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ABSTRACT

Decomposing the role of great recession on income polarization by population groups

In this paper we use two different non-parametric methods to disentangle the role of Great Recession on income polarization in Italy by population groups (gender, occupational status, education, age, residential area and state of birth). By using data from the Survey on Household Income and Wealth of the Bank of Italy, first, we decompose the Duclos, Esteban and Ray (DER) polarization index by population groups. Second, we employ the Relative Distribution Approach by groups. Our results show a general downgrading, particularly of lower incomes, where low-educated, young, southern and foreign head of household are located out of the crisis. Young people and especially foreigners have suffered the most from the crisis. The lowest (highest) homogeneity within groups and the lowest (highest) heterogeneity between groups is observed when groups are formed on the basis of the state of birth (residential area). Thus, the decomposition of the polarization indices by population groups is able to provide specific useful policy indications, tailored to groups' needs.

KEYWORDS: demographic analysis, wage inequality, economic recession, polarization

JEL CODES: D3, J3, C14

1. Introduction

With the positive change in GDP in the third and fourth quarters of 2014, Italy was technically out of the Great Recession (GR), at least until the advent of the recent Covid-19 pandemic. During the GR, since 2008, Italian economy lost more than one million employees: from the beginning of 2014, more than 850,000 people were recovered, but the structure of the labour market has also significantly changed, due to the crisis. In this context, has the change in income polarization been homogeneous during the crisis or have some groups suffered more than others? How population groups have contributed to total polarization during the crisis? In this paper we use two different non-parametric methods to decompose changes in the income polarization by population groups, in the period 2006-2016.

During the last two decades, there has been a growing attention in the literature to the income polarization, as a concept that is close but distinct from inequality: polarization broadly measures how much the population is clustered in a (small) number of distant poles (Duclos *et al.* 2004; Seshanna and Decornez 2003; Duro 2005; Chakravarty 2009; Foster and Wolfson 2010). It has been shown that the concept of polarization can be more telling in terms of distribution of income than that of inequality, especially when linked to social conflict between clustered groups of population. As a consequence, polarization is more appropriate as well as more suitable than inequality when discussing about groups (Esteban and Ray 1994). Just recently, some articles have investigated the impact of the GR on the polarization of incomes (Jenkins *et al.* 2013; D'Errico *et al.* 2015; Adelino *et al.* 2016; Baiardi and Morana 2018), but the empirical evidence of differentiated effects on population groups is scant. The point is that if we limit the analysis to the total polarization, without distinguishing on the basis of a set of individual characteristics (for example gender, occupational status, education, age, residential area and state of birth) we do not provide the necessary information to the policy maker on the right policies to be adopted (Araar 2008).

Usually, studies dealing with income inequality are based on summary statistics, which do not capture the most interesting aspects related to the income distribution (Massari *et al.* 2009). This paper adopts a non-parametric framework, with two different methodologies, to fill these gaps. In particular, we add to the current literature by investigating income polarization, as it results out of the GR between and within groups of population, by gender, occupational status, education, age, residential area and state of birth. First, we decompose the DER polarization index by population groups to identify and quantify the role of individuals characteristics in attracting people at the top or at the bottom of the distribution. Second, we employ the Relative Distribution Approach (RDA) by groups, to evaluate what kind of changes have occurred in the relative concentration of people at each income level, over the two different waves of the survey. The most interersting aspect of the RDA is that it captures both the location effects (jumps of the average and of the median) and the shape effects (changes in variation, skewness and higher moments) which accur along the income distribution between two populations.

Italy is one of the European countries that has suffered the most from the GR in terms of GDP and unemployment (Izquierdo *et al.* 2017). The Italian labour market seems to have undergone structural changes due to the crisis (Vesan and Pavolini 2018; Tronti and Gatto 2018; Scicchitano 2019; Filippi *et al.* 2020) and consequently the Welfare State is adapting to be able to adequately respond to the

effects of the crisis (Sacchi 2018). The consequences of the crisis seem to have been particularly serious for immigrants compared to the natives (Bonifazi and Marini 2014; Venturini and Villosio 2018). The crisis has also had other significant consequences in Italy such as those on cash holding among firms (Dottori and Micucci 2018) and on the composition of public expenditure (Prota and Ghisorio 2018). Despite the importance that the crisis seems to have had in Italy, there is no empirical evidence on the impact of GR on income polarization by population groups in Italy. Thus, we compare the income distribution of 2016 with that of 2006 in order to disentangle the changes that have occurred to population groups two years before and after the economic crisis.

Our results show that population groups have had a different weight in the total polarization of income during the GR and that change in income polarization by population groups has been heterogeneous. More specifically young people and especially foreigners have suffered the most from the crisis. The paper is organized as follows: section two reports previous literature on income polarization. Section three describes the non-parametric methodologies. In Section four, data are illustrated. Empirical results are shown in section five, while section six concludes.

2. Previous literature on income polarization

Over the last two decades, great concern has been given to the issue of polarization in the analysis of income distribution. The theoretical conceptualization of income polarization is often linked to the phenomenon of the disappearance of middle class. Much of the evidence presented in this strand of literature depends on the particular cut-offs selected. According to Foster and Wolfson (2010), the range defining the middle class is essentially arbitrary. Consequently, starting with the contributions of Foster and Wolfson (2010), Esteban and Ray (1994), and Wolfson (1994; 1997), a number of different polarization measures which tries to avoid conflicting results have been conceptualized (Wang and Tsui 2000; Chakravarty and Majumder 2001; Zhang and Kanbur 2001; Anderson 2004; Duclos *et al.* 2004; Esteban *et al.* 2007; Chakravarty and D'Ambrosio 2010).

In these studies polarization is related but distinct from inequality as demonstrated by Esteban (2002), Duclos *et al.* (2004), and Lasso de la Vega and Urrutia (2006). In fact, inequality considers the overall dispersion of the distribution, whereas polarization measures aim to explore whether it is possible to observe "the appearance of groups in a distribution" (Chakravarty 2009) and to capture the gap between those at the top and those at the bottom of society in developed nations. This is due to the grouping of community members around more than one pole and their consequent distancing from the middle, according to specific characteristics (e.g. income levels, occupational skills and wages).

It is possible to identify two different approaches to conceptualizing and measuring polarization (Esteban and Ray 2012). The first approach assumes that there may be an arbitrary number of groupings (or poles) in a distribution; this approach was proposed by Esteban and Ray, and it was fully axiomatized by Duclos *et al.* (2004) in the case of continuous distributions, and by Esteban and Ray (1994) in the case of discrete distributions. The second approach considers polarization as the process by which a distribution becomes "bi-polar". It measures the division of a society into two groups with the median value as a cut-off. Indices of this family are developed in Foster and Wolfson (1992), Wolfson (1994), Wang and Tsui (2000).

