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Income Polarization in the USA (1983-2016): what happened to the middle class?*

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Abstract

The rise in inequality in the US over the last few decades has been well documented. However, the effects of inequality on polarization and middle class in particular are less well studied and understood. We employ Relative Distribution tools (Handcock and Morris, 1998) on the well known PSID longitudinal dataset in order to provide a detailed analysis of the US income distribution during the period 1983 to 2015. The main result shows a hollowing out of the mid-range deciles with a corresponding fattening of the highest ones. Thus the analysis confirms the hollowing out of the middle class in the US over the last few decades--starting with the age of Reaganomics. Analyzing further the “pure distribution” effect (*i.e.*, deputed by the growth one), we find that this typical polarization profile emerged over time but especially in the 1990s and the 21st century. The typical hollowing out of the central deciles of the US income distribution has been indeed accompanied by “fattening” of both tails of income distribution with greater weight going increasingly to the bottom deciles. There are even some signs of acceleration of this trend recently. We also find some preliminary evidence for *intersectionality*, *i.e.* race, class and gender working together in a vicious cycle. Policies to counteract these tendencies must be anti-polarization policies along with those of relatively more egalitarian growth. However, the current policies including tax policies are headed in exactly the opposite direction.

Keywords: Polarization, Political Economy of the US, Relative Distribution Tools, Middle Class, Inequalities, Growth Effect, Distribution Effect

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1. Introduction:

The main purpose of this paper is to answer the question as to whether the middle class has suffered a decline in the US over the last few decades in light of both social and statistical theories and empirical methodologies. We answer this question affirmatively; but the route by which we arrive at this answer requires systematic exposition in terms of social and economic theory and statistical methodology. Since whether or not the middle class has in fact declined over the last few decades is a manifestly empirical question, answering this question statistically requires an appropriate empirical method grounded in rigorous theory along with a reliable longitudinal data set.

Fortunately, in the US case, there ~~are is a~~ large longitudinal data sets. Below we describe this PSID data set in section 3 and its relevance for our study. Subsequently we control our results employing the same tool on CPS data. We then discuss our particular approach to polarization and the statistical methodology. Finally, we present the empirical results and draw the appropriate political economic conclusions. But before all else, we need to ask the crucial questions: what is the middle class, and in fact is this a coherent concept grounded in socio-economic theory? This is answered at least in a preliminary manner in section 2 below.

However, we need to clarify technically the approach to polarization that emphasizes the middle class. There are two views on polarization in the literature.

As Chakravarty (2015-) explains:

While the first opinion is concerned with the “shrinking middle class” where the middle class is defined in terms of concentration of population with incomes in some range around the median income (Wolfson (1994, 1997) and Foster and Wolfson (2010)), the alternative notion deals with the clustering of population into different income subgroups (Esteban and Ray (1994) and Duclos et al. (2004)).

Work on polarization in the US is still an evolving agenda but is developing apace. Foster and Wolfson (2010) is a good source for a review of the earlier literature. Rose (2016) has reviewed the most recent studies. Most contributions reach the conclusion that polarization has increased since the 1970s, and that the hollowing out of the middle-income class has been more into high- than low-income classes. But for our analysis of the time-series which covers the decades since the 1980s reveals that the middle-income class has polarized evenly into the low- and high-income classes, and perhaps migrated increasingly into the lower income class recently. In addition, we are able to offer some preliminary findings that elucidate the *intersectionality* of race, gender and class in the US as well.

More specifically, most of the rise in polarization in the recent period of 2000-2014 has been into the low-income class.¹ We discuss this further in this paper by presenting the relevant statistical analysis. We are actually able to show robustly that this move of middle class to lower class in reality, started in the 1980s with the Reagan administration and accelerated as time passed.

In our work described below, we follow the median-based relative distribution method that allows us to look at the situation of the middle class in the US over a considerable span of historical time. This can also be called bipolarization (Chakravarty 2015, ch. 2). Here there is a group of relatively wealthier persons above the median and another group of poorer people below the median with some in the middle. Intuitively, it is the shift in distribution over time and the location of this

¹ In this sense our work is consistent with the findings of Alich et al. (2016). But we analyze using a different methodology the decades since the Reagan administration in more depth and detail. We also offer robustness checks.

middle group that we study in our paper. The more specific technical details are given later in this paper.

The paper is organized as follows. We first clarify some conceptual issues regarding the relations between the concept of polarization and the middle class in section 2. In section 3, we discuss the PSID data set, the source of our main empirical results and offer some descriptive analysis. Section 4 discusses our relative distribution methodology for analyzing polarization. Section 5 gives the main empirical results and section 6 gives the results of robustness checks using the Relative Distribution method to the Current Population Survey data provided by the United States Census Bureau. Section 7 is the concluding one.

We now turn to the conceptual and social theoretical aspects of middle class and polarization.

2. Middle class and Polarization

2.1 A conceptual and theoretical overview

First, it should also be noted that according to the recent anthropological and sociological literature, middle class itself can evolve. The middle class can change its socially expressive qualities as Bourdieu discusses in terms of distinctions and habitus. Three insightful new studies push this further through theoretical and empirical work on Pakistan (Maqsood 2017), India (Ghosh 2016) and on the US (Roediger 2017). In the US, in particular the *intersectionality* of race, class and gender is shown to be a major explanatory factor.

In our discussion below, the concept of polarization is associated with the dynamically evolving structural features of middle class; however as quantitatively oriented economists, we focus modestly on income polarization as an initial economic data-based step in the overall intersectional inquiry. As a first approximation, polarization implies a hollowing out of the middle class and a fattening of one or both tails of the distributional curve. Actually, the terms middle class and polarization are, by themselves, etymologically quite clear and intuitive. Limiting our focus on “objective” income distribution analysis,² it is apparent that (barring the extreme case of perfect equality) in every (national) society³ some people are rich, some are poor, and some are not-so-rich and not-so-poor. Utilizing heuristically and neutrally the term “class” to refer to each of these

² Many sociological and psychological studies have explored the relevance and diffusion of the “middle class values” and the varying subjective degrees of identification with the middle class on the part of different social groups that might be very distant from the latter’s objective belonging to a given income or wealth. For instance, it is well-known that most Americans tend to identify themselves as middle class, more so than their European counterparts. This difference is partly related to moral and ethical values attached to the term in different cultural contexts, and to the intrinsically different meaning that the terms “middle class” and “working class” have evolved into in different countries (see also Sosnaud et al., 2013; Hout, 2008; Jackman and Jackman, 1983).

³ Other studies adopt an international, or even a worldwide approach, utilizing concepts such as between-country inequality and, in some cases, global polarization and global middle class. The global middle class is usually identified with the worldwide aggregation of uneven population groups belonging to the population of many developed and developing countries, all of them unified by the characteristic of being endowed with a sufficient high purchasing power to be able to buy a certain bundle of modern tradable goods and services. The global middle class is composed by households with an income equal to or higher than a minimum threshold (set in international dollars). Given the focus of the analysis, many studies do not even establish any upper bound to the global middle class, thereby implicitly identifying the middle with the upper global class and thus classifying substantially the world population in only two classes: those who can accede to a minimum bundle of modern tradable consumerist items and those who can’t. See AfDB, 2011; OECD, 2011; Corral et al., 2015.

groupings, the last one can naturally be termed “middle class” – i.e., the middle class is simply that part of the population that, in terms of income (or consumption expenditures), is in the middle between the “rich” and the “poor.”⁴

In the domain of statistics, the concept of class is straightforward and uncontroversial although not identical with the anthropological or sociological conceptualizations.⁵ A class is a grouping of values by which data is binned for computation of a frequency distribution (Kenney and Keeping 1962, p. 14). Thus, in the case of income distributions, an income class is composed by households in which income falls between the limits of a range of values (called a *class* interval). Here the terms class and grouping are interchangeable and unconnected with any substantive social, political or economic theory. Therefore, when the term middle class is used neutrally (i.e., independently from any conceptual elaboration of its socioeconomic function) the middle class is simply identified with “middle-income households” – i.e., households with an income that falls in an arbitrarily determined interval centered around the median (see Alichì et al., 2016).⁶ Of course, this use of the term class in the context of income/ wealth distribution does not imply (or deny) that middle-income households – or, by the same token, low or rich-income households – form a class in the above-mentioned, strong sociological sense. We might call this meaning of class, which is in fact purely quantitative, neutral and unambiguous, a “weak” meaning. In the domain of applied research – as opposed to that of purely theoretical thinking – it is only after reaching robust quantitative results that analysts can (if they deem it meaningful) put forward an interpretation pivoting on the “strong,” socioeconomic concept of class.

The polarization methodology---particularly in our relative distribution version--- has come to the forefront of international socioeconomic research owing to its paramount role in the analysis of the evolution of income, consumption expenditures and wealth⁷ distribution. This methodology can be used to examine the potential for social conflicts, economic growth and development as well.⁸ The justification for this method is that the polarization approach is one fruitful attempt among others⁹ at measuring the objective segregation among social groups with respect to their respective material well-being. Polarization is statistically identified with the degree of within-group similarity and

⁴ Perceptive and rigorous scholars like Murakami (1997) have used the term “middle masses” which avoids the Marxist criticism that the middle class is a theoretically loose and underspecified term.

