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Abstract

The aim of this paper is to propose a set of dimensions and indicators to measure the incidence and trends of unmet social needs related to well-being and aggregate them into a composite index. We contribute to the current literature on the measurement of social needs through broader and more systematic indicators based on the principles of access, quality, and equity. Using different microdata sources, we take a selected sample of European countries that are representative of different welfare regimes to illustrate the possibilities of this proposal. Our results are not very sensitive to the use of different weighting schemes or aggregation methods and show that the degree of unmet needs is related to the country's type of welfare regime.

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ABSTRACT

The aim of this paper is to propose a set of dimensions and indicators to measure the incidence and trends of unmet social needs related to well-being and aggregate them into a composite index. We contribute to the current literature on the measurement of social needs through broader and more systematic indicators based on the principles of access, quality, and equity. Using different microdata sources, we take a selected sample of European countries that are representative of different welfare regimes to illustrate the possibilities of this proposal. Our results are not very sensitive to the use of different weighting schemes or aggregation methods and show that the degree of unmet needs is related to the country's type of welfare regime.

Keywords: social needs, composite index, Europe, welfare regimes.

1. INTRODUCTION

There is a growing debate on how to measure well-being in countries with different levels of economic development (Fleurbaey, 2009; Stiglitz et al., 2009; Jones and Klenow, 2016). In those where development has not yet reached a sufficient level, much of the attention has focused on multidimensional poverty indicators (Alkire and Santos, 2014). In developed countries, there is a widely recognised collective demand to build up unmet social needs measures that incorporate indicators beyond monetary poverty. Over the last decades, several social researchers have investigated social needs through a broader lens incorporating different aspects related to the quality of living conditions (Ravallion, 2012; OECD, 2013).

Despite the variety of proposals, no general agreement has been reached for a new measurement standard of key social needs. Since the 1970s different authors have created aggregate indices of economic well-being, such as the *Measure of Economic Welfare* (MEW) proposed by Nordhaus and Tobin (1972) and the *Index of Economic Well-being* (IEWB) by Osberg and Sharpe (2002). Both approaches, however, only focused on the economic aspects of well-being, without considering wider dimensions of the quality of life or the coverage of social needs. Other proposals focused on the poor such as Morris (1978) combined non-monetary indicators of literacy, infant mortality, and life expectancy in the *Physical Quality of Life Index* (PQLI) to analyse whether the very poor were benefitting from economic growth.

More recently, the OECD created the *Better Life Index* considering different dimensions related to the expansion of people's choices and opportunities to live the lives that they value (OECD, 2020) and the European Union (EU) has proposed a *Social Progress Index* (EU-SPI) considering basic human needs, foundations of well-being and opportunities (Annoni and Bolsi, 2020). Along with these international organization's proposals, many institutions, governments and researchers have been proposing different composite measures of well-being (e.g. the Canadian Index of Wellbeing, Measures of Australia's Progress, Italian Equitable and Sustainable Wellbeing Index, etc.). In this setting, we believe that there is a growing need for a deep discussion and specially for a larger systematization of these initiatives' methodological choices. Indeed, up to now, we find very little academic effort exerted to best clarify what should be the focus of composite well-being indexes measurement and, most importantly, which should be the

key principles underlying the choice of indicators within each key dimension of well-being.

In the analysis of social needs, the selection of dimensions and indicators capable of identifying situations of social need must be based on both theoretical and empirical criteria, in addition to the normative criteria implicit in a social rights approach. The key question is, in general, whether the multifaceted character of social needs can be measured and whether it is possible to define comparable indicators in space and time using a systematic approach to select them. Our purpose is to contribute to this debate by proposing to focus on measuring "unmet needs" (i.e. essential social conditions that individuals require but lack access to) and by clarifying under which set of principles should indicators within each dimension be chosen. As a reference, we follow the principles of the European Pillar of Social Rights aiming for a fair, inclusive and full of opportunity Europe after a large-scale public consultation in all member states (European Pillar of Social Rights, 2021): access, quality and equity.

We propose a broad set of social indicators grouped into six dimensions: material and economic well-being, employment, education, health, housing, and physical and social environment and we analyse the evolution of separate dimensions and of a synthetic index providing alternative aggregation procedures. Thus, our approach, being close to the proposals for objective social indicators, has the key following advantages: i) defines a set of challenges for each dimension, so that we offer a systematic analysis of the selection of social needs indicators based on the principles of access, quality and equity; ii) the dimensions can be relatively easily defined and quantified without relying heavily on individual perceptions; iii) the dimensions under study can be measured with great precision and with little measurement error; iv) we also offer the possibility of using a weighting system that takes into account society's ranking of dimensions.

To illustrate the possibilities of this proposal, we provide empirical evidence for a selected sample of nine European countries representative of the different EU welfare regimes. A further advantage of our approach over previous studies is the availability of homogeneous information for all these countries that allows us to identify the impact of both the welfare regime and the economic cycle on unmet social needs.

The paper is structured as follows. In section 2, we present a brief review of the main approaches to the measurement of social needs through synthetic measures. In section 3

we describe the dimensions and indicators chosen for our index of unmet social needs. In section 4 we present our empirical approach and in section 5 we discuss our results. Section 6 concludes.

2. SYNTHETIC MEASURES OF SOCIAL NEEDS

Over the last decades, researchers have tried to move from the traditional measurement of individual well-being through an economic perspective to broader indices. Nonetheless, there is still no agreement about which are the relevant dimensions and how to measure them.

Dissatisfaction with a concept of development focused on economic macro-magnitudes contributed to the emergence of the basic needs approach (BNA) during the 1970s (Streeten, 1979), promoting the idea that each household should be able to meet its basic needs in order to achieve economic and social progress. Despite subsequent advances, consensus has not been reached yet. While the first definitions of need identified it with a gap between the state desired by a person or group and the actual state, later proposals expanded it by defining needs as the basic requirements necessary to sustain human life (Reinert, 2023). Nevertheless, there was substantial disagreement about if these should be confined to a minimal set necessary to sustain human existence or should include more dimensions to ensure a wider well-being.

To analyse how well societies are doing in covering collective needs several new measures have been developed in the past few decades. According to their characteristics and construction method, they can be classified into two broad classes: i) multidimensional indices, and ii) composite indices.

Multidimensional indices are designed to measure to what extent everyone can meet a given set of different necessities. To that end, several dimensions and indicators are defined, and individual values are checked against this standard, so that an individual poverty -or deprivation, or well-being- value can be computed. Personal multidimensional scores can then be aggregated at the social level, to obtain a global index. The main advantage of multidimensional measures is the possibility of examining the different indicators jointly and evaluate dimensions at the individual level. The main disadvantage is that their construction requires the existence of a single data source offering individual information of all the dimensions and indicators included in the index,

which is difficult when using a comprehensive theoretical approach and/or comparing many countries.

An important example of these measures is the *Multidimensional Poverty Index* (MPI), developed by Alkire and Foster (2011). The MPI is based on the three key dimensions (health, education, and standard of living) which are approximated through ten underlying indicators.[1]

Composite indices, in contrast, follow a different route. The information is extracted from different datasets available on the population of interest (Seth and Villar, 2018). Thus, the joint distribution of the characteristics across the population remains unknown, i.e. we do not know to what extent the same individuals concentrate various unmet needs. The overall index is obtained after aggregating first across individuals and then across dimensions/indicators. These are precisely the kind of indices that we choose to discuss in this paper, due to their greater potential for comparative analysis in the field of social needs.

