Income polarization in European countries and Europe wide, 2004–2012

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Polarization is an interesting additional social indicator for analyzing income distribution across countries, as it captures the phenomenon of 'clustering around extreme poles'. Income polarization can be closely linked to social exclusion, which is relevant for EU social policy, because combatting social exclusion is a central element of the Lisbon Agenda and the Europe 2020 Strategy. Rising income polarization has been observed outside Europe, but within the EU, polarization is relatively unexplored. This paper provides theoretical insights into this relatively new dimension of income distribution and analyzes trends in income polarization in 28 EU countries and 3 non-EU countries, using micro-data from EU-SILC over the period 2004–2012. Income polarization is rather stable over this period in European countries, and Europe-wide. It was rising among the old EU15 countries in the sub-period 2004–2008, but declining afterwards. The opposite development is witnessed for New Member States. Despite the Great Recession we find quite stable income polarization in Europe.

Key words: Income polarization, Inequality, Poverty, EU-SILC
JEL classifications: H53, H55, I32

1. Introduction

Unlike inequality and poverty, which have received a great deal of attention in the literature, income polarization as a concept is relatively unexplored, especially in Europe. Income polarization and income inequality are both sensitive to the middle of the distribution but the two concepts are different. While income inequality concerns the distances of different individuals in a society from the population mean, income polarization focuses on income differences and income clusters, comparing the homogeneity within a group with the overall heterogeneity of a given population (Castro, 2003). As

such, income polarization is closer to the notion of segregation than income inequality (Esteban and Ray, 1994). Income polarization is also different from poverty since the latter focuses mainly on what has happened at the lower end of the income distribution (Caminada *et al.*, 2012).

Several authors argue that the relevant distributional phenomenon is not inequality, but polarization (Duclos *et al.*, 2004; Duro, 2005). Income polarization can be related to a shrinking middle class. A well-off middle class is important to every society since it is associated with high income, high economic growth and social and political stability (Easterly, 2001; Pressman, 2007). In contrast, high income polarization may generate several harms. First of all, high income polarization may lead to the emergence of social unrest and tension (Esteban and Ray, 1994, 1999, 2011). Second, high income polarization means less social mobility. In a highly polarized society, individuals in each cluster feel closer to each other but distant from other groups, causing barriers for mobility between groups. Consequently, the relatively poor face difficulties in moving up the income ladder (Motiram and Sarma, 2014). This is an important aspect of social exclusion. Further, income polarization thwarts economic growth. One reason is that social conflict and political instability underlying income polarization increase pressure on market activities and labor relations and may reduce the security of property rights (Keefer and Knack, 2002). Moreover, income polarization may harm health, since social tension and conflict create psychosocial stress. Also, income disparities increase disagreement between groups with conflictive interests on the provision of certain public goods, for instance health care, which may result in reduction of its provision and therefore affect health (Pérez and Ramos, 2010). Hence, in order to minimize such risks, it is necessary to monitor economic development in a society using indicators to depict to what degree the income distribution is divided into poles (Clementi *et al.*, 2015).

However, the (empirical) analysis of income polarization is relatively new in Europe, compared to countries outside Europe, for instance China (Wang and Wan, 2015; Zhang and Kanbur, 2001), India (Chakravarty and Majumder, 2001; Motiram and Sarma, 2014), Nigeria (Clementi *et al.*, 2015), Latin American countries (Deutsch *et al.*, 2014; Gasparini *et al.*, 2008) and more developed countries like the United States and Canada (D'Ambrosio and Wolff, 2001; Foster and Wolfson, 1992, 2010). In Europe, literature on income polarization has involved only single countries like Denmark (Hussain, 2009), Germany (Gigliarano and Mosler, 2009), Italy (D'Ambrosio, 2001; Poggi and Silber, 2010) and Spain (Gradín, 2000) or a limited number of European countries (Atkinson and Brandolini, 2013; Brzezinski, 2013; Chakravarty and D'Ambrosio, 2010; Esteban *et al.*, 2007; Seshanna and Decornez, 2003). This lack of attention in Europe is remarkable, since income polarization is closely related to social exclusion. Since 2000, combatting economic and social exclusion has been one of the central objectives of the European Union (EU) strategy both between and within member states (European Council, 2000). In this context, it is important to analyze income polarization in Europe more extensively.

Therefore, we first contribute to the existing studies to track the trends in income polarization in 31 European countries over the period of 2004–2012, including the 15 old EU countries, 13 New Member States (NMS) and three other European countries, namely Iceland, Norway and Switzerland. There are sizeable income differences across the member states, especially since the enlargement of the EU in 2004 and

2007. Hence, it is particularly interesting to see how the NMS compare to the well-established welfare states of the old EU15 member states.

While analyses of income distribution are often based on a national perspective, there are good reasons to look at Europe as a whole (Fredriksen, 2012). When it comes to options and pitfalls for social policy initiatives at the EU level to increase social cohesion, EU-wide income differences are as important as national income differences (e.g. Goedemé and Van Lancker, 2009; Levy *et al.*, 2013). Recently, EU-wide social indicators on income inequality and poverty have been analyzed (e.g. Fredriksen, 2012; Goedemé *et al.*, 2014). These EU-wide indicators can provide basic information in evaluating the process of the Union towards greater social cohesion (Brandolini, 2007). To the best of our knowledge, there is no study addressing income polarization considering Europe as a whole. Therefore, the second contribution of this study is to analyze the level of income polarization by taking the European countries as a single country, thus adding another perspective to the comparative research on income distribution.

The paper is structured as follows. Section 2 describes the characteristics of the income polarization indicator and its difference with income inequality measures. Section 3 describes our data (EU-SILC). The subsequent section contains empirical analyses on both the level and change of income polarization in 31 European countries and Europe-wide, for the period 2004–2012. Also, the empirical relationship between income polarization and other social indicators is discussed. The last section concludes.

2. Characteristics of the polarization indicator

2.1 The income polarization indicator

Polarization means different things to different people. So far economists usually focus on income polarization, which refers to the clustering of income groups (Gornick and Jäntti, 2013). To measure income polarization, several indicators have been put forward. These indicators can be generally classified into two families: bipolarization and multi-peaked income polarization. Bipolarization and multi-peaked polarization indicators are univariate and satisfy some basic axioms: (1) there is little polarization when only one group exists; (2) polarization increases when inter-group inequality increases; (3) polarization increases when intra-group inequality decreases. Besides income polarization, there are several other types of polarization which can be analyzed distinctively (Duclos and Taptué, 2015). For instance, job polarization (the disappearance of middle-class jobs) or health polarization have been analyzed by several scholars (e.g. Goos *et al.*, 2009; Pérez and Ramos, 2010). Social polarization describes cases in which variables of interest are qualitative or noncardinal (for instance ethnic polarization; see Montalvo and Reynal-Querol, 2005). In 2010, Apouey constructed a bivariate polarization indicator, which accounts for both income and health conditions in a distribution. Apouey's (2010) polarization indicator can be classified into the family of socioeconomic polarization indicators (Duclos and Taptué, 2015). Finally, Anderson (2010) and Gigliarano and Mosler (2009) develop a family of multivariate polarization indicators, which generalize income and socioeconomic polarization. In this study, we focus on the *income* polarization indicators only. We are interested in how income polarization has changed across European countries and over time.

Specifically, bipolarization describes the distances between two income groups. Usually the two groups are located at either side of the median. That is, bipolarization captures the process in which the middle class disappears while clusters move to the two opposite poles. Literature on the measurement of bipolarization can be traced back to Foster and Wolfson (1992, 2010).[1] More recently, various bipolarization indicators have been proposed by other scholars, including Chakravarty and D'Ambrosio (2010), Chakravarty and Majumder (2001), Lasso de la Vega *et al.* (2010), Rodriguez and Salas (2003), Silber *et al.* (2007) and Wang and Tsui (2000).

