



Health polarization and inequalities across Europe: an empirical approach

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Abstract

This paper examines inequality and polarization in self-assessed health, contributing towards the limited research existing on health economics. We use data from the European Health Interview Survey (EHIS) to investigate the relationship between health inequality and polarization across 27 European countries in two periods: 2006–2009 and 2013–2015. As our key variable is of an ordinal nature, we employ median based measures. Our empirical results suggest that Greece is the country with the highest level of health polarization in both periods, whereas Ireland has the lowest one when we consider countries where the median category is “very good”, coinciding with the findings obtained in the inequality index. Estonia, Hungary and Lithuania have the highest degree of health polarization in both periods while Malta, The Netherlands and Spain are the countries with the lowest when we focus on those countries whose median category is “good” health.

Keywords Self-assessed health · Polarization · Inequality · European health interview survey

JEL classification I14 · I32 · D63

Introduction

Polarization is a term which emerged in the 1980s, because of the impossibility of measuring the disappearance of the middle class with traditional inequality measurements. It can explain events such as mass relocation from the middle of some distribution (social, income or health, among others) to the poles. The concept of social polarization concerns the measurement of the distance between different social groups, defined on variables such as race, religion or ethnicity. If a distribution is concentrated around the median, it indicates a lower degree of polarization. By contrast, high polarization refers to those distributions expanded to the tails [12]. In our case, we focus on health polarization, so, it explains the mass relocation from the middle of Self-Assessed Health

(SAH) distribution to the poles (very good or very bad health). In other words, it is similar to the distance measurement between different SAH status. In this field, only a few studies so far have examined polarization.

In the same way, SAH inequalities have received less attention in health economics. The use of SAH has become very common as a study variable in empirical research. In order to measure dispersion for ordinal data, literature has focused on inequality, whose measurements are mean based. An alternative to mean-based inequality measurements is median-based polarization measurements. Authors such as Allison and Foster [4] recommend using the median as a reference level because it is central in the distribution and does not depend on scaling.

Both terms, polarization and inequality, are closely related, although each one highlights a different aspect of a distribution. The analysis of polarization may be of two-fold interest: economic and policy. If the economic reasons for a polarized system are understood, it could help policy makers to choose the necessary measures to reduce inequalities. There are contributions in the existing literature that demonstrate the differences between these two concepts, the pioneers being Wolfson [40] and Esteban and Ray [17]. In this field, we can also cite Apouey [6]. In short, we define

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polarization as the concentration around different tails, whereas inequality is the concentration around the average.

In general, SAH offers several advantages. First, many general population surveys include it as a measure. Second, it is one of the most commonly used health indicators because it covers and summarizes a large part of an individual's health condition. Last but not least, it is a relevant predictor of future mortality and morbidity [6, 23].

To the best of our knowledge, empirical evidence for polarization in Europe is not conclusive [8, 12, 22, 23, 24]. The purpose of this study was to bring polarization into the literature that analyses health inequalities because the number of empirical studies on health polarization is still limited. Therefore, this paper contributes to existing research providing the greatest possible comparison of inequality and polarization in health across Europe. We use the available information on SAH to analyse the most recent evolution. In short, this is the first study that examines health inequalities and polarization through SAH in European countries.

We provide an empirical illustration of health inequality and polarization using data from 27 countries from the European Health Interview Survey (EHIS) in two different waves: 2006–2009 and 2013–2015. As far as we know, this paper develops an original inequality measurement, which has only been used in applied health economics by Madden [25] and Jones et al. [24]. Our findings suggest that inequality is increasing in countries such as Greece, Ireland, Romania and Spain, among others, as well as polarization, when we focus on the calibration of the parameter α proposed by Apouey [6].

This paper is, therefore, structured as follows: First, the study reviews the existing literature about inequality and health polarization. Second, we describe the data and define the key variable. Third, we develop the approaches used in the measurement of health inequality and health polarization, respectively. Next, we present our main empirical findings. Finally, we make some concluding remarks.

Previous literature

Despite the fact that several studies have examined polarization, as mentioned above, it is only recently that this issue has received research attention. Specifically, it has become popular in economics. Studies on polarization typically describe the evolution of the disappearance of the middle class in income distributions [28, 40]. However, other studies on polarization cover issues such as social conflicts [17, 18] or health, among others. To describe the existing literature on this issue, we divide it into four sections: (1) income polarization in general, (2) income polarization related to economic growth, (3) income polarization introducing health and (4) health polarization.

We find some studies focused on income polarization but decomposing it according to population groups [12, 29, 35, 36, 39]. First, Winsberg [39] analyses income polarization of households in central cities and suburbs around the 37 largest metropolitan areas of the United States between 1950 and 1980. He concludes that polarization exists both among rich and among poor people, in urban areas as well as in suburbs. Nevertheless, income polarization depends on different socio-economic characteristics in each metropolitan area. Second, Chakravarty and Majumder [12] investigate the movement in polarization in six states in India using household expenditure data from the National Sample Survey Organisation (NSSO) in 1987–1988 and 1993–1994. Specifically, they distinguish between urban and rural sectors. They conclude that in the majority of rural areas, both, inequality and polarization decreased between 1997–1988, in comparison with 1993–1994. For China, Wang and Wan [35] analyse polarization and its changes. For the country as a whole as well as for urban and rural areas, their outcomes suggest that income polarization increased from 1986 to 1994 and from 2000 to 2003, when it reached a peak. Since 2003, polarization has decreased. A similar study by Sączewska-Piotrowska and Wąsowicz [29] shows how the middle-income class disappeared, analysing households with low, middle and high income in Poland from 2000 to 2015, using data from a Social Diagnosis project. In addition, they reveal how this is related to the place of residence. Their findings conclude that polarization measures vary over time. In spite of this, income polarization is higher in rural areas, where people also have lower income.

Focused on income polarization in general, there are some studies such as those developed by Abdel-Ghany [1] and by Azomahou and Diene [5]. Abdel-Ghany [1] studies the impact of demographic and economic aspects of the household on income polarization in America in 1990. Specifically, he uses the income polarization index to measure income inequality, defined as the bottom-to-top quintile income. His findings show that unemployment rate and education as well as women's labour force participation contribute to income polarization. In addition, the Southern States have greater income inequality than the national average. For the different African economies, Azomahou and Diene [5] analyse the polarization levels at the same time that they examine the effects of innovation over the period 1966–2008. For analysing income polarization, they use the gross domestic product (GDP) as indicator and, in the case of innovation, they use patents and registered trademarks. Their results show a growing bipolarization of income, which is related to specialization of African countries. They also find that in two sectors (services and mining) income bipolarization had reduced. Regarding innovation indicators, trademarks are statistically more significant than patents.