According to Esteban and Ray (2012), these different views are based on similar patterns: (i) polarization depends on groups so that when there is one group only polarization is not observable; (ii) polarization raises when ”within-group” inequality is reduced; (iii) polarization rises when ”across-group” inequality increases. These claims make clear that the assumption of discontinuity between social categories is a fundamental element. It assumes that there exist a number of clearly distinguishable social categories whose members differ from members of other categories (external heterogeneity) and are relatively similar to other members of the same category (internal homogeneity) along with a series of socioeconomic indicators (Ganzeboom *et al.* 1992; Cruces *et al.* 2011).

In particular, the theoretical analysis of Esteban and Ray (1994) defines polarization as the interaction between the identification and alienation that each individual feels with respect to the rest. The identity-alienation framework developed by these two authors points out that many individual attributes are relevant for creating differences and similarities between persons, which is coherent with classical studies on social classes. In fact, the coexistence of high level of homogeneity within each group and high level of heterogeneity between groups can generate social tensions, revolution and revolt, and social unrest in general. These studies aim to obtain a synthetic measures of polarization but can be applied to identify the relative position of middle groups and observe its changes over time. In this paper we apply the DER approach to population subgroups.

Similarly, other methodologies which lack of arbitrariness have been proposed by Jenkins (1995) and Handcock and Morris (1998). The first mentioned author suggested to examine the changes in the relative concentration of people at each income level using Kernel density estimation methods. Handcock and Morris (1998) introduced RDA in order to identify at the same time the location effects (jumps of the average and of the median) and the shape effects (changes in variation, skewness and higher moments) occurred along the income distribution between two populations. In both cases, decomposition of results by family socio-economic groups (i.e. considering sources of income, employment status, type of contract, occupational activity of the household head and so on) permits an analysis which considers multiple dimensions. In this paper we use the RDA to disentangle changes in the income distribution by population groups during the crisis.

A number of empirical papers have been recently proposed to investigate income polarization in different countries (Palacios González *et al.* 2014; Nissanov and Pittau 2015; Clementi and Schettino 2013; Wang *et al.* 2017; Clementi *et al.* 2017, 2018). Some studies have been specifically devoted to Italy. Boeri and Brandolini (2004) analyze income distribution in Italy in the period 1993-2002, by also estimating income polarization through the Wolfson index: they find that inequality and polarisation rose sharply between 1991 and 1993, but unlike inequality, the latter decreased in the following nine years. Massari *et al.* (2009) apply the RDA approach to italian income data between 2002 and 2004: the study detects a significant location effect, together with an increase in income polarization, driven by incomes below the median. D’ambrosio (2001) investigates Italian income polarization between 1987 and 1995, by focusing on changes in the entire distribution, rather than only in dispersion. Poggi and Silber (2010) by using 1985-2003 Italian data, show differences between *structural* and *exchange* mobility. Ricci (2016) provides a picture of income dynamics for the middle-income group in Italy between 2002 and 2012. Results from polarization indices show a gradual decline between 2002 and 2006. Then, the period from 2006 to 2012 is characterised by a tendency towards a rising polarisation, which implies a shirking of the middle-income group. Just recently, Simonazzi and Barbieri (2016) put

in evidence the erosion of Italian middle class, showing that while many typical jobs of the middle class are progressively disappearing or becoming increasingly precarious, wages in the last few years have remained substantially unaffected. Other estimates, based on different data-set, indicate that in Italy, until before the end of the crisis, there is a very small impact of changes in polarization with respect to other European countries (Petrarca and Ricciuti 2015). What this strand of literature has neglected are the economic consequences on population subgroups, expecially out of the GR. In this paper we decompose changes in the income polarization during the crisis by population groups in Italy: in particular we show evidence by gender, occupational status, education, age, residential area and state of birth.

3. The non-parametric methodology

3.1 The Decomposition of the DER index by population subgroups

An interesting decomposition of the DER index is by population groups (Araar 2008). This approach to polarization is based on the "alienation-identification" framework, according to which a population of individuals may be grouped into "clusters", such that each cluster is very homogeneous in terms of the attributes of its members, but many dissimilarities are observable between different clusters. In particular, recalling the DER index, the contribution of individual(s) with income y (where μ is the median) to the index is:

$$c(y) = \frac{a(y)f(y)^{1+\alpha}}{\mu^{1-\alpha}} \tag{1}$$

Where the parameter α measures the sensitivity of the index to the local identification. The alienation component $a(y)$ for the individual with income y belonging to group g can be splitted as:

$$a(y) = \varphi_g a_g(y) + \tilde{a}_g(y) \tag{2}$$

Where $a_g(y)$ is the alienation for the individual within its group g and $\tilde{a}_g(y)$ the alienation component at the population level ignoring within-group alienation. Denoting the local proportion of individuals of group g with $\pi_g(y)$, $c_g(y)$ is the local contribution of this group to the DER polarization index:

$$c_g(y) = \pi_g(y)f(y)^{\alpha}\frac{f(y)a(y)}{\mu^{1-\alpha}} \tag{3.1}$$

$$= \frac{\mu_g^{1-\alpha}}{\mu^{1-\alpha}}\left[\frac{\pi_g(y)\varphi_g a_g(y)f(y)^{1+\alpha}}{\mu_g^{1-\alpha}}\right] + \frac{\pi_g(y)\tilde{a}(y)f(y)^{1+\alpha}}{\mu^{1-\alpha}} \tag{3.2}$$

$$= \varphi_g^{\alpha}\psi_g^{1-\alpha}\left[\frac{\pi_g(y)a_g(y)f(y)^{1+\alpha}}{\mu_g^{1-\alpha}}\right] + \frac{\pi_g(y)\tilde{a}(y)f(y)^{1+\alpha}}{\mu^{1-\alpha}} \tag{3.3}$$