In this group of measures, the most well-known index of well-being that incorporates social needs indicators is the *Human Development Index* (HDI), developed by the United Nations. The HDI considers three key social needs dimensions: health, knowledge, and economic well-being approximated through four underlying indicators. The HDI has been subject to criticism as it does not capture how economic growth is distributed among the population. In line with the definition of human development based on Sen's (1985) conceptual framework of capabilities to achieve valued outcomes ('functionings') of being and doing, the HDI has been supplemented by an inequality-adjusted HDI, and indices of multidimensional poverty and gender inequality.[2]

More recent approaches such as the OECD's *Measuring Progress* or *Better Life Index*, together with those developed by the European Union (*Beyond GDP initiative* and *Quality of life indicators*) proposed new composite indices which expanded dimensions to consider aspects such as leisure, physical safety, social interactions or life satisfaction.

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[1] Similar measures have been proposed by the Census Bureau in the US using the American Community Survey (Multidimensional deprivation, MDI) and by a large research project at the Australian National University for Australia (Individual Measure of Multidimensional Poverty, IMMP).

[2] In 1996, the Human Development Report introduced the *Capability Poverty Measure* (CPM) as a composite index focused on the poor considering the basic capability shortfalls in three dimensions: living a healthy and well-nourished life, having the capability of safe and healthy reproduction, and being literate and knowledgeable. This index only focused on the deprivations of women and children.

Similarly, the development of the European Social Agenda prompted the elaboration of a broad set of social indicators to monitor the compliance of countries within its strategy to promote social inclusion. All these more modern approaches are based on detailed and individualised information on both income and the possession of certain material goods obtained from a set of specific household surveys. Regarding dimensions, the OECD approach to measuring well-being is probably the most complete. The Better Life Index includes eleven dimensions reflecting what the OECD identifies as essential to well-being in terms of material living conditions (housing, income, jobs) and quality of life (community, education, environment, governance, health, life satisfaction, safety and work-life balance).

In 2014, a non-profit organization (Social Progress Imperative) published the Social Progress Index (SPI), which is a composite index that measures country performance on many aspects of social and environmental functioning which are relevant for countries at all levels of economic development. The SPI measures the well-being of a society by observing social and environmental outcomes directly rather than the economic factors.[3] The index combines three dimensions (basic human needs, foundations of well-being, and opportunity) and each dimension includes four components. The European Commission agreed to partner with Social Progress Imperative to create a Social Progress Index for the European Union (EU-SPI), designed as a tool to facilitate benchmarking across EU regions on a wide range of criteria.[4]

The EU-SPI is a very important step in the incorporation of needs indicators into synthetic measures of social welfare. However, we consider that EU countries should measure broader social needs, so our proposal differs from SPI. Indeed, SPI has a first component confined to a minimal set necessary for the sustenance of human existence. This notion of needs is more closely related to what the seminal study of Wiggins (1998) identifies as vital needs, hence entrenched and absolute. When looking at high-income countries, it seems more appropriate to consider more general indicators of needs beyond subsistence. Our proposal reflects this idea of relative social needs rather than basic

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[3] The SPI uses the following definition: "Social progress is the capacity of a society to meet the basic human needs of its citizens, establish the building blocks that allow citizens and communities to enhance and sustain the quality of their lives, and create the conditions for all individuals to reach their full potential".

[4] Two editions of the index are available so far (2016 and 2020). Despite a stable methodology, the time comparison between the two editions has limited validity. The 2020 EU-SPI is an improvement on the first edition. It includes social and environmental indicators describing people's perceptions and needs.

individual needs. Additionally, the SPI is a "well-being index" based on mean values of positive and negative indicators within each dimension, while our proposal is an "unmet needs index" where all indicators within the dimensions are negative and can potentially be zero if all relevant needs are adequately covered.

Furthermore, the EU-SPI sub-dimensions include issues related to health, education, housing, and the environment, as well as political freedom, or social tolerance, but does not include others that are central to social needs: those related to economic and material well-being and the labour market. Moreover, differently from SPI our criteria to select indicators for each dimension are based on a set of key principles that follow the main challenges identified within the principles of the European Pillar of Social Rights (European Pillar of Social Rights, 2021). These challenges are faced by any household in each of the dimensions considered. Once these challenges have been defined, we choose indicators that try to represent them considering a triple criterion: access, quality, and equity in the coverage of social needs.

3. DIMENSIONS AND INDICATORS

The design of a composite index of social needs requires several normative judgements, being the first the selection of the dimensions in which these social needs are developed as well as the indicators within each dimension. To choose the dimensions, we have taken as reference those most related to social needs which are included in other key indices. We consider six social needs' components: material and economic well-being, employment, education, health, housing, and physical and social environment. Half of the selected dimensions are based on classic indices such as HDI or MPI: income, health, and education. The other three reflect aspects usually considered in composite indices of well-being: employment, housing and physical and social environment.

A second step is to select the indicators within each dimension. Although a wide range of variables adds richness and nuance to the analysis, an excessive number of indicators is not advisable, as it may hinder the agile and accurate monitoring of the coverage of social needs. Based on the three challenges of access, quality and equity, we choose a variety of indicators per dimension that aim to represent them (see Figure 1). All indicators are defined so that a higher value of each of them implies a worse situation in that dimension.

[Insert Figure 1 here]

2.1. Material and economic well-being

Any household or individual must be able to fulfil three fundamental challenges: to have sufficient and stable income, to maintain an economic-financial balance, and to avoid severe poverty.

Income is traditionally considered households' fundamental resource to avoid poverty and live a decent life. To measure the social needs linked to the first challenge, we use three indicators.[5] *At-risk-of monetary poverty* reflects the vulnerable situation of people receiving very low incomes, even if they manage to meet their basic needs. *Income losses* allow us to evaluate social needs related to income stability and, indirectly, the performing of the social protection system in avoiding abrupt income drops. We also include *lack of autonomy*, considering individual (not household) income of adults to capture the unequal access to income within the household (Bennett, 2013).

The second challenge refers to the degree to which income is perceived as adequate to cover household's expenditure needs. If households fail in this regard, they will inevitably reduce their wealth or incur in debt (Lusardi et al., 2011). This economic strain is also associated with food insecurity, poorer school performance, family conflict or worse mental and physical health (French and Vigne, 2019). We summarise this second challenge through *financial dissatisfaction*, that captures the imbalance between the income received and the income stated as necessary to make ends meet and *difficulty to make ends meet*, a common measure of financial stress (Hick, 2016).

Thirdly, preventing situations of poverty is a key social challenge in developed countries. The indicators chosen in this area go beyond the traditional definition based on relative low income. *Material deprivation* represents a direct measure of the low level of living suffered by the poor (Fusco et al., 2011). *Consistent poverty* allows us to identify households combining low income and material deprivation, a particularly disadvantaged group (Hick, 2014). Finally, we include an indicator of *persistent poverty*, since people with low incomes over long periods of time often experience more severe deprivation than those in transitory poverty (Arranz and Cantó, 2012).

2.2. Employment

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[5] See Table A1 in the Appendix to find the exact definition of each indicator.

Any household or individual must be able to fulfil three fundamental challenges: to have access to employment, to have adequate working conditions and to have a sufficient salary.

The most important need related to the labour market is having access to employment to achieve an adequate social and personal development. To measure the social needs linked to this first challenge we have selected three indicators: *jobless households*, *underemployment*, and *long-term unemployment*. The first two identify situations in which individuals are excluded from employment to different degrees: totally or partially, as they are unable to work the hours that they could and would be willing to work (Edelman and Holzer, 2013). We also consider that the duration of unemployment plays a very important role in determining higher difficulties to access employment and has relevant implications on both future salaries and worker's health (Nichols et al., 2013).

The second challenge is related to the job quality of the employed. First, we consider an indicator of household *employment instability* and then one capturing this phenomenon from the individual perspective (*temporary employment*). Furthermore, to capture more information on job quality, a third indicator is to what extent there is a mismatch between worker's knowledge and job requirements (Eurofound, 2023).

The third challenge of employment is related to equity and aims to capture whether employment provides a sufficient wage for a decent living avoiding poverty and income instability. We include a measure of *low earnings* and an indicator of *severe salary reduction* (OECD, 2024).

