NOVA SCHOOL OF BUSINESS AND ECONOMICS

UNIVERSIDADE NOVA DE LISBOA

Dissertation presented as part of the requirements for the degree of

Doctor of Philosophy in Economics

Essays in Poverty Measurement

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A dissertation carried out on the Ph.D. in Economics, under the supervision of

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March 30, 2023

Acknowledgements

I am grateful to everyone who has supported me throughout these tough but rewarding years.

First, and foremost, I want to thank my husband, Orkhan, who has been a true friend and the greatest supporter. Thank you for constantly encouraging me. I am grateful to my family in Azerbaijan for being so warm and understanding.

I would like to thank my advisor, Susana Peralta, for her guidance, support, and the freedom she gave me to explore my interests to the fullest. I am grateful to professor François Maniquet for kindly hosting me at the Catholic University of Louvain, for his patience, support, and invaluable contribution. I am also grateful to professor Markus Jännti for hosting me at the Swedish Institute of Social Research, his encouragement and inspiration. Special thanks to professor Pedro Brinca who has made this visit possible.

Last, but not least, I want to thank my doctoral colleagues for their friendship and encouragement. I am very lucky to meet you.

Abstract

This thesis presents three essays in poverty measurement employing the methods that go beyond the conventional approaches. Chapter 1 investigates the multidimensional poverty in selected European countries when preferences are taken into account, and the emphasis is put on different groups of poor or deprivation dimensions. Chapter 2 evaluates the bundle poverty among Portuguese singles, and lone parents incorporating ethical principles from the fairness literature. Chapter 3 explores the role and share of inequality of opportunity in attaining the minimum standard of living among working-age Portuguese individuals.

Key words: multidimensional poverty, fairness, inequality of opportunity, poverty in Portugal.

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Introduction

The comprehensive and accurate measurement of human welfare has become one of the central questions of theoretical, as well as empirical economic literature. Although the recent decades have witnessed a vast improvement in living conditions of individuals, the eradication of poverty and provision of a decent standard of living for all remains one of the crucial tasks of public policies. In order to achieve this, the first step is the accurate and comprehensive assessment of human deprivation. For a long time, public discussion has been focused on the access to minimum standard of living measured by income or consumption, and policy measures have been tailored to addressing this problem. However, discussions in recent years have revealed that focusing only on income or consumption may neither be an exhaustive, nor a fair approach to solving the poverty problem. This work is an attempt to contribute to these discussions and advocate for a more comprehensive approach to deprivation with additional empirical evidence and is composed of three essays embodying the multifaceted nature of poverty, on one hand, and incorporating fairness principles, on the other hand, to poverty measurement.

Chapter 1 measures multidimensional poverty among selected European countries by addressing some issues usually discussed in the literature. This chapter makes three contributions to the empirical literature on multidimensional poverty. It uses the Alkire-Foster method to build the multidimensional poverty index that accounts for the inequality in the distribution of deprivation among the population and for the substitutability between depri-

vation dimensions. The former allows for detecting the level of multidimensional poverty when the focus is shifted towards the poorer segments of population, whereas the latter adjustment allows for detecting the deprivation dimension in which the population suffers the most. Finally, the multidimensional poverty is measured via normative weights vs. subjective weights, which takes into account population preferences. The results show that, 1) higher-income European countries have lower levels of multidimensional poverty compared to lower-income European countries, 2) multidimensional index with higher aversion to inequality increases the level of poverty substantially, 3) multidimensional poverty measured with subjective weights produced systematically lower levels of poverty compared to that measured via normative weights, 4) the overlap of multidimensionally poor with income poor is not large, being even smaller for higher-income European countries, and 5) education is the largest contributor to multidimensional poverty.

Chapter 2 is another attempt to measure poverty by building upon multidimensionality and fairness principles. This measurement method is built on the egalitarian equivalence approach widely discussed in the fairness literature. This method evaluates individual welfare over the bundle of net income and work hours at counterfactual scenarios when everyone is assigned identical circumstances (i.e. wages) and compares their welfare to that if they would have a poverty threshold bundle of net income and work hours. In this manner, the poverty measure called *circumstance poverty* identifies those who do not have *access* to the bundle that gives them at least as much utility as the poverty threshold bundle. The adoption of this approach also allows for incorporating ethical principles to the poverty measurement, giving priority to individuals with more or less distaste for work. Moreover, the hours of work of parents with young children is adjusted to take into account the time cost of child rearing. The circumstance poverty is measured among working-age Portuguese singles with and without children. The results show that circumstance poor are mainly those without tertiary education, and single mothers are over-represented. Moreover, the adjustment of work

hours of single parents shows that single mothers become circumstance poor at a higher rate than single fathers. Last but not least, the overlap between income poor, circumstance poor, and poor via counting approach is not large, suggesting that using only one poverty measure for evaluating societal welfare does not describe this multifaceted phenomenon.

Chapter 3 takes a different perspective to the poverty measurement, but is not unrelated to other chapters in its focus on fairness. It is an attempt to reconcile the theory of equality of opportunity with poverty measurement, namely, to quantify the role of factors beyond individual control, i.e. circumstances in inequality in income deprivation. The chapter estimates the role of circumstances on individual poverty status with four alternative poverty thresholds, and for three samples, the two (of working individuals, and full-time working individuals) being the sub-sample of the other (whole sample comprising employed, unemployed, and inactive). The results show that, first, most of the circumstances included in the model are significantly correlated with individual poverty status, but this correlation becomes weaker and insignificant once the poverty threshold is lowered, i.e., when the focus shifts to poorer segments of the sample. Second, the absolute level of the inequality of opportunity in overall inequality in being income poor becomes smaller at lower poverty thresholds; the decrease is statistically significant. In contrast, the relative contribution of inequality of opportunity - the share of total inequality in income poverty explained by the inequality of opportunity - becomes larger when the poverty threshold is lowered - approximately 20-30% of total inequality in poverty is explained by the inequality of opportunity. However, the change in relative contribution between the poverty thresholds is not statistically significant. When the working or full-time working sample is considered, both absolute and relative inequality of opportunity are lower compared to those reported for the whole sample. Again, the absolute level of inequality of opportunity is found to decrease once the poverty threshold is lowered, but the relative contribution becomes larger.

Chapter 1

Multidimensional Poverty Measurement in Europe: taking population preferences into account

1.1 Introduction

The economic literature has long established that poverty is multidimensional (Atkinson and Bourguignon, 1982, Atkinson, 2003, Silber et al., 2007). The income or consumption status of an individual only partly reflects their well-being – other dimensions of life quality must also be taken into account for the full depiction of one's well-being. Existing empirical evidence from developed, as well as developing countries, has shown that unidimensional poverty measures are unable to capture all aspects of deprivation on an individual level (Nolan and Whelan, 2010), emphasizing the importance of the multidimensional approach when measuring poverty. For instance, Burchi et al. (2018) show that despite the noticeable correlation between the two, income poverty rates are lower than multidimensional poverty in low-income countries. In contrast, Ayala et al. (2011) discuss that the correlation between the two indicators is weak, if not absent. While analysing child poverty among EU countries,

De Neubourg et al. (2012) show how income poverty does not capture multidimensionally poor individuals or households in European counties. The latter is also supported by the findings of Whelan et al. (2014), which show higher rates of multidimensional poverty compared with income poverty. Given these findings, the importance of the multidimensional poverty measurement becomes more apparent; it is necessary to complement income poverty measures with the multidimensional approach to have a fuller picture of deprivation.

The European countries have also recognized the limited characteristics of monetary measures of well-being and drafted policies reaching beyond this aspect. The Lisbon strategy, developed in 2000 as a result of the European Council's meeting in Lisbon, Portugal, envisaged the extensive investment in human welfare by improving the skills and work conditions, as well as the addressing of environmental challenges throughout Europe. After the severe global economic crisis, the Europe 2020 strategy continues these efforts and encompasses the goal of reducing poverty and social exclusion in future decades Batzordea (2010). The flagship initiative "European Platform against Poverty" aims "[. . .] to ensure economic, social and territorial cohesion, building on the current European Year for combating poverty and social exclusion to raise awareness and recognize the fundamental rights of people experiencing poverty and social exclusion, enabling them to live in dignity and take an active part in society." These initiatives once again imply that it is pivotal to track the changes in deprivation levels in European countries by adopting the multidimensional approach to poverty.

The multidimensional approach has been developed in recent decades following the seminal work of the Nobel Prize winner Sen (1985). The author has emphasized the insufficiency of the utilitarian approach to welfare and poverty measurement, which mainly concentrated on income as a measure of well-being. Consequently, he proposed the famous capability approach, focused on measuring not only the material resources in command but

also the ability of individuals to convert those resources into beings and doings that people enjoy in everyday life, i.e., functionings. However, the author avoided presenting a concrete list of capabilities to be measured, defending it by noting that these capabilities must depend on the valuations of communities. In contrast, several studies have attempted to determine the main aspects of human well-being that are essential for leading a decent life (Nussbaum (2000, 2009), etc). The lists of capabilities proposed by different authors have several common dimensions (Alkire, 2002) that have laid the foundation for the empirical measurement of multidimensional poverty, although restricted by data availability.

The first multidimensional well-being index, known as the Human Development Index (UNDP, 1991) and widely reported ever since, has been developed by the United Nations. It encompasses GDP per capita, life expectancy, and education level. Moreover, Anand and Sen (1997) proposed the human poverty index (HPI) considering deprivations in GDP per capita, education, health represented by life expectancy, and long-term unemployment. Although being a breakthrough step in well-being or poverty measurements, these indices entail some drawbacks. First, both are reported at the country level, which does not allow for evaluating poverty at the individual level. Second, the aggregation method disguises the inequality in the well-being distribution among individuals, as differences are averaged for the aggregation.

Given these drawbacks, several studies have developed multidimensional poverty indices that allow for the evaluation of individual deprivations and provide a composite index. Alkire and Foster (2011) have proposed a new multidimensional poverty index (MPI) employing the counting approach proposed by Foster (2009). The indicator has introduced several improvements to the measurement of multidimensional poverty by including more dimensions with multiple indicators for each dimension. For example, the dimension of material deprivation includes several indicators such as housing conditions, possession of

durable goods, food intake depending on the classification of a country chosen (developed vs. developing) and data availability. Second, the aggregation is first carried out at the individual and then the societal level. Hence, it is possible to calculate the deprivation of each individual, which is a clear advantage compared to HPI.

This index has attracted academic attention and is applied to both developing and developed countries, including the members of the European Union. More recently, (Alkire et al., 2015) have used this indicator for the measurement of multidimensional deprivation in European countries with the EU-SILC dataset. The authors include four dimensions of individual deprivation – health, education, living standards, and living environment, with several indicators under each dimension. The results show a steady decline in multidimensional deprivation in EU countries although, some countries such as Portugal, Greece, and Bulgaria have suffered a sudden rise after 2011. Similarly, other authors have developed a family of multidimensional poverty measures with the counting (Chakravarty and D'Ambrosio, 2006, Bossert et al., 2009, 2013), and fuzzy set approaches (Betti et al., 2015, d'Ambrosio et al., 2011) and illustrated empirical applications of some of them (Whelan et al., 2014).

The measures of multidimensional deprivation proposed by the above-listed studies entail several favourable properties but fail to address some issues in poverty measurement. Widely used measures, such as the Alkire-Foster one, are simple weighted sums of deprivation indicators assuming perfect substitutability, and with no aversion to inequality. These indices do not allow for determining the deprivations in which the poor suffer the most, on the one hand, and how deprivations are distributed among the population, on the other. Some studies (Bourguignon and Chakravarty, 2003, Bossert et al., 2009) introduce an augmentation that accounts for the distribution of deprivations among the poor, but the problem is rarely applied in empirical illustrations. The second issue is related to the set of weights assigned to each indicator. Usually, normative weights are selected, and each dimension is

given equal weight while defending the equal importance of each aspect of deprivation. Except for Bossert et al. (2009, 2013) and Chakravarty and D'Ambrosio (2006), studies have mainly adopted normative weighting, disregarding the preferences of the population. This approach is suitable for conducting interpersonal and inter-country comparisons but is often criticized for not respecting population preferences (Fleurbaey and Blanchet, 2013). The promotion of agency and freedom of choice among individuals is an integral part of the capability approach on which this multidimensional poverty measurement is based. Moreover, this approach recognizes the differences in the valuation of capabilities among communities, so population preferences must be taken into account. Although both approaches to weighting have their own proponents and critics (Decancq and Lugo, 2013), it is important to carry out a comparative analysis of deprivation by taking into account the population preferences alongside the normative approach to weighting.

The present work aims to tackle the above-listed problems and contribute to the empirical MPI literature in the following ways. First, by introducing a specific functional form to individual deprivation function, we can calibrate the substitutability between deprivation dimensions as desired and reveal the dimension in which individuals suffer the most. Second, by aggregating individual deprivations via introducing the same functional form, it is possible to tailor the index to the desired level of inequality aversion (Bourguignon and Chakravarty, 2003). Moreover, the study will present the decomposition results of the multidimensional index via the Shapley method at various levels of substitutability and inequality aversion. Although not directly a contribution, decomposition results will show how each deprivation dimension contributes to the poverty of the moderately vs. deeply poor. The third contribution of the study is the calculation of the MPI by considering subjective (population) preferences and conducting a comparative analysis with normative valuations of deprivation dimensions. The subjective weights for each dimension are derived from the life satisfaction equation by incorporating the observed heterogeneity.

The paper employs the European Union Survey on Income and Life Conditions (EU-SILC), a rich dataset containing several questions on material deprivation, income, education, health, and environment. The choice of dimensions is guided by the selection of dimensions in (Alkire et al., 2015) with some modifications of the chosen indicators. Poverty is evaluated for 11 EU countries, restricted by data availability on the subjective satisfaction information used for the estimation of subjective preferences.

The rest of the paper is structured as follows. Section 2 will discuss the methodology in terms of the specification of deprivation function, dimensions/indicators included in the poverty measurement, disaggregation method, and the calculation of subjective preferences. The third section will present the main results on the multidimensional poverty measurement, decomposition of the poverty index, and the overlap analysis. The fourth section will conclude.

1.2 Methodology

This section will present the methodology according to which the multidimensional poverty will be evaluated. The Alkire-Foster approach, and the modifications to the approach, will be discussed in the first two subsections. Afterward, there will be an explanation of the decomposition method. The choice of multidimensional deprivation indicators and weights will then be presented thereafter. The last section will be concluded with the regression technique for evaluating the sociodemographic characteristics of the multidimensionally poor.

1.2.1 Definitions

Before proceeding to the methodology, it is useful to elaborate on some terminology. Following Alkire and Foster (2011), a dimension is a sphere of human deprivation that may include one or several indicators of deprivation – in sum, sub-spheres of poverty. An example can be taken from the EU-SILC dataset used in this paper. Health is a dimension of deprivation encompassing the indicators of "subjective health", "suffering from chronic illness" and "presence of unmet medical needs" in our construction.

1.2.2 The measurement of multidimensional poverty

The multidimensional poverty will be calculated with the counting approach that counts the indicators in which an individual is deprived (Foster, 2009). The analysis will follow the dual cut-off approach proposed by Alkire and Foster (2011) and discussed in detail in Alkire and Apablaza (2016). This method is widely applied in the empirical poverty assessment. First, the deprivation of an individual is determined for each deprivation indicator chosen. Thereafter, the weighted sum of deprivation indicators is calculated for each individual. An individual is considered multidimensionally poor when this weighted sum exceeds the threshold level of weighted deprivations. The concept can be formally represented in the following manner.

Let $X_i = \{x_{ij}\}$ represent the achievement vector of an individual $i = 1, 2, ...n$ in indicators $j = 1, 2, ...m$, and $Z = \{z_j\}$ is the vector for deprivation thresholds of deprivation indicators. An individual i is considered deprived in indicator j if $x_{ij} < z_j$ and non-deprived otherwise.

Define a_{ij} as:

$$a_{ij} = \begin{cases} 1, \text{if } x_{ij} < z_j \\ 0, \text{if } x_{ij} \geq z_j \end{cases} \tag{1.1}$$

Here, a_{ij} is the binary representation of the vector of j deprivations of an individual i. In the following matrix, called the deprivation matrix (1.2), cell (a_{ij}) represents an individual's deprivation in the indicator j. In this case, the indicators are assigned to zero and one if individuals are not deprived or deprived in a given indicator, respectively. This is *the first poverty cut-off* at the individual level. Following the example above, an individual i will be assigned zero in "suffering from chronic illness" j indicator if she does not have a chronic illness and one otherwise.

$$\Lambda_{n,m} = \begin{pmatrix} a_{1,1} & \cdots & a_{1,m} \\ a_{2,1} & \ddots & a_{2,m} \\ a_{n,1} & \cdots & a_{n,m} \end{pmatrix} \tag{1.2}$$

The *second poverty cut-off* is implemented while aggregating all indicators for each individual. Specifically, if the weighted sum of deprivations is higher than the poverty threshold level k, an individual is deemed poor. For example, lets assume that the multidimensional poverty is only measured in health dimension, three indicators mentioned above are chosen for this purpose, each indicator is assigned a weight of $1/3$, and an individual is deprived in two out of three. If the poverty threshold is $1/3$, then an individual is multidimensionally poor, as his deprivation score will be $2/3$. The weighted deprivation of nonpoor individuals in this case is censored – that is, replaced with zero. The poverty threshold for selected indicators, and the multidimensional poverty will be presented in Section 2.3.

The main difference between the Alkire-Foster approach and the one adopted in this paper is the aggregation of deprivation indicators at both individual and aggregate levels. The conventional approach calculates the simple weighted sum of deprivations to assess the

multidimensional poverty at the individual level [1] The study will depart from this approach and apply the CES functional form discussed by Bourguignon and Chakravarty (2003) and Bossert et al. (2009). This functional form allows to calibrate the degree of substitution between deprivation indicators to the desired level (more in detail below). Whether an individual is multidimensionally poor (the second poverty cutoff) is decided based on the individual deprivation function.

With the application of CES function, the individual deprivation function becomes:

$$p(\Lambda)_i = \Big(\sum_{j=1}^{m} w_j (a_{ij})^{\beta} \Big)^{1/\beta} \tag{1.4}$$

Here, w_j are weights assigned to each indicator and $\beta \geq 1$ is the parameter of substitution between deprivation indicators of an individual. However, one problem arises during the aggregation at individual level. Given that deprivation indicators take values of 0 or 1, it is not possible to retain the CES specification for individual deprivation function, and it simply becomes a linear weighted sum across indicators. To tackle this problem, the value of deprivation indicators is averaged within each dimension, and individual poverty measure is built on average values of dimensions instead:

$$p(\Lambda)_i = \left(\sum_{l=1}^{L} w_l \Big(\sum_{j} \frac{a_{ij}}{r_l} \Big)^{\beta} \right)^{1/\beta}, \tag{1.5}$$

where w_l is the weight attributed to each dimension l, and $l = 1, 2, ...L$, r_l is the number

[1] The individual poverty measure $p(\Lambda)_i$ is usually calculated as follows, which does not allow the application of the CES specification:

$$p(\Lambda)_i = \sum_{j=1}^{m} w_j a_{ij} \tag{1.3}$$

Here, w_j are weights assigned to each indicator.

of indicators within each dimension l. In this case, weights will be assigned to dimensions and not to indicators to preserve the weighted structure of the measure.

The poverty at societal level is also calculated by aggregating individual deprivations via the adoption of the CES functional form. As noted above, the aggregate poverty index only includes the deprivation of the multidimensionally poor and replaces the deprivation of nonpoor with zero. The aggregate poverty measure $P(\Lambda)_{MP}$ is constructed as below:

$$P(\Lambda)_{MD} = \frac{1}{n}\left(\sum_{i=1}^{q}\Big(p(\Lambda)_i\Big)^{\alpha}\right)^{1/\alpha} = \frac{1}{n}\left(\sum_{i=1}^{q}\left(\sum_{l=1}^{L} w_l\Big(\sum_{j}\frac{a_{ij}}{r_l}\Big)^{\beta}\right)^{\alpha/\beta}\right)^{1/\alpha} \tag{1.6}$$

Here, α represents the elasticity of substitution between multidimensional poverty of individuals, and larger values of α imply higher aversion to inequality. This functional form also includes the Alkire-Foster approach when elasticity parameters are appropriately calibrated, i.e., when $\beta = 1$ and $\alpha = 1$.

The CES specification entails a desirable property that makes this functional form attractive. In our specification, the value of the CES function approaches the value of its largest element in at higher values of substitution parameters (α or β). That is, when $\beta > 1$, the individual deprivation function will be representative of the deprivation dimensions in which an individual is deprived the most. Hence, those deprivations will not be averaged out by the value of other dimensions in which an individual is not deprived or has lower deprivation. For example, an individual might suffer from poor health, but not be deprived of education. In this case, higher β will give a larger implicit weight to the health deprivation of an individual, and it will not be averaged out by the value of the education dimension. On the other hand, the application of CES specification to the aggregation across individuals allows the calibration of the degree of aversion to inequality in the distribution of multidimensional deprivation among the population and the poor (Bourguignon and Chakravarty, 2003). Larger

values of α will assign higher implicit weights to the most deprived.

Denoting q the number of poor and n the number of individuals in the society, the measure can also be decomposed in terms of the headcount poverty index (H) and the poverty intensity index (A):

$$H = \frac{q}{n} \tag{1.7}$$

$$A = \frac{\left(\sum_{i=1}^{q} \left(\sum_{l=1}^{L} w_l \left(\sum_j \frac{a_{ij}}{r_l} \right)^{\beta} \right)^{\alpha/\beta} \right)^{1/\alpha}}{q} \tag{1.8}$$

$$P(\Lambda)_{MP} = H * A \tag{1.9}$$

This poverty index satisfies several axioms adapted from unidimensional poverty measures to the multidimensional setting (for further discussion, see Tsui (2002) and Bourguignon and Chakravarty (2003)). But the measure is not directly decomposable to subgroups or dimensions. This shortcoming can be handled with the application of the Shapley method (see below).

1.2.3 Selected dimensions and indicators

The study will assess the multidimensional poverty of individuals in four dimensions with thirteen corresponding indicators. The included dimensions are education, health, material deprivation, and the environment. The choice of dimensions and the corresponding indicators are mainly guided by the existing literature (Alkire et al., 2015, Alkire and Apablaza, 2016, Bossert et al., 2009, Decancq, 2017) as well as data availability. The EU-SILC dataset used in the paper collects extensive information covering selected dimensions of deprivation to construct the index. Dimensions, corresponding indicators, and deprivation cut-offs of

indicators are given in Table 1.1 below.

Among the dimensions selected, material deprivation is reported by Eurostat on an annual basis using the EU-SILC variables. The measure currently includes nine items: to pay their rent, mortgage, or utility bills; to keep their home adequately warm; to face unexpected expenses; to eat meat or proteins regularly; to go on holiday; to own a television; a washing machine; a car; and a telephone. Some of the indicators used by Eurostat are also included in this study (Table 1.1), namely, not being able to keep the dwelling warm, not affording meals with chicken/red meat (or a protein equivalent) every two days, and enforced lack of a telephone, washing machine, and TV, with the latter items comprised in one indicator (enforced lack of durables). The decision was made to modify the material deprivation dimension by excluding some indicators in the material deprivation reported by Eurostat and including other indicators available in the dataset – access to a bath/shower or toilet facilities, size of the housing, and housing conditions.

The inclusion of some indicators and the exclusion of others in material deprivation can be justified. Firstly, housing conditions, and possession of durable goods, allows us to produce a better picture of lifetime material deprivation (Ayala et al., 2011); these items reflect the long-term earning ability of households better than their current income level captured by income poverty. In contrast, some indicators in Eurostat's material deprivation – such as experiencing problems with paying the mortgage or rent and utility bills – are more reflective of the current monetary situation of individuals. Moreover, the inclusion and aggregation of large numbers of material deprivation indicators listed in Eurostat's measure would preclude us from producing meaningful poverty indices. It is better if these items are analysed separately to inform the readers about the current state of material deprivation. (For a detailed analysis of the material deprivation in the EU countries, see Guio et al. (2017)).

Table 1.1: Normative weights assigned to each dimension

Dimension	**Weight**	**Indicator**
Education	$1/4$	Not completed a secondary education
Health	$1/4$	Subjective health status below fair Suffering from chronic illness Presence of unmet medical needs
Material deprivation	$1/4$	Leaking roof, damp walls/floor or rot in window Not being able to keep the dwelling warm No access to bath/shower or indoor flushing toilet inside the dwelling Enforced lack of colour TV, washing machine, telephone, and computer Living in an overcrowded household Not affording meal with chicken/meat (or protein equivalent) every two days
Environment	$1/4$	Suffering from noise from neighbours or from the street Suffering from pollution Suffering from crime and violence

The multidimensional poverty threshold. The multidimensional poverty threshold is taken as 33%. That is, an individual deprived in at least 33% of weighted deprivations will be considered multidimensionally poor according to normative weights. This choice of the cutoff means that a person is poor if she is deprived in more than one dimension - the cutoff is equivalent to being deprived in one dimension and one indicator (weight of $1/12$ each) of health or environment or two indicators (weight of $1/24$ each) of material deprivation. As the identification of poor depends on the weights attributed to each indicator or dimension, the identification procedure will be based on normative weights. The multidimensional poverty index with subjective weights will be calculated for those deemed poor under normative weighting structure.

1.2.4 Decomposition method: Shapley value

Besides the level of multidimensional poverty, it is important to reveal how dimensions contribute to overall multidimensional poverty. The Shapley value will be used to assess how

each dimension of deprivation contributes to overall multidimensional poverty to overcome the decomposability issue of the multidimensional poverty index. The method has been introduced by Shapley (2020) into the field of cooperative game theory and was later reintroduced by Shorrocks (2013a) into the decomposition of various inequality and poverty measures. Increasingly it has been used in empirical poverty literature for the analysis of spatial and temporal contributions of various factors for the changes in multidimensional poverty (Chakravarty et al., 2008, Nicholas et al., 2019).

The method can be succinctly explained as follows. First, it calculates the poverty level with and without the presence of a specific deprivation dimension; that is, what the poverty level would be if individuals were not deprived in a given dimension. The method assumes that the order of elimination of a dimension from the poverty calculations matters; the level of poverty will differ if a dimension is eliminated before or after the exclusion of other dimensions from the calculations. Hence, it takes the average overall multidimensional poverty considering all orders of elimination of a chosen dimension. For a detailed description of the decomposition procedure, see Shorrocks (2013a).

1.2.5 Choosing weights

Two approaches will be adopted while assigning weights to the dimensions. The analysis will use both normative and subjective weights for the comparative analysis. In the case of normative weights, each dimension is assigned an equal weight of $1/4$, and those weights are equally distributed among indicators within each dimension (Table 1.1). This is the conventional approach adopted by the Alkire-Foster method to identify the poor, as mentioned above.

It is worth addressing this implementation here. The measurement of multidimensional

poverty aims to assess deprivation levels in various aspects of poverty, represented by dimensions. Indicators are used to quantify the deprivation level. Hence, assigning weights to the deprivation dimensions and not indicators is still consistent with the concept of a multidimensional poverty measurement. Moreover, as the measure will be calculated with average values of deprivation indicators within each deprivation dimension, it would not be possible to assign weights to indicators. Hence, the assignment of weights is conceptually purposeful and technically feasible.

Subjective weights . Subjective weights are derived from the life satisfaction information proposed by Schokkaert (2007) and used in other studies (for instance, Yang (2018)). These weights have the advantage of taking into account actual population preferences and producing a more realistic picture of the poor. Using satisfaction data as a measure of well-being is subject to severe criticisms ranging from different scaling factors (converting the self-reported well-being into a value within a defined interval of satisfaction values) to the dependence of reported well-being on different factors such as lifetime well-being, the well-being of peers or parents. However, it can still hold valuable information about what people value in their lives and what affects their well-being. Moreover, the scaling factors can affect the level of satisfaction but not the relative weights given to each dimension of well-being or deprivation (Decancq et al., 2015). Hence, it can be conveniently used for the construction of subjective preferences.

Another important advantage of this method is its independence of the incidence of deprivations across dimensions, as opposed to other non-normative weights. The departure from normative weighting is usually carried out by the adoption of endogenous weights, such as frequency weights or weights derived from the principal component analysis. These weights are linearly correlated with the deprivation incidence in a given dimension and can violate important axioms that a poverty measure must satisfy (for a technical discussion and

empirical illustration, see Dutta et al. (2021)). The weights derived from the satisfaction data are not susceptible to such endogeneity issues (also see Datt (2017) for the recent use of satisfaction data in a multidimensional poverty assessment).

The analysis will benefit from this discussion to estimate subjective preferences for constructing a subjective multidimensional poverty index. The 2013 cross-sectional wave of the EU-SILC dataset contains a set of questions regarding overall life satisfaction, which will be used for this purpose. The subjective weights of each dimension of deprivation will be obtained via ordered logit analysis as follows:

$$LS_i = \sum_{l=1}^{L} \alpha_l * D_{il} + \sum_{l=1}^{L} \sum_{k=1}^{K} \beta_{lk} * X_{ik} * D_{il} + \sum_{k=1}^{K} \gamma_k * X_{ik} + \epsilon_i \tag{1.10}$$

Here, LS_i is the life satisfaction indicator measuring the overall satisfaction with life in [0,10] interval; D_{il} is the deprivation in dimension $l \in \{$education, health, material deprivation, environment$\}$; X_{ik} is the vector of sociodemographic characteristics of respondents - sex of the respondent, being employed, living in an urban area and being in a civil union; and α_l, β_{lk} and γ_k are the parameters to be estimated. X_{ik} also includes individual-specific characteristics such as mood variables – the dataset provides a rich variety of those. The purpose of including these variables is to "clean out" the satisfaction scores from temporary mood changes of individuals and to estimate more robust preferences not affected by transient feelings.

The coefficients of dimensions and interaction terms will be normalised, so that obtained weights will sum to one. The inclusion of socioeconomic indicators of individuals in interaction with dimensions allows us to derive heterogeneous weights for various population groups. For example, the value attached to education by an urban population may differ from a rural population because urban employment opportunities may depend more on higher education levels than rural populations. In this case, being deprivation in education will have a

stronger impact on the life satisfaction of urban residents (hence, a larger coefficient of the interaction term of education and urban residence) compared to rural populations.

Some conditions have been set during the selection of weights. The coefficients of the deprivation dimensions with at least 10% significance level are used while calculating subjective weights. Likewise, only coefficients of interaction terms with at least a 10% significance level are presented and used in the calculations. If neither the coefficient of the deprivation dimension nor its interaction term with the sociodemographic characteristics are in line with the conditions above, zero weight is assigned to the dimension.

1.3 Data and Sample

The study uses the European Union Survey on Income and Life Conditions (EU-SILC) dataset for the calculation of the multidimensional poverty in the selected countries. It is a rich survey of individuals and households encompassing socioeconomic and demographic variables as well as ad hoc modules changing every year. Eurostat annually reports the social exclusion and material deprivation indicators for the EU members in addition to income or consumption poverty, increasingly recognising non-income deprivation as an important complement to monetary poverty. The main advantage of this dataset is that it is constructed based on common guidelines applied to all countries in the European Union and comparable across countries and time. The paper only uses the EU-SILC 2013 wave, which contains an ad hoc module dedicated to the satisfaction evaluation of respondents. The latter data is used for estimating population preferences.

Table 1.2: Countries and sample size

Country	Sample size (older than 18)	Sample with non-missing satisfaction data (older than 18)
Austria	10441	9423
Belgium	10952	9412
Bulgaria	10130	8468
Cyprus	10309	9509
Germany	19936	17036
Greece	14356	14215
Hungary	19475	16226
Romania	14829	14478
Slovak Republic	11833	11225
Spain	23116	22305
Switzerland	11615	11582

The sample contains the respondents from 11 countries who are 18 years or older (Table 1.2). As seen, the sample consists of countries with relatively high income per capita and low monetary poverty: Austria, Belgium, Switzerland, Germany, Slovak Republic, and Spain; and relatively lower levels of income per capita: Bulgaria, Romania, Hungary, and Cyprus. The selection of countries is conditioned by the number of missing values in satisfaction variables used for the estimation of population preferences; only countries with non-response rates under 20% are selected. The second column shows the number of respondents older than 18 with non-missing values on life satisfaction variables. It must be noted that, although the subjective weights are derived from satisfaction data where observations existed, those weights are applied to the whole sample (including to those with missing satisfaction information) in the calculation of a subjective-weighted multidimensional poverty index.

The missing values problem is also encountered while assessing the deprivation in each indicator (Table 1). Some measures have been taken to decrease the impact of missing observations to identify nonpoor individuals. For example, the missing values for durables have been handled such that, if a person has missing information in one durable and not lacking

other three durables, she is deemed not deprived in enforced lack of durables indicator, as her otherwise lacking that durable good would not affect her deprivation status in this indicator. Concerning the deprivation indicators in other dimensions, the following steps are taken. First, an individual's weighted deprivation is calculated without the indicator with missing information. Second, the deprivation score of these individuals are compared with the poverty cutoff; if a person would not be deemed poor even if she was deprived in a given indicator with missing information, she is considered not poor. This procedure is carried out for those who have missing information in only one indicator. The similar procedure is not carried out for those who miss information in some indicators and are already multidimensionally poor with the values of indicators with non-missing information. The reason is that, this would not give us a complete picture of multidimensional poverty or poverty intensity as only lower bound values of these measures would be obtained. This is not the conventional way of calculating and reporting multidimensional poverty, hence, these individuals are treated as missing observations.

1.4 Results

This section will present the main results of the study. The information on data used and sample size, the treatment of missing values, and summary statistics of the multidimensionally poor can be found in Appendix 1.1 and Appendix 1.2. The next subsection discusses the results of the life satisfaction regression and subjective weights. Thereafter, the multidimensional poverty level is reported for the selected countries at various levels of the degree of substitution and aversion to inequality. The Shapley decomposition results are presented afterwards. The section is concluded with the overlap analysis between income and multidimensionally poor.

1.4.1 Life satisfaction regression and subjective preferences

As discussed above, the life satisfaction analysis is carried out for each country in the sample in order to derive population preferences and corresponding subjective weights. The results of the life satisfaction regression are presented in Table 1.3. The selection of countries is based on the number of responses to the question "Overall, how satisfied are you with your life?", measured on a scale from 0 to 10. Alongside the main dimensions of deprivation, several sociodemographic characteristics and their interactions with deprivation dimensions are included in the regressions to account for heterogeneity in preferences, and hence, derive group-specific subjective weights.

Table 1.3: Life satisfaction regression results

	Austria	Belgium	Bulgaria	Cyprus	Germany	Greece
Education	-0.338^{**}	-0.282^{**}	-0.362^{**}	-0.156^{**}	-0.119	-0.413^{**}
	(0.0722)	(0.0476)	(0.0823)	(0.683)	(0.0886)	(0.0345)
Health	-2.916^{**}	-2.233^{**}	-1.475^{**}	-1.683^{**}	-2.578^{**}	-1.097^{**}
	(0.191)	(0.122)	(0.0844)	(0.154)	(0.148)	(0.0661)
Material deprivation	-2.260^{**}	-2.607^{**}	-2.012^{***}	-2.689^{***}	-3.511^{***}	-1.445^{***}
	(0.198)	(0.191)	(0.103)	(0.230)	(0.248)	(0.0911)
Environment	-0.295^{**}	-0.148^{*}	-0.181^{**}	-0.113^{**}	-0.494^{**}	-1.102^{**}
	(0.0812)	(0.0890)	(0.0785)	(0.0675)	(0.0805)	(0.0511)
Education x	-0.326^{**}		-0.314^{**}			
employed	(0.116)		(0.102)			
Education x			0.312^{**}		-0.355^{**}	
civil union			(0.0880)		(0.115)	
Education x				-0.188^{**}		
male				(0.0788)		
Education x			-0.237^{**}	-0.305^{**}		
urban residence			(0.109)	(0.0793)		
Health x	0.848^{***}	0.771^{***}			0.966^{**}	
employed	(0.199)	(0.204)			(0.148)	
Health x	0.363^{***}			0.604^{***}	0.318^{***}	
civil union	(0.198)			(0.177)	(0.154)	
Health x	0.608^{**}					
urban residence	(0.206)					
Material deprivation x					1.074^{**}	
employed					(0.304)	
Material deprivation x				-0.783^{**}	-0.600^{*}	
civil union				(0.262)	(0.309)	
Material deprivation			-0.367^{***}	1.095		
x urban residence			0.202	(0.260)		
Environment x					0.190^{*}	
employed					(0.0981)	
Environment		-0.260^{***}				
x urban residence		(0.142)				
Living in urban area	-1.121^{**}	-0.156^{**}	0.445^{**}	-0.656^{**}	0.149^{**}	0.0568^{*}
	(0.0509)	(0.0540)	(0.0886)	(0.0836)	(0.0298)	(0.0323)
Living in consensual	0.260^{**}	0.535^{**}	-0.0466	0.207^{**}	0.682^{**}	0.340^{*}
union	(0.0484)	(0.0427)	(0.0498)	(0.0860)	(0.0745)	(0.0312)
Employed	-0.0138	0.118^{**}	0.587^{**}	0.108^{**}	-0.526^{**}	0.265^{*}
	0.0503	(0.0463)	(0.0496)	(0.0405)	(0.0700)	(0.0328)
Male	-0.339^{**}	-0.0638^{*}	-0.0581^{**}	-0.0705	-0.102^{**}	-0.0545^{*}
	(0.0378)	(0.0381)	(0.0391)	(0.0449)	(0.0280)	(0.0298)
Being very nervous	0.493^{**}	0.390^{**}	0.191^{**}	0.676^{**}	0.465^{**}	0.516^{**}
	0.0220	(0.0205)	(0.0157)	(0.0182)	(0.0204)	(0.0172)
N	9423	9412	8468	9509	17036	14215
Chi-2	1960.1^{***}	1913.5^{***}	2412.1^{***}	2794.3^{***}	2884.1^{***}	2760.7^{***}
Pseudo-R2	0.0654	0.0703	0.0671	0.0784	0.0574	0.0591

Note: Robust standard errors are given in parentheses - $***-<0.01$, $**-<0.05$, $*-<0.10$.

Table 1.3: Life satisfaction regression results (cont-d)

	Hungary	Romania	Slovak Republic	Spain	Switzerland
Education	-0.289^{**}	0.0371	-0.434^{**}	-0.463^{***}	-0.0727
	(0.0429)	(0.0454)	(0.0826)	(0.0485)	(0.0636)
Health	-1.976^{***}	-1.834^{***}	-2.258^{***}	-1.856^{***}	-1.968^{***}
	(0.0995)	(0.0599)	(0.130)	(0.117)	(0.163)
Material deprivation	-1.854^{**}	-1.851^{***}	-2.608^{***}	-2.077^{***}	-3.397^{***}
	(0.102)	(0.107)	(0.126)	(0.119)	(0.477)
Environment	-0.0178	-0.192^{***}	-0.208^{***}	-0.0011	-0.449^{***}
	(0.0815)	(0.0720)	(0.073)	(0.0545)	(0.0822)
Education x	-0.235^{***}		-0.430^{***}		
employed	(0.0762)		(0.159)		
Education x			-0.304^{***}	0.153^{***}	
civil union			(0.117)	(0.0512)	
Education x		0.138^{***}		-0.0949^{*}	
male	(0.0638)		(0.0486)		
Health x	0.633^{***}		0.398^{***}	0.690^{***}	0.857^{***}
employed	(0.128)		(0.164)	(0.127)	(0.204)
Health x	0.324^{***}		0.542^{***}	0.350^{***}	
civil union	(0.108)		(0.151)	(0.126)	
Health x		0.0136		0.213^{*}	
male				(0.121)	
Health x	-0.392^{***}		-0.334^{*}		
urban residence	(0.112)		(0.186)		
Material deprivation x		-0.506^{**}			1.188^{***}
employed		(0.137)			(0.555)
Material deprivation x	-0.433^{***}				
civil union	(0.130)				
Material deprivation		0.340^{***}			1.535^{**}
x urban residence		(0.155)			(0.580)
Environment x	-0.262^{***}				
employed	(0.118)				
Environment x		-0.298^{**}	0.642^{**}		
urban residence		(0.106)	(0.164)		
Living in urban area	-0.0096	-0.195^{**}	1.129^{**}	0.159^{**}	-0.334^{**}
	0.0369	(0.0495)	0.0464	0.0245	0.119
Living in consensual	0.185^{***}	0.005	0.066	0.210^{***}	0.625^{***}
union	(0.0436)	(0.0671)	(0.0429)	(0.0359)	(0.0385)
Employed	0.236^{***}	0.328^{***}	0.133^{***}	0.276^{***}	-0.691^{***}
	(0.0404)	(0.0459)	(0.0446)	(0.0294)	(0.113)
Male	-0.184^{***}	-0.0485	-0.0819^{***}	-0.158^{***}	-0.236^{***}
	(0.0287)	(0.0371)	(0.0345)	(0.0344)	(0.0343)
Being very nervous	0.682^{**}	0.455^{**}	0.307^{**}	0.427^{**}	0.601^{**}
	(0.018)	(0.020)	(0.0185)	(0.012)	(0.022)
N	16266	14478	11225	22305	11582
Chi-2	5298.4^{***}	3737.3^{***}	1783.8^{***}	3660.1^{***}	1666.4^{***}
Pseudo-R2	0.0892	0.0753	0.0442	0.0468	0.0504

Note: Robust standard errors are given in parentheses - *** - < 0.01, ** - < 0.05, * - < 0.10.

The results show the diverse impact of each dimension on the overall life satisfaction of the respondents. First, the deprivation in education and environment comprising noise, pollution, and crime indicators are relatively less correlated with the life satisfaction of respondents. The negative association of being deprived in education with life satisfaction is stronger for employed individuals in Belgium, Bulgaria, and Greece. Living with a partner (i.e., in a consensual union) and being male has mixed implications for different countries. These factors weaken the negative correlation of being deprived in education with subjective well-being in some countries (e.g., Bulgaria and Romania, respectively) and strengthen it in others (e.g., Germany and Cyprus, respectively). Spatial differences play a somewhat significant role in the correlation of education deprivation with subjective well-being; those living in densely populated areas report lower satisfaction compared to those living in less densely populated areas. This could be related to the fact that high-density areas are usually cities where the main employment opportunities are clustered, and being deprived in education represents a disadvantage during the job search and in the participation in socio-political life.

Like education, deprivation in environment also has a weak, although significant correlation, with overall satisfaction for most of the sample. Small heterogeneity is observed in the correlation of environment deprivation with life satisfaction among different demographic groups. Those living in densely populated areas report lower satisfaction than those living in sparsely populated areas, probably due to higher noise and pollution concerns in the former.

In contrast, material and health deprivations have quite strong correlations with overall life satisfaction, although, for some population groups, the correlation is less adverse. For instance, employed people are less dissatisfied with life when suffering from material or health deprivations compared to non-employed. Moreover, males deprived in terms of health are

less satisfied with life compared to females, but only in Spain. The correlation of health deprivation with overall satisfaction is weakened by living with a partner; those in a consensual union are less affected by health deprivation. On the other hand, those living in a consensual union and materially deprived seem to suffer more in terms of satisfaction than those living without a partner. Those who are employed but are materially deprived have lower life satisfaction in Romania meanwhile the satisfaction is higher in Germany and Switzerland. Living in a densely populated (urban) area and being materially deprived mitigates the negative correlation of the latter with overall life satisfaction in Romania and Switzerland and aggravates it in Bulgaria. Finally, living in urban areas strengthens the negative association of health deprivation with overall satisfaction, except for Austria, and mitigates the negative association of material deprivation with life satisfaction, except for Bulgaria.

Subjective weights Based on the regression results, the subjective weights are derived from estimated coefficients. Firstly, weights for each population group are calculated based on the coefficients of main dimensions and their interactions with sociodemographic characteristics. Secondly, these weights are normalised so that their sum is equal to one. The mean subjective weights and standard errors (in brackets) are presented in Table 1.4. The mean values are calculated as averages of the coefficients of corresponding poverty dimensions across various groups taking into account both main coefficients and interactions with sociodemographic characteristics.

