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Relative income distribution in six European countries: market and disposable income*

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Abstract

The relationship between income inequality and polarization is an empirical fact: a change in equality might occur together with a change in polarization. At the same time, polarization might emerge while inequality remains constant. The outcome of this process entails relevant information about the evolution of the income distribution. We exploit the LIS micro-data to perform a relative distribution analysis for six European countries. Our aim is to describe how both the market and the disposable income distributions evolved over time. The results indicate that polarization increased in all the considered countries, being the largest in the United Kingdom and the smallest in Italy. At the beginning of the period the relative polarization of disposable income is lower than the one for market income. Over time, however, this pattern is reversed. Nonetheless, in all the countries downgrading prevails over upgrading: the relevance of the middle-class getting poorer is larger than the one of the middle-class getting richer.

Keywords: Income distribution, polarization, inequality, relative distribution methods.

JEL codes: C14, D31, D63, I32.

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1. Introduction

We apply the relative distribution analysis (Handcock and Morris, 1999), a non-parametric approach to visualize and analyze differences in distributions, to compare a set of country income time series with a reference distribution, set to the most recent available information, that is 2010.¹ By doing so, we observe how the pattern of polarization changes over time, namely if the past distributions were more or less polarized than the most recent one and decompose the "growth effect" from the "distributional effect" (Kakwani, 1993; Bourgouignon, 2003; 2004). We use the Luxembourg Income Study Database (LIS), which represents the most complete source of harmonized income information across countries and over time (Smeeding et al., 1985; Atkinson and Brandolini, 2001). The present analysis, therefore, significantly contributes to the current debate on income inequality and polarization mainly by providing results updated to 2010, that is the last LIS available survey data.

A second contribution is the analysis of the extent to which the government, through the welfare state design, affects the pattern of polarization. Following the literature (Milanovic, 2000; Scervini, 2012) we construct two measures of income, namely ex-ante (market) and ex-post (disposable) income, which differ because the latter includes taxation and transfers. Given that the LIS dataset has been restructured in 2011 and the old definitions of income do not apply mechanically to the new ones, this step updates the existing income series. The nature of the data, namely the specification of gross or net income deriving from the national sources, allows us to calculate disposable income in all the countries, but market income only in those countries for which data on gross income is available. Furthermore, as a third element of innovation of this paper, we consider both "monetary" and "monetary *plus* non-monetary" (that we label "total") sources of income, while the scholars so far employed only "monetary *plus* non-monetary" disposable income (Scervini, 2012).

Our main result is that past income polarization was lower than in 2010. In particular, we observe a slow convergence starting from the 1980s. At the beginning of the period the relative polarization of disposable income is lower than the one for market income: disposable income polarization was slightly lower than its level in 2010, while market income polarization was much smaller than its level in 2010. Over time, however, this pattern is reversed in those countries for which we have available data to compute both ex-ante and ex-post income. Hence, disposable income polarization significantly decrease from its level in 2010, whereas market income polarization increases and converges to its level in 2010. This evidence suggests an increasing effectiveness of the equalizing role of the welfare state, and a jump in disposable income polarization in 2010. This fact is consistent with the governmental response

¹ The most recent updated dataset is "France 2010", uploaded on the LIS website on November 26th, 2014. Source: <http://www.lisdatacenter.org/news-and-events/france-2010-added-to-the-lis-database/>.

to the Great Recession, which may have altered the equalizing aim of public finance instruments to face the economic downturn. Furthermore, in all the countries downgrading prevails over upgrading: the relevance of the middle-class getting poorer is larger than the one of the middle-class getting richer. Finally, the contribution of the lower tail of the distribution is always stronger than the one of the upper tail, again suggesting downgrading prevailing over upgrading.

The paper is organized as follows: Section 2 reviews the related literature, Section 3 describes the data and the methodology. Section 4 and Section 5 illustrate the results obtained by using respectively only the monetary and also the non-monetary income. Conclusions are drawn in Section 6.

2. Literature

Both income polarization and income inequality reflect the degree of alienation that individuals and groups feel from one another. Nonetheless, the concept of polarization is enriched with the dimension of within-group identity (Duclos et al., 2004). Beside the phenomenon of the groups' separation, special emphasis is devoted to their clustering. The notion that alienation must be complemented by a sense of identification is the milestone of the identification-alienation framework (Esteban and Ray, 1994), which is currently predominant in the literature.

While income polarization is negatively correlated with economic growth, the impact of inequality is not statistically significant (Brzezinski, 2013). Recent investigations of any short-run impact of income distribution on economic performance during the recent Great Recession failed to reach unambiguous conclusions (Agingen and Guger, 2013; Hellenbrandt, 2014). The correlation, therefore, seems to emerge in the long-run. This view is consistent with the long-run evolution of the middle-class consensus, which is commonly associated to better economic prospects (Easterly, 2001; Pressman, 2007). A closer look at today's polarization, therefore, might say something about the future economic potential of a country.

The scholars developed several measures of income polarizations that differ according to the grouping scheme applied to the income distribution. They are commonly divided into two main families. Specifically, the first one approaches the separation/clustering dilemma with arbitrary numbers of groupings (Esteban and Ray, 1994; Duclos, Esteban and Ray 2004, 2012; Reynal-Querol, 2002), while the latter sets the median income as a divide between only two-groups (Foster and Wolfson, 2010; Wolfson, 1994; Wang and Tsui, 2000). Cross-country applications of such measures provide partially contrasting results. While the Wolfson (1994) polarization measure draws a pattern of increasing income polarization (together with inequality) during the period 1960–2000 (Seshanna and Decornez, 2003), the ER measure

(Esteban et al., 1999) describes a curvilinear trajectory where a polarization increase is followed by a decrease in the most recent years (Duro, 2005). The limit of the use of an index lies in the loss of information regarding the income distribution. Some scholars proposed the application of distributional measures to illustrate how income distribution evolves over time. The change in the location of the curve, named "growth effect", might hide a variation in the shape, labeled "distributional effect" (Kakwani, 1993; Bourgouignon, 2003; 2004). One of the most commonly used methodologies in this field is the "relative distance" (Morris et al., 1994, 1995; Handcock and Morris, 1998) that we will implement in the empirical analyses.

The literature that studies inequality and polarization in the six countries that we consider suggests the presence of income polarization. The United Kingdom experienced the most severe inequality upswing observed since 1967 across the OECD countries (Alderson and Nielsen, 2002). The extended index of polarization introduced by Esteban et al. (2006) indicates a boom of polarization in 1986, followed by a stable pattern. Alderson et al. (2005) and Alderson and Doran (2005) apply distributional methods to the British income distribution over time. Alderson et al. (2005) analyze the period 1969-1999 and find a marked polarization: the middle class declines and both the top and the bottom of the income distribution simultaneously grow. While downgrading is more pronounced in Alderson et al. (2005), Alderson and Doran (2005) find that upgrading preceded downgrading in the period 1979-2004.

On the other hand, Germany experienced a modest decline in inequality (Alderson et al., 2005) and the extended index of polarization is stable over time, showing a slight reduction in the decade 1985-1995 (Esteban et al., 2006; Grabka and Frick 2008; Schmidt, 2002). The distributional analysis suggests the presence of a convergence pattern from the bottom to the center of the income distribution during the period 1973-2000 (Alderson et al., 2005), with downgrading dominating upgrading in the period 1981-2004 (Alderson and Doran, 2005).

A similar convergence pattern is reported for France from 1979 to 1994 (Alderson et al., 2005) but with a difference: inequality only modestly declined. This evidence is explained with the relative growth of the 10th decile: while the poorer were escaping poverty, the richer were getting richer.

Polarization in Italy is shaped by the downgrading of lower incomes acting against the location effect due to economic growth over time (Alderson et al., 2005; Massari et al., 2009; 2011). The net result is that "while households at the top of the distribution held on their positions and began to experience an upgrading of their incomes only in recent years, households at the poorest deciles lost ground" (Massari, 2009, page 14).

Alderson and Doran (2005) generalize the phenomenon of a middle class hollowing out also to transition countries. Poland, in particular, shows a modest increase in inequality and a mild

degree of polarization. In the years 1986-1994, when most of the structural reforms were implemented, upgrading preceded downgrading.

Gradin (2000) suggests a more detailed approach by specifying sub-populations. The main intuition is that inside a partition of the income distribution it is interesting to look at polarization within the partition only for those households with similar characteristics. His analysis of Spanish expenditures over the years 1973-1991 (Gradin, 2002) reveals the presence of a more complex picture: within each income partition the educational level drives polarization more than socio-economic variables.

It is worth noting that all the cited works measure inequality and polarization of disposable income, therefore their results refer to measures of income after taxation and transfers. However, redistribution policies affect polarization. In particular, they should be able to smooth the curve and lower the local maximum points in order to achieve more equal distributions. The role of the welfare state is a relevant determinant of the income distribution during the Great Recession (Hellenbrandt, 2014) and it would be interesting to check how much polarization is affected by the government intervention. The empirical literature of political economy focusing on the median voter theorem (Milanovic, 2000; Scervini, 2012) is, to the best of our knowledge, the only one discussing both ex-ante (market) and ex-post income (disposable) series and their Gini coefficients. Despite their failure to unambiguously support the theorem, they both show a decreasing strength of the middle class. Since this branch of the literature is the empirical starting point for our work, a more detailed discussion of the methodological approach at measuring both ex-ante and ex-post income is provided in the Appendix A.

3. Data and methodology

We use the Luxembourg Income Study Database (hereafter LIS) which includes both household and personal microdata for a large number of high- and middle-income countries. The potential of LIS rests in the availability of information in an harmonized shape covering several decades.

Nonetheless, one must note that the LIS microdata are based on country surveys and do not include the same units over time. Hence, they cannot be used for longitudinal analysis, but they still provide a rich source of information for comparing results across multiple time points because of the harmonization process carried out by the LIS. The limitations refer to the nature of secondary data, which make them available depending upon the original source, that is the institution that conducted the survey (e.g. the UK Data Archive, the Polish Central Statistical Office, the Bank of Italy, and so on). In particular, some surveys report gross income, that is before taxes and mandatory employee social contributions

are deducted. Other sources measure income after deductions, that is net income. The type of the dataset, either gross or net, determines the possibility to compute both ex-ante and ex-post income (gross dataset) or only ex-post income (net dataset).