Multi-peaked polarization indicators, on the other hand, attempt to capture the existence and importance of income groups clustering around any arbitrary number of groups. Leading studies include D'Ambrosio (2001), Duclos *et al.* (2004), Esteban and Ray (1994), Esteban *et al.* (1999, 2007) and Poggi and Silber (2010). Because multi-peaked polarization can deal with the existence of multiple groups, the concept is more flexible (Duclos and Taptué, 2015). For this reason, this study applies a multi-peaked income polarization indicator. The bipolarization index will not be used in our empirical analysis because it restricts its scope to the existence of two poles. Also, the split of data sample is arbitrarily set at the median income when computing bipolarization (Esteban and Ray, 2005). On the contrary, the *DER* index lets data determine the number of poles and the splits. However, the indicator of bipolarization (*FW*) and the indicator of multi-peaked polarization (*DER*) are strongly correlated. The correlation between the two indicators in our empirical analysis reaches 0.97.

Formalization of multi-peaked polarization indicators can rely on an 'identification-alienation' framework, first derived by Esteban and Ray (1994). The 'identification-alienation' framework states that in societies, income groups are likely to have different preferences for redistribution when they are far apart from each other. Such distances will bring about a feeling of alienation, which may lead to a lack of understanding of and tolerance for other income groups, therefore giving rise to societal tension. Meanwhile, as income groups are internally more homogeneous, their members have stronger feelings of belonging to their groups and identify more closely to others within the same group, which in turn may also increase social tension (Pérez and Ramos, 2010). According to Pérez and Ramos (2010), it is inequality between relevant population subgroups, i.e. alienation, rather than simply overall population inequality, that would increase differences in preferences for redistribution and lead to disagreement and conflict. Similarly, the more identity the members feel to their income groups, the more likely societal tension would arise.

Suppose the original distribution consists of n groups and p_i denotes the population share of group i ($i = 1, 2, …, n$). μ_i denotes the average income of group i. Esteban and Ray's (1994) (*ER*) indicator is expressed as:

$$ER = K \sum_{i=1}^{n} \sum_{j=1}^{n} p_i^{1+\alpha} p_j \left| \mu_i - \mu_j \right|,$$

[1] The bipolarization indicator proposed by Foster and Wolfson (1992, 2010) can be expressed as $FW = \left(G^B - G^W \right) \dfrac{\mu}{m}$, where G^B, G^W, μ and m are within-group inequality, between group inequality, the mean and the median income of the distribution.

where K and α are constants with $K > 0$ and $\alpha \in [0,1.6]$.[2] The selected sensitivity parameter α is chosen by the investigator and depicts the cohesion within a group. The higher α is, the characteristics of the members within groups are more similar and the groups are more homogeneous. When α equals 0, the ER indicator becomes the Gini coefficient. The higher α is, the more different the ER indicator is from the Gini coefficient.

The ER indicator is based on a discrete, finite set of income groups. This generates two shortcomings. First, a discrete, finite number of points suffers from a conceptual limitation of discontinuity. Second, the investigator needs to decide how many groups the population would be divided into. Practical difficulty thus arises when the population in one group could also be regarded as population in other groups (Duclos *et al.*, 2004). To overcome the two shortcomings, Duclos *et al.* (2004) extend the polarization indicator for continuous distributions:

$$DER = \left(\frac{1}{n}\right)\sum_{i=1}^{n}\hat{f}\left(v_i\right)^{\alpha}\hat{a}(v_i)$$

Income v_i is ordered such that $v_1 \le v_2 \le \cdots \le v$. The constant α reflects the strength of identity within a group. The higher α is, the stronger homogeneity the individuals feel to others within the same group. The DER indicator becomes the Gini coefficient when $\alpha = 0$. Duclos *et al.* (2004) impose additional axioms on the polarization measure. To meet these axioms, α must be bounded: $\alpha \in [0.25, 1]$. Taking into account the relationship between DER and Gini, we may expect that low values for α should produce values of the DER indices that are close in practice to the values of Gini, while values for α close to 1 lead potentially to the highest disparity between Gini and the DER indices.

2.2 The relationship between income polarization and income inequality

The income polarization index lies, as the Gini coefficient, between 0 and 1. Income polarization and Gini equal 0 for a perfectly equal distribution of incomes. When income polarization (Gini) increases, the society becomes more polarized (unequal). However, income polarization is different from inequality. Inequality concerns the distances of different individuals in a society from the population mean. Income polarization, on the other hand, is closer to the notion of segregation than income inequality (Esteban and Ray, 1994). Income polarization places both emphasis on income differences and income clusters, comparing the homogeneity within a group with the overall heterogeneity of a given population (Castro, 2003). As such, income polarization depicts the extent of similarity among members in a group and the distances between groups.[3]

In practice, income polarization and income inequality may not go hand in hand. With two or more groups, income polarization increases when inter-group income

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[2] The α is bounded [0, 1.6] to satisfy the axioms imposed on the ER and other intuitive properties of the measure (Esteban and Ray, 1994).

[3] The main differences between the three notions of inequality, bipolarization and polarization are also discussed by Deutsch *et al.* (2013).

inequality increases or when intra-group income inequality decreases. The latter case can best depict the difference between income polarization and all standard inequality indicators (Brezezinski, 2013). Both inequality and income polarization will decline if there is an 'equalizing transfer' of income from an individual above the median to an individual with income below the median. However, inequality and income polarization might diverge when there are equalizing transfers entirely on one side of the median (Wolfson, 1994, 1997). The difference between inequality and income polarization can be described by a hypothetical example where one individual owns the total income and all others none. In this case, inequality reaches the upper bound but the society is hardly polarized.

Income polarization and income inequality can even move in opposite directions; see Table 1 (see also Atkinson and Brandolini, 2013). Assume that the multiple-peaked distribution evolved from the uniform distribution; some middle incomes have disappeared, while both low- and high-income groups grew. Total income of the whole population has remained the same. Note that the multi-peaked distribution is more polarized than the uniform distribution. However, the more polarized multi-peaked distribution is also more equal (the Lorenz curve of the multi-peaked distribution lies closer to the egalitarian than the Lorenz curve of the uniform distribution). As a result, the Gini coefficient of the multi-peaked distribution is lower than the Gini of the uniform distribution. The same holds for the s80/s20 ratio. In this example, higher income polarization is accompanied by lower income inequality. Overall, income inequality and income polarization are two different concepts that should be examined separately when analyzing income distributions (Ezcurra, 2009). Phenomena such as 'the disappearing middle class' or 'clustering around extremes' do not appear to be easily captured by standard measures of inequality such as the Gini coefficient.

But would conclusions drawn from comparisons of inequality measures (Gini and poverty rates) be reversed or significantly changed if we use polarization measures in comparing societies over time? Empirical evidence is mixed. Ravallion and Chen (1997) and Zhang and Kanbur (2001) find that the polarization indicators do not

Table 1. *A numerical example on the relationship between polarization and Gini*

	Uniform distribution		Multi-peaked distribution	
	# households	income	# households	income
	3	25	1	25
	3	50	7	50
	3	75	1	75
	3	100	3	100
	3	12	1	125
	3	150	7	150
	3	175	1	175
	21	2,100	21	2,100
Gini coefficient		0.29		0.26
Ratio S80/S20		5.40		3.57
Polarization index		0.38		0.43

generate very different results from the inequality measures such as the Gini. Brzezinski (2013) and Lasso de la Vega and Urrutia (2006), on the other hand, provide evidence that inequality and polarization indices differ empirically and in significant ways. For example, based on micro data for more than 70 countries over the period of 1960–2005, Brzezinski (2013) suggests that using a standard inequality indicator like the Gini leads to misleading conclusions when analyzing the impact of income distribution on economic growth, while there is a good indication that income polarization is negatively associated with economic growth in the short term. Overall, the issue of whether income polarization and inequality (poverty rates) can be distinguished empirically has been a matter of some debate.