Table 1.4: Country means of subjective weights

Country	Education	Health	Material depr.	Environment
Austria	0.079	0.466	0.404	0.045
	(0.0285)	(0.0536)	(0.0262)	(0.0029)
Belgium	0.057	0.369	0.528	0.046
	(0.0047)	(0.0494)	(0.0437)	(0.0229)
Bulgaria	0.091	0.353	0.512	0.043
	(0.0499)	(0.0306)	(0.0248)	(0.0038)
Cyprus	0.092	0.290	0.592	0.026
	(0.0462)	(0.0764)	(0.1023)	(0.0024)
Germany	0.063	0.307	0.565	0.066
	(0.0289)	(0.0491)	(0.0254)	(0.0050)
Greece	0.135	0.359	0.473	0.033
	(0.000)	(0.000)	(0.000)	(0.000)
Hungary	0.095	0.376	0.496	0.034
	(0.0292)	(0.0897)	(0.0508)	(0.0313)
Romania	0.081	0.402	0.461	0.057
	(0.0178)	(0.024)	(0.0527)	(0.0307)
Slovak Republic	0.080	0.360	0.519	0.041
	(0.0577)	(0.0680)	(0.0187)	(0.0015)
Spain	0.111	0.325	0.564	0.0003
	(0.0216)	(0.0799)	(0.0699)	(0.0000)
Switzerland	0.018	0.350	0.521	0.111
	(0.0059)	(0.0714)	(0.1008)	(0.0368)

Note: The mean values are calculated as averages of the coefficients of corresponding multidimensional poverty dimensions across various groups taking into account both main coefficients and interactions with sociodemographic characteristics.

The subjective weights differ considerably from the equal normative weights (0.25) assigned to each dimension. Almost all countries attribute low importance to deprivation in education and environment not exceeding 0.12 for both dimensions. On the other hand, health deprivation plays a more important role in defining respondents' well-being. Respon-

dents attribute around 0.28-0.46 of the total weight to this dimension, with Austria giving the highest weight at 0.466. Material deprivation is the most important deprivation dimension according to the subjective weights (except for Austria) and has the largest impact on well-being. The highest weight attached to this dimension is 0.59 for Cyprus. Interestingly, the higher-income countries in the sample are more deprived in the education and environment dimensions compared to health and material deprivation dimensions (see Appendix 1.4 for country-specific poverty headcount ratios in deprivation indicators), however, the importance attached to them is not much different from that of the lower-income countries (Figure 1.1). In the same manner, the lower-income countries are more deprived in the material deprivation indicators, but the subjective weights assigned to these indicators do not differ substantially from those derived from higher-income countries.

Appendix 1.3 presents the group-specific subjective weights that will be used in the calculation of the subjective poverty index for these groups. Employed individuals, in general, seem to attach slightly higher importance to education level relative to the mean preferences, although the difference is quite small. Interestingly, they also attribute a smaller weight to health and a higher weight to material deprivation compared to the mean. The same tendency is also observed for those living with a partner (except for Hungary); they attach a lower weight to health deprivation, but the importance of material deprivation varies relative to the mean. A negligible difference is observed between males and females and those below and above 40 years old. Finally, the preferences for environmental deprivation do not differ noticeably among the groups.

Figure 1.1: Subjective weights attributed to deprivation dimensions for countries with different levels of income per capita

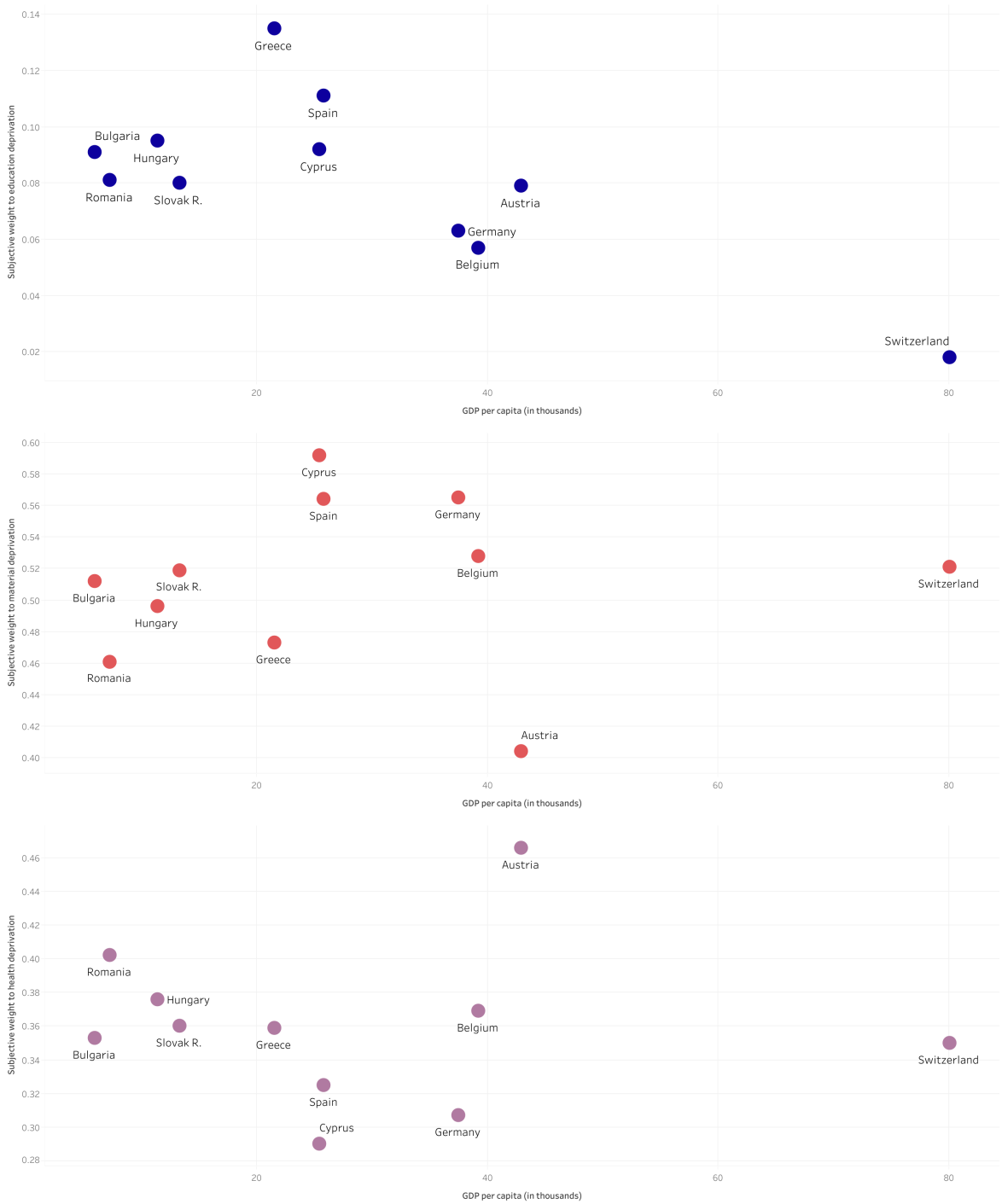


Figure 1.2: Subjective weights attributed to deprivation dimensions for countries with different levels of income per capita (cont-d)

1.4.2 Normative versus subjective MPI

Now we can proceed to the results of multidimensional poverty. Appendix 4 presents uncensored and censored headcount ratios per indicator for the countries in the sample, and readers interested in exploring these deprivations can be familiarised with those in Table 7. Table 1.5 summarises conventional MPI results with normative and subjective weights for $\alpha = 1$ and $\beta = 1$. Switzerland is found to have the lowest level of multidimensional poverty, while Romania shows the highest level of overall deprivation both in terms of normative and subjective weights, despite the latter being different from normative ones. The largest difference between the normative MPI and the subjective MPI is observed in Belgium, Cyprus, and Spain, with the subjective MPI being lower than the normative MPI (see Figure 1.3). The existence or absence of differences between normative and subjective MPIs has different implications. The population of the countries that have higher subjective MPI than normative MPI attributes higher importance to deprivation indicators/dimensions in which the population suffers the most in general. Regarding the countries in which the difference between the two MPIs is not observed, residents have given somewhat less importance (hence, smaller

subjective weights) to dimensions in which they are more deprived (for instance, education). This may be observed as a result of perceptions and aspirations of the deprived; the larger the deprived segment of the population in a given dimension is, the lower importance this dimension may have for them, because it is prevalent and hence not seen as a serious problem in the society. It is also to be noted that the subjective MPIs cannot be compared across countries, as the weights attached to each dimension are different. The main purpose is to reveal how the level of poverty of each country changes when population preferences are considered.

Table 1.5: Multidimensional poverty indices and poverty intensity indices with normative and subjective weights

Country	Normative MPI	Subjective MPI	Normative Intensity Index	Subjective Intensity Index	Headcount ratio
Austria	0.066	0.047	40.5%	28.4%	16.4%
Belgium	0.087	0.051	42%	24.7%	20.6%
Bulgaria	0.129	0.117	47.8%	43.4%	28.4%
Cyprus	0.112	0.072	43.1%	29.8%	24.2%
Germany	0.064	0.036	40.9%	23%	15.6%
Greece	0.126	0.102	43.9%	35.3%	28.8%
Hungary	0.108	0.094	45.5%	39.3%	23.8%
Romania	0.131	0.120	43.7%	39.3%	29.9%
Slovak Republic	0.055	0.038	42.8%	29.4%	13%
Spain	0.11	0.070	40.1%	25.4%	27.7%
Switzerland	0.046	0.022	39.5%	18.9%	11.7%

Note: The table presents the multidimensional poverty index (MPI) and poverty intensity index with two sets of weights, as well as a poverty headcount ratio – the share of population suffering in over three indicators. The MPI shows the weighted share of deprivations in which people suffer out of the total possible deprivations. The poverty intensity index shows the percentage of weighted deprivations suffered by the poor, and H indicates the share of the population who are multidimensionally poor.

The poverty headcount index (H) reported in the last column of Table 1.5 shows the

share of respondents deprived in more than 33% of weighted deprivations. The headcount ratio is the smallest for Switzerland and highest for Bulgaria, Greece, and Romania in line with the MPI findings. Almost one-third of the population of these countries is multidimensionally poor. Spain exhibits a slightly lower percentage, however the number is still high – more than one-fourth of the population.

Figure 1.3: Normative and subjective MPI across selected countries

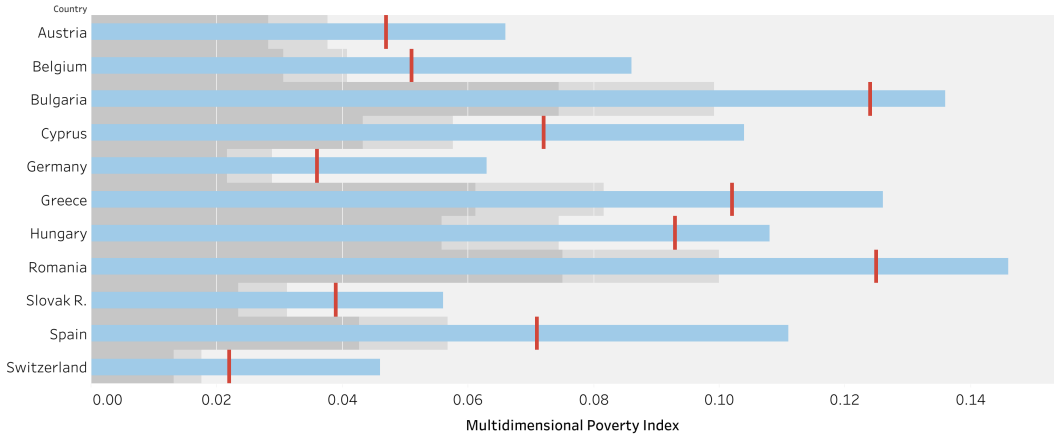
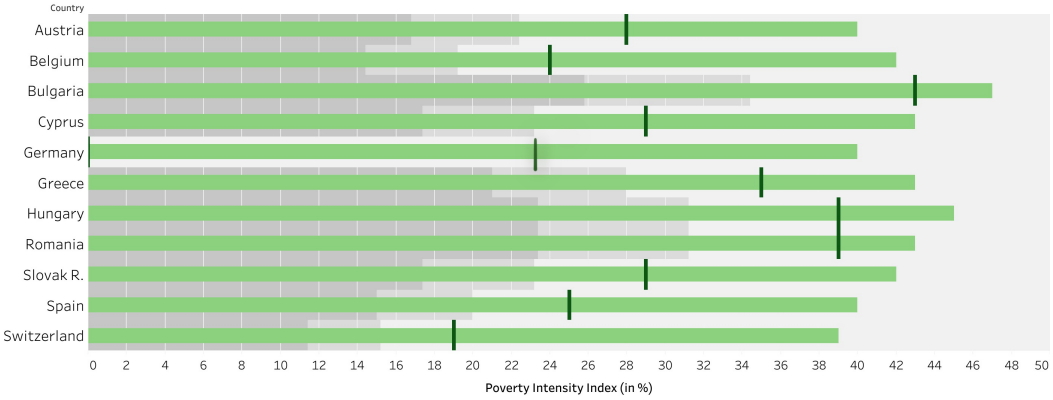


Figure 1.4: Normative and subjective poverty intensity index across selected countries



Note: The first chart shows the level of normative (blue bars) and subjective (red lines) MPI across selected European countries. The second chart shows the level of normative (light green bars) and subjective (dark green lines) poverty intensity index (A) across selected European countries.

The poverty intensity index (A) reveals more about the depth of multidimensional

poverty among the poor. Despite the low levels of MPI among the population, there is substantial poverty among the deprived in terms of its intensity. The average intensity of poverty is somewhat similar across the countries, despite the substantial differences in terms of the headcount poverty ratio index and MPI. On average, the underprivileged suffer in around 39-47% of the total weighted deprivations with normative weights, and the difference between the countries is not large. Second, the index is noticeably lower when calculated with subjective weights for all countries (see Figure 1.4). The differences are very large except for Bulgaria, Hungary, and Romania. The latter can be due to the higher subjective weights assigned to material deprivation and the high incidence of material deprivation in these countries. Overall, the intensity of poverty changes substantially, depending on the approach taken to assigning weights.

1.4.3 Normative and subjective MPIs with different levels of α and β

Conventional MPI and other poverty indicators reported above are suitable for obtaining a preliminary look at the living conditions of the poor in selected countries. However, those indicators are not able to reveal how deprivations are distributed within a population in general and among the poor in particular. This section presents the poverty indices measured with various levels of substitutability among poverty dimensions and aversion to inequality by appropriately calibrating β and α, respectively. It is useful to remember that higher values of β gives larger implicit weight on *dimensions* in which individuals are deprived the most, whereas higher α gives larger implicit weight to *population groups* that are deprived the most.

Table 1.6 presents the results for the MPI with normative and subjective weights. First, it confirms that the calculations have produced systematically lower values for MPIs measured with subjective weights compared to those measured with normative weights. It seems that

the subjective perception of poverty is not as high as the normative evaluation. Moreover, the difference between normative and subjective MPIs persists at all levels of α and β.

Second, the values of the MPI change drastically as the parameters of substitution between indicators and aversion to inequality are increased. For the higher-income countries in the sample, the observed values are almost five-fold, such as for Austria, Belgium, Germany, and Switzerland. This shows that the population in these countries is unequally deprived and that the differences in deprivation are substantial for different segments of the population. Still, lower-income countries in the sample show higher levels of multidimensional deprivation – the population on average suffer from almost half of the weighted deprivations when the degree of substitution between indicators is very low ($\beta = 5$) and the implicit weight assigned to the poorest is the highest ($\alpha = 5$). The largest values are observed for Bulgaria and Romania, followed by Spain and Hungary. Not only are the poor unequally deprived across the deprivation indicators, but the intensity of poverty is also substantially different among them. It is also noteworthy that the multidimensional poverty levels in the higher-income countries come very close to those in the lower-income countries in the sample, as both parameters are increased in the case of the normative-weighted MPI.

Table 1.6: MPI results with different levels of α and β

		MPI with normative weights			MPI with subjective weights		
Country		$\alpha = 1$	$\alpha = 2$	$\alpha = 5$	$\alpha = 1$	$\alpha = 2$	$\alpha = 5$
Austria	$\beta = 1$	0.066	0.167	0.309	0.047	0.126	0.264
	$\beta = 2$	0.092	0.228	0.401	0.064	0.165	0.313
	$\beta = 5$	0.123	0.306	0.531	0.097	0.242	0.424
Belgium	$\beta = 1$	0.087	0.195	0.341	0.051	0.127	0.263
	$\beta = 2$	0.119	0.264	0.434	0.0762	0.175	0.318
	$\beta = 5$	0.158	0.349	0.564	0.122	0.270	0.442
Bulgaria	$\beta = 1$	0.129	0.264	0.429	0.123	0.247	0.418
	$\beta = 2$	0.175	0.332	0.505	0.149	0.291	0.468
	$\beta = 5$	0.220	0.415	0.614	0.187	0.358	0.548
Cyprus	$\beta = 1$	0.112	0.217	0.357	0.063	0.159	0.289
	$\beta = 2$	0.139	0.284	0.443	0.097	0.204	0.339
	$\beta = 5$	0.184	0.375	0.578	0.146	0.300	0.471
Germany	$\beta = 1$	0.064	0.165	0.310	0.036	0.102	0.234
	$\beta = 2$	0.088	0.226	0.404	0.054	0.144	0.284
	$\beta = 5$	0.118	0.300	0.529	0.088	0.225	0.406
Greece	$\beta = 1$	0.126	0.242	0.383	0.102	0.201	0.340
	$\beta = 2$	0.170	0.319	0.476	0.139	0.264	0.410
	$\beta = 5$	0.222	0.415	0.608	0.197	0.369	0.544
Hungary	$\beta = 1$	0.108	0.228	0.387	0.094	0.206	0.377
	$\beta = 2$	0.141	0.293	0.466	0.116	0.247	0.419
	$\beta = 5$	0.181	0.374	0.582	0.153	0.317	0.504
Romania	$\beta = 1$	0.131	0.268	0.422	0.120	0.241	0.412
	$\beta = 2$	0.194	0.347	0.507	0.162	0.298	0.469
	$\beta = 5$	0.249	0.443	0.629	0.217	0.389	0.567
Slovak Republic	$\beta = 1$	0.055	0.159	0.323	0.038	0.118	0.270
	$\beta = 2$	0.0754	0.211	0.399	0.049	0.145	0.309
	$\beta = 5$	0.099	0.276	0.512	0.065	0.188	0.384
Spain	$\beta = 1$	0.112	0.215	0.338	0.070	0.145	0.256
	$\beta = 2$	0.157	0.299	0.447	0.111	0.216	0.335
	$\beta = 5$	0.212	0.404	0.596	0.178	0.339	0.390
Switzerland	$\beta = 1$	0.046	0.138	0.282	0.022	0.752	0.194
	$\beta = 2$	0.065	0.192	0.375	0.341	0.107	0.242
	$\beta = 5$	0.089	0.260	0.498	0.058	0.172	0.346

Table 1.7: Poverty intensity (A) results with different levels of α and β

		A with normative weights			A with subjective weights		
Country		$\alpha = 1$	$\alpha = 2$	$\alpha = 5$	$\alpha = 1$	$\alpha = 2$	$\alpha = 5$
Austria	$\beta = 1$	40.5%	41.3%	44.4%	28.4%%	31.3%	38%
	$\beta = 2$	44.4%	56.1%	57.6%	39.4%	40.8%	45%
	$\beta = 5$	75.4%	75.7%	76.2%	49.6%	60%	60.9%
Belgium	$\beta = 1$	41.9%	43%	46.8%	24.7%	28.1%	36.1%
	$\beta = 2$	57.7%	58.1%	59.5%	37%	38.6%	43.6%
	$\beta = 5$	76.7%	76.9%	77.4%	59.2%	59.5%	60.7%
Bulgaria	$\beta = 1$	47.8%	49.5%	55.2%	43.4%	46.3%	53.8%
	$\beta = 2$	61.5%	62.3%	64.9%	52.4%	54.6%	60.2%
	$\beta = 5$	77.5%	77.9%	78.9%	66%	67.2%	70.4%
Cyprus	$\beta = 1$	43.1%	44%	47.4%	29.9%	32.3%	38.4%
	$\beta = 2$	57.3%	57.7%	58.9%	40.1%	41.4%	45%
	$\beta = 5$	76%	76.2%	76.7%	60.5%	61%	62.6%
Germany	$\beta = 1$	40.9%	41.8%	45%	23%	26.1%	34%
	$\beta = 2$	56.9%	57.2%	58.6%	34.9%	36.5%	41.2%
	$\beta = 5$	75.9%	76.2%	76.9%	56.7%	57.2%	59%
Greece	$\beta = 1$	43.9%	45%	49.2%	35.3%	37.5%	43.6%
	$\beta = 2$	58.8%	59.3%	61%	48.2%	49.2%	52.6%
	$\beta = 5$	77.1%	77.4%	77.9%	68.2%	68.6%	69.8%
Hungary	$\beta = 1$	45.5%	46.8%	51.6%	39.3%	42.2%	50.2%
	$\beta = 2$	59.4%	60.1%	62.1%	48.8%	50.5%	55.8%
	$\beta = 5$	76.4%	76.7%	77.5%	64.5%	65.1%	67.2%
Romania	$\beta = 1$	45.8%	47.4%	53%	39.2%	42.6%	51.8%
	$\beta = 2$	60.6%	61.3%	63.7%	50.6%	52.7%	58.9%
	$\beta = 5$	78.1%	78.3%	79%	68%	68.8%	71.3%
Slovak Republic	$\beta = 1$	42.8%	44%	48.5%	29.4%	32.6%	40.6%
	$\beta = 2$	57.8%	58.3%	60%	37.7%	40.3%	46.5%
	$\beta = 5$	76%	76.3%	77%	49.6%	52.2%	57.7%
Spain	$\beta = 1$	40.1%	40.9%	43.6%	25.4%	27.6%	33.1%
	$\beta = 2$	56.6%	56.8%	57.8%	40.2%	41%	43.3%
	$\beta = 5$	76.7%	76.8%	77%	64.2%	64.5%	65%
Switzerland	$\beta = 1$	39.5%	40.3%	43.3%	18.9%	22%	29.8%
	$\beta = 2$	55.9%	56.2%	57.2%	29.2%	31.2%	37.2%
	$\beta = 5$	76%	76.2%	76.5%	49.6%	50.4%	53.1%

The results in Table 1.7 present the poverty intensity index (A) with different values of the parameters. The values are much higher compared to the MPI, as these values show the distribution of deprivation only among the poor. Moreover, the intensity values are close to the normative-weighted and subjective-weighted MPI values calculated with higher values of α, which shows the consistency of the results. That is, when α is increased for the MPI, the values of the index approach the poverty intensity of the most deprived among *the population*, i.e., the multidimensionally poor. When α is increased for the poverty intensity index A, the value of the index approaches the poverty intensity of the most deprived among those who are *multidimensionally poor*.

The results are somewhat similar to those of the MPI. The values of the poverty intensity index calculated with subjective weights are consistently lower than those produced with normative weights, and the difference persists as the implicit weight assigned to the deprivations of the poorest becomes larger (as α becomes larger). This again implies that the underprivileged assign comparatively lower importance to deprivations that population is more deprived in because the incidence of the deprivation in the population is high and might not be perceived as problematic.

Another important observation is that the differences in values of poverty intensity indices are not large among countries in the sample in the case of the normative A. That is, the poor are equally deprived regardless of the economic performance of the countries in terms of income per capita, except for Switzerland. The figures become almost similar when the value of the aversion to inequality and substitution parameters is the highest, exhibiting a similar deprivation of the poorest in selected countries; they suffer from over 76% of total deprivations.

The values of the poverty intensity index increase less when the inequality of aversion is increased, however. The increase is smaller with normative weights – 4-6 percentage points.

There are approximately $12 - 13\%$ points in the case of the subjective poverty intensity scores. There are two implications of these results. First, the distribution of deprivations among the poor is not unequal; there are small differences in deprivation intensity of we look at all poor with different poverty intensity, and the poorest. Second, the intensity of deprivation is more unequally distributed once the population preferences are taken into account.

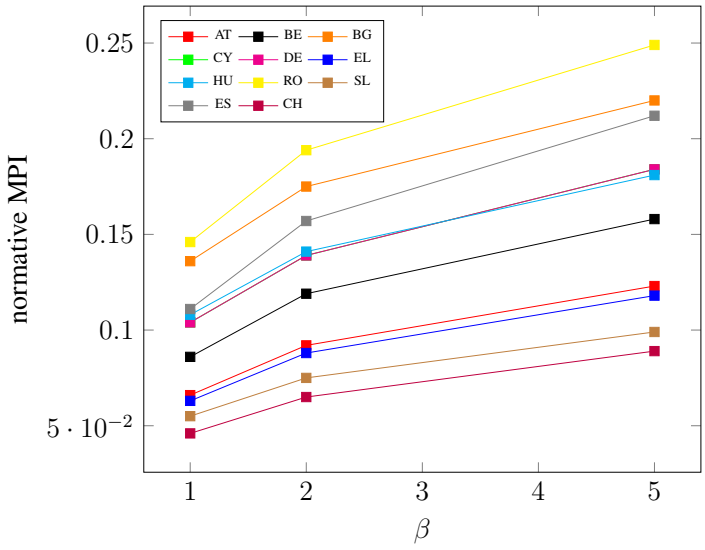
Figures 1.5-1.8 illustrate some of the findings. As observed, the lines for the countries are not steep and the differences are preserved across the values of β. This is an indicator of uneven deprivation across selected indicators in both countries. When the perfect substitution between the dimensions is retained and the aversion to inequality is increased (Figure 1.6), there is almost a parallel change in MPI levels except for Switzerland. This may imply that the inequality in the distribution of deprivations among the population is more or less similar, but not the depth (intensity) of deprivation.

The results are different when we only look at the sample of the poor represented by the poverty intensity index A (Figures 1.7 and 1.8). When the aversion to inequality in deprivation distribution across individuals is low, the poverty intensity index increase significantly across all countries, except for Austria, the line for some countries crossing. All countries converge to a similar level of poverty intensity index when β takes its highest value. That is, countries are unequally deprived across the dimensions, and higher values of β parameter emphasize that.

When the inequality aversion is taken into account, the lines representing the different levels of α are not steep, and the difference between the intensity scores of the countries are preserved at all three levels of the parameters. Only two countries' lines cross - Slovak Republic and Cyprus. The poverty intensity of the poorest in Slovak Republic is deeper than those in Cyprus, which is not seen when looking at the overall picture of the multidimen-

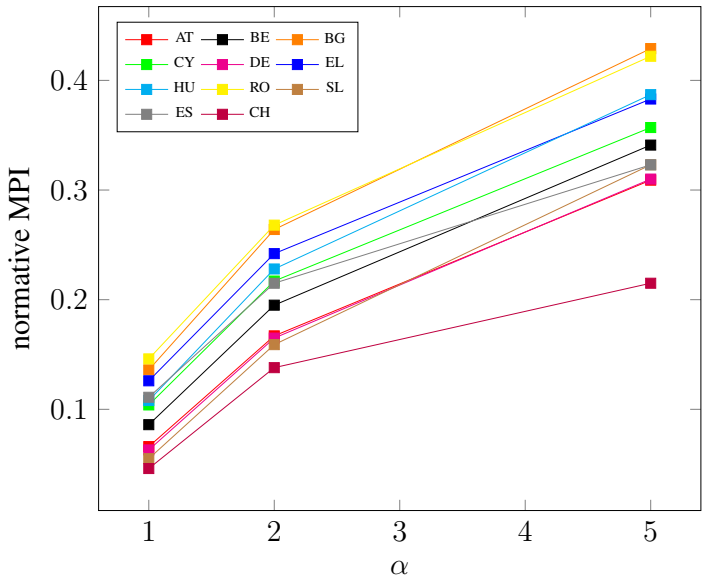
sionally poor ($\alpha = 1$).

Figure 1.5: Normative MPI at different levels of β when $\alpha = 1$



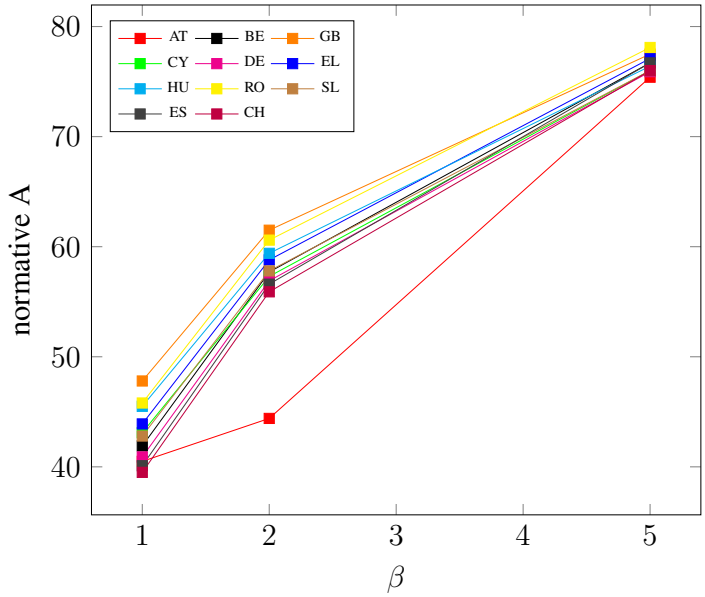
Note: AT - Austria, BE - Belgium, BG - Bulgaria, CY - Cyprus, DE - Germany, EL - Greece, HU - Hungary, RO - Romania, SL - Slovak Republic, ES - Spain, CH - Switzerland.

Figure 1.6: Normative MPI at different levels of α when $\beta = 1$



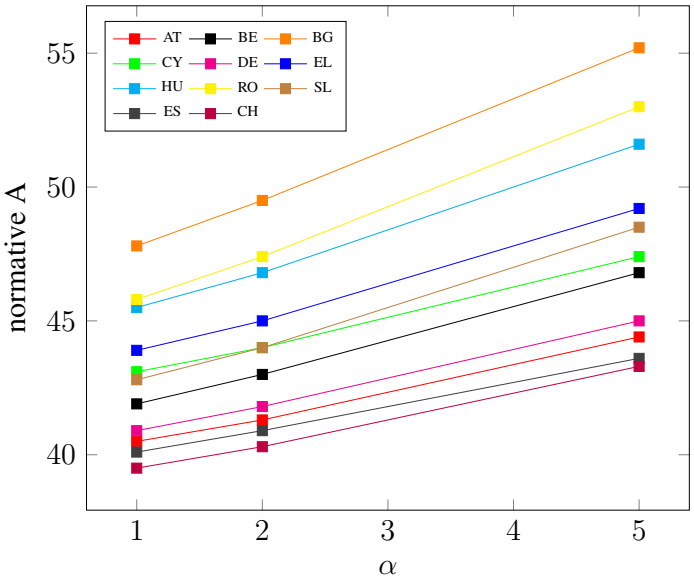
Note: AT - Austria, BE - Belgium, BG - Bulgaria, CY - Cyprus, DE - Germany, EL - Greece, HU - Hungary, RO - Romania, SL - Slovak Republic, ES - Spain, CH - Switzerland.

Figure 1.7: Normative A at different levels of β when $\alpha = 1$



Note: AT - Austria, BE - Belgium, BG - Bulgaria, CY - Cyprus, DE - Germany, EL - Greece, HU - Hungary, RO - Romania, SL - Slovak Republic, ES - Spain, CH - Switzerland.

Figure 1.8: Normative A at different levels of α when $\beta = 1$



Note: AT - Austria, BE - Belgium, BG - Bulgaria, CY - Cyprus, DE - Germany, EL - Greece, HU - Hungary, RO - Romania, SL - Slovak Republic, ES - Spain, CH - Switzerland.

The results above show that higher-income countries have both a smaller share of multidimensionally poor individuals and lower levels of multidimensional poverty among the population. Despite this, the countries in the sample have a more or less similar intensity of multidimensional deprivation when only the sample of the poor is taken into account and normative weights are adopted. The differences emerge when population preferences are considered, i.e., subjective weights are adopted. This is an important implication emphasizing that the economic growth or mean income should in no case be seen as the sole determinant of a country's well-being, and the poverty analysis must systematically consider other indicators of the quality of life.

1.4.4 Decomposition of MPI

The above-mentioned results are interesting in terms of detecting the level of non-income deprivation within countries. However, it is important to reveal the contribution of each deprivation dimension in order to produce more focused policy implications. The decomposition of multidimensional poverty indices is carried out via the Shapley method, and the results for MPIs with normative and subjective weights are presented in Figures 1.9-1.10 for normative MPI and Figures 1.11-1.12 for subjective MPI (see Tables 8-9 in Appendix 1.5 for various levels of α and β).

The dimensions of deprivation have a varying contribution in multidimensional poverty in selected countries, and the shares change as the inequality aversion parameter becomes larger (Figure 1.9 in Appendix 1.5). Education is responsible for the largest contribution to total deprivation – $44 - 57\%$ – in the sample. This means that if no one was deprived in education in the society (if everyone would have completed secondary education), the multidimensional poverty would be $44 - 57\%$ lower. The share becomes slightly smaller as the measure accounts for inequality in multidimensional poverty among populations in all

countries. This implies that the poorest suffer from education deprivation relatively less than the moderately poor, compared to other deprivation dimensions.

The share of material deprivation differs according to the economic development level of the sampled countries. Its share is around 10% or less in higher-income countries and relatively higher in lower-income countries, 20-27%. Interestingly, its share shrinks in lower-income countries and slightly increases in higher-income countries with the increase in inequality aversion when dimensions are perfectly substitutable ($\beta = 1$). That is, the poorest segments of the population suffer from material deprivation relatively less in the former group of countries and more in the latter group.

The share of deprivation in health does not vary significantly across the countries. It varies around 14-17%, being slightly higher in higher-income countries. The share merely changes when the aversion to inequality increases. This shows that there are no differences in the contribution of health deprivation to total deprivation in the group of moderately poor and the poorest, and these two underprivileged groups suffer from this deprivation equally in these countries in relative terms.

Environment deprivation has a sizable share in total deprivation as well. The share does not vary significantly; it contributes to 15-21% of overall poverty. There is a small increase in its share as the focus shifts to the poorest segments in Germany and Switzerland, where environment deprivation contributes to almost one-third of the deprivation of the poorest.

Figure 1.9: Shapley decomposition of the normative multidimensional index when $\alpha = 1$, $\beta = 1$

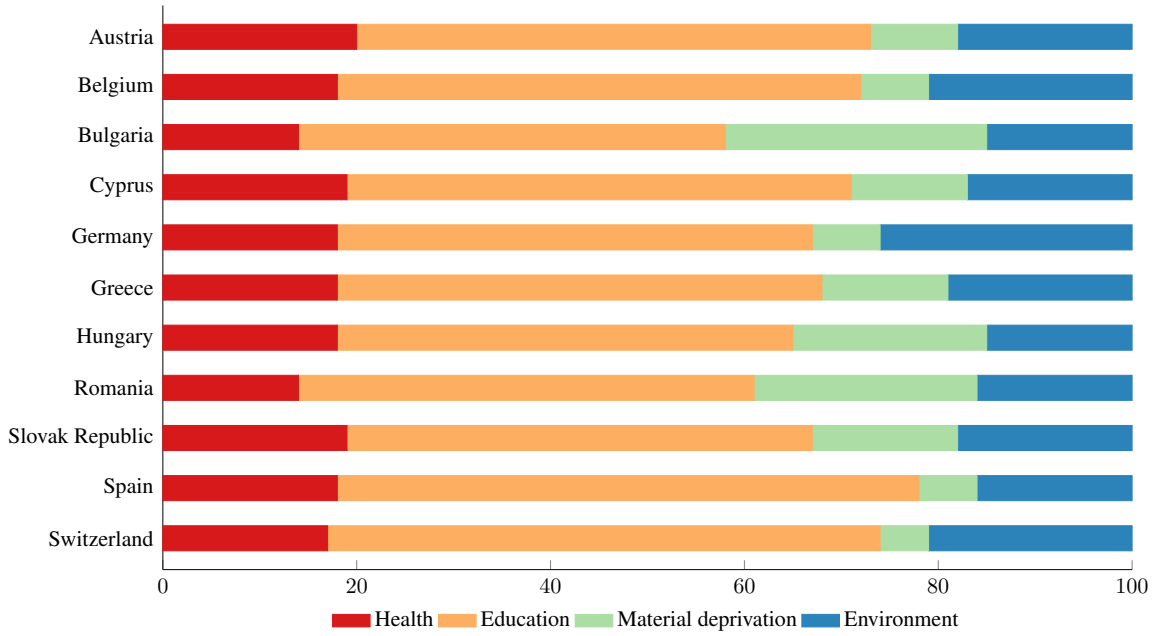
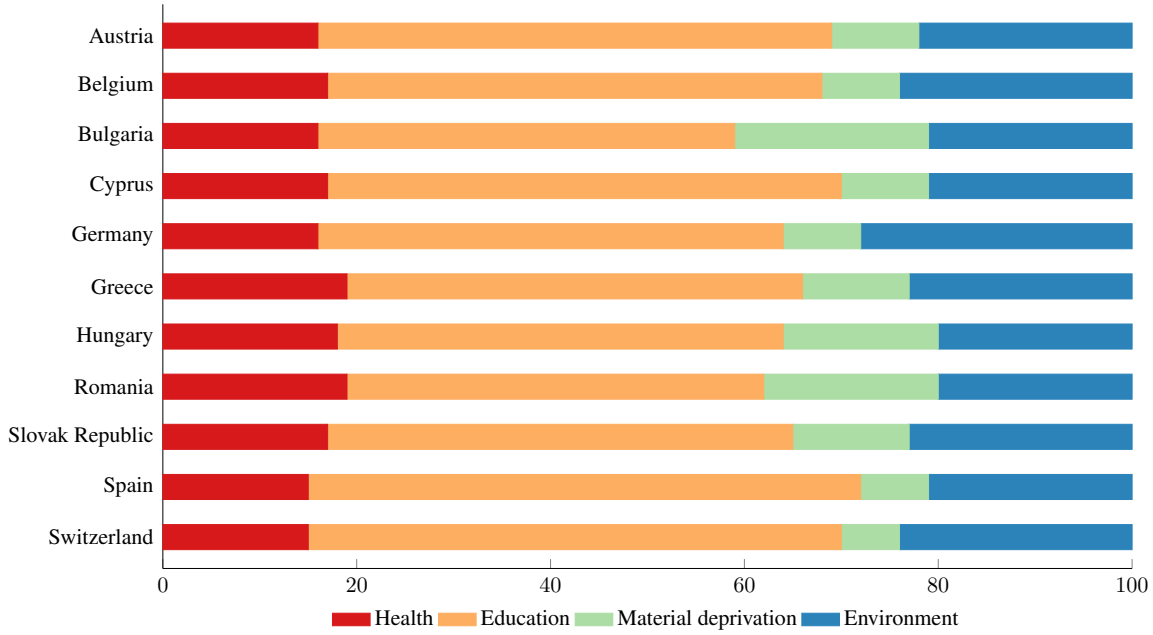


Figure 1.10: Shapley decomposition of the normative multidimensional index when $\alpha = 5$, $\beta = 5$



The increase or decrease in the share of each deprivation is even stronger when the sub-

stitutability of poverty dimensions becomes weaker (Appendix 1.5, Table 8). The share of education deprivation in the total deprivation becomes larger when the value of β becomes larger. The reverse is true for the contribution of other dimensions – as the degree of substitution between dimensions becomes smaller, their shares decrease in all the countries in the sample. This can be interpreted such that the education dimension with the increasing share is the dimension from which the poor suffer the most, while other deprivations are experienced relatively less by the multidimensionally poor. This can also be seen from Table 10 that shows a positive relationship between β and relative contribution of education deprivation to total deprivation, and negative relationship with the other two deprivation dimensions. The relative contribution of environment dimension at higher values of β differs between higher-income and lower-income countries for the normative MPI; it is increasing for higher-income countries, but decreasing in lower-income countries at larger values of β.

The contribution of each deprivation dimension changes significantly when calculated with subjective weights, as presented Figures 1.11 and 1.12 (also Appendix 1.5, Table 9 for the full set of results). The contribution of education is significantly smaller compared to when the MPI is measured with normative weights for all countries, and it decreases as the aversion to inequality in deprivations is increased. In contrast, the shares of health and material deprivations are substantial; in lower-income countries, the contribution of material deprivation ranges from 40% to 60%, whereas in higher-income countries, the health deprivation contributes to $40 - 55\%$ of the total deprivation. The contribution of environment deprivation is the smallest, except for Switzerland, which is expected given the small subjective weight attached to this dimension.

Table 9 presents the decomposition results for various levels of β and α, correspondingly. The shares vary with the degree of substitution between deprivation dimensions as well. It shows that the share of education and environment deprivation in total deprivation

increases when $\beta = 2$ and $\beta = 5$, and $\alpha = 1$. This implies that education is the deprivation dimension in which the poor suffer the most. It is not surprising when the uncensored and censored headcount ratios in this deprivation dimension are taken into account. The contribution of environment deprivation also increases, especially for those where the contribution was already sizable, i.e., Germany and Switzerland. In contrast, the shares of material deprivation and health decrease to around 5-20% and 14-20%, respectively, depending on the country. This correlation between β and the relative share of deprivation dimensions is presented in Table 10 as well; the relative contributions of education and environment dimensions increase with β, whereas the opposite is true for health and material deprivations.

The relative contribution of deprivation dimensions to total multidimensional deprivation changes differently as the inequality aversion parameter (α) increases, and the focus is shifted to the poorer segments. The contribution of education deprivation shrinks similarly to that when it is measured with the normative MPI. In contrast, the shares of health and material deprivations in total deprivation increase with α. However, there are some exceptions. For instance, Germany and Switzerland represent the largest contribution of health dimension to overall poverty, but this share decreases as α becomes larger. Bulgaria and Romania have the largest contribution of material deprivation to total multidimensional poverty in these countries, but its share also shrinks at larger values of α. Finally, the share of the environment deprivation merely changes or decreases slightly in the case of Germany. The results on Table 10 shows negative relationship between α and contribution of education deprivation, on one hand, and positive relationship with health deprivation and material deprivation, on the other. The results are mixed and insignificant for the environment deprivation.