In addition, based on the European Union Statistics in Income and Living Conditions (EU-SILC), we find Wang et al. [37] and Mysíková and Večerník [26]. The first authors analyse income polarization as well as its determinants in 20 European countries from 2004 to 2013, finding a difference between Western countries and Central and Eastern European New Member States (EEC NMS). They conclude that there is an increase in income polarization followed by a decrease at the end in Western countries whereas the opposite happens in the EEC NMS. Meanwhile, the second authors analyse it in Austria, Czech Republic and Poland in two waves, 2004–2007 and 2007–2010. Specifically, they examine the trends of personal earnings distribution before and during the economic crisis. Their findings show that work sector, gender and education are the factors that contribute the most to income inequality. In addition, they cannot conclude that crisis drives income polarization.

On the other hand, different research has been carried out to study income polarization related with economic growth [11, 15, 20, 30]. First, Seshanna and Decornez [30] analyse polarization and inequality through the mean real GDP per capita, making between-country comparisons from 1960 to 1999. Their results conclude that constant economic growth has benefited almost every country under analysis. The whole world is becoming more polarized over time. Moreover, richer countries are the least polarized regardless of whether they are classified by organization, level of globalization, geographical or income group. On the other hand, Duro [15] finds no evidence of monotonous growth in international income polarization from 1960 to 2000, using the Esteban et al. [16] indices. He observes a curvilinear time trajectory, with polarization increasing in the early years but declining afterwards. Second, Ezcurra [20] analyses the relationship between income polarization and socio-economic growth in the European regions from 1993 to 2003, using data from the European Community Household Panel (ECHP) survey. He uses the polarization measurements developed by Esteban and Ray [17] and Esteban et al. [18]. To complete the study, he includes additional variables. His findings suggest that income polarization may affect regional economic growth in a negative way. Polarization level varies significantly in European Union regions, the most polarized being located in Southern Europe. Additionally, we find Brzezinski [11], who examines whether income polarization has an effect on economic growth, using the World Income Inequality Database (WIID) to examine more than 70 countries around the world between 1960 and 2005. His main conclusions are that there is a negative and statistically significant short-term impact of income on growth. Meanwhile, he finds no statistically significant impact of inequality on economic growth.

Furthermore, other studies of income polarization include health in their analysis [8, 10]. We find Blanco and Ramos

[10], who analyse the relationship between income polarization and individual health, using Spanish data from the ECHP survey. They employ two measures of inequality such as the Theil index and mean logarithmic deviation. They analyse polarization between regions and age-education groups. Their results indicate that polarization has a negative effect on the health of the individual. In addition, polarization is relevant between reference groups but the opposite is the case between regions. Besides, Apouey and Silber [8] measure inequality and bipolarization in socio-economic status, specifically, income and health, proposing two approaches to quantifying it. They use data for 2004–2006 and 2011 from the EU-SILC. Their findings suggest that Estonia has the highest degree of income and health dispersion, in both years of the data. Moreover, Cyprus and Portugal also have a high degree. The opposite is true for Iceland and Italy, where they find the lowest levels of inequality and bi-polarization, followed by The Netherlands.

As for health economics, only a few studies so far have examined polarization [6, 23, 24]. Apouey [6] compares inequality and polarization, using the British Household Panel Survey (BHPS) data from 1992 to 2004. Her findings demonstrate that inequality and polarization are empirically different, but there are cases where both behave similarly. Basing the study on the European Union, using the World Health Survey (WHS) data, Jones et al. [24] measure and compare inequalities and polarization in health in the responsiveness of health systems of 25 European countries. The results suggest inequalities in responsiveness, with the countries in Northern Europe showing the greatest inequalities and those in Southern Europe the smallest. Similarly, Fusco and Silber [23] develop two social polarization measures based on SAH status, using cross-sectional data from the EU-SILC. Their aim is to discover the extent to which the distributions between the five possible answers about SAH vary from the immigrants subgroup to the non-immigrants one. They conclude that Estonia and Latvia have the largest levels of social polarization in health while Luxembourg and Belgium have the lowest ones.

Data

We study polarization across Europe, using individual-level data from the EHIS during the period for which data are available. This survey accumulates data from individuals older than 15 living in private households. Its aim is to provide data across some European countries such as SAH, chronic conditions, hospitalisation, use of medicines, height and weight, smoking, sex or age, among others. Thus, it is possible to support the analysis of health policies that promote social inclusion as well as health inequalities. All this information is divided in four modules, which deal with

health status, health care, health determinants and socioeconomic background variables. We focus on the first one, the European Health Status Module (EHSM).

It is expected that these surveys will be conducted every 5 years. So far, there are only two waves available. The first one (EHIS 1) was introduced in 17 Member States between 2006 and 2009. The first year of data depends on the country we are focusing on. Meanwhile, the second one (EHIS 2) was implemented between 2013 and 2015 after a review process of the first wave. For our study, we use data from both of them.

Our first attempt was to measure and compare inequalities and polarization among the 28 EU Member States. Nevertheless, we have removed Croatia from our sample because we analysed the dynamics of the countries over two periods of time and it does not make any sense to analyse this country as there are only data for the wave between 2013 and 2015. Therefore, our final dataset has information about 27 European countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom (Table 1).

As we have indicated above, we focus on the EHSM, which provides how a person perceives their health status in general, including all the different dimensions of health (physical as well as social). The key variable of our study is SAH, which asks individuals to assess their general level of health through the answer to the following question: “How is your health in general?” It represents health status over the past 12 months and there is a five-category ordered variable: “very good” (value 5), “good” (value 4), “fair” (value 3), “poor” (value 2) and “very poor” (value 1) health. Therefore, an individual answering 4 enjoys better health than one answering 2. As we mentioned above, Allison and Foster (2004) suggest using the median health status as reference point. In our analysis, we take the fourth category (good health) as the median.