⁵ In our earlier work, we have discussed the historical genealogy of class starting with Marx and Weber. See Khan, Gabriele and Schettino(2017)

⁶ Alichì et al., define “middle-income households” as those with an income falling in an interval ranging from 50 to 150 percent of median income, and show that their weight in total US population fell from 58% in 1970 to 47 % in 2014 (Fig 3, p. 5).

⁷ In the remainder of this paper we will use simply the term “income distribution,” implicitly referring both to monetary (income and expenditures) and non-monetary distribution studies. See Fisher (xxxx) Khan and Parvin(1984) for further discussion of non-monetary aspects and the concept of PRC or potential real consumption.

⁸ See among others Esteban and Ray, 2008, Esteban and Schneider, 2008 (and more generally, the *Journal of Peace Research*, Vol. 45, No. 2, *Special Issue on Polarization and Conflict*, March 2008); recently, Gochoco-Bautista et al., 2013; Corral et al., 2015.

⁹ There are attempts, for example, by scholars like Erik Olin Wright to objectively quantify empirical class divisions. Social Accounting Matrices of various designs try to do the same or something more eclectic, similar to polarization literature in terms of classification of households and mapping from factors to households. See Taylor, 1990; Khan 1985, 1997a,b, 1998, 199a,b, 2004a,b, 2007, 2010, 2017; James and Khan, 1993, 1997, 1998; Khan and Thorbecke, 1988, 1989.

between-group disparity. The concept of polarization is thus intrinsically related to that of socio-economic classes and class-consciousness – although not exclusively with the Marxian or Weberian concepts (other salient concepts are that of middle class and of marginal/excluded class). Polarization describes the degree to which a population is segregated into groups in a society (Gradín, 2000: 457). It detects the presence or disappearance of such groups in a distribution (Chakravarty, 2009), indicates how individuals and groups feel toward one another (Duclos, Esteban and Ray, 2004), and captures the phenomena of a diminishing middle class or a divided society (Zhang and Kanbur, 2001). Thus in our view, polarization can be seen as a warning signpost urging corrective interventions, and ultimately (unless such policy actions are promptly and effectively carried out) as a predictor of future social conflict.

Middle class (the boundaries of which are set according to specific¹⁰ statistical criteria by researchers themselves) and polarization are mostly analyzed both in a cross-country and a historical time-series perspective. The purpose is to find out whether the middle class has been evolving over time to constitute a larger or smaller share of the population, and/or capturing a larger or smaller share of total national income.¹¹ In this context, polarization can be understood as a tendency on the part of the population and/or of national income to concentrate itself around two opposite “poles” (the rich and the poor).

Thus, polarization naturally points towards an analytic and descriptive distributional vision of society that is rather clear-cut, essentially constituted by just three major groupings. If the third, intermediate group tends to wither out while the population concentrates itself towards the upper or the lower tail, a polarization process is going on. This “pure” form of polarization can be estimated with two relatively straightforward and unambiguous methodologies. One consists in choosing arbitrarily a statistical interval setting the boundaries of the middle class (for instance, defining it as consisting of households with 50-150 percent of median income), and using it to estimate the relative share on middle class households in the total population. The other is based on the Wolfson index (W), which estimates the relative size of the middle class measuring the degree of clustering around the median (see also Foster and Wolfson , 1992 and Wolfson, 1994, Alichì et al., 2016).

In the recent literature on the statistical measurement of polarization, multi-polar polarization refers to the “clustering around local means of the distribution, wherever these local means are located on the income scale” (Chakravarty, 2015, p. vii). Our particular relative polarization methodology described in section 4 below, follows the statistical approach with some social theoretical justification as well (Khan 2016, 2018). We can also begin with our methodology a preliminary exploration of the *intersectionality* of race, gender and class in a complex social formation. Empirically, we are able to offer some preliminary findings that elucidate the *intersectionality* of race, gender and class in the US as well, and make plausible the possibility in future to apply the

¹⁰ “Subjective” is not synonymous with haphazard. Researchers can legitimately adopt various and possibly diverging criteria in setting the boundaries of the middle class, according to their different ex-ante theoretical views and analytical goals.

¹¹ The two phenomena might evolve in opposite directions. For instance, in a period of sustained growth characterized by poverty reduction, on one hand, and a shift of income distribution favoring the very rich, on the other hand, the relative weight of middle class households might increase while the share of total income they capture diminishes.

methodology to more robust data sets in a multi-dimensional polarization setting to explore the complexities of *intersectionality*.

But first we need to look at the relevant data. Therefore, we now turn to a discussion of the actual data for the US ---the PSID data set.

3. The PSID Data Set

3.1 History and Analytical Relevance

The PSID was created to assess President Lyndon Johnson's War on Poverty and in the mid-60s the Office of Economic Opportunity (OEO) directed the U.S. Bureau of the Census to conduct a study called the Survey of Economic Opportunity (SEO), interviewing almost 30,000 households. Subsequently, OEO approached the Survey Research Center (SRC) at the University of Michigan about interviewing a sub-sample of approximately 2000 low-income SEO households. In the following years the new SRC director added a fresh cross-section of households from the SRC national sampling frame so that the survey turned to be representative of the entire population of the United States (both poor and not poor households). Moreover, deciding to follow members of the families who moved away from their original households, such as children who came of age during the study, he permits the sample to remain representative at national level over time. This way was created what is currently known as Panel Study of Income Dynamics (Hill, 1992; McGonagle, et al., 2012). Thus, in 1968 the survey was already nationally representative sampling over 18000 individuals living in 5000 families in the United States. Information about income, wealth, expenditures, health, and other several features have been collected continuously over time (see Table 1).

Table 1. Number of Individuals and Families in Each Wave, by Sample Type: 1968-2015

Year	Families					Individuals								
	Core	SRC	Core	SEO	Latino	Immigrant	Total	Core	SRC	Core	SEO	Latino	Immigrant	Total
1968	2,930	1,872					4,802	9,461	8,772					18,233
1969	2,643	1,817					4,460	8,643	8,569					17,212
1970	2,754	1,891					4,645	8,752	8,597					17,349
1971	2,834	2,006					4,840	8,827	8,763					17,590
1972	2,947	2,113					5,060	9,109	8,942					18,051
1973	3,057	2,228					5,285	9,191	9,045					18,236
1974	3,165	2,352					5,517	9,286	9,110					18,396
1975	3,252	2,473					5,725	9,437	9,186					18,623
1976	3,318	2,544					5,862	9,556	9,212					18,768
1977	3,382	2,625					6,007	9,670	9,328					18,998
1978	3,416	2,738					6,154	9,697	9,443					19,140
1979	3,497	2,876					6,373	9,856	9,587					19,443
1980	3,589	2,944					6,533	10,034	9,713					19,747
1981	3,617	3,003					6,620	10,080	9,716					19,796
1982	3,673	3,069					6,742	10,232	9,880					20,112
1983	3,715	3,137					6,852	10,322	10,005					20,327
1984	3,729	3,189					6,918	10,349	10,044					20,393
1985	3,753	3,279					7,032	10,474	10,206					20,680
1986	3,750	3,268					7,018	10,400	10,037					20,437
1987	3,778	3,283					7,061	10,508	9,978					20,486
1988	3,809	3,305					7,114	10,555	9,951					20,506
1989	3,809	3,305					7,114	10,524	9,927					20,451
1990	3,935	3,393	2,043				9,371	10,677	10,068	7,452				28,197
1991	3,957	3,418	1,988				9,363	10,707	10,063	7,075				27,845
1992	4,051	3,510	2,268				9,829	10,934	10,211	8,130				29,275
1993	4,231	3,642	2,104				9,977	11,560	10,751	7,415				29,726
1994	4,624	4,034	2,106				10,764	12,576	11,936	7,033				31,545
1995	4,565	4,002	1,834				10,401	12,314	11,615	5,955				29,884
1996	4,547	3,964					8,511	12,294	11,516					23,810
1997	4,592	1,714			441		6,747	12,363	5,703			1,695		19,761
1999	4,740	1,787			470		6,997	12,787	5,937			1,791		20,515
2001	4,970	1,945			491		7,406	13,340	6,232			1,828		21,400
2003	5,159	2,126			537		7,822	13,684	6,661			1,945		22,290
2005	5,175	2,260			567		8,002	13,873	6,998			2,047		22,918
2007	5,295	2,412			582		8,289	14,150	7,263			2,088		23,501
2009	5,446	2,607			637		8,690	14,606	7,593			2,186		24,385
2011	5,495	2,767			645		8,907	14,607	7,844			2,210		24,661
2013	5,450	2,932			681		9,063	14,562	8,099			2,291		24,952
2015	5,318	3,037			693		9,048	14,151	8,247			2,239		24,637