Figure 1.11: Shapley decomposition of the multidimensional index with subjective weights when $\alpha = 1$, $\beta = 1$

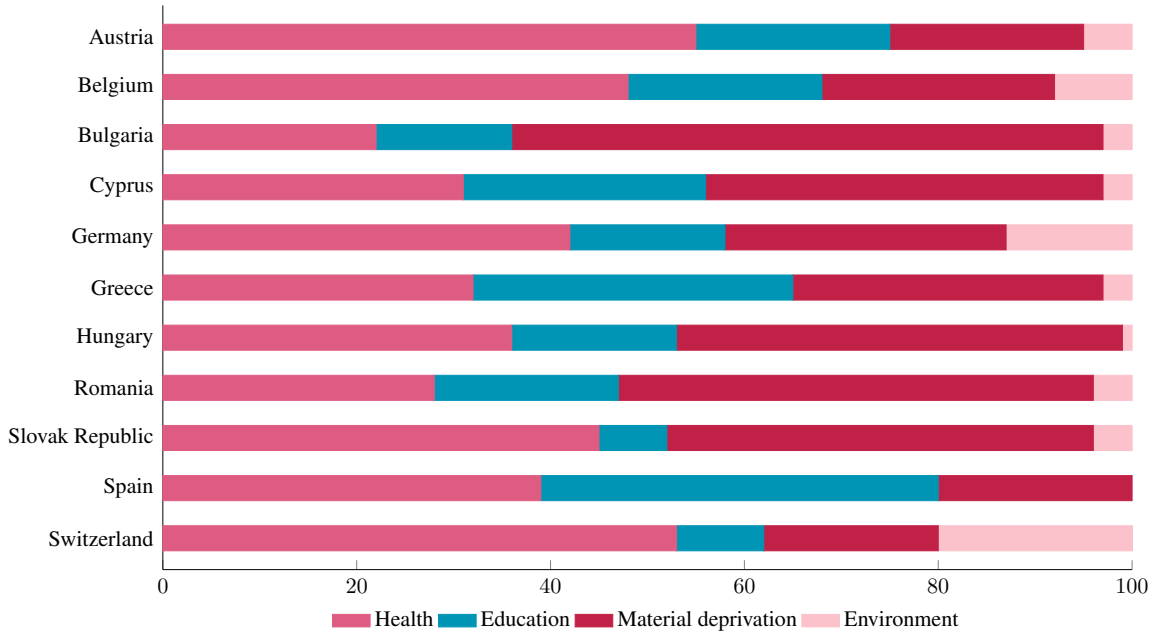
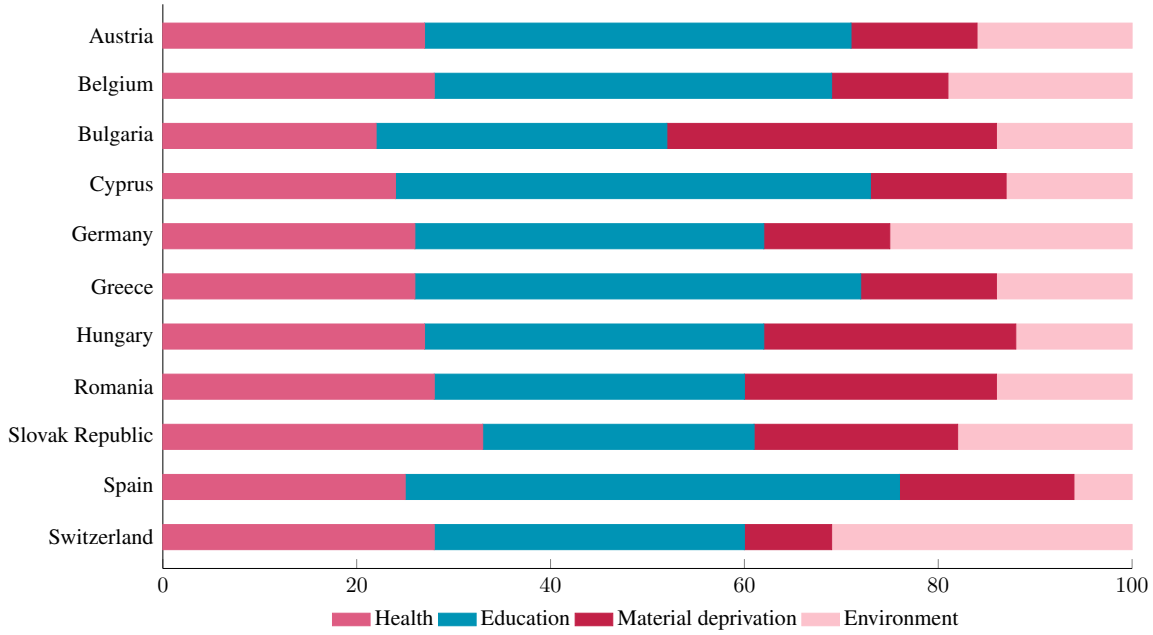


Figure 1.12: Shapley decomposition of the multidimensional index with subjective weights when $\alpha = 5$, $\beta = 5$



Overall, the decomposition results show that the contribution of each deprivation di-

mension to the overall deprivation varies depending on the weights used and the parameters of the deprivation function. The differences are observed between the moderately poor and the poorest, as well as when the normative vs. subjective preferences are adopted. However, one deprivation dimension has a higher prevalence among the poor regardless of the level of income per capita of the countries: education. Its contribution is larger when the poverty measurement is based on normative preferences.

1.4.5 Overlap between income poverty and multidimensional poverty

The purpose of building multidimensional poverty indices is to capture the deprivation of individuals not represented by income or consumption poverty measures. For this purpose, it is important to examine to what extent the two poverty measures overlap, and whether the multidimensional poverty index is necessary for capturing the full picture of the deprived. The income poverty measure is represented by the at-risk poverty index measured as the percentage of those falling below the 60% of median equivalised disposable income[2]. The multidimensional poverty is represented by the headcount ratio index reported in Table 1.5. The overlap between the two indices is calculated as the share of those who are simultaneously income and multidimensionally poor in the population.

[2]The labour market information in the dataset pertains to the period one year before the date of interview. Hence, the previous year's equivalised disposable income is used as a proxy for this year's equivalised disposable income, and the interpretation of the results must take that into account.

Table 1.8: Overlap between income and multidimensional poverty

Country	Income poverty headcount ratio	Income and multi-dimensionally poor	Income poor, not multidimensionally poor	Multidimensionally poor, not income poor
Austria	16.4%	3.9%	10.5%	12.5%
Belgium	14.9%	6.6%	8.3%	13.9%
Bulgaria	19.8%	12.9%	7%	15.5%
Cyprus	15.2%	6.4%	8.8%	17.8%
Germany	14.6%	4%	10.6%	11.6%
Greece	23.1%	9.7%	13.4%	19.1%
Hungary	13.4%	7.4%	6.3%	16.4%
Romania	22.2%	12.4%	9.8%	19.5%
Slovak Rep.	12.7%	3.7%	8.9%	9.3%
Spain	19.9%	7%	12.9%	20.7%
Switzerland	14.9%	3.3%	11.5%	8.4%
Average	17.1%	6.4%	10.7%	15.1%

Note: The table presents the share of respondents considered poor under two different criteria. The third column shows the share of respondents who are both income and multidimensionally poor - the share is calculated from the total population of each country (with non-missing information on their multidimensional poverty status). The fourth and fifth columns present the share of respondents who are poor under one criterion, but not poor under the other.

The overlap between two poverty indices is given in Table 1.8 (third column). The share of individuals who are both income poor and multidimensionally poor varies significantly between the countries. The largest overlap is observed for countries with the highest multidimensional poverty headcount ratio: Bulgaria, Greece, and Romania. In these countries, the portion of multidimensionally poor among the population is higher than those who are poor according to the income poverty index (Table 1.8, second column). The large overlap can be due to the higher prevalence of material deprivation in the latter group of countries, as this deprivation dimension is more closely related to the income of individuals (Sevinc, 2020) compared with other deprivation dimensions or indicators. The smallest overlap is in Switzerland. This is not surprising given that only the share of the multidimensionally poor is much smaller than the income poverty share.

These results, once again, show that the measurement of multidimensional poverty is important for capturing aspects of human deprivation not represented by the income or consumption of individuals. These monetary indicators capture the short-term welfare of individuals and may be prone to seasonal variations (depending on the source of income), temporary shocks, or measurement errors. Non-income or non-consumption indicators of welfare, such as material deprivation or health, can represent the long-term earning capacity or access to specific services. That is why it is important to present a fuller picture of poverty by reporting both poverty indicators.

1.5 Conclusion

The paper aimed to conduct a comparative analysis of multidimensional poverty in selected European Union countries. It addresses several shortcomings of existing multidimensional poverty indices (MPI) in terms of normative vs. subjective weights, calibration of the degree of substitution between dimensions, and various degrees of aversion to inequality in the distribution of deprivation. The multidimensional poverty index is constructed with four dimensions of deprivation: education, health, material deprivation, and environment and utilises the 2013 cross-sectional wave of EU-SILC dataset for 11 countries with respondents above 18 years old.

Subjective weights are calculated from the estimation of life satisfaction regression, weights being proxies for population preferences. The results of the life satisfaction regression show that respondents' overall life satisfaction is mainly associated with health and material dimensions of deprivation, whereas the correlation with education and environment deprivation is rather small. Some heterogeneity is observed in this regard among different sociodemographic groups, that is incorporated into the calculation of subjective weights.

The MPI calculations produce interesting results. Higher-income countries in the sample have lower levels of multidimensional poverty in terms of average weighted deprivation and the share of the multidimensionally poor. Interestingly, the average intensity of poverty among the poor (measured by the intensity index) is more or less similar among the sampled countries when normative approaches to weighting are adopted. This implies that the poor are equally deprived in terms of intensity, regardless of the income per capita level of the countries of the sample, although the share of multidimensionally poor is much higher for countries with relatively lower levels of economic development.

The image of the poor changes depending on the weights used; the subjective weighting produced systematically lower deprivation levels for all countries, both in terms of the MPI and the poverty intensity index. The difference is larger when we look at the poverty intensity index that measures the average multidimensional poverty among the poor. That is, the poor do not see themselves as deprived when their preferences are considered.

The calibration of the poverty index for different degrees of substitution between dimensions, and the aversion to inequality, provides more insight into the multidimensional deprivation among respondents. Decreasing the degree of substitution increases the poverty index drastically for all countries, implying that respondents are unequally deprived across deprivation dimensions in selected countries. This can also be seen when the focus is on censored headcount ratios per each deprivation indicator. Moreover, the higher the aversion to inequality is in the distribution of weighted deprivations, the higher the level of deprivation is, both in the case of the multidimensional poverty index and the poverty intensity index. This illustrates the unequal intensity of multidimensional poverty among populations, on one hand, and among the poor, on the other.

The Shapley decomposition of the poverty index shows the contribution of each dimension of deprivation in total deprivation. The difference in the contribution of each dimension

in the case of normative- and subjective-weighted indices is noteworthy. For instance, education has a large contribution to overall poverty in the case of normative-weighted MPI, but its contribution is much smaller in the case of subjective-weighted MPI due to a smaller subjective weight on education. In contrast, material and health deprivations contribute less concerning the normative-weighted MPI and have a higher share in the total deprivation in the case of subjective-weighted MPI, accounting for almost 70% of total deprivation altogether. Environment deprivation has a relatively small share in total poverty, its contribution being even smaller in case of the MPI with subjective weights. The contribution of each dimension to overall poverty also varies with different values of α and β. However, one of them stands out at the dimension in which the poor are deprived the most – education. Its contribution increases with a lower degree of substitution between deprivation dimensions, regardless of the weights used. Given higher incidence of deprivation in this dimension in general, this problem requires special attention.

As can be seen, the modification of conventional multidimensional poverty indices bears large importance and presents a fuller picture of poverty. Although some contributions are easier to comprehend, others are more complex. For instance, the use of subjective weights gives us an opportunity to look at the deprivation level of respondents using their own attitude to well-being, the latter being proxied by life satisfaction data. It enables us to spot the differences in the perception of poverty by both policymakers and the poor. The calibration of the poverty index according to different levels of aversion to inequality provides insight into inequalities of how underprivileged individuals are multidimensionally deprived. On the other hand, the calibration of substitutability among deprivation dimensions does not seem to be practically useful. However, it plays a significant role when it comes to the decomposition of the poverty index. For example, it gives us insight into which deprivation dimension contributes to overall multidimensional poverty the most, and how the share of dimensions in total deprivation varies for different segments of the poor (moderately poor

vs. the poorest).

Several implications can be drawn from the findings. First, multidimensional poverty is observed both in countries with higher and lower levels of income per capita in the sample, with the latter being more deprived overall. Despite improvements in living conditions of the poor, the problem is noteworthy. Second, the similar levels of intensity of poverty among the sampled countries with normative weighting show that the countries with higher income have not fully achieved the prosperity for all, although the share of the poor is significantly lower compared to other countries. That is, the representation of a country's welfare level with monetary indicators only is by no means sufficient for judging its development, and the measurement of poverty in a multidimensional setting must be conducted complementarily. This is also confirmed by the small overlap between income poor and multidimensionally poor. Third, the consideration of population preferences changes the image of the deprived. The poor are not as poor when their subjective preferences are taken into account, and they attribute varying importance to each deprivation dimension. This information can help to reveal which deprivations the population considers the most important and where the resources must be directed to improve their welfare. Last, the information from the various contributions of each deprivation dimension to overall poverty can assist us in developing more targeted policies to tackle multidimensional poverty. For instance, given the high contribution of education to the overall deprivation of the poor, specific policies may be developed to reduce the drop-out rates from the secondary education level. As education is important for further labour market performance, these policies may be able to tackle both multidimensional and income poverty simultaneously.

Chapter 2

Measuring the circumstance poverty in Portugal: who are the worst off?

2.1 Introduction

The comprehensive measurement of human deprivation has become one of the central issues of welfare economics in recent decades. Although providing a consistent and comparable means for assessing poverty, traditional methods of deprivation measurement via income or consumption present a limited view (Nolan and Whelan, 2010); hence, the measurement must go beyond this aspect of welfare. First, income or consumption can inform policymakers about the command over some material resources, but not the level of effort individuals must exert to obtain those resources. For instance, these monetary measures alone do not provide any information on how many hours individuals must work to earn a certain level of income and disutility they get from working.

Moreover, the existing literature rarely takes into account individual preferences while measuring the welfare or deprivation level of individuals. Even when poverty measurement

includes other deprivation dimensions alongside income (Alkire et al., 2015), each dimension is deemed equally important, and the measure is not tailored to the preferences of the population. This approach conflicts with the Paretianity principle that calls for respecting individual preferences. Hence, the wellbeing or poverty measurement exercise merely becomes the assessment of command over resources, but not the satisfaction of needs, when preferences are not taken into account.

Given the two above-mentioned issues, using the income dimension alone does not provide any information about fair versus unfair inequalities in outcomes. In the context of poverty measurement, the question can be posed as a fair versus unfair shortfall from a certain level of income or consumption. The equality of opportunity literature (Roemer, 1998, Peragine and Ferreira, 2015) distinguishes two sets of factors affecting individuals' outcomes, although those factors are not independent of each other – circumstances, that an individual cannot control, thus cannot be deemed responsible for, and effort for which they can partially be held responsible for. The principle of responsibility requires that unfair inequalities due to circumstances must be eliminated, whereas inequalities due to responsibility characteristics are not unfair and can be left untouched (Fleurbaey, 2008, Fleurbaey and Maniquet, 2011). As looking at income or consumption level of individuals does not provide any information about the effort individuals exerted, it is not possible to distinguish fair from unfair inequalities in income or consumption, or shortfalls from a certain level of it.

This study is an attempt to solve these issues by estimating the poverty level in Portugal using specific welfare metrics. Given that individuals differ not only in skills but also in preferences, their welfare will be assessed over the bundle of net income and work (or leisure) hours by evaluating it in a counterfactual situation where everyone is assigned a budget with the same gross wage. As a result, it is determined whether individuals' implicit budget gives

them access to any bundle that is equivalent to some chosen poverty threshold bundle of net income and work hours. If individuals do not have access to that poverty threshold bundle, they are deemed poor.

This measure addresses several issues described above. First, it takes into account not only the net income of individuals but also the hours they work, hence, leisure time available to them. In this manner, it evaluates the ability of individuals to satisfy their need for goods and services, as well as to have decent time for rest and play (Nussbaum, 2000). Second, the construction of the poverty measure will utilise information on ordinal preferences of individuals, thus respecting one of the key principles of welfare economics – Paretianity. Third, the shortfall from the poverty threshold will be due to factors beyond individuals' control. These factors can include skill poverty, disadvantage due to tax-transfer policies or household composition. The literature often assumes or implies that skills or returns to work of individuals are mainly shaped by factors beyond individual's control, hence, cannot be deemed within their responsibility. Similarly, existing tax-benefit systems are mainly formed by factors beyond an individual's control. The view on the household composition is more controversial, as it is mostly deemed to be shaped by personal choices. However, given our sample of singles and lone parents, its inclusion in circumstances may be deemed appropriate. The poverty defined in this manner is defined as circumstance poverty, and poor are circumstance poor.

Another advantage of this poverty measure is that it allows for the incorporation of specific ethical priors to poverty measurement. It gives priority to the compensation principle that requires eliminating differences in outcomes of individuals with identical preferences (Fleurbaey, 1994), and ranks low-skilled agents as the worst off (Fleurbaey, 2008). Moreover, the choice of reference values affects the ranking of low-skilled individuals with different preferences. By treating differences in work hours of individuals either as a responsibility

or as luck characteristic, the measure specifies work-loving and work-averse poor, respectively. This can be seen as both an advantage and disadvantage of the measure, as it does not provide concrete guidelines for poverty measurement. However, it allows societies to tailor the measure to own ethical considerations, by choosing the specific value of the reference skill parameter, which presents a wider approach to measuring deprivation. The study also adopts an ethical approach to the consideration of work hours of single parents proposed by Maniquet and Neumann (2014), although this is not directly related to the construction of the poverty measure. Work hours of single parents are adjusted by considering the presence of non-adult children in their household and defining the time cost parameter of child-rearing. The latter reflects the social value of child-rearing.

The poverty measure is built using the concept of equivalent income or money-metric utilities. As extensively discussed by Preston and Walker (1999), and most recently by Fleurbaey and Maniquet (2018), the construction of money-metric utilities can accommodate the compensation principle without disregarding preferences. This measure has been increasingly used in the welfare assessment of individuals, be it the analysis of individual characteristics of the worst off (detailed below), welfare evaluation of tax reforms (Picchio and Valletta, 2018), or development of optimal taxation for individuals with various skill levels and preferences (de Frahan and Maniquet, 2016).

The empirical literature on this topic is newly emerging and scant. Some studies have incorporated individual preferences into poverty measurement with multiple dimensions; other studies, although not directly related to poverty measurement, have adopted a similar methodology to identify the worst off. The poverty measurement respecting individual preferences has been extensively studied and shown by Decancq et al. (2019) for the Russian data. The authors present theoretical foundations of poverty measures that can take into account individual preferences without violating fundamental axioms of poverty mea-

surement. By estimating preferences from satisfaction data, the study computes equivalent incomes with four dimensions of deprivation – education, health status, employment status, and housing quality, as well as equivalent income poverty rates by introducing group-specific poverty thresholds for each dimension. The authors also conduct the overlap analysis with unidimensional and multidimensional poverty measures, such as the counting approach. Ravallion (2017) calculates poverty rates using the US population survey data and adopting full income (potential net income earned by working full time) and equivalent income concepts. The latter two indicators include net income and leisure as deprivation dimensions. By assigning various threshold levels of leisure, and one threshold for net income, the author finds the significant impact of including leisure as a basic need while measuring poverty.

Other studies adopt methods more similar to the one used in the current study. Decoster and Haan (2015) adopt the egalitarian equivalence approach and estimate the welfare of married females using the German household survey data. The authors further their analysis by evaluating the characteristics of the worst and best off for stylised, as well as real-life, households. Carpantier and Sapata (2016) conduct an empirical exercise for the identification of the worst off by adopting both egalitarian equivalence and conditional equality approaches. By estimating group vs. individual preferences to be used in welfare evaluation of single adults in the US, the authors show that the two concepts of welfare measurement are consistent with theoretical considerations and produce expected characteristics of the worst off.

This study aims to contribute to the empirical literature introduced above. The poverty level is assessed among single individuals and single parents of the working age, i.e., 20-60 years old, in Portugal for the years 2017-2018. The study employs the EU-SILC dataset, that contains a rich set of labor market indicators, such as gross earnings, work hours, whether individuals work in more than one job, as well as different sociodemographic characteristics. The choice of Portugal is not a coincidence. It is one of the European countries with sizable

share of the population earning at or slightly above the minimum wage (Portugal et al., 2018), although the share of those earning below the 105% of minimum wage is among the lowest[1] Moreover, almost 10% of the working-age population experiences in-work poverty (Perista, 2019). Taking into account the work hours of individuals and their preferences may produce a more realistic picture of their deprivation incorporating the disutility of work. This is important to develop optimal policies for poverty alleviation, as income poverty reduction may be accompanied by a decrease in overall satisfaction. Hence, the first step for effective poverty alleviation policies is to determine the shortfall from the poverty threshold consistent with population preferences.

This paper is organized as follows. Section 2.2 presents the methodology for the application of the concept of egalitarian equivalence to poverty measurement, choice of threshold values of net income and leisure hours, and estimation method of preferences. Section 2.3 provides an insight into the sample used in the paper. The results of preference estimation and calculated poverty rates are presented in Section 2.4. This section also presents the overlap analysis of the poor under proposed poverty measures and other unidimensional and multidimensional poverty measures. Section 2.5 concludes.

2.2 Methodology

This section discusses the theoretical context used for poverty measurement among single individuals and single parents in Portugal with the consideration of individual preferences. The theoretical framework is built on Fleurbaey (2008) and Fleurbaey and Maniquet (2005; 2011; 2018). The model and welfare metrics to be used as a well-being measure are presented in the next subsection, followed by the construction of poverty indicators. Thereafter,

[1] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Minimum_wage_statistics.

adopted poverty thresholds for net income and leisure are provided with the elaboration on an ethical approach to the work time of single parents. Lastly, the estimation technique of preferences is elaborated on.

2.2.1 The theoretical framework: welfare measurement with preference heterogeneity

The model. Assume that the preferences of an individual $i \in \{1, 2, ...n\}$ are represented by $U(y_i, h_i, R_i)$ over the bundle (y_i, h_i) consisting of net income y_i, work time h_i (hence, leisure time $l_i = T - h_i$, T being total time endowment), and preference ordering R_i. Two individuals with similar R_i are assumed to have similar preferences. The preferences are differentiable, monotonic, and convex. The bundle is defined by restrictions $y \in \mathbb{R}_+$ and $h \in [0, 1]$. An individual chooses the bundle (y_i, h_i) to maximise her utility:

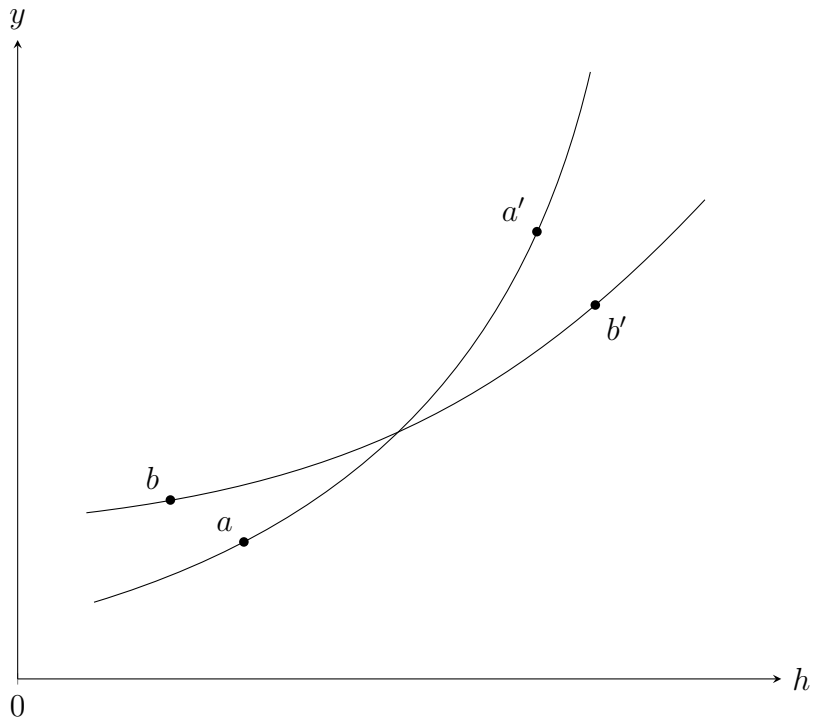
$$(y_i, h_i) = \arg\max[U(y_i, h_i, R_i)|\ y \leq f(w_i h_i + E_i)] \tag{2.1}$$

Here, $f(.)$ represents the tax-benefit system transforming labour income $w_i h$ and non-labour income E_i into net income y_i, and w_i is the gross wage of the individual. In this model, the differences in outcomes depend on preferences R_i, individual skills represented by wages, and non-labour income.

Given that individuals differ not only in preferences but also in skills (in our case, wages), it becomes a complex task to construct their welfare ranking in a consistent manner. For instance, as clearly illustrated and elaborated in previous works (Decoster and Haan, 2015, Decancq et al., 2015), there will be a conflict in ranking the welfare of two individuals with different consumption-leisure bundles and preferences. Figure 2.1 illustrates this com-

plexity. When bundles a and b are compared, b dominates a. On the other hand, the bundle $b^{'}$ is dominated by $a^{'}$. Given that, a and $a^{'}$ attain equal satisfaction as well as b and $b^{'}$, the inconsistency in rankings with dominance and Paretianity principles becomes clear.

Figure 2.1: Inconsistency of dominance and Pareto principles



In order to tackle this problem, several solutions have been proposed (Fleurbaey, 1994, Fleurbaey and Maniquet, 2011). These solutions give priority to two different dominant principles in the economic literature, and the choice of a specific solution entails certain ethical approach to welfare ranking of individuals. One of these principles is the natural reward principle, which states that no redistribution must take place between two individuals with identical circumstances, the latter represented by the wage parameter in our case. The second principle, the compensation principle, demands that any differences in outcomes between two individuals with identical preferences must be eliminated, and compensation must take place from a high-outcome to a low-outcome individual. It is shown in detail that

these two principles are inherently incompatible, although logically independent (Fleurbaey, 1994, Fleurbaey and Peragine, 2013); hence, the choice of a specific solution implies giving priority to a certain principle.

This study will adopt the egalitarian equivalence approach, giving priority to the compensation principle. It was previously proposed by Pazner and Schmeidler (1978) and elaborated by Fleurbaey (1995) for a pure exchange economy and enhanced for economies with production by Fleurbaey and Maniquet (2005, 2011). The compensation principle, and hence, egalitarian equivalence approach, are preferred in this context, because those give priority to individuals who are disadvantaged due to their circumstances, including low skills ("unskilled" as labeled by (Fleurbaey, 2008, p. 135) for any sub-population with a given set of preferences.

The egalitarian equivalence solution is built on defining a reference skill parameter and evaluating individual welfare at this reference value. That is, it assigns to all individuals an implicit budget $IB(w, R, z)$, at a specific value of the reference skill parameter w and computes an equivalent consumption-leisure bundle z', that gives the same satisfaction to individuals as their actual bundle (Fleurbaey and Maniquet, 2005). The actual bundle does not need to belong to the implicit budget, but this budget includes the equivalent bundle to which an individual is indifferent:

$$IB(w, R, z) = B(w, z') \text{ for any z' such that } z' I z \text{ and } z \in m(R, B(w, z')) \qquad (2.2)$$

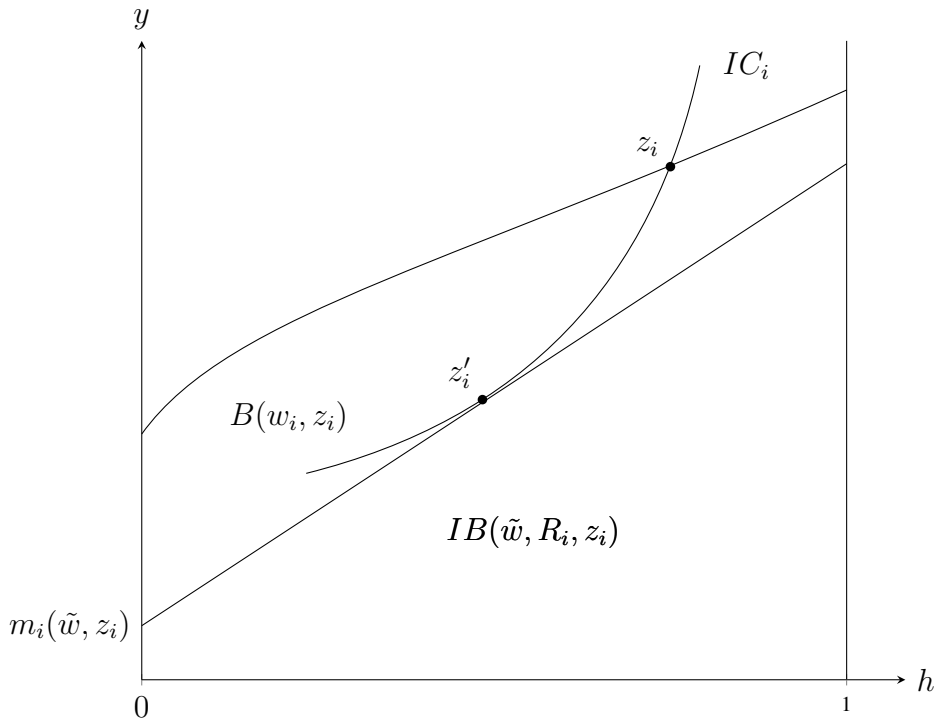
Here, $IB(w, R, z)$ denotes the implicit budget, and $m(R, B(w, z'))$ is the utility-maximising set of bundles for preferences R. Individuals are ranked by comparing their implicit budgets assigned to them at this reference skill parameter. For example, an individual A is better off

than individual B if their implicit budget includes the implicit budget of the other:

$$IB(w, R_b, z_b) \in IB(w, R_a, z_a) \tag{2.3}$$

Figure 2.2 illustrates the construction of an implicit budget. The implicit budget is the area below the budget line with the slope $\tilde{w}$ limited by the $h = 1$ vertical line, and $B(w_i, z_i)$ denotes the actual budget of an individual, such that z_i is on the frontier of the budget set. As can be observed, the construction of equivalent bundles is dependent on the shape of indifference curves of individuals, i.e., their preferences. In this case, the social planner aims at equalising the welfare of individuals by equalising budget sets faced by individuals but leaves the differences in welfare arising from preferences untouched. The reason behind it is that being on different implicit budgets is not due to different preferences, but because of the (lack of) access to specific consumption-leisure bundles. Compensating individuals by bringing everyone to the same implicit budget, the social planner eliminates differences in access to some consumption-leisure bundles, thus equalising the opportunity sets of individuals and eliminating unfair inequalities (Fleurbaey and Maniquet, 2005).

Figure 2.2: Construction of implicit budgets and money-metric utilities under egalitarian equivalence approach



In order to quantify the welfare of individuals and rank them consistently, the concept of money-metric utilities is employed. The money-metric utility is a monetary transfer that would allow individuals to reach their current level of utility when they choose to work an arbitrary number of hours at a chosen value of the reference skill parameter and have corresponding consumption level (Fleurbaey and Maniquet, 2018). In other words, it is the amount of transfer that makes individuals indifferent between their actual net income and leisure bundle and a hypothetical bundle that they would choose:

$$m_i(\tilde{w}; y_i, h_i) = \min\{t \in \mathbb{R} | y = t + \tilde{w}h, U_i(y, l) \geqslant U_i(y_i, h_i), 0 \leqslant h \leqslant 1, y \geqslant 0\} \quad (2.4)$$

Here, t denotes the monetary transfer, and $\tilde{w}$ is the reference wage level representing the slope of the implicit budget. Graphically, money-metric utilities can be presented as un-

earned intercept income ($m_i(\tilde{w}; z_i)$) in Figure 2.2.

The assignment of implicit budgets is based on the choice of the reference skill parameter, and the latter choice entails distinct ethical considerations. For instance, at close-to-zero values of the reference skill $\tilde{w}_i$, the disutility of work is disregarded; that is, the assignment of money-metric utilities does not take into account the differences in work hours. Hence, differences in consumption or net income due to differences in work hours are treated as unjustified. The choice of such values of the reference skill parameter gives priority to individuals with low skills and a higher aversion to work – those who do not work or work very few hours. Here, the money-metric utility will be equal to the intercept income at the reference skill parameter and zero work hours, also named the "unearned income metric" by Preston and Walker (1999).

Larger values of the reference skill parameter imply that differences in incomes due to different work hours are legitimate. That is, it is fair for one individual working more hours to receive a higher income compared to an individual with lower work hours, net income being proportional to work hours at a certain wage rate. These reference values give priority to those with lower work aversion, i.e. lower preference for leisure. Here, the money-metric utility will be equal to a transfer that deems individuals indifferent between their actual and equivalent bundles. This metric is also called the "consumption metric" by Preston and Walker (1999).

Figure 2.3: Choice of reference wage parameter and identification of the worse off

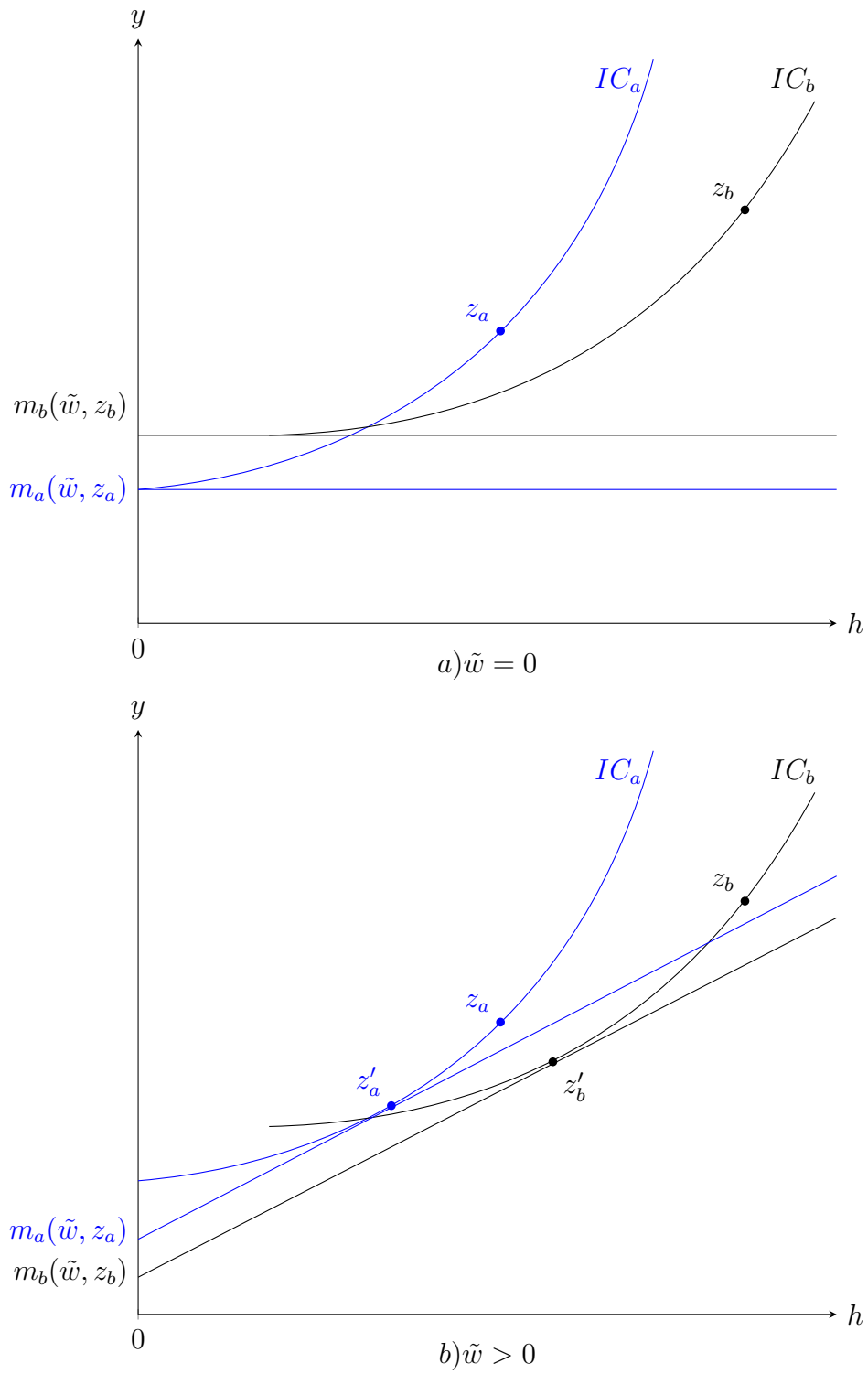


Figure 2.3 shows two individuals with different preferences for consumption and leisure. Individual A has a higher aversion for work, while individual B has a relatively lower aversion to work. z_a and z_b the actual bundles of A and B, respectively, and IC_a and IC_b represent their indifference curves. When the reference skill $\tilde{w} = 0$, the money-metric utility attributed to individual A is smaller than that attributed to individual B, and A is deemed worse off. In contrast, when $\tilde{w} > 0$, individual B is attributed smaller money-metric utility and deemed worse off.

After describing the theoretical framework and ethical priors incorporated, we can proceed to the construction of the poverty measure. The following subsection is devoted to this matter.

2.2.2 Identification of poor

We can now construct the poverty measure based on the notions of implicit budget and money-metric utility explained above. First, implicit budgets are constructed with a certain value of the reference wage parameter for individuals that contain a bundle equivalent to each individual's actual bundle. Second, we define the poverty threshold bundle of net income and leisure and construct bundles equivalent to the poverty threshold bundle. This equivalent bundle will depend on the preferences of individuals and will be specific to each one of them. Third, we determine if an individual is able to "afford" the poverty threshold equivalent bundle with their implicit budget, that if an individual's implicit budget contains some equivalent bundle that makes them at least as well off as the poverty threshold equivalent bundle. If individual cannot "afford" this threshold equivalent bundle of net income and leisure, i.e., their implicit budget does not include some equivalent bundle that makes them as well off as the threshold equivalent bundle, they will be deemed poor.

Formally, this condition can be presented as follows. An individual is poor if:

$$z_i^{'pov} \notin IB(\tilde{w}, R_i, z_i) \tag{2.5}$$

The evaluation boils down to comparing money-metric utilities of individuals with their actual bundles and with the poverty threshold bundle. We compare the monetary transfer needed for individuals to achieve their actual level of satisfaction with their equivalent bundle to the transfer they would need to achieve the satisfaction level if they would have had the poverty threshold bundle. An individual is poor if the amount of transfer needed to achieve her actual level of satisfaction is smaller than the transfer needed to achieve the satisfaction level with the poverty threshold bundle of net income (y^{pov}) and work hours (h^{pov}):

$$m_i(\tilde{w}; y_i, h_i) < m_i(\tilde{w}; y^{pov}, h^{pov}) \tag{2.6}$$

Figure 2.4: Individual A is poor under egalitarian equivalence approach

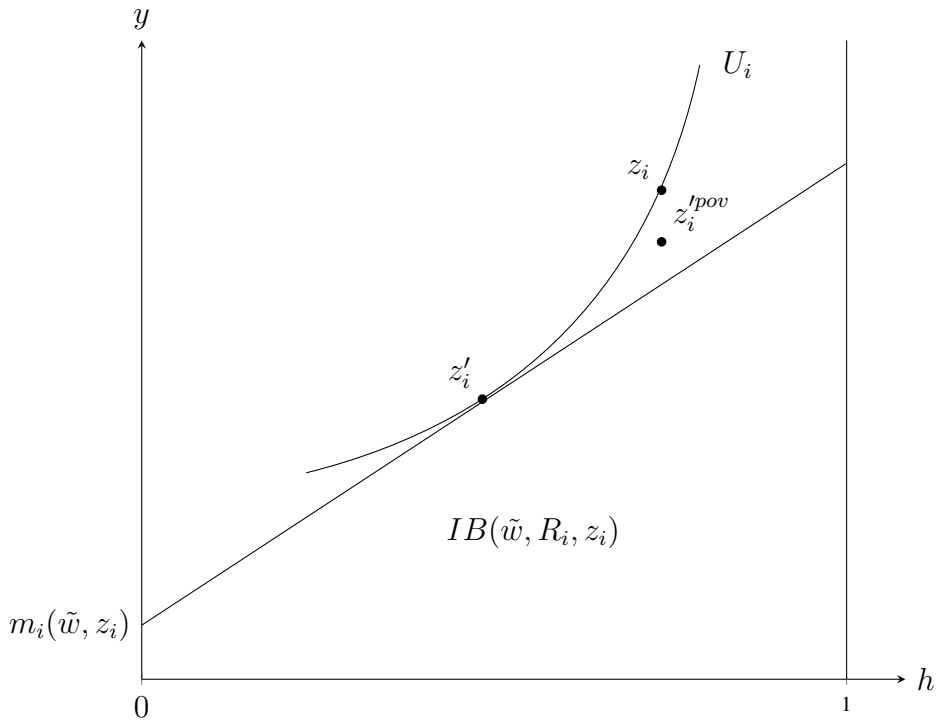


Figure 2.4 illustrates a situation when an individual is deemed poor. z_i and z_i' are individual's actual and equivalent bundles, respectively, and $z_i^{\prime pov}$ is the poverty threshold equivalent bundle. Regardless of her preferences, this threshold equivalent bundle is not attainable for her at a given value of the reference skill parameter which would imply that she is on a higher implicit budget. Her poverty status does not depend on her preferences, but other factors. Hence, this poverty is the *circumstance* poverty - an individual is deemed poor due to the factors beyond her control that do not allow her to achieve a certain minimum quality of life. Hence, this state of no access to a minimum quality of life is unjust and must be compensated for. Note that this approach aims to evaluate *the access* of individuals to a bundle, bringing at least as much satisfaction as some poverty threshold bundle, not *the possession* of that specific bundle. It is an important point if the preferences of individuals are to be respected.

The circumstances can include several factors. Those can be factors affecting the skill level of individuals, disadvantaged position due to tax-transfer systems or household size or structure. First two aspects belong to circumstances for obvious reasons. It has been widely discussed that the skills of individuals are formed by a multiplicity of factors throughout our life. Those are the result of the socioeconomic background of individuals, such as parental financial situation, education facilities individuals attend, their physical and mental health during childhood and adolescence, etc. (Hufe et al., 2017). These factors are usually deemed beyond the individuals' control and take place before they reach the adulthood. Similarly, the tax-benefit system is developed beyond an individuals' choices, hence, cannot be in their sphere of responsibility. The household composition is somewhat different. It can be the combination of individual choices (decision to have children and how many children) and other factors (pressure from spouse or partner, having older parents to care for, etc.). In fact, some authors have attributed this factor to the responsibility sphere (Checchi et al., 2016). In this study, it will be assumed that the household composition belongs to the circumstances of individuals, given the complexity of its nature, and the sample in the current study that is composed of single individuals, and single parents.

The application of the above concept to the poverty measurement addresses some of the existing problems encountered when poverty is measured via income or consumption alone. First, this measure considers not only income deprivation but takes into account the work hours needed to attain this level of income, hence, evaluating the ability of an individual to satisfy her need for goods and to have decent time for rest and play (Nussbaum, 2000). Second, it takes into account the preferences of individuals, which allows avoiding the largely criticised paternalistic value judgment used in poverty measurement (Decancq and Lugo, 2013). Last, but not least, the choice of specific values of the reference wage parameter allows for introducing ethical considerations to the measurement of individual deprivation. It enables us to distinguish the groups of poor with different preferences for work and develop

corresponding policy measures by calibrating the values of the reference skill parameter.

This approach fails to address one issue that is an important topic of discussion among economists and philosophers alike. It does not take into account the impact of circumstances on effort, stemming from the fact that the egalitarian equivalence uses the level of effort (Roemer and Trannoy, 2015) to construct equivalent bundles and compute money-metric utilities. The approach disregards that the distribution of effort can be specific to groups sharing similar circumstances (i.e., types) (Roemer, 1998) and assigns any impact of circumstances on effort to the responsibility sphere. This is in line with the approach of resource egalitarians (Dworkin, 1981a,b) who advocate for respecting individual preferences and acknowledge the difficulty of determining "pure" (i.e., decontaminated from the impact of circumstances) preferences of individuals. The issue can be partly addressed setting the reference skill parameter to $\tilde{w} = 0$ (i.e., zero egalitarian equivalence) that treats differences in work hours as luck, hence, beyond individual's responsibility (Maniquet and Neumann, 2014). It can help to take into account the correlation between responsibility characteristics of individuals and factors beyond individuals' control to some extent, whereas larger values of $\tilde{w}$ are more likely to disregard this correlation. In this case, the choice of the values of the reference wage parameter becomes an ethical and empirical issue at the same time; the impact of circumstances on the effort exerted may change from sample to sample, and this necessitates the development of robust methods. However, this issue is beyond the scope of the current study.

2.2.3 Choice of reference values of skill parameter

Two reference values of skill parameter will be adopted for constructing the poverty measure. Each choice will entail a certain approach to defining the worst off in the society and who is given priority in compensation. The poverty will be measured with the headcount poverty

index.