2.3. Housing

Any household or individual must be able to fulfil three fundamental challenges: have access to housing, enjoy minimum housing conditions and meet energy consumption needs.

Housing has traditionally been considered as essential for a decent life, as well as an asset that can act as a buffer against falling incomes. Moreover, differences in access to housing, housing conditions and the ability to meet domestic energy needs contribute to exacerbating inequalities in other basic dimensions of social well-being such as health (Navarro et al., 2010) or deprivation (Dewilde, 2022).

Regarding the access criterion, the first challenge is strongly related to housing prices. When the cost of housing exceeds a high percentage of household income it could jeopardise other family expenses leading to a high probability of default on mortgage or rent payments (Kutty, 2005). First, we consider *rent overburden* to capture the excessive financial effort to access rental housing. Second, we also include *housing costs overburden* (both for renters and owners) to reflect how excessive housing costs relative to household income may impede access (Saunders, 2017) and *rent or mortgage arrears* that addresses more directly the urgent housing problems that can lead to eviction and homelessness.

The quality of housing implies that it should meet some minimum conditions. *Poor housing conditions* reflects those conditions that directly affect human health, such as damp walls, leaks or lack of an indoor toilet (Shaw, 2004). *Overcrowding* captures households that do not have the number of rooms required to provide sufficient living space and privacy (Marsh et al, 2000). *Severe housing deprivation* reflects the incidence of overcrowding problems when combined with other housing deficiencies.

A third housing challenge is to ensure that households' energy consumption needs are met, thereby reducing the risk of energy poverty. Living in houses that are too cold worsens various diseases and contributes to higher mortality (Tirado et al., 2016). In addition, energy poverty can reinforce processes of social exclusion if household members avoid inviting friends or relatives due to the lack of environmental comfort (Middlemiss et al., 2019). To measure these needs we include *lack of thermal comfort* and *arrears on utility bills*.

2.4. Health

Any household or individual must be able to fulfil three fundamental challenges: be as healthy as possible, have healthy lifestyle habits, and have access to health.

The health dimension encompasses health status and health protection, defined not only as the absence of disease but also as a state of physical, mental, and social well-being. To measure health status and the social needs associated with the first challenge, we use four indicators. *Self-assessed health status* has been widely used to analyse the health status of the population because of its high correlation with objective measures and its good predictive capacity for mortality or use of medical services (Borg and Kristensen,

2000).[6] We also include *chronically ill*, as chronic diseases generate health problems that last or worsen over time (Strong et al., 2005). *Limitations for daily activities* is widely used internationally and helps to construct the "disability-free life expectancy" indicator. We also consider *mental health problems*, as neuropsychiatric disorders are the second leading cause of disease burden in Europe after cardiovascular diseases (Prince et al., 2007).

Promoting healthy lifestyles and reducing avoidable risk factors is a second health challenge. We focus on *obesity*, associated with an increased risk of coronary heart disease, cardiovascular disease, diabetes, certain types of tumours, and mental health problems (Kopelman, 2000). *Tobacco use* poses a clear health risk because of its demonstrated association with respiratory and cardiovascular diseases, as well as several types of cancer (Britton, 2017).

Thirdly, having a public health service with near universal coverage implies some guarantee of adequate access to health care. Waiting times, cost, distance, or shortages of appropriate specialists in certain areas can undermine equity of access (Moscelli et al, 2018). Indicators that represent this challenge are *inaccessibility to medical care*, which attempts to capture areas not fully covered by public health care, and *inaccessibility to dental care*, with limited public coverage which disadvantaged families cannot afford.

2.5. Education

Any household or individual must be able to fulfil three fundamental challenges: have access to good quality education, have the possibility to obtain adequate knowledge, and be part of an inclusive educational system.

It is well known that higher educational attainment is associated to a lower probability of unemployment, higher and more stable wages, and less job instability (Böckerman, 2004). Moreover, education can also have an impact on physical and mental health, as well as on crime and civic engagement (Brunello et al., 2016).

We analyse our first challenge (access to good quality education) through six indicators. We include the percentage of individuals *not achieving intermediate level*, and the percentage of individuals *not achieving tertiary studies (30-34)* to reflect society's

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[6] This variable is also the one used to calculate the indicator known as healthy life expectancy (HALE), which is sometimes used to make comparisons of health-adjusted life expectancy.

educational level. We also incorporate *children not in formal education (0-3)*, as education shows a significant positive impact in early stages of life on both cognitive and non-cognitive development, reducing educational inequalities and leading to better living conditions in adulthood (Carneiro et al., 2007). In addition, we consider *adults not in education (25-64)*, as lifelong learning allows for further personal and professional development, improvement of current employment status and better adaptation to technological changes (Midtsundstad, 2019). Finally, we include an indicator of *early school leavers* (Brunello and De Paola, 2014).

Low educational attainment has several effects on people's quality of life, but it also has macroeconomic consequences (Sauer and Zagler, 2014). Therefore, we approximate the second challenge (having the possibility to obtain adequate knowledge) with the percentage of *low performers in secondary education*, and *grade repetition*.

The third challenge is to have an inclusive education system that is not segregated by social origin. School segregation has important negative consequences, as it increases inequality of opportunity and impacts on social cohesion (Karsten, 2010). We measure the *level of segregation* by student socio-economic background (Alonso-Villar and Del Río, 2010).

2.6. Physical and social environment

Any household or individual must be able to fulfil three fundamental challenges: have sufficient relational capital, participate actively in society, and live in a safe and clean environment.

Physical and social environment are increasingly recognized as key factors for health and well-being. Social connections (often called 'social and relational capital') allow for better resistance to the consequences of crises and have large positive impacts on health, happiness, and quality of life (Ehsan et al., 2019). To measure the insufficient access to relational capital we use two indicators: *infrequent relationships* (not having relationships with family or friends at least monthly) and *no possibility to talk with others about personal issues*.

Regarding the second challenge (being able to actively participate in society), only those people who participate in social activities can increase their social capital (Wilding et al., 2023). For disadvantaged groups, social participation can be hindered or limited by

discrimination, especially in the case of minority groups (Denison et al., 2021). We use *no participation in activities* and *belonging to a discriminated group* to proxy this challenge. Note that both indicators capture some form of exclusion from social participation, rather than just social relationships, thus introducing an equity related perspective.

Finally, many studies have highlighted the negative impact of physical environmental problems on well-being and health (OECD, 2001). To measure the social needs related to the third challenge, four indicators are used: *insecurity in the area*, *noise from neighbours or outside*, *pollution in the area*, and *crime in the area*.

4. A COMPOSITE INDEX OF UNMET SOCIAL NEEDS

Social needs are a multifaceted and complex phenomenon that cannot be measured by a single variable. Instead, a variety of dimensions and indicators contribute to shape this socioeconomic concept. Analysing each one of these indicators and trying to disentangle their common trend may difficult the understanding of the phenomenon (Greco et al., 2019). Therefore, constructing a composite (or synthetic) index of unmet social needs allows us to summarize the information provided by our set of indicators and to assess the phenomenon in different countries over time with a simpler interpretation than by analysing each indicator separately (Mazziotta and Pareto, 2017).

Despite the large information requirements of our composite index, we have been able to gather EU-wide homogeneous data from a variety of surveys that covers a large period with four data points: 2005, 2010, 2015, 2019, so that we have information on different phases of the economic cycle: boom (2005-2008), recession (2008-2015) and subsequent recovery (2015-2019). We conduct an empirical illustration in nine European countries representing different welfare states: Denmark and Sweden (Nordic); Germany and France (Central European); United Kingdom and Ireland (Anglo-Saxon); Italy and Spain (Mediterranean); and Poland (Eastern European). The index relies on 48 indicators in nine countries in four time periods (1,728 data points).