Table 2 includes for each country the distribution of answers for each of the five ordered categories of SAH in our sample. The countries are stratified into those with a median of “very good” (first category) and those with a median of “good” health status (second category), the last one being more common in both waves. In the period from 2006 to 2009, Spain and the Netherlands, with a population share of 55.9 and 53.5, respectively, report better health than the rest of the European countries in that health status. In contrast, in 2013–2015, Spain (55.6) continues at the top of the ranking, but the Netherlands (54.1) is in third position, behind Malta (54.6). Nevertheless, there are some exceptions such as Cyprus, Greece and Ireland as well as the United Kingdom in 2006–2009, where the median is higher (category

“very good”). We observe that Greece (52.3) appears as the healthiest country in the sample for the first wave while Cyprus (45.3) occupies this position in 2013–2015. On the other hand, some countries such as Malta and Slovenia have experienced an improvement in health. We conclude that because the proportion of population in the two top categories (“very good” and “good” health status) increases, those in the three lowest categories (“fair”, “poor” and “very poor” health status) decrease between 2006 and 2009 and 2013–2015. The opposite happens in the United Kingdom and Portugal.

Now, we define “good” and “fair” health status as the middle categories whereas “very good”, “poor” and “very poor” health status are the extreme ones. In this sense, in Finland and Sweden, the percentages of population in the middle categories increase from 2006 to 2009 to 2013–2015. In contrast, those corresponding to the extreme ones decrease. This means that there is a decrease in (unidimensional) bi-polarization in health over time, since the distribution of SAH is more concentrated around the median category in 2013–2015.

Health inequality measurements

In this section, we develop the measurement of inequality used in this paper. In the literature analysing inequalities in health, there are several inequality measurements. These include the Generalized Entropy (GE) measurements of inequality proposed by Theil [31]. However, although it is a good indicator for overall health with five ordered categories such as SAH, it is not appropriate for the application of standard inequality indices. In other words, Allison and Foster [4] show that inequality measurements used for analysing cardinal variables cannot be employed when the study is ordinal.

Thus, we use indices which are specifically designed to deal with ordinal data. Among them, we find the Foster–Greer–Thorbecke (FGT) index, developed by Foster et al. [21] and Bennett and Hatzimasoura [9]. A more popular measurement of poverty is the health Concentration Index [34], which is a measurement of health related to income. Meanwhile, Tubeuf and Perronnin [32] utilise the health index. In addition, Abul Naga and Yalcin [2] propose a parametric family of inequality measurements for ordinal data. As far as we know, these indices are only used in applied health economics by Madden [25] and Jones et al. [24].

To provide originality to our study, we use the Abul Naga–Yalcin index. It should be emphasized that this index can only be used to compare distributions with the same median category.

Table 1 Main conclusions of the studies about polarization review

Topic	Authors	Year	Country	Methodology	Main results
Income polarization	Chakravarty and Majumder (2001)	1987–1988 1993–1994	India	Wolfson's (1994) polarization index and a new index Qr	Polarization decreases from the period 1 to period 2 in both rural and urban areas (i.e., from 1.96 to 1.19 and from 2.06 to 1.88, respectively)
	Sączewska-Piotrowska and Wąsowicz (2017)	2000–2015	Poland	Wolfson's (1994) polarization index	Income polarization is higher in rural (range from 25.75 to 24.03) than in urban areas (vary from 24.52 to 23.25)
	Wang and Wan (2015)	1978–2010	China	Wolfson's (1994) polarization measure	Income polarization increases first from 0.20 to 0.27 (1986–2003) and then decreases until 0.26 (2003–2010)
	Winsberg (1989)	1950–1980	United States	Polarization or disparity index	Polarization increases for poor people between urban areas and suburbs (from -0.27 in 1960 to -0.44 in 1970)
	Azomahou and Diene (2012)	1966–2008	Africa	Wolfson's (1994) bipolarization measure	Income bipolarization increases, but some sectors (services and mining) reduce it
	Mysíková and Večerník (2017)	2004–2007 2007–2010	Austria Czech Republic Poland	Distribution method developed by Handcock and Morris (1999)	No evidence that crisis drives income polarization
	Wang et al. (2017)	2004–2013	Europe	DER (Duclos et al. 2004) indicator	Income polarization is lower in Northern Europe (0.164 in Norway and 0.171 in Denmark) than in the CEE NMS (0.212 in UK and 0.219 in Cyprus)
	Abdel-Ghany (1996)	1990	United States	Income polarization ratio	Southern States have indices higher than the national average

Table 1 (continued)

Topic	Authors	Year	Country	Methodology	Main results
Polarization and Economic Growth	Seshanna and Decornez (2003)	1960–1999	World	Wolfson's (1994) polarization index	World is more polarized over time, varying from 0.15 to 0.20 in 20 years
	Duro (2005)	1960–2000	World	Wolfson's (1994) polarization index and EGR indices	First, income polarization increases from 0.18 to 0.19, but it decreases later to 0.13
	Ezcurra (2009)	1993–2003	Europe	Polarization measurements proposed by Esteban et al. (1994, 2007)	Average polarization decreases for all income distribution groups when δ increases: from 0.134 to 0.60 (two groups), 0.141 to 0.054 (three groups), 0.124 to 0.065 (four groups)
	Brzeinski (2013)	1960–2005	World	DER family of polarization indices and W index	Inequality and polarization indices differ empirically and in significant ways
Income polarization and health	Blanco and Ramos (2010)	1994–2001	Spain	Mean Logarithmic Deviation (MLD)	Polarization decreases from 0.204 to 0.196. It also may affect individuals' health in a negative way
	Apouey and Silber (2013)	2004–2006/2011	Europe	They develop two approaches to measure bi-polarization	Estonia has the highest degree of income and health dispersion, rising from 0.025 to 0.028. Iceland and Italy have the lowest ones in 2011 (0.009 and 0.008, respectively)
Health polarization	Apouey (2007)	1992–2004	Great Britain	Her own measurements: P2	Polarization decreases from 0.242 (in 1992) to 0.231 (in 2004)
	Fusco and Silber (2014)	2009	Europe	Their own social polarization measurements (POLOR)	Baltic states have the largest levels of social polarization in health (0.0165 Estonia and 0.0123 Latvia) whereas central Europe has the lowest ones (0.0001 Belgium and 0.00003 Luxembourg)
	Jones et al. (2011)	2002–2003	Europe	The polarisation index proposed by Apouey (2007)	Polarization measures across the four domains of responsiveness vary from 0.142 to 0.302 (dignity), 0.205 to 0.343 (prompt attention), 0.165 to 0.383 (confidentiality), 0.156 to 0.403 (clarity of communication)