The first is the poverty index with money-metric utility at $\tilde{w} = 0$: this measure will give priority to the poor with higher work aversion and low earning ability:

$$P_0 = \frac{1}{N} \sum_{i=1}^{N} 1((m_i(0; y_i, h_i) < m_i(0; y^{pov}, h^{pov})) \tag{2.7}$$

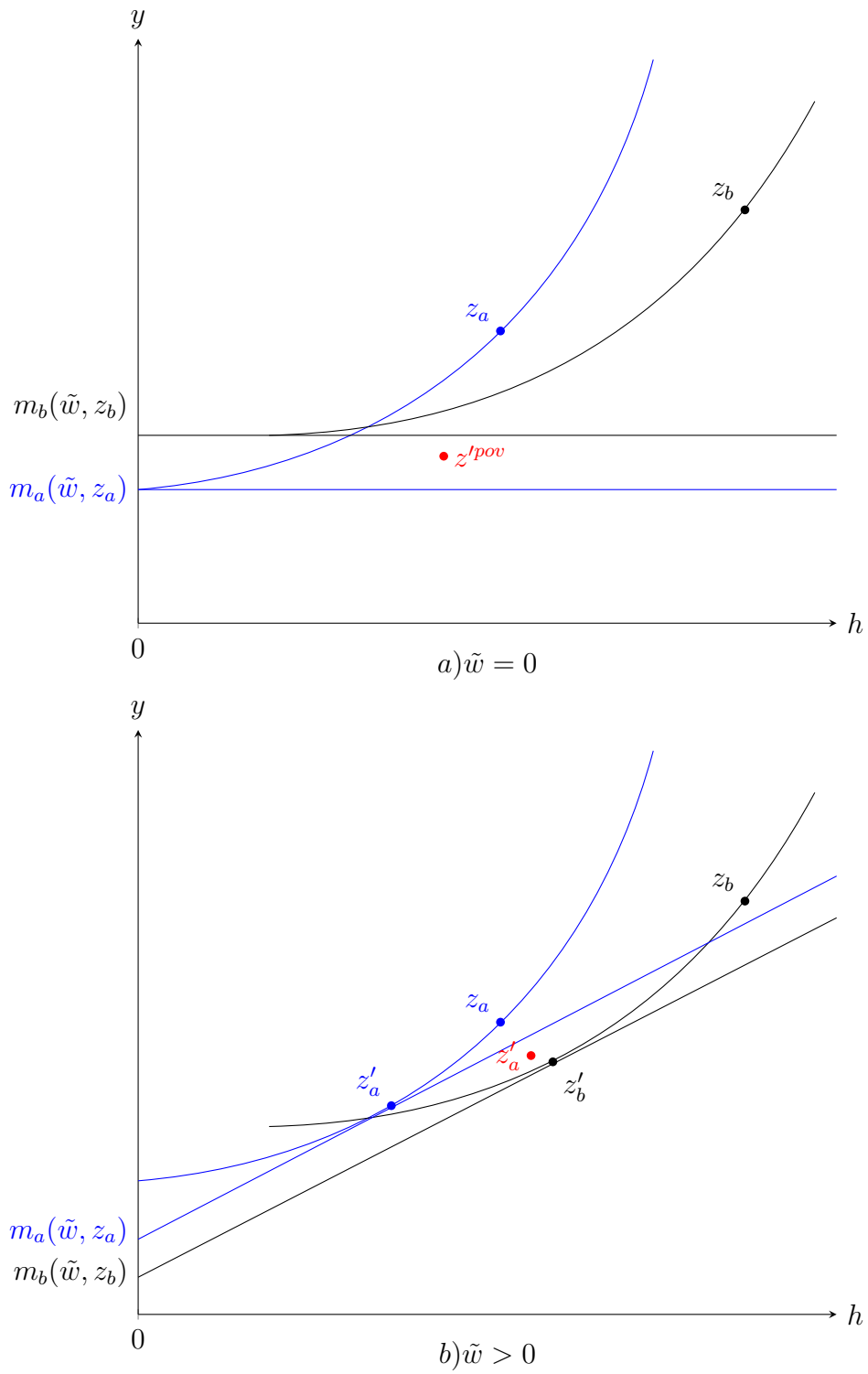
The second is the poverty index with money-metric utility at $\tilde{w} > 0$ represented by the average gross wage: the measure will give priority to the poor with lower work aversion and low earning ability:

$$P_{\tilde{w}} = \frac{1}{N} \sum_{i=1}^{N} 1(m_i(\tilde{w}; y_i, h_i) < m_i(\tilde{w}; y^{pov}, h^{pov})) \tag{2.8}$$

Here, N is the sample size.

The application of implicit budgets can be illustrated for individuals with different preferences in Figure 2.5. In Fig. 2.5a), individual A is more work averse, whereas individual B is work-loving. The former is deemed poor under $\tilde{w} = 0$, as her implicit budget does not include the equivalent poverty threshold bundle z_{pov} (assuming both individuals have the same equivalent poverty threshold bundle). That is, there is no equivalent bundle in her implicit budget that would give her at least as much satisfaction as the poverty threshold equivalent bundle. When $\tilde{w} > 0$, (Fig. 2.5b)), she is no longer deemed poor, as their implicit budget now also contains the poverty threshold equivalent bundle. The reverse can be observed for an individual B. She is not deemed circumstance poor under $\tilde{w} = 0$, but specified as such under $\tilde{w} > 0$.

Figure 2.5: Choice of reference wage parameter and identification of the worse off



The choice of certain values of the reference skill parameter ranks circumstance-poor individuals consistent with who is given priority. If both work-averse and work-loving individuals are defined as poor under the specific reference skill parameter, their ranking will accord with the specification of the poor explained above. Under $\tilde{w} = 0$, the work-averse poor are assigned smaller money-metric utility; hence, they are ranked lower compared to the poor with lower work aversion and make up the majority among the worst off. The larger the $\tilde{w}$, the smaller the money-metric utility assigned to the poor with a lower distaste for work, and the lower their ranking is.

2.2.4 Threshold values of net income and work hours

The poverty threshold values are specified both for net income and work hours. The threshold for net income is the at-risk poverty threshold defined as the 60% of median equivalised disposable household income. It is the official threshold used for measuring income poverty in European countries and corresponds to a monthly sum of 467.3 euros in 2017 and 501.2 euros in 2018 for Portugal. The threshold for work hours is 40 hours per week or 173 hours per month conditional on being employed (full-time or part-time). This value is close to the mean hours of work observed in the sample (38.4 hours overall and 39.4 hours conditional on being employed full time or part time) and to the reference value chosen by Ravallion (2017) for poverty analysis. Note that, these work hours include both the hours worked in the main job, and other jobs. In other words, this threshold allows us to see whether individuals can achieve a decent living standard by working full time given their work-leisure preferences.

As the sample includes singles and single parents (described more in detail in the next section), the study will adopt an ethical approach to defining the threshold level of work hours (or leisure) for this group. Single parents devote a large share of their time to child-rearing activities, and receiving professional help in this matter would require larger monetary re-

sources and, consequently, more work hours. Their ability to enjoy leisure time becomes more restricted compared to single individuals without children or couples with or without children. To do so, we will follow Maniquet and Neumann (2014). The adjustment will consider that single parents are constrained in their choice of work time, and their work time is not one-to-one equivalent to that of singles. There is a time cost c to child-rearing, and the equivalence will be guaranteed with a factor $1/(1 - cn_k)$, where n_k denotes the number of children below 18 years old of a single parent and c denotes time cost of child-rearing. The work hours of single parents are adjusted upwards as $h/(1 - cn_k)$, and h work hours of a single parent will be deemed equivalent to $h/(1 - cn_k)$ work hours of a single person with no children. As discussed by the authors, the value of the time cost parameter is not a real value, but an ethical choice; $c = 0.1$ implies that the time cost of child-rearing is relatively less valuable for society compared to $c = 0.2$. $c = 0$ corresponds to the case where the time cost of child-rearing is disregarded; the choice to have children and how many children is completely the responsibility of individuals, and their choice of fewer work hours cannot be justified. The study will adopt three values of the time cost $c = \{0, 0.1, 0.2\}$. As discussed above, positive values of c will imply differential treatment of single parents. The social value will depend on how large the time cost c is.

Some studies have discussed the impact of the limitations faced by single parents on personal welfare, although they do not specifically focus on this group. Couprie and Ferrant (2015) build a model of economies of scale of time use for single people vs. couples and show that singles, on average, require more leisure time to achieve the same utility as those who live with a partner and have similar preferences. The reason is that couples benefit from sharing household chores and saving up time to spend on "pure" leisure, whereas single individuals do not have this opportunity. Maniquet and Neumann (2014) apply time equivalence scale while measuring the welfare of households, ethically justifying this choice with the fact that couples with children need time to devote to child rearing, hence, more

leisure time compared to couples without children. In this case, the former might work less, not (at least directly) because of their preferences, but because they are constrained in their choice of work hours. The findings of both studies above imply that single parents require more time to take care of the household and child-rearing tasks, as well more free time to achieve a similar level of satisfaction, compared to single people, or to those who live with a partner and have children. So, the adjustment of their leisure time according to the number of their children can be ethically justified.

2.2.5 Estimating preferences: discrete choice model of labour supply

The crucial part of the study is to estimate preferences, as the construction of equivalent bundles is based on preference parameters of individuals. The study will use the structural discrete choice labour supply model. The discrete choice models of labour supply are shown to be as consistent as continuous choice models and was first introduced by Van Soest (1995). These models assume that individuals choose a consumption-leisure bundle among the finite number of discrete alternatives and allow for dealing with nonlinear budget sets (Aaberge and Colombino, 2018, Van Soest et al., 2002, Aaberge and Colombino, 2018). These models were largely used in welfare analysis by Bargain et al. (2013), Decoster and Haan (2015), and Picchio and Valletta (2018), among others.

The discrete choice structural model is a random utility model, where utility of individuals consists of the deterministic part $u(y_{ij}, h_{ij}, \nu_i)$ and unobserved discrete hours-specific error term ϵ_{ij}. Individual i supplies j among J alternatives, $j = \{1....J\}$:

$$U(y_{ij}, h_{ij}, \nu_i) = u(y_{ij}, h_{ij}, \nu_i) + \epsilon_{ij} \tag{2.9}$$

Here, ν_i is the vector of individual characteristics. The deterministic part of the utility func-

tion assumes the Box-Cox specification:

$$u(y_{ij}, h_{ij}, \nu_i) = \beta_y \frac{y_{ij}^{\alpha_y} - 1}{\alpha_y} + \beta_h(\nu_i) \frac{(1 - h_{ij})^{\alpha_h} - 1}{\alpha_h} + \beta_f \delta_i \tag{2.10}$$

Here, δ_i is the dummy that accounts for fixed costs of working. Following Van Soest (1995), we assume that, there are monetary or non-monetary drawbacks of working part-time, but the disutility emanating from those cannot be observed. Hence, the inclusion of such dummy is aimed to account for that.

Given that the purpose of the study is not to estimate the complex labour supply model, but to conduct poverty analysis with specific welfare metrics, this simple approach is adopted. Parameters β_y and $\beta_h(\nu_i)$ determine the marginal utility of net income and leisure $(1 - h)$, respectively, and α_y and α_h determine the concavity of the utility function. The observed heterogeneity is captured by the parameter $\beta_h(\nu_i)$ of leisure only, implying that we assume heterogeneity in preferences for leisure, but not for income:

$$\beta_h(\nu_i) = \beta_{h0} + \sum_{k=1}^{K} \beta_{hk} \nu_i \tag{2.11}$$

The vector ν_i includes various characteristics: age, education level, number of children specified separately for male and female parents, and health status of individuals. The estimation boils down to the well-known conditional logit framework, where we estimate the probability of choosing an alternative via the maximum likelihood analysis:

$$P_{ij} = \frac{\exp(u_{ij})}{\sum_{j=1}^{J} \exp(u_{ij})} \tag{2.12}$$

Given their preferences, individuals choose an alternative that gives them the highest utility, and this alternative will have the highest probability of being chosen.

2.3 Data and Sample

The study uses the 2017 and 2018 Portuguese cross-sectional waves of the European Union Statistics on Income and Living Conditions (EU-SILC). The EU-SILC gathers rich data on demographic, socioeconomic, and health characteristics, which allows us to include this information in the estimation of preferences. Income variables in the dataset pertain to the year before the interview is conducted, while the information on hours of work and gross monthly earnings, as well as household composition, are collected at the year of interview. Given that net incomes are required for estimating preference parameters over bundles of net income and work/leisure hours, as well as for computing equivalent bundles of individuals, current net incomes are computed by simulating gross monthly earnings via the appropriate tax-benefit simulator (For the calculation of hourly wages and net incomes, as well as for the information on the tax-benefit simulator, see Appendix A2.1 and Appendix A2.2, respectively).

The sample includes full-time employed, part-time employed, and inactive (excluding those who are inactive due to disability) singles with and without children of 20-60 years old. It does not include students, those in compulsory military service, self-employed, and unemployed. The study also excludes individuals with positive capital or investment incomes. The final sample used for the preference estimation and computation of money-metric utilities does not include some observations with negative disposable incomes as a result of tax simulations (Table 2.1).

Table 2.1: Selected sample for Portugal

Year	Sample size for wage estimation	Final sample size
2017	2567	2544
2018	3239	3218
Total	5806	5762

Note: The final sample size does not include those with capital or investment income, as well as inactive individuals with negative net incomes at zero hours choice point. See Appendix 2.2 for the detailed description.

Table 2.2 presents the distribution of work hours for males and females separately for single individuals and single parents. We construct six discrete choices of work hours: $j = \{0, 1-15, 16-30, 31-45, 46-60, > 60\}$. The work hours include total hours worked at all jobs, beyond the main one, when applicable (the latter sub-sample constitutes 3.24% of the total sample). The largest share of both males and females work around 31-45 hours–81.3% and 77.8%, respectively, followed by those working in the interval of 46-60 hours. The higher share of single women (1.18%), especially single mothers (7%) have worked zero hours compared to men; in fact, none of single fathers in the sample have worked zero hours in the periods considered. The number of individuals clustered in other work hours intervals is much lower.

Table 2.2: Distribution of work hours

	Single males		Single females	
Weekly work hours	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency
0	29	0.0118	65	0.0346
1-15	9	0.0037	32	0.0170
16-30	138	0.0561	144	0.0767
31-45	1999	0.8129	1464	0.7800
46-60	246	0.1000	152	0.0810
> 60	38	0.0155	20	0.0107
Total	2459		1877	
	Male single parents		Female single parents	
0	0	0.00	89	0.0703
1-15	0	0.00	19	0.0150
16-30	4	0.0250	77	0.0608
31-45	123	0.7688	944	0.7457
46-60	28	0.1750	121	0.0956
> 60	5	0.0312	16	0.0126
Total	160		1266	

Table 2.3 presents the main characteristics of the sample. As expected, on average, single men and women are younger than single parents. Their disposable income is also higher; in fact, single women have a higher disposable income than single males and single parents on average. Women are more educated compared to men; 37.4% of single women and 19.7% of single mothers hold tertiary education as opposed to 15.3% of single men and 6.8% single fathers. In contrast, women seem to suffer from chronic illnesses more.

Table 2.3: Sample characteristics

	Male singles		Female singles		Male single parents		Female single parents	
	Mean	st.error	Mean	st.error				
Share in the sample	43.3%	-	31%	-	3.0%	-	22.7%	-
With children < 18 years old	-	-	-	-	1.4%	-	13.4%	-
With children < 6 years old	-	-	-	-	0.2%	-	3.1%	-
Age	33.7	0.220	36.5	0.287	46.2	0.616	44.7	0.257
Equivalised monthly net income	935.7	9.81	957.9	11.4	815.62	27.11	738.8	10.8
Number of kids <18 (if present)	-	-	-	-	1.326	0.529	1.31	0.541
Number of kids <6 (if present)	-	-	-	-	1.19	0.402	1.07	0.270
With lower-secondary education	0.268	0.009	0.132	0.008	0.272	0.035	0.229	0.012
With upper-secondary education	0.337	0.009	0.333	0.011	0.241	0.034	0.246	0.012
With post-secondary/ tertiary education	0.163	0.007	0.386	0.011	0.080	0.020	0.307	0.011
Suffering from chronic illness	0.189	0.008	0.290	0.010	0.173	0.0298	0.339	0.0133
Weekly hours of work	39.9	1.74	37.3	0.25	41.9	0.69	36.5	0.36
With children < 18 years old	-	-	-	-	42.5	0.88	37.6	0.42
With children < 6 years old	-	-	-	-	43.1	2.01	37.5	0.83

Table 2.3 also presents the share of single parents with children from different age groups, given that the second part of the results will focus on single parents. Single mothers make up almost one-fourth of the total sample, whereas male single parents have a much smaller share. The differences persist among those with school- and preschool-age children as well. Single fathers work more on average, compared to female single parents. Interestingly, single father with younger children seem to work more on average than those with school-age or older children. In the case of female single parents, the average work hours are almost the same.

2.4 Results

This section reports the main results of the study. We start with the estimation results of the structural labour supply model. These results are followed by poverty rates calculated under

each criterion, and with the ethical approach to work hours of single parents with preadult children. Finally, the overlap with other poverty measures is presented.

2.4.1 Preference Estimation Results

The estimation results of the Box-Cox utility function described in equation 2.10 are presented in Table 2.4. Preferences are estimated with monthly disposable incomes and hours of leisure. The observed heterogeneity is represented by age, education level, health status represented by a chronic illness, and the number of preadult children of single mothers and single fathers. Estimated parameters are as expected; the marginal utility of income is positive ($\beta_y > 0$) and diminishing with $0 < \alpha_y < 1$. 11 individuals have a negative marginal utility of leisure (i.e., $\beta_h(\nu_i) < 0$ in equation 2.11); they are single fathers mainly with school-age children who work full time (40-55 hours a week). The negative marginal utility of leisure implies that these parents may be constrained in their choice of labour supply and would like to work more if not constrained.

Table 2.4: Estimation results of Box-Cox utility function

	Coefficient	St.error
Net income		
β_y	0.2218^{***}	0.0256
α_y	0.3644^{***}	0.0423
Leisure		
β_{h0}	7.6687^{***}	0.6196
α_h	0.1372^{***}	0.0368
β_{hk}		
$Age/10$	-2.3607^{***}	0.3115
$(Age/10)^2$	0.2746^{***}	0.0391
Lower-secondary education	-0.6842^{***}	0.1382
Upper-secondary education	-0.9685^{***}	0.1337
Tertiary education	-1.3231^{***}	0.1499
No. of children 6^- years old of father	-0.7360	0.7317
No. of children 6^- years old of mother	0.2842	0.2207
No. of children 5^+ and 18^- years old of father	-0.9103^{***}	0.2056
No. of children 5^+ and 18^- years old of mother	0.0699	0.1083
Suffering from chronic illness	0.2451^{**}	0.1054
Fixed costs (β_f)	4.5967^{***}	0.0844
Chi2(2)	61.68^{***}	
Pseudo-R2	0.5264	
Log-likelihood	-4916.17	

Note: $^{*} - p < 0.10$, $^{**} - p < 0.05$, $^{***} - p < 0.01$. The model estimates the parameters of the utility function presented in the equation 2.10. The estimates of personal characteristics pertain to the parameters introduced in equation 2.11 and are used to compute $\beta_h(\nu_i)$ for each individual. In our case, $\beta_h(\nu_i)$ represents the marginal utility of leisure of a group sharing identical personal characteristics.

The preferences for leisure (that is, the size of $\beta_h(\nu_i)$) differ significantly within the sample. A lower preference for leisure (smaller-than-average $\beta_h(\nu_i)$) is observed for those with higher secondary and tertiary education (at least bachelors degree) compared to those with lower education level and similar characteristics, which is related to a higher potential return for each hour worked compared to the base group with primary or no education. The preference for leisure increases as individuals get older, the threshold being at 43 years.

Those suffering from chronic illness also have a higher preference for leisure, compared to those with no chronic illnesses. In the case of single parents with children younger than 18 years old, there are differences between male and female single parents. Having more children of preschool or school age implies a lower preference for leisure for male single parents, whereas the opposite is true for female single parents. It is an interesting result; the reason might be a higher need for professional childcare by male single parents, and this requires more money resources, thus, more hours of work. Female single parents, on the other hand, are expected to care for their children themselves, thus limiting their hours worked.

The predictive power of the model is presented in Table 2.5. The model over-predicts at zero and 31-45 choice points, where 81% of total observations are clustered. The model is able to predict over 90% of choices in 31-45 choice point and performs fairly overall.

Table 2.5: Predicted and actual probabilities of choice points

Weekly work hours choice points	Predicted probabilities	Actual probabilities	Percentage of correctly predicted observations
0	0.0888	0.0321	29%
1-15	0.0071	0.0105	1.64%
16-30	0.0007	0.0630	0%
31-45	0.8942	0.7855	90.5%
46-60	0.0079	0.0952	1.5%
Over 60	0.0012	0.0136	0%

Note: The probabilities are predicted based on the equation 2.12 and show the share of individuals choosing the given choice point according to the estimated model. The last column of the table is obtained by comparing the choice based on model predictions vs. actual choice of labour supply of individuals.

Table 2.6 presents the marginal rates of substitution for various population groups in

the sample[2]. Those with tertiary education, and single fathers have lower marginal rate of substitution compared to those without tertiary education, and single mothers, respectively.

Table 2.6: Change in monthly net income when leisure increases by 1 hour, in euros

	Marginal rates of substitution	95% Confidence interval
Whole sample	-9.4	[-9.4, -9.3]
Singles without children	-9.6	[-9.7, -9.5]
Single father with children < 18 years old	-4.3	[-4.9, -3.6]
Single mother with children < 18 years old	-8.3	[-8.5, -8.1]
Single fathers with children < 6 years old	-4.4	[-6.8, -2.0]
Single mothers with children < 6 years old	-9.7	[-10.1, -9.4]
With tertiary education	-6.6	[-6.7, -6.6]
Without tertiary education	-9.7	[-9.8, -9.6]

Note: The marginal rates of substitution are computed at mean monthly net equivalised disposable income of 899.5 euros and 186 hours of leisure.

The estimated parameters of the utility function are used to construct money-metric utilities and headcount poverty ratios under chosen values of reference wage parameter. The next subsection will present the poverty level and characteristics of the worst off.

2.4.2 Headcount poverty ratios with money-metric utilities

The next step is the computation of money-metric utilities for the actual net income-leisure bundle of individuals and its comparison to money-metric utilities that individuals would have had if they had the poverty threshold bundle. The actual net incomes of individuals are obtained from the tax-benefit simulator (for the detailed procedure, see Appendix 2.2) given the information on their current employee earnings. The monthly leisure hours are

[2]The marginal rates of substitution are computed based on the formula $MRS = -\frac{\hat{\beta}_h(\nu_i)(1-h)^{\hat{\alpha}_h-1}}{\hat{\beta}_y y^{\hat{\alpha}_y-1}}$. y and h represent the mean monthly equalised household net income and monthly hours of work, respectively.

computed from weekly hours of work of individuals at their main, as well as additional, jobs. The poverty threshold levels of net income and leisure are as given in Section 2.2.4 with $c = 0$, i.e., not adjusted for time cost of child rearing.

Table 2.7 presents the headcount poverty ratios measured via money-metric utilities at two values of the reference skill, i.e. wage parameter. The skill level is represented by gross hourly wages, and those will be used from now on. We use two values of the reference skill parameter are chosen: zero and nonzero reference values. The second value is represented by the average gross wages observed in the sample corresponding to each year as indicated in Table 2.7. In accordance with the discussions in Section 2.2.2 circumstance poor specified with $\tilde{w} = 0$ are will be defined as work-averse circumstance poor or poor with higher distaste for work, whereas the circumstance poor with $\tilde{w} > 0$ are defined as work-loving poor or poor with lower distaste for work.

Table 2.7: Headcount poverty ratios with reference wage metric

	2017	2018	2017	2018
	$\tilde{w} = 0$		$\tilde{w} = 5.99$	$\tilde{w} = 6.96$
Headcount poverty ratio	10.5%	8.2%	14.8%	12.9%
Mean weekly hours of work	49.3	48.6	48.1	47
Mean gross hourly wage of the poor	3.9	4.5	4.1	4.7

The headcount poverty ratios differ noticeably depending on the chosen value of the reference wage parameter. 8-10% of the sample is found to be poor when $\tilde{w} = 0$. The mean observed hourly wage of this group is lower than the average wage in the sample, and closer to the minimum wage in Portugal in given years; those are mainly skill-poor. In contrast, their work hours are higher than that of the total sample (38.4 weekly work hours in both years). Interestingly, this poverty measure is expected to specify those with low skills and higher work aversion as poor, but those identified as poor work more hours than non-poor,

which is counter-intuitive. However, note that the preferences are estimated for groups, and not for individuals; although the groups to which the worst off in this category belongs have higher distaste for work and may work lower hours (such as single mothers in Table 2.3), that is not the case for the circumstance poor.

When we use the average wage as the value of the reference wage parameter, the share of the poor is around 12-15% (Table 2.7, third and fourth columns). The average wage in this group is lower than the mean wage of the sample. This group represents the poor with lower work aversion and low wages. Their work hours are also higher than that of the sample mean. It again shows that the poor work much more than those who are not poor, and their deprived condition is mainly due to lower returns at work. In addition, the average weekly hours of work of the circumstance poor under nonzero reference wage parameter is slightly lower than those specified under the zero-reference wage criterion – the work-averse poor work more than the work-loving poor.

When looking at how individuals are ranked under each criterion, we can see that the differences among single individuals and single parents are as expected. When $\tilde{w} = 0$, poor male parents are assigned a higher ranking on average; given their lower preference for leisure, it is a valid observation, as this measure assigns a larger money-metric utility to work-loving poor. Female single parents are assigned a lower ranking on average, which is also in line with theoretical expectations. Interestingly, single females and males, on average, have a lower ranking compared to single parents, and single males are assigned the lowest ranking under this poverty measure.

Table 2.8: Share of different groups among total circumstance poor

	2017	2018	2017	2018
	$\tilde{w} = 0$		$\tilde{w} = 5.99$	$\tilde{w} = 6.96$
Without tertiary education	95.5%	96.1%	89.6%	89.4%
Females	49.6%	44.3%	57.2%	53.9%
Single parents				
Male	1.5%	2.3%	3.5%	3.6%
Female	29.9%	23.7%	35.6%	32.1%
Single parents with children <18 age				
Male	0%	0.8%	1.9%	2.2%
Female	19%	13%	26.1%	22.7%
Single parents with children <6 age				
Male	0%	0%	0%	0.2%
Female	5.2%	4.6%	5.6%	4.3%

Note: The table presents the share of various sociodemographic groups in total number of circumstance poor under each value of $\tilde{w}$, i.e., the percentage of individuals belonging to a given group (e.g., females, single mothers, single fathers with children below 6 years old, etc) among the circumstance poor.

The portrait of the circumstance poor under both reference wage criteria shows how various sociodemographic groups are susceptible to poverty (Table 2.8). The share of females is slightly lower than that of males among the work-averse circumstance poor. In contrast, among the circumstance poor with lower work aversion, more than half of the deprived are females in 2017, and the shares are noticeably lower in 2018. Over 97% of the deprived are without tertiary education when $\tilde{w} = 0$ and over 89% when $\tilde{w} > 0$; given that circumstance poor mainly include low-skilled poor (they have close-to-minimum hourly gross wages), this is not surprising. There are substantial differences between circumstance-poor male and female single parents under both criteria. Female single parents constitute around 23-35% of the circumstance poor depending on the value of the reference wage parameter; the share of male single parents is much lower. Gender differences among poor single parents are also related to their share in the total sample; however, these shares are disproportionate, and female single parents constitute an equal or larger share compared to their share in the total sample regardless the value of the reference wage parameter chosen, especially those with

children below 18 years old, showing their overrepresentation among the circumstance poor. It is interesting that the share of lone mothers is even higher among the circumstance poor with lower work aversion, despite their group beind found to have higher distaste for work. This implies that the work hours of these parents is high enough to place them among the circumstance poor with lower work aversion.

When looking at how individuals are ranked under each criterion, we can see that the differences among single individuals and single parents are as expected. When $\tilde{w} = 0$, poor male parents are assigned a higher ranking on average; given their lower preference for leisure, it is a valid observation, as this measure assigns a larger money-metric utility to work-loving poor. Female single parents are assigned a lower ranking on average, which is also in line with theoretical expectations. Interestingly, single females and males, on average, have a lower ranking compared to single parents, and single males are assigned the lowest ranking under this poverty measure.

When $\tilde{w} > 0$, the situation is reversed. Note that implicit budgets with $\tilde{w} > 0$ specifies work-loving circumstance poor as the worst-off and assigns lower money-metric utilities to them; hence, they are expected to have the lowest ranking. It is observed that single fathers are the worst off under this criterion, and those with two or three kids occupy the lowest three ranks among the poor. Single mothers are relatively better off than males in this regard. In contrast, single men and women without children have a higher ranking on average in this case. In fact, their share among the poorest is much smaller compared to their overall share among the poor under this criterion.

The poverty analysis shows that the proposed poverty measure specifies groups of poor with different characteristics as expected. The poor are mainly low-wage earners, implying that their disadvantage is due to their lack of skills. Interestingly, work-averse circumstance poor have higher hours of work on average compared to work-loving poor. This makes

this group of poor more disadvantaged and dissatisfied given their preferences. This can be related to the debatable distinction between the so-called "undeserving" and "deserving" poor, the latter having a lower distaste for work. The choice of reference values favoring work-averse individuals does not necessarily imply not rewarding hard-working individuals, especially when we consider the deprivation and aim at providing minimum living standards to individuals.

2.4.3 Headcount poverty rates with ethical approach to work hours

When an ethical approach is adopted regarding the work hours of single parents with younger children, the results change dramatically for these individuals. Table 2.9 presents headcount poverty ratios for different values of reference wage and time cost parameters. $c = 0.1$ implies that the total work hours of a single parent is increased by $1/(1-0.1n_k)$, and $c = 0.2$ implies the analogous upward adjustment by $1/(1 - 0.2n_k)$, where n_k is the number of preadult children of single parents. Depending on the reference criterion, the magnitude of change in the share of the poor varies. For instance, the share of the poor under the zero-reference wage criterion increases by approximately 1-2% points when $c = 0.1$, whereas the share of the poor changes by 2.7-3.3% points when the reference wage criterion is the average wage. The changes are even larger when $c = 0.2$ - 5.9%-6% points when $\tilde{w} = 0$ and 6.1%-6.4% when $\tilde{w} > 0$.

Table 2.9: Headcount poverty ratios with time cost of child rearing

	2017	2018	2017	2018
	$\tilde{w} = 0$		$\tilde{w} > 0$	
$c = 0$	10.5%	8.2%	14.8%	12.9%
$c = 0.1$	12.1%	9.6%	17.7%	15.9%
$c = 0.2$	15.1%	12.5%	21.4%	18.7%

Note: The table presents headcount poverty rates based when the time cost of child rearing is considered. Work hours of single parents are adjusted as explained in Section 2.2.4.

Table 2.10 presents the characteristics of single parents that have become circumstance poor with the adjustment. The indicated shares are calculated as the shares of the respective group. For example, 6.2% of single parents become worse off when $c = 0.1$, whereas 3.2% of female single parents with 1 child younger than 18 years old become worse off. The results differ depending on the value of c. First, the worse off are mainly those who have one preadult child, both for male and female single parents. The share of those who become worse off among single mothers with preschool children is larger compared to single fathers. Second, a larger share of single parents become deprived at a higher value of time cost parameter - 1.2% at $c = 0.1$ versus 5.4% $c = 0.2$ for single fathers, and 6.9% at $c = 0.1$ versus 18.5% at $c = 0.2$ for single mothers when $\tilde{w} = 0$. These shares are even higher when $\tilde{w} > 0$ for single parents at each age category of children. Given that single fathers are found to have a higher preference for work, $\tilde{w} > 0$ criterion specifies a higher share of single fathers compared to when $\tilde{w} = 0$ as expected. Single mothers, on the other hand, become worse off at a higher rate compared to single fathers at $\tilde{w} > 0$ as well; they have a larger share in the sample at each age category of children. Third, it can be seen that these parents work more hours per week than the sample average and have leisure time below the poverty threshold, with single fathers working 10 hours more compared to single mothers,

on average, when $\tilde{w} = 0$. This difference is very small when reference wage parameter $\tilde{w} > 0$. On the other hand, single mothers have a larger share of those who hold more than one job when $\tilde{w} = 0$. The share of single mothers, and single fathers having more than one job is equal when $\tilde{w} > 0$ and $c = 0.2$.

Table 2.10: Share of the worse off in respective samples of single parents

	$\tilde{w} = 0$		$\tilde{w} > 0$	
	$c = 0.1$	$c = 0.2$	$c = 0.1$	$c = 0.2$
% of worse off with children < 18	6.2%	19.3%	11.9%	24.2%
Male				
1 child	0.6%	3.1%	5%	13.8%
2 children	0.6%	2.3%	1.3%	3.1%
Female				
1 child	3.2%	9.8%	8.2%	17.2%
2 children	2.7%	7.3%	3.8%	7.1%
3 children	1.0%	1.4%	0.6%	0.8%
% of worse off with children < 6	2.5%	4.9%	3.8%	7.2%
Male				
1 child	0.06%	0.14%	3.1%	3.9%
Female				
1 child	2.6%	5.2%	3.9%	7.1%
2 children	0.16%	0.16%	0.08%	0.24%
Monthly equivalised household disposable income				
Male	508.2	536.3	559	647
Female	571.4	644.5	651	709
Weekly work hours				
Male	53.5	50.1	40.8	41.4
Female	42.9	41.8	40.8	40
% of the worse off having more than one job				
Male	0%	0%	0%	1.1%
Female	2.3%	4.1%	0.7%	1.1%

Note: The table shows the share of worse off single parents along with some work characteristics under two values of c. The shares must be interpreted as the share of single parents who have become worse off out of the respective group of single parents. The only exception is the share of single parents having over one job; they show the share of worse off parents with this characteristic among the single parents who have become worse off.

When we look at the ranking of single parents after the ethical adjustment of work hours, we can see similar results to that observed when $c = 0$. When $\tilde{w} = 0$, circumstance-

poor single mothers seem to be worse off than circumstance-poor single fathers, the former being assigned a lower ranking, on average, based on their money-metric utilities. In fact, the higher the number of children below 18, the worse off single mothers become on average by construction. With $\tilde{w} > 0$, circumstance-poor single fathers seem to be worse off compared to poor single mothers, and having more children younger than 18 years old lowers their ranking more, on average.

To conclude the findings above, single parents become significantly worse off when the ethical adjustment of their work hours is carried out. Single mothers are more disadvantaged compared to single fathers under both values of the reference wage parameter and time cost parameter c. These circumstance-poor single parents already work higher-than-threshold hours and earn a close-to-poverty threshold net income on average. Hence, such a large share of single parents become worse off when the ethical adjustment of work hours is adopted. The rank analysis shows that single mothers are the most deprived among the worse off when disutility from work is not accounted for ($\tilde{w} = 0$). A similar conclusion is obtained with regard to single father when the disutility from work is accounted for ($\tilde{w} > 0$).

These results invalidate some of the broadly proposed policy measures targeting poverty reduction, especially among those with low pay and low skills. Increasing the work intensity among the poor and transitioning from part-time to full-time jobs is usually seen as one of the powerful tools to fight deprivation (see McKnight et al. (2016) for an extensive overview of literature). It might be valid for some individuals without constraints in labour market participation, but it is clearly invalid for low-income or poor single mothers. Given the cultural norms still dominant in societies, single mothers are the main undertakers of the household chores and childcare responsibilities; unlike single fathers, they are expected to take care of their children and households without additional help. This creates dilemma for single mothers in terms of providing for their families on one hand and devoting full attention to

their children on the other. While it is less likely for single fathers to forego full-time jobs because of caring responsibilities (for instance, in our sample, 14.6% of single mothers work 30 hours or less (Table 2.2) as opposed. to 2.5% of single fathers), females are more likely to prefer to undertake part-time jobs (Ray et al., 2014). These jobs are more likely to be low-pay or low-skilled jobs (Frazer and Marlier, 2010) that inevitably increases the probability of falling into income poverty for these parents. So, increasing their work intensity may reduce in-work income poverty and still be accompanied by lower satisfaction. That is why this situation requires more tailored policy actions by solving structural problems. The recommendations in this regard include: radical changes in approaches to part-time work by providing more high-skilled part-time jobs, regulation of labour markets such as reducing labour market segmentation, increasing minimum wages accompanied with specific regulatory measures that would not allow employers to pass higher labour costs onto workers, and allowing for more flexible hours of work (McKnight et al., 2016). These measures must also be accompanied by public provision of high-quality childcare services not to interrupt the labour market experience of single mothers and to increase their chances of transition to higher-paying jobs (Bosch, 2009).

2.4.4 Overlap analysis

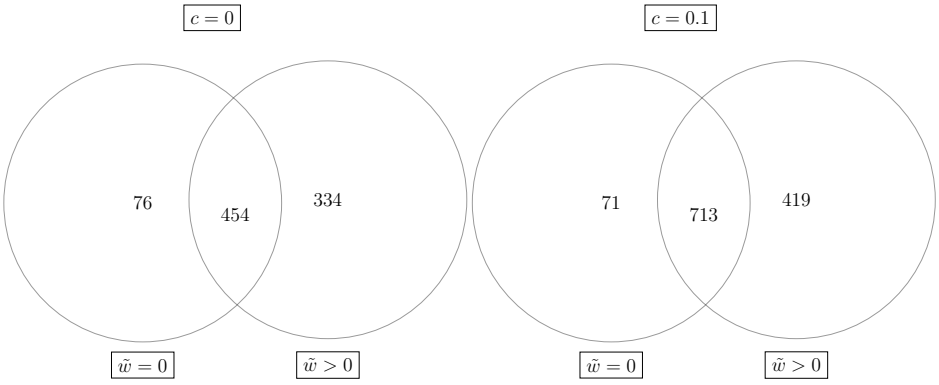
Overlap of poor under different reference criteria

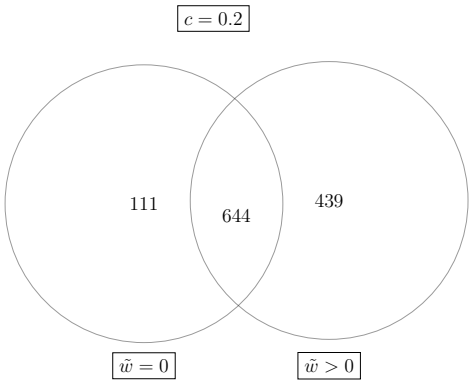
Different values of the reference wage parameter specify a varying number of individuals as circumstance poor. But what number of individuals are specified as poor under both criteria? This question is important if these measures are going to be used as guides for policy measures to target circumstance poor individuals for.

Figure 2.6 presents the overlap of the poor defined under all values of the reference wage parameter and time cost parameter of child-rearing. There is a fairly large overlap between the poor defined under two criteria; almost 80% of the poor under the zero-wage criterion is also poor under the non-zero wage criterion, where almost half of the poor under the latter criterion are also poor under the former. The overlap may be surprising, given that two criteria are expected to define groups of poor with different characteristics. However, this finding is in line with the findings of Carpantier and Sapata (2016), who also found a large overlap between the worst-off defined under different reference values with the egalitarian equivalence approach.

When the work hours of single parents are adjusted by $c = 0.1$, the overlap becomes larger, but the relative overlap (in terms of percentages) is similar to that when $c = 0$. Also, at $c = 0.2$, the overlap is the largest in absolute terms, but does not change in relative terms to that when the work hours of single parents with preadult children are not adjusted. That is, after the adjustment, they become so much more worse off that a higher-than-threshold level of net income is not enough to compensate for the loss of leisure time, regardless of the degree of work aversion of these parents.

Figure 2.6: Overlap between the poor under different reference wage parameters





Overlap between the poor defined with income and counting approaches

It is also interesting to explore whether considering population preferences and incorporating distinct ethical priors to poverty measurement makes a difference in terms of the specification of circumstance poor. For this purpose, the poor defined under circumstance poverty measures are compared with other more widely used measures of deprivation, i.e., income poverty measure and multidimensional poverty measure with the counting approach. The income poverty threshold is the at-risk-of-poverty rate calculated as the share of individuals earning below the 60% of median equivalised disposable household income. The multidimensional poverty measure is constructed as a bi-dimensional poverty headcount ratio with net income and leisure as deprivation dimensions. This indicator is calculated via intersection (when an individual is poor if she is deprived in both income and leisure dimensions) and union (an individual is poor if she is deprived in least in one of the dimensions) approaches.

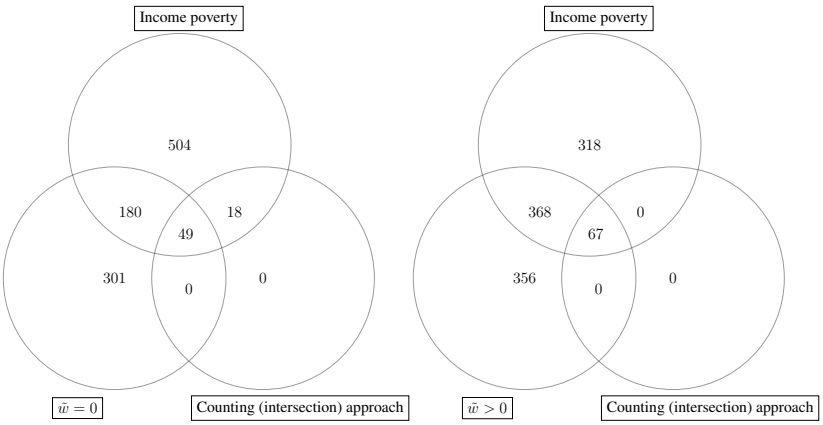
Table 2.11 presents the headcount poverty ratios for these deprivation measures. The income poverty headcount ratio produces the percentage of poor, similar to that specified under circumstance poverty. The intersection approach specifies very few people as poor: around 1-2%. In contrast, the share of the poor defined via the union approach is much larger as expected.

Table 2.11: Headcount poverty rations according to equivalised disposable income and counting approaches

	2017	2018
Income poverty (at-risk poverty)	13.8%	12.5%
Counting (intersection) approach	1.4%	1.0%
Counting (union) approach	29.3%	27.3%

Figure 2.7 presents the overlap between the groups of poor defined the circumstance poverty with two values of reference wage parameter, income poor, and bidimensionally poor with the intersection approach described above. The overlap of circumstance poor with income poor and a bidimensionally poor under the union approach is given in Appendix 2.3 (Figures 3 - 5). As seen, the overall overlap of the circumstance poor with the poor specified under different poverty measures is not large; less than 10% of the poor are also specified as such both when $\tilde{w} = 0$ and $\tilde{w} > 0$. The percentage of the poor overlapping with income poor is larger when $\tilde{w} > 0$ - 46.5% vs 35.2% when $\tilde{w} = 0$. The non-overlapping poor are those not defined as deprived under either income poverty or bidimensional poverty measures. That is, these individuals earn above the threshold of net income and would not be seen as poor by conventional poverty reduction policies. This creates an incomplete picture of deprivation in the society and may lead to outcomes opposite to what is aimed at by such policies.

Figure 2.7: Overlap with other poverty measures when $c = 0$



How circumstance poverty measures perform with respect to income poverty calls for closer attention (Table 2.12). The income poverty is the primary tool used for measuring poverty and designing corresponding poverty alleviation policies, hence, it is important to see how circumstance poverty measures take into account the income poor. The first observation that catches the eye is that circumstance poverty with non-zero reference wage criterion captures a higher number of income poor (57% of the latter), and those are mainly full-time employed income poor. In fact, more than 80% of income poor not specified as circumstance poor under this criterion are part-time employed or inactive. The average hours of work are also very low at 15 hours per week. The circumstance poverty measure under the zero-reference wage criterion, on the other hand, captures only 31% of income poor. It does not capture full-time employed income poor very well–almost 50% of income poor in this category are left out by this circumstance poverty measure. Correspondingly, the average hours of work of the left-out income poor are also higher.

Table 2.12: Characteristics of income poor not specified as circumstance poor

Criterion	$\tilde{w} = 0$	$\tilde{w} > 0$
% of income poor	70%	42%
Full-time employed, %	49%	18%
Part-time employed, %	28%	45%
Inactive, %	23%	37%
Average weekly work hours	25	15

Figures 2.8 and 2.9 show how the overlap changes when the ethical approach to work hours of single parents is adopted. The overlap does not change or merely changes in absolute terms under all three poverty measures for $\tilde{w} > 0$ and $\tilde{w} = 0$, respectively; however, more income poor are defined as circumstance poor when work hours of singles parents are adjusted. This overlap increases further when $c = 0.2$. These are apparently income-poor single parents with children below 18 years old. Although earning below the net income

threshold, these income-poor individuals did not consider themselves deprived when their work hours and preferences for leisure were taken into account. But after the adjustment, they have become worse off in both net income and leisure, as their work hours were adjusted upwards.

On the other hand, more than half of those who are circumstance poor are still not specified as deprived under the other two poverty measures. These people earn above the net income threshold (as seen from average net incomes in Table 2.10), but the disutility of work after the adjustment is large enough to specify them as circumstance poor.