Consequently, writing DER index as follow:

$$P = \sum_g \int c_g(x)dx \tag{4}$$

it can be decomposed as:

$$P = \underbrace{\sum_g \varphi_g^{1+\alpha} \psi_g^{1-\alpha} R_g P_g}_{\substack{Within \\ W}} + \underbrace{\tilde{P}}_{\substack{Between \\ B}} \tag{5}$$

where

$$R_g = \frac{\int a_g(y)\pi_g(y) f(y)^{1+\alpha} dx}{\varphi_g \int a_g(x) f_g(x)^{1+\alpha} dx} \tag{6}$$

and φ_g and ψ_g are respectively the population and income shares of group g, $\pi_g(y)$ denotes the local proportion of individual belonging to group g and having income y and $\tilde{P}$ is the DER polarization index when the within-group polarization is ignored. R_g depends on the correlation between the density function of the group and that of the population and its equal to 1 if group incomes do not overlap. The indicator $\left(1 - \frac{W}{P}\right)$ shows how much groups are locally polarized, while the indicator B/W can be used to show how much the considered groups polarize the distribution. Finally, to identify the main masses that attract each group we need to decompose the local alienation within each group into two different component: the expected deprivation (*Dg*) and expected surplus components (*Sg*). In fact, the alienation component simply expresses the expected absolute distance between income x and other incomes which can be positive or negative. Then, substituting in the polarization index we have:

$$P = \sum_g D_g + S_g \tag{7}$$

When the distribution is symmetric or when the parameter α equals zero, these two components are equal. Given the usual asymmetric distribution of incomes, expectedly *Dg/Sg >0*. For each population subgroup g, this means that if g is composed of a significant part of low income individuals, the ratio $D_g/S_g > 0$ will be relatively higher than that of other groups. Similarly the DER polarization index can be decomposed by income sources to identify how each source contributes to the total polarization.

3.2 The Relative Distribution Approach (RDA)

The RDA is a non-parametric approach to perform distributional analysis of group differences during the time (Handcock and Morris 1998). The relative distribution method assumes two populations, the "reference" and the "comparison" population, permitting to return the fractions of the "comparison" population that fall in each quintile of the "reference" population. In this way it is possible to test hypotheses about distributional differences and, using decomposition techniques, to isolate location, shape and compositional effects. This enables researchers to distinguish the impact of changes in population mix (a demographic process) from changes in attribute allocation (a social or economic process).

Let Y_0 be a continuous random variable for the reference population (e.g. household income in 2006) and *Y*, the comparison population (e.g. household income in 2016). The cumulative distribution function (CDF) and the probability density function (PDF) are *F* and *f* respectively. The objective is to study the differences between the distributions of *Y* and Y_0 using Y_0 as the reference. The "relative rank" is defined as $R=F_0(y)$ with $R \in [0; 1]$. The CDF of the relative data R is $G(r) = F(F_0^{-1})$ with $0 \leq r \leq 1$.

The corresponding PDF is:

$$g_r = \frac{f(F_0^{-1}(r))}{f_0(F_0^{-1}(r))} = \frac{f(y_r)}{f_0(y_r)} \qquad 0 \le r \le 1, \quad y_r \ge 0 \tag{8}$$

where *f* and f_0 are the densities functions of *Y* and Y_0, while *r* represents the proportion of values. On the one hand, $\mathrm{G(r)}$ is the proportion of the target population which is below the level of a proportion r of the reference population. On the other hand, $\mathrm{g(r)}$ represents the ratio of the frequency of the target population to the frequency of the reference population at the rth quantile of the reference population level $[F_0^{-1}(r)]$. If the two distributions are identical then the relative distribution is uniform on [0; 1].

A value of *g(r)* higher (lower) than 1 means a higher (lower) share of households in the comparison population respect to the reference population, at the r^{th} quantile of the latter distribution. Estimating the density functions with a non-parametric Kernel method is possible to obtain relative density functions for different realizations of R. Than a local-polynomial model can be fitted for each estimated point to have an accurate description of the relative density. In this way it is possible to decompose the relative distribution into location effect, in general associated with changes in the mean of the income distribution and shape effect, which captures changes in the covariate-outcome relationships.

Let $Y_{0L} = Y_0 + \rho$ be an *additive* location-adjusted population with the shape as the reference distribution and the median as the comparison distribution, where ρ is the difference between the medians of *Y* and Y_0. Thus, the CDF of F_{0L} is defined as $F_{0L}(y_r) = F_0(y + \rho)$ and its derivative PDF is f_{0L}.

Formally,

$$\frac{f(y_r)}{f_0(y_r)} = \frac{f_{0L}(y_r)}{f_0(y_r)} \times \frac{f(y_r)}{f_{0L}(y_r)} \tag{9}$$

In this way it is possible to decompose the relative distribution into *location effect* (the first right hand term), in general associated with changes in the median of the income distribution and *shape effect* (the second right hand term), which captures changes in the covariate-outcome relationships.

To isolate the shape component in the relative distribution has been developed the Median Relative Polarization index (MRP) of *Y* with respect to Y_0 which is formally defined as it follows:

$$MRP(F, F_0) = 4 \int_0^1 \left| r - \tfrac{1}{2} \right| g_g(r) dr - 1 \tag{10}$$

Finally, the MRP index can be decomposed into a Lower Relative Polarization (LRP) index and Upper Relative Polarization (URP) index which investigate the change of the overall polarization due to income above and below the median of the relative distribution.

They are defined by:

$$LRP(F, F_0) = 8 \int_0^{1/2} \left| r - \tfrac{1}{2} \right| g_g(r) dr - 1 \tag{11}$$

$$URP(F, F_0) = 8 \int_{1/2}^1 \left| r - \tfrac{1}{2} \right| g_g(r) dr - 1 \tag{12}$$

and can be estimated in a similar way.

4. Data

The data used in this paper are from the Survey on Household Income and Wealth (SHIW) of the Bank of Italy, which provides data on the incomes and savings of Italian households. We rely on data from the Historical Archive (HA) of the survey: we use the latest version 10.0, released in March 2018.
The income variable used in the analysis is net disposable income, which is the sum of all cash incomes earned by the household and comprises compensation of employees, pension and other transfer, income from self-employment and entrepreneurial income and property income including income from financial assets, net of income taxes, social security contribution and imputed rents.
Similarly to the majority of studies which examine income distribution, the economic unit of aggregation is the household. This is defined as a group of persons living together who, independently of their kinship, share their income wholly or in part (Boeri and Brandolini 2004). This choice reflects the conviction that the standard of living of an individual is closely linked to the household of belonging, while the traditional concept of family is no suitable to represent the current reality. However, as in Horrigan and Haugen (1988) who find that the middle class is better identifiable with families rather than households, different positions regarding the unit of observation from the sample can be adopted. In our case, intra-household distribution is assumed as egalitarian and the unit considered is the person (rather than the household). This means that each household's income is counted as many times as the number of household's members. Distribution is thus measured between individuals, attributing to each person the equivalent income of the household to which he or she belongs. Henceforth, household income and equivalent household income are used as synonymous.
Incomes are adjusted for household size using the Italian social equivalence scale[1] and real incomes are examined at 2016 prices by multiplying nominal values by the revaluation index provided in SHIW derived from the ratio between the National Accounts data on consumption of resident households and Private Social Institutions at current prices and at chain-linked prices. Following Atkinson and Brandolini (2013), to minimize the impact of outliers, all records with zero income are dropped, and observations are bottom-coded at 1 per cent of the mean of equivalent disposable income and top-coded at 10 times the median of unadjusted disposable income.