We follow the specification of market income in Milanovic (2000, page 373): "*Factor income is defined as pre-transfer and pre-tax income, and includes wages, income from self-employment, income from ownership of physical and financial capital, and gifts. Factor income P includes, in addition, public pensions. The reason for including pensions along with the usual factor incomes is that pensions are specific transfers that do not respond to current contingencies, and are not paid with the objective of redistributing income. Pensions are, of course, deferred wages, with some redistribution component. By treating pensions as factor income, we can better focus on other social transfers such as unemployment benefits, family allowances, and social assistance that have a clearer redistributive function. Gross income is equal to factor income plus all government cash transfers. Disposable income is equal to gross income minus direct personal taxes and mandatory employee contributions*".

While the literature usually employs total amounts (Scervini, 2012), we separately compute income using only monetary amounts or total amounts. The details of the computation are provided in Appendix A. A graphical comparison between the Gini index computed using our approach with those presented in Scervini (2012) is shown in Appendix B. In general, we find a good match between the two series, both for ex-ante and ex-post income, therefore we are confident in the comparability of our series with the existing ones. To compare the series over time we must deflate the LIS income variables,² and convert the older currencies into the 2010 one.³

The relative distribution is a non-parametric approach to perform distributional analysis of group differences (Bernhardt et al. 1994 and 1995; Handcock and Morris 1998, 1999). It has been widely adopted in the literature and recently applied also to less developed countries (e.g. Nigeria, see Clementi et al., 2014). For a comprehensive description of the methodology please refer to Handcock and Morris (1999); in this Section we present a short illustration of the intuition behind the methodology, which we tailor on our application.

Let Y_0 be income (either ex-post or ex-ante income) in the reference group, that we set to the year 2010. We choose 2010 because it is the year of the latest available survey in all the six countries we consider. Let Y_t be income in the comparison group, where t is the year of the

² We use the GDP deflator on: <http://www.indexmundi.com/facts/country/gdp-deflator>. The real value is computed as the ratio between the nominal value and the GDP deflator. Since the source reports deflators based on 2005 and we are interested in those based on 2010, we apply the deflator base change: $I_{2010} = 2005 I_{2010} / 2005 I_t$, where t is the year under consideration.

³ Except for the United Kingdom, in fact, all the six countries changed currency over time. Germany, France, Spain and Italy moved to Euro in 2002; Poland introduced the "new zloty" in 1995, following the dramatic devaluation of its national currency, the "old zloty".

comparable survey.⁴ The relative distribution is "*the ratio of the fraction of households in the baseline year to the fraction of households in the comparison year in each decile of the distribution of income*" (Alderson et al., 2005).

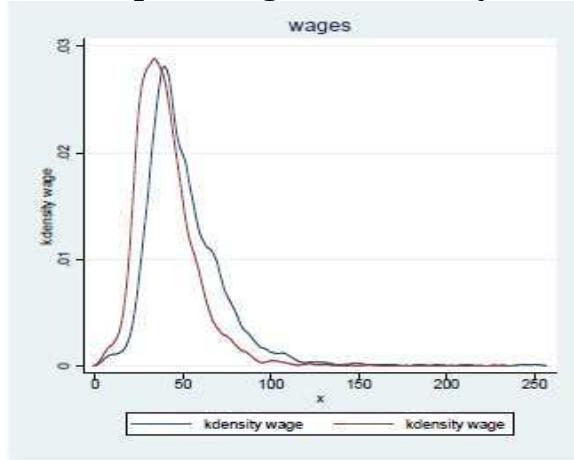
First, one must derive the density function of the relative data:

$$g(r) = f(F_0^{-1}(r))/f(F_t^{-1}(r)) \quad [1]$$

where $F_0(Y)$ is the cumulative distribution function of Y_0 , $F_t(Y)$ is the cumulative distribution function of Y_t , $f_0()$ and $f_t()$ are the density functions of Y_t and Y_0 , and r ranges from 0 to 1. To give an interpretation, the relative density at percentile p of Y_0 is the distance between $f_0()$ and $f_t()$. Such a distance is based on the fact that the distribution in 2010 shifted leftward or rightward after an overall increase or decrease of income. The most plausible case is a rightward shift motivated by economic growth. This component is named "location effect". The distance, however, might also depend on the curvature of the distribution that might emphasize or smooth some peaks along the percentiles. The peaks captures polarization, and this component is named "shape effect". The two effects are obtained by applying a decomposition to the relative distance and their product results in the "overall effect".

Graph 1 depicts the wage distribution by gender in Jann (2008).⁵ The red curve is for women, the blue one is for men. As we can see, the distribution from $x=0$ to $x=50$ is lower for men than for women: among the lowest earners there are more women than men.

Graph 1. Wage PDF overlays



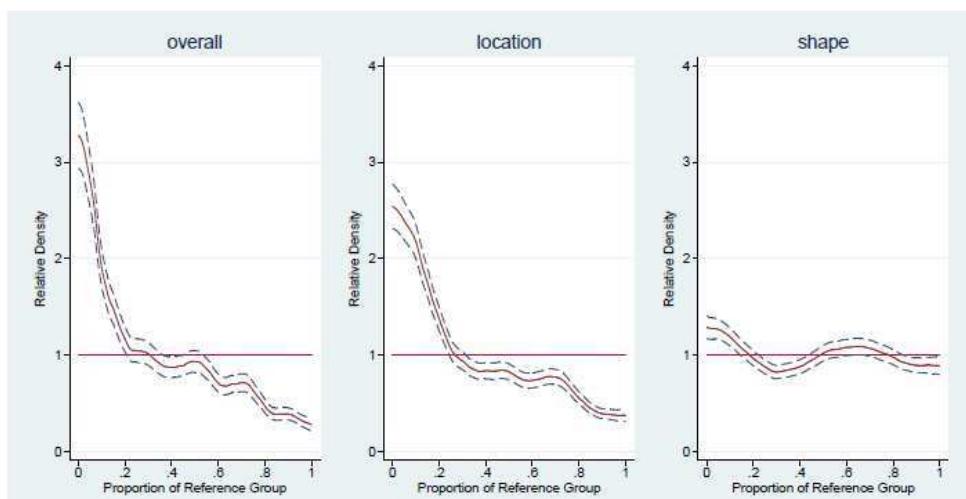
Source: Jann (2008)

⁴ Specifically: United Kingdom $t=(1969, 1974, 1979, 1986, 1991, 1994, 1995, 1999, 2004, 2007)$; Germany $t=(1973, 1978, 1981, 1983, 1984, 1989, 1994, 2000, 2004, 2007)$; France $t=(1978, 1984, 1989, 1994, 2000, 2005; 2010)$; Spain $t=(1980, 1985, 1990, 1995, 2000, 2004, 2007)$; Italy $t=(1985, 1987, 1989, 1991, 1993, 1995, 1998, 2000, 2004, 2008)$; Poland $t=(1986, 1992, 1995, 1999, 2004, 2007)$.

⁵ Data are from the Swiss Labor Force Survey 1991-2006 by the Swiss Federal Statistical Office, and refer to 2006.

The relative distribution is built by setting the proportion of units of the reference group, that is men, equal to one for each quintile of the distribution. The relative distribution is illustrated in the panel "overall" of Graph 2. The red curve is the women's relative distribution, and the dotted blue lines delimit its confidence interval. The "overall" panel tell us that, as an example, the proportion of units in the comparison group falling in the very poorest quantile of the distribution was larger than in the reference group. The ratio was about 3.5: there were a number of very poor women 3.5 times larger than in the number of very poor men. The central panel considers only the fact that men earn more than women at every point of the distribution; in Graph 1 this is shown by the blue line being always on the right side of the red line. If the shape of the distribution is assumed to remain unchanged, we observe once again a number of poorest unit that is larger for women than for men. The ratio decreases up to 2.5, but still suggests a relevant importance of the location effect. The "shape" panel on the right, on the other hand, illustrates the effect of a change in the curvature of the distributions assuming to overlay the curves in Graph 1. The ratio of the very poorest units is about 1.5, suggesting a smaller importance of the shape effect with respect to the location effect.

Graph 2. Relative PDF: location and shape effect



Source: Jann (2008)

We perform the relative distribution analysis using LISSY - Stata 12.1,⁶ with the package *reldist* (Jann, 2008). This procedure computes the decomposition of the overall effect into location and shape, and provides summary measures for the relative distribution, i.e. the

⁶ Source: <http://www.lisdatacenter.org/resources/faq/#manage1>.

relative polarization index (RP). The index is evaluated at the median, lower and upper percentiles of the distribution. The coefficients are labeled respectively MRP, LRP and URP:

$$MRP(F_t, F_0) = 4 \int_0^1 |r - 0.5| g_s(r) d_r - 1 \quad [2]$$

$$LRP(F_t, F_0) = 8 \int_0^{0.5} |r - 0.5| g_s(r) d_r - 1 \quad [3]$$

$$URP(F_t, F_0) = 8 \int_{0.5}^1 |r - 0.5| g_s(r) d_r - 1 \quad [4]$$

A positive MRP is interpreted as evidence of a median comparison distribution more polarized than the median reference distribution. In our analysis, it means that the median distribution at time t is more polarized than in 2010. The interpretations of the LRP and URP are similar, but they refer respectively to the below-the-median and the above-the-median parts of the distribution. The RP coefficients provide a more synthetic description of the relative distribution analysis than the graphs. For sake of completeness, however, we performed also the graphical analysis. Due to the double nature of our income variable, the number of countries and the length of the time considered period, the number of figures is hard to manage in the main text, hence, the full graphical analysis is reported in Appendix C.1 for monetary income and Appendix C.2 for total income.

4. Relative distribution analysis by country: monetary income

In this Section we present the results of the relative distance analysis using only monetary sources of income. Each country sub-section includes a short commentary of the results and a table reporting inference of the relative polarization indexes. The coefficient of the RP index is presented together with the standard error (SE) and the confidence interval.

A list of the Graphs associated to each year, setting 2010 as a reference, are provided in Appendix C. For each income variable, for each country and for each considered year t , there are three figures. In each panel the red line drawn at $y=1$ is the reference distribution referring to the year 2010. The blue line represents the relative distance, being the dotted blue lines the boundaries of the confidence interval. The three graphs illustrate the shape, the location component, and the overall relative distance, respectively. The shape effect depicts the relative distance obtained by superimposing the probability distribution functions, keeping fixed the position of the distribution and focusing on the differences in the shape. The location effect, on the other hand, illustrates the effect of a shift leftward or rightward of the income distribution, keeping the curvature fixed. Since the graphs tell the same story in a different way, for sake of conciseness we focus the comments on the RP indexes.