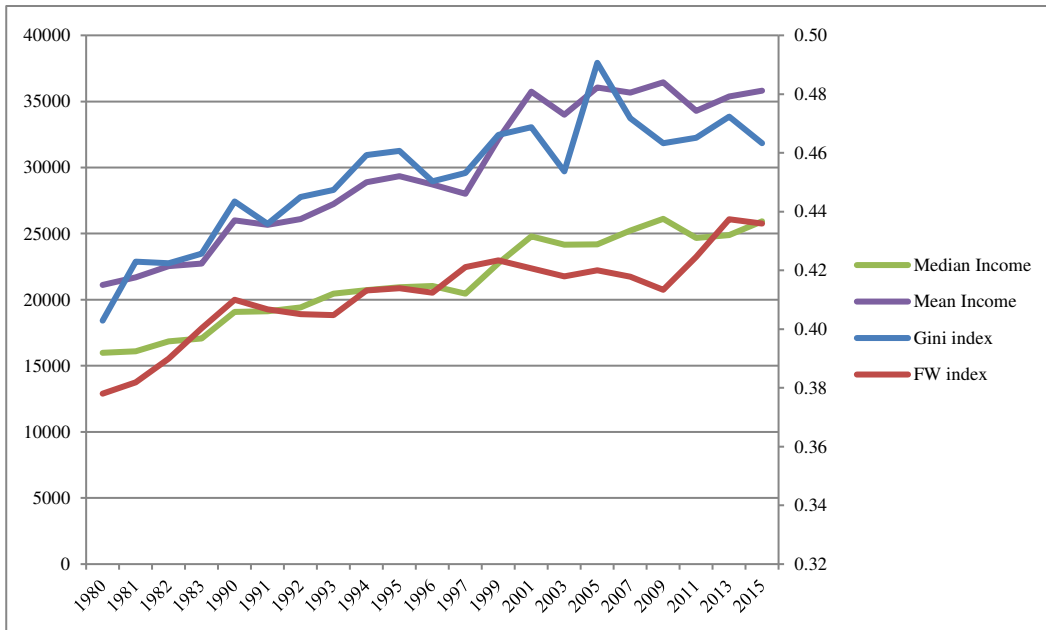
Notes: Sample type is defined by ER30001: Core SRC=1-2930/Immigrant=3001-3511/Core Seo=5001-6872/Latino=7000+. Sequence Number (SN) for each year can be used to determine family level (SN=1) and individuals in that year (SN>=1).

Indeed PSID is unique principally for two main reasons: 1. It is national representative; 2. It contains the longest duration of a panel.

Moreover, it includes adult respondents of all ages following individuals across the entire lifecycle. Adult children are interviewed in their own family units after they achieve economic independence from their parents' households. This unique self-replacing design means that, for many families, PSID includes self-reported information on three (and occasionally four, or even five) generations of the same family at various points in their life (McGonagle et al., 2016). PSID actually represent the sole survey collected on lifecycle and multigenerational economic conditions in a long-term panel representative of the full U.S. population. As a results the analysis based on PSID data can be used to produce both quantitative and qualitative statistical evidences about the entire U.S. population and also major demographic subgroups.

3.2 Brief Background Descriptive analysis

Figure 1 – Basic Trends of Income distribution



As already well described by Alichì et al. (2016) both income inequality and polarization continuously increased since 1970. Polarization index has grown faster than the Gini coefficient during the period considered by the authors. Using the Current Population Survey (CPS)¹², they sketched out that while the Gini coefficient has been broadly flat since 2000, the polarization index has significantly increased after the beginning of the Great Recession, confirming the idea of a strong hollowing out of the mid-deciles of the distribution. In other words, also the US households belonging to the middle class moved mainly towards the lowest part of the distribution. These stylized facts confirm other studies' outcomes provided for several countries (see among others, Piketty 2014 and Atkinson, 2015). All these information should be first summarized with the cold fact that after the 2008, the capitalist system generated an overall trend of polarizing societies.

Figure 1 captures the basic trends in the income distribution data in the US for the several decades following the 1980 election of Ronald Reagan. Clearly, the dynamism of the US economy can not be ignored. The mean and median income grew along with the positive trend growth rate which has been lower than that during the "golden" age (1945-73) but still positive with some acceleration in the 1990s. However both the Gini index of income inequality and the FW index of polarization¹³ also show clear upward trends. Thus the US economy does present a polarizing picture that

¹² <https://www.census.gov/programs-surveys/cps.html>

¹³ There are several different polarization indexes. For the conceptual and empirical aspects of polarization-inequalities connections, see

Alderson, A. S., & Doran, K. (2011;2013). Alderson, A. S., Beckfield, J., & Nielsen, F. (2005) Alichì A, Katenga K and J Solé (2016), Anderson, G., Linton, O., & Leo, T. W. (2012). Borraz, F., Pampillon, N. G., & Rossi, M. (2011). Chakravarty, S. R. (2015) Chakravarty, S. R., and D'Ambrosio, C. (2010). Chakravarty, S. R., and Majumder, A. (2001). Clementi, F., and Schettino, F. (2015), Conti, P. L., Pittau, M. G and Zelli, R. (2006). Duclos, J.-Y., Esteban, J.-M., & Ray, D. (2004) Esteban, J.-M., & Ray, D. (1994). Esteban, J.-M., & Ray, D. (1999). Esteban, J.-M., & Ray, D. (2011). Esteban, J.-M., Gradin, C., & Ray, D. (2007). Foster JE and MC Wolfson, (1992) Gradin, C. (2000). Handcock, M. S. (2011) Handcock, M. S. and Morris, M. (1998) Handcock, M. S. and Morris, M. (1999). James and Khan (1993, 1997, 1998).

deserves deeper scrutiny using the method of studying polarization via relative distribution to which we now turn.¹⁴

4. The Relative polarization method

In the current application, the *relative distribution* approach has some important advantages as a method to investigate income polarization. First, it readily lends itself to simple and informative graphical displays of relative data that reveal precisely how and to which extent an income distribution has changed over time. Second, by providing the potential for decomposition into location and shape components, it allows one to examine several hypotheses regarding the origins of distributional change. Actually, two extreme cases are theoretically possible in the income distribution change pattern from time 0 to time 1. In the first one, there is a homogeneous absolute subtraction or addition to all incomes, that moves the overall distribution either to the left or to the right, while leaving its shape unaltered. In the second case, the mean income is the same in time 1 and time 0, and only the shape of the distribution changes (without any location shift). Of course, in the real world, both location and shape effects – named respectively as “growth” and “inequality” (or “distributional”) effect (Kakwani, 1993; Bourguignon, 2003, 2004, Khan, 1996, 2003, 2004, 2006, 2017; Picketty 2014; Khan and Thorbecke 1988, 1989; Khan, Schettino and Gabriele, 2017) – jointly concur to produce the distributional change. However, this technique conveniently allows to disentangle and quantify the polarization effect due to changes in distributional shape only (i.e., net of location shifts), thus enabling researchers to properly identify a location-independent dimension of intertemporal distributional dynamics-inequality that would not otherwise be identified as such. Clearly, this analytical advantage is particularly relevant when studying the evolution of polarization in a country undergoing very fast economic development, and therefore characterized by a very rapid growth of the median income, as it is the case for China.

The relative distribution method can be applied whenever the distribution of some quantity across two populations is to be compared, either cross-sectionally or over time.¹⁵ To proceed, it is necessary to single out one of the two populations, refer to it as the “comparison” population, and refer to the other as the “reference” population. More formally, let Y_0 be the income variable for the reference population and Y the income variable for the comparison population. The relative distribution of Y to Y_0 is defined as the distribution of the random variable:

$$R = F_0(Y), \quad (1)$$

which is obtained from Y by transforming it by the cumulative distribution function of Y_0 , F_0 . As a random variable, R is continuous on the outcome space $[0,1]$, and its realizations, r , are referred

¹⁴ Some earlier work exploring this is important. See Jenkins (1995, 1996).

¹⁵ Here we limit ourselves to illustrating the basic concepts underlying the relative distribution method. Interested readers are referred to Handcock and Morris (1998, 1999) for a more detailed explication and a discussion of its relationship to alternative econometric methods for measuring distributional differences.

to as “relative data.” Intuitively, the relative data can be interpreted as the set of positions that the income observations of the comparison population would have if they were located in the income distribution of the reference population. The probability density function of R , which is called the “relative density,” can be obtained from the ratio of the density of the comparison population to the density of the reference population, evaluated at the relative data r :

$$g(r) = \frac{f(F_0^{-1}(r))}{f_0(F_0^{-1}(r))} = \frac{f(y_r)}{f_0(y_r)}, \quad 0 \leq r \leq 1, \quad y_r \geq 0, \quad (2)$$

where $f(\cdot)$ and $f_0(\cdot)$ denote the density functions of Y and Y_0 , respectively, and $y_r = F_0^{-1}(r)$ is the quantile function of Y_0 . The relative density has a simple interpretation, as it describes where households at various quantiles in the comparison distribution are concentrated in terms of the quantiles of the reference distribution. As for any density function, it integrates to 1 over the unit interval, and the area under the curve between two values r_1 and r_2 is the proportion of the comparison population whose income values lie between the r_1^{th} and r_2^{th} quantiles of the reference population.

