51.6		
Female	288,492	48.4	100.0		
Education					
Primary	182.777	30.9	30.9		
Secondary	242,695	41.0	71.9		
Tertiary	165,934	28.1	100.0		