4.1. Data preparation: treatment of missing data and normalisation

The use of multiple data sources for the construction of our 48 indicators poses serious difficulties regarding the coverage of the data. We use some surveys which are produced on an annual basis (for instance, EU-SILC or LFS), but others are issued every two or

three years (ESS, PISA). Thus, we have some gaps in our database if the corresponding survey for a given indicator is not produced in one of our selected years. Our strategy is to replace the missing data with the information of the closest period for which the indicator is available. We believe that the size of our dataset does not allow to use explicit predictive distribution models to impute missing data (OECD, 2008).

The construction of a composite index requires all underlying indicators to be measured in a common scale. In our case, all indicators are expressed as percentages and exhibit a negative relation with social needs: each indicator represents how many individuals in each country are unable to meet a certain aspect of social needs. Even though all our proposed variables are measured in the same unit, some indicators display larger values, as some facets of social needs are more covered than others regardless of the period or country analysed. Therefore, as we want to avoid that these indicators systematically raise the value of the composite index, we choose to normalise the underlying indicators each period. We discard applying normalisation to the whole dataset, as our proposal aims to assess and monitor unmet social needs on a regular basis. Considering all available values of an indicator for normalisation would require recalculating the composite indicator series each time new information is included (OECD, 2008, p. 85).

Our main analysis is conducted by normalising the 48 underlying indicators in each period using the following min-max method:

$$I_{qc}^t = \frac{x_{qc}^t - \min_c(x_q^t)}{\max_c(x_q^t) - \min_c(x_q^t)}$$

where x_{qc}^t represents the value of the indicator q for a country c and time t; $\min_c(x_q^t)$ and $\max_c(x_q^t)$ are the minimum and maximum values of the indicator across all countries at time t. That is, indicators are transformed into relative gains so that the resulted normalised indicators I_{qc}^t have values between 0 and 1. The min-max method is most convenient when using bounded indicators that differ in range, resulting in indicators with similar variances and which hardly introduce implicit weighting (Mazziotta and Pareto, 2017).[7]

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[7] Robustness tests regarding the normalisation procedure are provided in the Appendix.

4.2. Weighting and aggregation

When calculating a composite index, there are two crucial methodological decisions: first, the choice of weighting schemes to determine the relative importance of the dimensions within society's global index and indicators within a given dimension, and second, the choice of an aggregation method which will induce the degree of compensability between indicators.

The main results of this paper are computed with the most straightforward procedure: the scores for the six dimensions of unmet social needs are the arithmetic mean of their underlying indicators, and the composite index is calculated as the arithmetic mean of the selected dimensions. Therefore, our benchmark results are based on an additive aggregation method with an equal weighting scheme. Note that setting weights equal to one is a normative approach that implies a value judgement, assuming that all variables are equally relevant to the multidimensional phenomenon under study (Decancq and Lugo, 2013). If this assumption is not valid, we could be duplicating the common information in indicators and dimensions if they are strongly correlated. Nevertheless, in the light of robustness test results, we choose to follow Booysen (2002) and consider equal weighting as the norm.

Analytically, we calculate the value of unmet social needs in every dimension i for country c at moment t so that:

$$D_{ic}^t = \sum_{q=1}^{8} \delta_{qc}^t I_{qc}^t$$

where I_{qc}^t are the normalised values for the indicator q for a country c and time t, and δ_{qc}^t are the weights applied to each indicator q. We consider equal weights to aggregate from indicators to dimensions so $\delta_{qc}^t = 1/8$.

Once the relative deprivation level on each dimension is obtained, we can construct each country's c unmet social needs index at moment t by summing up dimensions:

$$S_c^t = \sum_{i=1}^{6} w_{ic}^t D_{ic}^t$$

where w_{ic}^t are the weights applied to aggregate from dimensions to a composite index (equal weighting, $w_{ic}^t = 1/6$).

In addition to equal weighting, we propose the use of subjective weights when aggregating our six selected dimensions. We start from the country-specific information provided by the OECD Better Life Index (OECD, 2020) and try to capture the relevance of each social needs dimension based on citizen's opinions. First, we rank the dimensions of the Better Life Index most similar to our proposed social needs dimensions (housing, income, jobs and work-life balance, education and health) and give a score from 2 to 6 depending on how respondents classify them, from the least important to the more relevant. We consider environment as the least important dimension for all countries (with a score of 1), as we are not capable of ranking it from the Better Life Index dimensions (as it is disaggregated into community, environment, civic engagement, and safety). Subsequently, we transform these scores into weights w_{ic}^t, so that the sum of dimensional weights for each country equals 1. Thus, we calculate our unmet social needs index as a weighted average.[8]

4.3. Robustness checks

To assess the robustness of the index of unmet social needs to the aggregation method, the index is recalculated using diverse alternative procedures. First, we use Principal Components Analysis (PCA) to aggregate indicators within dimensions. Each of the resulted scores is transformed into a scale of 0 to 1 using the min-max method. Subsequently, we compute the composite index as the arithmetic mean of dimensions. PCA uses statistical weights than help to reduce the dimensionality of indicators by capturing the variability in the data and avoiding the double counting problem, as it transforms the initial set of variables into a set of uncorrelated linear combinations of indicators. This procedure is hard to interpret, lacks transparency and is sensitive to the definition of original data and to the presence of outliers and small samples, while the obtained linear combination of indicators or dimensions and their correlations do not necessarily represent their real influence (Greco et al., 2019; OECD, 2008). Moreover, as PCA is based on the covariance structure between indicators, it is not appropriate when

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[8] To check the robustness of our results to the normalisation procedure of the proposed indicators, we calculate our unmet social needs index previously described with three different strategies: (a) without normalising indicators; (b) using the z-scores standardization method; and (c) applying the min-max normalisation method for each indicator across countries and time. All robustness results are presented in the Appendix. Note that the forthcoming results are consistent regardless of the normalization strategy used in the calculation of the composite indicator (see Tables A2, A3 and A4 in the Appendix) and Spearman's rank correlation coefficients are always higher than 0.9.

constructing formative composite indices as the correlation of the proposed variables could be potentially zero (Mazziotta and Pareto, 2019).

It is worth noting that additive aggregation can imply full compensation between indicators (dimensions) so that a poor performance in some of them can be compensated by good performances in others. Geometric aggregation aims to avoid full compensation and indicates the central tendency or the typical value by using the product instead of the addition. We check the robustness of our results by computing the composite index of unmet social needs using a geometric mean to calculate a country's c unmet social needs index in year t:

$$S_c^t = \prod_{i=1}^{6} (w_{ict} D_{ict})^{1/6}$$

However, as Ravallion (2012) clearly notes, the geometric aggregation approach has a variety of flaws and does not assure a good measurement of development. This author suggests the use of a generalized index proposed by Chakravarty (2003) which includes a parametric special case where one can maintain an additive aggregation of dimensions constructing a smoothly increasing and strictly concave function within each dimension by adding a parameter r:

$$S_c^t = \sum_{i=1}^{6} (w_{ic}^t D_{ic}^t)^r$$

When the parameter r is equal to 1, this index corresponds with the arithmetic mean of dimensions, which imposes perfect substitutability between dimensions. Considering smaller values between 0 and 1 allow us to relax this assumption. Following Chakravarty (2003) and Ravallion (2012), we consider different values of the parameter r: 0.75, 0.5 and 0.25.

5. RESULTS

5.1. Dimensions of social needs

A central issue for the assessment of unmet social needs in the European countries considered is whether the analysis of their extent in the different dimensions shape a global index. As Figure 2 shows, no dimension dominates over all the others. The dimension where unmet needs seem to be lowest is material and economic well-being. At

one extreme, the experience of the Nordic countries stands out, with very low levels of the index corresponding to this dimension. In the case of Denmark, it is below 10% which is the lowest value of all the indicators and countries considered. At the other side are the countries of Southern Europe, with similar and very high indicators. These differences are related, above all, to the inadequacy of income guarantee schemes in these countries (Van Lancker, 2016). The Anglo-Saxon countries, where these systems are also less extensive (especially the United Kingdom) still have a high percentage of households with unmet needs in this dimension.