Before moving to the country sub-sections, it is worth pointing out that we develop the relative distance analysis for market income and disposable income separately. This means that when we comment on the RE index we cannot derive direct conclusions about the effectiveness of the welfare state, as we are not comparing the two types of income. The time evolution of the RP index, however, indicates a convergence/divergence pattern of income with respect to its 2010 level, which is fixed. Hence, it provides us information about the time increase/decrease of income polarization.

4.1 The United Kingdom

The LIS datasets for the UK cover the period since 1969 until 2010. If we look at the Relative Polarization (RP) indexes associated with market income, we observe that until 1995 there is a negative MRP showing relative convergence towards the 2010 level of the median portion of the distribution. After 1995 the MRP switches to a positive sign, suggesting a relative increase in the tails, therefore more polarization than in 2010. While the LRP shows a similar pattern, the URP converges less and less. It is noteworthy to signal the year 1991, where the highest deciles converge less than before ($URP=-0.193$) and the lowest deciles show polarization ($LRP=0.036$).

If we look at the disposable income RP, we observe that until 2004 all the three indexes are negative. The coefficient of the LRP is the largest, meaning that convergence to the level of polarization of 2010 occurs mainly in the lowest deciles through downgrading. In 2007 the distributions show RP indexes positive but close to zero, therefore it is slightly more polarized than in 2010. The year 1991 is no longer a deviant one: the indexes still indicate convergence, although it seems to be weaker than both in 1986 and in 1994.

We observe a pattern over time of decreasing effectiveness of the welfare state. In particular, the gap between the current polarization level converges over time to the reference 2010 level for disposable income. As for market income, the current polarization level converges over time to the reference 2010 level until 1995; after that year it shows a larger polarization level. At the beginning of the period, the MRP was larger for market income than for disposable income. In 1991 the relative polarization for disposable income becomes smaller than that for market income. Finally, since 1999 disposable income is less polarized than in 2010 and market income is more polarized than in 2010. This pattern is consistent with the results of Brandolini and Smeeding (2009) who document a drop in the equalizing effect of taxes and transfers from the early 1980s, which is reversed in the late 1990s.

It is worth noting that 1990 was the introductory year of the shortly-lived poll tax (formally named "Community Charge"). The pool tax set a single flat-rate per-capita tax on every adult, whose rate was decided by the local authority. Many scholars argue that the poll tax increased

inequality. In terms of our analysis, this type of regressive tax either shifts the curve leftwards and changes its shape. According to the RP indexes, the degree of market income polarization dramatically increased (77%), but the RP for disposable income increased less (38%). If the increased polarization of market income is commonly related to technological change and market force in place after the economic crisis (Hills, 1998: 16), these figures suggest that the welfare state acted as a buffer.

In contrast, we observe a relatively more polarized disposable income than market income for the survey years 1994 and 1995. Since the population income in the mid-90s was less polarized than in 2010, the redistribution effort of the government maybe transferred resources to the poorest population incentivizing the extension of the middle class and making it richer, but exacerbating the tails of the distribution - the poorest and the richest. Hills (1998) reports that after the Thatcher government the extent of means-tested benefits as the Income Support (the national minimum income benefit) and Family Credit (wage supplementation) increased and boosted welfare expenditure. This policy came together with a remarkable increase in taxation during the Major Cabinet. The Graphs for ex-ante income in the United Kingdom reported in Appendix C.1 draw a reduction of the middle class and a clustering of households around the 10th decile of the distribution. The Graphs in Appendix C.2, on the contrary, indicate more or less the same share of ex-post median income households than in 2010, but much more poors and much less riches than in 2010. Income polarization kept increasing since 1997 until 2007, being market income even more polarized than in 2010. Disposable income remained less or equally polarized than in 2010, failing to indicate a larger effectiveness of the New Labour welfare policies with respect to the post-Thatcher ones.

Table 1. Relative Polarization Index, United Kingdom (reference year 2010, 57928 obs.)

Comparison year	Ex-ante income				# Obs.	Ex-post income			
	Index	Coef.	SE	Confidence interval		Index	Coef.	SE	Confidence interval
1969	MRP	-0.676	0.003	-0.682 -0.670	24,756	MRP	-0.552	0.003	-0.559 -0.546
	LRP	-0.732	0.004	-0.740 -0.725		LRP	-0.637	0.005	-0.646 -0.628
	URP	-0.620	0.004	-0.629 -0.611		URP	-0.468	0.005	-0.478 -0.457
1974	MRP	-0.539	0.004	-0.547 -0.531	18,974	MRP	-0.397	0.005	-0.407 -0.388
	LRP	-0.580	0.006	-0.593 -0.567		LRP	-0.437	0.008	-0.453 -0.420
	URP	-0.499	0.006	-0.511 -0.486		URP	-0.358	0.006	-0.370 -0.345
1979	MRP	-0.457	0.004	-0.465 -0.449	18,314	MRP	-0.365	0.005	-0.374 -0.356
	LRP	-0.477	0.007	-0.490 -0.463		LRP	-0.397	0.008	-0.413 -0.382
	URP	-0.438	0.006	-0.449 -0.426		URP	-0.333	0.005	-0.344 -0.322
1986	MRP	-0.348	0.005	-0.358 -0.339	18,330	MRP	-0.296	0.005	-0.305 -0.287
	LRP	-0.409	0.008	-0.424 -0.393		LRP	-0.346	0.007	-0.361 -0.331
	URP	-0.288	0.007	-0.302 -0.274		URP	-0.245	0.007	-0.259 -0.232
1991	MRP	-0.078	0.017	-0.113 -0.044	17,089	MRP	-0.181	0.007	-0.194 -0.167
	LRP	0.036	0.037	-0.038 0.111		LRP	-0.226	0.010	-0.247 -0.205
	URP	-0.193	0.008	-0.209 -0.177		URP	-0.135	0.008	-0.151 -0.119
1994	MRP	-0.223	0.005	-0.232 -0.213	62,821	MRP	-0.202	0.004	-0.209 -0.194
	LRP	-0.284	0.009	-0.302 -0.266		LRP	-0.287	0.005	-0.297 -0.277
	URP	-0.162	0.005	-0.172 -0.151		URP	-0.117	0.005	-0.126 -0.108
1995	MRP	-0.193	0.026	-0.246 -0.141	16,586	MRP	-0.159	0.005	-0.170 -0.148
	LRP	-0.242	0.055	-0.353 -0.131		LRP	-0.199	0.009	-0.218 -0.181
	URP	-0.145	0.010	-0.166 -0.125		URP	-0.118	0.007	-0.132 -0.104
1999	MRP	0.062	0.005	0.051 0.073	59,010	MRP	-0.096	0.004	-0.103 -0.088
	LRP	0.221	0.011	0.198 0.244		LRP	-0.140	0.006	-0.152 -0.128
	URP	-0.097	0.005	-0.108 -0.087		URP	-0.051	0.004	-0.060 -0.042
2004	MRP	0.120	0.004	0.112 0.128	65,232	MRP	-0.064	0.005	-0.073 -0.054
	LRP	0.278	0.008	0.261 0.295		LRP	-0.099	0.007	-0.113 -0.084
	URP	-0.038	0.005	-0.048 -0.027		URP	-0.029	0.005	-0.038 -0.019
2007	MRP	0.134	0.005	0.124 0.143	56,926	MRP	0.015	0.005	0.006 0.024
	LRP	0.276	0.009	0.258 0.295		LRP	0.019	0.008	0.003 0.035
	URP	-0.009	0.005	-0.020 0.002		URP	0.011	0.005	0.001 0.022

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level

4.2 Germany

The LIS datasets for Germany span from 1973 through 2010. If we look at the RP indexes we observe the same changes in both ex-ante and ex-post income, because the coefficients move in the same direction. Despite this similarity and the fact that until 2004 they both are less polarized than 2010, one must note that disposable income appears to be relatively more polarized than market income. If we take a look at the RP index we observe a fluctuating pattern of polarization until the survey year 1984. The available data after the year 1984 show that polarization increases until 2000. Interestingly, there seems not to be any breakpoint around the year of the reunification, that is 1990. Nonetheless, the main driver of the time pattern of polarization depends upon the contribution of the lower tail, which is associated to the phenomenon of downgrading. It is well known that reunification led to a GDP loss for Germany (Abadie et al., 2014), but the extent of redistribution from the West to the East is not evident in the analysis of the LIS microdata. From 2004 to 2007 market income polarization is larger than in 2010, while disposable income is smaller.

Interestingly, while in the most recent years the lower tail is more polarized than in 2010, the upper tail is less polarized and median polarization is very close to the 2010 level. All in all, these figures suggest that in Germany downgrading seems to be predominant over upgrading. This result is consistent with Biewen and Juhasz (2012) that explain most of the inequality increase in Germany with changes in employment outcomes, market returns, and the tax system. The Hartz reforms in the mid 2000s in fact increased the flexibility of the labor market to fight unemployment. If unemployment has decreased, inequality has grown (Fredriksen, 2012), due to the generation of low-wage sectors and the rise in earnings at the top of the distribution. The abolishment of wealth taxes in 1997, moreover, triggered the upgrading pattern of the upper quantiles.

Table 2. Relative Polarization Index, Germany (reference year 2010, 26952 obs.)