5. Results

Table 1 shows results from the decompositon of DER index in the 2016, for each population group by household head's characteristics: gender, occupational status, education, age group, residential area and state of birth. The highest value of polarization is shown by heads whose state of birth is a foreign country. The ratio D_g/S_g of DER is higher (>2) amongst low and middle-educated (the value for low-educated is greater), young, residents in the South and foreigners: it means that they tend to be

[1] This scale assigns 1 to a 2-member household, 0.599, 1.335, 1.632, 1.905, 2.150 and 2.401 to households of 1, 3, 4, 5, 6 and 7 or more members, respectively.

located in the lower part of the distribution. People from foreign country definitely show the highest value of the ratio. Compared to 2006, young people, but especially foreigners, worsen their condition[2]. The lowest (highest) homogeneity within groups and the lowest (highest) heterogeneity between groups is observed when groups are formed on the basis of the state of birth (residential area).

Table 1. Decomposition of the polarization index according to head of household's characteristics (2016)

	φ_g	ψ_g	P_g	D_g	S_g	D_g/S_g	Δ Dg/Sg 16-06	AC	RC
Gender									
Male	0.707	0.712	0.214	0.091	0.059	1.555	-0.145	0.107	0.506
Female	0.293	0.288	0.211	0.037	0.025	1.463	-0.070	0.018	0.083
Within-group								0.125	0.589
Between group								0.087	0.411
Occupational status									
Employed	0.537	0.525	0.205	0.070	0.045	1.556	-0.203	0.057	0.269
Self employed	0.122	0.150	0.241	0.013	0.012	1.149	0.042	0.004	0.018
Pensioner and not employed	0.341	0.324	0.226	0.045	0.027	1.642	-0.175	0.025	0.117
Within-group								0.085	0.404
Between group								0.126	0.596
Education									
Low education	0.161	0.124	0.202	0.025	0.010	2.580	-0.470	0.004	0.020
Middle education	0.414	0.334	0.216	0.063	0.027	2.282	0.028	0.032	0.149
High education	0.424	0.542	0.203	0.040	0.046	0.857	-0.044	0.041	0.192
Within-group								0.076	0.361
Between group								0.135	0.639
Age									
Age <41	0.155	0.132	0.240	0.023	0.011	2.041	0.234	0.005	0.023
Age 41-55	0.411	0.387	0.217	0.056	0.032	1.728	-0.042	0.035	0.164
Age >55	0.434	0.481	0.207	0.050	0.040	1.227	-0.232	0.041	0.192
Within-group								0.080	0.379
Between group								0.131	0.621
Residential area									
North	0.459	0.531	0.202	0.048	0.046	1.046	-0.011	0.045	0.214
Centre	0.195	0.224	0.202	0.020	0.020	1.031	-0.090	0.008	0.037
Sud	0.346	0.245	0.218	0.059	0.018	3.332	-0.634	0.020	0.095
Within-group								0.073	0.346
Between group								0.138	0.654
State of birth									
Italy	0.903	0.942	0.207	0.109	0.080	1.368	-0.234	0.173	0.816
Foreing country	0.097	0.058	0.245	0.018	0.004	4.985	1.627	0.001	0.007
Within-group								0.174	0.823
Between group								0.037	0.177

Note: DER with the parameter of identification $\alpha = 0.5$. φ_g, ψ_g, P_g indicate respectively population size, income share and the value of the DER polarization index. D is the deprivation component and S its complementary part the surplus. Furthermore AC and RC indicate the absolute and the relative contribution of the characteristic considered to the within-group polarization component in absolute and relative terms.

Source: survey on Household Income and Wealth (SHIW) of the Bank of Italy

[2] The decomposition of DER index in the 2006 is show in the table A1 in the appendix.

Figure 1 plots the kernel estimates of the income density for 2006 and 2016 (left panels) and the relative density functions (right panels, with their corresponding 95% confidence intervals) for the entire population and for every population group (in the first page of figure 1 groups with the higher D/S ratio in 2016 are plotted). The relative density function reported in the panel directly compares the two densities. It represents the ratio of the income density in the comparison year to the income density in the reference year evaluated at each percentile of the income distribution. It can be interpreted as the fraction of individuals in the comparison population that fall in each reference income percentile. This means that when the fraction of the comparison population in a percentile is higher (lower) than the fraction in the reference year, the relative distribution will be higher (lower) than 1. When the relative density has a value of 1.0, it indicates there has been no change at that point on the distribution over the period under consideration.

Looking at the entire population a couple of results are evident i) the income distribution in 2016 is clearly shifted to the left with respect to that in 2006, with a higher smoothed graphical difference between the curves on the left tail of the distributions ii) the relative distribution is more than 1 below the 2nd decile and less than 1 above the 6th decile. This means that if we choose any percentile between the 1st and the 20th in the 2006 distribution, the fraction of households in 2016 that earn an amount of income corresponding to the chosen percentile is higher than the analogous fraction of households in 2006. The decreasing trend of the curve below 1 is then particularly evident also starting from the 80th percentile, consistently with the hypothesis that a significant share of people is shifted from the top to the middle and from the middle to the bottom of the distribution. The negative peak of 0.75 is at around the 90th percentile, meaning that households in 2016 are approximately 75% less likely to fall at the level of 2006 income corresponding to the 90th percentile than households in 2006.

Results for the popultation groups are similar, but some interesting peculiarities emerge. First of all, foreigners are confirmed to be the group with the most evident changes. For households with foreign head employee, the PDF shifts from a tri-modal distribution in 2006 to an approximate bi-modal distribution in 2016. For this group of people, changes are grafically more visible: density curve of wages in 2016 is much more clearly shifted to the left of that of 2006 with respect to the other groups. As a consequence, the relative distribution for low and high quantiles is much farther from the value of 1.0 compared to that of the other groups. Moreover, the peak of income distribution in 2016 is reached at a level of income significantly lower than in 2006. These results are even clearer compared to those of Italians (last two panels in figure 1 *continued*). As to the age, young households (age less than 41) are those with the most noticeable changes compared to the groups of age 41-55 and over 55. The Center shows the flattest curve especially for the lower quantiles, compared to the South and to the North. The middle education evidences the clearer changes at the lower quantiles with respect to the low and the high education. Men show the greater effect at lowest quantiles compared to women. Self-employed households make the clearest evidence of changes, compared to employed and pensioners and not employed.