Figure 2.8: Overlap with other poverty measures ($c = 0.1$)

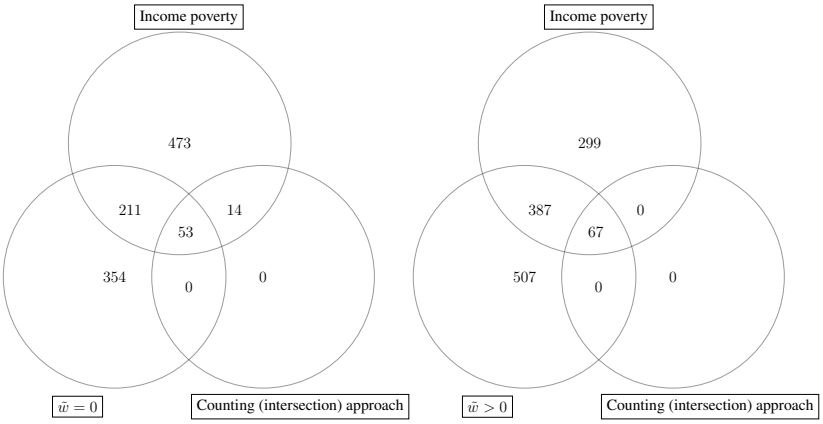
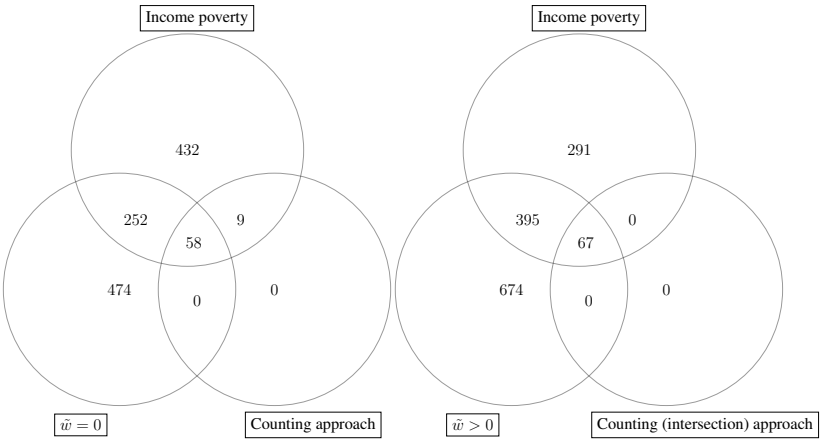


Figure 2.9: Overlap with other poverty measures ($c = 0.2$)



The overlap between income poverty and circumstance poverty shows that a one-dimensional approach to deprivation measurement can produce an incomplete picture of deprivation. Poverty measures must incorporate work hours and constraints for work, and the disregard for individual preferences can significantly distort the overall picture of the deprived, leading to misguided policy decisions. Bi-dimensional poverty measures, on the other hand, rely on normative (usually equal) evaluation of each dimension of deprivation, which does not consider individual attitudes to or preferences for each dimension.

2.5 Conclusion

This paper proposes a poverty measure that overcomes the issues usually encountered in conventional unidimensional or multidimensional poverty measures. By adopting the egalitarian equivalence approach to welfare evaluation, the proposed poverty measure takes into account 1) work hours alongside net income, 2) group preferences towards consumption and leisure, and 3) incorporates ethical considerations into poverty measurement. This measure defines circumstance poverty; the poor defined under this measure are deprived due to factors beyond their control. The calibration of the reference wage parameter of the poverty measure allows one to adopt distinct ethical priors for the identification of the worst off with different preferences. Moreover, the measure takes into account the time cost of child rearing for single parents with children younger than 18 and evaluates their deprivation status for different values of the time cost parameter.

The results produce the image of the poor consistent with theoretical expectations. Around 8-10% are found to be work-averse circumstance poor, whereas 12.5-15% are work-loving circumstance poor. The difference in average work hours between the two groups of poor is rather small. Those are mainly individuals without tertiary education, and with

lower-than-average gross hourly wages close to the official minimum wage. The share of females is slightly higher than males among circumstance poor with lower work aversion, and slightly lower among the poor with higher work aversion. The number of poor increases significantly when the ethical approach to work hours is adopted. This increase is much higher for single mothers than their male counterparts. Higher values of the time cost parameter of child-rearing increase the ratio of the single parents who become even poorer.

Lastly, the overlap analysis between the poor under different poverty measures shows the importance of taking into account individual preferences. More than half of circumstance poor are not deemed poor by income poverty measure or multidimensional poverty measure via the counting approach. This shows the importance of taking into account individual (in our case, group) preferences and hours of work while evaluating welfare of individuals. This is important if poverty reduction in income or other dimensions is aligned with the increasing satisfaction of individuals.

The results have several implications. First, evaluating wellbeing in a wider spectrum, and not only via unidimensional measures, radically changes the image of the poor; if the purpose of redistributive or tax-benefit policies is to provide individuals with decent living standards, those must also consider more than one dimension of wellbeing. It is not possible to do so if policymakers only look at a certain indicator of material wellbeing, but not at the disutility incurred while achieving it. Second, giving priority to individuals with specific preferences does not imply that the hard work is not rewarded. As we have seen, work-averse circumstance poor, on average, are found to work more hours than work-loving poor, and the former can be seen as the worst-off given their preferences.

The analysis of the characteristics of circumstance poor shows the irrelevance of some conventional policy recommendations for poverty alleviation. Each group of poor, whether income or circumstance poor, require different solutions for bettering their condition. Poverty,

especially in-work poverty, is usually seen as a result of a combination of low pay and low work intensity. Hence, increasing work intensity is advised as one remedy for poverty reduction. However, circumstance poor in our sample already work above-the-average work hours, and poverty alleviation for these individuals must focus on increasing the returns from working. This is due to the fact that these individuals do not have access to a bundle that would give them as much satisfaction as a poverty threshold bundle, and there is no way to increase their consumption without decreasing their leisure time and vice versa. Hence, the solution would be the availability high-paying part-time jobs, more generous benefits without high phasing-out rates, or improvements in the labour market system that would lead to the elimination of market segmentation and low-pay careers. On the other hand, those who are income poor, but not circumstance poor, can be made better-off by increasing their work intensity; their net income can be increased by stimulating their labour supply via active labour market programs, given that they have access to bundles that can make them better off in terms of consumption and without decreasing their overall satisfaction.

The above mentioned is especially true for single individuals with children. Single mothers are in a particularly disadvantaged position. They face significant time constraints to take care of children and to maintain a decent standard of living for the household. Given the gendered nature of socially reproductive work, cultural norms, and resulting societal expectations regarding child rearing, they need to balance work to earn enough not to fall into poverty, on one hand, and take care of the household and childcare responsibilities, on the other. This trade-off can be mitigated by the public provision of quality childcare, and more generous benefits for households with single parent heads, especially female-headed households alongside the policy steps above. Single mothers can also benefit from more flexible work hours with secure employment, which would allow them to allocate their time in a more satisfaction-increasing way.

Although capturing more dimensions of human welfare, this approach to deprivation measurement also has shortcomings. The main shortcoming is that the egalitarian equivalence approach does not take into account that preferences are also shaped by factors beyond individual control. The choice of values of the reference wage parameter can somehow account for that, but it does not present a concrete way of taking into account this correlation. Although some scholars, especially, resource egalitarians state that preferences must be fully respected, preferences are also partly shaped by circumstances, and holding individuals wholly responsible for their preferences contradicts fairness principles. Recent studies have shown that accounting for more circumstances reveals a higher share of unfair differences in incomes, and the role of effort (or preferences) decreases, as more comprehensive datasets become available. When the impact of circumstances on how preferences are shaped can be accounted for, we can get a fuller and fairer picture of deprivation, and an interpretation of the results must take that into account.

Chapter 3

Inequality of opportunity and poverty in Portugal: do circumstances matter?

3.1 Introduction

The rising income inequality has become one of the hotly debated topics in recent years along with persistent levels of income poverty in many countries. Portugal is no exception - it is one of the most unequal countries in Western Europe, both in terms of income inequality and opportunity inequality, and has suffered from high levels of income poverty. The urgency of the latter problem has started to be recognised in the 90s (Pereirinha, 2006) and has been a topical problem ever since. Even before the global financial crisis, poverty has shown stable rates, but the depth of poverty has been increasing (Arnold and Farinha Rodrigues, 2015), and the situation has been worsened by the crisis. During the post-crisis recovery period, poverty rates have decreased, but this trend was interrupted by the COVID pandemic, increasing income poverty rates to almost 19% in 2020 (INE, 2021), the rate is particularly high among children (20.4%), the elderly (20.1%), and the unemployed (46.5%)

(EAPN, 2022). As of 2021, the share of those living in income poverty or social exclusion is even higher - 22,4% placing Portugal above the EU average. This share is similar for the households with and without dependent children (Eurostat, 2021). Although being significantly lower among the employed, it was around 10% in 2017 in Portugal, slightly higher than the EU average, with an upward trend in the last years (Perista, 2019). In a recent attempt to curtail high poverty rates and intensity, the Portuguese government introduced the 2021-2030 National Strategy for Combating Poverty (Estratégia Nacional de Combate à Pobreza, ENCP) at the end of 2021 that explicitly aims to reduce both income and multidimensional poverty, and boosting skills to reduce the risk of poverty (Perista, 2021). All these once again show the urgency of the problem and the importance of poverty assessment in Portugal.

Such persistently high levels of income poverty necessitate an adequate evaluation of the deprivation and development of effective policy responses to mitigate differences in outcomes, and reduce the incidence of income poverty. However, theoretical debates among political philosophers and economists alike has shown that, not all inequalities are deemed problematic by scholars; that is, the complete equality of outcomes per se must not be the goal. These theories differentiate between fair and unfair sources of inequality in outcomes. In particular, the egalitarian tradition in political philosophy, and the theory of equality of opportunity in economics distinguish two groups of such factors. The first group comprises all factors beyond the individual's control that are called circumstances, whereas the second group comprises factors within the individual's control, although the two groups of factors can be interrelated. Any differences in the welfare of individuals due to the former are deemed unjust and should not be tolerated, whereas the differences due to the latter group are deemed tolerable. Like income inequality, individuals' income poverty status is also shaped by these different groups of factors. Those can include characteristics: skills, education, employment status, work intensity, family structure, etc (See Crespo et al. (2013) for

the case of Portugal), which can be shaped by circumstances beyond individual control in a direct or indirect manner. This study aims to gain a deeper understanding of income poverty by quantifying unfair inequalities and evaluating unjust differences in the welfare level of individuals, i.e., differences in poverty status due to factors beyond the individual's control. This is an important step in fighting income poverty more effectively via interventions before individuals reach the age where they can be deemed responsible for their actions and equalize their opportunities before they enter adult life and the labour market.

The application of the inequality of opportunity concept to poverty evaluation in Portugal is the first focus and contribution of the study. The existing empirical literature has mainly engaged in evaluating inequality of opportunity in gross earnings or disposable incomes, but not the poverty status. The evaluation of unfair inequalities in relation to poverty is more urgent; although any unfair difference or inequality must be eliminated, the provision of a minimum standard of living for everyone may be prioritized over equal opportunities by some policymakers, and unequal opportunities may not seem as problematic as long as everyone escapes poverty. This study aims to fill the gap in the empirical literature and link these two topical issues.

By linking inequality of opportunity and income poverty, the study also encompasses major concerns and goals discussed in policy strategies and documents of the European Commission. The first issue is poverty reduction among the European population. The Flagship Initiative "European Platform against Poverty" included in the Europe 2020 strategy envisages "to promote shared collective and individual responsibility in combating poverty and social exclusion" and "define and implement measures addressing the specific circumstances of groups at particular risk". The second issue is related to providing equal opportunities and removing unfair differences in the welfare of individuals. Article 21 of the EU Charter of fundamental rights (EU, 2012) prohibits any discrimination based on gender, ethnic ori-

gin, social origin, genetic features, sexual orientation, etc[1]. The second and third principles of chapter 1 of the European Pillar of Social Rights also promote equal opportunities and prioritise gender equality and equal opportunities, thus, requiring offensive differences in outcomes to be eliminated. Despite having a more general appeal, this article can be reformulated and applied to economic welfare – any differences due to such factors in the welfare of individuals are deemed unjust and must be eliminated. In addition, the Social Summit held in Porto in 2021 commits participating European countries, including Portugal, to 2030 social targets built upon the European Pillar of Social Rights that promotes economic development leaving no one behind and providing equal opportunities for all[2]. In this light, the analysis presented in this study becomes even more relevant.

Another principle encompassed in strategic and policy documents of the European Union is fair pay and equal opportunities in the workplace. This principle can be understood as both closing gaps in pay between various demographic groups and making work pay to provide a decent standard of living for all. The former interpretation is mainly focused around the gender pay gap or, in the case of some countries (for instance, Iceland), eliminating gaps related to ethnic origin, age, gender identity, or sexual orientation (Brose et al., 2021, 2022) guided by the Treaty of Rome adopted in 1957 and Article 157 of the EU Charter of fundamental rights (European Union, 2012). The second interpretation, making work pay, is enshrined in the Flagship Initiative "An Agenda for new skill and jobs" with a particular focus on low-skilled jobs. It implies that, regardless of their skill level, individuals must be rewarded for their hard work decently, such that pay gaps must not be large. This principle echoes theoretical discussions in the closely interlinked literatures of equality of opportunity, and fairness (Fleurbaey and Maniquet, 2012). One of the main ethical principles in the fairness literature states that, differences in outcomes of individuals due to their

[1] https://fra.europa.eu/en/eu-charter/article/21-non-discrimination
[2] https://www.2021portugal.eu/media/icfksbgy/porto-social-commitment.pdf

productivity is not just, and must be reduced, given that the productivity of individuals are shaped by factors beyond their control. Moreover, the access to resources must be independent of individual preferences, and effort exerted by individuals. The latter statement is also the essential ethical principle of the equality of opportunity - equalising access to the set of outcomes that individuals can freely choose from according to their preferences is a tenet of this literature (Arneson, 1989, Cohen, 1989, Roemer, 1993). That is, any impact of factors that may generate unequal access to resources or outcomes must be reduced or nullified. This naturally implies that individuals exerting comparable levels of effort must have comparable outcomes independent of their circumstances (factors beyond individual control). All the above brings us to the second goal and contribution of the study with its application to income poverty – it aims to evaluate whether inequality of opportunity in being income poor is lower among the employed or those exerting comparable levels of effort in comparison with those who are unemployed or inactive. In this case, the distinction is made between all employed and full-time employed to see whether unfair differences in being poor shrink when we look at individuals exerting similar effort.

The study also conducts sensitivity analysis by taking into account the income poverty intensity of individuals while conducting the analysis. Inequality of opportunity in being income poor is evaluated at alternative income poverty threshold levels, which allows for focusing on the role of circumstances or contribution of inequality of opportunity to being in deep or even extreme income poverty. In this manner, the role of inequality of opportunity is not only evaluated for the official income poverty threshold but also for lower poverty thresholds focusing on relatively poorer or the poorest among income deprived, thus helping to prepare policy implications for individuals with varying poverty depth. This analysis of various poverty intensities is conducted for the whole population, the working population, and the full-time working population.

The chapter is organized as follows. Section 3.2 elaborates on theoretical and empirical literature on the inequality of opportunity, including Portugal. Section 3.3 describes the theoretical framework and estimation strategy. Section 3.4 presents data and sample. Section 3.5 presents and discusses the main results. Section 3.6 concludes.

3.2 Literature Review

This section presents a brief review of the literature on inequality of opportunity. The next subsection presents the main theoretical approaches to the formulation and measurement of inequality of opportunity. Thereafter, the empirical literature on the inequality of opportunity, as well as the review of studies linking inequality of opportunity and income poverty, are reviewed.

3.2.1 Inequality of Opportunity: theoretical approaches

The economic literature on (in)equality of opportunity is rooted in long-standing discussions in egalitarian political philosophy. As mentioned by Roemer (1998) (p. 4), his essay's "immediate intellectual forbearers are the writings of three philosophers: Ronald Dworkin (1981a, 1981b), Richard Arneson (1989, 1990) and G.A. Cohen (1989)." Despite radical differences in their propositions, these authors have laid ground for subsequent theoretical and empirical work in this field. Following (Rawls, 1971), Dworkin (1981a,b) was one of the first to criticise the welfarist approach to equality rejecting equality of welfare, as the latter would not hold individuals responsible for their preferences. Instead, he advocated for *equality of resources*, and individuals must choose prospects according to their aspirations and wants. Arneson (1989) agreed with bringing personal responsibility into the egalitarian theory, but advocated for *equalizing opportunities for welfare*. He argued for distributing

resources in a way that everyone would have equal opportunity for welfare achievement, but the actual welfare level would differ due to personal choices.

The economic formalization of the problem was introduced by Roemer (1993, 1998) in his seminal works. Following the discussion above, he distinguished two sets of factors affecting personal outcomes. The former are circumstances individuals cannot be held responsible for, which can include parental income, education, the financial situation in the household an individual has lived in during childhood, etc. The second factor is effort – these are the factors that individuals are held responsible for, and include preferences, choices, and actions of individuals. Accordingly, any differences arising because of circumstances between individuals are intolerable and to be eliminated, whereas differences because of effort exerted by individuals are not seen as problematic. In this sense, normative economists differ in terms of their approach to distinguishing circumstances versus effort. For Roemer (1998), circumstances are factors beyond individuals' control, and effort encompasses all remaining factors – this is the control approach. On the other hand, Fleurbaey (2008) holds individuals responsible for their preferences, and all remaining factors are circumstances - this is the preference approach (Trannoy, 2016).

The differences between these approaches do not end here. Cohen (1989) criticises Dworkin from a different perspectives claiming that holding individuals fully responsible for their preferences might not be fair. Because preferences can be affected by circumstances, and assuming that the former takes place before individuals can be held responsible for their preferences, they are not fully accountable for them. This critique sides with the control approach which considers direct and indirect effects of circumstances as something beyond individuals' control. Economists siding with the control-based approach claim that preferences must be "decontaminated" from the impact of circumstances, and this part of preferences must be attributed to circumstances (Roemer, 1998). Advocates of the preference-based ap-

proach do not agree with this claim and state that this separation is not valid; individuals must be held responsible for their choices and actions fully (Fleurbaey and Maniquet, 2011).

Opportunity egalitarianism rests on two fundamental ethical principles that give rise to different approaches to inequality of opportunity measurement. Its first principle, known as the *principle of compensation*, states that individuals must be compensated for differences in outcomes because of factors beyond their control. The second principle, the *reward principle*, states that differences in individuals' outcomes with similar circumstances are legitimate, as they are due to the effort of individuals. The two principles are independent but inconsistent with each other (for illustration, see Fleurbaey and Peragine (2013) among others). Hence, any solution to the problem of distribution must give priority to one principle and satisfy the weaker versions of the other (Fleurbaey and Maniquet, 2011). The principle of compensation can be formulated in two different ways that result in two measurement approaches. The ex-ante compensation principle aims to eliminate differences due to circumstances by equalizing opportunity sets of individuals before effort takes place. The ex-post compensation principle aims to evaluate equality of opportunity after effort is realised and requires that individuals exerting similar effort must have similar outcomes regardless of their circumstances (Ferreira and Peragine, 2016). Hence, the ex-ante approach evaluates inequality in average outcomes among individuals with a different set of circumstances and is closely related to the reward principle, whereas the ex-post approach evaluates inequality among individuals that have exerted a similar degree of effort and conflicts with ex-ante compensation and reward principles when circumstances and preferences are not independent (Fleurbaey and Peragine, 2013).

The current study sides with the control approach. It is assumed that preferences are affected by circumstances, and the estimated impact of circumstances on selected outcomes will account for this interaction. Furthermore, the ex-ante compensation principle is adopted

for the measurement of inequality of opportunity, it is evaluated how unequal the opportunity sets of individuals are in attaining certain outcomes.

3.2.2 Inequality of Opportunity in Portugal: empirical evidence

The literature on the empirical measurement of the inequality of opportunity in Portugal is scant. Portugal has mainly been analysed as a part of a general comparative analysis among European countries. Moreover, the analysis mainly focused on the measurement of the inequality of opportunity in earnings or disposable incomes and has not related the results to poverty except for one study that will be discussed below.

The inclusion of an ad-hoc module on intergenerational transmission of disadvantages in the European Union Survey on Income and Living Conditions (EU-SILC) has given impetus to several inter-country studies focusing on European countries. Checchi et al. (2010) employ both ex-ante and ex-post approaches to the inequality of opportunity and find that Portugal is one of the most unequal countries both in terms of post-tax earnings and opportunities in Western Europe. The ex-post evaluation of inequality of opportunity shows that circumstances explain at least 35% of total inequality (with a somewhat lower share in the case of the ex-ante approach) in earnings, hence, labelling the country as having "high-income inequality" and "low equality of opportunities". Marrero and Rodríguez (2012) employ the same dataset to analyse the ex-ante inequality of opportunity among household heads aged 26-50 years old using disposable equivalent household income. According to their findings, at least 22% of total inequality is explained by chosen circumstances, which is the highest among sampled countries. Checchi et al. (2016) employ the 2005 and 2011 waves of the EU-SILC dataset to compare country rankings both in terms of income inequality and ex-ante opportunity inequality. Authors use individual incomes while assessing the ex-ante inequality of opportunity to isolate the impact of household composition and fertility decisions, as

the latter are deemed choices. The authors find that Portugal is among the countries with a moderate level of inequality of opportunity, and that, moreover, the contribution of inequality of opportunity to overall income inequality has decreased in 2011 compared to 2005. The latter finding is also supported by Álvarez and Menéndez (2018), as well as Álvarez and Lopez Menendez (2021). Brzezinski et al. (2015) obtains similar results using household disposable income as an outcome variable and estimating absolute and relative ex-ante inequality of opportunity among 26-50 years old household heads.

Only one study has incorporated the concept to poverty measurement. Hufe et al. (2022) develop a measure of inequality of opportunity by employing two main principles of fairness: equality of opportunity (measuring inequality between types) and freedom from poverty (no one must fall below the minimum standard of living). Using the 2011 EU-SILC dataset for the analysis, they find that Portugal has both relatively high opportunity inequality and total inequality. Moreover, the authors show that the main violation of fairness emanates from the violation of the equality of opportunity principle.

Despite the existing findings above, there are no other empirical studies that focus on poverty in Portugal and its relation to the inequality of opportunity. This paper aims to fill this gap by employing a large set of circumstances to fulfill this task.

3.3 Methodology

3.3.1 Theoretical framework

Consider a finite population of discrete number of individuals indexed by $i = \{1, ...N\}$. Individual outcomes are given by non-negative probabilities, p_i, of falling short of a specific

level of standard of living, and determined by the set of circumstances C_i, and effort parameter of individuals, E_i. As elaborated in the literature review, the former are factors beyond an individual's control, while the latter are assumed to be within an individual's responsibility. Moreover, the effort that individuals exert is assumed to be influenced by circumstances alongside other factors. Hence, the probability of an individual falling short of the given standard of living, i.e., the poverty line, can be expressed as follows:

$$P_i = f(C_i, E(C_i, \epsilon_i)). \tag{3.1}$$

Here, circumstances C_i and endogenous effort $E(C_i, .)$ are considered the causes of unfair inequality, whereas inequalities in outcomes as a result of $E(., \epsilon_i)$, that is, the differential effort net of circumstances, are not considered unfair.

The population is then partitioned into K *types*, mutually exclusive groups sharing identical circumstances. Individuals $i, j \in N$ are said to belong to the same type T^k if $C_i = C_j$ for $i \in T^k$ and $j \in T^k$, $T^k \in T$. Differences between types arise due to factors beyond individual control and must be eliminated. In contrast, individuals belonging to the same type only differ in the level of effort exerted. Hence, any inequality observed within types is not considered problematic. Hence, equality of opportunity is achieved when probabilities to have income or consumption below a certain level of disposable income are not dependent on belonging to a certain type:

$$P_i^{T^k}(C_i, E(C_i, .) = P_s^{T^m}(C_s, E(C_s, .), i \in T^k, s \in T^m. \tag{3.2}$$

The inequality of opportunity, on the other hand, is present if the distribution of outcomes, in our case, the probability to be income poor, differs between types. In order to quantify it, inequality is measured using the average of outcomes of each type. The between-type in-

equality index can be measured both in absolute terms by choosing an appropriate inequality index, and in relative terms by calculating what share of total inequality can be attributed to the between-type inequality. The following section elaborates on the approach chosen to obtain type-specific average outcomes, and the choice of inequality index to compute the between-type inequality, i.e., inequality of opportunity in being income poor.

3.3.2 Estimation strategy

Studies measuring inequality of opportunity adopt non-parametric (Lefranc et al., 2008), and parametric approaches (see, among others, Checchi et al. (2010), Marrero and Rodríguez (2012)). The former aims to quantify the inequality of opportunity by partitioning individuals into types and measuring differences in average outcomes of types. However, this approach is not suitable in the case of a relatively small sample and a large set of circumstances. In our case, adopting a non-parametric approach would leave most of the type groups with no, or very small, number of observations; hence, the parametric approach is more appropriate. This method computes the between-type inequality by estimating the impact of circumstances on selected outcomes and obtaining expected outcomes for each type based on estimations. The estimation is carried out via logistic regression model. As discussed above, the probability of an individual i to be income poor is determined by circumstances C_i and E_i:

$$\frac{P(y_i < z)}{1 - P(y_i < z)} = \exp(C_i\beta + E_i\alpha + \eta_i) \tag{3.3}$$

where

$$E_i = C_i\gamma + \epsilon_i \tag{3.4}$$

Here, y_i is individual equivalised disposable income, z is the official at-risk poverty threshold, and ϵ_i is the type-specific error term. We follow Roemer (1998) recognising that cir-

cumstances take place before individuals reach the age of consent and can be responsible for their choices, be it occupation or employment status. Hence, it is fair to attribute the indirect impact of circumstances to factors beyond an individual's control. The reduced-form of equation (3.3) is given as:

$$\frac{P(y_i < z|C_i)}{1 - P(y_i < z|C_i)} = \exp(C_i(\beta + \alpha\gamma) + (\alpha\epsilon_i + \eta_i)) \tag{3.5}$$

Based on the estimation results, conditional probabilities are predicted as below:

$$\hat{P}_i^{T^k} = \frac{\exp(C_i(\widehat{\beta} + \widehat{\alpha\gamma}))}{1 + \exp(C_i(\widehat{\beta} + \widehat{\alpha\gamma}))} \tag{3.6}$$

Predicted probabilities represent the average probability of a type T^k to be income poor and are called smoothed distribution. The inequality of opportunity is calculated using the dissimilarity index used in previous studies in different contexts (see De Barros et al. (2009) in the context of opportunity inequality in access to basic services, Hufe and Peichl (2020) for evaluating the inequality of opportunity in political participation, etc.) when the outcome of interest is binary. The absolute dissimilarity index, i.e., the absolute measure of inequality of opportunity is constructed as below:

$$ADI = \frac{2}{N}\sum_{i}^{N} |\hat{P}_i^{T^k} - \bar{\hat{P}}| \tag{3.7}$$

The constructed measure differs from the conventional dissimilarity index used by the above-mentioned authors given by $DI = \frac{2}{N\bar{\hat{P}}}\sum_i^N |\hat{P}_i^{T^k} - \bar{\hat{P}}|$ which is not translation invariant, but scale invariant as shown by Chávez-Juárez and Soloaga (2015). To illustrate in our case, the problem with using the conventional dissimilarity index is that the estimate of inequality of opportunity in the probability of being poor (when poor are assigned ones and non-poor zeros) will have a result different from the estimate of inequality of opportunity

in the probability of *not* being poor (when non-poor assigned ones and poor zeros). Given that conditional probabilities will always lie in the same interval of [0,1] (at least in the case of logit or probit estimations), the violation of scale invariance will not be a problem while estimating the inequality of opportunity. That is why the index satisfying translation invariance is used.

To estimate the relative contribution of inequality of opportunity, the relative dissimilarity index is calculated as the share of total inequality in being income-poor attributed to inequality of opportunity:

$$RDI = \frac{\frac{2}{N}\sum_i^N |\hat{P_i}^{T^k} - \bar{\hat{P}}|}{\frac{2}{N}\sum_i^N |P_i - \bar{P}|} \tag{3.8}$$

It must be kept in mind that the estimated absolute and relative dissimilarity index are lower-bound estimates. The datasets cannot and usually do not include all circumstances of individuals, and unobserved circumstances are included in the error term and not deemed the source of unfair inequalities. Adding more circumstances increases the number of types, and hence, the variation of the counterfactual distribution of conditional probabilities, unless added circumstances are not correlated with the outcome of interest. Hence, the estimated inequality of opportunity cannot exceed its true value.

Last, the study carries out Shapley decomposition to assess the contribution of each group of circumstances to total inequality of opportunity. The Shapley decomposition method estimates the contribution of a specific factor to the total outcome of interest by estimating the latter with and without including that factor. Its major advantage is that it accounts for the sequence of exclusion of factors and calculates the contribution of some factors to the outcome as the weighted average of contributions with all sequences of exclusion. The method has been brought into the inequality and poverty literature by Shorrocks (2013b) and has been used in the inequality of opportunity literature by Björklund et al. (2012), and more recently by Prieto et al. (2018), and Wu et al. (2021).

As discussed in the introduction, one of the goals of the study is to evaluate whether work or being employed reduces unfair inequalities in Portugal. For this purpose, the estimations will be carried out for three samples: for the whole sample with the selected age range, the employed sample, and the full-time employed sample. Three sets of results will be reported corresponding to each sample.

Inequality of opportunity at different poverty intensities Using the official poverty line to estimate the susceptibility to poverty of types does not reveal whether the impact of circumstances changes when we look at individuals with various depths (measured by the distance between actual income and poverty threshold) of income poverty. For this purpose, three alternative poverty lines are adopted alongside the official poverty threshold, and the impact of circumstances is also estimated at these alternative poverty thresholds. These thresholds are determined based on the income-to-poverty line ratio ($IPL = y/z$, the poverty line being the official poverty threshold in Portugal for a given year) adapted from Peng et al. (2019) and Garza-Rodriguez et al. (2021) as described in Table 3.1. Lower poverty thresholds allow us to shift focus to individuals in deeper poverty, whereas individuals defined under poverty lines with higher income thresholds allows for considering vulnerable to poverty besides the poor with different poverty intensities. The procedure explained above is carried out and corresponding dissimilarity indexes are calculated for each poverty threshold and each sample.

Table 3.1: Poverty thresholds

Poverty intensity	Threshold
Extreme poverty	$IPL < 0.5$
Deep poverty	$IPL < 0.75$
Official poverty	$IPL < 1$
Vulnerability to poverty	$IPL < 1.25$

3.4 Data and Sample

3.4.1 Dataset and selected variables

The study employs the 2019 cross-sectional waves of the European Union Survey on Income and Living Conditions. It is a rich dataset with various socioeconomic indicators; in addition, the 2005, 2011, and 2019 cross-sectional waves collect information on the childhood circumstances of individuals. However, only the 2019 dataset is utilised because it contains a wider set of circumstances than 2011 and 2005 waves. Moreover, the 2011 dataset collects information on income variables and poverty status in 2010, which was the crisis year. Hence, this information may not represent individuals' lifetime or long-run income.

Dependent variable

The dependent variable is a binary variable indicating whether an individual is income poor. Income poverty is defined as having disposable household income below the specified poverty threshold. As explained above, four binary dependent variables are defined corresponding to four poverty thresholds. The official poverty threshold is the at-risk of poverty threshold defined as 60% of median equivalised disposable income. Alternative poverty thresholds are defined as in Table 3.1.

Selected circumstances

The choice of circumstances is guided by the empirical literature and the availability of information on background variables. Most selected circumstances coincide with variables chosen in the main empirical literature on the inequality of opportunity discussed in the literature review, with some additional variables available only in the most recent wave of

the EU-SILC dataset in an ad hoc module on intergenerational transmission of disadvantages. All variables refer to circumstances when respondents were 14 years old.

Demographics The first group of variables is the demographic characteristics of the sample. Gender discrimination in wages/earnings, as well as differences in monetary welfare among males and females, is a largely discussed issue in the case of Portugal (Bastos et al., 2009, Cardoso et al., 2016). Given that individuals cannot be held accountable for their biological sex, it is considered a circumstance and included in the analysis. Age is different; some recent studies advocate against considering age as a circumstance and offer to do the analysis looking at cohorts instead to eliminate any differences in outcomes related to age (Andreoli et al., 2021). Although not directly considered as a circumstance, it is important to include age to account for the impact of individuals' position in their life cycle. Younger individuals are more likely to have lower incomes at the beginning of their careers, whereas individuals at the peak of their careers with incomes more representative of their permanent incomes are mainly in their middle ages.

Migration Status Like gender discrimination, the differences in migrants vs. natives are also largely discussed, including the case of Portugal (Isabel Pereira Esteves et al., 2018). The recent report (Amo-Agyei et al., 2020) shows that the pay gap between natives and migrants is as large as 28.9%, mainly due to the concentration of migrants in low-skilled jobs, not matching their education. Other studies show that the difference is not only due to worse endowments of migrants, but mainly due to lower returns to education level and skills of migrants (Cabral and Duarte, 2013). This circumstance is constructed as a binary indicator taking the value of 1 if an individual has a migrant background. The latter category includes both first-generation and second-generation migrants from both EU and non-EU countries.

Parental education Father's education is one of the main circumstance factors affecting

the offspring's future outcomes, especially in the case of Portugal. Some studies (Carneiro, 2008, Bago D'Uva and Fernandes, 2017) show a high correlation between parental education and offspring's education level. That is, its impact can be both direct (affecting the outcome, in our case, poverty staus of individuals) and indirect (via offspring's education level) shaping the individual's future in the labour market and their earnings level (Palomino et al., 2019). The variable is defined in three categories as given in the dataset:

- father had low-level (pre-primary, primary, or lower-secondary) education;
- father had middle-level (upper-secondary, and non-tertiary post-secondary) education; and
- father had high-level (bachelor's or higher) education.

Although information on mothers' education is also available in the dataset, it is not included in the analysis. This is because the number of observations with missing information on a mother's education is slightly larger, and the correlation between the education levels of both parents is quite high.

Parental employment status and occupation Parental occupation is usually considered among circumstances affecting the economic well-being of offspring in the literature (Lefranc et al., 2008, Whelan et al., 2013, Brunory, 2017). Like education, it can operate directly or via the occupational choice of children. In our case, this circumstance is constructed based on two variables available in the dataset: parental occupation and employment status. The reason is that occupational information is only available for employed parents. Including it as a separate variable would leave out some observations on one hand, and won't allow for estimating the impact of parental employment status. That is why information about the father's occupation is merged with his employment status [3]. Again, information on

[3]The merge of two indicators is carried out as follows. If father was employed when individuals were 14

the mother's occupation and employment is not included to preserve as many observations as possible and to avoid any correlation with fathers' characteristics. Seven categories are constructed as a result:

- Father was employed in the armed forces;
- Father was employed in high-skilled white-collar job;
- Father was employed in low-skilled white-collar job;
- Father was employed in high-skilled blue-collar job;
- Father was employed in low-skilled blue-collar job;
- Father was inactive;
- Father was unemployed.

Financial situation in the household This indicator can be seen as a circumstance accounting for intergenerational income mobility and has been used in similar studies measuring inequality of opportunity (among others, Marrero and Rodríguez (2012)). The impact of the financial status of the household where individuals grew up is multifaceted. First, it can directly affect adolescents' opportunities for better educational opportunities (Layte, 2022) that include access to better schooling as well as extracurricular activities that contribute to the personal and skill development of individuals. Second, a bad financial situation in the household can cause emotional distress for adolescents, which can impair their personal development and affect their aspirations (Andersen, 2013), eventually their future economic performance.

This circumstance is a categorical variable with six categories:

years old, they are assigned the occupation. For unemployed and inactive fathers, their employment status is assigned.

- Very bad;
- Bad;
- Moderately bad;
- Moderately good;
- Good; and
- Very good.

Household size and structure Two variables are included to account for the size of households in which respondents grew up – the number of children in the household, and the number of adults in the household when a respondent was 14 years old. Larger households may be more prone to live in poverty, especially if households have a high dependency ratio, i.e. a large number of children and elderly (Bird, 2013). Growing up in poor households may increase a person's probability to be poor in the future, i.e., strengthening an intergenerational transmission of disadvantages in incomes Jenkins and Siedler (2007). Hence, it is appropriate to include the household size as a circumstance.

Insufficient protein intake This circumstance is included among circumstances as a proxy for the nutrition of respondents during adolescence. Poor nutrition can lead to poor health and low cognitive abilities (Nelson, 2000, Behrman et al., 2020) which, in turn, may result in low skills during adulthood (Case et al., 2005), and hence, a higher probability of having low income/being poor. The variable is a binary indicator taking the value of 1 if respondents have answered "No" to the statement "Having a meal with meat, chicken, fish (or vegetarian equivalent) daily".

Basic school needs not met This indicator is used as a proxy for parental investment in a child's education and development. Family investment in the education of children im-

proves their subsequent educational outcomes, which can significantly increase their market incomes during adulthood. The variable taken from the dataset is a binary indicator taking the value of 1 if respondents have answered "No" to the statement "Basic school needs (books and equipment for school) met". School needs include books and equipment needed for school (such as notepads, school supplies, and clothes for PE lessons).

The inclusion of the last two indicators is one novelty of the current study. These variables are only available in the 2019 dataset, and their impact has not been assessed in the Portuguese context. Surely, those may also be closely correlated with the financial situation in the household (see Table 18 in Appendix 2), and it may be redundant to include these variables. However, it is important to see the distinct effect of each circumstance factor on respondents' income deprivation, as these circumstances may not completely overlap.

3.4.2 Descriptive Statistics

The study assesses inequality of opportunity in income poverty for three samples. The first sample comprises individuals 30-59 years old who are full- or part-time employed or self-employed, unemployed, or inactive (1959-1988 cohort). It excludes students, individuals in compulsory military service, or unfit for work in the income reference year. The second sample comprises full- and part-time waged employees or self-employees. Given that the employment status of individuals is available on a monthly basis for the income reference year in the dataset, individuals are employed if they were so for over six months in the income reference year (Perista, 2019). The first sample only comprises full-time waged employees and self-employees - individuals are deemed full-time employees if they were full-time employed for eleven or twelve months in the income reference year.

The sample statistics are presented in Figures 3.1, 3.2, and 3.3, as well as in Tables

12, 13, and 14 in Appendix 1 for the whole sample, working sample, and full-time working sample, respectively. We can immediately see that work indeed decreases the probability of being income poor. A smaller share of the sample is income poor when the focus is shifted from the whole sample to the working sample. The full-time working sample has a smaller share that is income poor than the working sample. The characteristics of non-poor and poor differ, but only marginally in the case of some characteristics. There is a small gender differences in being income poor. A very small share of the sample is made up of non-natives (migrants), and no significant differences are observed between poor and non-poor for the full-time working sample. The share of migrants is slightly higher among full-time working poor, and the difference is statistically (although marginally) significant. Regarding fathers' education, those whose father has low-level education are the majority, although their share is lower among non-poor in all three groups. Those with high-level educated fathers constitute 5% of the sample among the non-poor and 2% among the poor, and the difference is statistically significant. The share of individuals with high-skilled fathers (white-collar or blue-collar) is also higher for the non-poor with a significantly lower share among the poor. Those with unemployed fathers have a somewhat larger share among the poor and working poor, although their share in the sample is tiny. For the financial situation of households of individuals during adolescence, we can observe that poor individuals are more likely to grow up in households with financial difficulties, whereas the reverse is seen for non-poor individuals, among all poor and working poor in particular. Poorer individuals tend to grow up in larger households – the average number of adults and children is larger among the poor than non-poor in all three samples, the differences in the average number of children being even larger. Last but not least, the parents of poor individuals seem to invest less in their off-springs be it in terms of protein intake or meeting basic school needs.