Comparison year	Ex-ante income				# Obs.	Ex-post income					
	Index	Coef.	SE	Confidence interval		Index	Coef.	SE	Confidence interval		
1973	MRP	-0.459	0.004	-0.466	-0.452	135088	MRP	-0.240	0.005	-0.250	-0.231
	LRP	-0.507	0.006	-0.519	-0.495		LRP	-0.287	0.009	-0.305	-0.269
	URP	-0.411	0.005	-0.422	-0.400		URP	-0.194	0.005	-0.204	-0.184
1978	MRP	-0.367	0.004	-0.375	-0.358	128810	MRP	-0.174	0.004	-0.181	-0.166
	LRP	-0.399	0.007	-0.414	-0.385		LRP	-0.202	0.007	-0.217	-0.188
	URP	-0.334	0.006	-0.345	-0.323		URP	-0.145	0.006	-0.156	-0.134
1981	MRP	-0.378	0.006	-0.391	-0.365	7356	MRP	-0.271	0.009	-0.288	-0.253
	LRP	-0.414	0.008	-0.430	-0.397		LRP	-0.314	0.015	-0.345	-0.284
	URP	-0.342	0.009	-0.360	-0.324		URP	-0.227	0.011	-0.249	-0.205
1983	MRP	-0.301	0.005	-0.311	-0.291	118367	MRP	-0.130	0.006	-0.142	-0.118
	LRP	-0.286	0.012	-0.309	-0.262		LRP	-0.124	0.010	-0.143	-0.104
	URP	-0.316	0.006	-0.328	-0.303		URP	-0.137	0.006	-0.148	-0.125
1984	MRP	-0.375	0.005	-0.386	-0.364	14663	MRP	-0.260	0.006	-0.272	-0.248
	LRP	-0.429	0.010	-0.448	-0.410		LRP	-0.276	0.008	-0.293	-0.260
	URP	-0.321	0.007	-0.335	-0.306		URP	-0.244	0.009	-0.262	-0.227
1989	MRP	-0.317	0.013	-0.343	-0.290	12495	MRP	-0.242	0.007	-0.256	-0.227
	LRP	-0.364	0.030	-0.424	-0.303		LRP	-0.279	0.012	-0.303	-0.255
	URP	-0.269	0.010	-0.289	-0.250		URP	-0.204	0.009	-0.223	-0.186
1994	MRP	-0.318	0.006	-0.331	-0.305	17812	MRP	-0.247	0.006	-0.260	-0.234
	LRP	-0.375	0.011	-0.397	-0.354		LRP	-0.286	0.011	-0.308	-0.263
	URP	-0.260	0.010	-0.281	-0.240		URP	-0.208	0.008	-0.225	-0.191
2000	MRP	-0.180	0.015	-0.211	-0.149	28890	MRP	-0.164	0.005	-0.175	-0.153
	LRP	-0.206	0.032	-0.269	-0.142		LRP	-0.191	0.009	-0.209	-0.174
	URP	-0.155	0.009	-0.172	-0.137		URP	-0.136	0.007	-0.150	-0.123
2004	MRP	0.023	0.007	0.009	0.037	26824	MRP	-0.013	0.006	-0.025	-0.001
	LRP	0.065	0.014	0.037	0.092		LRP	-0.044	0.010	-0.065	-0.023
	URP	-0.019	0.008	-0.035	-0.003		URP	0.018	0.008	0.002	0.033
2007	MRP	0.033	0.007	0.019	0.047	24999	MRP	-0.019	0.005	-0.029	-0.008
	LRP	0.092	0.012	0.067	0.116		LRP	-0.050	0.010	-0.070	-0.030
	URP	-0.025	0.006	-0.038	-0.013		URP	0.013	0.006	0.000	0.026

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level

4.3 France

We consider the LIS datasets for France, ranging from 1978 until 2010. The nature of the dataset is heterogeneous: in 1978 it is gross, until 2010 it is mixed. The LIS reports that: "*the French data have a hybrid structure between NET and GROSS, incomes are reported NET of contributions and GROSS of taxes*" and "*[fr10] The French data were received net of contributions and gross of income taxes which are paid in France at the end of the fiscal year. However, we had information on the income taxes paid for the previous fiscal year that were used as a proxy for the income taxes for the income reference year*".⁷ As a consequence, we can compute only disposable income.

If we look at the RP indexes for disposable income, we observe that polarization is always lower than in 2010. Specifically, it follows a non monotonic pattern: it decreases in the 1980s, and increases afterwards. The contribution of the lower tail, despite its erratic pattern in the early years, is always stronger than the contribution of the upper one, as indicated by the larger magnitude of the LRP with respect to the URP. Notably, in 1984 and in 1989 the upper median part of the ex-post income distribution shows the lowest level of polarization in the period under consideration, suggesting the presence of downgrading in the mid-1980s.

In the considered period the French welfare system, framed in the state-led economic policy ('*dirigisme*') exacerbates socio-economic problems as unemployment and social exclusion.

Despite no fundamental welfare reform were implemented, in the 1980s social expenditure increased rapidly, mainly because of social contributions (Palier 2001). In the early 1990s sector-specific changes were made, by introducing new welfare instruments. In particular, the 1990 Finance Act introduced the Generalized Social Contribution (GSC), which is a tax to fund some welfare services that is paid by the residents in France and not only by income earners. The aim of the GSC was to spread the burden of social contribution among a largest share of the population, and it is the most relevant change occurred in the early 1990s. It is hard to associate the pattern of ex-post income polarization to GSC, but we suppose that the redistribution that it put into place increased the tails of the income distribution by hinging relatively more on median income contributors.

⁷ Source: <http://www.lisdatacenter.org/our-data/lis-database/by-country/france-2/>

Table 3. Relative Polarization Index, France (reference year 2010, 41285 obs.)

Comparison year	# Obs.	Ex-post income			
		Index	Coef.	SE	Confidence interval
1978	32475	MRP	-0.165	0.004	-0.174 -0.156
		LRP	-0.236	0.006	-0.249 -0.223
		URP	-0.094	0.006	-0.107 -0.082
1984	33241	MRP	-0.193	0.005	-0.202 -0.184
		LRP	-0.200	0.006	-0.212 -0.187
		URP	-0.187	0.007	-0.200 -0.174
1989	24595	MRP	-0.205	0.004	-0.212 -0.198
		LRP	-0.229	0.006	-0.242 -0.217
		URP	-0.180	0.007	-0.194 -0.167
1994	29260	MRP	-0.186	0.004	-0.195 -0.177
		LRP	-0.287	0.007	-0.302 -0.272
		URP	-0.084	0.006	-0.096 -0.073
2000	25803	MRP	-0.161	0.004	-0.169 -0.152
		LRP	-0.257	0.007	-0.272 -0.242
		URP	-0.064	0.007	-0.078 -0.051
2005	25364	MRP	-0.141	0.005	-0.150 -0.131
		LRP	-0.223	0.007	-0.236 -0.210
		URP	-0.058	0.007	-0.072 -0.045

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level

4.4 Spain

The LIS datasets for Spain starts in 1984. The nature of the datasets is net for the years 1980-2004, gross for the years 2007 and 2010. The LIS reports that: "*taxes and contributions [are] not captured.*"⁸ Hence, we perform a relative distribution analysis only using the disposable income for the period 1980-2004 and also market income for 2007.

If we look at the indexes associated to ex-post income, we observe that compared with the survey year 2010, the distribution converges in polarization. This pattern is clear since the beginning of the series and it presents a sharp increase between 1990 and 1995, a period of economic crises. The Spanish welfare state after the late 1990s has been able to keep polarization more or less constant until 2010. Politically, both Christian Democrats and Socialist governments ruled during this period. Deep reforms of some welfare provisions have been rejected by popular protest, as for the unemployment benefit retrenchment proposed in 2002, or the austerity measures to face the Great Recession in 2008.

By looking at the LRP and the URP we see that while the density of the poorest deciles converges to the level of 2010, the richest deciles show a larger density than in 2010. Finally, the middle class is stable just below the median. The contribution of the upper tail to

⁸ Source: <http://www.lisdatacenter.org/our-data/lis-database/by-country/spain-2/>

convergence is more important than the contribution of the lower tail, which indicates the predominance of downgrading over upgrading. In 2007, the survey year for which we can compute also ex-ante income, we observe that the distribution is slightly more polarized than the 2010 one. The associated coefficient, however, is close to zero and consistently with previous evidence, it is determined by mainly the contribution of the polarization of the lower tail.

Table 4. Relative Polarization Index, Spain (reference year 2010, 34756 obs.)

Comparison year	# Obs.	Ex-post income								
		Index	Coef.	SE	Confidence interval					
1980	88543	MRP	-0.343	0.003	-0.349 -0.336					
		LRP	-0.407	0.005	-0.418 -0.396					
		URP	-0.278	0.004	-0.287 -0.269					
1985	11582	MRP	-0.361	0.006	-0.373 -0.349					
		LRP	-0.443	0.010	-0.462 -0.424					
		URP	-0.280	0.008	-0.295 -0.265					
1990	72119	MRP	-0.256	0.004	-0.265 -0.248					
		LRP	-0.314	0.007	-0.327 -0.301					
		URP	-0.198	0.005	-0.209 -0.188					
1995	18643	MRP	-0.079	0.006	-0.091 -0.067					
		LRP	-0.148	0.010	-0.167 -0.128					
		URP	-0.010	0.008	-0.026 0.007					
2000	14320	MRP	0.038	0.007	0.024 0.052					
		LRP	0.047	0.012	0.023 0.070					
		URP	0.029	0.008	0.013 0.045					
2004	37491	MRP	-0.049	0.005	-0.060 -0.039					
		LRP	-0.055	0.010	-0.074 -0.036					
		URP	-0.043	0.006	-0.055 -0.032					
Ex-post income										
2007	35970	MRP	-0.026	0.006	-0.038 -0.014	MRP	0.016	0.005	0.007	0.025
		LRP	-0.018	0.008	-0.034 -0.003	LRP	0.071	0.008	0.055	0.086
		URP	-0.033	0.007	-0.047 -0.019	URP	-0.039	0.006	-0.051	-0.026

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level

4.5 Italy

The LIS datasets collect Italian data since 1986. In the period 1986-2000 they are net ("taxes and contributions [are] not captured"), while for the years 2004-2010 they are mixed ("total income account for full taxes and contributions, subcomponents do not").⁹

If we look at the indexes associated to ex-post income, we observe that compared with the 2010 the distribution shows an erratic polarization pattern over time. In the 1980s the very poor deciles have less households than in 2010, the density of the intermediate deciles

⁹ Source: <http://www.lisdatacenter.org/our-data/lis-database/by-country/italy-2/>

decreases below the level of 2010, and there are more rich households. In the second half of the 1990s the poor households increase with respect to the 2010 distribution. In the years 2000s the number of the poorest households decreases but those around the 20th percentile increase. All in all, the magnitude of the coefficients, always closer to zero, indicates a very small impact of changes in polarization with respect to the other countries. The lack of information about the pattern of market income polarization, we cannot say nothing on the effectiveness of the welfare state.

Table 5. Relative Polarization Index, Italy (reference year 2010, 19836 obs.)