3. Data

The European Union Statistics on Income and Living Conditions (EU-SILC) is the EU reference source for micro income data. EU-SILC provides an up-to-date source for comparative research on income and living conditions in the EU. This dataset contains internationally and cross-temporarily comparable variables for all EU member states and some other countries. EU-SILC is unique since it offers information on a range of social indicators. Many EU indicators designed to monitor poverty, income inequality and social inclusion in the EU are based on EU-SILC (European Commission, 2006). At the EU level, EU-SILC has become a standard source for social reporting (Lohmann, 2011). Since we are interested in how income polarization has developed across European countries and Europe-wide, data from EU-SILC are suitable, as they cover all European countries and over a long period. For the empirical analyses presented in this paper, EU-SILC 2004–2012 data are taken for 31 countries, namely all 28 EU member states plus three non-EU countries: Iceland, Norway and Switzerland.

EU-SILC contains detailed information on individual and household characteristics as well as income by source. All income information of EU-SILC refers to the 'income reference period'. Except for Ireland and the UK, in all countries the income reference period covers the 12 months of the calendar year prior to the survey year. In Ireland, the income reference period is the last 12 months prior to the interview. In the UK, current weekly or monthly income is annualized and the income reference period refers to the year of the survey (Eurostat, 2008). It should be noted that there are considerable differences between participating countries in EU-SILC in terms of sample design, sample frame and data source (Goedemé, 2013). Furthermore, the data collection approach varies over time. For instance, prior to 2007, some of the countries provided no information on gross incomes (France, Greece, Italy, Latvia, Portugal, Spain). Data from these countries are not used in years when only net income information is available. Moreover, the analysis of trends of income polarization is restricted to 20 European countries due to data availability.

In this paper, we track the trends in income polarization of household disposable income across European countries over the period 2004–2012. We further split the period into two, using 2008 as the mid-point to investigate effects before and since the Great Recession. We compute the level of income polarization for household disposable income, equivalized using the square-root scale. Disposable income is defined as the sum of gross market income and cash benefits, net of direct taxes and social

insurance contributions. Following common practice (see e.g. Lohmann, 2011), we exclude non-positive incomes. In line with Eurostat practice, no top-coding of income has been applied. All incomes are converted into euros of 2005 (deflating by a country-specific consumer price index taken from World Bank, 2012). Available countries and data years are presented in Table 2.

To calculate income polarization across countries and over time, we use the *DER*, which can overcome the limitation of other polarization indicators (e.g. *ER* and *WF* indicators). The *DER* indicator has been widely used (e.g. Hussain, 2009; Wang and Wan, 2015). Following their common practice, the value of $\alpha = 0.5$ is chosen. In the sensitivity analysis, we compute the *DER* indicator for a range of values of α.

4. Empirical analysis

4.1 Levels and trends in income polarization across European countries

Table 3 shows estimates for the income polarization indicator (*DER*, $\alpha = 0.5$) for European countries and the direction of movement in the indicator in the two sub-periods 2004–2008 and 2008–2012.

Relatively low levels of income polarization for 2012 are mainly found in Norway, Denmark, Slovenia and Sweden while relatively high income polarization levels are observed in countries like Bulgaria, Cyprus, Portugal and Latvia. We computed the polarization measure *DER* for a range of values of α across countries for 2012, but

Table 2. *Available countries and data years in EU-SILC*

Old EU-15			*NMS-13*		
AT	Austria	2004–2012	*BG*	*Bulgaria*	*2007–2012*
BE	Belgium	2004–2012	CY	Cyprus	2005–2012
DE	Germany	2005–2012	CZ	Czech Republic	2005–2012
DK	Denmark	2004–2012	EE	Estonia	2004–2012
ES	*Spain*	*2004–2012*	*HR*	*Croatia*	*2011–2012*
FI	Finland	2004–2012	HU	Hungary	2005–2012
FR	*France*	*2004–2012*	LT	Lithuania	2005–2012
GR	*Greece*	*2004–2012*	*LV*	*Latvia*	*2007–2012*
IE	Ireland	2004–2012	*MT*	*Malta*	*2008–2012*
IT	*Italy*	*2004–2012*	PL	Poland	2005–2012
LU	Luxembourg	2004–2012	*RO*	*Romania*	*2007–2012*
NL	Netherlands	2005–2012	SI	Slovenia	2005–2012
PT	*Portugal*	*2004–2012*	SK	Slovakia	2005–2012
SE	Sweden	2004–2012			
UK	United Kingdom	2005–2012	*Other*		
			CH	*Switzerland*	*2008–2012*
			IS	Iceland	2004–2012
			NO	Norway	2004–2012

Note: No time-series analyses for countries presented in *italic* due to lack of quality of data (no gross incomes) for ES (2004–2005), FR (2004–2006), GR (2004–2006), IT (2004–2006), LV (2005–2006), PT (2004–2006), or missing data for BG (2004–2006), HR (2004–2010), MT (2004–2007), RO (2004–2006), and CH (2004–2007).
Source: EU-SILC.

Table 3. *Polarization indicator 2004, 2008 and 2012(DER, α = 0.5)*

	Country	Available in EU-SILC	Level polarization indicator			Change over time		
			2004	2008	2012	2004–2008	2008–2012	2004–2012
Old EU-15								
AT	Austria	2004–2012	0.183	0.188	0.191	2.8%	1.6%	4.5%
BE	Belgium	2004–2012	0.188	0.194	0.188	3.1%	–3.0%	0.0%
DE	Germany	2005–2012	0.191	0.193	0.189	1.4%	–2.1%	–0.8%
DK	Denmark	2004–2012	0.166	0.191	0.170	15.4%	–10.8%	3.0%
ES	Spain	2006–2012		0.202	0.209			
FI	Finland	2004–2012	0.187	0.189	0.189	1.0%	0.3%	1.3%
FR	France	2007–2012		0.204	0.204			
GR	Greece	2007–2012		0.212	0.204			
IE	Ireland	2004–2012	0.216	0.215	0.204	–0.5%	–4.9%	–5.4%
IT	Italy	2007–2012		0.200	0.207			
LU	Luxembourg	2004–2012	0.189	0.212	0.194	11.9%	–8.2%	2.7%
NL	Netherlands	2005–2012	0.172	0.181	0.175	5.4%	–3.4%	1.8%
PT	Portugal	2007–2012		0.228	0.216			
SE	Sweden	2004–2012	0.164	0.169	0.174	3.0%	3.4%	6.5%
UK	United Kingdom	2005–2012	0.223	0.217	0.208	–2.8%	–4.2%	–6.8%
Mean-10			*0.188*	*0.195*	*0.188*	*3.8%*	*–3.3%*	*0.3%*
Coefficient of variation			*0.098*	*0.075*	*0.062*	*–24%*	*–17%*	*–37%*
NMS-13								
BG	Bulgaria	2007–2012		0.226	0.213			
CY	Cyprus	2005–2012	0.199	0.200	0.214	0.6%	6.8%	7.5%
CZ	Czech Republic	2005–2012	0.186	0.178	0.177	–4.2%	–0.4%	–4.6%
EE	Estonia	2004–2012	0.220	0.200	0.204	–9.1%	2.1%	–7.2%
HR	Croatia	2011–2012			0.205			
HU	Hungary	2005–2012	0.188	0.182	0.187	–3.0%	2.7%	–0.3%
LT	Lithuania	2005–2012	0.219	0.214	0.206	–2.5%	–3.8%	–6.1%
LV	Latvia	2005–2012		0.239	0.221			
MT	Malta	2008–2012		0.199	0.197			
PL	Poland	2005–2012	0.217	0.203	0.199	–6.7%	–1.8%	–8.3%
RO	Romania	2007–2012		0.220	0.207			
SI	Slovenia	2005–2012	0.172	0.171	0.173	–0.4%	1.1%	0.6%
SK	Slovakia	2005–2012	0.186	0.177	0.180	–4.6%	1.9%	–2.8%
Mean-8			*0.198*	*0.191*	*0.193*	*–3.9%*	*1.0%*	*–2.9%*
Coefficient of variation			*0.087*	*0.075*	*0.073*	*–14%*	*–3%*	*–16%*
Other								
CH	Switzerland	2008–2012		0.205	0.195			
IS	Iceland	2004–2012	0.177	0.191	0.175	7.8%	–8.3%	–1.2%
NO	Norway	2004–2012	0.188	0.173	0.165	–7.9%	–5.0%	–12.6%
Mean-20			*0.191*	*0.192*	*0.188*	*0.2%*	*–1.9%*	*–1.7%*
Coefficient of variation			*0.094*	*0.076*	*0.074*	*–20%*	*–3%*	*–22%*

Note: No data for ES (2004–2005), FR (2004–2006), GR (2004–2006), IT (2004–2006), PT (2004–2006), BG (2004–2006), HR (2004–2010), LV (2005–2006), MT (2004–2007), RO (2004–2006), and CH (2004–2007). Both Mean-10 Old EU15 countries and Mean-8 NMS only include countries for which all data years are available.