When the relative density function shows values near to 1, it means that the two populations have a similar density at the r^{th} quantile of the reference population, and thus R has a uniform distribution in the interval $[0,1]$. A relative density greater than 1 means that the comparison population has more density than the reference population at the r^{th} quantile of the latter. Finally, a function less than 1 indicates the opposite. In this way, one can distinguish between growth, stability, or decline at specific points of the income distribution.

As we have said before, one of the major advantages of this method is the possibility to decompose the relative distribution into changes in location, usually associated with changes in the median (or mean) of the income distribution, and changes in shape (including differences in variance, asymmetry and/or other distributional characteristics) that could be linked with several factors like, for instance, polarization. Formally, the decomposition can be written as:

$$g_t(r) = \frac{f(y_r)}{f_0(y_r)} = \frac{f_{0L}(y_r)}{f_0(y_r)} * \frac{f_t(y_r)}{f_{0L}(y_r)} \quad (3)$$

where $f_{0L}(y_r) = f_0(y_r + \rho)$ is a density function adjusted by an additive shift with the same shape as the reference distribution but with the median of the comparison one.¹⁶ The value ρ is the difference between the medians of the comparison and reference distributions. If the latter two

¹⁶ Median adjustment is preferred here to mean adjustment because of the well-known drawbacks of the mean when distributions are skewed. A *multiplicative* median shift can also be applied. However, the multiplicative shift has the drawback of affecting the shape of the distribution. Indeed, the equi-proportionate income changes increase the variance, and the rightward shift of the distribution is accompanied by a flattening (or shrinking) of its shape (see e.g., Jenkins and Van Kerm, 2005).

distributions have the same median, the density ratio for location differences is uniform [0,1]. Conversely, if the two distributions have a different median, the “location effect” is increasing (decreasing) in r if the comparison median is higher (lower) than the reference one. The second term, which is the “shape effect,” represents the relative density net of the location effect and is useful to isolate movements (re-distribution) occurring between the reference and comparison populations. For instance, we could observe a shape effect function with some sort of (inverse) U-shaped pattern if the comparison distribution is relatively (less) more spread around the median than the location-adjusted one. Thus, it is possible to determine whether there is polarization of the income distribution (increases in both tails), “downgrading” (increases in the lower tail), “upgrading” (increases in the upper tail) or convergence of incomes towards the median (decreases in both tails).

The relative distribution approach also includes a *median relative polarization* index (MRP), which is based on changes in the shape of the income distribution to account for polarization. This index is normalized so that it varies between -1 and 1, with 0 representing no change in the income distribution relative to the reference year. Positive values represent more polarization – i.e., increases in the tails of the distribution – and negative values represent less polarization – i.e., convergence towards the center of the distribution. The MRP index for the comparison population can be estimated as (Morris et al., 1994, p. 217):

$$\text{MRP} = \frac{4}{n} \left(\sum_{i=1}^n \left| r_i - \frac{1}{2} \right| \right) - 1, \quad (4)$$

where r_i is the proportion of the median-adjusted reference incomes that are less than the i^{th} income from the comparison sample, for $i = 1, \dots, n$, and n is the sample size of the comparison population.

The MRP index can be additively decomposed into the contributions to overall polarization made by the lower and upper halves of the median-adjusted relative distribution, enabling one to distinguish downgrading from upgrading. In terms of data, the *lower relative polarization* index (LRP) and the *upper relative polarization* index (URP) can be calculated as follows:

$$\text{LRP} = \frac{8}{n} \left[\sum_{i=1}^{n/2} \left(\frac{1}{2} - r_i \right) \right] - 1, \quad (5)$$

$$\text{URP} = \frac{8}{n} \left[\sum_{i=n/2+1}^n \left(r_i - \frac{1}{2} \right) \right] - 1, \quad (6)$$

with $\text{MRP} = \frac{1}{2}(\text{LRP} + \text{URP})$. The MRP, LRP and URP range from -1 to 1, and equal 0 when there is no change.

Using this method we are able to discover some significant trends with respect to the evolution of the middle class in the US during the recent decades. We now turn to a discussion of these major empirical findings.

5. Main Empirical Results

In this section we present the principal results of the polarization analysis using the PSID data set. We estimated the evolution of the variable per capita HH income. The traditional measures of income polarization---e.g., Foster and Wolfson (1992) and Duclos et al., (2004),¹⁷ ---substantially confirm the last decade's worsening trend of income distribution (see also Figure 1). It seems that, similar to the case of inequality indices, the peak has been reached in the mid-2000s decade, and in the last years of the Obama administration, a reduction, albeit slight, is detectable.

We now go deeper in the polarization analysis, using the Relative distribution tools (Handcock & Morris, 1998 and 1999) that we have previously presented. The main advantage, as compared to the other measures, consists in the fact that by comparing two different distributions at a time, it is possible to extract two different aspects of the polarization process. The first one can be considered as the "growth" effect (the location component). The second represents the "pure distributional" effect (the shape component). As a consequence, following the interpretation given by Clementi and Schettino (2015) and Clementi et al., (2015), the application of this methodological tool permits one to analyze what is "hidden behind" the overall evolution of structure of the distribution shape that was also affected by the overall growth of the US economy.

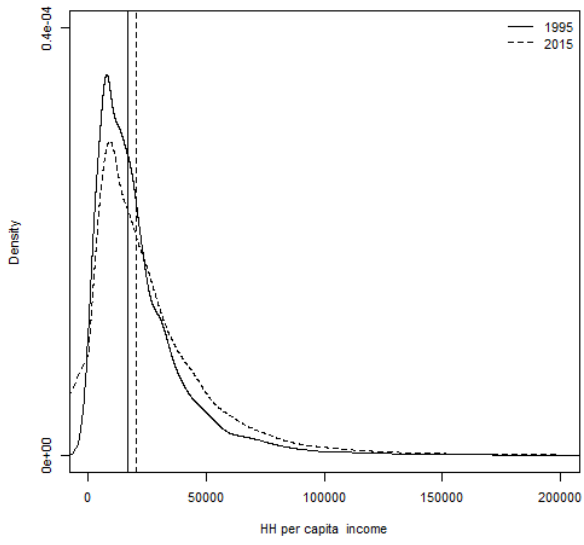
The flexibility of RD tools joint with a big dataset (PSID) availability gives us the possibility of provide different results in relation to the temporal scenario we want to analyze.

In Figure 3, we present the first one, that is, the main outcomes of RD analysis over the last twenty years. The top left graph shows the Kernel densities of the Reference and Comparison Distribution, highlighting also the difference in terms of median income. The top right histogram instead shows the overall result in terms of RD. Remembering what we sketched out in previous Chapters it is possible to note that in the considered period, a hollowing out of the first deciles has been counterbalanced by the fattening of the richest three. In other word, on average, in the last 20 years American households increased their wealth. Anyway, the method that we adopted gives us the chance to split this overall effect in two other ones. The first, Location effect, that should be considered as the growth effect. The second, the Shape effect, that represents the "pure" distributional changes, that are captured by the RP indices. The results are quite impressive: depurating the overall effect by the growth one a significant (relative) income polarization emerges. In other words an evident hollowing out of the mid-range deciles, counterbalanced by the fattening of the poorest decile (principally) and the richest two, is detectable.

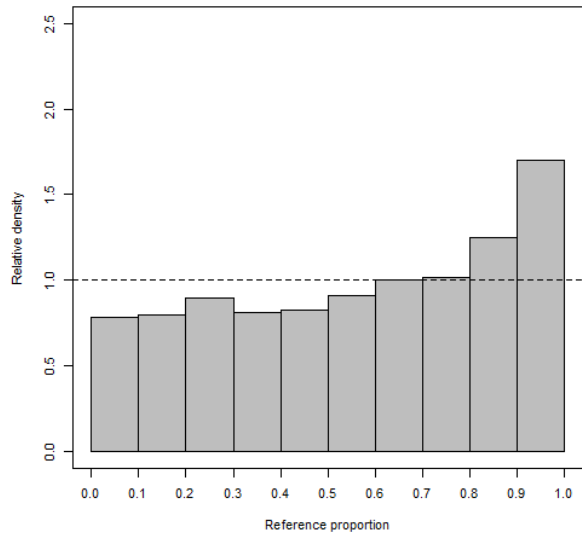
Figure 2 - Relative distribution in last decades (1995-2015)

¹⁷ Both the indices have been calculated using DASP: Distributive Analysis Stata Package, Araar & Duclos, 2009. DER index has been calculating with $\alpha=0.5$.