These deficiencies in needs related to material and economic well-being have a natural cause in the degree to which households manage to satisfy their needs in the labour market. Low levels of unemployment and sufficient wages should a priori be associated with fewer problems in the first of these areas. As the results show, it is also the Mediterranean countries that perform worst in the indicators related to employment. In general, there is a certain correlation between the two types of needs. Even so, several countries manage to prevent situations of unemployment, low wages and reduced quality of work from translating into a major deterioration in the indicators of lack of economic resources. In this dimension, the case of Poland stands out, where the strength of the labour market makes it the country with the greatest achievements.

[Insert Figure 2 here]

In the case of housing, considering the problems of access and poor conditions of this asset, the difference in results by typology of welfare regimes continues being present. The countries that most deviate from this characterization are, on the positive side, Germany, with a very low value in the aggregate indicator for this dimension, and, on the negative side, Denmark and, especially, the United Kingdom. In the case of the Nordic countries, this dimension presents a high value compared to other dimensions, and the United Kingdom is by far the country where housing needs are covered to a lesser degree.

Of all the dimensions, it is in health where we find the most homogeneous results. In general terms, the level of the synthetic indicator for all countries is high, but the range of variation is the narrowest of all. Even so, the previous results of higher achievements in the Nordic countries are repeated, there are worse results in Southern European countries, and the highest levels, once again, are found in the United Kingdom, where large deficits in housing and health outstand in the comparative analysis.

In almost all countries the unmet needs in terms of access, skills and segregation in the education system are high. Only the two Nordic countries escape this situation. At the other extreme, Italy and Spain again have very high indicators. Broadly speaking, an inclusive system will promote equality of life opportunities for people coming from families with different socio-economic backgrounds and will allow that, whatever a person's social origin, investment in human capital will allow her to develop her skills and acquire the necessary knowledge to achieve her full social development. The reality in several European countries is far from this objective.

Finally, the range of variation in the coverage of social needs is also high in the case of the physical and social environment. The better position of the Nordic countries is also observable in this dimension, while Central European countries together with the United Kingdom show the worst results. In these countries, both the intensity of social relations and social participation are lower, as well as the quality of the physical and social environment.

The availability of data at different points in time makes it possible to compare these results with those of 2005, prior to the onset of the Great Recession. The crisis affected all countries, albeit with unequal intensity and with different effects on each dimension. Poland is the only country in which all the synthetic indicators by dimension decreased. The opposite cases are the United Kingdom, where all indicators increased, and the Mediterranean countries, where the same was true except for the physical and social environment dimension. The worst performance in the dynamics of social needs coverage is found in employment and housing dimensions, where most countries recorded significant increases. A relatively positive development is the reduction in educational needs in some countries, such as France, Ireland, Poland, and Sweden.

[Insert Table 1 here]

A final analysis has to do with the hierarchy of needs in each country and the possibility of finding different results by welfare models. As Table 1 shows, there is also a clear differentiation of models in this area. In Nordic countries, the dimensions where the problems in reducing social needs are greatest, although lower than in other countries, are the labour market and health. In Central European countries, the worst results are in education, health and the physical and social environment. Anglo-Saxon countries share the difficulty in reducing needs in health, while the opposite is true for education.

Southern European countries, in addition to generally presenting a lower coverage of social needs, show as their main singularity a higher incidence in material and economic well-being and employment. Finally, Poland also presents a differential experience, with greater relative difficulties in health and housing.

This hierarchy of needs allows us to state that in relative terms European countries present in general the greatest problems in the dimensions of health and employment, and the least, except for the United Kingdom and Germany, in needs related to the physical and social environment and housing. This pattern is relatively similar to that observed before the Great Recession, when the best-covered needs were the same as in 2019. The main change is that while in many countries the major problems had to do with the labour market, such as the Nordic and some Central European countries, the opposite was true for Mediterranean countries, with labour markets with a remarkable strength before that crisis. Our results seem to show that the shock of the crisis left significant after-effects in these last countries in their capacity to generate stable incomes through employment.

5.2. Composite index of unmet social needs

As shown in Figure 3 and Table 2, the results for the synthetic index of unmet social needs reveal a relationship between the degree of unmet needs and welfare regimes. The two Nordic countries, Denmark and Sweden, are relatively similar in terms of the index, with the lowest levels within the group of countries considered and becoming more equal during the observed period. This similarity is also observable in Southern European countries, and the incidence of unmet needs is also analogous in Ireland and the United Kingdom, although in the most recent period the latter is characterised by an upward trend in the synthetic indicator, while the opposite happened in Ireland. Central European countries also have somewhat similar values for most of the period analysed.

Of all the countries considered, the most unique experience is that of Poland, which in little more than a decade went from being the country with the worst indicators to levels that are very similar to those of Central European countries such as France or Germany. This evolution is fundamentally related to the strength of its labour market, shifting towards higher-skilled employment (OECD, 2020), and well targeted spending programs in support of low-income families (World Bank, 2015). A stable economic growth rate has translated into a well-functioning labour market. The unemployment rate is at record low levels, less than half that of the European Union.

There is also some homogeneity in the changes over time regarding the incidence of unmet needs (Figure 3). Although the pattern is not entirely common, the increase in social needs in the first phase of the 2008 crisis in most countries stands out, although in the case of the Mediterranean countries the prolongation of the crisis meant that the increase took place mainly between 2010 and 2015. Economic recovery generally implied a decrease in the combined rate of unmet social needs. However, in some countries, not only did this not occur, but, on the contrary, the incidence of the problem steadily increased. This is the case in Nordic countries and, most outstandingly, in the UK.

[Insert Figure 3 here]

Something similar happens when a subjective scheme is used as a weighting system. As Table 3 shows, the correspondence between unmet needs and welfare typology does not change, nor does the evolution of the index over time. It is important to highlight that in almost all countries the use of these subjective weightings raises the synthetic indicator of social needs, the two exceptions being Italy and the United Kingdom.

[Insert Table 3 here]

The evolution of our composite index of unmet social needs when calculated with a PCA-EW strategy is more volatile, even though the annual ranking of countries is pretty similar to those obtained with an arithmetic mean of indicators and dimensions (Figure 4 and Table A5) and the Spearman's rank correlation coefficient is always higher than 0.93 (Table A6). These results highlight the sensitivity of this method to the definition of original data and to the presence of outliers and small samples.

As noted earlier, an arithmetic mean imposes perfect compensation between dimensions. We can relax this assumption by considering smaller values of the parameter r, allowing for imperfect substitutability between dimensions without the unintended properties that geometric aggregation implies. We can see that, by construction, higher values of r reduce the absolute value of the synthetic indicator (Figure 4 and Table A9), that is, the level of unmet social needs is lower when considering an arithmetic mean compared to introducing a certain degree of penalty for compensability between dimensions ($r < 1$). Moreover, reducing the substitutability assumption has implications on the comparative levels of unmet social needs and their trends: as r gets smaller both the levels of unmet needs are more similar between countries, and they are also more

stable in time. However, country rankings remain very similar for all values of r (see Tables A5 and A6).

[Insert Figure 4 here]

Results are also not very sensitive to the use of other weighting schemes (given $r = 1$). When the geometric mean of the dimensions is used instead of the arithmetic mean, the two previous results are broadly confirmed: a clear correspondence between the synthetic indicator of unmet needs and the welfare typology or regime, and a similar evolution over time. The first of these results confirms the poorer position in the comparative table of the Mediterranean countries, the intermediate position of the Central European and Anglo-Saxon countries, although not in the case of the United Kingdom, the better results of the Nordic countries, and further confirms Poland's improvement over time.