Figure 1. Changes in the Italian household income distribution between 2006 and 2016 by population groups: Kernel and Relative distribution

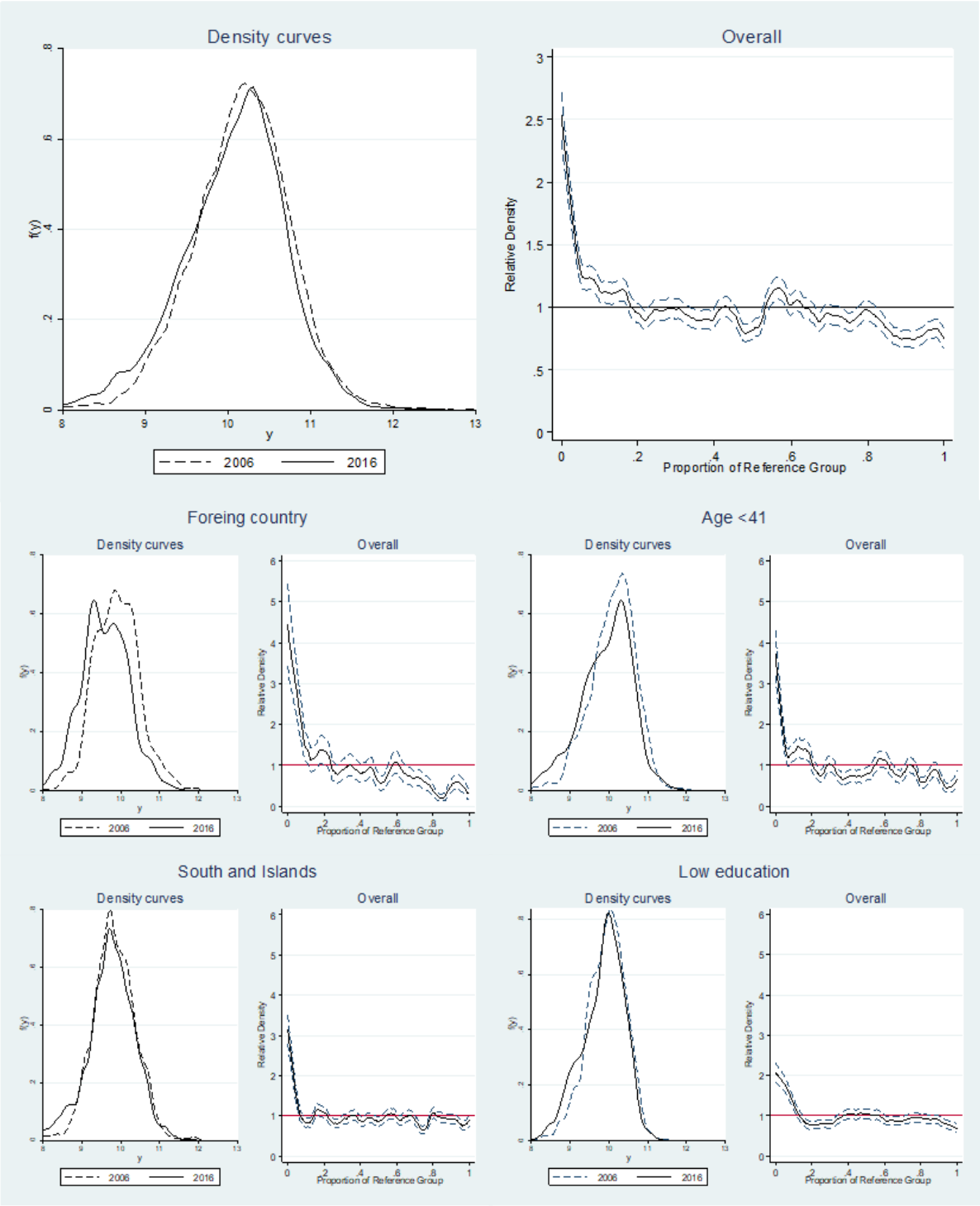
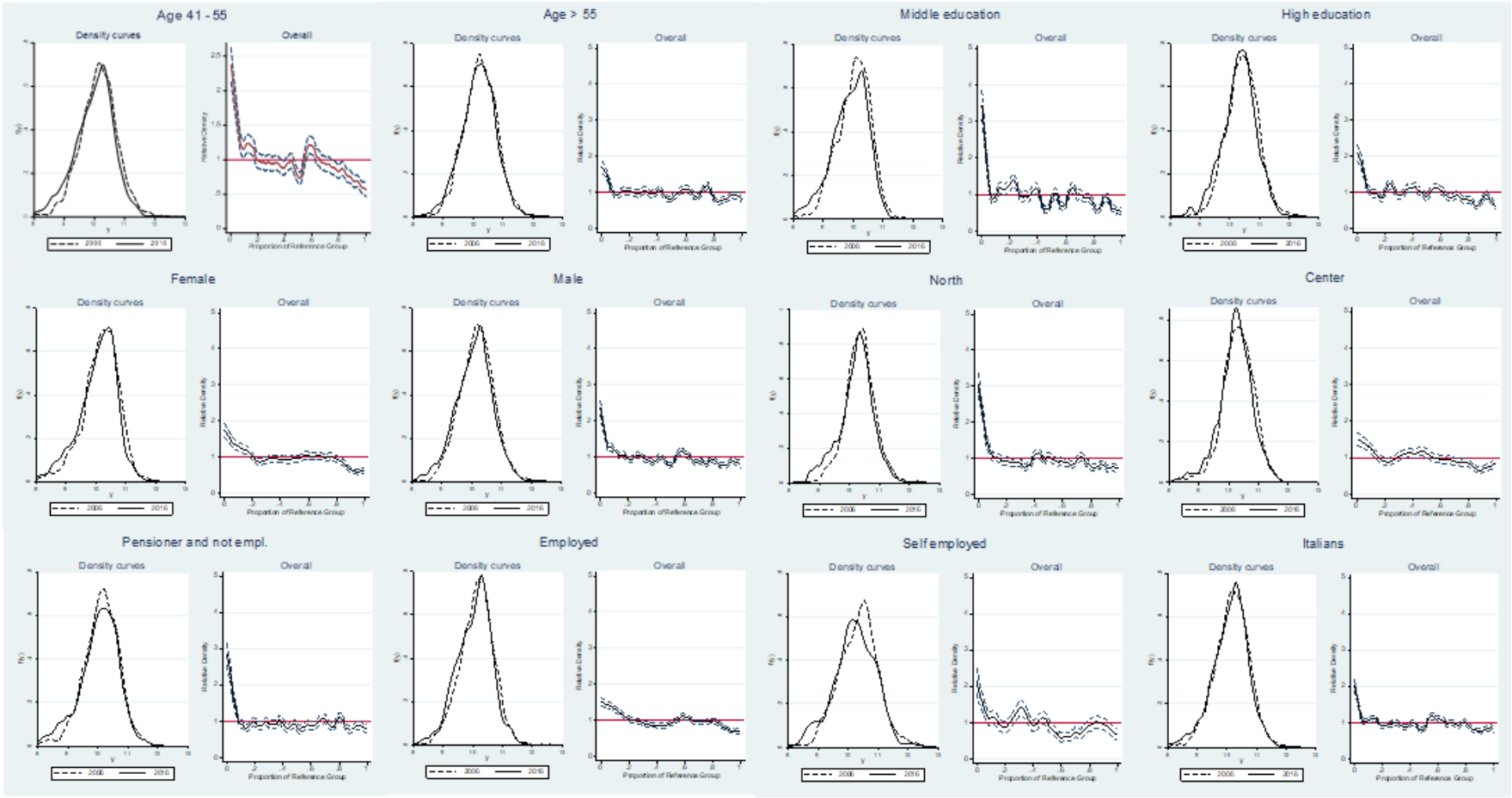