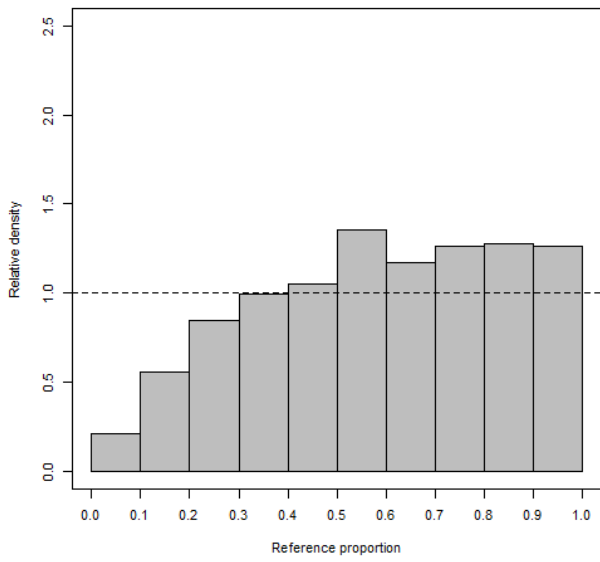
Kernel densities



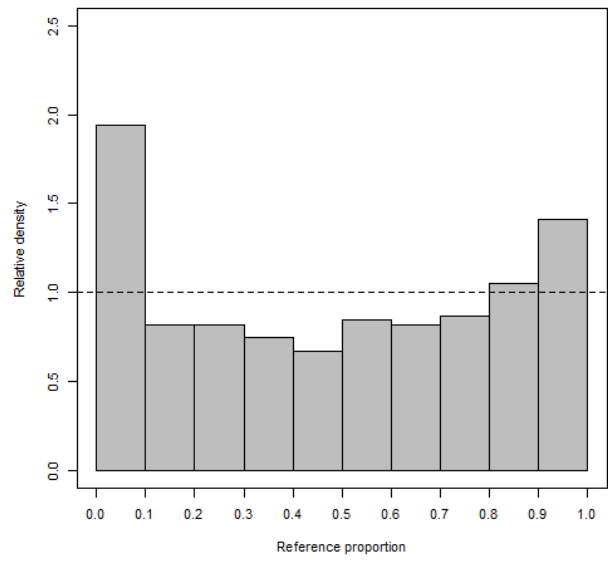
Relative distribution



Location effect



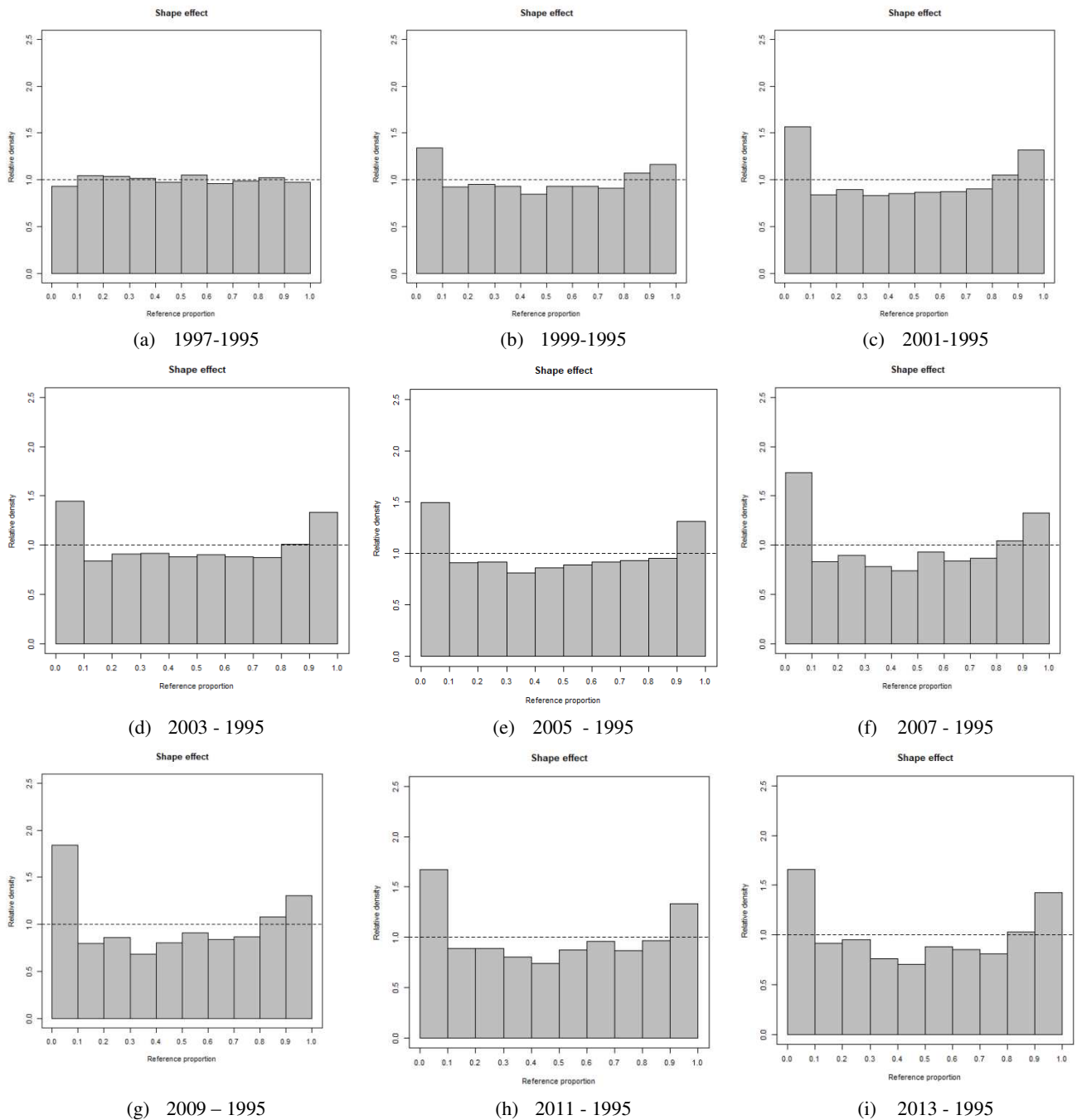
Shape effect

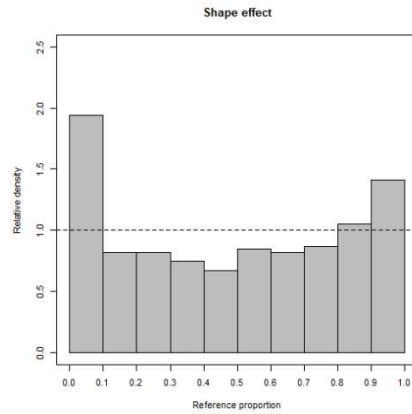


In Figure 3, we go deeper in the previous analysis, calculating the Shape effect – that is the main core of RP analysis and of our investigation – using the same Reference distribution (1995) while moving towards the most recent one the Comparison one.

From Subgraph (a) to Subgraph (l) the story of an increasing (relative) polarization is well described. In fact, especially from the beginning of the millennium, a worsening of the income distribution is clearly appearing. Thus, taking into account the last two decades we can sustain the process of (relative) polarization – that is the hollowing out of the middle class – has increased its effect during the whole period and, particularly, after the turning point of the new century. Figure 4, finally provide a 3d point of view of the *phenomenon* substantially confirming the previous results.

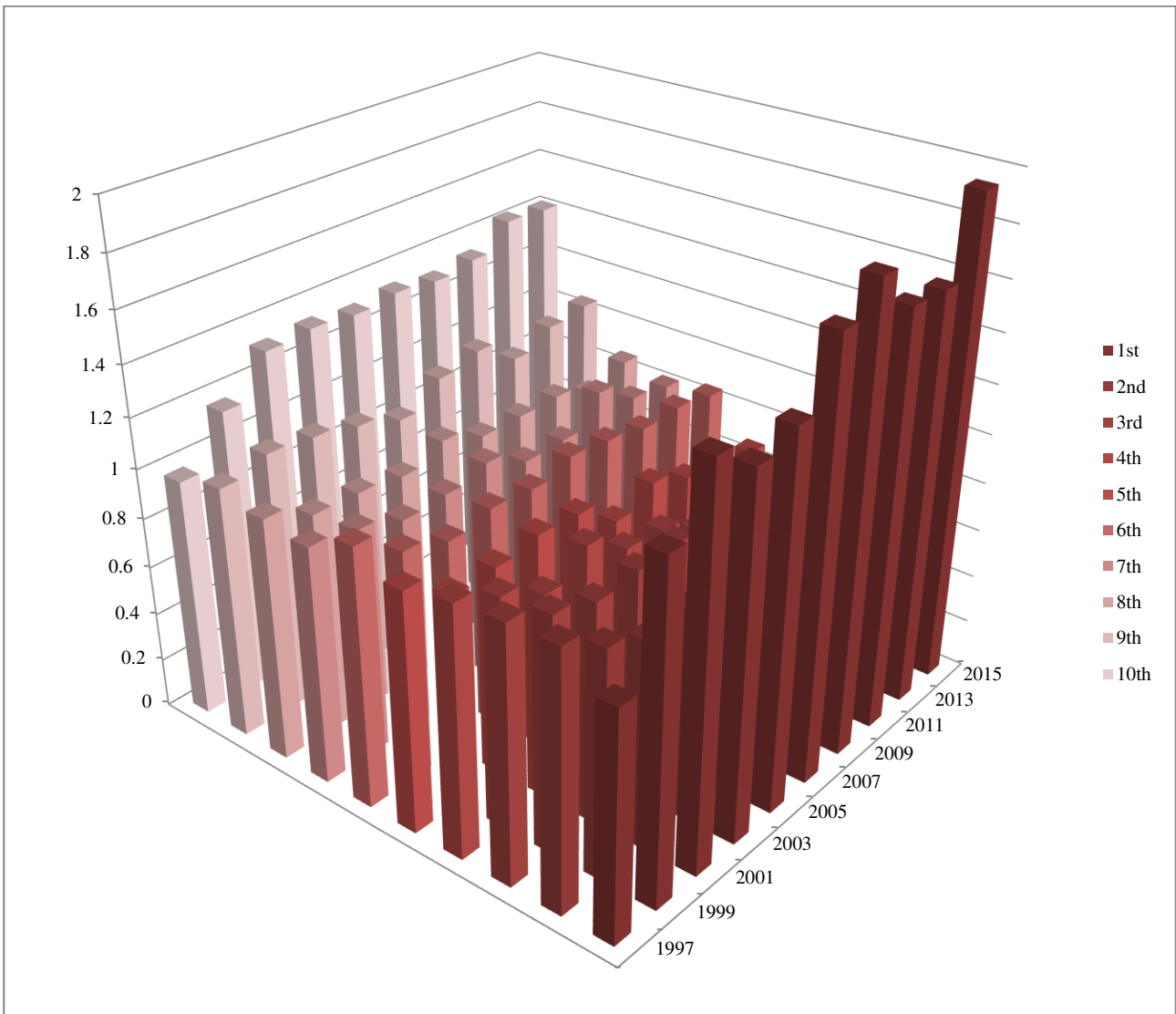
Figure 3 – Shape effects (Reference Distribution 1995)