CEE NMS (Central and Eastern European New Member States). Source: Authors' elaboration

Table 2 Distribution of SAH by group of age, country and year

Country	2006–2009					2013–2015					2006–2009					2013–2015												
	Age	Very good	Good	Fair	Poor	Very poor	Age	Very good	Good	Fair	Poor	Very poor	Country	Age	Very good	Good	Fair	Poor	Very poor	Country	Age	Very good	Good	Fair	Poor	Very poor		
Cyprus	16–64	50.0	34.0	11.7	3.3	1.1	52.2	33.1	11.9	2.4	0.4	Italy	16–64	16.8	59.5	19.0	3.8	1.0	18.6	62.0	14.0	4.4	1.0	62.0	14.0	4.4	1.0	
	65+	6.4	26.6	37.1	21.6	8.3	6.9	28.3	44.6	15.8	4.3		65+	1.7	21.9	47.0	22.6	6.8	1.8	28.5	38.1	23.7	7.9	28.5	38.1	23.7	7.9	
Greece	16–64	63.8	23.5	8.6	2.8	1.3	56.8	29.2	9.1	3.6	1.3	Latvia	16–64	5.1	50.4	34.8	8.5	1.2	5.9	51.2	33.5	8.1	1.3	51.2	33.5	8.1	1.3	
	65+	7.5	27.7	37.4	19.0	8.4	6.9	27.8	36.3	21.1	7.9		65+	0.3	11.0	46.1	33.2	9.5	0.4	7.8	49.0	32.0	10.8	7.8	49.0	32.0	10.8	
Ireland	16–64	47.5	39.4	11.0	1.8	0.3	47.8	38.4	10.8	2.3	0.6	Lithuania	16–64	8.7	51.4	30.2	8.5	1.2	9.5	47.9	34.2	7.4	1.0	9.5	47.9	34.2	7.4	1.0
	65+	19.9	43.7	30.2	5.0	1.2	20.2	45.6	26.1	5.6	2.5		65+	0.8	6.3	43.7	39.3	9.8	0.5	3.5	47.0	39.6	9.3	3.5	47.0	39.6	9.3	
United Kingdom	16–64	46.9	37.7	11.4	3.3	0.6	37.4	39.0	16.8	5.5	1.4	Luxembourg	16–64	38.8	41.1	14.2	5.0	0.9	29.2	48.2	15.9	5.7	1.0	29.2	48.2	15.9	5.7	1.0
	65+	19.6	40.7	28.8	8.4	2.5	15.4	36.2	33.3	11.5	3.6		65+	7.5	37.6	36.1	15.1	3.8	7.0	44.1	32.9	13.5	2.4	44.1	32.9	13.5	2.4	
Austria	16–64	37.3	39.9	17.1	4.4	1.2	37.5	38.9	17.6	4.6	1.4	Malta	16–64	28.2	48.5	20.7	2.3	0.3	24.3	60.3	13.8	1.4	0.2	24.3	60.3	13.8	1.4	0.2
	65+	9.5	32.2	37.5	15.1	5.8	10.5	34.0	36.2	15.4	3.9		65+	5.2	24.2	56.6	12.1	2.0	4.0	32.2	53.7	9.3	0.8	32.2	53.7	9.3	0.8	
Belgium	16–64	33.0	46.8	13.6	5.4	1.2	36.2	45.0	12.1	5.6	1.2	Netherlands	16–64	26.9	55.2	14.1	3.2	0.5	26.5	55.0	14.1	4.0	0.4	26.5	55.0	14.1	4.0	0.4
	65+	8.3	39.8	34.7	13.6	3.7	8.5	43.2	30.0	14.8	3.5		65+	11.3	46.1	32.9	8.4	1.3	10.5	50.4	30.0	8.1	1.1	10.5	50.4	30.0	8.1	1.1
Bulgaria	16–64	22.4	55.9	15.4	5.1	1.2	22.3	57.5	14.1	4.7	1.4	Poland	16–64	20.8	45.0	24.4	8.4	1.4	21.1	47.0	23.7	7.1	1.1	21.1	47.0	23.7	7.1	1.1
	65+	0.2	15.3	46.7	28.1	9.8	0.5	19.0	48.2	24.4	7.9		65+	0.7	9.6	41.2	37.9	10.6	1.0	13.8	47.5	29.9	7.8	1.0	13.8	47.5	29.9	7.8
Czech Republic	16–64	23.4	48.3	20.6	6.5	1.3	24.7	48.3	20.0	5.7	1.4	Portugal	16–64	11.9	47.3	30.4	8.3	2.1	10.5	46.4	32.9	7.9	2.3	10.5	46.4	32.9	7.9	2.3
	65+	1.0	18.3	48.3	26.1	6.3	1.4	21.8	51.3	21.4	4.1		65+	1.1	14.2	44.2	27.7	12.8	0.7	10.0	44.6	31.3	13.3	0.7	10.0	44.6	31.3	13.3
Denmark	16–64	32.0	44.5	17.5	4.1	1.8	29.4	46.8	17.0	5.3	1.5	Romania	16–64	30.7	49.4	15.1	3.9	0.9	33.4	48.3	13.5	3.9	0.9	33.4	48.3	13.5	3.9	0.9
	65+	18.9	38.1	30.7	7.7	4.5	18.0	41.7	31.0	6.9	2.4		65+	1.2	20.2	53.3	20.1	5.1	0.7	18.0	53.8	22.6	4.9	0.7	18.0	53.8	22.6	4.9
Estonia	16–64	8.3	54.6	29.8	6.7	0.6	13.9	50.2	26.4	8.0	1.1	Slovakia	16–64	24.6	46.8	20.5	6.5	1.6	24.7	47.8	18.4	6.0	1.2	24.7	47.8	18.4	6.0	1.2
	65+	0.6	13.1	49.3	32.5	4.5	0.8	14.7	47.5	30.6	6.4		65+	0.9	11.6	38.5	34.7	14.3	0.7	16.9	43.0	30.8	8.6	0.7	16.9	43.0	30.8	8.6
Finland	16–64	25.7	51.8	18.4	3.5	0.6	25.5	52.8	18.0	3.2	0.5	Slovenia	16–64	20.4	47.4	23.5	6.9	1.7	25.2	50.0	20.1	5.7	0.9	25.2	50.0	20.1	5.7	0.9
	65+	6.2	29.9	44.4	15.9	3.7	7.7	32.8	44.6	12.4	2.6		65+	2.6	23.2	41.6	24.7	7.9	3.8	26.1	41.5	23.0	5.4	3.8	26.1	41.5	23.0	5.4
France	16–64	30.4	46.8	17.7	4.6	0.5	28.9	47.0	18.8	4.7	0.7	Spain	16–64	19.7	60.2	15.8	3.4	0.9	20.9	60.7	14.1	3.5	0.9	20.9	60.7	14.1	3.5	0.9
	65+	4.0	31.4	40.5	20.8	3.2	4.9	36.7	39.8	15.8	2.9		65+	4.9	34.0	38.3	16.5	6.3	4.0	36.4	37.0	16.6	5.9	4.0	36.4	37.0	16.6	5.9
Germany	16–64	21.1	52.2	20.9	4.8	1.0	21.4	51.5	20.7	5.3	1.1	Sweden	16–64	43.3	40.0	11.8	3.8	1.0	34.8	47.6	13.7	3.0	0.9	34.8	47.6	13.7	3.0	0.9
	65+	3.0	35.2	47.2	11.8	2.9	3.7	36.9	46.3	11.1	2.1		65+	18.0	41.8	30.7	7.3	2.3	19.4	47.0	26.7	5.4	1.4	19.4	47.0	26.7	5.4	1.4
Hungary	16–64	21.4	44.2	23.4	8.8	2.3	22.2	45.3	22.6	7.8	2.0		65+	1.3	12.5	40.3	33.2	12.7	0.9	12.0	46.9	30.9	9.2	0.9	12.0	46.9	30.9	9.2