Figure 3.1: Descriptive statistics of whole sample

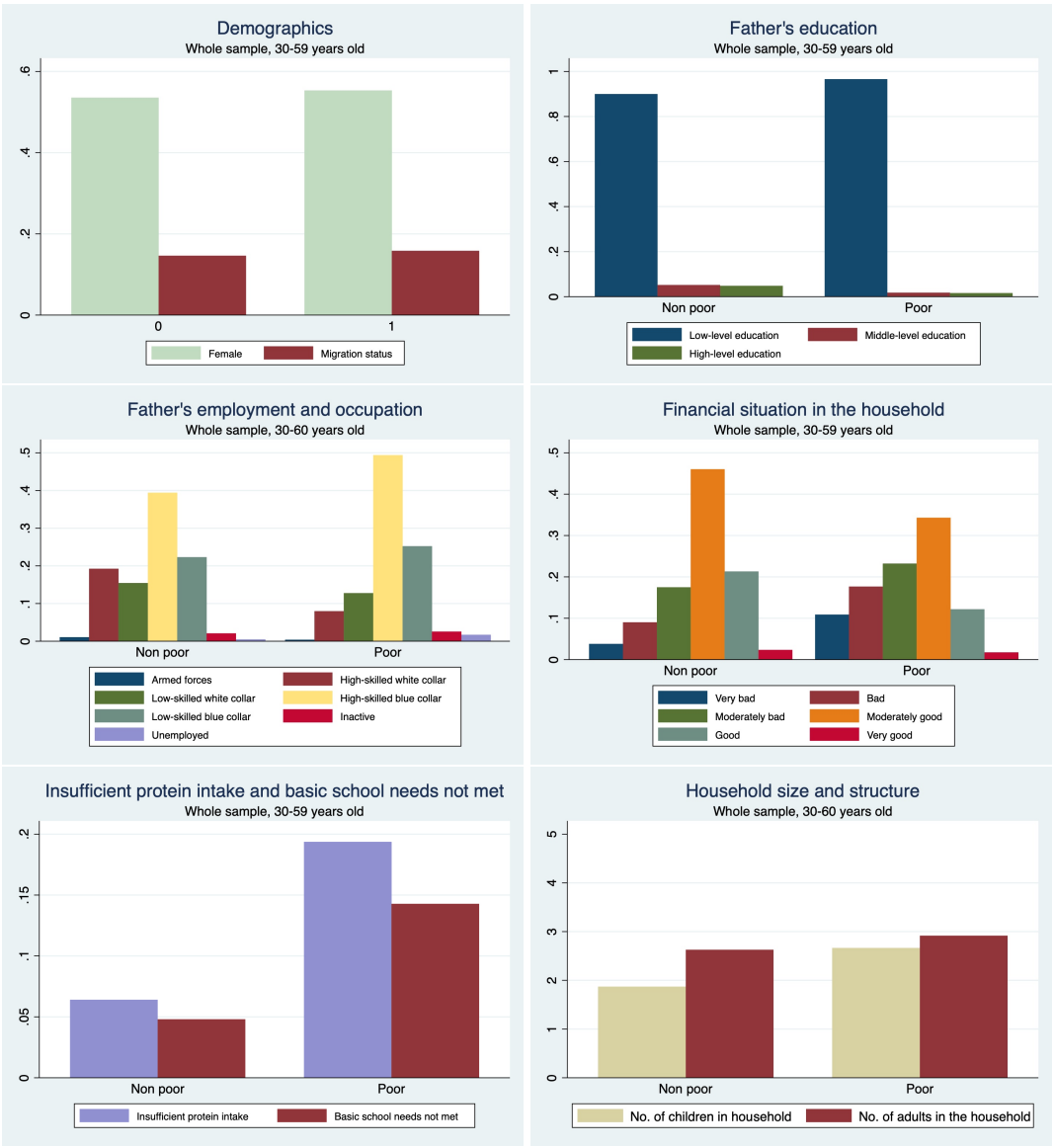


Figure 3.2: Descriptive statistics of working sample

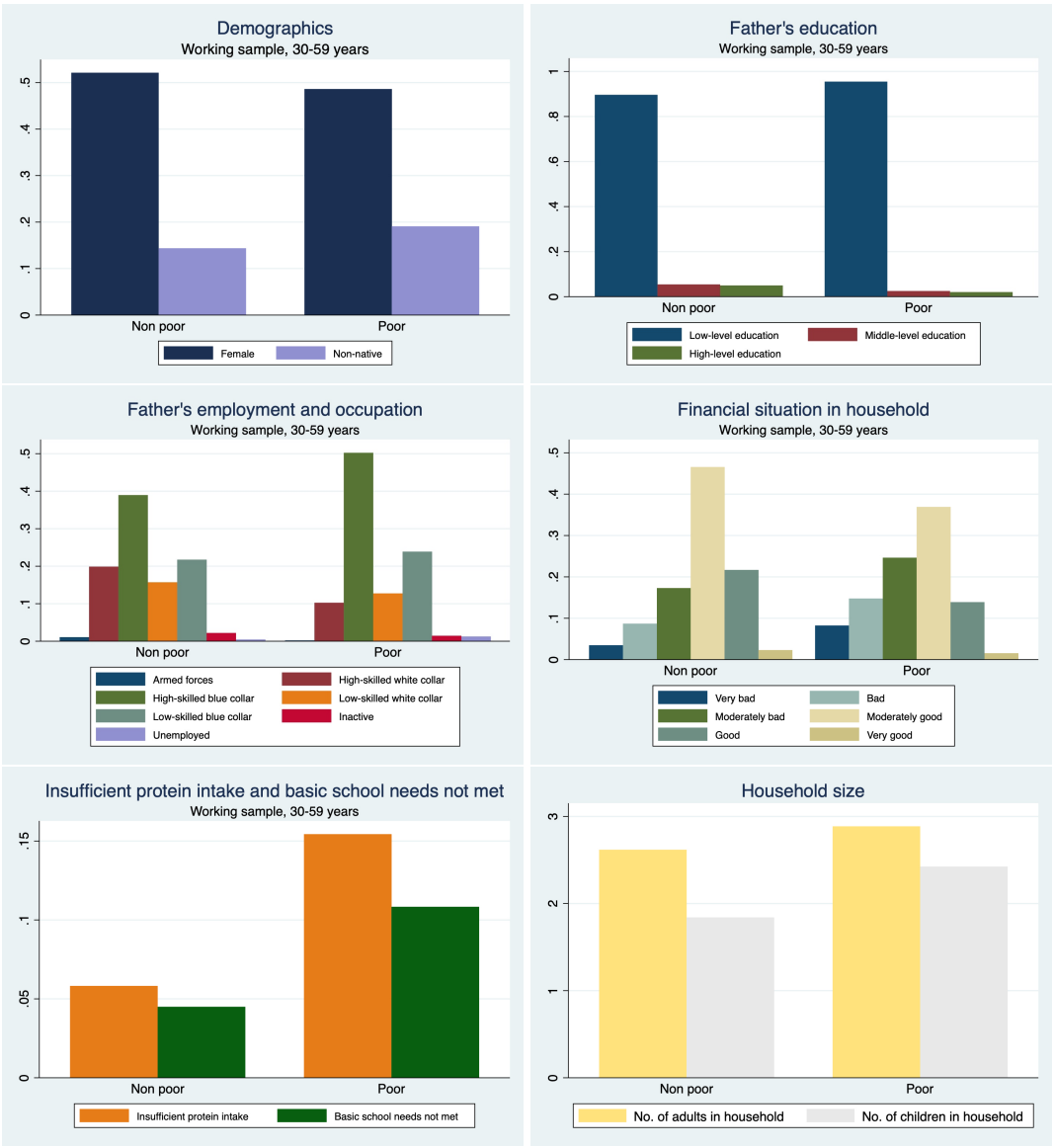
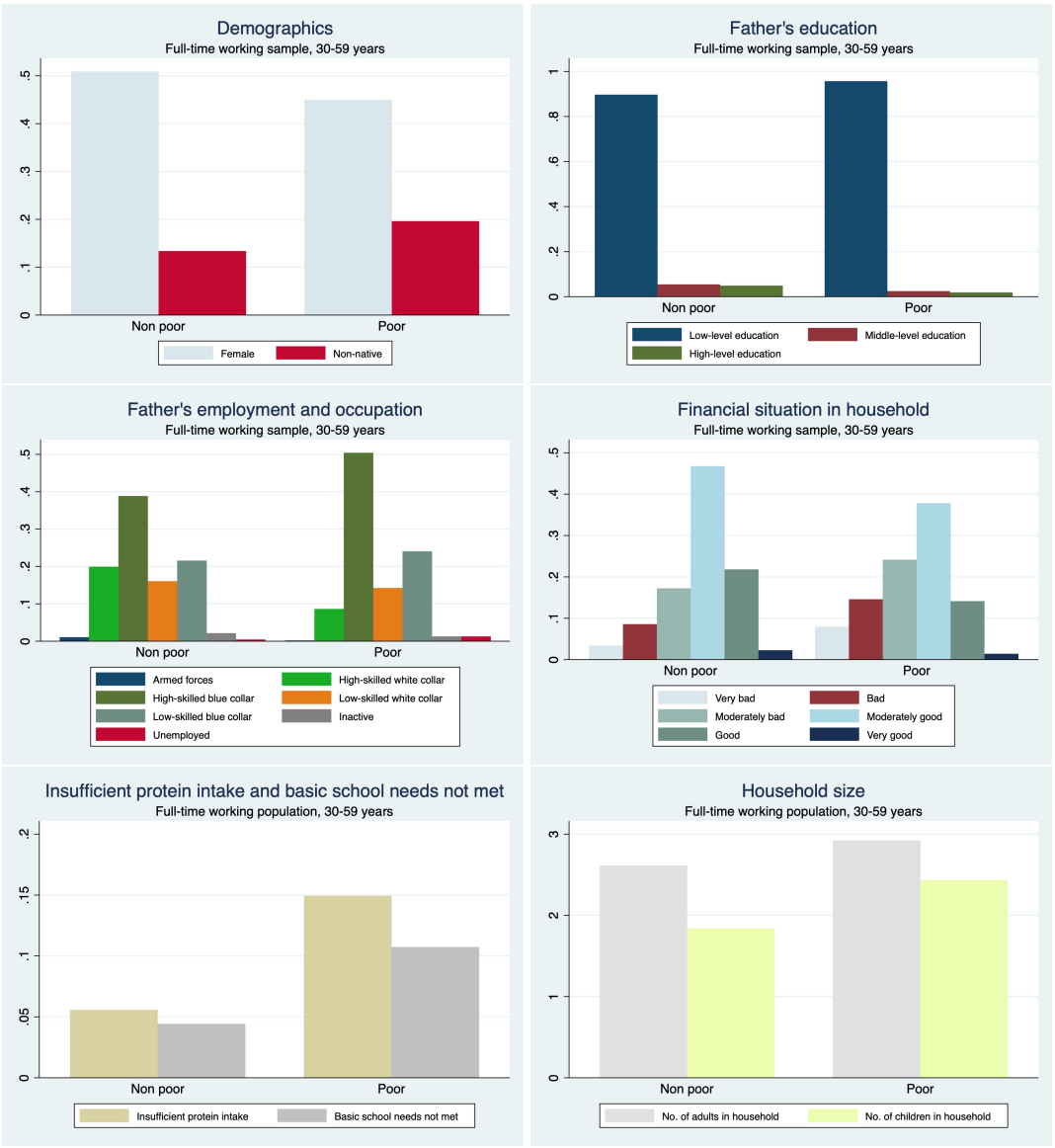


Figure 3.3: Descriptive statistics of full-time working sample



Tables 15, 16, and 17 in Appendix 1 present the summary statistics of those with different poverty intensities. As explained in the methodology, the poor are additionally specified under three alternative poverty lines that allow for describing the characteristics of less poor and poorer segments of the sample. First, there are no significant differences in terms of age between various groups of poor. The share of females becomes slightly smaller as the poverty line is moved further down; that is, the share of females is smaller among the poor-

est. No differences are observed in the share of migrants. Second, there are no significant differences in terms of fathers' education; shares of those with various levels of education are almost stable whether the poor with higher or lower income poverty intensity is considered. The only exception is a lower share of low-educated fathers and a slightly higher share of fathers with middle-level and high-education among the extremely poor, which is counter-intuitive. In terms of the occupation of the father, there are no differences among the vulnerable, deeply poor, and extremely poor. However, poorer individuals tend to have fathers who were unemployed or inactive during the respondents' adolescence. When we focus on the working poor under alternative poverty lines, we see a different picture – a higher share of extremely poor individuals have/had high-skilled fathers compared to deeply poor, but nevertheless, a higher share of inactive or unemployed fathers compared to less poor. As expected, individuals who lived in households with financial difficulties have a larger share among poorer groups. Household size characterized by the number of adults and children in households where individuals grew up seems to be larger among poorer groups. Last but not least, parents of poorer individuals seem to invest less in them – the share of those reporting insufficient protein intake and that their basic school needs were not satisfied when they were adolescents is larger among the poorest.

3.5 Results

This section presents the results of the impact and contribution of selected circumstances to the inequality in being income poor. The next subsection discusses the results of logit regression analysis for all three samples. Next, logit regression results for the poor with alternative poverty lines are presented. Thereafter, the inequality of opportunity in income poverty is quantified via absolute and relative dissimilarity indexes for official and alternative poverty thresholds, and Shapley decomposition results are reported alongside.

3.5.1 Income poverty and childhood circumstances

In order to calculate ex-ante inequality of opportunity indexes, logit regressions are estimated for each sample using the selected set of circumstances. It must be mentioned that, the results cannot be seen as a causal analysis; although, as established by the empirical literature, it is highly probable that these circumstances play an instrumental role in the formation of individual outcomes when they reach adulthood, the study does not seek to claim so. The results exploring the first dimension of the analysis, i.e., the (changing) impact of circumstances on three samples, are reported in Table 3.2 (estimation results with alternative models presented given in Appendix 3, Table 19). The impact of circumstances is mostly similar for all three samples, but there are some differences. Starting with gender, females are more likely to be poor when the whole sample is considered, whereas they have a lower likelihood to be income poor when we only focus on working individuals. Interestingly, the difference between males and females becomes larger and gains higher significance when only a full-time working sample is analysed. This finding points to the potential of employment to lead to higher economic welfare, on one hand, and meager economic situation in which non-working women are, on the other hand. Such that, non-working individuals from estimations changes the direction and significance of correlation substantially, hence, implying that, the role of gender in being income poor among unemployed and inactive is stronger. The same can be observed for natives vs. migrants; although the difference between the two groups in falling below the poverty threshold is not significant when the whole sample is analysed, the difference becomes larger and highly significant when the working or full-time working sample is considered.

The father's education correlates with the likelihood to be poor significantly. This resonates with the findings of previous studies that investigate the impact of parental education on differences in gross or net incomes. But the correlation becomes weaker when we focus

on the working sample - the coefficients are only significant at the 10% level – and the relationship disappears when moved to the full-time working sample. The father's occupation seems to play a significant role as well. Compared to those whose fathers were unemployed when they were 14 years old, those with employed fathers are less likely to be poor, especially those whose fathers were employed in high-skilled white-collar occupations. Those whose fathers were inactive during their adolescence are also less susceptible to income poverty. These findings are also supported by the joint significance tests reported in Table 3.3.

Next, as expected, a household's financial situation when respondents were 14 years old is significantly correlated with their current economic well-being. These observations are valid for all three samples, although, again, the correlation is weakened for the working part of the sample in the case of those who have had a moderately bad financial situation in the household. The joint significance test reported in Table 3.3 also support these findings. This result can be interpreted in terms of intergenerational mobility; those who lived in financially struggling households as a child are more likely to live in such households when they are adults, given that the poverty status is defined as falling below the equivalised household disposable income. Regarding the household's composition, individuals that lived in households with more members, be it children or adults, are more likely to be income poor. This is again expected, given larger households might be more susceptible to income poverty and financial problems, and, as seen above, individuals growing up in financially struggling households have a higher likelihood to be income poor. Last, the variables signifying deficiencies in nutrition and unmet school needs seem to be significantly correlated with an individual's current economic well-being. Those who didn't have sufficient food with protein content during adolescence are significantly more likely to be poor, as well as those without proper provision in terms of school materials and equipment. This is true in the case of all poor in general and working or full-time working poor.

Table 3.2: Logit results (average marginal effects) on the impact of circumstances on poverty status at official poverty threshold

	Whole sample	Working sample	Full-time working sample
Age	0.007	0.009*	0.0167***
	(0.006)	(0.054)	(0.005)
Age^2	-0.0001	-0.0001*	-0.0002***
	(0.000)	(0.001)	(0.000)
Female	0.009*	-0.012**	-0.020***
	(0.005)	(0.055)	(0.006)
Non-native	0.032	0.041**	0.048***
	(0.020)	(0.170)	(0.012)
Father's education (base group: low-level education)			
Mid-level education	-0.075***	-0.033*	-0.033
	(0.026)	(0.022)	(0.022)
High-level education	-0.040**	-0.431*	-0.028
	(0.028)	(0.024)	(0.024)
Father's employment status and occupation (base group: unemployed)			
Armed forces	-0.211***	-0.206***	-0.233**
	(0.061)	(0.077)	(0.094)
High-skilled white collar	-0.1824***	-0.099***	-0.110***
	(0.036)	(0.035)	(0.034)
High-skilled blue collar	-0.097***	-0.046	-0.044
	(0.034)	(0.034)	(0.0328)
Low-skilled white collar	-0.124***	-0.0722**	-0.0615*
	(0.035)	(0.034)	(0.033)
Low-skilled blue collar	-0.108***	-0.061*	-0.057*
	(0.034)	(0.034)	(0.033)
Inactive	-0.109***	-0.117***	-0.120***
	(0.041)	(0.016)	(0.042)
Financial situation in the household (base group: very bad)			
Bad	-0.014	-0.012	-0.008
	(0.017)	(0.042)	(0.016)
Moderately bad	-0.036**	-0.011	-0.009
	(0.017)	(0.016)	(0.017)
Moderately good	-0.078***	-0.046***	-0.035**
	(0.017)	(0.017)	(0.017)
Good	-0.087***	-0.051***	-0.035**
	(0.0197)	(0.019)	(0.019)
Very good	-0.036	-0.040	-0.035
	(0.002)	(0.031)	(0.031)

Table 8 (cont-d). Logit results (average marginal effects) on the impact of circumstances on poverty status at official poverty threshold

	Whole sample	Working sample	Full-time working sample
	Household size		
No. of adults	0.0102***	0.0078***	0.0088***
	(0.0027)	(0.0025)	(0.0024)
No. of children	0.0152***	0.0083***	0.0079***
	(0.0021)	(0.0019)	(0.0020)
Insufficient protein intake	0.0741***	0.539***	0.0479***
	(0.0131)	(0.0120)	(0.0118)
Basic school needs not met	0.0591***	0.0274**	0.0239*
	(0.0138)	(0.0129)	(0.0126)
Constant	0.1781*	0.1133***	0.1002***
	(0.0044)	(0.0037)	(0.0036)
N	11243	9204	8549
Wald stat.	500.3	254.2	237.0
Pseudo-R2	0.0685	0.0468	0.0527

Standard errors given in parentheses are clustered at household level; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.3: Joint significance test results for selected circumstances

Circumstances	Whole sample	Working sample	Full-time working sample
Father's education	10.89	4.72	2.87
	(0.004)	(0.095)	(0.239)
Father's employment and occupation	19.88	21.08	17.88
(inactive excluded)	(0.001)	(0.001)	(0.003)
Financial situation in the household	41.54	20.74	12.76
	(0.000)	(0.001)	(0.027)

Note: The table presents chi-squared test results testing the joint significance of categories of selected circumstances; p-values are reported in parentheses.

3.5.2 Poverty intensity and childhood circumstances

The previous results focus on the poor specified under the official poverty line defined by the Eurostat. The results reported in this section explore the second dimension of the analysis, and shed some light on how the impact of circumstance changes if the poverty line is moved upwards or downwards. This allows us to focus on the segments of the poor with various depths of income poverty, i.e., the distance between the income of individuals and the poverty threshold level of income. Alternative poverty lines are defined as in Table 3.1. The results of all three samples are shown in Table 3.4 (see Appendix 3, Tables 20 and 21 for alternative models' results). Respondents seem to become more vulnerable to income poverty as their age increases, but this is only true when the vulnerability of working or full-time working individuals is assessed. The role of age is insignificant for the whole sample, as well as the working sample under other alternative poverty lines. Gender differences in the probability to be income poor persisting under all alternative poverty lines (except for deep or extreme poverty line for the whole sample) is strong when the focus is on the working sample or the full-time working sample. Moreover, the probability of being poor becomes smaller for females as the poverty threshold is moved down, working or full-time working males are more likely to be in deep or extreme income poverty compared to females of the same category. In contrast, the role of the father's education becomes smaller and loses significance when moving the poverty threshold further down.

The father's education is strongly correlated with the probability of being vulnerable to poverty for all three samples, but not with being in deep or extreme poverty (Table 3.5). The role of the father's occupation persists when the whole sample is taken into account and increases in importance as we move down the poverty threshold. However, its impact disappears in the case when we focus on the working sample – interestingly, the contribution of the father's occupation and employment is not robust to alternative poverty lines. This

result implies that father's education has a strong link with whether individuals are poor, and partly whether they are vulnerable to poverty, but not in being in deep poverty or in extreme poverty.

The financial situation of the household is again significantly correlated with income poverty, and this link is stronger for deep or extremely poor than for all poor when the whole sample is analysed. Growing up in households with a moderately good or good financial situation reduces the probability of being income poor compared to those who grew up in households with a very bad financial situation at all alternative poverty lines. However, the impact of growing up in households with different financial situations on the probability of being income poor is not as robust except for the extreme poverty threshold. Interestingly, those who grew up in households with a very good financial situation are not less likely to be income poor. Again, when focused on the sample of full-time working individuals, the impact of the financial situation of the household of individuals' poverty status partly vanishes. Only those who grew up in households with a moderately good or good financial situation are less likely to be in income poverty regardless of the depth of poverty (see also Table 3.5).

Household size is persistently correlated with the probability to be income poor under all alternative poverty lines for the whole sample and working sample. For the full-time working sample, the role of the number of children in households where individuals grew up becomes insignificant in terms of being in extreme poverty. Lastly, the variables characterising deficiencies in nutrition and school supplies also preserve its impact on the probability of being poor regardless of the poverty threshold adopted. The only exception is insufficient protein intake when only full-time working individuals are analysed; its impact becomes insignificant in terms of being in extreme income poverty.

Table 3.4: Logit results (average marginal effects) at alternative poverty lines

	Whole sample			Working sample			Full-time working sample		
	Vulnerable to poverty th.	Deep poverty th.	Extreme poverty th.	Vulnerable to poverty th.	Deep poverty th.	Extreme poverty th.	Vulnerable to poverty th.	Deep poverty th.	Extreme poverty th.
Age	0.008	-0.002	-0.003	0.014**	0.002	0.004	0.020***	0.008**	0.004*
	(0.007)	(0.005)	(0.003)	(0.007)	(0.004)	(0.003)	(0.007)	(0.004)	(0.003)
Age^2	-0.000	0.000	0.000	-0.000**	-0.000	-0.000	-0.002***	-0.000**	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.013**	-0.000	-0.004	-0.015**	-0.014***	-0.010***	-0.025***	-0.018***	-0.012***
	(0.006)	(0.004)	(0.003)	(0.007)	(0.004)	(0.003)	(0.0.007)	(0.004)	(0.003)
Non-native	0.053**	0.029*	0.0083	0.058***	0.034***	0.014*	0.063***	0.037***	0.012
	(0.024)	(0.015)	(0.003)	(0.022)	(0.011)	(0.007)	(0.022)	(0.011)	(0.008)
	Father's education (base group: low-level education)								
Middle-level education	-0.131***	-0.046**	-0.014	-0.091***	-0.027	-0.007	-0.083***	-0.029	-0.0102
	(0.029)	(0.023)	(0.015)	(0.027)	(0.018)	(0.010)	(0.027)	(0.019)	(0.011)
High-level education	-0.100***	-0.022	-0.017	-0.080***	-0.011	-0.001	-0.004**	0.002	0.004
	(0.032)	(0.022)	(0.015)	(0.032)	(0.016)	(0.009)	(0.033)	(0.015)	(0.009)
	Father's employment status and occupation (base group: unemployed)								
Armed forces	-0.226***	-0.093**	-0.071**	-0.194**	-0.043	-	-0.191**	-0.049	-
	(0.070)	(0.043)	(0.033)	(0.078)	(0.043)	(-)	(0.078)	(1.050)	(-)
High-skilled white collar	-0.218***	-0.122***	-0.063***	-0.111**	-0.033	-0.013	-0.127***	-0.026	-0.016
	(0.048)	(0.026)	(0.016)	(0.049)	(0.026)	(0.012)	(0.049)	(0.028)	(0.012)
High-skilled blue collar	-0.087*	-0.061**	-0.046***	-0.009	-0.008	-0.012	-0.017	0.003	-0.010
	(0.046)	(0.024)	(0.014)	(0.048)	(0.025)	(0.011)	(0.047)	(0.027)	(0.62)
Low-skilled white collar	-0.149***	-0.070***	-0.052***	-0.070	-0.012	-0.017	-0.065	-0.005	-0.013
	(0.047)	(0.025)	(0.014)	(0.049)	(0.025)	(0.123)	(0.048)	(0.027)	(0.012)
Low-skilled blue collar	-0.111**	-0.066***	-0.049***	-0.038	-0.019	-0.017	-0.045	-0.005	-0.013
	(0.047)	(0.025)	(0.014)	(0.048)	(0.025)	(0.012)	(0.048)	(0.027)	(0.012)
Inactive	-0.118**	-0.062**	-0.047***	-0.069	-0.027*	-0.027	-0.075	-0.034	-0.019
	(0.053)	(0.029)	(0.018)	(0.055)	(0.032)	(0.017)	(0.055)	(0.033)	(0.015)

Table 9. Logit results (average marginal effects) at alternative poverty lines (cont-d)

	Whole sample			Working sample			Full-time working sample		
	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty
				Financial situation in the household					
Bad	-0.025	-0.013	-0.015**	-0.025	-0.010	-0.011*	-0.024	-0.007	-0.009
	(0.022)	(0.012)	(0.007)	(0.022)	(0.011)	(0.006)	(0.023)	(0.011)	(0.007)
Moderately bad	-0.045**	-0.022*	-0.026***	-0.013	-0.006	-0.013*	-0.002	-0.054	-0.011
	(0.022)	(0.013)	(0.008)	(0.022)	(0.011)	(0.007)	(0.022)	(0.012)	(0.007)
Moderately good	-0.102***	-0.045***	-0.042***	-0.071***	-0.027**	-0.023***	-0.062***	-0.020*	-0.019**
	(0.022)	(0.013)	(0.009)	(0.022)	(0.012)	(0.008)	(0.023)	(0.012)	(0.008)
Good	-0.111***	-0.061***	-0.047***	-0.078***	-0.044***	-0.031***	-0.067***	-0.037***	-0.028***
	(0.024)	(0.016)	(0.011)	(0.024)	(0.014)	(0.009)	(0.025)	(0.014)	(0.009)
Very good	-0.0234	-0.023	-0.0202	-0.018	-0.017	-0.024	-0.010	-0.013	-0.015
	(0.036)	(0.024)	(0.016)	(0.036)	(0.021)	(0.014)	(0.037)	(0.021)	(0.013)
				Household size					
No. of adults	0.010***	0.005**	0.0023	0.007**	0.005***	0.002**	0.008**	0.005***	0.002**
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
No. of children	0.019***	0.009***	0.003***	0.013***	0.0033**	0.001	0.012***	0.003*	0.000
	(0.003)	(0.002)	(0.001)	(0.003)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
Insufficient protein intake	0.096***	0.047***	0.018***	0.081***	0.032***	0.009*	0.073***	0.027***	0.007
	(0.017)	(0.010)	(0.007)	(0.016)	(0.008)	(0.005)	(0.017)	(0.008)	(0.005)
Basic school needs not met	0.0836***	0.0460***	0.0204***	0.046***	0.018**	0.010**	0.041**	0.017**	0.011**
	(0.018)	(0.010)	(0.007)	(0.018)	(0.008)	(0.005)	(0.018)	(0.008)	(0.005)
Constant	0.276	0.096	0.045	0.201***	0.053**	0.022**	0.184***	0.046***	0.019**
	(0.005)	(0.003)	(0.003)	(0.005)	(0.003)	(0.002)	(0.005)	(0.003)	(0.002)
N	11243	11243	11243	9204	9204	9114	8549	8549	8466
Wald stat.	575.5	370.9	230.8	356.5	200.1	120.4	328.6	171.5	99.04
Pseudo R2	0.0665	0.0704	0.0664	0.0498	0.0556	0.0586	0.0513	0.0599	0.0626

Standard errors clustered at household level are given in parentheses are clustered at household level; * $p < 0.10$, *** $p < 0.05$, *** $p < 0.01$. Note: There are no observations who work, are extremely poor, and have had fathers in armed forces; hence, this variable is dropped from estimations with extreme poverty threshold.

Table 3.5: Joint significance test results for selected circumstances

Poverty threshold	Circumstances	Whole sample	Working sample	Full-time working sample
Vulnerable to poverty	Father's education	25.88 (0.000)	14.83 (0.001)	11.49 (0.003)
	Father's employment and occupation (inactive excluded)	35.03 (0.000)	35.35 (0.000)	27.08 (0.000)
	Financial situation in the household	52.86 (0.000)	35.22 (0.000)	29.77 (0.000)
Deep poverty	Father's education	4.13 (0.127)	2.28 (0.320)	2.61 (0.272)
	Father's employment and occupation (inactive excluded)	9.18 (0.102)	10.43 (0.104)	6.98 (0.222)
	Financial situation in the household	23.90 (0.000)	21.87 (0.001)	17.24 (0.004)
Extreme poverty	Father's education	1.60 (0.449)	0.63 (0.732)	2.13 (0.345)
	Father's employment and occupation (inactive excluded)	14.11 (0.015)	4.72 (0.317)	2.35 (0.672)
	Financial situation in the household	28.18 (0.000)	14.69 (0.012)	11.79 (0.038)

Note: The table presents chi-squared test results testing the joint significance of categories of selected circumstances; p-values are reported in parentheses.

We can see that the role of circumstances changes, and they become less and less important once the sample is shrunk to employed, and especially, to full-time employed individuals. The weakening link between these circumstances in adolescence and income poverty status as an adult can be seen from both insignificance of the links explored, as well as from the shrinking magnitude of those links. Interestingly, circumstances usually seen as key components of inequality of opportunity such as father's education or employment/occupation become insignificant and lose explanatory power, especially for the extremely poor. This can be seen as a favourable result, as being in extreme poverty is not correlated with such background characteristics of individuals. However, other circumstances (e.g., financial struggles/advantages of households where individuals grew up) still demonstrate strong links with

individual welfare, and individuals in deep or extreme poverty may be punished for factors affecting their outcomes beyond their control. This shows how necessary and still relevant the addressing of intergenerational correlation in disadvantages is.

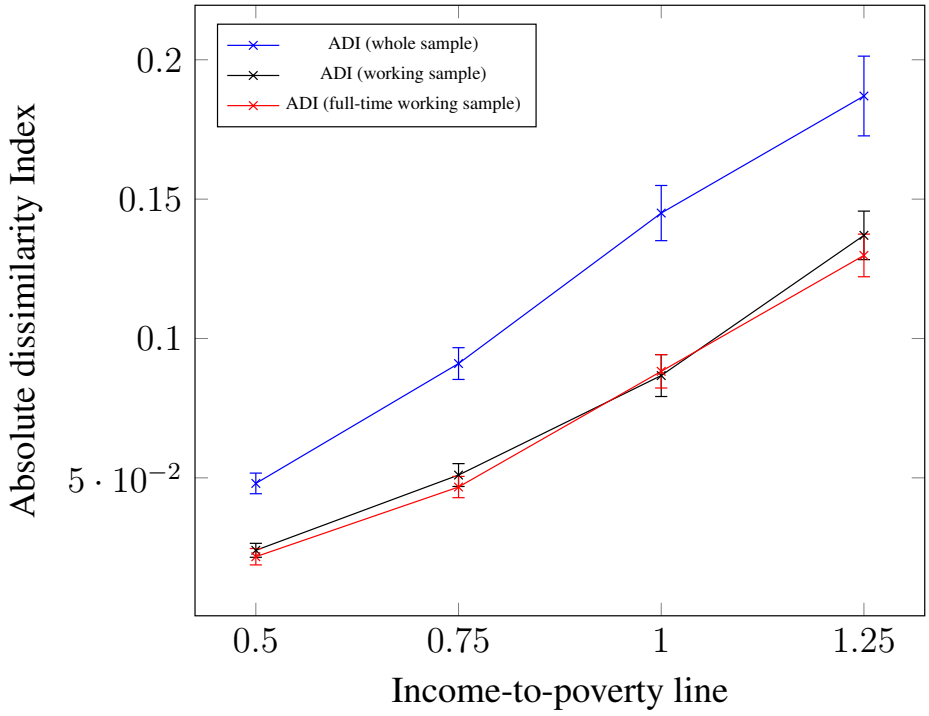
3.5.3 Inequality of opportunity and income poverty: dissimilarity indexes

After obtaining predicted probabilities from the regressions reported above, absolute and relative dissimilarity indices are computed. Tables 22 in Appendix 4 reports absolute and relative dissimilarity indexes for all three samples. As explained in Section 3.3, the absolute dissimilarity index is calculated based on equation 3.7 (Tables 23 and 24 in Appendix 4 also report dissimilarity indexes compute via probit and linear probability models, respectively). Inequality of opportunity in being income poor is not high for income poverty and even lower among working or full-time working individuals at the official poverty threshold. The difference between the first two is substantial; the absolute dissimilarity index decreases by 40% when the focus shifts to the working sample and is statistically significant. But this is not observed between working and full-time working samples. These findings imply that, work may indeed decrease absolute inequality in opportunities, but when we narrow our focus to individuals with comparable levels of effort, absolute unfair inequalities in being income poor do not change. Figure 3.4 illustrates absolute dissimilarity indexes for all three samples with 95% confidence intervals. We can see that the values of the absolute dissimilarity index lie above the values for working or full-time working samples. But for the latter two, their lines overlap.

One point is worth discussing. There can be another reason for such a drastic decrease. The income poverty rate is almost twice smaller among working or full-time working respondents than that of the whole sample, the actual inequality in being poor is also much

smaller. Correspondingly, it is expected that the absolute value of inequality of opportunity will be lower as well, as it is the component of total inequality in income poverty status. It is also interesting to examine what share of the decrease is due to the actual decrease in unfair inequalities vs. due to the mechanical decrease due to lower actual inequality in being income poor. But this is beyond the scope of this work.

Figure 3.4: Inequality of opportunity in income poverty: Absolute dissimilarity index

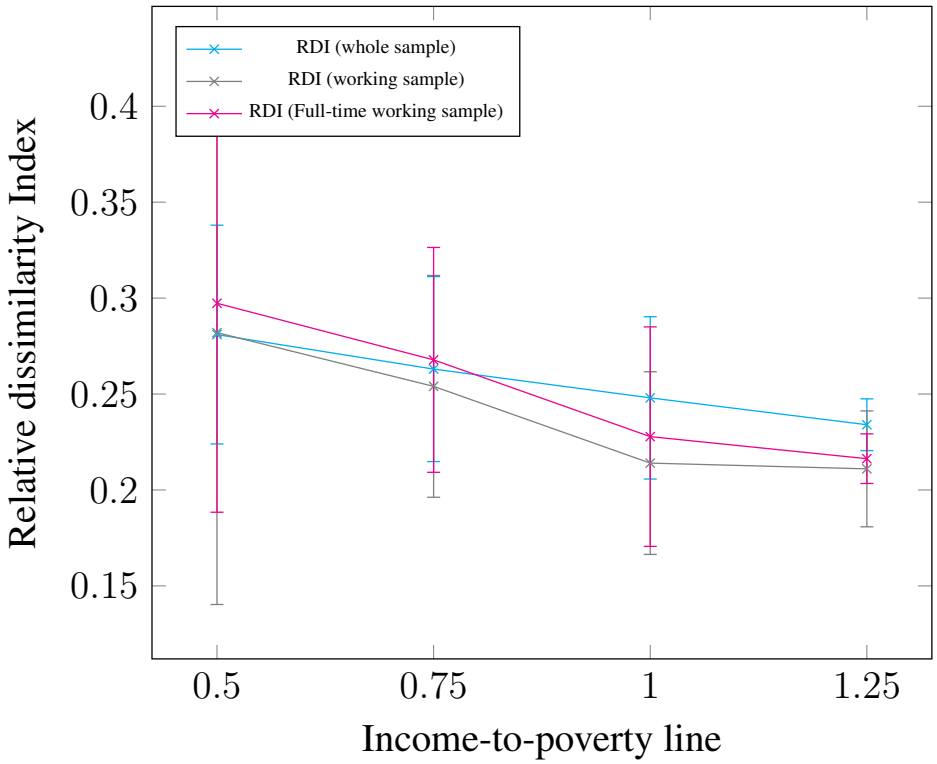


Note: The figure represents the absolute dissimilarity index for three samples reported in Table 22. Bars indicate 95% confidence intervals with bootstrapped standard errors.

The relative dissimilarity index, that is the contribution of inequality of opportunity to total inequality in income poverty status, provides more insight in terms of the relative importance of circumstances in the probability of being poor. We find that almost 25% of total inequality in being income-poor is explained by selected circumstances only; for the working sample, it is lower (almost 22%) and the difference in contributions is not significant. More-

over, its contribution slightly increases in the case of the full-time working sample. Given the small set of reported circumstances about individuals' life before the age of consent and this share being interpreted as a lower bound estimate, the relative contribution of circumstances found is quite high, and Portugal can be deemed highly unequal in opportunities to attain some minimum standard of living. Figure 3.5 illustrates relative dissimilarity indexes for all three samples.

Figure 3.5: Inequality of opportunity in income poverty: Relative dissimilarity index



Note: The figure represents the relative dissimilarity index for three samples reported in Table 22. Bars indicate 95% confidence intervals calculated with bootstrapped standard errors.

Two points can be discussed more in detail. First, the relative index can be contrasted with the findings of other studies, although those use datasets of previous years and focus on differences in incomes. The relative contribution of circumstances to total inequality found in this study is somewhat lower than those obtained for differences in individual or

household incomes in studies using the EU-SILC dataset (Checchi et al., 2016, Álvarez and Lopez Menendez, 2021); these studies find that around one-third of total income differences are explained by opportunity inequality. Considering the first two studies, we can conclude that there is higher equality of opportunity in having economic well-being that allows individuals to escape income poverty and sustain some minimum standard of living. However, its contribution to inequality in income poverty can still be considered high.

Second, the differences between absolute and relative indexes for the whole sample vs. the working sample or full-time working sample are important given the second focus of the study. We can see that the differences in the probability of being income poor is explained by opportunity inequality to a lesser extent in absolute terms when individuals are employed or full-time employed. However, the relative contribution of unfair sources of inequalities is still substantial. Work as such does not reward individuals in a way to eliminate unfair disadvantages, be it gender or ethnic origin, or a more broad set of circumstances that are deemed as causes of unfair inequalities. Although their poverty rate is twice as small among the working sample compared to the whole sample and even smaller for the full-time working sample, the share of unfair inequalities in falling below a certain standard of living is as high as when the whole sample is taken into account.

Table 22 also reports absolute and relative dissimilarity indexes for alternative poverty lines. Starting with the absolute dissimilarity index, we can see that the value of the index decreases as the poverty line is lowered consistently within all three samples, and the change is significant as shown in tables 25-27 (see tables 28-33 for results with alternative models). That is, for instance, inequality of opportunity in being deeply income poor is larger than being extremely income poor in absolute terms. The opposite is true for the relative dissimilarity index; as we focus on poorer segments of the sample, the relative contribution of inequality of opportunity to total inequality in being poor becomes larger. However, the

change in the relative contribution of inequality of opportunity to total inequality in poverty is not significant.

3.5.4 Shapley decomposition results

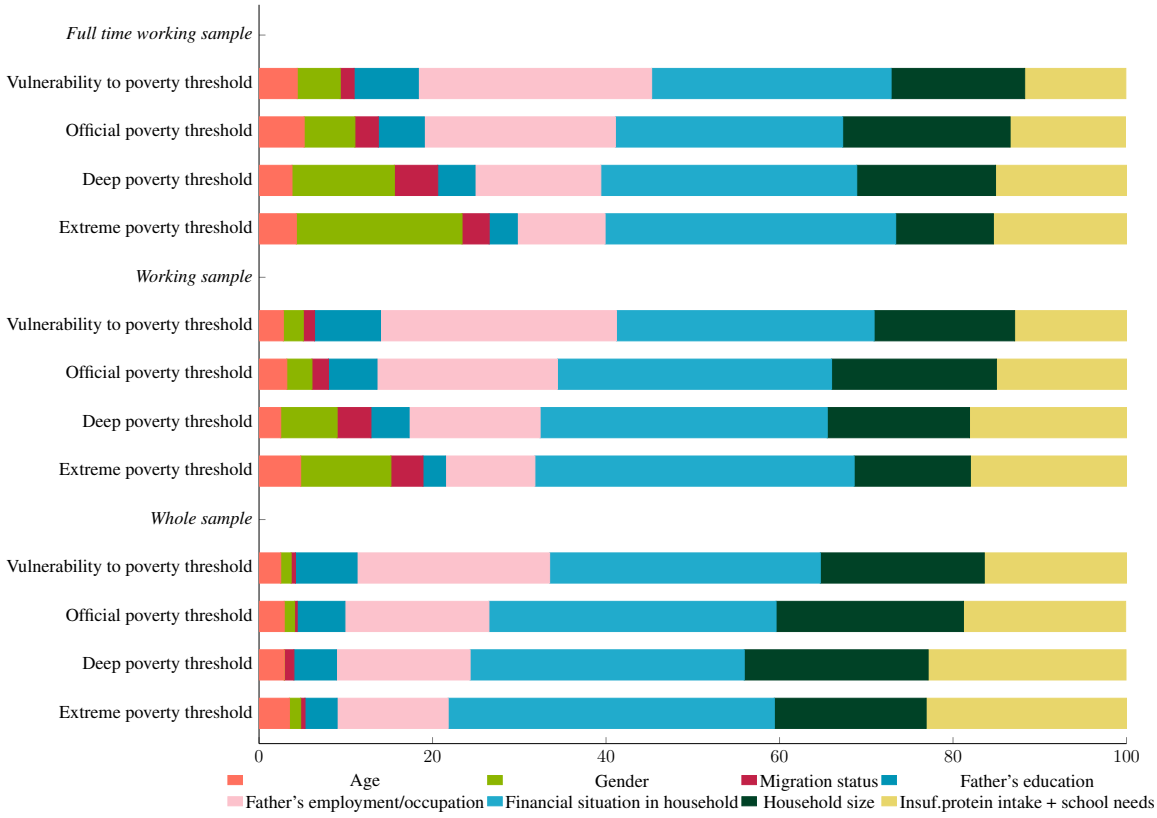
This last subsection presents the decomposition results of the relative contribution of each circumstance to total inequality of opportunity. Figure 3.6 reports Shapley decomposition results for all poverty lines and samples. Let's start with the results when the whole sample is considered. The contribution of some factors to total inequality of opportunity consistently increases or decreases for some variables, while having a more erratic pattern for others. Starting with father's education, we can see that its contribution to total inequality of opportunity is smaller for poorer segments of the sample when the whole sample is taken into account. The same is observed for father's employment status and occupation; the impact of this factor is weaker for the poorest, despite the overall contribution of inequality of opportunity to total inequality in poverty becoming larger.

In contrast, the contribution of the financial situation in the household where individuals grew up, as well as deficiencies in nutrition and school supplies become larger when the poverty line is moved down. That is, not only the link between these circumstance and being in deep or extreme poverty is strong, their contribution to inequality of opportunity for individuals in deep or extreme poverty is also larger. Given that financial situation can be an important determinant of other two circumstances, we can say that financial welfare of households where individuals grew up is the main contributor to the unfair inequalities in being income poor.

Other factors do not show such consistency in terms of their contribution to the inequality of opportunity in being income poor. For instance, the share of gender first decreases and

then increases sharply. This result must be viewed by considering how being female is correlated with being income poor at different poverty lines. While females are more likely to be poor under poverty thresholds for vulnerability to poverty or official poverty threshold, they become less susceptible to extreme poverty compared to males. Another factor indicating such a tendency is the household size. Its contribution decreases consistently, but increases when the poverty line is fixed at the deep poverty threshold, and then decreases again when the poverty line is lowered to the extreme poverty threshold. Given that the impact of both variables characterising household size is consistent throughout the thresholds, we can conclude that the role of household size in inequality of opportunity is larger for those who are deeply poor, but not extremely poor in comparison with those defined as poor under the official poverty line or extreme poverty line. A similar result can be concluded for migration status.

Figure 3.6: Shapley decomposition of inequality of opportunity



Note: The figure presents the relative contribution of each circumstance group to total inequality of opportunity measured via the dissimilarity index reported above. The contributions are computed by estimating logit models with appropriate order of exclusion of circumstances.

Regarding the working sample, some results are in line with those reported for the whole sample; the role of the father's education and occupation/employment status diminishes as we move focus to poorer segments of the sample. However, the impact of these factors on the probability of being poor at alternative poverty lines is not significant, hence, cannot be taken as a robust result. In contrast, the contribution of the financial situation of the household where respondents grew up becomes larger consistently. Unlike for the whole sample, the contribution of gender becomes larger when the poverty line is moved down for the working part of the sample. For example, if there were no gender differences in the prob-

ability of being extremely poor, inequality of opportunity in being extremely poor would be 10.4% less. Other factors show a more mixed pattern – for example, the contribution of the household size where respondents grew up to inequality of opportunity increases at the deep poverty threshold and decreases again when we move to the extreme poverty threshold. Likewise, the contribution of deficiencies in nutrition and school supplies increases consistently and decreases a little when the poverty line is moved to the extreme poverty threshold.

The decomposition results for the full-time working sample are quite similar to those obtained for the working sample. The difference between genders in being income poor becomes even larger – the contribution of these circumstances increases to almost 20% at the lowest poverty threshold (extreme poverty threshold). Again, the financial situation is the largest contributor to inequality of opportunity, and its contribution becomes larger as the poverty line is moved further down. The role of household size, where respondents grew up, becomes large in the case of the official poverty threshold and gradually decreases when the threshold is lowered. Last but not least, the role of deficiencies in nutrition and school supplies becomes larger when moved from higher to lower poverty thresholds. Comparing the results in panels B and C with the results in panel A shows that, being employed or full-time employed does not really mitigate neither the impact, nor the contribution of financial welfare of individuals' adolescent households to their welfare when they are adults, and its contribution becomes almost similar for all three samples when analysing the extreme poor.

3.5.5 Discussion

To summarise the findings above, inequality of opportunity is quite high in the case of Portugal, although the assessment is limited to one year of survey and a small sample. The relative contribution of circumstances to total inequality in being income-poor is significant. It must be kept in mind that these results are lower-bound estimates of the inequality of opportunity

in income poverty, as it is only possible to employ a limited number of circumstances available in the dataset. The true inequality of opportunity both in absolute and relative terms is higher. The results regarding Shapley decomposition show that the financial situation of the household where individuals lived during adolescence is the largest component of inequality of opportunity, followed by the differences in deficiencies in nutrition and school supplies. This observation is valid regardless if individuals are employed or not. As discussed above, this can be an indicator of the lack of economic mobility between generations. If there would be no correlation between the financial welfare of parents and their offspring, estimated inequality of opportunity would be 27-37% lower, depending on the poverty threshold chosen.

The above results emphasize the urgency of policy actions toward mitigating these correlations. Several policy tools are proposed in the economic literature that can mitigate or eliminate intergenerational links of economic disadvantage. The role and quality of social policies is paramount in this sense. Empirical literature finds that targeting financial difficulties of low-resource families can reduce household poverty significantly in European countries (for the extensive literature review, see Szarfenberg (2021)), hence, lead to higher economic welfare of offsprings in the future. Improving the financial situation of households is found to weaken the intergenerational transmission in education as well (Huang, 2013), hence, can improve education level and future chances of young people growing up in households with poorly educated household heads. Such transfers can promote household wellbeing and life satisfaction and aspirations of adolescents in these households (Moreno-Maldonado et al., 2020) that can eventually stimulate their school attendance, transition to post-secondary education (Lindemann and Gangl, 2020), their efforts to developing their skills, and help them escape income poverty in the future. Special attention must be dedicated to lone-parent households, as they are more prone to income poverty, with lone mothers being more susceptible than lone fathers (Maldonado and Nieuwenhuis, 2015). The policies can be more targeted providing cash or in-kind benefits in the form of education allowances

or material support for education opportunities for adolescents or young adults.

Portugal already has several policies in place to address high poverty rates and assist low-income individuals or families that can address intergenerational poverty. One of these measures is the social integration income (*Rendimento Social de Integração, RSI*) scheme. This benefit has been introduced in 1996 (Pereirinha et al., 2020) and is a monthly cash benefit assists individuals and households in extreme poverty (Pereirinha and Murteira, 2019, Nata and Cadima, 2019). Another measure is the family allowance (*Abono da Familia para Crianças e Jovens*[4]) provided to families with children, the goal of which is to help families to meet education expenses of children up to their tertiary education. The assistance is universal, but it is provided according to the income level of households defined in terms of income brackets. To support children's education further, Portugal implements the national program of school meals, where schools provide free lunches every weekday (Picken et al., 2021) to ensure adequate nutrition of children at least once a day. Its the price is also dependent to the income level of families. These measures are paramount for decreasing poverty and social exclusion among population and facilitating more equal opportunities for future generations, but some scholars propose several recommendations to widen the coverage of social safety nets and raise the minimum level of social benefits provided to families to tackle poverty more effectively and in shorter period of time (Arnold and Farinha Rodrigues, 2015). Given the relatively recent implementation of several social support schemes, it is not possible to evaluate their impact on intergenerational transmission of disadvantages, and inequality of opportunity. With the availability of longitudinal and more comprehensive data, the impact of such policies can be assessed and improved.