Comparison year	# Obs.	Ex-post income			
		Index	Coef.	SE	Confidence interval
1986	25068	MRP	-0.088	0.005	-0.099 -0.077
		LRP	-0.141	0.012	-0.166 -0.117
		URP	-0.035	0.009	-0.053 -0.016
1987	25092	MRP	0.062	0.007	0.047 0.077
		LRP	0.021	0.014	-0.007 0.049
		URP	0.103	0.009	0.086 0.121
1989	25150	MRP	-0.024	0.007	-0.038 -0.010
		LRP	-0.069	0.014	-0.096 -0.041
		URP	0.020	0.006	0.007 0.033
1991	24930	MRP	-0.054	0.007	-0.069 -0.039
		LRP	-0.079	0.016	-0.111 -0.047
		URP	-0.029	0.010	-0.050 -0.008
1993	24013	MRP	-0.003	0.008	-0.018 0.013
		LRP	-0.022	0.015	-0.052 0.008
		URP	0.017	0.008	0.002 0.033
1995	23924	MRP	-0.028	0.006	-0.041 -0.016
		LRP	-0.060	0.012	-0.085 -0.035
		URP	0.004	0.007	-0.010 0.017
1998	20901	MRP	0.004	0.006	-0.007 0.016
		LRP	0.006	0.012	-0.018 0.030
		URP	0.003	0.009	-0.014 0.020
2000	22268	MRP	0.019	0.007	0.005 0.033
		LRP	-0.004	0.013	-0.030 0.023
		URP	0.043	0.009	0.025 0.060
2004	20581	MRP	-0.021	0.006	-0.034 -0.008
		LRP	-0.037	0.013	-0.062 -0.011
		URP	-0.006	0.008	-0.021 0.010
2008	19907	MRP	-0.007	0.007	-0.021 0.007
		LRP	-0.016	0.013	-0.041 0.009
		URP	0.002	0.009	-0.016 0.020

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level.

4.6 Poland

We consider the LIS datasets for Poland since 1986. The datasets 1986-1992 are net ("taxes and contributions [are] not captured"), in 1995 it is mixed ("total income account for full taxes and contributions, subcomponents do not") and after 1999 they are gross. We perform a

relative distribution analysis only using the disposable income for the period 1986-1995 and also market income for the period 1999-2010.¹⁰

If we look at the indexes associated to ex-post and ex-ante income, we observe that compared with the 2010 the distribution it is less polarized since the survey year 1992, with a major contribution of the lower tail. The figures decrease over time, therefore polarization increases since around 1992, which is a pattern consistent with the transition to capitalism that the country experienced since the late 1980s. Notably, in 1986 the distribution of ex-post income was more polarized with a major contribution of the lower tail.

It is worth noting that the RP index for disposable income is very close to 1, suggesting full polarization. Such an extreme result requires a proper motivation; a careful inspection of the data indicates the presence of a significant share of non-monetary sources of income in Poland, which is not the case for the other countries. We believe that this exclusion affects the fit of the ex-ante income measurement: omitting non-monetary income generates a distortion in the RP computation. Hence, for ex-ante income in Poland we feel more confident in relying on the results of the next Section that includes also non-monetary amounts of income.

Table 6. Relative Polarization Index, Poland (reference year 2010, 108967 obs.)

Comparison year	# Obs.	Ex-post income				Ex-ante income					
		Index	Coef.	SE	Confidence interval		Index	Coef.	SE	Confidence interval	
1986	34201	MRP	0.399	0.003	0.392	0.405					
		LRP	0.553	0.006	0.541	0.564					
		URP	0.245	0.006	0.233	0.257					
1992	18807	MRP	-0.122	0.005	-0.132	-0.111					
		LRP	-0.044	0.011	-0.067	-0.022					
		URP	-0.199	0.006	-0.212	-0.186					
1995	103530	MRP	-0.219	0.004	-0.227	-0.211					
		LRP	-0.169	0.008	-0.185	-0.153					
		URP	-0.270	0.003	-0.276	-0.264					
1999	99791	MRP	-0.113	0.005	-0.122	-0.103	MRP	-0.965	0.001	-0.967	-0.964
		LRP	-0.055	0.009	-0.072	-0.038	LRP	-0.964	0.001	-0.966	-0.962
		URP	-0.170	0.004	-0.177	-0.163	URP	-0.966	0.001	-0.968	-0.964
2004	99038	MRP	-0.177	0.026	-0.230	-0.124	MRP	-0.964	0.001	-0.965	-0.962
		LRP	-0.221	0.053	-0.327	-0.115	LRP	-0.964	0.001	-0.966	-0.963
		URP	-0.134	0.003	-0.141	-0.127	URP	-0.963	0.001	-0.966	-0.961
2007	111992	MRP	-0.175	0.003	-0.181	-0.169	MRP	-0.965	0.001	-0.967	-0.964
		LRP	-0.253	0.005	-0.264	-0.242	LRP	-0.964	0.001	-0.966	-0.962
		URP	-0.097	0.003	-0.104	-0.090	URP	-0.966	0.001	-0.968	-0.964

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level. Estimates excluding hm_other.

¹⁰ Since the 1986 deflator is not available, we applied the 1990 one in 1986.

5. Relative distribution analysis by country: monetary plus non-monetary amounts

In this Section we replicate the analysis of Section 4 by including in the income definition both monetary and non-monetary amounts.¹¹ This step highlights the relevance of in-kind transfers, which are mostly relevant in Poland, especially in the form of transfers. All the countries show RP indexes consistent with those presented in Section 3, both in the signs and the standard errors. The differences between the coefficients, when different from zero, are very small. The cross-country pattern of polarization does not present significant changes in all the countries and helps correcting the distortion of the RP calculated on ex-post income in Poland, confirming the general trend: an increasing income polarization characterized by the phenomenon of downgrading of the middle class.

¹¹ Technically, in the Stata codes we specify the *H-* prefix of the variables instead of the *HM-* one, referring to *Household* and not *Household Monetary* amounts.

5.1 The United Kingdom

Table 7. Relative Polarization Index, the United Kingdom (reference year 2010, 57928 obs.)

years	Index	Ex-ante					Ex-post				
		Coef.	SE	Conf. interval	Conf. interval	N comparison	Index	Coef.	SE	Conf. interval	Conf. interval
1969	MRP	-0.676	0.003	-0.682	-0.670	24,756	MRP	-0.552	0.003	-0.558	-0.545
	LRP	-0.732	0.004	-0.740	-0.725		LRP	-0.636	0.004	-0.645	-0.627
	URP	-0.620	0.004	-0.629	-0.611		URP	-0.468	0.005	-0.478	-0.457
1974	MRP	-0.539	0.004	-0.547	-0.531	18,974	MRP	-0.396	0.005	-0.406	-0.387
	LRP	-0.580	0.006	-0.593	-0.567		LRP	-0.435	0.008	-0.451	-0.418
	URP	-0.499	0.006	-0.511	-0.486		URP	-0.358	0.006	-0.370	-0.346
1979	MRP	-0.456	0.004	-0.463	-0.448	18,314	MRP	-0.365	0.004	-0.374	-0.356
	LRP	-0.473	0.007	-0.487	-0.460		LRP	-0.401	0.007	-0.416	-0.386
	URP	-0.438	0.006	-0.449	-0.427		URP	-0.329	0.006	-0.341	-0.318
1986	MRP	-0.347	0.005	-0.357	-0.337	18,330	MRP	-0.293	0.004	-0.302	-0.284
	LRP	-0.406	0.008	-0.422	-0.391		LRP	-0.342	0.007	-0.357	-0.327
	URP	-0.288	0.007	-0.301	-0.275		URP	-0.244	0.007	-0.258	-0.230
1991	MRP	-0.077	0.016	-0.110	-0.044	17,089	MRP	-0.179	0.007	-0.193	-0.165
	LRP	0.042	0.036	-0.030	0.114		LRP	-0.223	0.010	-0.243	-0.202
	URP	-0.195	0.008	-0.211	-0.180		URP	-0.135	0.008	-0.151	-0.120
1994	MRP	-0.223	0.005	-0.232	-0.213	62,821	MRP	-0.200	0.004	-0.208	-0.193
	LRP	-0.284	0.009	-0.302	-0.266		LRP	-0.284	0.005	-0.294	-0.274
	URP	-0.162	0.005	-0.172	-0.151		URP	-0.117	0.005	-0.126	-0.108
1995	MRP	-0.193	0.026	-0.246	-0.141	16,586	MRP	-0.157	0.005	-0.168	-0.146
	LRP	-0.242	0.055	-0.353	-0.131		LRP	-0.196	0.009	-0.215	-0.177
	URP	-0.145	0.010	-0.165	-0.124		URP	-0.117	0.007	-0.131	-0.104
1999	MRP	0.062	0.005	0.051	0.073	59,010	MRP	-0.097	0.004	-0.104	-0.089
	LRP	0.221	0.011	0.198	0.243		LRP	-0.142	0.006	-0.154	-0.130
	URP	-0.097	0.005	-0.107	-0.086		URP	-0.051	0.004	-0.060	-0.042
2004	MRP	0.120	0.004	0.112	0.128	65,232	MRP	-0.064	0.005	-0.073	-0.054
	LRP	0.278	0.008	0.261	0.295		LRP	-0.098	0.007	-0.112	-0.083
	URP	-0.037	0.005	-0.048	-0.027		URP	-0.030	0.005	-0.040	-0.020
2007	MRP	0.134	0.005	0.124	0.143	56,926	MRP	0.015	0.005	0.006	0.025
	LRP	0.276	0.009	0.258	0.295		LRP	0.020	0.008	0.004	0.036
	URP	-0.009	0.005	-0.020	0.002		URP	0.011	0.005	0.000	0.021

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level.

5.2 Germany

Table 8. Relative Polarization Index, Germany (reference year 2010, 26952 obs.)