Source: own calculations EU-SILC.

country rankings seem to be independent of the value of α (see additional supporting information)

For our trend analysis, only 20 countries are included which have data starting from the year 2004 or 2005 to 2012. We further split the period into two, using 2008 as the mid-point to investigate effects before and since the Great Recession. The economic crisis has given rise to challenges to the welfare state and may have influenced income polarization in European countries.
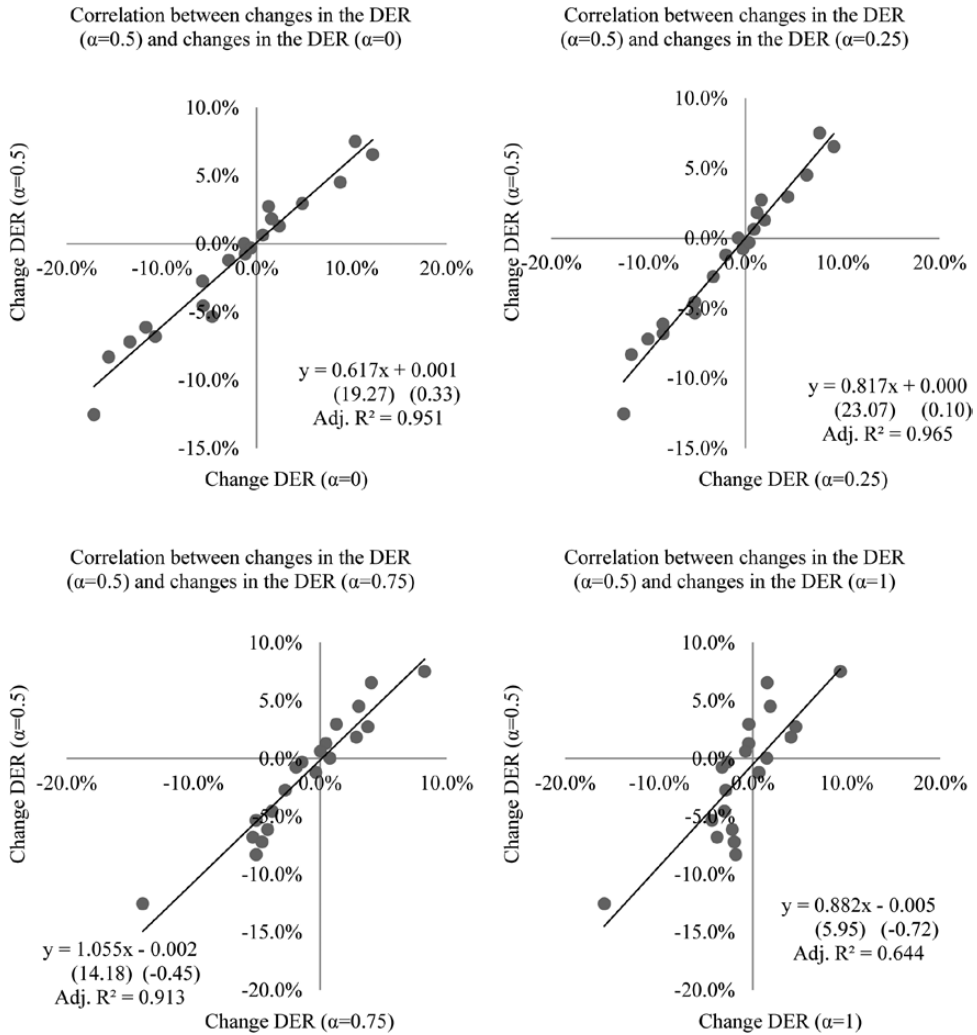
Table 3 shows a rise of income polarization from 2004 to 2008 for seven out of 10 old EU15 countries, but a decline afterwards (with the exception of three countries). For some countries, as Denmark and Luxembourg, a rather large increase of income polarization was followed by a rather large decrease since 2008. The opposite development is witnessed for the NMS: a decline of income polarization from 2004 to 2008 for seven out of eight NMS, but a slight increase afterwards (with the exception of three countries). So the pattern for the old EU15 countries differs from the NMS. However, differences between countries became smaller over time, especially between 2004 and 2008. The coefficient of variation declined from 0.094 to 0.074 in the period 2004–2012 across the 20 countries (–22%), indicating convergence of income polarization outcomes. The convergence between the NMS mainly occurred in the period 2004–2008.

Despite the Great Recession, and despite cross-country differences of both levels and changes in income polarization, Table 3 shows a rather stable income polarization in European countries. It appears that income shocks of the crisis were distributed equally over different groups in these countries.

Results are robust regarding the trends in income polarization (*DER*) by using different values of α (see Figure 1). We find pretty good fits with respect to the correlation between changes in the *DER* (α = 0), *DER* (α = 0.25), *DER* (α = 0.75) and changes in the *DER* (α = 0.5) for the period 2004–2012. The correlation between changes in the *DER* (α = 1) and changes in the *DER* (α = 0.5) is somewhat weaker.

4.2 EU-wide income polarization

For EU policymakers and researchers, there are good reasons to look not only at national income dynamics but also at EU-wide dynamics in the distribution of incomes to grasp trends in social cohesion in the EU and to identify options and pitfalls for social policy initiatives at the EU level (Goedemé *et al.*, 2014). EU-wide policies and objectives are already in place in a number of fields. In 2000 the European Council set the goal that besides economic growth social cohesion should be strengthened in the EU (the Lisbon Agenda, European Council, 2000). On 17 June 2010, the European Council agreed to define inclusive growth as one of the priorities for the EU and to reduce the number of Europeans at risk of poverty or social exclusion by at least 20 million by 2020. As such, the Europe 2020 Strategy aims to improve social inclusion in Europe and to reduce regional income disparities. Concerns for social cohesion in the Union now appear to be gaining momentum. Finally, with deeper integration, individuals in Europe are more likely to look beyond their national borders when they make relative income comparisons (Fredriksen, 2012). However, until now the picture of the Union emerges mainly by aggregation of the national evidence, and little attempt is made to directly estimate EU-wide values: these are typically computed as (population-weighted) averages of available national values (European Commission,

Correlation between changes in the DER
(α=0.5) and changes in the DER (α=0)

$$y = 0.617x + 0.001$$
$$(19.27) \quad (0.33)$$
$$\text{Adj. } R^2 = 0.951$$

Correlation between changes in the DER
(α=0.5) and changes in the DER (α=0.25)

$$y = 0.817x + 0.000$$
$$(23.07) \quad (0.10)$$
$$\text{Adj. } R^2 = 0.965$$

Correlation between changes in the DER
(α=0.5) and changes in the DER (α=0.75)

$$y = 1.055x - 0.002$$
$$(14.18) \quad (-0.45)$$
$$\text{Adj. } R^2 = 0.913$$

Correlation between changes in the DER
(α=0.5) and changes in the DER (α=1)

$$y = 0.882x - 0.005$$
$$(5.95) \quad (-0.72)$$
$$\text{Adj. } R^2 = 0.644$$

Fig. 1. *Correlation between changes in the polarization indicator with different values of α, 2004–2012.*
*Note*: Simple OLS regression; *t*-values between brackets.
Source: Own calculations EU-SILC.