Figure 1. *continued*



Note: The scale of the vertical axis in the graphs of the second page of figure 1 is not coherent in order to better observe graphically the differences between the 2006 and 2016 distributions for each of the groups

Source: survey on Household Income and Wealth (SHIW) of the Bank of Italy

Figure 2 shows the corresponding decompositions of the relative distribution into location and shape effects, with their 95% confidence intervals (following figure 1, in the first page of figure 2 groups with the higher D/S ratio in 2016 are plotted).

The first panel (location effect) represents the effect associated with changes in the median (or mean) of the income distribution. Thus, the location effect increases the share of households in the lowest 2 deciles while decreasing those in the right side of the distribution, generarly from the 45th percentile onward. The shape effect (panel two), which represents the relative density net of the median influence, indicates a significant increase of the fraction of households at the poorest decile of the distribution. Moreover, the upper part of the relative density reveals a significant decrease of the mass from the 85th percentile onward.

Again, the groups show heterogeneous results. The location effect shows that foreign households are confirmed as the group with the greatest increase of the share of people at the lowest quantiles. This evidence is even more visible if compared to the curve of Italians. Young people show the greatest location effect compared to the other groups of age. The shape effect evidences that foreign households are the only group with a decreasing share of people at both lowest and highest quantiles. South, pensioners and not employed are the groups with the relatively higher positive peaks at the lowest quantiles.

Table 2 reports the change from 2006 to 2016 of the average and median income and the three polarization indices, together with the corresponding decomposition by groups[3]. Observing the change in average and median income, young people, but especially foreigners, are confirmed as the categories that have suffered the most from the crisis. As to polarization, the general MRP is not significant, while the LRP (URP) is both significant and positive (negative). Therefore, during the GR (i) the median relative polarization index did not change (ii) operating by itself, the shape effect would have confirmed a strong general population shift, from the upper to the median and from the median to the lower positions. A decrease (increase) in median polarization is observed for heads of households with high education, located in the center and born in a foreign country (pensioner and not employed). High positive (negative) and significant values of LRP (URP) are observed when the head of household is male, pensioner and not employed, low educated and located in the South (female, employed, with a high education, in the age group 41-55, located in the Center, born in Italy).

[3] The absolute values for mean and median income in 2006 and 2016 by household heads characteristics are reported in table A2 in the appendix. From a gender point of view it should be noted that women's income has decreased a little more than men's income, thus tending to amplify the gender pay gap, which is already evident in Italy (Biagetti and Scicchitano 2011, 2014a, 2014b; Mussida and Picchio, 2014a, 2014b)

Figure 2. Changes in the Italian household income distribution between 2006 and 2016 by population groups: Kernel and Relative distribution