Comparison year	Ex-ante income				# Obs.	Ex-post income					
	Index	Coef.	SE	Confidence		Index	Coef.	SE	Confidence interval		
1973	MRP	-0.459	0.004	-0.466	-0.452	135088	MRP	-0.240	0.005	-0.250	-0.231
	LRP	-0.507	0.006	-0.519	-0.495		LRP	-0.287	0.009	-0.305	-0.269
	URP	-0.411	0.005	-0.422	-0.400		URP	-0.194	0.005	-0.204	-0.184
1978	MRP	-0.367	0.004	-0.375	-0.358	128810	MRP	-0.176	0.004	-0.184	-0.169
	LRP	-0.399	0.007	-0.414	-0.385		LRP	-0.208	0.007	-0.223	-0.193
	URP	-0.334	0.006	-0.345	-0.323		URP	-0.145	0.006	-0.156	-0.134
1981	MRP	-0.378	0.006	-0.391	-0.365	7356	MRP	-0.271	0.009	-0.288	-0.253
	LRP	-0.414	0.008	-0.430	-0.397		LRP	-0.314	0.015	-0.345	-0.284
	URP	-0.342	0.009	-0.360	-0.324		URP	-0.227	0.011	-0.249	-0.205
1983	MRP	-0.301	0.005	-0.311	-0.291	118367	MRP	-0.136	0.006	-0.148	-0.124
	LRP	-0.286	0.012	-0.309	-0.262		LRP	-0.135	0.010	-0.155	-0.116
	URP	-0.316	0.006	-0.328	-0.303		URP	-0.136	0.006	-0.148	-0.125
1984	MRP	-0.375	0.005	-0.386	-0.364	14663	MRP	-0.260	0.006	-0.272	-0.248
	LRP	-0.429	0.010	-0.448	-0.410		LRP	-0.276	0.008	-0.293	-0.260
	URP	-0.321	0.007	-0.335	-0.306		URP	-0.244	0.009	-0.262	-0.227
1989	MRP	-0.317	0.013	-0.343	-0.290	12495	MRP	-0.242	0.007	-0.256	-0.227
	LRP	-0.364	0.030	-0.424	-0.303		LRP	-0.279	0.012	-0.303	-0.255
	URP	-0.269	0.010	-0.289	-0.250		URP	-0.204	0.009	-0.223	-0.186
1994	MRP	-0.318	0.006	-0.331	-0.305	17812	MRP	-0.247	0.006	-0.260	-0.234
	LRP	-0.375	0.011	-0.397	-0.354		LRP	-0.286	0.011	-0.308	-0.263
	URP	-0.260	0.010	-0.281	-0.240		URP	-0.208	0.008	-0.225	-0.191
2000	MRP	-0.180	0.015	-0.211	-0.149	28890	MRP	-0.164	0.005	-0.175	-0.153
	LRP	-0.206	0.032	-0.269	-0.142		LRP	-0.191	0.009	-0.209	-0.174
	URP	-0.155	0.009	-0.172	-0.137		URP	-0.136	0.007	-0.150	-0.123
2004	MRP	0.023	0.007	0.009	0.037	26824	MRP	-0.013	0.006	-0.025	-0.001
	LRP	0.065	0.014	0.037	0.092		LRP	-0.044	0.010	-0.065	-0.023
	URP	-0.019	0.008	-0.035	-0.003		URP	0.018	0.008	0.002	0.033
2007	MRP	0.033	0.007	0.019	0.047	24999	MRP	-0.019	0.005	-0.029	-0.008
	LRP	0.092	0.012	0.067	0.116		LRP	-0.050	0.010	-0.070	-0.030
	URP	-0.025	0.006	-0.038	-0.013		URP	0.013	0.006	0.000	0.026

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level.

5.3 France

Table 9. Relative Polarization Index, France (reference year 2010, 41285 obs.)

Mone + non mon			Ex-post income		
Comparison year	# Obs.	Index	Coef.	SE	Confidence interval
1978	32475	MRP	-0.177	0.004	-0.186
		LRP	-0.253	0.006	-0.265
		URP	-0.102	0.006	-0.090
1984	33241	MRP	-0.191	0.004	-0.200
		LRP	-0.209	0.005	-0.220
		URP	-0.172	0.007	-0.187
1989	24595	MRP	-0.217	0.004	-0.224
		LRP	-0.245	0.006	-0.258
		URP	-0.188	0.007	-0.202
1994	29260	MRP	-0.198	0.004	-0.207
		LRP	-0.304	0.007	-0.318
		URP	-0.092	0.006	-0.104
2000	25803	MRP	-0.174	0.004	-0.182
		LRP	-0.275	0.008	-0.291
		URP	-0.072	0.007	-0.086
2005	25364	MRP	-0.152	0.005	-0.162
		LRP	-0.234	0.007	-0.249
		URP	-0.069	0.007	-0.084

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level.

5.4 Spain

Table 10. Relative Polarization Index, Spain (reference year 2010, 34756 obs.)

Mon + non mon		Ex-post income											
Comparison year	#	Obs.	Index	Confidence									
				Coef.	SE	interval							
1980	88543		MRP	-0.348	0.003	-0.355	-0.341						
			LRP	-0.413	0.007	-0.427	-0.399						
			URP	-0.282	0.005	-0.292	-0.272						
1985	11582		MRP	-0.360	0.006	-0.372	-0.348						
			LRP	-0.428	0.010	-0.448	-0.409						
			URP	-0.291	0.008	-0.306	-0.275						
1990	72119		MRP	-0.255	0.005	-0.265	-0.246						
			LRP	-0.319	0.009	-0.338	-0.300						
			URP	-0.192	0.006	-0.204	-0.180						
1995	18643		MRP	-0.084	0.006	-0.096	-0.072						
			LRP	-0.154	0.010	-0.174	-0.134						
			URP	-0.014	0.008	-0.030	0.002						
2000	14320		MRP	0.033	0.007	0.019	0.047						
			LRP	0.041	0.012	0.016	0.065						
			URP	0.025	0.009	0.007	0.042						
2004	37491		MRP	-0.054	0.006	-0.065	-0.043						
			LRP	-0.062	0.011	-0.085	-0.039						
			URP	-0.046	0.005	-0.057	-0.035						
Ex-post income													
2007	35970		MRP	-0.023	0.006	-0.035	-0.011	MRP	0.018	0.005	0.009	0.028	
			LRP	-0.011	0.008	-0.028	0.006	LRP	0.075	0.008	0.059	0.091	
			URP	-0.034	0.007	-0.048	-0.020	URP	-0.038	0.006	-0.050	-0.026	
Ex-ante income													

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level.

5.5 Italy

Table 11. Relative Polarization Index, Italy (reference year 2010, 19836 obs.)

Mon+non mon		Ex-post income			
Comparison year	# Obs.	Index	Coef.	SE	Confidence interval
1986	25068	MRP	-0.092	0.005	-0.103
		LRP	-0.143	0.012	-0.168
		URP	-0.042	0.009	-0.060
1987	25092	MRP	0.063	0.008	0.047
		LRP	0.024	0.015	-0.007
		URP	0.102	0.008	0.085
1989	25150	MRP	-0.025	0.007	-0.039
		LRP	-0.066	0.013	-0.092
		URP	0.016	0.006	0.004
1991	24930	MRP	-0.055	0.007	-0.069
		LRP	-0.076	0.015	-0.107
		URP	-0.033	0.010	-0.054
1993	24013	MRP	-0.004	0.008	-0.019
		LRP	-0.019	0.015	-0.049
		URP	0.011	0.007	-0.004
1995	23924	MRP	-0.029	0.006	-0.042
		LRP	-0.058	0.013	-0.084
		URP	0.001	0.007	-0.013
1998	20901	MRP	0.005	0.006	-0.007
		LRP	0.010	0.012	-0.015
		URP	-0.001	0.009	-0.019
2000	22268	MRP	0.019	0.007	0.004
		LRP	-0.004	0.015	-0.034
		URP	0.041	0.009	0.024
2004	20581	MRP	-0.023	0.006	-0.035
		LRP	-0.036	0.013	-0.063
		URP	-0.009	0.008	-0.026
2008	19907	MRP	-0.008	0.007	-0.022
		LRP	-0.010	0.013	-0.036
		URP	-0.005	0.009	-0.022

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level.

5.6 Poland

Table 12. Relative Polarization Index, Poland (reference year 2010, 108967 obs.)

Comparison year	# Obs.	Ex-post income				Ex-ante income					
		Index	Coef.	SE	Confidence interval		Index	Coef.	SE	Confidence interval	
1986	34201	MRP	0.160	0.004	0.152	0.168					
		LRP	0.230	0.007	0.216	0.244					
		URP	0.090	0.006	0.079	0.102					
1992	18807	MRP	-0.308	0.004	-0.317	-0.299					
		LRP	-0.371	0.007	-0.385	-0.357					
		URP	-0.246	0.006	-0.257	-0.234					
1995	103530	MRP	-0.347	0.003	-0.352	-0.342					
		LRP	-0.381	0.004	-0.389	-0.373					
		URP	-0.313	0.003	-0.319	-0.307					
1999	99791	MRP	-0.263	0.003	-0.269	-0.258	MRP	-0.253	0.002	-0.257	-0.248
		LRP	-0.282	0.004	-0.290	-0.274	LRP	-0.312	0.004	-0.321	-0.304
		URP	-0.244	0.004	-0.252	-0.236	URP	-0.193	0.004	-0.202	-0.184
2004	99038	MRP	-0.194	0.003	-0.199	-0.188	MRP	-0.233	0.003	-0.240	-0.226
		LRP	-0.223	0.004	-0.232	-0.214	LRP	-0.320	0.005	-0.330	-0.310
		URP	-0.165	0.004	-0.173	-0.157	URP	-0.146	0.005	-0.156	-0.136
2007	111992	MRP	-0.127	0.002	-0.131	-0.123	MRP	-0.167	0.002	-0.172	-0.162
		LRP	-0.158	0.004	-0.166	-0.150	LRP	-0.246	0.004	-0.254	-0.237
		URP	-0.096	0.003	-0.103	-0.090	URP	-0.089	0.003	-0.095	-0.083

Note: MRP stands for median polarization index; LRP and URP stand for lower and upper polarization index. Bootstrap SE (50 replications), Confidence interval at the 95% level.

6. Summary and conclusions

This paper analyzed the pattern of income polarization in six European countries, i.e. United Kingdom, Germany, France, Spain, Italy and Poland. We applied the relative distribution analysis (Handcock and Morris, 1998), a non-parametric approach to visualize and analyze differences in distributions, and compare the data with a reference year set to the most recent available information, that is 2010.

Despite its descriptive nature, this paper contributes to the literature by computing both ex-ante and ex-post income using the updated LIS database containing information until 2010. Beyond the extension of the existing income series, this work considers both monetary and monetary *plus* non-monetary sources of income, which make a difference in Poland.

Our main result is that, compared to 2010, market income polarization was lower in the past. In particular, we observe a slow convergence to highest levels of polarization beginning in the 1980s. The degree of relative polarization of disposable income is always lower than the one of market income. The welfare state, as expected, acts as a smoother of the distribution and improves equality. Nonetheless, the pattern is generally pointing to a larger degree of polarization in all the countries except for Italy, where we observe a fluctuating pattern close to null relative polarization. Finally, in all the countries downgrading prevails over upgrading: the relevance of the middle-class getting poorer is larger than the one of the middle-class getting richer. The effectiveness of the welfare state in mitigating polarization is hard to evaluate, but if we look at the pattern of relative polarization in both ex-ante and ex-post income, which is possible for the United Kingdom and Germany, we observe some interesting pattern. In fact, over time income polarization increases but disposable income polarization grows more slowly, making us claim for a time increasing effectiveness of the equalizing role of the welfare state.