2006). According to Fredriksen (2012), if indicators on income dispersion are calculated as the weighted mean of national values, between-state income differences in the EU are excluded. So far, EU-wide social indicators on income inequality and poverty have been discussed, but not indicators on income polarization. Inspired by, among others, Brandolini (2007), Fredriksen (2012) and Goedemé *et al.* (2014), this paper computes an aggregate EU-wide income polarization indicator that takes into account both within and between national income dispersion.

To start with, instead of calculating kernel densities and income polarization for each country individually, this section groups countries together and shows the income distribution Europe-wide, for the old EU15 countries and for the NMS. Kernel density

estimation gives us an impression of the probability density of the equivalized dispos-
able income in our sample. We are able to cover 20 countries for this analysis. When
calculating kernel densities and income polarization Europe-wide, it is necessary to
make incomes comparable across countries in terms of purchasing power. Incomes are
adjusted to take account of price-level differences between countries, using purchas-
ing power standard estimates taken from Eurostat (2015). The use of PPPs is not a
perfect solution for making incomes cross-nationally comparable. For instance, they
do not easily allow for a consistent comparison over time, as PPPs are (by necessity)
constructed for a certain moment in time (Goedemé *et al.*, 2014). Hence, when com-
paring incomes both cross-nationally and cross-temporally, we also have to take into
account the differences in price levels (both over time and between countries). All
incomes are therefore converted into euros of 2005 using country-specific consumer
price indexes taken from the World Bank (2012) and purchasing power standards from
Eurostat (2015, EU28 = 1).

The graphs in Figure 2 below could be interpreted as the population-weighted
income distributions of the countries belonging to the respective groups (old EU15
countries, NMS or Europe-wide, in line with the work of Bönke and Schröder, 2015).[4]
Within our grouped old EU15 countries, a single pole in the distribution is found
around 15 thousand equivalized disposable income, while this peak is much lower in
the NMS (around 5 to 7 thousand euro); see Figure 2. While there is only one single
pole in the distribution in the old EU15 countries, small multiple poles seem to be
present in the distribution of the group with the old EU15 and the NMS (between
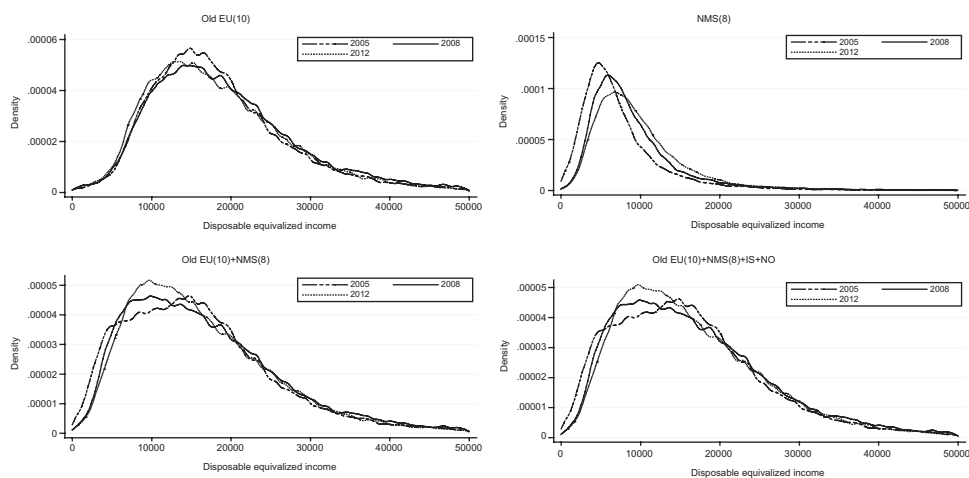
Fig. 2. *Kernel densities of disposable equivalized income Europe-wide, 2005–2012.*
Note: *Old EU15* (10): Austria, Belgium, Germany, Denmark, Spain, Finland,
Ireland, Luxembourg, the Netherlands, Sweden and the UK.
NMS-13 (8): Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Poland,
Slovenia and Slovakia.
Non-EU countries (2): Iceland and Norway.
Source: Own calculations EU-SILC.

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[4] In all cases, we use the weighting factor (RB050) from EU-SILC.

around 5 to 7 thousand and around 17 thousand euro), generating higher polarization in this latter group of countries compared to the old EU15 group. Multiple peaks are also present in our EU-wide distribution covering 20 countries in our sample, with peaks between around 5 to 7 and 18 thousand euro. Adding both Norway and Iceland does not alter the picture much.

The level of income polarization in the old EU15 countries is rather low compared to the NMS, as can be seen from the summary statistics for income polarization; see Figure 3 (see also Table 5). Figure 3 confirms a stable income polarization in the old EU15 countries and the 20 European countries as a whole. The polarization indicator declined significantly within our grouped NMS in the period 2005–2012.

Similar to the indicators on poverty and inequality, the level and evolution of income polarization measured for the EU as if it was a single country can be regarded as basic information in evaluating the progress of the Union towards greater social cohesion. It is, however, important to be clear about the meaning and implications of such EU-wide measures. As Brandolini (2007) has suggested, the expansion of the EU population in the mid-2000s to include a considerable number of households with much lower real incomes has led to a fall of the EU median income. This is a warning against using a country average as a proxy for an EU-wide indicator whenever real income differences are large.

Table 4 presents the results of the income polarization indicator (*DER*, α = 0.5) by taking the EU countries as a whole and by calculating the simple averages of national values. The results show that the level of income polarization for the EU as a whole is higher than the simple average of national values, since the latter method does not take into account the between-country component of European income dispersion.[5] Further, income polarization is lower in the old EU15 countries as a whole than that in the NMS group. Over the period 2005–2012, income polarization remains stable in the old EU15 countries and the 20 European countries while it declined significantly

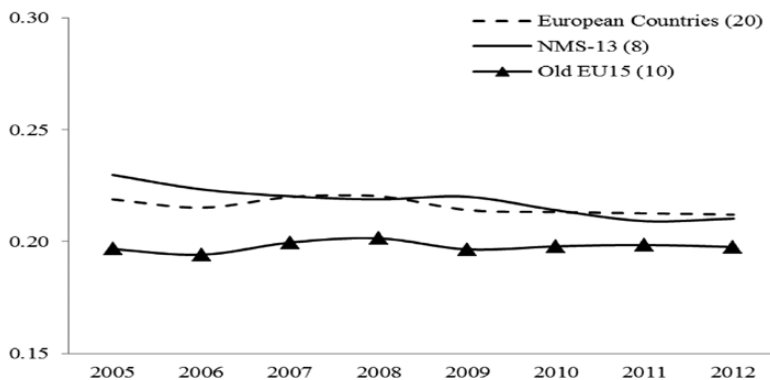**Fig. 3.** *Trend polarization indicator EU-wide, 2005–2012.*
Source: Own calculations EU-SILC.

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[5] Additional analysis shows that also the Gini coefficient for Europe as a whole is higher than the Gini calculated as a simple average of national Gini indexes. Also, if we measure at-risk-of-poverty rates with a European-wide poverty line instead of national thresholds, poverty is generally higher.