6. CONCLUSIONS

The construction of synthetic measures of social well-being has registered an important momentum in recent decades. Despite these advances, there are still few composite indexes that can be used as a representative measure of the coverage of unmet social needs. This reality, which can be generalized to any country, is especially noticeable in the case of countries that have reached a high level of economic development. In these countries, there is a growing demand for new measures and approaches that go beyond traditional monetary poverty indicators.

The available approaches present some problems to be applied with this objective, such as an excessive emphasis on needs linked to the idea of subsistence or a limited applicability to relatively long-time intervals. In this paper we have proposed a set of dimensions and indicators to measure the incidence and trends of unmet social needs and aggregate them into a synthetic index for a selected sample of European countries. The primary aim has been to improve the measurement of social needs through broader and more systematic indicators than income poverty or other strictly distributional outcomes. The main advantage of our proposal over previous studies is the number of indicators, and the criteria used to select them.

One key contribution of our work has been to define a series of commonly accepted challenges in the European Pillars of Social Rights to guide the selection of different

indicators in each dimension based on three principles: access, quality, and equity. Another contribution is the elaboration and use of information for many countries at different moments in time so that we can most accurately identify the impact of the economic cycle on social needs.

The main result is to have defined an operational methodology for measuring unmet social needs in developed countries. We have constructed a composite indicator for nine European countries including six social needs dimensions each of which is based on eight social needs indicators. This measure could be extended to other countries and time periods. For the sample of selected countries, our results show that the proposed synthetic index is useful to identify a relationship between the degree of unmet needs and welfare regimes.

Our measure can also help to determine in which dimensions the achievements in the coverage of social needs are greater or lesser. The results by dimensions show that both before and after the Great Recession the greatest problems of European countries in relative terms are related to health and the labour market, and the least, except for the United Kingdom and Germany, are related to the physical and social environment and housing. The main change in the last decade has been the loss of strength of the labour market in Southern European countries which have increased their difficulties in providing employment and generating stable incomes.

The proposed approach also allows sensitivity analysis of the results to different methodological decisions. In general, results are not very sensitive to the use of other weighting schemes or aggregation methods. Nevertheless, relaxing the assumption of perfect substitutability of dimensions implies a higher value of our synthetic measure. We find that it also has some relevant implications for comparisons and time trends: as a lower perfect substitutability is assumed the levels of unmet needs are more similar between countries and they are also more stable in time, while country rankings remain very similar.

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Figure 1. Dimensions and Indicators of Unmet Social Needs.

- At-risk-of monetary poverty
- Income losses
- Lack of autonomy
- Financial dissatisfaction
- Difficulty to make ends meet
- Material deprivation
- Consistent poverty
- At-risk-of chronic poverty

Material and economic well-being

- Jobless household
- Underemployment
- Long-term unemployment
- Employment instability
- Temporary employment
- Overqualified workers
- Low earnings
- Severe salary reduction

Labour market

Environment

Social Needs

Housing

Education

- Rent overburden
- Housing costs overburden
- Rent or mortgage arrears
- Poor housing conditions
- Overcrowding
- Severe housing deprivation
- Lack of thermal comfort
- Arrears on utility bills

Health

- Self-assessed health status
- Chronically ill
- Limitations for daily activities
- Mental health problems
- Obesity
- Tobacco use
- Inaccessibility to medical care
- Inaccessibility to dental care

Figure 2. Unmet Social Needs by Dimensions

2005

Wellbeing — Labour market — Housing — Health — Education — Environment

2019

Wellbeing — Labour market — Housing — Health — Education — Environment
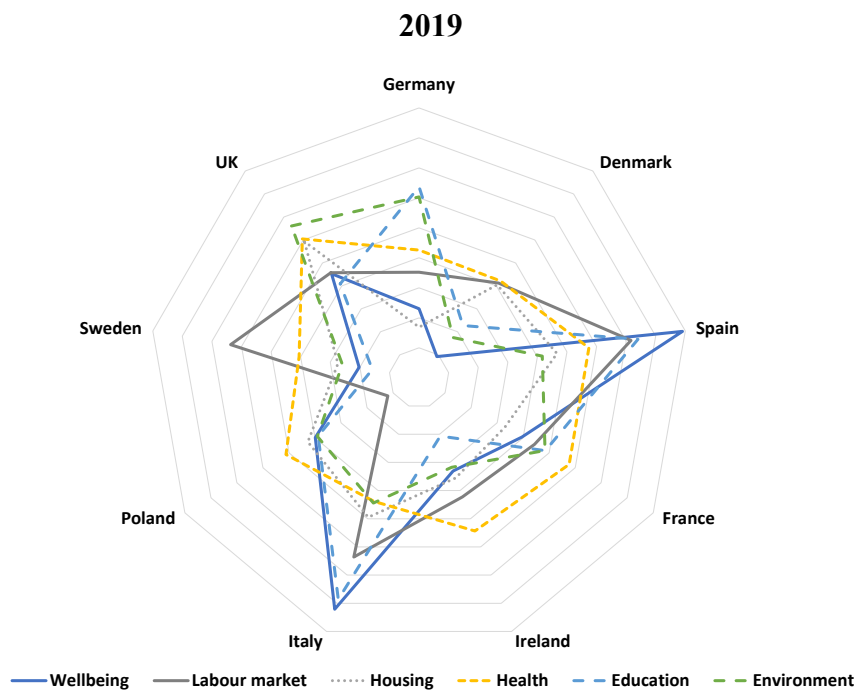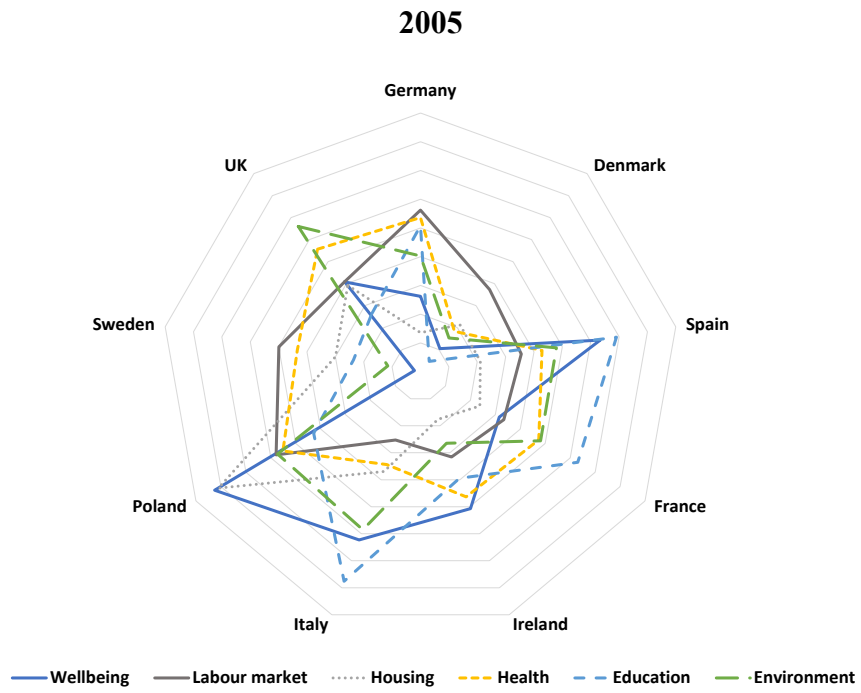
Figure 3. Composite Index of Unmet Social Needs, arithmetic mean
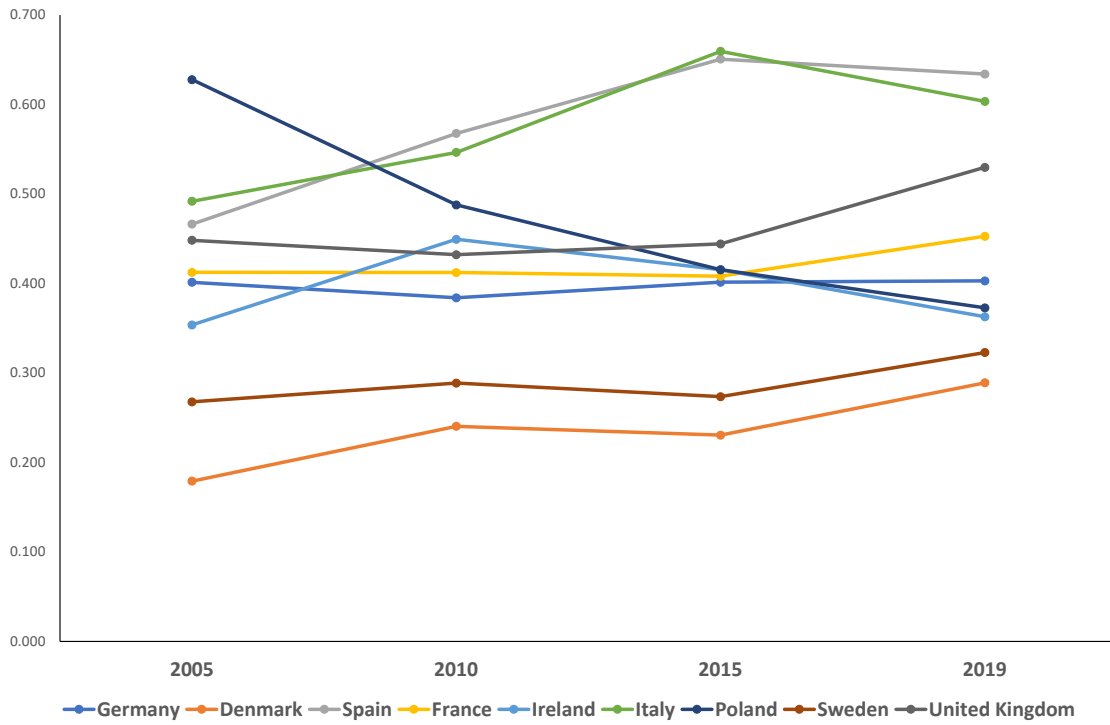
Figure 4. Sensitivity analysis by country