Source: authors' elaboration from EHIS

Suppose we have an ordered variable with n different categories $1, \dots, n$, with the median denoted by m . Besides, P_i is the cumulative proportion of individuals of the sample in each category i , where $i = 1, \dots, n$. That way, we can denote the inequality measurement proposed by Abul Naga and Yalcin [2] as:

$$I_{\alpha,\beta} = \frac{\sum_{i < m} P_i^\alpha - \sum_{i \geq m} P_i^\beta + (n + 1 - m)}{k + (n + 1 - m)}, \quad \alpha, \beta \geq 1, \quad (1)$$

where $k = (m - 1)\left(\frac{1}{2}\right)^\alpha - \left[1 + (n - m)\left(\frac{1}{2}\right)^\beta\right]$ is a normalisation to ensure that this index is in the interval $[0, 1]$. In addition, α and β are parameters chosen by the researcher. There are two different possible situations: ($\alpha = \beta$) and ($\alpha \neq \beta$). Identical calibrations of these parameters indicate that inequality is at a minimum level when the whole population is in the same category whereas if half of the individuals are located in the lowest category and half in the highest one, inequality is at a maximum. By contrast, with ($\alpha \neq \beta$) different weights to inequalities above and below the median of the SAH distribution are reflected. That is, for higher values of α , less weight is given to disparities below the median, while, similarly, for higher values of β , less weight is given to inequalities above the median. Thus, we apply this index both in the case of symmetry and in the case of disparity. In the last one, following health economics literature such as Wagstaff [33], who attributes special importance to inequalities affecting the poorest levels, we analyse the case when a greater weight is given to disparities below the median SAH value ($\alpha = 1, \beta = 4$).

Health polarization measurements

In the literature, different methodologies to measure polarization have been proposed and they can be classified into two groups: measurements of polarization and measurements of bi-polarization. The first set captures the formation of any arbitrary number of poles. The second one analyses polarization as the process by which a distribution becomes bi-polar.

In terms of polarization measurements, we highlight Esteban and Ray [17], who create an index for discrete distributions, and Duclos et al. [14], who create a measurement for continuous distributions. To that measurement for discrete distributions, Esteban et al. [16] introduce a modification. Besides, alternative measurements have been proposed by Chakravarty and Majumder [12] and by Zhang and Kanbur [42].

In the case of bi-polarization measurements, there are some measurements such as the one created by Wolfson in

collaboration with James Foster and, after that, he improves the index [40, 41]. In addition, we find other indices developed by Alesina and Spolaore [3] as well as by Wang and Tsui [38], which can be considered as members of these measurements.

Thus, we focus on health polarization, using a more appropriate measurement. Apouey [6, 7] proposes a median-based index and applicable to the case of ordered response variables such as the one analysed here. Specifically, she suggests a measurement of polarization based on SAH. This index is defined as follows:

$$P = 1 - \frac{2^\alpha}{N - 1} \sum_{N=1}^{N-1} \left| P_n - \frac{1}{2} \right|^\alpha, \quad 0 \leq \alpha \leq 1, \quad (2)$$

where N denotes the different SAH categories $1, \dots, n$, and P_n is the cumulative proportion of category n in the population. The index is in the interval $[0, 1]$. The parameter α measures the weight given to the median category. We should emphasize that, as α approaches zero, the relative weight given to the median category rises and the relative contribution of the other categories decreases. Now, looking at the values for the calibration of this parameter, we use that proposed by Apouey [6] where there are five categories, $\alpha = 0.73$. In addition, we use other values such as 0.1, 0.5 and 0.9.

Empirical results

In this section, we provide an empirical illustration of the use of the indices developed above in a comparison in 27 European countries of the two available waves, 2006–2009 and 2013–2015. In terms of the indices, they integrate different hypotheses about the relative importance of a distribution. On the one hand, that importance is established in various parts of the distribution, that is, inequality measurements. On the other hand, importance is placed on various measurements of the shape of the distribution, that is, inequality and polarization are compared. Thus, we present two tables providing the numerical estimates of health inequality and polarization indices.