(I) 2015 - 1995

Figure 4 - Trend of Shape Effect by year (Reference Distribution 1995)



Thus, the polarization trend is confirmed in the period as a whole (see Figures 2 to 4). It is important to note that the decreasing trend of MRP-LRP-URP is due to the fact that the more the

reference year is close to the comparison one, the lower is the polarization degree.¹⁸ Overall, for each reference year the analysis confirms the fact that the MRP is principally driven by the LRP. *In other words, in the considered period the US middle class has moved mainly to the lower deciles of the distribution.* However, this “pure distributional” effect has been somewhat mitigated by the GDP growth. But the level of mitigation is surprisingly small. The Shape effect change in the period, as a whole shows this. From a sociological and economic point of view, it shows the hollowing out movement of the middle class; at the same time, a significant tendency towards polarization on the top and bottom deciles of the distribution is also confirmed.

The last three figures are able to give other points of view of the relative polarization. Figure 5 describes the biennial trend of the Polarization indices. In other words we calculate that indices using very timely close distributions (from 1997-1995 to 2015-2013) Notwithstanding the fact that two years should be a short period to capture structural distribution movement, we can see that in 8 cases (on 12) the polarization is increased.

Figure 6 and 7 provide another picture of the RP trend considering in the first case the 1993 as the reference distribution, while in the other, the 1983 is selected. In both cases an impressive increase of the MRP – LRP’s driven – is described. Indeed, concluding, these other two points of view are able to confirm once more that the hollowing out of the middle class has moved principally towards the lower deciles.

Figure 5 – Polarization Indices (LRP, MRP, URP): Biennial trend

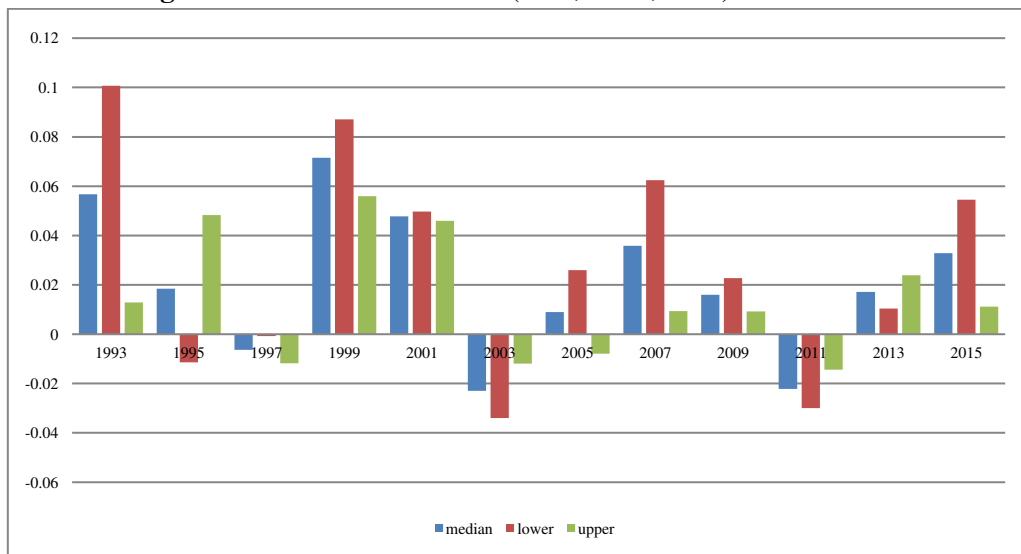


Figure 6 – Polarization Indices (LRP, MRP, URP) – Reference Distribution year 1993

¹⁸ Relevant distributional changes occur normally in a medium/long period.

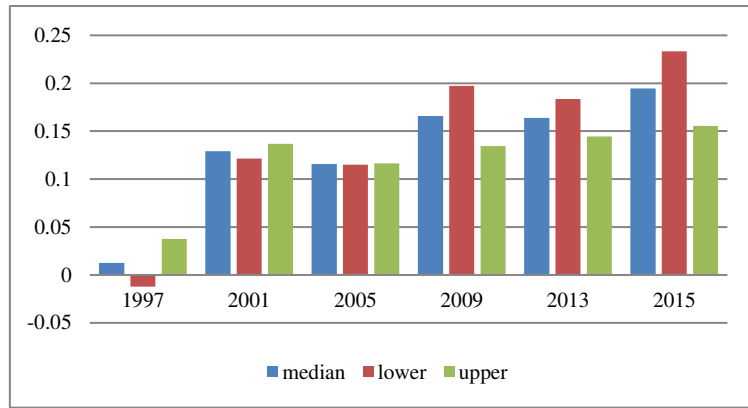
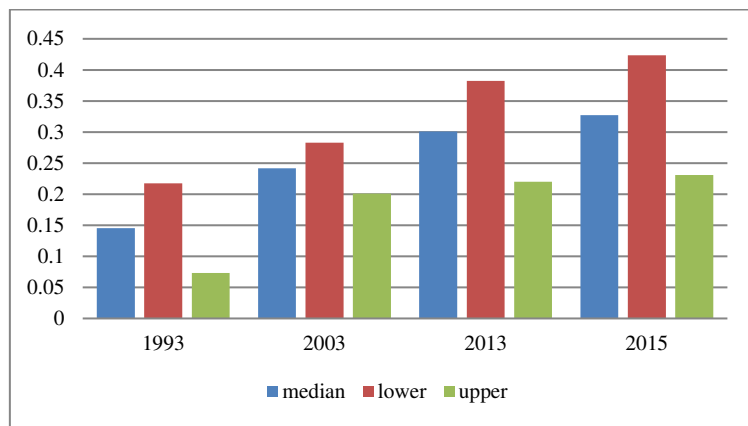


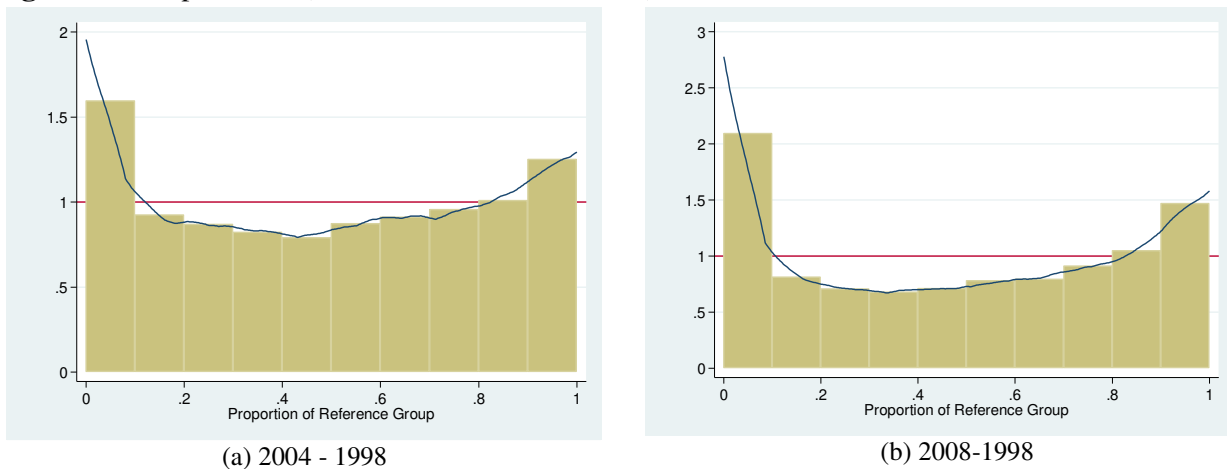
Figure 7 – Polarization Indices – Reference Distribution year 1983



5.1 Robustness Check

In order to provide a robustness check to the previous results we run the Relative Distribution method to the Current Population Survey data provided by the United States Census Bureau¹⁹. Figure 8 and 9 summarize the main results.