Table 4. *Trend several social indicators Europe-wide, 2005–2012*

	EU-wide			Country-average		
	Level social indicator		Change	Level social indicator		Change
	2005	2012		2005	2012	
Polarization Indicator ($\alpha = 0.5$)						
Old EU15 (10)	0.197	0.198	0%	0.190	0.188	−1%
NMS-10 (8)	0.230	0.210	−8%★★	0.197	0.193	−2%
Old EU + NMS (18)	0.219	0.212	−3%★	0.193	0.190	−1%★★
European Countries (20)	0.219	0.212	−3%★	0.192	0.188	−2%★★

Note: Simple OLS regression; ★★ significant at 0.01 level; ★ significant at 0.05 level.
Source: Own calculations EU-SILC.

in the group of NMS. This is confirmed by simple linear regression analyses, also reported in Table 4.

4.3 Discussion on income polarization and other social indicators

The results for the polarization index can be compared with the more familiar inequality measures. But the EU has developed the indicator of people at risk of poverty or social exclusion to monitor the improvements with respect to social cohesion, which has been one of the EU objectives since 2000 (the Lisbon Agenda). The indicator of people at risk of poverty or social exclusion corresponds to the sum of persons who are at risk of poverty or severely materially deprived or living in households with very low work intensity. One could argue that this indicator and the polarization index measure different aspects of social exclusion. While the at-risk-of-poverty or social-exclusion indicator is focused on the deprived in general, the polarization index gives information on the distance between groups.

Table 5 depicts the point estimates around 2012 for several social indicators: the income polarization indicator (*DER*, α = 0.5), the Gini coefficient, the poverty rate (threshold 60 percent of the median income for each country) and the indicator of people at risk of poverty or social exclusion. Countries are ranked in order of their level of the income polarization indicator from smallest (Norway) to highest (Latvia). Using different indicators, we may get different rankings of the distributions. For example, Norway ranks low for both the income polarization indicator and the other social indicators. Denmark, however, ranks low based on the polarization indicator, but relatively high based on the Gini. In addition, we do not find strong correlation between changes in income polarization and changes in Gini coefficient, changes in at-risk-of-poverty rates or people at risk of poverty or social exclusion (see Figure 4). There are some countries where income polarization and other social indicators present opposite trends between around 2004 and 2012. Overall, income polarization, the Gini coefficient, at-risk-of-poverty rates and social exclusion are empirically different from each other. We suggest that the indicator of income polarization can function as an interesting additional social indicator for analyzing income distribution in Europe.

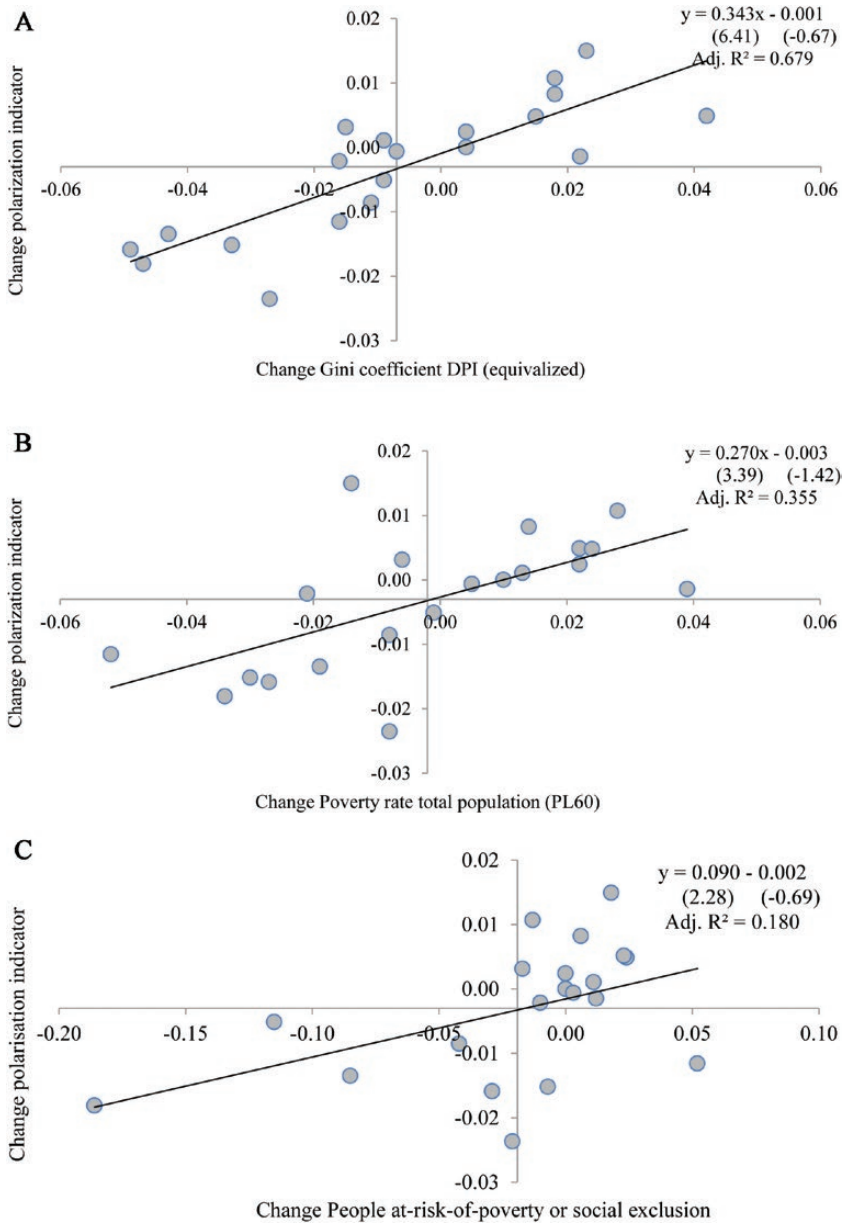**Table 5.** *Income polarization (DER, α = 0.5) and other social indicators, 2012*

Country	DER (a = 0.5)		Gini coefficient		Povertyrate (PL60)		People at risk of poverty or social exclusion	
	Level	Rank	Level	Rank	Level	Rank	Level	Rank
Norway (a)	0.165	(1)	0.225	(1)	0.100	(3)	0.137	(2)
Denmark	0.170	(2)	0.281	(14)	0.131	(5)	0.190	(10)
Slovenia★	0.173	(3)	0.237	(2)	0.135	(8)	0.196	(13)
Sweden	0.174	(4)	0.248	(4)	0.141	(11)	0.156	(5)
Netherlands	0.175	(5)	0.254	(7)	0.101	(4)	0.150	(3)
Iceland (a)	0.175	(6)	0.240	(3)	0.079	(1)	0.127	(1)
CzechRepublic★	0.177	(7)	0.249	(5)	0.096	(2)	0.154	(4)
Slovakia★	0.180	(8)	0.253	(6)	0.132	(7)	0.205	(14)
Hungary★	0.187	(9)	0.269	(10)	0.140	(9)	0.324	(25)
Belgium	0.188	(10)	0.265	(9)	0.153	(16)	0.216	(15)
Germany	0.189	(11)	0.283	(15)	0.161	(20)	0.196	(13)
Finland	0.189	(12)	0.259	(8)	0.132	(7)	0.172	(6)
Austria	0.191	(13)	0.276	(12)	0.144	(12)	0.185	(9)
Luxembourg	0.194	(14)	0.280	(13)	0.151	(15)	0.184	(8)
Switzerland (a)	0.195	(15)	0.288	(16)	0.159	(18)	0.175	(7)
Malta★	0.197	(16)	0.271	(11)	0.151	(15)	0.231	(16)
Poland★	0.199	(17)	0.309	(20)	0.171	(21)	0.267	(20)
France	0.204	(18)	0.305	(18)	0.141	(11)	0.191	(11)
Estonia★	0.204	(19)	0.325	(25)	0.175	(22)	0.234	(17)
Ireland	0.204	(20)	0.299	(17)	0.157	(17)	0.300	(24)
Greece	0.204	(21)	0.343	(28)	0.231	(31)	0.346	(28)
Croatia★	0.205	(22)	0.309	(20)	0.204	(27)	0.326	(27)
Lithuania★	0.206	(23)	0.320	(24)	0.186	(24)	0.325	(26)
Italy	0.207	(24)	0.319	(23)	0.194	(26)	0.299	(23)
Romania★	0.207	(25)	0.332	(26)	0.226	(30)	0.417	(30)
United Kingdom	0.208	(26)	0.313	(22)	0.160	(19)	0.241	(18)
Spain	0.209	(27)	0.350	(30)	0.208	(28)	0.272	(22)
Bulgaria★	0.213	(28)	0.336	(27)	0.212	(29)	0.493	(31)
Cyprus★	0.214	(29)	0.310	(21)	0.147	(13)	0.271	(21)
Portugal	0.216	(30)	0.345	(29)	0.179	(23)	0.253	(19)
Latvia★	0.221	(31)	0.357	(31)	0.192	(25)	0.362	(29)
Mean-31	*0.195*		*0.292*		*0.158*		*0.245*	

Note: ★ = NMS (a)= Non-EU countries.
Source: Own calculations EU-SILC.