We start by investigating health inequality in Europe for which we present the findings in Table 3. The first column indicates the country under consideration. In columns 2 and 5, we present the median category of SAH of each country. Finally, columns 3–4 and 6–7 give the values for the Abul Naga-Yalcin measurement. As seen above, this inequality index can only be used to compare distributions with the same median category. Thus, we present the countries classified into those with a median of “very good” and those with a median of “good” health status. For each

Table 3 Inequality index in SAH in 2006–2009 and 2013–2015

Country	Wave 1			Wave 2		
	<i>m</i>	$I_{\alpha\beta}$		<i>m</i>	$I_{\alpha\beta}$	
		$I_{1,1}$	$I_{1,4}$		$I_{1,1}$	$I_{1,4}$
Cyprus	5	0.451 (1)	0.451 (1)	5	0.419 (2)	0.419 (2)
Greece	5	0.413 (3)	0.413 (3)	5	0.476 (1)	0.476 (1)
Ireland	5	0.381 (4)	0.381 (4)	5	0.396 (3)	0.396 (3)
United Kingdom	5	0.428 (2)	0.428 (2)	4	0.363 (8)	0.489 (3)
Austria	4	0.362 (9)	0.488 (2)	4	0.365 (7)	0.490 (2)
Belgium	4	0.325 (17)	0.452 (10)	4	0.332 (13)	0.461 (5)
Bulgaria	4	0.340 (12)	0.430 (13)	4	0.332 (14)	0.419 (16)
Czech Republic	4	0.363 (8)	0.453 (8)	4	0.358 (9)	0.449 (8)
Denmark	4	0.331 (14)	0.459 (7)	4	0.317 (16)	0.442 (9)
Estonia	4	0.352 (10)	0.359 (23)	4	0.390 (5)	0.425 (14)
Finland	4	0.306 (19)	0.418 (15)	4	0.297 (20)	0.409 (17)
France	4	0.333 (13)	0.451 (11)	4	0.324 (15)	0.440 (10)
Germany	4	0.305 (20)	0.396 (18)	4	0.308 (18)	0.399 (18)
Hungary	4	0.417 (1)	0.491 (1)	4	0.407 (3)	0.493 (1)
Italy	4	0.308 (18)	0.377 (20)	4	0.305 (19)	0.382 (21)
Latvia	4	0.387 (4)	0.364 (22)	4	0.397 (4)	0.377 (22)
Lithuania	4	0.400 (3)	0.402 (17)	4	0.416 (2)	0.420 (15)
Luxemburg	4	0.345 (11)	0.475 (4)	4	0.310 (17)	0.433 (12)
Malta	4	0.300 (21)	0.423 (14)	4	0.245 (24)	0.360 (24)
Netherlands	4	0.261 (23)	0.475 (5)	4	0.259 (23)	0.384 (20)
Poland	4	0.401 (2)	0.389 (19)	4	0.375 (6)	0.456 (6)
Portugal	4	0.380 (6)	0.414 (16)	4	0.427 (1)	0.436 (11)
Romania	4	0.329 (15)	0.452 (9)	4	0.341 (12)	0.465 (4)
Slovakia	4	0.383 (5)	0.479 (3)	4	0.353 (10)	0.452 (7)
Slovenia	4	0.364 (7)	0.446 (12)	4	0.347 (11)	0.399 (19)
Spain	4	0.266 (22)	0.366 (21)	4	0.273 (22)	0.370 (23)
Sweden	4	0.329 (16)	0.463 (6)	4	0.286 (21)	0.426 (13)
EU-27	4	0.347	0.460	4	0.346	0.456

m is the median category of SAH. The inequality rank appears in parentheses. Source: authors' elaboration

category, the rank in inequality across countries is provided in parentheses. So, comparing the rankings, we can see that four countries have a median category of “very good” SAH in the period 2006–2009 whereas 23 belong to “good” SAH. For 2013–2015, three countries have a median category of “very good” and 24 “good” SAH.

The absolute values and ranking of countries are equivalent for both when the inequality index influences the top and bottom of the distribution symmetrically ($\alpha = \beta = 1$) and when greater weight is placed on the lower part of the distribution ($\alpha = 1, \beta = 4$). This happens only if we have the highest median category of the distribution. If we observe the four countries with a median category of “very good” (5th category) in the period 2006–2009, SAH inequality ranges from 0.381 (Ireland) to 0.451 (Cyprus). For 2013–2015, for the three countries with a median

category of “very good”, it varies between 0.396 (Ireland) and 0.476 (Greece).

If we focus on the set of countries for which the median category is “good”, our findings indicate a greater variation in SAH inequality than when compared to the countries in the 5th category over both periods of time. The values of the index, with symmetrical weights, vary from 0.261 (Netherlands) to 0.417 (Hungary) in 2006–2009. When the influence of the inequality index is taken away from the top of the distribution, the values of the index become lower, ranging from 0.359 (Estonia) to 0.491 (Hungary). In other words, comparing both cases when symmetric weights are applied, and when more weight is placed on the lower part of the distribution in 2006–2009, in the first situation inequality in Hungary is clearly greater than that observed in the Netherlands. In the second one, the Netherlands is ranked in

fifth place whereas if $\alpha = \beta = 1$ it comes last. Notably, the ranking of countries changes depending on which weight is used. Only two countries are placed in the same position: Czech Republic and Hungary.

Meanwhile, in 2013–2015, the index ranges from 0.245 (Malta) to 0.427 (Portugal) when $\alpha = \beta = 1$. In the other case, if $\alpha = 1$ and $\beta = 4$, the values of the index become lower again, ranging from 0.360 (Malta) to 0.493 (Hungary). This year, Malta is in last place in both situations whereas Portugal and Hungary are in first place when symmetric weights are applied and when greater weight is placed on the lower part of the distribution, respectively. This time, three countries retain their rank when comparing the two indices.

On the one hand, countries that seem to perform relatively well on inequality in both years are Finland, Germany, Italy and Spain. We can include Malta, but only in 2013–2015. Meanwhile, countries that seem to perform relatively poorly are Hungary, Czech Republic, Latvia and Lithuania. The last two countries only have high levels of inequality if $\alpha = \beta = 1$. All these countries remain in the same or in a very similar position in the 2 years under consideration. The other countries vary their place more widely. On the other hand, the inequality level decreases from 2006 to 2009 to 2013–2015 in Cyprus whereas it increases in countries such as Greece and Ireland in the case of a median category such as “very good”. When we focus on the “good” median category, we find that inequality degree decreases in Northern Europe (Denmark, Finland and Sweden) and in Central Europe (Czech Republic, Luxemburg, Slovakia and Slovenia). It increases in other countries in the north of Europe (Estonia, Latvia and Lithuania), the centre (Belgium and Romania) and the south (Portugal and Spain).