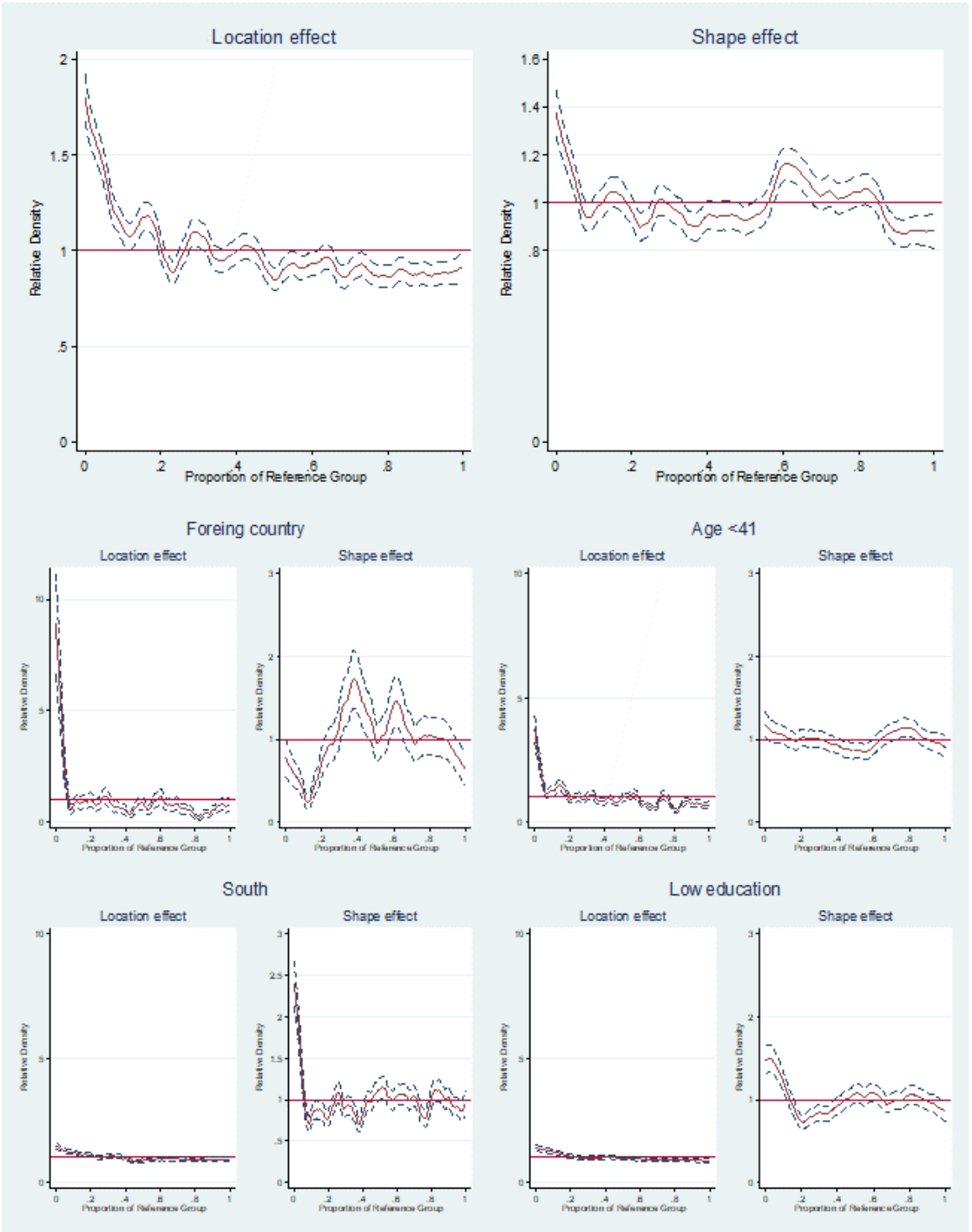
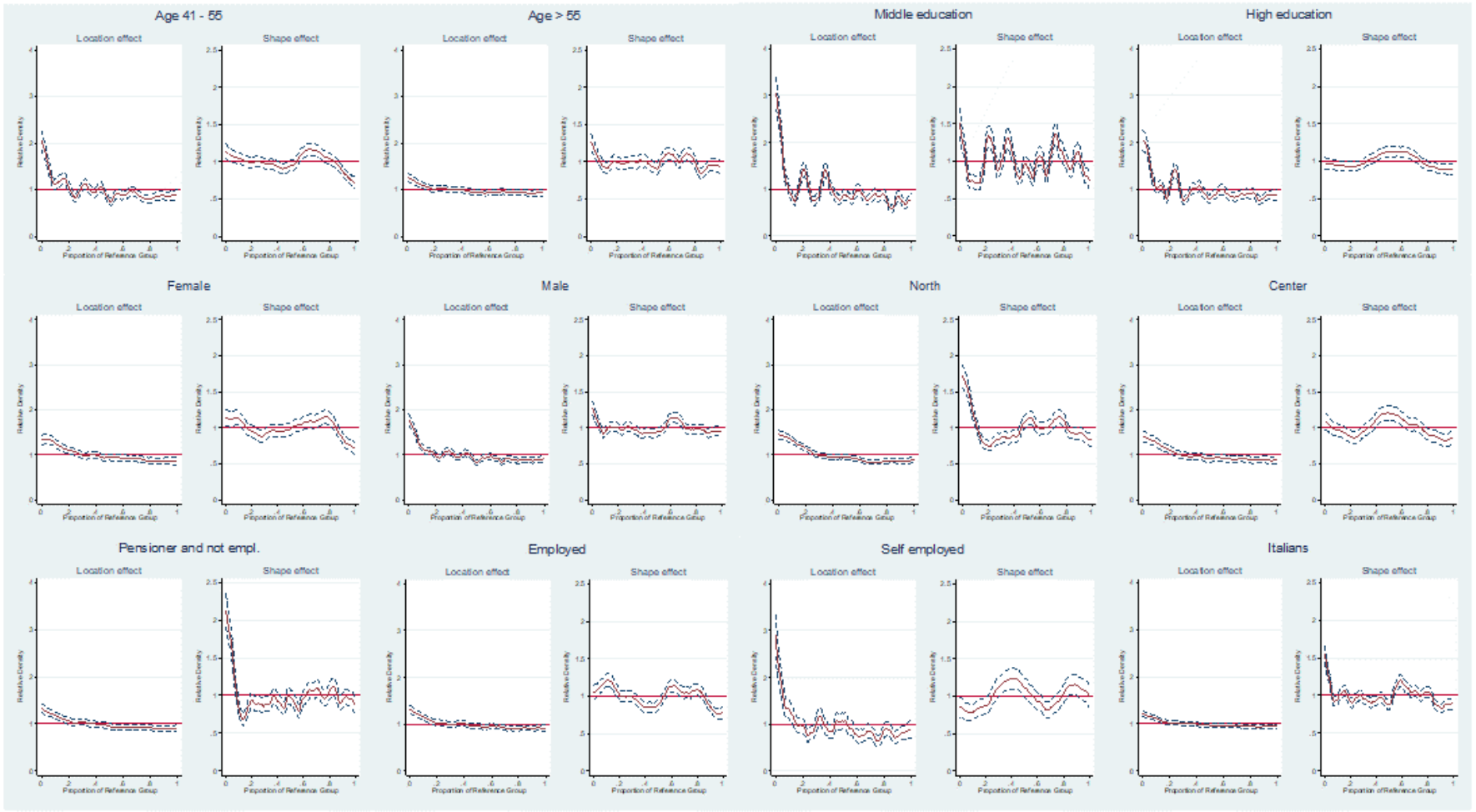


Figure 2. *continued*



Note : see Figure 1

Source: survey on Household Income and Wealth (SHIW) of the Bank of Italy

Table 2. Decomposition of the polarization index according to head of household's characteristics (2016)

	Δ Mean 2006-16	Δ Median 2006-16	MRP	LRP	URP	N. Obs. 2006	N. Obs. 2016
General index	-10%	-7%	0.005	0.040 ***	-0.029 **	19,551	16,464
			(0.008)	(0.011)	(0.013)		
Gender							
Male	-9%	-7%	0.007	0.035 *	-0.021	14,994	11,497
			(0.011)	(0.020)	(0.015)		
Female	-10%	-8%	-0.007	0.034	-0.048 *	4,557	4,967
			(0.016)	(0.035)	(0.025)		
Occupational status							
Employed	-8%	-5%	0.009	0.067 **	-0.050 ***	7,390	10,050
			(0.016)	(0.027)	(0.019)		
Self employed	-13%	-14%	-0.038	-0.089	0.012	1,749	2,706
			(0.039)	(0.083)	(0.044)		
Pensioner and not emp.	-8%	-6%	0.050 ***	0.111 ***	-0.010	6,795	7,325
			(0.015)	(0.022)	(0.021)		
Education							
Low education	-8%	-6%	0.027	0.079 **	-0.025	3,297	4,399
			(0.020)	(0.038)	(0.028)		
Middle education	-5%	-22%	-0.001	0.002	-0.004	7,583	6,537
			(0.016)	(0.029)	(0.020)		
High education	-10%	-8%	-0.046 **	-0.036	-0.055 ***	7,569	6,630
			(0.019)	(0.030)	(0.021)		
Age group							
Age <41	-18%	-17%	0.038	0.062	0.014	3,902	1,755
			(0.024)	(0.043)	(0.039)		
Age 41-55	-14%	-9%	-0.011	0.036	-0.059 ***	7,659	5,602
			(0.013)	(0.026)	(0.016)		
Age >55	-6%	-4%	-0.002	0.025	-0.029 *	7,980	9,107
			(0.019)	(0.030)	(0.016)		
Residential area							
North	-10%	-8%	0.020	0.080 ***	-0.039 **	8,725	6,741
			(0.014)	(0.026)	(0.017)		
Centre	-9%	-7%	-0.057 **	-0.033	-0.080 ***	3,935	3,475
			(0.026)	(0.046)	(0.029)		
South and Islands	-9%	-6%	0.028	0.084 **	-0.029	6,901	6,248
			(0.022)	(0.036)	(0.021)		
State of birth							
Italy	-7%	-3%	0.003	0.053 **	-0.047 ***	18,638	15,247
			(0.011)	(0.021)	(0.013)		
Foreing country	-29%	-32%	-0.149 ***	-0.255 **	-0.043	913	1,217
			(0.047)	(0.101)	(0.048)		