[4] `https://en.seg-social.pt/family-benefits-for-children-and-young-people`

3.6 Conclusion

The aim of this study is to demonstrate how inequality of opportunity is related to being in income poverty in the case of Portugal. The role of inequality of opportunity in being income deprived is evaluated for three different samples, one that comprises employed and jobless individuals, and two other samples of only employed or only full-time employed individuals. Income is measured as equivalised household disposable income, and the dissimilarity index is chosen as the preferred index of inequality because of the binary nature of the income poverty status. Results show that some selected circumstances such the financial situation in the household where individuals grew up or deficiencies in nutrition and school supplies during adolescence have a significant impact on the probability of being income poor for all three samples, whereas circumstances such as father's education are only important for the whole sample, but not when the focus is shifted to working individuals only. The absolute level of inequality of opportunity in being income poor is not high as opposed to its relative contribution to overall inequality of being income poor – 22-25% depending on the sample.

The study also evaluates inequality of opportunity in being income poor at alternative poverty thresholds. These thresholds allow for evaluating the role of factors beyond individuals' control on being in deep or extreme income poverty. The results show that the impact of most circumstances fade away once poverty threshold is lowered to deep or extreme poverty, implying that selected circumstances do not play a significant role in being in deep or extremely poor, especially for working or full-time working samples. The financial situation of the household where respondents grew up is the only exception – its importance persists across samples and various poverty thresholds. While absolute level of inequality of opportunity also becomes lower, the relative contribution of inequality of opportunity to total inequality in being income poor increases as the poverty threshold is lowered. However, given the insignificance of the role of some circumstances, the results must be taken with

caution.

Another finding is that, being employed indeed decreases the level of absolute and relative inequality of opportunity. When only full- and part-time waged and self-employed individuals are analysed, absolute level of inequality almost halves, and the changes are significant. However, this is not the case for the relative contribution of inequality of opportunity, especially at lower poverty thresholds. There are also no significant differences between the samples consisting of employed, and full-time employed individuals in terms of the absolute level, as well as the relative contribution of inequality of opportunity to total inequality of being income poor. That is, inequality of opportunity between individuals with comparable or similar levels of effort is not different. The results demonstrate that inequality of opportunity in monetary welfare in Portugal is as high as it was found in previous studies. The findings can serve as another indicator of urgency of addressing unequal opportunities and intergenerational links in economic welfare, as it not only creates unfair inequalities in income levels but causes shortfalls from the minimum standard of living that are beyond individual responsibility. However, it must be kept in mind that they are not the result of a causal analysis.

Last but not least, the goal of the study is not to advocate for eliminating unfair inequalities while not touching inequalities generated by responsibility characteristics of individuals. First, the estimated contribution of inequality of opportunity to total inequality in income poverty is a lower-bound estimate, as only few circumstances of individuals are measured and reported in datasets. That is, what we deem as inequalities not caused by unfair sources of inequality comprise responsibility characteristics, unobserved circumstances, as well as the luck factor. Studies show that, the larger the set of circumstances relevant for individual outcomes, the larger the share of unfair inequalities in total inequality of outcome (Hufe et al., 2017). Better datasets with an exhaustive list of circumstances will show

that circumstances are more important in shaping individual outcomes than found in existing empirical literature. Second, disentangling the impact of circumstances from the impact of factors within individual control requires different policy responses to poverty poverty. Low effort or low work intensity can be stimulated via active labour market programs or provision of high-quality public services in the case of lone mothers who are in need of affordable childcare. But low incomes due to low skills or disadvantages caused by tax-benefit systems necessitate pecuniary support to low-income individuals or families. Moreover, acknowledging the correlation between circumstances and effort characteristic of individuals, improving the former factors can also stimulate the effort that individuals exert when they acquire skills and competences necessary for having decent returns to work or when they realise those skills in the work process.

Some shortcomings of the study must be noted. First, presented results cannot be interpreted as a causal. Although both theoretical, and empirical economic literature has largely discussed the impact of socioeconomic characteristics of one generation on the outcomes of the other, this study does not employ suitable methods to show that. Second, the cross-sectional nature of the dataset used limits the possibility to conduct a more thorough analysis, as the poverty status of individuals may not be representative of the longer-term welfare. Some studies show that, the consideration of longer period in such analysis may show that inequality of opportunity or income mobility may be lower compared to analysis done with data covering shorter periods. These caveats must be kept in mind while interpreting results.

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Chapter 1 Appendix

A.1.1 Missing observations per country and deprivation indicator

Table 1: % of missing observations per deprivation indicator

	Austria	Belgium	Bulgaria	Cyprus	Germany	Greece	Hungary	Romania	Slovak Republic	Spain	Switzerland
Education											
Upper secondary education not completed	0%	1.5%	1.2%	0.8%	0%	1.9%	0.23%	1.2%	0.3%	6%	0.04%
Health											
Self-reported health	0.02%	1%	0%	0.08%	0.2%	0%	0.4%	0%	0.5%	1.7%	12.3%
Suffering from chronic illness	0.03%	1%	0%	0.08%	3.9%	0%	0.4%	0%	1.3%	1.6%	9.1%
Presence of unmet medical needs	0.7%	1.9%	4.5%	1.1%	5.1%	2.2%	4.5%	2.7%	5.1%	5.8%	9.9%
Material deprivation											
Leaking roof	0%	0%	0%	0%	0%	0%	0%	0%	0.1%	0%	0.1%
Cold dwelling	0%	0.01%	0%	0%	0%	0%	0.02%	0%	0.01%	0%	0.04%
Overcrowded household	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Not affording durables	0%	0%	0%	1.1%	0%	0%	0.1%	0%	0.04%	0%	0.03%
No access to bath and toilet	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Irregular protein intake	0%	0.01%	0%	0%	0.2%	0%	0.02%	0%	0.01%	0%	0.06%
Environment											
Noise	0%	0.06%	0%	0%	0%	0%	0%	0.02%	0.03%	0%	0.06%
Crime	0%	0%	0%	0%	0%	0%	0%	0.02%	0.03%	0%	0.2%
Pollution	0.1%	0%	0%	0%	0%	0%	0.02%	0.02%	0.03%	0%	0.01%
Multidimensional poverty index	0.4%	1.9%	3.4%	1.1%	4.8%	2.5%	2.8%	2.6%	3%	5.6%	0.8%

The table shows the percentage of observations for which the information on corresponding deprivation indicators is missing.

A.1.2 Characteristics of multidimensionally poor

It is interesting to explore the share of various sociodemographic groups in total number of the poor. Table 2 presents the summary statistics of those classified as such. The multidimensionally poor are mainly females; the share of males constitute less than half of the poor sample in all countries. The share of individuals older than 40 years old is also larger. In terms of education, the poor are mainly have lower-secondary education which is natural as the threshold for education indicator is the lack of upper-secondary education. It is interesting that there is a noticeable share of individuals with tertiary education among the poor. Share of employed among the poor is smaller, whereas the inactive compose over half of the sample (except Germany). Finally, countries have varying percentage of those living in an urban area; those with relatively higher level of income per capita such as Austria, Belgium, and Germany have higher share of urban poor than those with lower level of income per capita such as Bulgaria, Hungary, and Romania.

Table 2: Summary statistics of multidimensionally poor

	Austria	Belgium	Bulgaria	Cyprus	Germany	Greece	Hungary	Romania	Slovak Republic	Spain	Switzerland
Male	37.8%	41.4%	42.4%	43.1%	40.1%	43.4%	36.4%	41.6%	37.3%	44.6%	34.1%
Older than 40	63.9%	52.9%	65.9%	66.2%	63.1%	67.2%	56.1%	67.3%	59.3%	62.7%	59.2%
Married	42.8%	42%	44.9%	65%	45.8%	56.8%	35.3%	51.6%	37.9%	52.4%	50%
Living in a single parent household	9.7%	14.6%	2.2%	2.9%	9.5%	2.3%	5.9%	1.7%	2.9%	3%	10%
Average no. of children < 14 of age in HH[a]	1.8	1.2	1.8	0.69	0.73	0.81	1.1	0.93	1	1.55	0.91
Employed	28.1%	25.2%	26.6%	28.3%	42.1%	20.8%	25.9%	33.4%	25.7%	25%	42.5%
Inactive	57.7%	62.9%	56.3%	56.1%	45.3%	62.3%	62.5%	63.1%	61.8%	49.5%	54%
Lower secondary education	45.1%	31.4%	42.1%	13.5%	21.7%	14.4%	45.6%	42.8%	37.1%	35.5%	41.9%
Upper secondary education	36.3%	34.5%	34.5%	22.7%	43.1%	22.8%	37.5%	28.7%	49.9%	8.8%	37.9%
Post secondary education	37.9%	1.7%	0.6%	1.3%	5.6%	3.5%	1.6%	2.3%	1.8%	0.04%	0%
Tertiary education	6.8%	15.6%	7.7%	10.6%	25.1%	8.3%	6%	3.7%	9.2%	6.9%	18.4%
Living in urban area	48.1%	55.1%	31%	41.2%	43.2%	41.7%	22.4%	25.6%	20.4%	53%	44.1%

Note: Table presents the share of different sociodemographic groups in total number of multidimensionally poor.

[a]The indicator shows the average number of children in the households where children are present.

A.1.3 Group-specific subjective weights

Table 3: Country means of subjective weights for employed

Country	Education	Health	Material deprivation	Environment
Austria	0.1061	0.4216	0.4251	0.0471
	(0.0054)	(0.0293)	(0.0215)	(0.0024)
Belgium	0.0617	0.3198	0.5704	0.0481
	(0.0012)	(0.0081)	(0.0144)	(0.0278)
Bulgaria	0.1258	0.3380	0.5704	0.0481
	(0.0339)	(0.0256)	(0.0172)	(0.0014)
Cyprus	0.0936	0.2775	0.6034	0.0256
	(0.0459)	(0.0711)	(0.0980)	(0.0024)
Germany	0.0744	0.2829	0.5807	0.0620
	(0.0296)	(0.0480)	(0.0038)	(0.0038)
Greece	0.1351	0.3589	0.4727	0.0333
	(0.000)	(0.000)	(0.000)	(0.000)
Hungary	0.1251	0.2976	0.5105	0.0667
	(0.0054)	(0.0509)	(0.0486)	(0.0029)
Romania	0.0734	0.3770	0.4965	0.0531
	(0.0153)	(0.0063)	(0.382)	(0.0287)
Slovak Republic	0.1265	0.3135	0.5186	0.0414
	(0.0211)	(0.0478)	(0.0188)	(0.0015)
Spain	0.1239	0.2333	0.6324	0.0003
	(0.0200)	(0.0426)	(0.0449)	(0.0000)
Switzerland	0.0220	0.3366	0.5053	0.1361
	(0.0054)	(0.0829)	(0.1219)	(0.0335)

Table 4: Country means of subjective weights for males

Country	Education	Health	Material deprivation	Environment
Austria	0.0834	0.4587	0.4122	0.0457
	(0.0279)	(0.0524)	(0.0257)	(0.0029)
Belgium	0.0575	0.3650	0.5316	0.0459
	(0.0047)	(0.0492)	(0.0437)	(0.0230)
Bulgaria	0.0915	0.3534	0.5118	0.0433
	(0.0510)	(0.0304)	(0.0260)	(0.0037)
Cyprus	0.1116	0.2782	0.5852	0.0250
	(0.0433)	(0.0709)	(0.0977)	(0.0366)
Germany	0.0651	0.3023	0.5676	0.0651
	(0.0283)	(0.0482)	(0.0049)	(0.0050)
Greece	0.1351	0.3589	0.4727	0.0333
	(0.000)	(0.000)	(0.000)	(0.000)
Hungary	0.0988	0.3599	0.5029	0.0382
	(0.0292)	(0.0872)	(0.0490)	(0.0312)
Romania	0.0630	0.3904	0.4918	0.04198
	(0.0034)	(0.0212)	(0.0423)	(0.0299)
Slovak Republic	0.1045	0.3577	0.4882	0.0495
	(0.0163)	(0.0755)	(0.0595)	(0.0026)
Spain	0.1272	0.2900	0.5825	0.0003
	(0.0156)	(0.0764)	(0.0714)	(0.0000)
Switzerland	0.0185	0.3468	0.5206	0.1141
	(0.0059)	(0.0726)	(0.1022)	(0.0366)

Table 5: Country means of subjective weights for those in consensual union

Country	Education	Health	Material deprivation	Environment
Austria	0.0822	0.4546	0.417	0.0462
	(0.0287)	(0.0526)	(0.0247)	(0.0027)
Belgium	0.0578	0.3634	0.5345	0.0443
	(0.0047)	(0.0491)	(0.0433)	(0.0223)
Bulgaria	0.0687	0.3622	0.5246	0.0445
	(0.0441)	(0.0298)	(0.0204)	(0.0037)
Cyprus	0.0914	0.2405	0.6427	0.0253
	(0.0458)	(0.0217)	(0.0986)	(0.0363)
Germany	0.0796	0.2787	0.5784	0.0632
	(0.0141)	(0.0273)	(0.0179)	(0.0039)
Greece	0.1351	0.3589	0.4727	0.0333
	(0.000)	(0.000)	(0.000)	(0.000)
Hungary	0.0976	0.3302	0.5346	0.0375
	(0.0290)	(0.0725)	(0.0226)	(0.0310)
Romania	0.0807	0.3989	0.4619	0.0585
	(0.0177)	(0.0242)	(0.0522)	(0.0312)
Slovak Republic	0.1146	0.3141	0.5290	0.0423
	(0.0422)	(0.0438)	(0.0149)	(0.0012)
Spain	0.1031	0.2992	0.5974	0.0003
	(0.0196)	(0.0773)	(0.0615)	(0.0000)
Switzerland	0.0180	0.3448	0.5260	0.1112
	(0.0058)	(0.0696)	(0.0986)	(0.0363)

Table 6: Country means of subjective weights for aged 40 or older

Country	Education	Health	Material deprivation	Environment
Austria	0.0814	0.4711	0.4080	0.0452
	(0.0286)	(0.0543)	(0.0263)	(0.0029)
Belgium	0.0565	0.3764	0.5230	0.0440
	(0.0046)	(0.0490)	(0.0429)	(0.0222)
Bulgaria	0.0834	0.3556	0.5165	0.0438
	(0.0482)	(0.0302)	(0.0239)	(0.0037)
Cyprus	0.0913	0.2704	0.6127	0.0255
	(0.0459)	(0.0672)	(0.0932)	(0.0024)
Germany	0.0642	0.3043	0.5659	0.0655
	(0.0274)	(0.0469)	(0.0246)	(0.0049)
Greece	0.1351	0.3589	0.4727	0.0333
	(0.000)	(0.000)	(0.000)	(0.000)
Hungary	0.1351	0.3589	0.4727	0.0333
	(0.0288)	(0.0899)	(0.0499)	(0.0308)
Romania	0.0820	0.4046	0.4569	0.0564
	(0.0178)	(0.0239)	(0.0527)	(0.0308)
Slovak Republic	0.0847	0.3515	0.5221	0.0417
	(0.0571)	(0.0662)	(0.0181)	(0.0014)
Spain	0.1078	0.3253	0.5666	0.0003
	(0.0206)	(0.0783)	(0.0690)	(0.0000)
Switzerland	0.0175	0.3488	0.5165	0.1082
	(0.0057)	(0.0689)	(0.0961)	(0.0354)

A.1.4 Headcount poverty ratios per deprivation indicator

Table 7 presents uncensored and censored poverty headcount ratios per each indicator - that is, these ratios represent the fraction of population deprived in a given indicator regardless their multidimensional poverty status and of those who are also multidimensionally poor, respectively. As seen, education and suffering from chronic diseases are the indicators in which residents are deprived the most – almost one-third of the sample. The numbers are particularly high for some countries. Spain stands out as the country with the highest share of population without secondary education – 48.2%. The lowest share in this deprivation indicator is observed for the Slovak Republic. Austria, Germany, and Switzerland show the highest rates of population suffering from chronic diseases, while Bulgaria is the country with the lowest population share in this deprivation indicator in the sample. The presence of unmet medical needs is not seen as a serious problem except for Bulgaria, Greece, and Romania.

The indicators included in the material deprivation require a closer look as the percentages differ significantly among countries for this dimension. It is to be noted that, Western European countries do not suffer from material deprivation as much which can be related to higher monetary welfare in those countries. For instance, Bulgarian residents specifically suffer from insufficient food intake in terms of proteins – more than half of the population is not able to have a regular intake of some proteins and nutrients. Hungary, Romania, and Slovak Republic show comparatively lower levels of deprivation in this indicator; however, the rates are still high. Bulgarians also suffer from a cold dwelling – 46% - as well as Cypriots and Greeks with 29-30% of total population being deprived in this indicator. Almost one-third of the respondents of Cyprus and Hungary have leaking roof and damp walls problem. Bulgaria and Romania also lack the access to indoor bath/shower and toilet facilities. Living in an overcrowded household is another issue largely reported by the respondents.

Relatively smaller share of population suffers from environmental deprivation in observed countries. Germany and Greece appear to suffer more in two environment indicators compared to the average. In contrast, Hungary and Spain perform below the average in all three indicators.

Table 7: Uncensored and censored poverty headcount ratios per indicator

Uncensored headcount ratios													
	Education	Health			Material deprivation						Environment		
Country	Upper secondary education not completed	Self-reported health	Suffering from chronic disease	Presence of unmet needs	Leaking roof	Cold dwelling	Overcrowded household	Not affording durables	No access to bath and toilet	Irregular protein intake	Noise	Crime	Pollution
Austria	23.8%	8.1%	32%	0.59%	12.5%	2.7%	14.7%	0.3%	1.1%	8.3%	18.9%	11.3%	10.9%
Belgium	30.6%	7.8%	23.7%	2.2%	17.9%	5.8%	2%	0.9%	2.4%	4.6%	17.5%	19.3%	17.4%
Bulgaria	28.8%	10%	16.7%	8.8%	12.3%	44.6%	44%	7.1%	21.7%	50.5%	10.7%	25.3%	14%
Cyprus	29.3%	5.9%	29.1%	4.6%	30.9%	30.6%	2.2%	0.05%	1%	7.9%	26.2%	15.3%	15.8%
Germany	21.3%	6.4%	33.7%	2.1%	12.8%	5%	6.2%	0.35%	0.12%	7.8%	25.1%	12.2%	21.1%
Greece	36.5%	8.2%	19.4%	9.1%	13.7%	29.2%	27.2%	0.8%	0.9%	13.9%	24.3%	18.9%	26.6%
Hungary	25.6%	13.3%	32.3%	3.5%	24.8%	12.7%	45.4%	1.8%	4.8%	31.9%	12%	11.9%	13.6%
Romania	36%	7.7%	16.3%	9.6%	14.8%	14.3%	53.1%	9.8%	34.2%	21.9%	26.3%	15.7%	17.5%
Slovak Republic	16.8%	9.6%	27.2%	2.3%	7.1%	5.3%	39.9%	8.9%	0.6%	23.1%	14.6%	8.6%	14.2%
Spain	48.2%	6.4%	27.3%	2.9%	16%	7.3%	5.1%	0.3%	0.10%	3.1%	17.9%	13.8%	9.6%
Switzerland	19.1%	3.2%	32.6%	1.4%	11.5%	0.4%	6%	0.03%	0.01%	1.7%	16.3%	14.8%	9.2%
Average	30.4%	7.2%	28.2%	3.7%	14.4%	9.4%	16.3%	1.7%	4.9%	11.3%	21.2%	14.1%	16.6%
Censored headcount ratios													
Austria	14.3%	4.2%	11.1%	0.31%	3.8%	1.5%	4.5%	0.2%	0.4%	3.4%	6.2%	3.8%	3.9%
Belgium	18.6%	5.3%	11.8%	1.5%	5.7%	3.3%	1%	0.6%	1%	2.8%	7.1%	7.9%	7%
Bulgaria	24.1%	6.9%	9.4%	6.2%	8.2%	20.1%	15.5%	6%	14.5%	23%	5.7%	10.9%	7.8%
Cyprus	21.7%	4.8%	16.3%	2.4%	11.2%	12.4%	0.9%	0.04%	0.8%	4.3%	10%	5.6%	6.3%
Germany	12.3%	3.1%	9.6%	1%	3.7%	2.3%	2.1%	0.2%	0.01%	3%	8.2%	4.8%	7%
Greece	25%	7%	14.6%	5.7%	7.3%	14.1%	10.6%	0.5%	0.6%	7.7%	10.3%	8.1%	10.7%
Hungary	20.2%	7.9%	13.8%	2.1%	12.2%	6.7%	14.3%	1.6%	3.9%	14%	6.3%	6.4%	6.3%
Romania	27.7%	6.2%	11.1%	7.6%	10.4%	8.7%	19.6%	7.9%	20.1%	13.9%	11.1%	8.1%	8.2%
Slovak Republic	10.8%	4.3%	7.6%	0.9%	2.9%	1.8%	7.3%	0.5%	0.4%	7%	4.3%	3.1%	4.5%
Spain	27.1%	5.1%	17.2%	1.3%	6.9%	4%	2.3%	0.2%	0.04%	2.1%	9.2%	7.5%	5.2%
Switzerland	10.5%	1.5%	7.5%	0.6%	2.2%	0.2%	1.7%	0%	0.004%	0.9%	4.6%	3.8%	3.4%
Average	18.9%	4.6%	11.9%	2.2%	5.9%	4.8%	5.9%	1.3%	2.9%	5.5%	8.3%	6.2%	6.6%

The table presents the share of individuals deprived in each indicator in general (uncensored headcount ratios), and deprived and multidimensionally poor (censored headcount ratios).

A.1.5 Shapley decomposition results

Table 8: Shapley decomposition of normative MPI

Country	Dimension	$\beta=1$			$\beta=2$			$\beta=5$		
		$\alpha=1$	$\alpha=2$	$\alpha=5$	$\alpha=1$	$\alpha=2$	$\alpha=5$	$\alpha=1$	$\alpha=2$	$\alpha=5$
Austria	Education	53%	52%	45%	62%	58%	51%	65%	62%	53%
	Health	20%	20%	21%	16%	17%	18%	15%	15%	16%
	Material deprivation	9%	9%	11%	6%	7%	9%	5%	6%	9%
	Environment	18%	19%	23%	16%	18%	22%	15%	17%	22%
Belgium	Education	54%	50%	43%	61%	57%	49%	65%	60%	51%
	Health	18%	19%	21%	15%	16%	18%	13%	15%	17%
	Material deprivation	7%	8%	10%	5%	6%	8%	4%	5%	8%
	Environment	21%	23%	26%	19%	21%	25%	18%	20%	24%
Bulgaria	Education	44%	42%	36%	50%	47%	40%	54%	51%	43%
	Health	14%	15%	17%	12%	14%	16%	11%	13%	16%
	Material deprivation	27%	26%	26%	24%	23%	23%	4%	5%	20%
	Environment	15%	17%	21%	14%	16%	21%	22%	20%	21%
Cyprus	Education	52%	49%	43%	60%	57%	50%	64%	61%	53%
	Health	19%	20%	21%	16%	16%	18%	14%	15%	17%
	Material deprivation	12%	12%	13%	8%	9%	10%	7%	7%	9%
	Environment	17%	19%	23%	16%	18%	22%	15%	17%	21%
Germany	Education	49%	47%	41%	55%	52%	45%	57%	55%	48%
	Health	18%	18%	20%	15%	16%	18%	14%	14%	16%
	Material deprivation	7%	8%	10%	5%	6%	8%	5%	6%	8%
	Environment	26%	27%	29%	25%	26%	29%	24%	25%	28%
Greece	Education	50%	46%	40%	56%	53%	45%	60%	56%	47%
	Health	18%	20%	22%	16%	17%	20%	14%	16%	19%
	Material deprivation	13%	13%	24%	10%	10%	11%	9%	9%	11%
	Environment	19%	21%	24%	18%	20%	24%	17%	19%	23%
Hungary	Education	47%	44%	38%	54%	50%	43%	57%	54%	46%
	Health	18%	19%	20%	16%	17%	19%	15%	16%	18%
	Material deprivation	20%	20%	21%	17%	17%	18%	15%	15%	16%
	Environment	15%	17%	21%	13%	16%	20%	13%	15%	20%
Romania	Education	47%	44%	37%	53%	49%	41%	57%	52%	43%
	Health	14%	17%	20%	13%	16%	20%	12%	15%	19%
	Material deprivation	23%	22%	22%	20%	19%	19%	18%	17%	18%
	Environment	16%	17%	21%	14%	16%	20%	13%	16%	20%
Slovak Republic	Education	48%	45%	39%	55%	52%	44%	58%	55%	48%
	Health	19%	20%	21%	17%	17%	19%	15%	16%	17%
	Material deprivation	15%	15%	16%	11%	11%	13%	10%	10%	12%
	Environment	18%	20%	24%	17%	20%	24%	17%	19%	23%
Spain	Education	60%	56%	49%	68%	64%	55%	72%	67%	57%
	Health	18%	18%	19%	14%	15%	16%	13%	13%	15%
	Material deprivation	6%	7%	9%	4%	5%	7%	3%	5%	7%
	Environment	16%	19%	23%	14%	16%	22%	12%	15%	21%
Switzerland	Education	57%	53%	46%	64%	61%	52%	68%	64%	55%
	Health	17%	18%	20%	14%	14%	17%	12%	13%	15%
	Material deprivation	5%	6%	7%	3%	4%	6%	2%	4%	6%
	Environment	21%	23%	27%	19%	21%	25%	18%	19%	24%

Table 9: Shapley decomposition of subjective MPI

Country	Dimension	$\beta=1$			$\beta=2$			$\beta=5$		
		$\alpha=1$	$\alpha=2$	$\alpha=5$	$\alpha=1$	$\alpha=2$	$\alpha=5$	$\alpha=1$	$\alpha=2$	$\alpha=5$
Austria	Education	20%	16%	15%	38%	33%	25%	57%	52%	44%
	Health	55%	58%	58%	41%	44%	47%	23%	25%	27%
	Material deprivation	20%	22%	24%	13%	15%	19%	8%	9%	13%
	Environment	5%	4%	3%	8%	8%	9%	12%	14%	16%
Belgium	Education	20%	15%	11%	39%	32%	22%	57%	51%	41%
	Health	48%	51%	51%	36%	41%	46%	22%	24%	28%
	Material deprivation	24%	27%	31%	13%	15%	19%	6%	8%	12%
	Environment	8%	7%	7%	12%	12%	13%	15%	17%	19%
Bulgaria	Education	14%	13%	10%	25%	23%	19%	41%	37%	30%
	Health	22%	25%	29%	19%	22%	26%	15%	18%	22%
	Material deprivation	61%	59%	57%	51%	49%	48%	35%	33%	34%
	Environment	3%	3%	4%	5%	6%	7%	9%	12%	14%
Cyprus	Education	25%	23%	20%	43%	40%	34%	59%	56%	49%
	Health	31%	33%	36%	28%	29%	33%	19%	21%	24%
	Material deprivation	41%	42%	42%	24%	25%	26%	12%	12%	14%
	Environment	3%	2%	2%	5%	6%	7%	10%	11%	13%
Germany	Education	16%	13%	10%	31%	27%	21%	48%	44%	36%
	Health	42%	42%	41%	33%	36%	39%	21%	22%	26%
	Material deprivation	29%	34%	41%	16%	19%	24%	7%	10%	13%
	Environment	13%	11%	8%	20%	18%	16%	24%	24%	25%
Greece	Education	33%	29%	24%	48%	43%	35%	58%	54%	46%
	Health	32%	36%	40%	26%	30%	36%	19%	21%	26%
	Material deprivation	32%	32%	33%	20%	21%	22%	12%	13%	14%
	Environment	3%	3%	3%	6%	6%	7%	11%	12%	14%
Hungary	Education	17%	14%	12%	30%	26%	21%	48%	44%	35%
	Health	36%	39%	40%	31%	34%	36%	22%	24%	27%
	Material deprivation	46%	45%	45%	36%	36%	37%	23%	24%	26%
	Environment	1%	2%	3%	3%	4%	6%	7%	8%	12%
Romania	Education	19%	16%	12%	32%	27%	20%	48%	42%	32%
	Health	28%	34%	40%	23%	29%	35%	16%	21%	28%
	Material deprivation	49%	46%	43%	38%	37%	36%	26%	25%	26%
	Environment	4%	4%	5%	7%	7%	9%	10%	12%	14%
Slovak Republic	Education	7%	8%	9%	12%	15%	17%	19%	25%	28%
	Health	45%	46%	43%	43%	44%	42%	36%	35%	33%
	Material deprivation	44%	42%	44%	36%	32%	32%	27%	22%	21%
	Environment	4%	4%	4%	9%	9%	9%	18%	18%	18%
Spain	Education	41%	34%	28%	62%	55%	44%	74%	69%	51%
	Health	39%	41%	41%	28%	31%	35%	18%	20%	25%
	Material deprivation	20%	24%	31%	10%	14%	20%	5%	8%	18%
	Environment	0%	0%	0%	0%	0%	1%	3%	3%	6%
Switzerland	Education	9%	6%	6%	25%	19%	12%	51%	45%	32%
	Health	53%	52%	50%	41%	43%	44%	22%	24%	28%
	Material deprivation	18%	22%	25%	9%	12%	15%	4%	6%	9%
	Environment	21%	20%	21%	25%	26%	29%	23%	25%	31%

A.1.6 Change in the contribution of each deprivation dimension to total multidimensional poverty with α and β

Table 10: OLS regression results

	With normative weights				With subjective weights			
	Education	Health	Material depr.	Environment	Education	Health	Material depr.	Environment
Panel A: Higher-income countries: Austria, Belgium, Germany, Spain, Switzerland								
$\alpha = 2$	-3.222***	1.444**	-0.333	0.667	-2.389	2.778	-1.000	0.667
	(1.055)	(0.548)	(1.754)	(0.695)	(3.274)	(2.109)	(2.894)	(0.695)
$\alpha = 5$	-10.56***	3.667***	1.222	1.833**	-6.944**	5.833***	-0.889	1.833**
	(1.055)	(0.548)	(1.754)	(0.695)	(3.274)	(2.109)	(2.894)	(0.695)
$\beta = 2$	6.000***	-1.944***	-3.722**	3.333***	11.39***	-3.833*	-10.78***	3.333***
	(1.055)	(0.548)	(1.754)	(0.695)	(3.274)	(2.109)	(2.894)	(0.695)
$\beta = 5$	9.389***	-3.111***	-5.222***	9.167***	24.78***	-11.56***	-22.28***	9.167***
	(1.055)	(0.548)	(1.754)	(0.695)	(3.274)	(2.109)	(2.894)	(0.695)
Constant	48.54***	16.85***	18.59***	2.39***	20.06***	32.41***	45.07***	2.389***
	(0.963)	(0.500)	(1.601)	(0.634)	(2.989)	(1.925)	(2.642)	(0.634)
N	54	54	54	54	54	54	54	54
F-stat	46.64	19.60	2.569	46.39	15.51	9.704	14.85	46.39
R-squared	0.792	0.615	0.173	0.791	0.559	0.442	0.548	0.791
Panel B	Lower-income countries: Bulgaria, Cyprus, Greece, Hungary, Romania, Slovak Republic							
$\alpha = 2$	-3.467**	0.533	1.067**	1.800	-5.133	2.133	2.867**	-0.000
	(1.460)	(0.344)	(0.430)	(1.233)	(3.880)	(1.862)	(1.320)	(3.142)
$\alpha = 5$	-11.33***	2.267***	3.133***	5.867***	-12.670***	4.267**	7.467***	1.000
	(1.460)	(0.344)	(0.430)	(1.233)	(3.880)	(1.862)	(1.320)	(3.142)
$\beta = 2$	6.600***	-3.000***	-2.000***	-1.533	15.00***	-9.133***	-10.60***	4.600
	(1.460)	(0.344)	(0.430)	(1.233)	(3.880)	(1.862)	(1.320)	(3.142)
$\beta = 5$	9.600***	-4.600***	-2.400***	-2.600**	32.80***	-24.47***	-17.07***	8.600***
	(1.460)	(0.344)	(0.430)	(1.233)	(3.880)	(1.862)	(1.320)	(3.142)
Constant	55.27***	18.07***	6.533***	20.18***	23.27***	46.00***	22.69***	8.200***
	(1.333)	(0.314)	(0.393)	(1.126)	(3.542)	(1.700)	(1.205)	(2.868)
N	45	45	45	45	45	45	45	45
F-stat	27.14	58.01	22.67	7.065	20.60	45.38	50.75	1.910
R-squared	0.731	0.853	0.694	0.414	0.673	0.819	0.835	0.160

Robust standard errors are given in parentheses; $^{*} - p < 0.10$, $^{**} - p < 0.05$, $^{***} - p < 0.01$. Note: Explanatory variables in the analysis are dummies indicating that the parameters of the multidimensional index take the given values.

Chapter 2 Appendix

A.2.1 Computation and imputation of hourly wages

Individual wages are computed using the information available for the period of the interview. The dataset contains a variable providing gross monthly employee earnings of individuals from their primary job that also includes "usual paid overtime, tips and commission but excludes income from investments- assets, savings, stocks and shares. If a person receives, as a part of a salary, supplementary payments (13^{th} or 14^{th} month payments), or payments such as holiday pay, profit share, bonuses, these payments should be taken into account on a monthly basis." (Eurostat, 2018). This variable is divided by weekly hours usually worked (converted to monthly values by multiplying by a factor of 4.32) by individuals at their main job. The source of information in the EU-SILC is either personal interviews or registers, hence, they may be subject to errors or imprecision. However, Portugal is the "survey country", that is, all information is collected through personal interviews and is more prone to imprecision, which must be taken into account while interpreting the results. The dataset also contains employee's cash or near cash gross/net income from the income reference period (annual income for the last 12 months), however, there is no information on hours worked and, therefore, can only help to derive monthly wages depending on the employment status of individuals for each month (for a detailed procedure, see Berger and Schaffner (2012)) . Some studies have used the information on annual income for computing monthly or hourly wages by utilising the longitudinal European Consumption Household Panel, the predecessor of the EU-SILC dataset (Bargain et al., 2012). But the information of weekly hours worked is only available for the time of interview in the longitudinal EU-SILC, and may not match average monthly hours worked for a given year. Hence, the study opted for the computation method described above by using hours worked and gross employees earnings pertaining to the same period.

Hourly wages are imputed with estimated values for those with missing information.

The sample also contains inactive respondents in the sample, as well as zero reported (or unreported) gross monthly earnings by some full-time and part-time employees. Using the ordinary least squares approach would produce inconsistent results; that is why the Heckman's two-step estimator (Heckman, 1979) is applied to account for the selection problem and estimate the wages of those who do not participate in the labour market or reported zero gross employee earnings in the income reference period.

The wage equation is constructed as:

$$\log w_i = X_{i,w}\beta + u_{1i} \tag{1}$$

Here, $X_{i,w}$ are individual covariates affecting the wage of individuals, and γ_i is an idiosyncratic error. However, the wages are only observed if individuals participate in the labour market in the period considered. Denoting s_i as a binary indicator equal to 1 if individuals participate in the market, s_i is determined by the following probit model:

$$s_i = \mathbb{1}(X_{i,s}\gamma + u_{2i}) \tag{2}$$

Here, s_i is a binary indicator whether an individual participates in the labour market. $X_{i,s}$ is the vector of covariates affecting her decision to participate that also includes $X_{i,w}$, and ϵ_i is normally distributed error with mean zero and variance of 1. The problem arises if $\rho_{u_{1,i},u_{2,i}} \neq 0$, where ρ indicates covariance between the error terms of two equations; in this case, estimates of the OLS become biased. To account for the possible selection, we estimate the impact of the determinants of gross wages in two steps. First, the probit model (equation 2)is estimated with covariates $X_{i,s}$. As a result, we obtain an additional "regressor" $\lambda(X_{i,s}\hat{\gamma}) = \frac{\phi(X_{i,s}\hat{\gamma})}{\Phi(X_{i,s}\hat{\gamma})}$ called the inverse Mill's ratio and include in the wage equation to account for the selection ($\phi(X_{i,s}\hat{\gamma})$ is the probability distribution function, whereas $\overline{\Phi(X_{i,s}\hat{\gamma})}$

is the complementary cumulative distribution function). Hence, denoting $\sigma_{u_{1,i}}$ the standard deviation of the error term of the wage equation, the equation becomes:

$$logw_i = X_{i,w}\beta + \sigma_{u_{1i}}\rho_{u_{1,i},u_{2,i}}\lambda(X_{i,s}\hat{\gamma}) + v_i \tag{3}$$

Table 11 presents the estimation results of wage equation. The wages are estimated separately for males and females. The estimated wages are only used for those whose wages are not observed, whereas those with observed wages are assigned their actual wages (net incomes were simulated and the model was estimated also by assigning estimated wages to all observations, but the results were similar).

The impact of covariates are in line with the expectations. The number of children is excluded from the selection equation for men due to the problems with the convergence. The selection equation shows that single fathers are more likely to participate in labour markets compared to single individuals with no children. Single mothers are higher preferences for leisure compared to women with no children, although the coefficient of the latter is not significant. Similarly, mothers with children of preschool and school-age are less likely to work, however, this effect is not significant as well. The LR test of independence shows that the selection problem is only present for females, but not for males.

Table 11: Wage and probit selection equations

	Males			
	Wage equation	Selection equation	Wage equation	Selection equation
Age	0.0198^{***}	0.0359	0.0235^{**}	0.109^{***}
	(0.0050)	(0.0248)	(0.0048)	(0.0226)
Age^2	-0.0001	-0.0004	0.0001	-0.0012^{***}
	(0.0001)	(0.0000)	(0.0001)	(0.0003)
Lower secondary	0.165^{***}	0.326^{***}	0.266^{***}	0.712^{***}
	(0.0224)	(0.108)	(0.0224)	(0.0993)
Upper secondary	0.282^{***}	0.224^{***}	0.455^{***}	0.948^{***}
	(0.0222)	(0.103)	(0.0243)	(0.0965)
Post secondary	0.188^{**}	0.238	0.536^{***}	1.057^{**}
	(0.0768)	(0.372)	(0.0676)	(0.392)
Tertiary	0.660^{***}	0.369^{***}	0.844^{***}	1.030^{***}
	(0.0258)	(0.135)	(0.0222)	(0.115)
Number of kids younger than 18	-	-	-	-0.110
	(-)	(-)	(-)	(0.0699)
Number of kids younger than 6	-	-	-	-0.0487
	(-)	(-)	(-)	(0.134)
Single parent	-	0.484^{**}	-	-0.0183
	(-)	(0.218)	(-)	(0.0830)
Constant	0.862^{**}	0.497	0.420^{***}	-1.600^{***}
	(0.0938)	(0.448)	(0.0918)	(0.425)
N	2648		3190	
Log-likelihood	-1712.33		-2035.49	
LR test of independence	1.15		41.4^{***}	
Wald statistic	933.9^{***}		2313.3^{***}	

Note: Robust standard errors are given in parentheses. $^{***} - p < 0.01$; $^{**} - p < 0.05$; $^{*} - p < 0.10$.

The impact of covariates are in line with the expectations. The number of children is excluded from the selection equation for men due to the problems with the convergence. The selection equation shows that single fathers are more likely to participate in labour markets compared to single individuals with no children. Single mothers are higher preferences for leisure compared to women with no children, although the coefficient of the latter is not significant. Similarly, mothers with children of preschool and school-age are less likely to

work, however, this effect is not significant as well. The LR test of independence shows that the selection problem is only present for females, but not for males.

A.2.2 Simulation of net incomes

In order to estimate the structural labour supply model, information on potential net incomes and work hours must be available. The work hours are built as six discrete choices as described in Table 2.2. First, gross monthly earnings are computed using the gross hourly wages of individuals for each choice point. Given that some individuals have more than one job but only report their gross earnings for their main job (3.24% of the sample; the dataset provides such information), it is assumed that those individuals earn the same gross wage per hour at those jobs. Hence, work hours of additional jobs and corresponding gross earnings are added to available information on monthly work hours and gross earnings. Thereafter, individual net incomes are obtained via the tax-benefit simulator EUROMOD (Sutherland and Figari, 2013) using tax-benefit rules for corresponding years (i.e., 2017 and 2018) for each discrete choice point. EUROMOD is a simulation tool developed for all European countries with corresponding tax-benefit rules for each country and year. Some observations are assigned negative disposable incomes after tax simulations at zero choice point. Negative incomes appear due to non-income taxes, such as property taxes. These taxes are only subtracted from labour income if an individual is at the choice point that is at least as large as her actual labour supply. There are also 46 inactive individuals who have negative disposable income at zero choice point and do not take part in the labour market. This treatment is not suitable for them as their labour supply is zero in real life. Hence, they are excluded.

Actual household disposable incomes are also obtained via the simulation of available gross earnings of individuals in EUROMOD. First, gross earnings are computed using the

information on gross earnings from their main job, and the work hours in their second, third, etc. jobs, assuming that individuals earn the same gross hourly wage at each job. Thereafter, the disposable income of household members is simulated (Figure 1), summed and divided by equivalised household size (available in the dataset). The resulting net incomes approximate equivalised disposable household incomes from the previous year with 89.9% correlation (Figure 2). This is not surprising considering the proximity of the interview time (41% have had their interview conducted in January and 59% in February of the interview year) with income reference period. Moreover, 83.6% (3% have not answered) have not changed their jobs since the previous year, whereas among those who have changed their jobs, over 75% have worked at least 6 months with the same employment status as they have in the current period (i.e., those who are full-time employed were full-time employed, part-time employed in the current period were also part-time employed in the previous period, etc).

Figure 1: Scatterplot of gross monthly employee earnings and simulated individual net incomes

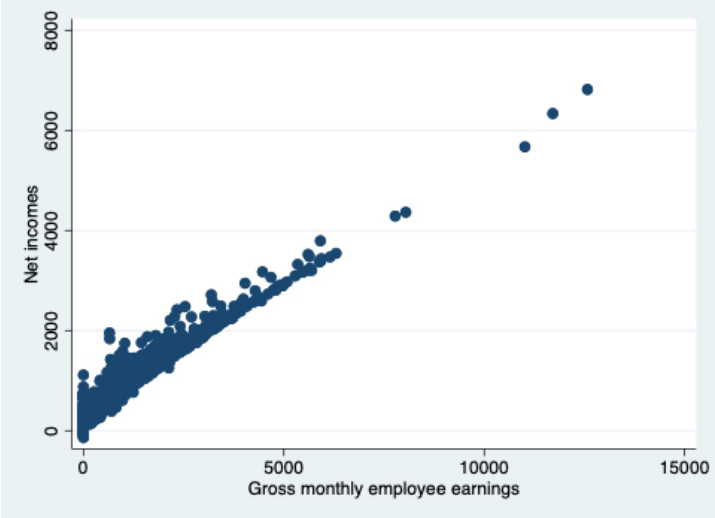
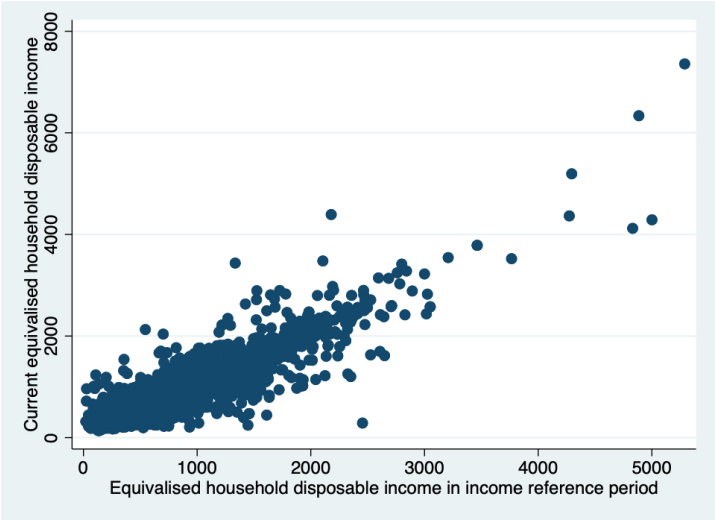


Figure 2: Scatterplot of simulated equivalised household disposable incomes and equivalised household disposable incomes from income reference period (previous year)



A.2.3. Overlap with income poverty and union approaches

This section presents the overlap between the poor according to circumstance poverty, income poverty measure, and bidimensional poverty measures calculated via the union counting approach. Note that, union approach considers individuals as poor if they are deprived at least in one of deprivation dimensions - household equivalised disposable, and leisure. When the latter approach is adopted, its overlap with the income poor and circumstance poor changes dramatically (Figure 3). Over 80% of circumstance poor under $\tilde{w} = 0$ and all income poor are specified as poor by the counting approach. This is expected by the definition of the union approach, as the income poor are the subset of the poor under this approach. The overlap is almost 100% when $\tilde{w} > 0$. This overlap with circumstance poor is more interesting – those who are not income poor are at the intersection of these two poverty measures. This implies that, these individuals have above-the-threshold net incomes, but the leisure available to them is below the leisure poverty threshold. These individuals would be left out if the wellbeing of individuals is only evaluated based on income measure, but are

captured by circumstance poverty and bi-dimensional poverty via the counting approach. We can see that, the counting approach to deprivation measurement is more consistent in terms of defining circumstance poor as deprived compared to the intersection approach or income poverty approaches.