We highlight the case of the United Kingdom. In the first year, most of the respondents report “very good” health whereas, in the second year, the medium category goes down to “good”. So, it is not possible to make an appropriate comparison.

Table 4 shows the estimates of the polarization index across the European countries considered. The first column of this Table indicates the country analysed. In columns 2–5, we present the values for the Apouey polarization measurement for four different values of the parameter ($= 0.1; 0.5; 0.73; 0.9$). As previously, we present the countries classified into those four with a median of “very good” and those 23 with a median of “good” SAH in 2006–2009. Meanwhile, three countries have a median category of “very good” and 24 corresponding to “good” health status in 2013–2015. In addition, for each country, we provide the ranking in polarization in parentheses. In general, if we examine the value for the calibration of α , proposed by Apouey [6], $\alpha = 0.73$, most of the considered countries show a decrease in health polarization from 2006 to 2009 to 2013–2015.

First, we describe the findings obtained for the period 2006–2009. When we focus on the three countries whose median category is “very good”, the ranking countries are equivalent for all the weights of α , except for $\alpha = 0.1$. In this case, polarization in SAH ranges from 0.056 (United Kingdom) to 0.088 (Greece). The absolute values for each country increase with $\alpha = 0.5$, $\alpha = 0.73$ and $\alpha = 0.9$. In the last case, polarization varies from 0.300 (Ireland) to 0.394 (Greece). In other words, Ireland is ranked in third place when $\alpha = 0.1$, but if $\alpha = 0.5; 0.73; 0.9$, it is in last place. Quite the opposite happens with the United Kingdom, which moves from fourth to third place, depending on whether $\alpha = 0.1$ or if $\alpha = 0.5; 0.73; 0.9$, respectively.

If we focus on those countries whose median category is “good”, the polarization indices range from 0.033 (Netherlands) to 0.089 (Lithuania) whereas it varies from 0.149 (Netherlands) to 0.282 (Lithuania), when $\alpha = 0.1$ and if $\alpha = 0.5$, respectively. Besides, the measurements range from 0.204 (Netherlands) to 0.348 (Hungary) while they vary from 0.241 (Netherlands) to 0.393 (Hungary). In other words, the Netherlands is in last place for all α values. Lithuania takes up the first, second and third place depending on whether $\alpha = 0.1; 0.5$, $\alpha = 0.73$ or $\alpha = 0.9$, respectively, and Hungary is in fourth, second and first position if $\alpha = 0.1$, $\alpha = 0.5$ and $\alpha = 0.73; 0.9$, respectively. Most of the European countries analysed change their position in the ranking, based on the value given to α . Nevertheless, Denmark, Netherlands, Romania and Spain continue in the same position.

Second, we develop the results for 2013–2015. If we turn our attention to the set of countries for which the median category is “very good”, the polarization ranking across the countries is equivalent for all the weights given to α . In addition, it ranges from 0.058 (Ireland) to 0.076 (Greece) when $\alpha = 0.1$ whereas it varies from 0.309 (Ireland) to 0.402 (Greece) if $\alpha = 0.9$.

If we now focus on the 24 countries whose median category is “good”, polarization in SAH varies from 0.031 (Malta) to 0.087 (Estonia) when $\alpha = 0.1$. The polarization ranking in Malta is equivalent for all the weights given to α . In the case of Estonia it is always in first place unless $\alpha = 0.9$, when Hungary leads the ranking. So, if we give α a value such as 0.9, polarization ranges from 0.226 (Malta) to 0.383 (Hungary). Similarly in 2006–2009, half of the countries in the sample change their position in the ranking slightly, based on the value given to α . However, the other half are in the same place (Belgium, Bulgaria, Finland, France, Italy, Malta, Netherlands, Romania, Slovakia, Slovenia, Spain and Sweden).

In short, in the case of the set of countries for which the median category is “very good”, specifically, Cyprus and Greece, the polarization ranking is equivalent for all the weights given to α for both periods of time, 2006–2009 and 2013–2015. Also, we have computed correlation