Note: ***p < 0.01, **p < 0.05, *p < 0.1

Source: survey on Household Income and Wealth (SHIW) of the Bank of Italy

6. Conclusions and policy indications

In this paper we have shown how population groups have contributed to the total polarization of incomes in Italy during the GR. We have detected a general downgrading, particularly of lower incomes, where low-educated, young, southern and foreign head of household are located out of the GR.

Economic crisis is a major driver of the relatively worse conditions of young people[4] and especially immigrants. The ratio between the deficit and the surplus component highlights that the polarization of the Italian society is actually based on the state of birth: in 2016, the foreigners have the highest value of this ratio, which means that they tend to be located in the lower part of the distribution. Moreover, comparing these findings with the ones obtained for 2006, it is possible to consider that foreign people have experienced the highest increase, thus meaning that heaviest burden of the GR has fallen on foreigners. Our findings are largely consistent with those by Venturini and Villosio (2018) who show that foreign employment in Italy suffered from a greater segregation in terms of insecure, low-skilled and low-payed jobs during the recession. Similar conclusions are also obtained by Bonifazi and Marini (2014) who find that foreign workers have suffered the effects of the crisis more than Italian ones in terms of employment rates. Comparable results are obtained also for the US: Gassoumis (2012), Wolff (2013), Amuedo-Dorantes and Pozo (2015), report that immigrant households have experienced the greater wealth losses due to recession.

In this context, if it is true that countries with a higher polarization in terms of population tend to have a worse economic development than countries with a more heterogeneous composition of the population (Rodríguez-Pose and von Berlepsch 2019), then the fact that foreigners have suffered the worst consequences of the crisis can be a serious challenge for current economic policy.

Evaluating and calculating the polarization of income at a given moment or in a time period is not sufficient to provide the necessary information to design appropriate redistributive policies in favor of the most disadvantaged population groups. Thus, this article employs a decomposition of the polarization indices by population groups, which is able to provide specific useful policy indications, tailored to groups' needs.

The current emergency from Covid-19 seems to be able to create an unprecedented impact on income polarization (Bonacini *et al.* 2021), thus further research will be able to investigate more in detail the impact of the new crisis due to the coronavirus pandemic on income polarization.

[4] The evidence of a significant impact of crisis on young people is in line with Ghoshray *et al.* (2016) and Pastore (2018).

Appendix

Table A1
Mean and median income in 2006 and 2016 by household head's characteristics

	Mean		Median	
	2006	2016	2006	2016
General	30,552	26,399	27,645	24,491
Gender				
Male	30,603	27,820	26,189	24,271
Female	30,382	27,224	27,239	25,094
Occupational status				
Employed	29,304	27,023	25,861	24,653
Self employed	39,133	34,105	32,683	28,047
Pensioner and not employed	28,734	26,320	25,230	23,755
Education				
Low education	22,928	21,204	21,356	20,158
Middle education	23,455	22,264	25,813	20,239
High education	39,465	35,353	33,998	31,177
Age				
Age <41	22,928	21,204	21,356	20,158
Age 41-55	23,455	22,264	25,813	20,239
Age >55	39,465	35,353	33,998	31,177
Residential area				
North	35,723	31,993	31,323	28,954
Centre	35,055	31,762	30,557	28,510
Sud	21,477	19,561	17,969	16,955
State of birth				
Italy	30,947	28,827	26,731	25,840
Foreing country	23,322	16,588	19,914	13,495

Source: survey on Household Income and Wealth (SHIW) of the Bank of Italy

Table A2

Decomposition of the DER polarization index according to head of household's characteristics (2006)

	φ_g	ψ_g	P_g	D_g	S_g	D_g/S_g	AC	RC
Gender								
Male	0.769	0.770	0.209	0.101	0.059	1.700	0.123	0.597
Female	0.231	0.230	0.205	0.029	0.019	1.533	0.011	0.052
Within-group							0.134	0.648
Between group							0.073	0.352
Occupational status								
Employed	0.547	0.524	0.201	0.073	0.041	1.759	0.058	0.280
Self employed	0.145	0.186	0.234	0.015	0.014	1.107	0.005	0.027
Pensioner and not employed	0.308	0.290	0.207	0.041	0.023	1.817	0.019	0.090
Within-group							0.082	0.397
Between group							0.125	0.603
Education								
Low education	0.207	0.155	0.189	0.034	0.011	3.050	0.006	0.031
Middle education	0.402	0.340	0.201	0.059	0.026	2.254	0.029	0.139
High education	0.391	0.505	0.206	0.037	0.041	0.901	0.035	0.170
Within-group							0.070	0.340
Between group							0.136	0.660
Age								
Age <41	0.257	0.241	0.206	0.035	0.019	1.807	0.013	0.062
Age 41-55	0.386	0.381	0.214	0.051	0.029	1.770	0.031	0.151
Age >55	0.356	0.379	0.208	0.043	0.030	1.459	0.027	0.130
Within-group							0.071	0.343
Between group							0.136	0.657
Residential area								
North	0.454	0.530	0.193	0.046	0.044	1.057	0.042	0.204
Centre	0.192	0.221	0.203	0.020	0.018	1.121	0.008	0.038
Sud	0.354	0.249	0.209	0.062	0.016	3.966	0.020	0.096
Within-group							0.070	0.337
Between group							0.137	0.663
State of birth								
Italy	0.948	0.960	0.206	0.120	0.075	1.602	0.187	0.902
Foreing country	0.052	0.040	0.235	0.009	0.003	3.358	0.000	0.002
Within-group							0.187	0.904
Between group							0.020	0.096

Note: see table 1 in the article

Source: survey on Household Income and Wealth (SHIW) of the Bank of Italy

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