5. Conclusion

Vast literature relies on traditional social indicators such as the Gini coefficient and relative poverty rates to analyze national and cross-national differences in earnings and income inequality. Income polarization is another interesting indicator, which has drawn some attention in Asia and the USA, but hardly in Europe. This is remarkable since income polarization is closely linked to social exclusion, one of the important elements of the Lisbon Agenda and the Europe 2020 Strategy. This study provides theoretical and empirical insights into this relatively new dimension of the income

A

$$y = 0.343x - 0.001$$
$$(6.41) \quad (-0.67)$$
$$\text{Adj. } R^2 = 0.679$$

Change polarization indicator (y-axis)

Change Gini coefficient DPI (equivalized) (x-axis)

B

$$y = 0.270x - 0.003$$
$$(3.39) \quad (-1.42)$$
$$\text{Adj. } R^2 = 0.355$$

Change polarization indicator (y-axis)

Change Poverty rate total population (PL60) (x-axis)

C

$$y = 0.090 - 0.002$$
$$(2.28) \quad (-0.69)$$
$$\text{Adj. } R^2 = 0.180$$

Change polarisation indicator (y-axis)

Change People at-risk-of-poverty or social exclusion (x-axis)

Fig. 4. *Correlation between changes in the polarization index and other indicators, 2004–2012.* (**A**) *Correlation between changes in the polarization index and changes in Gini coefficient* (**B**) *Correlation between changes in the polarization index and changes in poverty* (**C**) *Correlation between changes in the polarization index and changes in social exclusion*
Note: Simple OLS regression; *t*-values between brackets.
Source: Own calculations EU-SILC.

distribution. We rely on micro-data from EU-SILC. We first explore the development of income polarization in European countries over the period 2004–2012. Furthermore, we take Europe as a whole to track the changes in income polarization Europe-wide.

Our analysis suggests that income polarization is conceptually and empirically distinguishable from other inequality indicators. Income polarization compares the homogeneity within a group with the heterogeneity of the total population. More income polarization can be associated with a divided society and social exclusion, and may also harm economic growth. We show that there is considerable variation in the ranking of countries regarding income polarization and other popular social indicators like the Gini coefficient and at-risk-of-poverty rates. Moreover, income polarization and Gini coefficients may not go hand in hand: an increase in Gini does not necessarily relate to an increase in income polarization. Variation in income polarization between countries and over time may result from changes in income equality (alienation) between groups, but the effect can be reinforced or offset by identification within groups (e.g. Hussain, 2009). Overall, we suggest that income polarization adds new insights into income distribution in Europe and can be used as an additional useful tool in analyzing social exclusion.

The empirical results indicate that, over the period 2004–2012, income polarization is rather stable in European countries, and Europe as a whole. Income polarization was rising among the old EU15 countries in the sub-period 2004–2008, but declining afterwards. The Great Recession can thus be associated with lower levels of income polarization. Apparently, the income shock of the crisis has been distributed quite evenly over different groups in these countries. However, the NMS witnessed an opposite development. Also, in these countries, income polarization is much higher than in the old EU15 countries. Income polarization in Europe as a whole is higher than the simple average of national polarization indicators. Overall, income polarization shows a converging pattern over the decade, indicating convergence at lower levels of income polarization in European countries and Europe as a whole. In terms of combatting social exclusion, this seems to be a good sign.

Finally, this study does not examine which factors may contribute to the trends in income polarization across European countries. Existing studies suggest that the tax-benefit system is essential in reducing market income inequality (e.g. Wang *et al.*, 2012, 2014). We expect that the tax-benefit system may also play an important role in the development of income polarization. Future work will examine the impact of the tax-benefit system on changing income polarization in European countries and Europe-wide.

Bibliography

Anderson, G. 2010. Polarization of the poor: multivariate relative poverty measurement sans frontiers, *Review of Income and Wealth*, vol. 56, no. 1, 84–101

Apouey, B. 2010. On measuring and explaining socioeconomic polarization in health with an application to French data, *Review of Income and Wealth*, vol. 56, no. 1, 141–70

Atkinson, A. B. and Brandolini, A. 2013. On the identification of the middle class, pp. 77–100 in Gornick, J. and Jäntti, M. (eds.), *Income Inequality: Economic Disparities and the Middle Class in Affluent Countries*, Stanford, CA, Stanford University Press

Bönke, T. and Schröder, C. 2015. 'European-Wide Inequality in Times of the Financial Crisis', Discussion Paper no. 2015/14, School of Business & Economics

Brandolini, A. 2007. 'Measurement of Income Distribution in Supranational Entities: The Case of the European Union', Bank of Italy Temi di Discussione Working Paper no. 623

Brzezinski, M. 2013. 'Income Polarization and Economic Growth', National Bank of Poland Working Paper no. 147

Caminada, K., Goudswaard, K. P. and Koster, F. 2012. Social income transfers and poverty: a cross-country analysis for OECD countries, *International Journal of Social Welfare*, vol. 21, no. 2, 115–26

Castro, J. V. 2003. Regional convergence, polarisation and mobility in the European Union, 1980–1996, *Journal of European Integration*, vol. 25, no. 1, 73–86

Chakravarty, S. R. and D'Ambrosio, C. 2010. Polarization orderings of income distributions, *Review of Income and Wealth*, vol. 56, no. 1, 47–64

Chakravarty, S. R. and Majumder, A. 2001. Inequality, polarisation and welfare: theory and applications, *Australian Economic Papers*, vol. 40, no. 1, 1–13

Clementi, F., Dabalen, A. L., Molini, V. and Schettino, F. 2015. The centre cannot hold: patterns of polarization in Nigeria, *Review of Income and Wealth*, Advance Access published 18 August 2015, doi:10.1111/roiw.12212

D'Ambrosio, C. 2001. Household characteristics and the distribution of income in Italy: an application of social distance measures, *Review of Income and Wealth*, vol. 47, no. 1, 43–64

D'Ambrosio, C. and Wolff, E. N. 2001. 'Is Wealth Becoming More Polarized in the United States?', Jerome Levy Economics Institute of Bard College Working Paper no. 330

Deutsch, J., Fusco, A. and Silber, J. 2013. The BIP trilogy (bipolarization, inequality and polarization): one saga but three different stories, *Economics: The Open-Access, Open-Assessment E-Journal*, vol. 7, no. 2013–22, 1–33

Deutsch, J., Silber, J. and Yalonetzky, G. 2014. On bi-polarization and the middle class in Latin America: a look at the first decade of the twenty-first century, *Review of Income and Wealth*, vol. 60, no. S2, S332–52

Duclos, J. Y., Esteban, J. and Ray, D. 2004. Polarization: concepts, measurement, estimation, *Econometrica*, vol. 72, no. 6, 1737–72