Table 4 Values of the polarization index in SAH in 2006–2009 and 2013–2015

Country	Wave 1				Wave 2			
	$\alpha=0.1$	$\alpha=0.5$	$\alpha=0.73$	$\alpha=0.9$	$\alpha=0.1$	$\alpha=0.5$	$\alpha=0.73$	$\alpha=0.9$
Cyprus	0.067 (2)	0.255 (2)	0.325 (2)	0.366 (2)	0.070 (2)	0.253 (2)	0.317 (2)	0.353 (2)
Greece	0.088 (1)	0.294 (1)	0.358 (1)	0.394 (1)	0.076 (1)	0.283 (1)	0.359 (1)	0.402 (1)
Ireland	0.058 (3)	0.213 (4)	0.268 (4)	0.300 (4)	0.058 (3)	0.217 (3)	0.276 (3)	0.309 (3)
United Kingdom	0.056 (4)	0.219 (3)	0.283 (3)	0.321 (3)	0.052 (9)	0.219 (9)	0.292 (8)	0.338 (7)
Austria	0.051 (10)	0.218 (10)	0.292 (10)	0.338 (9)	0.052 (8)	0.221 (8)	0.294 (7)	0.340 (6)
Belgium	0.044 (18)	0.190 (17)	0.258 (17)	0.302 (17)	0.045 (14)	0.195 (14)	0.264 (14)	0.308 (14)
Bulgaria	0.047 (13)	0.201 (13)	0.271 (12)	0.316 (12)	0.046 (13)	0.196 (13)	0.264 (13)	0.308 (13)
Czech Republic	0.055 (9)	0.224 (9)	0.296 (9)	0.340 (7)	0.054 (7)	0.222 (7)	0.292 (9)	0.335 (9)
Denmark	0.045 (15)	0.195 (15)	0.264 (15)	0.307 (15)	0.043 (17)	0.186 (16)	0.252 (16)	0.294 (16)
Estonia	0.084 (2)	0.263 (4)	0.312 (5)	0.339 (8)	0.087 (1)	0.282 (1)	0.340 (1)	0.373 (2)
Finland	0.041 (21)	0.179 (20)	0.243 (20)	0.284 (19)	0.040 (20)	0.174 (20)	0.236 (20)	0.276 (20)
France	0.046 (14)	0.197 (14)	0.266 (14)	0.310 (13)	0.044 (15)	0.192 (15)	0.259 (15)	0.301 (15)
Germany	0.043 (19)	0.182 (19)	0.244 (19)	0.284 (20)	0.044 (16)	0.184 (17)	0.247 (17)	0.286 (18)
Hungary	0.071 (4)	0.271 (2)	0.348 (1)	0.393 (1)	0.066 (5)	0.260 (3)	0.337 (2)	0.383 (1)
Italy	0.044 (17)	0.185 (18)	0.247 (18)	0.287 (18)	0.041 (19)	0.178 (19)	0.241 (19)	0.283 (19)
Latvia	0.070 (5)	0.245 (6)	0.301 (7)	0.333 (10)	0.069 (3)	0.245 (5)	0.305 (6)	0.338 (8)
Lithuania	0.089 (1)	0.282 (1)	0.338 (2)	0.369 (3)	0.068 (4)	0.247 (4)	0.311 (4)	0.347 (5)
Luxemburg	0.049 (12)	0.208 (11)	0.278 (11)	0.321 (11)	0.041 (18)	0.180 (18)	0.245 (18)	0.287 (17)
Malta	0.041 (20)	0.178 (21)	0.240 (21)	0.279 (21)	0.031 (24)	0.140 (24)	0.192 (24)	0.226 (24)
Netherlands	0.033 (23)	0.149 (23)	0.204 (23)	0.241 (23)	0.033 (23)	0.147 (23)	0.202 (23)	0.239 (23)
Poland	0.068 (6)	0.260 (5)	0.334 (3)	0.378 (2)	0.061 (6)	0.239 (6)	0.310 (5)	0.353 (4)
Portugal	0.079 (3)	0.268 (3)	0.328 (4)	0.363 (4)	0.074 (2)	0.264 (2)	0.330 (3)	0.368 (3)
Romania	0.045 (16)	0.194 (16)	0.262 (16)	0.305 (16)	0.047 (12)	0.202 (12)	0.272 (12)	0.317 (12)
Slovakia	0.056 (7)	0.234 (7)	0.310 (6)	0.358 (5)	0.050 (10)	0.211 (10)	0.283 (10)	0.328 (10)
Slovenia	0.056 (8)	0.226 (8)	0.297 (8)	0.341 (6)	0.049 (11)	0.208 (11)	0.278 (11)	0.323 (11)
Spain	0.034 (22)	0.151 (22)	0.208 (22)	0.245 (22)	0.035 (22)	0.155 (22)	0.213 (22)	0.251 (22)
Sweden	0.051 (11)	0.207 (12)	0.270 (13)	0.309 (14)	0.040 (21)	0.170 (21)	0.229 (21)	0.266 (21)
EU-27	0.048	0.207	0.277	0.323	0.047	0.204	0.274	0.319

The polarization rank appears in parentheses. Source: authors' elaboration

indices and they are very high in the case of polarization indices ($r=0.9$) but smaller if we consider inequality measures ($r=0.8$ if $\alpha = \beta = 1$ and $r = 0.5$ if $\alpha = 1$ and $\beta = 4$).

The polarization measurement produces a very similar ranking as those observed for inequality when applying symmetric weighting. In our study, comparing both inequality and polarization indices, when we are focused on those countries whose median category is “very good”, we can see that in 2006–2009, the indices do not show the same ranking whereas in 2013–2015 they do. Obviously, some countries could score worse values because they have lower educated or more elderly people [13, 27]. In fact, low birth rates and higher life expectancy are transforming the shape of the EU's age pyramid [19].

Conclusions

In this study, we have examined polarization and health inequalities using the two available waves from EHIS, 2006–2009 and 2013–2015, for 27 European countries. EHIS aims at measuring on a harmonised basis and with a high degree of comparability. Our main objective is to analyse the evolution of health inequality and polarization. In addition, our focus is to propose measurements of the inequality and polarization degrees of an ordinal variable such as SAH. So, we use an appropriate median-based measure of inequality because of the nature of our key variable. Specifically, this measurement is the Abul Naga-Yalcin index, which has advantages with regard to

the ordinality data and this is why it can be applied in our study. Moreover, we do the same in the case of polarization. We develop the Apouey index, with different values in its parameter (α). This is a polarization measurement, based on SAH.

Our results suggest that inequalities in SAH exist in a high number of European countries. The indices change across countries, Cyprus and Greece being the countries with the greatest inequality in 2006–2009 and 2013–2015, respectively, and Ireland the one with the least inequality for both years when the median category is “very good”. When the median category is “good”, Czech Republic and Hungary have the highest level of inequality. Meanwhile, Malta, Italy and Spain have the lowest ones. In the case of Malta, its inequality degree, in 2013–2015, indicates an improvement compared to the one obtained in 2006–2009.

In the case of polarization, the ranking is very similar for all the weights given to α for both periods of time, 2006–2009 and 2013–2015. This study provides evidence that, when the median category is “very good”, Greece has the highest level of health polarization whereas United Kingdom and Ireland have the lowest, in 2006–2009 and in 2013–2015, respectively. If the median category is “good”, Estonia, Hungary and Lithuania are the countries with the highest level of health polarization whereas Malta, Netherlands and Spain have the lowest. In both cases, inequality and polarization, we cannot compare United Kingdom from the 2 years because, first, it is classified as a country with a “very good” median category and, second, it belongs to the “good” median category.

In short, 4 years ago, in 2013–2015, both inequality and polarization indices showed similar ranking, whereby countries with higher inequality also have greater polarization. In all, the results support the importance of recent efforts by the EU countries to bring SAH to the forefront of the policy debate.

Furthermore, as possible future research, we could investigate the decomposition of the inequality and polarization measurements by socio-economic, cultural and/or environmental conditions to observe the reasons why both, inequality and polarization, exist in Europe and to determine which of them explain the changes in their disparity degree over time. In other words, we could identify whether these factors affect directly, either positively or negatively, the health of the individual. Other health determinants provided by EHIS, instead of SAH, could also be considered.

Compliance with ethical standards

Conflict of interest None.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

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