Germany, Denmark, Spain, France, Ireland, Italy, Poland, Sweden, United Kingdom

Legend:
- Arithmetic mean
- Geometric mean
- Ravallion's proposal (r = 0.25)
- Ravallion's proposal (r = 0.5)
- Ravallion's proposal (r = 0.75)
- Subjective weights
- PCA-EW
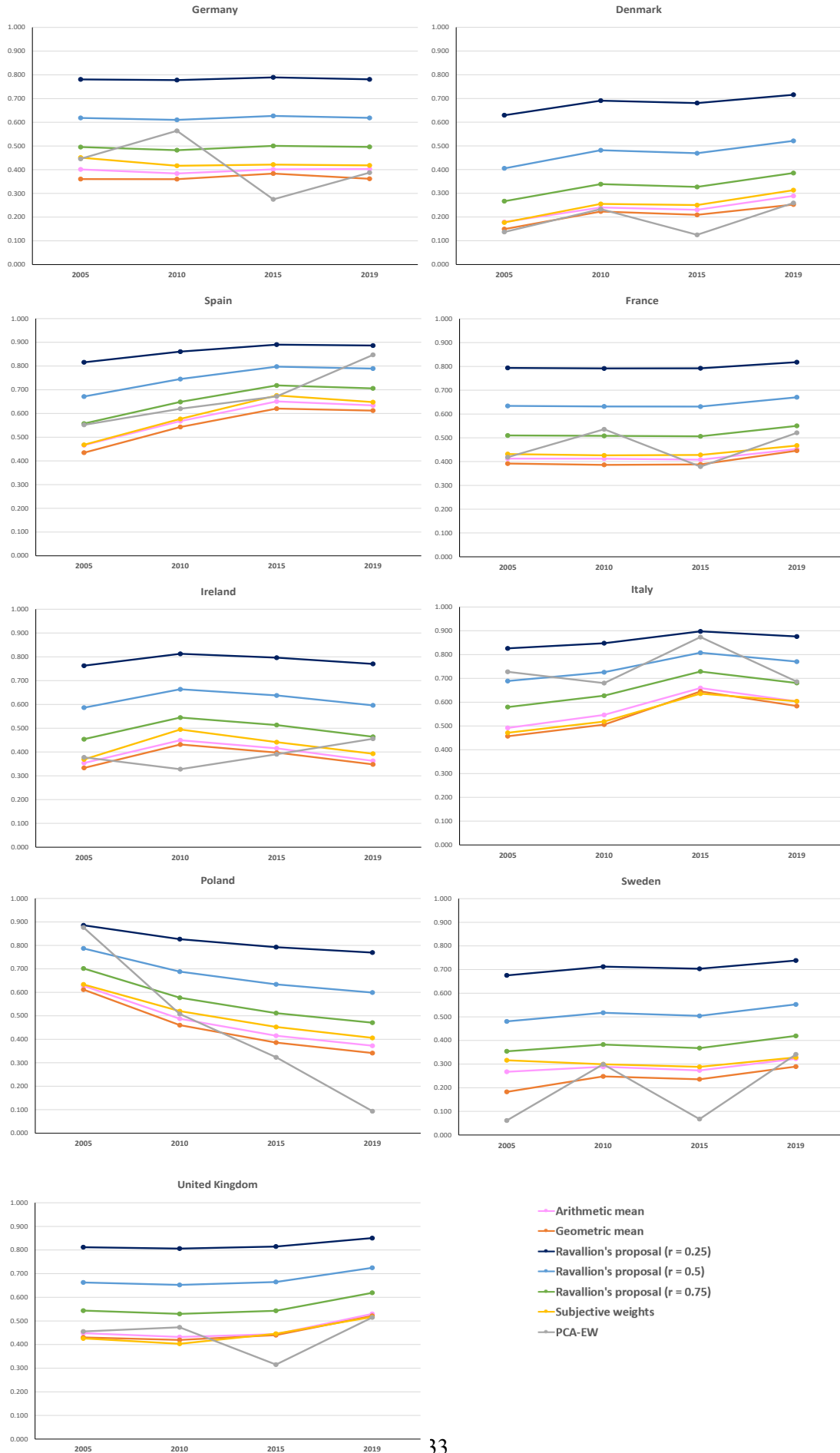
Table 1. Composite Index of Unmet Social Needs by Dimensions (ranking of needs)

	2005					
	Wellbeing	Labour market	Housing	Health	Education	Environment
Germany	5	1	6	2	3	4
Denmark	5	1	2	3	6	4
Spain	2	5	6	3	1	4
France	5	4	6	3	1	2
Ireland	1	4	6	2	3	5
Italy	2	6	4	5	1	3
Poland	1	3	2	5	6	4
Sweden	6	1	3	2	4	5
UK	4	3	5	2	6	1

	2019					
	Wellbeing	Labour market	Housing	Health	Education	Environment
Germany	5	4	6	3	1	2
Denmark	6	2	3	1	4	5
Spain	1	3	5	4	2	6
France	5	4	6	1	2	3
Ireland	4	2	3	1	6	5
Italy	1	3	4	6	2	5
Poland	3	6	2	1	5	4
Sweden	5	1	3	2	6	4
UK	5	4	3	2	6	1