Duclos, J.Y. and Taptué, A. M. 2015. Polarization, pp. 301–58 in Atkinson, A. B. and Bourguignon, F. (eds.), *Handbook of Income Distribution*, Amsterdam, Elsevier

Duro, J. A. 2005. Another look to income polarization across countries, *Journal of Policy Modeling*, vol. 27, no. 9, 1001–7

Easterly, W. 2001. The middle class consensus and economic development, *Journal of Economic Growth*, vol. 6, no. 4, 317–35

Esteban, J. and Ray, D. 1994. On the measurement of polarization, *Econometrica: Journal of the Econometric Society*, vol. 62, no. 4, 819–51

Esteban, J. and Ray, D. 1999. Conflict and distribution, *Journal of Economic Theory*, vol. 87, no. 2, 379–415

Esteban, J. and Ray, D. 2005. *'A Comparison of Polarization Measures'*, mimeo, Institut d'Analisi Economica, Universitat Autonoma de Barcelona

Esteban, J. and Ray, D. 2011. Linking conflict to inequality and polarization, *American Economic Review*, vol. 101, no. 4, 1345–74

Esteban, J. M., Gradín, C. and Ray, D. 1999. 'Extensions of a Measure of Polarization, with an Application to the Income Distribution of Five OECD Countries', Luxembourg Income Study Working Paper Series no. 218

Esteban, J. M., Gradín, C. and Ray, D. 2007. An extension of a measure of polarization, with an application to the income distribution of five OECD countries, *Journal of Economic Inequality*, vol. 5, no. 1, 1–19

European Commission. 2006. *'Joint Report on Social Protection and Social Inclusion 2006'*, Luxembourg, Office for Official Publications of the European Communities

European Council. 2000. 'Fight against Poverty and Social Exclusion—Definition of Appropriate Objectives', Document Submitted to the European Council in Nice by the Employment and Social Affairs Council, Document no. 14110/00

Eurostat. 2008. *'Comparative Final EU Quality Report 2005'* (Version 2–September 2008), Luxembourg, Eurostat

Eurostat. 2015. *Exchange Rates Database*, Brussels

Ezcurra, R. 2009. Does income polarization affect economic growth? The case of the European regions, *Regional Studies*, vol. 43, no. 2, 267–85

Foster, J. E. and Wolfson, M. C. 1992. *'Polarization and the Decline of the Middle Class: Canada and the U.S.'*, mimeo, Vanderbilt University

Foster, J. E. and Wolfson, M. C. 2010. Polarization and the decline of the middle class: Canada and the U.S., *Journal of Economic Inequality*, vol. 8, no. 2, 247–73

Fredriksen, K. B. 2012. 'Income Inequality in the European Union', OECD Economics Department Working Papers no. 952, OECD Publishing

Gasparini, L., Horenstein, M., Molina, E. and Olivieri, S. 2008. Income polarization in Latin America: patterns and links with institutions and conflict, *Oxford Development Studies*, vol. 36, no. 4, 461–84

Gigliarano, C. and Mosler, K. 2009. Constructing indices of multivariate polarization, *Journal of Economic Inequality*, vol. 7, no. 4, 425–60

Goedemé, T. 2013. How much confidence can we have in EU-SILC? Complex sample designs and the standard error of the Europe 2020 poverty indicators, *Social Indicators Research*, vol. 110, no. 1, 89–110

Goedemé, T., Collado, D. and Meeusen, L. 2014. *Mountains on the Move: Recent Trends in National and EU-Wide Income Dynamics in Old and New EU Member States*, Herman Deleeck Centre for Social Policy, University of Antwerp

Goedemé, T. and Van Lancker, W. 2009. A universal basic pension for Europe's elderly: options and pitfalls, *Basic Income Studies*, vol. 4, no. 1, 1–26

Goos, M., Manning, A. and Salomon, A. 2009. Job polarization in Europe, *American Economic Review*, vol. 99, no. 2, 58–63

Gornick, J. C. and Jäntti, M. 2013. *Income Inequality: Economic Disparities and the Middle Class in Affluent Countries*, Stanford, CA, Standard University Press

Gradín, C. 2000. Polarization by sub-population in Spain, 1973–91, *Review of Income and Wealth*, vol. 46, no. 4, 457–74

Hussain, M. A. 2009. The sensitivity of income polarization, *Journal of Economic Inequality*, vol. 7, no. 3, 207–23

Keefer, P. and Knack, S. 2002. Polarization, politics and property rights: links between inequality and growth, *Public Choice*, vol. 111, no. 1–2, 127–54

Lasso de la Vega, M. C. and Urrutia, A. M. 2006. An alternative formulation of the Esteban-Gradín-Ray extended measure of polarization, *Journal of Income Distribution*, vol. 15, no. 1, 42–54

Lasso de la Vega, M. C., Urrutia, A. and Diez, H. 2010. Unit consistency and bipolarization of income distributions, *Review of Income and Wealth*, vol. 56, no. 1, 65–83

Levy, H., Matsaganis, M. and Sutherland, H. 2013. Towards a European Union child basic income? Within and between country effects, *International Journal of Microsimulation*, vol. 6, no. 1, 63–85

Lohmann, H. 2011. Comparability of EU-SILC survey and register data: the relationship among employment, earnings and poverty, *Journal of European Social Policy*, vol. 21, no. 1, 37–54

Montalvo, J. G. and Reynal-Querol, M. 2005. Ethnic polarization, potential conflict, and civil wars, *American Economic Review*, vol. 95, no. 3, 796–816

Motiram, S. and Sarma, N. 2014. Polarization, inequality, and growth: the Indian experience, *Oxford Development Studies*, vol. 42, no. 3, 297–318

Pérez, C. B. and Ramos, X. 2010. Polarization and health, *Review of Income and Wealth*, vol. 56, no. 1, 171–85

Poggi, A. and Silber, J. 2010. On polarization and mobility: a look at polarization in the wage–career profile in Italy, *Review of Income and Wealth*, vol. 56, no. 1, 123–40

Pressman, S. 2007. The decline of the middle class: an international perspective, *Journal of Economic Issues*, vol. 41, no. 1, 181–200

Ravallion, M. and Chen, S. 1997. What can new survey data tell us about recent changes in distribution and poverty? *World Bank Economic Review*, vol. 11, no. 2, 357–82

Rodriguez, J. G. and Salas, R. 2003. Extended bi-polarization and inequality measures, *Research on Economic Inequality*, vol. 9, 69–83

Seshanna, S. and Decornez, S. 2003. Income polarization and inequality across countries: an empirical study, *Journal of Policy Modeling*, vol. 25, no. 4, 335–58

Silber, J., Deutsch, J. and Hanoka, M. 2007. On the link between the concepts of kurtosis and bipolarization, *Economics Bulletin*, vol. 4, no. 36, 1–5

Wang, C., Caminada, K. and Goudswaard, K. P. 2012. The redistributive effect of social transfer programmes and taxes: a decomposition across countries, *International Social Security Review*, vol. 65, no. 3, 27–48

Wang, C., Caminada, K. and Goudswaard, K. P. 2014. Income distribution in 20 countries over time, *International Journal of Social Welfare*, vol. 23, no. 3, 262–75

Wang, C. and Wan, G. 2015. Income polarization in China: trends and changes, *China Economic Review*, vol. 36, 58–72

Wang, Y. Q. and Tsui, K. Y. 2000. Polarization orderings and new classes of polarization indices, *Journal of Public Economic Theory*, vol. 2, no. 3, 349–63

Wolfson, M. C. 1994. When inequalities diverge, *American Economic Review*, vol. 84, no. 2, 353–58

Wolfson, M. C. 1997. Divergent inequalities: theory and empirical results, *Review of Income and Wealth*, vol. 43, no. 4, 401–21

World Bank. 2012. *World Development Indicators*, Washington, DC

Zhang, X. and Kanbur, R. 2001. What difference do polarisation measures make? An application to China, *Journal of Development Studies*, vol. 37, no. 3, 85–98Note