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Appendix

A. Ex-ante and ex-post income distribution: measurement issues

Using LIS notation in the "Definition of summary income variables", we can sum the income variables in Milanovic (2000) as:

$$[A1] \text{GROSS FI}^P = \text{FI} + \text{SOCTRANS}$$

$$[A2] \text{DISPOSABLE FI}^P = \text{MI} + \text{PRIVATI} + \text{V36} + \text{SOCTRANS-PAYROLL-V11}$$

where $\text{FI}^P = \text{MI} + \text{PRIVATI} + \text{V36} + \text{V19}$ and $\text{FI} = \text{MI} + \text{PRIVATI} + \text{V36}$.

Scervini (2012) builds on Milanovic (2000) and defines "*market income*, or *ex-ante income*, as the sum of earnings from any source of income and pensions, and *disposable income*, or *ex-post income*, as the sum of market income plus all the social transfers, minus all income taxes and pension contributions. [...] Using LIS notation in the "Definition of summary income variables": market income=MI+PRIVATI+V19, analogous to *factor P income* in Milanovic (2000), disposable income=MI+PRIVATI+SOCTRANS-PAYROLL-V11, where V11 are income taxes" (pages 534-535).

To sum up, it is exactly as in Milanovic (2000):

$$[A3] Y^M = \text{FI}^P = \text{MI} + \text{PRIVATI} + \text{V19} + \text{V36} \text{ (note: V36 not defined but included)}$$

$$[A4] Y^D = \text{MI} + \text{PRIVATI} + (\text{V36}) + \text{SOCTRANS-PAYROLL-V11}$$

In 2011 the LIS database has been restructured, and the current data have been aggregated under different labels. Specifically, part of old MI is now already moved to transfers. we checked the documents available on the *lisdatacenter.org* website to match the old version variables with the new ones. A perfect match is hard to find.

The LIS defines disposable household income as:

$$[A5] DHI = HI - HXIT$$

where $HI = HIL + HIC + HIT$, $HIL + HIC = FACTOR$, $HITS = SOCRED$, $HITP = PRIVRED$, $PENSION = HITSIL + HITSUP + HITSAP + HICVIP$.

We therefore computed a measure of disposable income to match the disposable household income provided by the LIS, labeled DHI:

$$[A6] DHI \sim Y^d = FACTOR + PRIVRED + SOCRED + V36 - PAYROLL - TAXES$$

$$= HMIL + HMIC + HMIT + HM_OTHER - HMXIT$$

We verified the similarity of the series through a set of descriptive statistics.

Pensions are included into HMITS (social security transfers). HMIT=HMITP+HMITS+ e , where e is a residual. Therefore, we use the aggregate HMIT instead of the two components separately.

We then start from Y^D to obtain a measure of market income.

$$\begin{aligned} [A7] \quad Y^m &= \text{FACTOR} + \text{PRIVRED} + \text{PENSION} + V36 \\ &= Y^d + \text{HMXIT-HIT} + \text{ITSUPO} + \text{ITSUPS} + \text{ITSAPO} + \text{ITSAPS} \end{aligned}$$

Once computed ex-ante and ex-post income, that we label respectively Y^m and Y^d , we divide for the square root of the household size to obtain individual income:

$$[A8] \quad Y^{*i} = Y^i / N^{0.5} \quad \text{where } i=(m, d) \text{ and } N=NHHMEM$$

B. Comparison with the Gini indexes of Scervini (2012)

We can compute only disposable income Y^d for countries with NET dataset. We can compute both for 169 datasets (+62.5% observations with respect to Scervini, 2012). Specifically, there are 157 gross datasets, 12 mixed and 63 net¹².

The following Graphs show the match between our Gini series and the Scervini (2012) one.

Table B1. List of countries

Country	id	Country	id
Belgium	1	Netherlands	13
Brazil	2	Norway	14
Canada	3	Poland	15
Czech Republic	4	Romania	16
Denmark	5	Slovak Republic	17
Finland	6	South Korea	18
France	7	Sweden	19
Germany	8	Switzerland	20
Guatemala	9	Taiwan	21
Ireland	10	United Kingdom	22
Israel	11	United States	23
Luxembourg	12	Netherlands	13

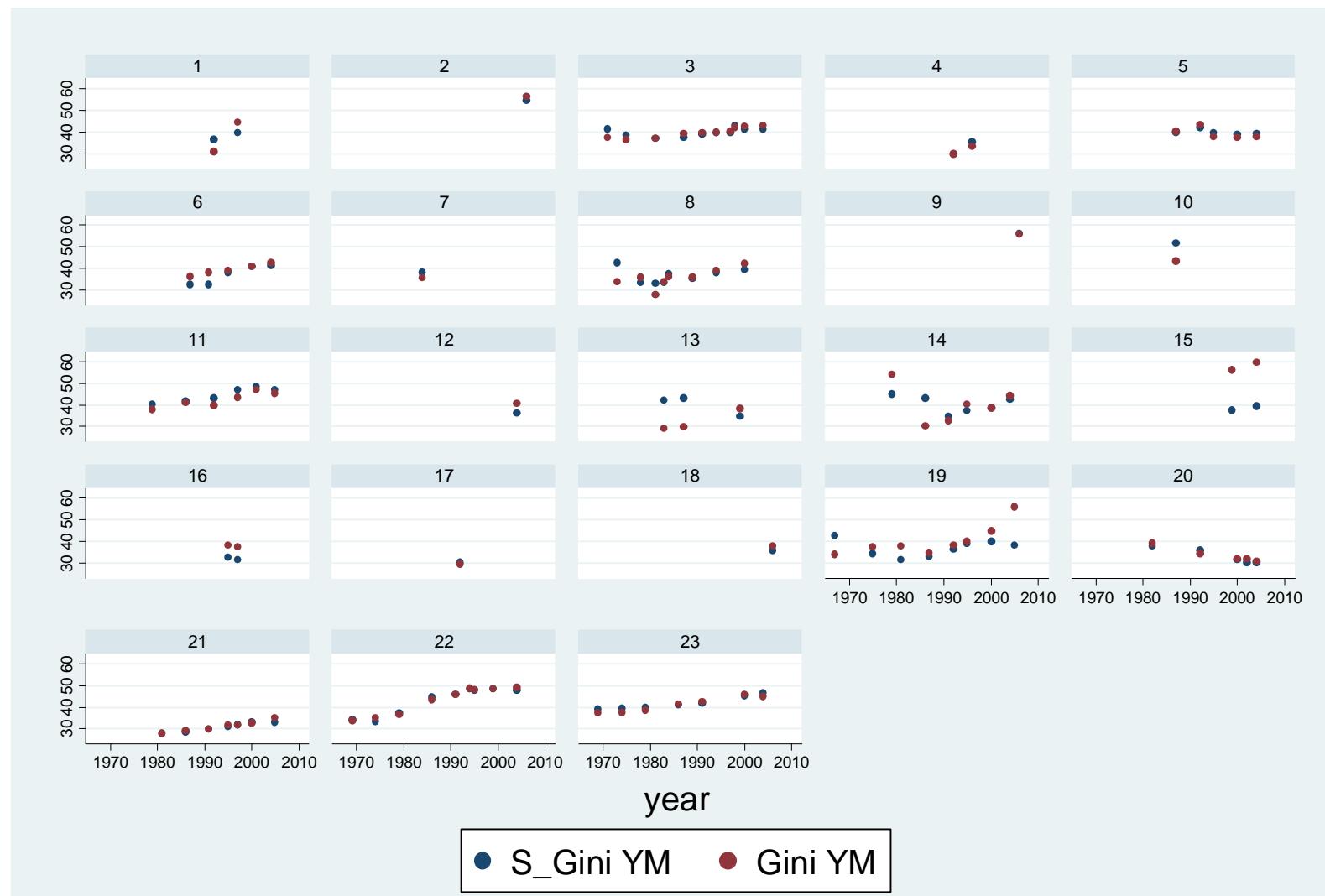
¹² Here we perform a comparison with Scervini (2012) series, but we could compare our GINIs also with *alltheginis* dataset (Milanovic, 2014) and the Standardized World Income Inequality Database (Solt, 2014). This exercise is left for future research.

The discrepancy in DHI and Y^D is larger for Sweden and Norway (beginning of the series). Since DHI is the benchmark disposable income computed by LIS, we suppose that the discrepancy derives from the fact that the new classification does not compare with the old one.

The discrepancy in the series of market income is larger for the same countries plus Belgium, Netherlands and Poland. Some descriptive statistics regarding the pension variables and $hmic$ (those who do not have a non-monetary value) confirm that $hm^*=h^*$, e.g. $hmic=hic$. Nonetheless, note that IL non-monetary >0 in Norway at the beginning of the series and IT non-monetary >0 in Poland (therefore it is better to use total amounts for Norway and Poland). We do not report any anomaly in the descriptive statistics for Belgium, Netherlands and Sweden.