Table 2. Composite Index of Unmet Social Needs, arithmetic mean

	2005	2010	2015	2019
Germany	0.401	0.384	0.401	0.403
Denmark	0.179	0.240	0.231	0.289
Spain	0.466	0.568	0.651	0.634
France	0.412	0.412	0.408	0.453
Ireland	0.354	0.449	0.415	0.363
Italy	0.492	0.546	0.659	0.603
Poland	0.628	0.488	0.415	0.373
Sweden	0.268	0.289	0.273	0.323
United Kingdom	0.448	0.432	0.444	0.530

Table 3. Composite Index of Unmet Social Needs, subjective weights

	2005	2010	2015	2019
Germany	0.451	0.417	0.422	0.418
Denmark	0.177	0.255	0.250	0.313
Spain	0.468	0.577	0.676	0.648
France	0.432	0.426	0.428	0.467
Ireland	0.369	0.495	0.441	0.393
Italy	0.471	0.518	0.636	0.604
Poland	0.634	0.520	0.452	0.406
Sweden	0.316	0.300	0.288	0.328
United Kingdom	0.426	0.403	0.446	0.517

Table A2. Composite Index of Unmet Social Needs, arithmetic mean, without normalization

	2005	2010	2015	2019
Germany	0.199	0.196	0.183	0.175
Denmark	0.147	0.160	0.148	0.155
Spain	0.211	0.211	0.224	0.206
France	0.200	0.194	0.182	0.178
Ireland	0.196	0.203	0.196	0.176
Italy	0.231	0.228	0.243	0.218
Poland	0.265	0.220	0.194	0.178
Sweden	0.162	0.164	0.150	0.159
United Kingdom	0.201	0.192	0.189	0.194

Table A3. Composite Index of Unmet Social Needs, arithmetic mean, z-score standardization

	2005	2010	2015	2019
Germany	-0.017	-0.088	-0.078	-0.104
Denmark	-0.695	-0.558	-0.605	-0.442
Spain	0.195	0.415	0.652	0.539
France	0.019	-0.028	-0.074	0.045
Ireland	-0.160	0.046	-0.059	-0.245
Italy	0.253	0.371	0.688	0.468
Poland	0.711	0.233	-0.077	-0.192
Sweden	-0.426	-0.426	-0.488	-0.355
United Kingdom	0.121	0.035	0.040	0.285

Table A4. Composite Index of Unmet Social Needs, arithmetic mean, alternative min-max normalization

	2005	2010	2015	2019
Germany	0.382	0.377	0.344	0.332
Denmark	0.217	0.271	0.221	0.240
Spain	0.454	0.485	0.528	0.447
France	0.394	0.378	0.350	0.339
Ireland	0.349	0.406	0.364	0.283
Italy	0.478	0.467	0.521	0.434
Poland	0.589	0.426	0.330	0.273
Sweden	0.266	0.298	0.264	0.274
United Kingdom	0.404	0.395	0.363	0.391

Table A5. Composite Index of Social Needs, ranking of countries

		Arithmetic mean	Subjective weights	PCA-EW	Geometric mean	Ravallion's proposal		
						r = 0.25	r = 0.5	r = 0.75
	Germany	6	4	4	6	6	6	6
	Denmark	9	9	9	9	9	9	9
	Spain	3	3	3	3	3	3	3
	France	5	5	5	5	5	5	5
2005	Ireland	7	7	7	7	7	7	7
	Italy	2	2	2	2	2	2	2
	Poland	1	1	1	1	1	1	1
	Sweden	8	8	8	8	8	8	8
	United Kingdom	4	6	6	4	4	4	4
	Germany	7	6	6	7	7	7	7
	Denmark	9	9	9	9	9	9	9
	Spain	1	1	1	1	1	1	1
	France	6	5	5	6	6	6	6
2010	Ireland	4	4	4	4	4	4	4
	Italy	2	3	3	2	2	2	2
	Poland	3	2	2	3	3	3	3
	Sweden	8	8	8	8	8	8	8
	United Kingdom	5	7	7	5	5	5	5
	Germany	7	7	7	7	7	7	7
	Denmark	9	9	9	9	9	9	9
	Spain	2	1	1	2	2	2	2
	France	6	6	6	5	6	6	6
2015	Ireland	4	5	5	4	4	4	4
	Italy	1	2	2	1	1	1	1
	Poland	5	3	3	6	5	5	5
	Sweden	8	8	8	8	8	8	8
	United Kingdom	3	4	4	3	3	3	3
	Germany	5	5	5	5	5	5	5
	Denmark	9	9	9	9	9	9	9
	Spain	1	1	1	1	1	1	1
	France	4	4	4	4	4	4	4
2019	Ireland	7	7	7	6	6	7	7
	Italy	2	2	2	2	2	2	2
	Poland	6	6	6	7	7	6	6
	Sweden	8	8	8	8	8	8	8
	United Kingdom	3	3	3	3	3	3	3

Table A6. Spearman's rank correlation coefficient with arithmetic mean by method and year

		2005	2010	2015	2019
Subjective weights		0.933	0.933	0.933	1
PCA-EW		0.933	0.933	0.933	1
Geometric mean		1	1	0.983	0.983
.Ravallion's proposal	r = 0.25	1	1	1	0.983
	r = 0.5	1	1	1	1
	r = 0.75	1	1	1	1

Table A7. Composite Index of Unmet Social Needs, Principal Components Analysis

	2005	2010	2015	2019
Germany	0.446	0.564	0.275	0.388
Denmark	0.137	0.233	0.125	0.259
Spain	0.552	0.62	0.672	0.847
France	0.418	0.536	0.379	0.521
Ireland	0.378	0.328	0.39	0.456
Italy	0.728	0.68	0.874	0.686
Poland	0.877	0.508	0.323	0.094
Sweden	0.061	0.299	0.067	0.341
United Kingdom	0.455	0.473	0.315	0.515

Table A8. Composite Index of Unmet Social Needs, geometric mean

	2005	2010	2015	2019
Germany	0.361	0.360	0.384	0.362
Denmark	0.149	0.223	0.209	0.253
Spain	0.435	0.543	0.621	0.612
France	0.392	0.386	0.388	0.446
Ireland	0.333	0.432	0.397	0.348
Italy	0.457	0.506	0.645	0.584
Poland	0.612	0.460	0.386	0.341
Sweden	0.183	0.248	0.236	0.289
United Kingdom	0.430	0.419	0.440	0.521

Table A9. Composite Index of Unmet Social Needs, Ravallion's proposal (based on Chakravarty, 2003)

	r = 0.25			
	2005	2010	2015	2019
Germany	0.781	0.778	0.789	0.781
Denmark	0.629	0.691	0.681	0.716
Spain	0.816	0.861	0.890	0.887
France	0.794	0.792	0.792	0.818
Ireland	0.763	0.813	0.796	0.770
Italy	0.826	0.848	0.897	0.876
Poland	0.886	0.827	0.793	0.770
Sweden	0.675	0.712	0.703	0.738
United Kingdom	0.812	0.806	0.815	0.851

	r = 0.5			
	2005	2010	2015	2019
Germany	0.618	0.610	0.627	0.619
Denmark	0.405	0.482	0.469	0.521
Spain	0.672	0.745	0.797	0.789
France	0.634	0.632	0.631	0.670
Ireland	0.586	0.664	0.638	0.596
Italy	0.689	0.726	0.808	0.770
Poland	0.787	0.688	0.634	0.599
Sweden	0.481	0.517	0.504	0.553
United Kingdom	0.663	0.652	0.665	0.725

	r = 0.75			
	2005	2010	2015	2019
Germany	0.496	0.482	0.500	0.496
Denmark	0.267	0.339	0.327	0.385
Spain	0.557	0.649	0.718	0.706
France	0.510	0.508	0.506	0.550
Ireland	0.454	0.545	0.513	0.464
Italy	0.579	0.627	0.729	0.680
Poland	0.702	0.577	0.511	0.471
Sweden	0.354	0.383	0.368	0.419
United Kingdom	0.544	0.530	0.543	0.619