Figure 8 – Shape effects (Reference Distribution 1998)



¹⁹ We use the March Supplement Data from 1998 to 2016. For further details see https://thedataweb.rm.census.gov/ftp/cps_ftp.html#cpscert

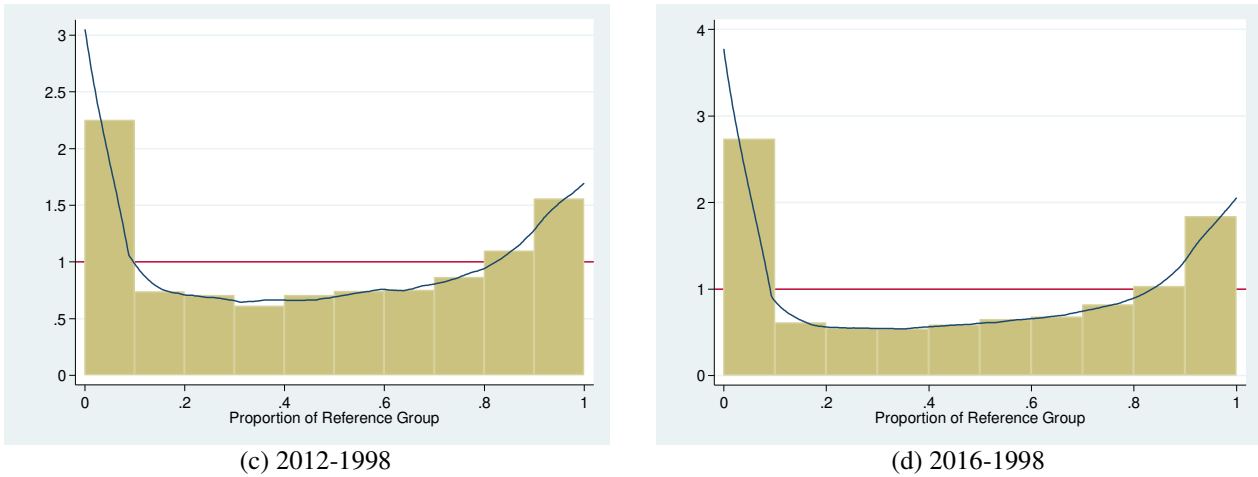
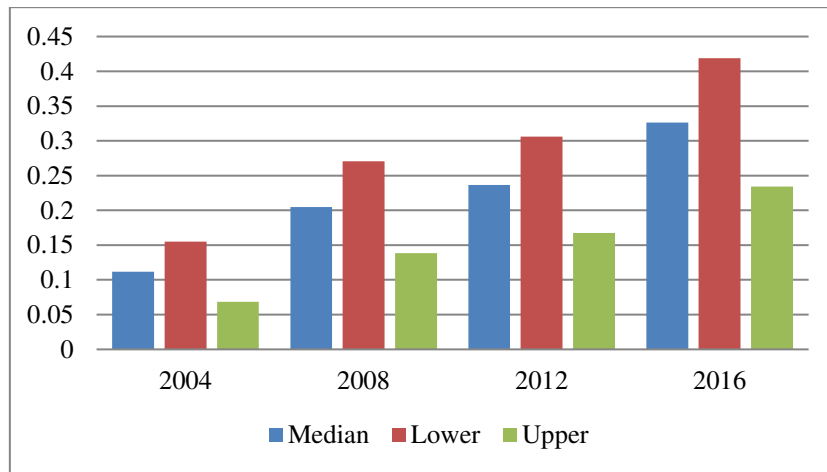


Figure 9 – Polarization Indices – Reference Distribution year 1998



The similarities with the figures presented in the previous Section are impressive. That clearly confirm the trends we discussed formerly. In other word, at least in the last two decades a significant tendency to the hollowing out of the American middle class is profoundly modifying the US economic and social structure.

6. Covariates analysis

As with location and shape decomposition, it is possible to adjust the relative distribution for changes in the distribution of other covariates. The covariate adjustment technique can be used to separate the impacts of changes in population composition from changes in the covariate-response relationship. This decomposition according to covariates draws on the definition of a counter-factual distribution for the response variable in the reference population that is *composition-adjusted* to have the same distribution of the covariates as the comparison population.

Assume for simplicity that the covariate Z is categorical.²⁰ Let $\{\pi_k^0\}_{k=1}^K$ and $\{\pi_k^t\}_{k=1}^K$, where K is the number of categories of the covariate, denote the probability mass functions of Z for the reference and comparison populations, i.e. their composition according to the covariate. For conditional comparisons of the response variable Y across the two populations one can consider the density of Y_0 given that $Z_0 = k$,

²⁰ The extensions to continuous and multivariate covariates are considered in Handcock and Morris (1999: ch. 7).

$$f_{Y_0|Z_0}(y|k), \quad k=1, \dots, K, \quad (7)$$

and the density of Y_t given that $Z_t = k$,

$$f_{Y_t|Z_t}(y|k), \quad k=1, \dots, K. \quad (8)$$

These densities represent the covariate-response relationship. The marginal densities of Y_0 and Y_t can be written, respectively, as

$$f_0(y) = \sum_{k=1}^K \pi_k^0 f_{Y_0|Z_0}(y|k) \quad (9)$$

and

$$f_t(y) = \sum_{k=1}^K \pi_k^t f_{Y_t|Z_t}(y|k). \quad (10)$$

Then, the counter-factual distribution with the covariate composition of the comparison population and the covariate-response relationship of the reference population is

$$f_{0,c}(y) = \sum_{k=1}^K \pi_k^t f_{Y_0|Z_0}(y|k), \quad (11)$$

and can be used to decompose the overall relative distribution into a component that represents the effect of changes in the marginal distribution of the covariate (the “composition effect”) and a component that represents the residual changes (the “residual effect”). The decomposition can be represented in the following terms

$$g_t(r) = \frac{f(y_r)}{f_0(y_r)} = \frac{f_{0,c}(y_r)}{f_0(y_r)} * \frac{f_t(y_r)}{f_{0,c}(y_r)}$$

Comparison of $f_t(y)$ to $f_{0,c}(y)$ – i.e, the residual effect – holds the population composition constant, and therefore isolate differences in the covariate-response relationship (changes of income distribution due to the fact that returns to the selected covariate changed over time). By contrast, $f_{0,c}(y)$ and $f_0(y)$ have the same covariate-response relationship, and the comparison between them – i.e, the composition effect – isolate the changes due to the different composition of the population under the assumption that the conditional distribution of income remain unchanged.

In order to provide a more exhaustive analysis, we decompose the detected polarization by household features (gender, race and education), applying the covariate adjustment technique directly on the overall residual effect, following the methodology suggested by Clementi and Schettino (2015).

Table 1 – Descriptive Statistics by Covariate (1983-2015)

		1983	2015	1983	2015	1983	2015	1983	2015
Gender	Male	70.15%	67.08%	24,651.12	39,007.2	0.42	0.45	0.24	0.26
	Female	29.85%	32.92%	18,362.24	29,156.9	0.43	0.46	0.25	0.26
Race	White	59.47%	55.63%	24,269.51	38,695.2	0.41	0.48	0.24	0.26
	Not White	40.53%	44.37%	14,142.5	25,650.15	0.47	0.50	0.27	0.28

Education	At least completed High-School	65.51%	84.48%	26,304.81	38,705.57	0.40	0.44	0.24	0.25
	Less than High School	34.49%	15.52%	14,200.02	16,961.26	0.40	0.45	0.24	0.25

Figure 10 – Non-White Household Head’s families RD results (1983-2015)

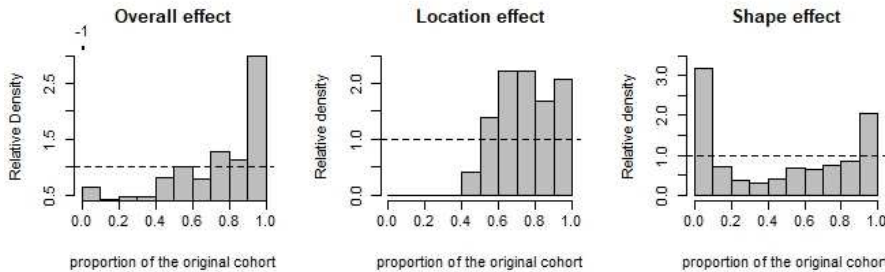


Figure 10 clearly depicts that the population subgroup composed by not-white household head suffered in the period a strong (relative) polarization (confirming the national trend) driven principally by the LRP. This confirms also the DER results (Table 1). In other terms, during the considered period the hollowing out of the middle deciles fattened the lowest decile and, with lower intensity, the top 10%. Using the covariates analysis we can evaluate the effect of the race composition change on the income relative polarization from 1983 to 2015.