When the time cost of the child-rearing is taken into account (Figures 4 and 5), the number of the overlapping does not change significantly. However, the share of poor defined with the egalitarian equivalence approach and other approaches simultaneously is smaller. Non-overlapping poor are single parents with children below 18 years old who do not work as many hours that would make them leisure poor, but the upward adjustment of their work hours places them below the poverty threshold. These are single parents with above-the-threshold disposable net income and work hours that would be deemed well off by bi-dimensional poverty or income poverty measures, but the ethical approach to their leisure time reveals that their deprivation is not captured by the counting or income approaches to poverty measurement.

Figure 3: Overlap with other poverty measures ($c = 0$)

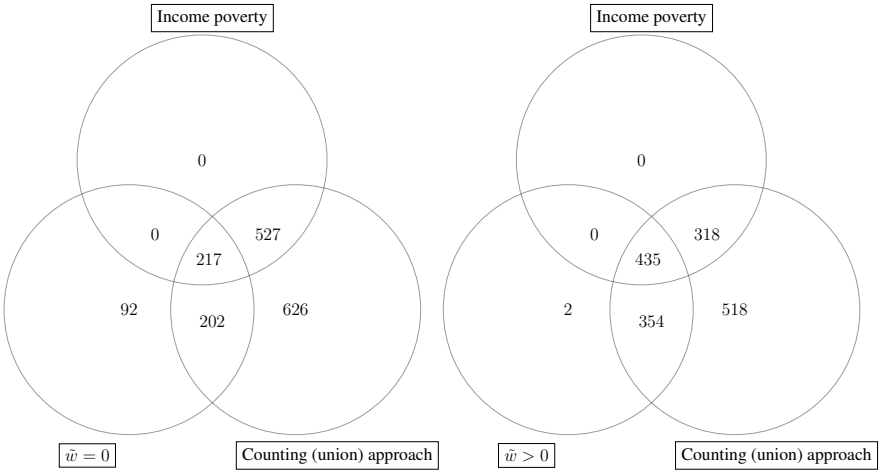


Figure 4: Overlap with other poverty measures ($c = 0.1$)

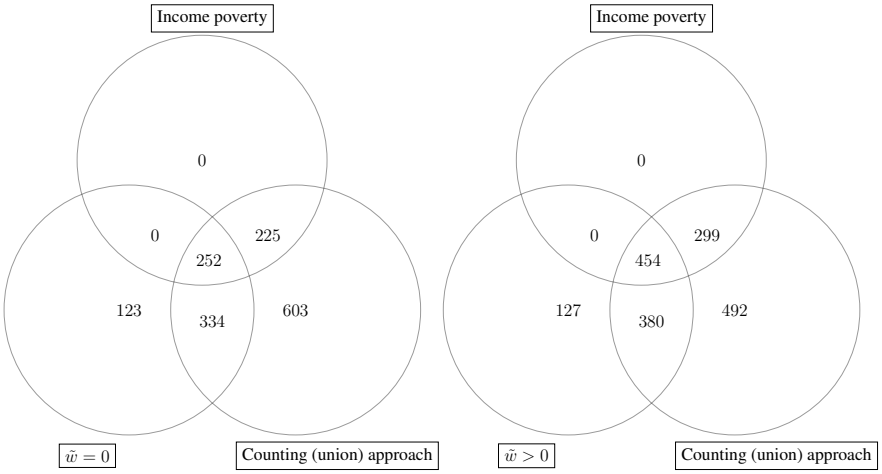
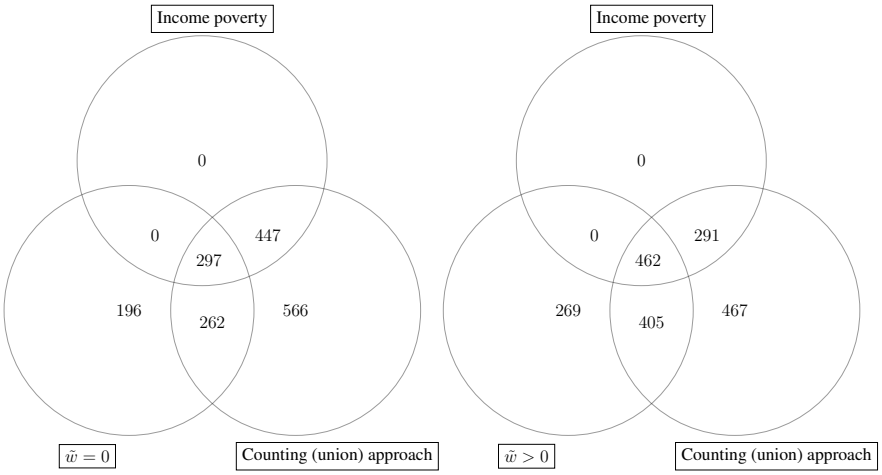


Figure 5: Overlap with other poverty measures ($c = 0.2$)



Chapter 3 Appendix

A.3.1 Descriptive statistics

Table 12: Summary statistics of whole sample, age 30-59

	Nonpoor		Poor		Test of
	Mean	s.d.	Mean	s.d.	difference
Share of income poor in the sample	0.822	-	0.178	-	-
Age	46.17	8.14	46.96	8.00	***
Female	0.54	0.50	0.55	0.50	
Non-native	0.04	0.21	0.05	0.21	
Father's education					***
Low-level education	0.90	0.30	0.97	0.18	
Middle-level education	0.05	0.22	0.02	0.13	
High-level education	0.05	0.21	0.02	0.13	
Father's employment status and occupation					***
Armed forces	0.01	0.10	0.00	0.06	
High-skilled white collar	0.19	0.39	0.08	0.27	
Low-skilled white collar	0.15	0.36	0.13	0.33	
High-skilled blue collar	0.39	0.49	0.49	0.50	
Low-skilled blue collar	0.22	0.42	0.25	0.43	
Inactive	0.02	0.14	0.03	0.16	
Unemployed	0.00	0.07	0.02	0.13	
Financial situation in the household					***
Very bad	0.04	0.19	0.11	0.31	
Bad	0.09	0.29	0.18	0.38	
Moderately bad	0.17	0.38	0.23	0.42	
Moderately good	0.46	0.50	0.34	0.47	
Good	0.21	0.41	0.12	0.33	
Very good	0.02	0.15	0.02	0.13	
Household size					
No. of adults in the HH	2.63	1.24	2.92	1.68	***
No. of children in the HH	1.87	1.72	2.66	2.32	***
Insufficient protein intake	0.06	0.24	0.19	0.40	***
Basic school needs not met	0.05	0.21	0.14	0.35	***
N	9226		2002		11228

Note: * - p-value< 0.10; ** - p-value< 0.05; *** - p-value< 0.01. Differences in age, and household size and structure variables are evaluated via z-test, whereas the differences in the distribution of other variables are evaluated via chi-squared test.

Table 13: Summary statistics of working sample, age 30-59

	Working nonpoor		Working poor		Test of
	Mean	s.d.	Mean	s.d.	difference
Share of income poor in the sample	0.886	-	0.114	-	
Age	45.76	7.99	46.38	7.78	***
Female	0.52	0.50	0.49	0.50	**
Non-native	0.04	0.21	0.06	0.23	*
Father's education					***
Low-level education	0.90	0.31	0.96	0.21	
Middle-level education	0.05	0.23	0.02	0.16	
High-level education	0.05	0.22	0.02	0.14	
Father's employment status and occupation					
Armed forces	0.01	0.10	0.00	0.04	***
High-skilled white collar	0.20	0.40	0.10	0.30	
Low-skilled white collar	0.16	0.36	0.13	0.34	
High-skilled blue collar	0.39	0.49	0.50	0.50	
Low-skilled blue collar	0.22	0.41	0.24	0.43	
Inactive	0.02	0.15	0.01	0.12	
Unemployed	0.00	0.07	0.01	0.11	
Financial situation in the household					***
Very bad	0.03	0.18	0.08	0.27	
Bad	0.09	0.28	0.15	0.36	
Moderately bad	0.17	0.38	0.25	0.43	
Moderately good	0.46	0.50	0.37	0.48	
Good	0.22	0.41	0.14	0.35	
Very good	0.02	0.15	0.02	0.12	
Household size					
No. of adults	2.62	1.22	2.88	1.59	***
No. of children	1.84	1.68	2.43	2.12	***
Insufficient protein intake	0.06	0.23	0.15	0.36	***
Basic school needs not met	0.04	0.21	0.11	0.31	***
N	8193		1056		9249

Note: * - p-value<0.10; ** - p-value<0.05; *** - p-value<0.01. Differences in age, and household size and structure variables are evaluated via z-test, whereas the differences in the distribution of other categorical variables are evaluated via chi-squared test.

Table 14: Summary statistics of full-time working sample, age 30-59

	Full-time working non poor		Full-time working poor		Test of difference
	Mean	s.d.	Mean	s.d.	
Share of poor in the sample	0.900	-	0.100	-	
Age	45.81	7.96	46.30	7.54	***
Female	0.51	0.50	0.45	0.50	***
Non-native	0.04	0.20	0.06	0.23	**
Father's education					***
Low-level education	0.90	0.30	0.96	0.20	
Middle-level education	0.05	0.23	0.02	0.15	
High-level education	0.05	0.22	0.02	0.14	
Father's employment status and occupation					***
Armed forces	0.01	0.10	0.00	0.03	
High-skilled white collar	0.20	0.40	0.09	0.28	
High-skilled blue collar	0.39	0.49	0.50	0.50	
Low-skilled white collar	0.16	0.37	0.14	0.35	
Low-skilled blue collar	0.22	0.41	0.24	0.43	
Inactive	0.02	0.15	0.01	0.11	
Unemployed	0.00	0.07	0.01	0.11	
Financial situation in the household					***
Very bad	0.03	0.18	0.08	0.27	
Bad	0.09	0.28	0.15	0.35	***
Moderately bad	0.17	0.38	0.24	0.43	
Moderately good	0.47	0.50	0.38	0.49	
Good	0.22	0.41	0.14	0.35	
Very good	0.02	0.15	0.01	0.12	
Household size					
No. of adults	2.61	1.22	2.92	1.61	***
No. of children	1.84	1.68	2.44	2.13	***
Insufficient protein intake	0.06	0.23	0.15	0.36	***
basic school needs not met	0.04	0.21	0.11	0.31	***
N	7679		857		8536

Note: * - p-value<0.10; ** - p-value<0.05; *** - p-value<0.01. Differences in age, and household size and structure variables are evaluated via z-test, whereas the differences in the distribution of other categorical variables are evaluated via ch-squared test.

Table 15: Summary statistics with alternative poverty lines, whole sample

	Vulnerable		Deeply poor		Extremely poor	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Share in the sample	0.276	-	0.095	-	0.045	-
Age	46.77	8.05	47.02	8.17	47.15	8.29
Female	0.55	0.50	0.54	0.50	0.52	0.50
Non-native	0.05	0.21	0.05	0.22	0.05	0.22
Father's education						
Low-level education	0.96	0.18	0.96	0.18	0.96	0.19
Middle-level education	0.02	0.13	0.02	0.12	0.02	0.14
High-level education	0.02	0.13	0.02	0.12	0.02	0.13
Father's employment status and occupation						
Armed forces	0.00	0.07	0.01	0.07	0.00	0.06
High-skilled white collar	0.09	0.28	0.07	0.25	0.08	0.27
Low-skilled white collar	0.12	0.33	0.13	0.34	0.12	0.32
High-skilled blue collar	0.50	0.50	0.50	0.50	0.49	0.50
Low-skilled blue collar	0.25	0.43	0.25	0.44	0.25	0.43
Inactive	0.02	0.15	0.03	0.16	0.03	0.16
Unemployed	0.01	0.11	0.02	0.14	0.03	0.18
Financial situation in the household						
Very bad	0.09	0.29	0.13	0.33	0.17	0.37
Bad	0.16	0.37	0.18	0.39	0.20	0.40
Moderately bad	0.23	0.42	0.23	0.42	0.22	0.42
Moderately good	0.36	0.48	0.33	0.47	0.29	0.46
Good	0.13	0.34	0.10	0.30	0.10	0.30
Very good	0.02	0.14	0.02	0.13	0.02	0.14
Household size						
No. of adults	2.84	1.57	2.93	1.66	2.98	1.78
No. of children	2.51	2.17	2.81	2.41	2.84	2.42
Insufficient protein intake	0.17	0.37	0.23	0.42	0.24	0.43
Basic school needs not met	0.12	0.33	0.17	0.38	0.19	0.39
N	3101		1076		504	

Table 16: Summary statistics with alternative poverty lines, working sample

	Vulnerable		Deeply poor		Extremely poor	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Share in the sample	0.203	-	0.053	-	0.021	-
Age	46.14	7.81	46.54	7.90	46.99	7.56
Female	0.50	0.50	0.45	0.50	0.41	0.49
Non-native	0.05	0.22	0.07	0.26	0.08	0.27
Father's education						
Low-level education	0.96	0.20	0.96	0.20	0.94	0.23
Middle-level education	0.02	0.15	0.02	0.14	0.03	0.16
High-level education	0.02	0.14	0.02	0.15	0.03	0.17
Father's employment status and occupation						
Armed forces	0.00	0.06	0.00	0.06	0.00	0.00
High-skilled white collar	0.10	0.30	0.09	0.29	0.13	0.34
Low-skilled white collar	0.12	0.33	0.14	0.35	0.11	0.32
High-skilled blue collar	0.50	0.50	0.52	0.50	0.51	0.50
Low-skilled blue collar	0.24	0.43	0.22	0.42	0.21	0.41
Inactive	0.02	0.14	0.01	0.11	0.02	0.12
Unemployed	0.01	0.09	0.01	0.11	0.02	0.14
Financial situation in the household						
Very bad	0.07	0.26	0.10	0.30	0.14	0.35
Bad	0.14	0.34	0.15	0.36	0.17	0.37
Moderately bad	0.24	0.43	0.27	0.44	0.25	0.44
Moderately good	0.38	0.49	0.35	0.48	0.32	0.47
Good	0.15	0.35	0.11	0.31	0.10	0.30
Very good	0.02	0.14	0.02	0.13	0.02	0.12
Household size						
No. of adults	2.80	1.48	2.97	1.77	3.07	2.03
No. of children	2.32	1.99	2.50	2.15	2.50	2.03
Insufficient protein intake	0.14	0.34	0.19	0.39	0.20	0.40
Basic school needs not met	0.10	0.30	0.13	0.34	0.16	0.37
N	1875		492		197	

Table 17: Summary statistics with alternative poverty lines, full-time working sample

	Vulnerable		Deeply poor		Extremely poor	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Age	46.02	7.67	46.35	7.58	46.68	7.44
Female	0.46	0.50	0.40	0.490	0.34	0.47
Non-native	0.05	0.22	0.08	0.27	0.07	0.26
Father's education						
Low-level education	0.96	0.20	0.96	0.20	0.95	0.22
Middle-level education	0.02	0.15	0.02	0.13	0.02	0.14
High-level education	0.02	0.14	0.03	0.16	0.03	0.18
Father's employment status and occupation						
Armed forces	0.003	0.06	0.003	0.05	0.000	0.000
High-skilled white collar	0.09	0.29	0.08	0.28	0.11	0.31
Low-skilled white collar	0.13	0.34	0.16	0.36	0.13	0.33
High-skilled blue collar	0.51	0.50	0.50	0.50	0.50	0.50
Low-skilled blue collar	0.24	0.43	0.23	0.42	0.23	0.42
Inactive	0.02	0.14	0.01	0.11	0.02	0.14
Unemployed	0.01	0.09	0.01	0.10	0.02	0.14
Financial situation in the household						
Very bad	0.07	0.25	0.09	0.29	0.13	0.34
Bad	0.13	0.34	0.15	0.36	0.17	0.37
Moderately bad	0.25	0.43	0.27	0.44	0.26	0.44
Moderately good	0.39	0.49	0.37	0.48	0.34	0.47
Good	0.15	0.36	0.10	0.30	0.09	0.29
Very good	0.02	0.14	0.02	0.13	0.02	0.14
Household size						
No. of adults	2.80	1.46	3.02	1.77	3.08	1.99
No. of children	2.32	1.98	2.45	2.10	2.38	2.01
Insufficient protein intake	0.13	0.34	0.17	0.38	0.19	0.39
Basic school needs not met	0.09	0.29	0.13	0.33	0.16	0.37
N	1568		391		157	

A.3.2 Correlation matrix of selected circumstances

Table 18: Correlation matrix

Variables	Age	Female	Non-native	Father's education	Father's occupation	Financial situation	No. of adults	No. of children	Insuf.protein intake	School needs not met
Age	1.000									
Female	0.070	1.000								
Non-native	-0.063	0.022	1.000							
Father's education	-0.124	-0.004	0.185	1.000						
Father's occupation	0.077	0.005	-0.050	-0.381	1.000					
Financial situation	-0.204	0.020	0.068	0.248	-0.315	1.000				
No. of adults	0.091	0.020	-0.023	-0.065	0.060	-0.127	1.000			
No. of children	0.179	0.015	0.016	-0.086	0.105	-0.310	0.088	1.000		
Insuf.protein intake	0.159	-0.004	-0.021	-0.086	0.145	-0.433	0.086	0.243	1.000	
School needs not met	0.107	-0.003	-0.017	-0.076	0.109	-0.330	0.076	0.207	0.334	1.000

A.3.3 Robustness check: LPM and Probit results of the impact of circumstances on income poverty status

Table 19: Linear probability and probit models' results at official poverty threshold

	Linear Probability Model			Probit Model		
	Whole sample	Working sample	Full-time working sample	Whole sample	Working sample	Full-time working sample
Age	0.008	0.009*	0.016***	0.008	0.009*	0.016***
	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
Age^2	-0.0001	-0.0001*	-0.0002***	-0.0001	-0.0001*	-0.0002***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Female	0.009*	-0.013**	-0.020***	0.010*	-0.011**	-0.018***
	(0.005)	(0.006)	(0.005)	(0.021)	(0.005)	(0.005)
Non-native	0.026	0.040**	0.049**	0.0328	0.041**	0.048***
	(0.020)	(0.019)	(0.0202)	(0.020)	(0.017)	(0.016)
	Father's education (base group: low-level education)					
Middle-level education	-0.043***	-0.024*	-0.019	-0.066***	-0.033*	-0.026
	(0.014)	(0.012)	(0.020)	(0.023)	(0.020)	(0.120)
High-level education	-0.037***	-0.024*	-0.016	-0.0563**	-0.03746*	-0.0249
	(0.014)	(0.013)	(0.012)	(0.024)	(0.021)	(0.021)
	Father's employment status and occupation (base group: unemployed)					
Armed forces	-0.229***	-0.166***	-0.164***	-0.209***	-0.192***	-0.204***
	(0.0605)	(0.062)	(0.0622)	(0.059)	(0.066)	(0.454)
High-skilled white collar	-0.214***	-0.126**	-0.132**	-0.1774***	-0.0939**	-0.103***
	(0.0556)	(0.0599)	(0.061)	(0.165)	(0.038)	(0.038)
High-skilled blue collar	-0.148***	-0.082	-0.0808	-0.098**	-0.045	-0.041
	(0.055)	(0.060)	(0.061)	(0.0388)	(0.038)	(0.0369)
Low-skilled white collar	-0.174***	-0.109*	-0.100	-0.124***	-0.071*	-0.059
	(0.056)	(0.060)	(0.061)	(0.163)	(0.038)	(0.037)
Low-skilled blue collar	-0.160***	-0.0993*	-0.095	-0.108***	-0.059	-0.053
	(0.056)	(0.060)	(0.0611)	(0.034)	(0.038)	(0.037)
Inactive	-0.161***	-0.151**	-0.151**	-0.110**	-0.117***	-0.116***
	(0.061)	(0.063)	(0.063)	(0.045)	(0.045)	(0.045)

Standard errors in parentheses; * (p¡0.10), ** $p < 0.05$, *** $p < 0.01$

Table 13. Linear probability and probit models' results at official poverty threshold (cont-d)

	Linear Probability Model			Probit Model		
	Whole sample	Working sample	Full-time working sample	Whole sample	Working sample	Full-time working sample
Financial situation of the household (base group: very bad)						
Bad	-0.029	-0.024	-0.018	-0.016	-0.0139	-0.010
	(0.026)	(0.027)	(0.0273)	(0.018)	(0.0174)	(0.018)
Moderately bad	-0.060**	-0.024	-0.020	-0.039**	-0.014	-0.011
	(0.026)	(0.026)	(0.027)	(0.018)	(0.018)	(0.018)
Moderately good	-0.102***	-0.060**	-0.047*	-0.082***	-0.049***	-0.037**
	(0.025)	(0.026)	(0.027)	(0.018)	(0.018)	(0.018)
Good	-0.106***	-0.063**	-0.049*	-0.090***	-0.054***	-0.042**
	(0.026)	(0.027)	(0.027)	(0.020)	(0.019)	(0.020)
Very good	-0.066**	-0.055*	-0.0467	-0.041	-0.0438	-0.0398
	(0.0337)	(0.0322)	(0.032)	(0.031)	(0.030)	(0.031)
Household size						
No. of children	0.019***	0.011***	0.010***	0.015***	0.009***	0.008***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
No. of adults	0.012***	0.010***	0.012***	0.010***	0.008***	0.009***
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Insufficient protein intake	0.114***	0.08***	0.079***	0.080***	0.056***	0.051***
	(0.021)	(0.020)	(0.021)	(0.01)	(0.013)	(0.013)
Basic school needs not met	0.093***	0.047**	0.043**	0.064***	0.030**	0.026*
	(0.022)	(0.022)	(0.022)	(0.015)	(0.012)	(0.014)
Constant	0.199	0.033	-0.143	0.178***	0.113***	0.1017***
	(0.138)	(0.128)	(0.125)	(0.004)	(0.004)	(0.004)
N	11243	9204	8549	11243	9204	8549
F-stat	24.28	11.52	11.63	-	-	-
Wald stat.	-	-	-	498.7	253.1	237.5
R2	0.070	0.037	0.037	-	-	-
Pseudo-R2	-	-	-	0.068	0.047	0.053

Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 20: Probit results at alternative poverty thresholds

	Whole sample			Working sample			Full-time working sample		
	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty
Age	0.008	-0.002	-0.003	0.015**	0.002	0.003	0.021***	0.007**	0.004
	(0.007)	(0.004)	(0.003)	(0.007)	(0.004)	(0.003)	(0.007)	(0.004)	(0.002)
Age^2	-0.000	0.000	0.000	-0.000**	-0.000	-0.000	-0.0007***	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.013**	0.000	-0.003	-0.014**	-0.013***	-0.009***	-0.0250***	-0.0171***	-0.012***
	(0.006)	(0.004)	(0.003)	(0.007)	(0.004)	(0.003)	(0.007)	(0.00388)	(0.003)
Non-native	0.054**	0.031**	0.010	0.058***	0.034***	0.014*	0.063***	0.037***	0.013*
	(0.024)	(0.015)	(0.011)	(0.022)	(0.011)	(0.007)	(0.02)	(0.011)	(0.008)
Father's education (base group: low-level education									
Middle-level education	-0.120***	-0.041**	-0.013	-0.084***	-0.024	-0.008	-0.076***	-0.025	-0.009
	(0.026)	(0.020)	(0.013)	(0.024)	(0.0160)	(0.009)	(0.025)	(0.017)	(0.010)
High-level education	-0.091***	-0.020	-0.016	-0.073***	-0.011	-0.0015	-0.062**	0.0015	0.00384
	(0.029)	(0.019)	(0.013)	(0.028)	(0.015)	(0.009)	(0.029)	(0.014)	(0.009)
Father's employment status and occupation (base group: unemployed									
Armed forces	-0.224***	-0.0972**	-0.0732**	-0.188**	-0.0439	0	-0.183**	-0.0418	0
	(0.0700)	(0.0423)	(0.0312)	(0.0734)	(0.0403)	(.)	(0.0740)	(0.0450)	(.)
High-skilled white collar	-0.210***	-0.120***	-0.067***	-0.101*	-0.032	-0.014	-0.115**	-0.023	-0.016
	(0.051)	(0.029)	(0.0176)	(0.053)	(0.026)	(0.014)	(0.0525)	(0.027)	(0.013)
High-skilled blue collar	-0.083*	-0.064**	-0.052***	-0.002	-0.008	-0.012	-0.00924	0.004	-0.010
	(0.050)	(0.028)	(0.017)	(0.0516)	(0.026)	(0.013)	(0.05)	(0.026)	(0.012)
Low-skilled white collar	-0.146***	-0.074***	-0.0578***	-0.064	-0.013	-0.017	-0.059	0.003	-0.013
	(0.051)	(0.028)	(0.017)	(0.052)	(0.026)	(0.0135)	(0.052)	(0.026)	(0.013)
Low-skilled blue collar	-0.108**	-0.069**	-0.0546***	-0.0312	-0.019	-0.017	-0.038	-0.003	-0.013
	(0.051)	(0.028)	(0.017)	(0.052)	(0.026)	(0.013)	(0.051)	(0.026)	(0.013)
Inactive	-0.116**	-0.069**	-0.055***	-0.065	-0.055*	-0.029*	-0.0693	-0.035	-0.021
	(0.056)	(0.032)	(0.020)	(0.058)	(0.0318)	(0.017)	(0.058)	(0.031)	(0.016)

Standard errors clustered at household level are given in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 14. Probit results at alternative poverty thresholds (cont-d)

	Whole sample			Working sample			Full-time working sample		
	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty
Financial situation of the household (base group: very bad)									
Bad	-0.026	-0.017	-0.018**	-0.028	-0.0123	-0.013*	-0.027	-0.00916	-0.011
	(0.0225)	(0.0130)	(0.008)	(0.0232)	(0.012)	(0.007)	(0.024)	(0.012)	(0.007)
Moderately bad	-0.0471**	-0.026*	-0.028***	-0.016	-0.008	-0.0147**	-0.010	-0.004	-0.012
	(0.0223)	(0.014)	(0.009)	(0.023)	(0.012)	(0.007)	(0.024)	(0.012)	(0.008)
Moderately good	-0.106***	-0.048***	-0.043***	-0.075***	-0.029**	-0.024***	-0.065***	-0.021*	-0.020**
	(0.022)	(0.014)	(0.009)	(0.023)	(0.012)	(0.008)	(0.024)	(0.013)	(0.008)
Good	-0.114***	-0.062***	-0.048***	-0.080***	-0.045***	-0.031***	-0.069***	-0.037**	-0.027***
	(0.0242)	(0.016)	(0.011)	(0.025)	(0.014)	(0.009)	(0.025)	(0.014)	(0.010)
Very good	-0.0311	-0.025	-0.024	-0.025	-0.019	-0.026*	-0.017	-0.016	-0.017
	(0.036)	(0.024)	(0.016)	(0.0364)	(0.021)	(0.014)	(0.037)	(0.020)	(0.013)
Household size									
No. of children	0.0187***	0.009***	0.00347***	0.0134***	0.00359***	0.001	0.013***	0.003**	0.000
	(0.003)	(0.002)	(0.001)	(0.003)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
No. of adults	0.009***	0.005**	0.00244*	0.00730**	0.005***	0.003**	0.008**	0.006***	0.003**
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.003)	(0.00160)	(0.001)
Insufficient protein intake	0.101***	0.051***	0.020***	0.086***	0.035***	0.010*	0.078***	0.028***	0.007
	(0.017)	(0.011)	(0.007)	(0.018)	(0.009)	(0.006)	(0.018)	(0.009)	(0.006)
Basic school needs not met	0.088***	0.051***	0.023***	0.0496***	0.020**	0.010*	0.045**	0.019**	0.011**
	(0.0186)	(0.011)	(0.007)	(0.019)	(0.009)	(0.006)	(0.019)	(0.009)	(0.005)
N	11243	11243	11243	9204	9204	9114	8549	8549	8466
Wald stat.	601.8	362.4	215.3	372.4	194.4	106.0	337.9	168.4	89.92
Pseudo-R2	0.0663	0.0709	0.0668	0.0506	0.0568	0.0579	0.0514	0.0600	0.0623

Standard errors clustered at household level are given in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 21: Linear probability model results at alternative poverty thresholds

	Whole sample			Working sample			Full-time working sample		
	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty
Age	0.0078	-0.0014	-0.0025	0.0146**	0.0024	0.0033	0.020***	0.00729**	0.00393*
	(0.0066)	(0.0045)	(0.0032)	(0.0064)	(0.0036)	(0.0022)	(0.0063)	(0.0034)	(0.002)
Age^2	-0.000	0.000	0.000	-0.0002**	-0.000	-0.000	-0.000***	-0.0001**	-0.0001*
	(0.0001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.0124**	-0.001	-0.004	-0.015**	-0.014***	-0.009***	-0.026***	-0.018***	-0.012***
	(0.006)	(0.004)	(0.0028)	(0.0066)	(0.004)	(0.0027)	(0.007)	(0.004)	(0.0026)
Non-native	0.046*	0.0257	0.00700	0.054**	0.0380**	0.0167	0.0595**	0.0440***	0.0138
	(0.024)	(0.017)	(0.012)	(0.0236)	(0.0153)	(0.0109)	(0.0246)	(0.0164)	(0.0113)
	Father's education (base group: low-level education								
Middle-level education	-0.086***	-0.023**	-0.0068	-0.060***	-0.015*	-0.0042	-0.054***	-0.015*	-0.005
	(0.016)	(0.010)	(0.007)	(0.015)	(0.008)	(0.005)	(0.015)	(0.008)	(0.005)
High-level education	-0.067***	-0.013	-0.0094	-0.0514***	-0.0071	-0.001	-0.044**	0.000	0.002
	(0.019)	(0.010)	(0.007)	(0.018)	(0.009)	(0.006)	(0.017)	(0.009)	(0.006)
	Father's employment status and occupation (base group: unemployed								
Armed forces	-0.223***	-0.148**	-0.147***	-0.145**	-0.0487	-0.0554	-0.146**	-0.0332	-0.0449
	(0.0657)	(0.0582)	(0.0523)	(0.0665)	(0.0474)	(0.0366)	(0.0685)	(0.0422)	(0.0351)
High-skilled white collar	-0.219***	-0.164***	-0.143***	-0.107*	-0.0450	-0.0406	-0.122*	-0.027	-0.035
	(0.058)	(0.054)	(0.051)	(0.0628)	(0.045)	(0.037)	(0.0648)	(0.040)	(0.035)
High-skilled blue collar	-0.104*	-0.124**	-0.133***	-0.0155	-0.0258	-0.039	-0.027	-0.007	-0.031
	(0.058)	(0.054)	(0.051)	(0.063)	(0.045)	(0.037)	(0.065)	(0.040)	(0.035)
Low-skilled white collar	-0.169***	-0.134**	-0.138***	-0.0795	-0.0314	-0.0435	-0.079	-0.008	-0.034
	(0.058)	(0.054)	(0.0504)	(0.063)	(0.045)	(0.037)	(0.065)	(0.040)	(0.035)
Low-skilled blue collar	-0.132**	-0.130**	-0.135***	-0.049	-0.039	-0.045	-0.0599	-0.016	-0.034
	(0.058)	(0.0541)	(0.051)	(0.063)	(0.045)	(0.0369)	(0.065)	(0.040)	(0.0354)
Inactive	-0.140**	-0.126**	-0.134**	-0.082	-0.066	-0.054	-0.091	-0.041	-0.041
	(0.064)	(0.058)	(0.053)	(0.0678)	(0.047)	(0.038)	(0.070)	(0.042)	(0.037)

Standard errors clustered at household level are given in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 15. Linear probability model results at alternative poverty thresholds (cont-d)

	Whole sample			Working sample			Full-time working sample		
	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty	Vulnerable to poverty	Deep poverty	Extreme poverty
Financial situation of the household (base group: very bad)									
Bad	-0.035	-0.034	-0.044**	-0.038	-0.024	-0.030*	-0.037	-0.018	-0.025
	(0.027)	(0.023)	(0.018)	(0.031)	(0.022)	(0.017)	(0.032)	(0.022)	(0.018)
Moderately bad	-0.061**	-0.047**	-0.059***	-0.024	-0.0184	-0.033*	-0.017	-0.010	-0.027
	(0.027)	(0.023)	(0.018)	(0.030)	(0.022)	(0.017)	(0.032)	(0.022)	(0.018)
Moderately good	-0.122***	-0.066***	-0.0698***	-0.087***	-0.0405*	-0.041**	-0.077**	-0.029	-0.034*
	(0.027)	(0.023)	(0.018)	(0.030)	(0.022)	(0.017)	(0.031)	(0.022)	(0.018)
Good	-0.127***	-0.075***	-0.072***	-0.091***	-0.050**	-0.046***	-0.078**	-0.039*	-0.039**
	(0.028)	(0.023)	(0.018)	(0.031)	(0.022)	(0.018)	(0.032)	(0.022)	(0.018)
Very good	-0.052	-0.049*	-0.053**	-0.041	-0.033	-0.042**	-0.032	-0.025	-0.031
	(0.038)	(0.028)	(0.022)	(0.040)	(0.026)	(0.019)	(0.041)	(0.026)	(0.020)
Household size									
No of adults in HH	0.010***	0.006**	0.004	0.009**	0.007***	0.004*	0.009**	0.008***	0.003*
	(0.004)	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)
No. of children in HH	0.021***	0.012***	0.005***	0.016***	0.005***	0.001	0.015***	0.004**	0.001
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Insufficient protein intake	0.124***	0.083***	0.035***	0.113***	0.059***	0.019*	0.104***	0.049***	0.014
	(0.0215)	(0.018)	(0.0132)	(0.0238)	(0.017)	(0.0111)	(0.0245)	(0.016)	(0.0110)
Basic school needs not met	0.108***	0.087***	0.044***	0.066***	0.036**	0.021*	0.0613**	0.033**	0.023*
	(0.023)	(0.0194)	(0.015)	(0.025)	(0.017)	(0.012)	(0.0258)	(0.017)	(0.012)
Constant	0.292*	0.285**	0.284***	-0.0110	0.053	0.019	-0.139	-0.088	-0.007
	(0.160)	(0.11)	(0.089)	(0.155)	(0.092)	(0.065)	(0.155)	(0.086)	(0.0625)
N	11243	11243	11243	9204	9204	9204	8549	8549	8549
F-stat	35.51	14.03	5.860	19.45	6.662	5.196	17.64	6.195	4.361
R2	0.079	0.053	0.034	0.052	0.028	0.016	0.050	0.026	0.015

Standard errors clustered at household level are given in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

A.3.4 Absolute and relative dissimilarity indexes

Table 22: Absolute and relative dissimilarity index for poverty intensity with logistic regression results

Poverty threshold	Dissimilarity index	Whole sample (1)	Working sample (2)	Full-time working sample (3)	Difference (1) - (2)	Difference (1) - (3)	Difference (2) - (3)
Vulnerable to poverty	Absolute	0.187	0.137	0.130	0.050***	0.057***	0.007
		(0.007)	(0.005)	(0.004)			
	Relative	0.234	0.213	0.216	0.022	0.018	0.005
		(0.007)	(0.007)	(0.007)			
Official poverty line	Absolute	0.145	0.087	0.082	0.058***	0.063***	0.005
		(0.009)	(0.004)	(0.003)			
	Relative	0.248	0.214	0.228	0.034	0.02	-0.013
		(0.022)	(0.024)	(0.029)			
Deep poverty	Absolute	0.091	0.051	0.047	0.040***	0.044***	0.004
		(0.003)	(0.002)	(0.002)			
	Relative	0.264	0.254	0.268	0.010	-0.004	-0.014
		(0.025)	(0.030)	(0.030)			
Extreme poverty	Absolute	0.048	0.024	0.022	0.024***	0.026***	0.002
		(0.002)	(0.001)	(0.002)			
	Relative	0.281	0.282	0.297	-0.01	-0.016	-0.015
		(0.029)	(0.072)	(0.056)			

Bootstrapped standard errors are given in parentheses. Standard errors are generated via 100 replications. The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 23: Absolute and relative dissimilarity index for poverty intensity with probit regression results

Poverty threshold	Dissimilarity index	Whole sample (1)	Working sample (2)	Full-time working sample (3)	Difference (1) - (2)	Difference (2) - (3)
Vulnerable to poverty	Absolute	0.1859	0.1362	0.1301	0.0497***	0.0061
		(0.0088)	(0.0039)	(0.0038)		
	Relative	0.2326	0.2131	0.2167	0.0195	0.0050
		(0.0052)	(0.0069)	(0.0062)		
Official poverty line	Absolute	0.1448	0.0862	0.0823	0.0586***	0.0039
		(0.0088)	(0.0034)	(0.0028)		
	Relative	0.2469	0.2156	0.2283	0.0313	-0.0127
		(0.0185)	(0.0328)	(0.0287)		
Deep poverty	Absolute	0.0915	0.0517	0.0471	0.0398***	0.0046
		(0.0063)	(0.0024)	(0.0019)		
	Relative	0.2644	0.2598	0.2695	0.0046	-0.0003
		(0.0353)	(0.0339)	(0.0304)		
Extreme poverty	Absolute	0.0485	0.0237	0.0218	0.0248***	0.0019
		(0.0042)	(0.0016)	(0.0014)		
	Relative	0.2831	0.2838	0.2993	-0.007	-0.0155
		(0.0326)	(0.0581)	(0.0562)		

Bootstrapped standard errors are given in parentheses. Standard errors are generated via 100 replications. The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 24: Absolute and relative dissimilarity index for poverty intensity with LPM regression results

Poverty threshold	Dissimilarity index	Whole sample (1)	Working sample (2)	Full-time working sample (3)	Difference (1) - (2)	Difference (2) - (3)
Vulnerable to poverty	Absolute	0.1859	0.1371	0.1301	0.0488***	0.0070
		(0.0188)	(0.0038)	(0.0035)		
	Relative	0.2343	0.2144	0.2178	0.0199	-0.0034
		(0.0069)	(0.0068)	(0.0059)		
Official poverty line	Absolute	0.1478	0.0886	0.0851	0.0592***	0.0035
		(0.0083)	(0.0030)	(0.0025)		
	Relative	0.2521	0.2215	0.2359	0.0306	-0.0144
		(0.0175)	(0.0331)	(0.0304)		
Deep poverty	Absolute	0.0951	0.0539	0.0493	0.0412***	0.0046
		(0.0057)	(0.0021)	(0.0016)		
	Relative	0.2748	0.2704	0.2825	0.0044	-0.0121
		(0.0355)	(0.0370)	(0.0299)		
Extreme poverty	Absolute	0.0515	0.0255	0.0231	0.026***	0.0024
		(0.0039)	(0.0013)	(0.0012)		
	Relative	0.3008	0.3039	0.3172	-0.003	-0.0133
		(0.0337)	(0.0602)	(0.0589)		

Note: Bootstrapped standard errors are given in parentheses. Standard errors are generated via 100 replications. The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

A.3.5 Change in absolute and relative dissimilarity indexes at alternative poverty lines with logit model

Table 25: Differences in absolute and relative dissimilarity indexes with logit model: whole sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI Relative DI	-		
Official poverty line	Absolute DI Relative DI	-0.0427*** 0.0139	-	
Deep poverty	Absolute DI Relative DI	-0.0959*** 0.0293	-0.0532*** 0.0154	-
Extreme poverty	Absolute DI Relative DI	-0.1391*** 0.0465	-0.0964*** 0.0326	-0.0432*** 0.0172

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 26: Differences in absolute and relative dissimilarity indexes with logit model: working sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI Relative DI	-		
Official poverty line	Absolute DI Relative DI	-0.0730*** 0.0017	-	
Deep poverty	Absolute DI Relative DI	-0.0855*** 0.0411	-0.0356*** 0.0394	-
Extreme poverty	Absolute DI Relative DI	-0.1129*** 0.0691	-0.0625*** 0.0674	-0.0274*** 0.0280

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 27: Differences in absolute and relative dissimilarity indexes with logit model: full-time working sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI	-		
	Relative DI			
Official poverty line	Absolute DI	-0.0476***	-	
	Relative DI	0.0115		
Deep poverty	Absolute DI	-0.0831***	-0.0355***	-
	Relative DI	0.0515*	0.040	
Extreme poverty	Absolute DI	-0.1081***	-0.0605***	-0.025***
	Relative DI	0.081	0.0695	0.0295

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 28: Differences in absolute and relative dissimilarity indexes with probit model: whole sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI	-		
	Relative DI			
Official poverty line	Absolute DI	-0.0411***	-	
	Relative DI	0.0143		
Deep poverty	Absolute DI	-0.0944***	-0.0533***	-
	Relative DI	0.0318	0.0175	
Extreme poverty	Absolute DI	-0.1374***	-0.0963***	-0.043***
	Relative DI	0.0505	0.0362	0.0187

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 29: Differences in absolute and relative dissimilarity indexes with probit model: working sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI Relative DI	-		
Official poverty line	Absolute DI Relative DI	-0.050*** 0.0025	-	
Deep poverty	Absolute DI Relative DI	-0.0845*** 0.0467	-0.0345*** 0.0442	-
Extreme poverty	Absolute DI Relative DI	-0.1125*** 0.0707	-0.0625*** 0.0682	-0.0238*** 0.0240

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 30: Differences in absolute and relative dissimilarity indexes with probit model: full-time working sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI Relative DI	-		
Official poverty line	Absolute DI Relative DI	-0.0478*** 0.0116	-	
Deep poverty	Absolute DI Relative DI	-0.0830*** 0.0528	-0.0471*** 0.0412	-
Extreme poverty	Absolute DI Relative DI	-0.1083*** 0.0826	-0.0605*** 0.071	-0.0253*** 0.0298

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 31: Differences in absolute and relative dissimilarity indexes with linear probability model: whole sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI	-		
	Relative DI			
Official poverty line	Absolute DI	-0.0381***	-	
	Relative DI	0.0178		
Deep poverty	Absolute DI	-0.0908***	-0.0527***	-
	Relative DI	0.0405	0.0227	
Extreme poverty	Absolute DI	-0.1344***	-0.0963***	-0.0436***
	Relative DI	0.0665	0.0487	0.0260

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 32: Differences in absolute and relative dissimilarity indexes with linear probability model: working sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI	-		
	Relative DI			
Official poverty line	Absolute DI	-0.0485***	-	
	Relative DI	0.0071		
Deep poverty	Absolute DI	-0.0832***	-0.0347***	-
	Relative DI	0.0556	0.0489	
Extreme poverty	Absolute DI	-0.1160***	-0.0631***	-0.0284***
	Relative DI	0.0895	0.0824	0.0335

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 33: Differences in absolute and relative dissimilarity indexes with linear probability model: full-time working sample

		Vulnerable to poverty	Official poverty line	Deep poverty
Vulnerable to poverty	Absolute DI	-		
	Relative DI			
Official poverty line	Absolute DI	-0.0450***	-	
	Relative DI	0.0181		
Deep poverty	Absolute DI	-0.0808***	-0.0338***	-
	Relative DI	0.0647	0.0466	
Extreme poverty	Absolute DI	-0.1070***	-0.0620***	-0.0262***
	Relative DI	0.0994	0.0813	0.0347

The differences in absolute and relative inequality indexes are evaluated with z-test; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.