Figure 11 – RD Distribution results – covariate: HH Race

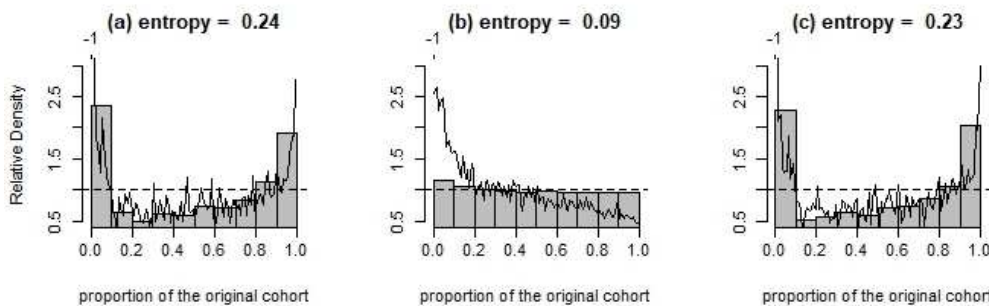
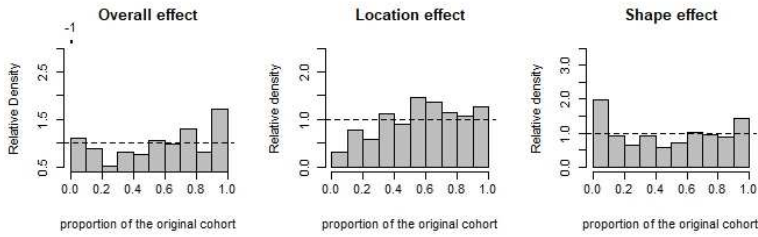


Table 1 shows that in the last 20 years the not-white HH families increased by almost 5%. As we can see in Figure 11, the overall effect in the absence of composition change (graph c) would not differ in terms of the overall shape (graph a). The calculated entropy index tells us that the composition change increased the overall entropy and, as a consequence, the overall relative polarization. In fact, the calculated entropy in the absence of composition change (Graph c, 0.23) is inferior to the overall one (Graph a, 0.24).

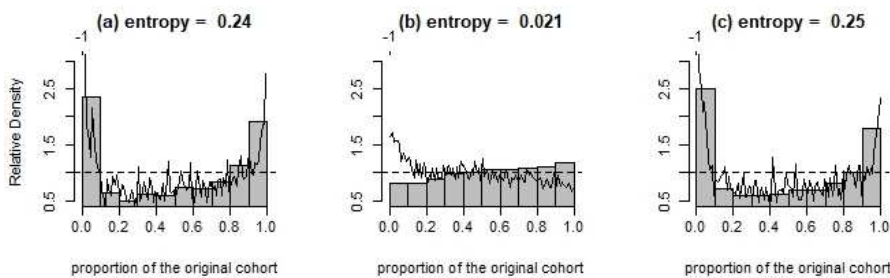
We employ the same methodology using Education and Gender covariates. Apropos of the latter, we split the sample into two groups. The first is composed by HHs having an education degree higher or equal to high school. The second includes the others. Table 1 shows that the share of more educated persons increased in the last 30 years.

Figure 12 – Less than High School Educated Household Head - RD results (1983-2015)



Also in this case, the less educated HH families lived during the considered period an important polarization. Especially for what concerns the fattening of lowest deciles, confirming the same trend of race covariate.

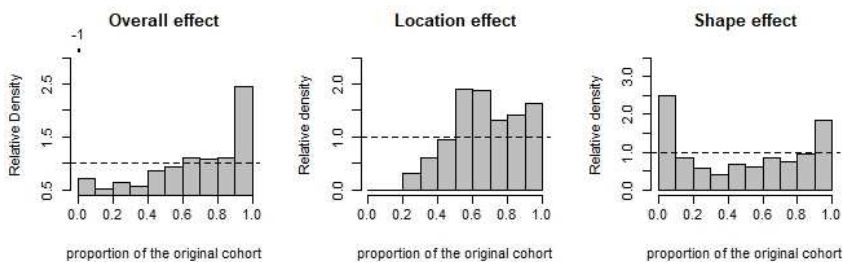
Figure 13 – RD Distribution results – covariate: HH Education



Differently than the case of Race variable, the increasing level of education reduced the impact of polarization in the US society. In fact, as we can see in Figure 13, in absence of composition change of the proportions (Graph c) the correlated entropy index (0.25) should be higher than the one calculated taking it into consideration (Graph a, 0.24). This effect is also detectable observing Graph b that clearly shows a mitigation of the overall relative polarization.

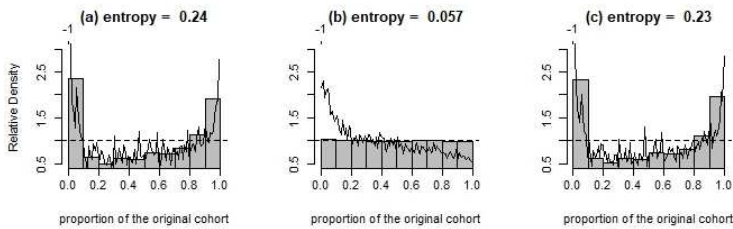
Finally, we check for Gender variable. Figure 14 shows the results in terms of RD highlighting in this case the existing polarization between the Female Household Head families.

Figure 14 – Female Household Head - RD results (1983-2015)



In the considered period we did not observe a strong composition change of households headed by male and female. In any case, the share of female headed households increased from 30% to 33%.

Figure 15 - RD Distribution results – covariate: HH Gender



As in the case of race, this (little) change increased the overall polarization, mainly in the lowest deciles. In fact the entropy calculated in absence of the composition change (Graph c, 0.23) is lower than the overall one (Graph a, 0.24).

The exercises of this Section helped us to highlight that there still exist an increasing gap in terms of gender and race also from a polarization point of view. On the other side a generally higher degree of education should act as a reducing factor for the polarization of income per capita.

7. Concluding Remarks

Since Reagan's election in 1980, and the inauguration of neoliberal policies, successive US administrations regardless of their party affiliations have launched a series of progressively deeper attempts to dismantle the welfare state and deregulate real and financial markets. In the 1990s, under Clinton, these actually accelerated and predictably inequality increased. The new post-new deal US socioeconomic system is still in transition but has become unstable since the 2007-8 crises.

The rapidly evolving polarization in the 1990s and the 21st century in particular has left its mark on the US middle class. Polarization, as opposed to inequality, has the characteristic of showing scientifically distinct distributional problems as features related to the formation, consolidation or the hollowing out of the middle class.

We studied the polarization features applying the Relative Distribution method (Handcock and Morris, 1998, 1999) using the well known PSID dataset from 1983 to 2015. The overall effect over time has been a movement of the majority of the population towards lower levels of income and a concentration of historically very high incomes at the top.

Summarizing, we can see that:

- Decomposing the overall effect in location and residual effect an income polarization profile clearly emerges in last 4 decades.
- The indices trend (mrp, lrp and urp) describe a monotonic increasing polarization in the considered period.
- The Median relative polarization index is driven mainly by the Lower Relative polarization index, demonstrating unambiguously the last 4 decade-long decline of the American Middle Class.

- Consistent results have been obtained employing the same methodology also on CPS Survey for the same period.
- Finally, decomposing the residual effect by covariates we assert that while the increasing number of non-white or female HHs increased the polarization, the opposite occurs in the case of the education degree of HHs.
- This makes evident the fact that the not-white and female economic discriminations are far to be resolved in the US, while the higher is the HHs' education degree, the lesser is tendentially polarized the income distribution.

The most important feature of the method we employ consists in the possibility of separating the overall effect in the location (growth) and shape ("pure distribution") of the statistical distributions. Following this methodological step, we obtain some new results that provide a novel interpretation of the US distributional inequalities in terms of the relative polarization indexes. The location effect shows that one part of the overall effect is due to the distribution's very moderate (median) right-shift, a consequence of the modest GDP growth of last decade(s). When excluding this growth-location effect, a typical polarization profile emerges. This is nothing other than the so-called shape effect. More specifically, the typical hollowing out of the central deciles of the distribution in the US has been indeed accompanied by "fattening" of both tails of income distribution.

Thus, the method we employed enabled us to examine critically the idea that the US middle class has declined in economic terms. This will have serious socio-political implications since many members of this class are being driven now to the bottom deciles of the distribution with resulting disorientation and resentment---particularly among the whites. As a consequence, and especially if there is another financial and economic crisis, unless countervailing distributional policies are undertaken, polarization will reveal itself more sharply. This will lead to even more intense distributional conflicts with racist and sexist overtones. There will consequently be related political polarization and conflicts in the US. With the 2016 elections, the polity is already at the initial stages of such conflicts. The future evolution of US distributional politics is uncertain but without doubt it will be intensely conflictual with unpredictable political consequences.

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