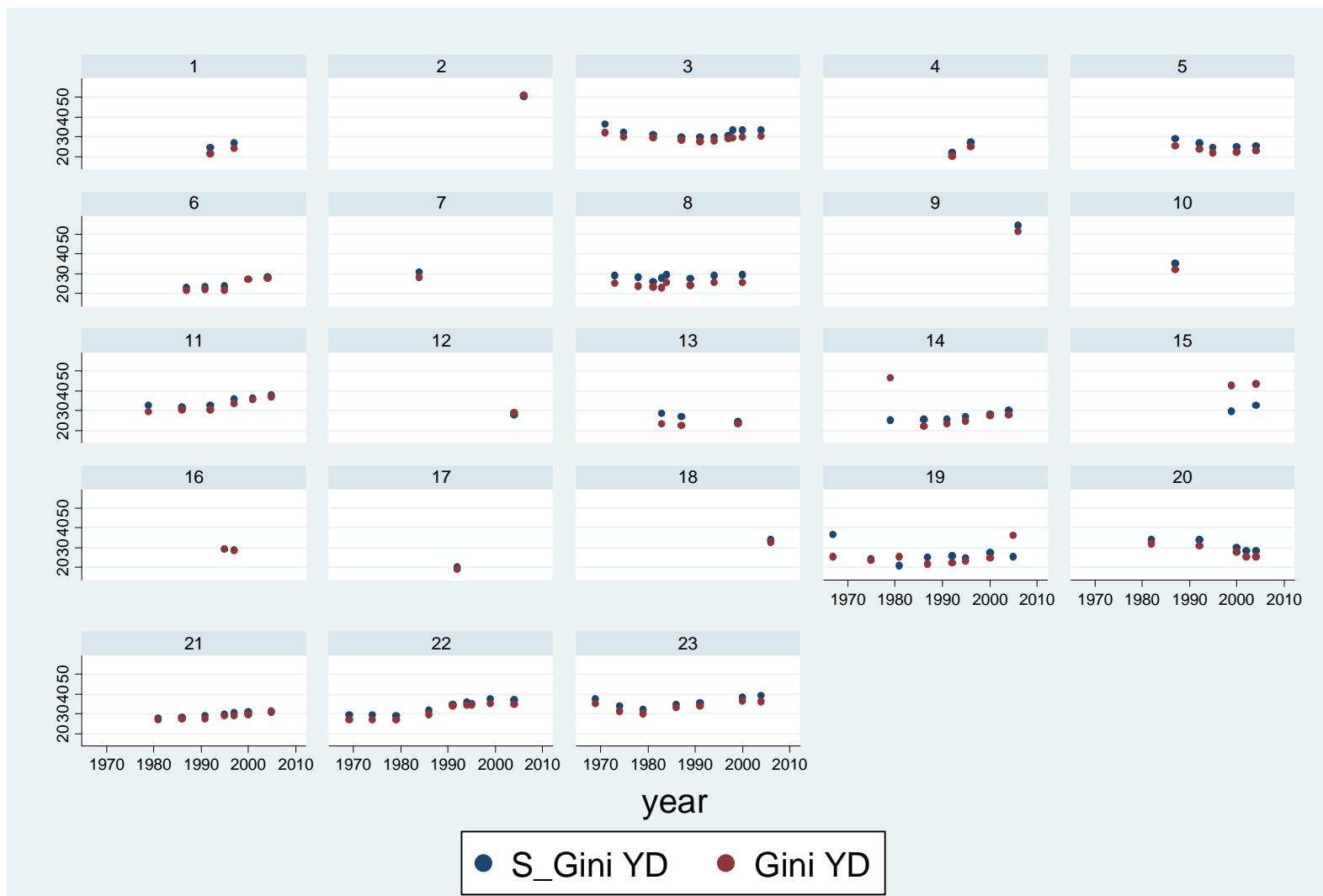
Finally, we report that there are some missing datasets present in the Scervini (2012) series but unavailable in the updated version of LIS. They are: France 1979, Netherlands 1991, 1994 and United States 1996. For more information see <http://www.lisdatacenter.org/our-data/lis-database/datasets-information/>.

Table B2. Market income Gini index



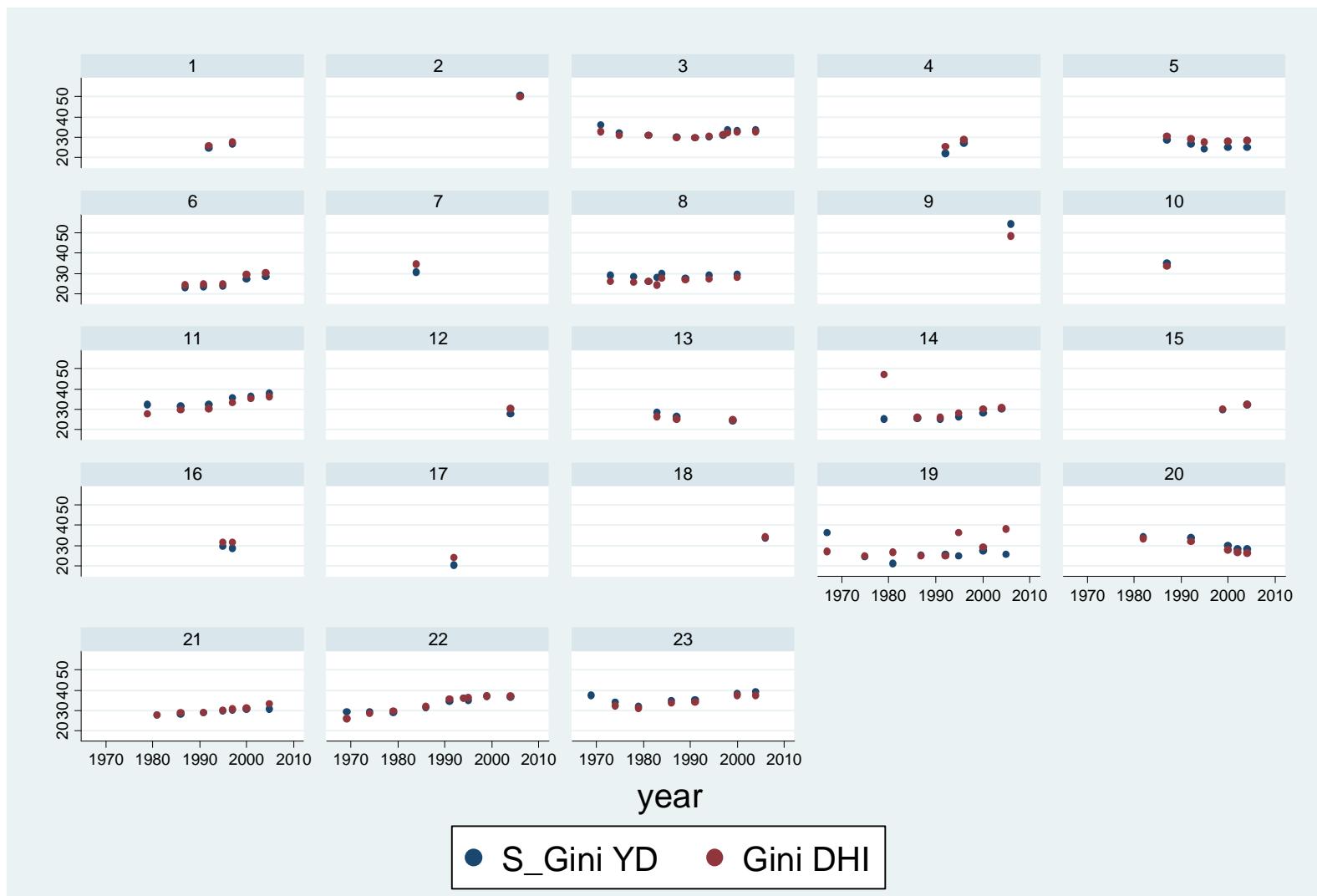
Note. Own elaboration from LIIs data. S_Gini YM is the Scervini (2012) series, Gini YM is our series.

Table B3. Disposable income Gini index



Note. Own elaboration from LIIs data. S_Gini YD is the Scervini (2012) series, Gini YD is our series.

Table B4. Disposable income Gini index, LIS DHI



Note. Own elaboration from LIIs data. S_Gini YM is the Scervini (2012) series, Gini DHI is disposable income available from LIS.

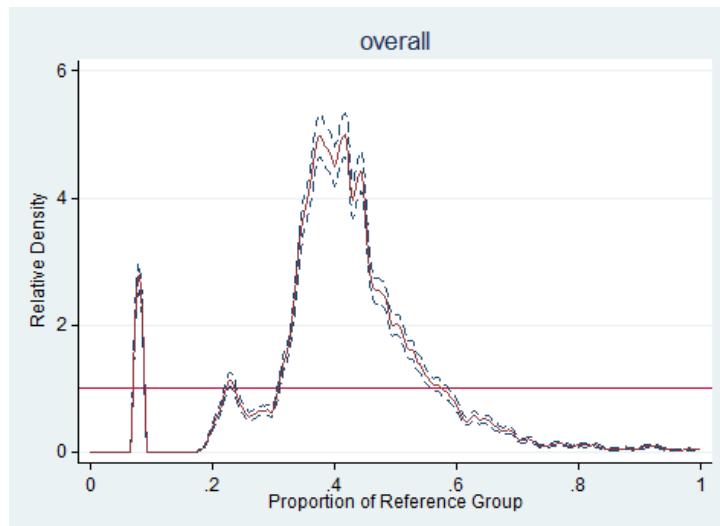
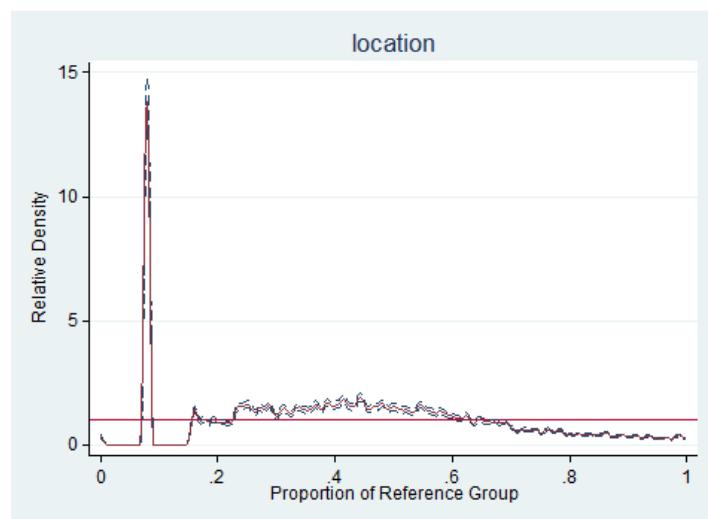
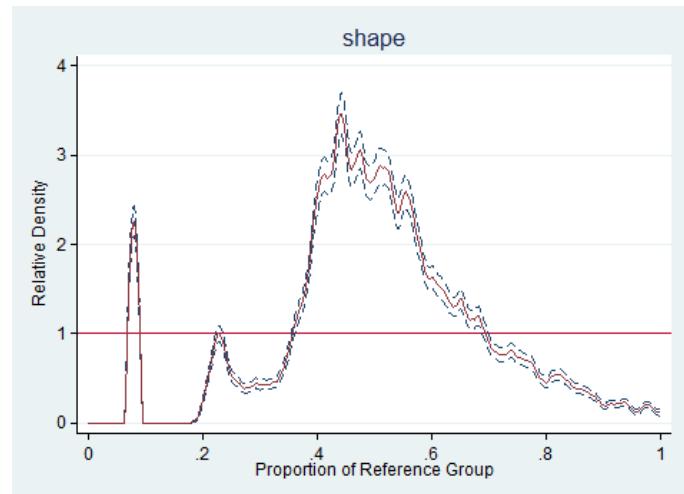
README

For each income variable, for each country and for each considered year t , there are three figures. In each panel the red line drawn at $y=1$ is the reference distribution referring to the year 2010. The blue line represent the relative distance, being the dotted blue lines the boundaries of the confidence interval. The three graphs illustrate respectively the shape, the location component, and the overall relative distance. The shape effect depicts the relative distance obtained by superimposing the probability distribution functions, keeping fixed the position of the distribution and focusing on the differences in the shape. The location effect, on the other hand, illustrates the effect of a shift leftward or rightward of the income distribution, keeping the curvature fixed. Since the graphs tell the same story in a different way, for sake of conciseness we focus the comments on the RP indexes.

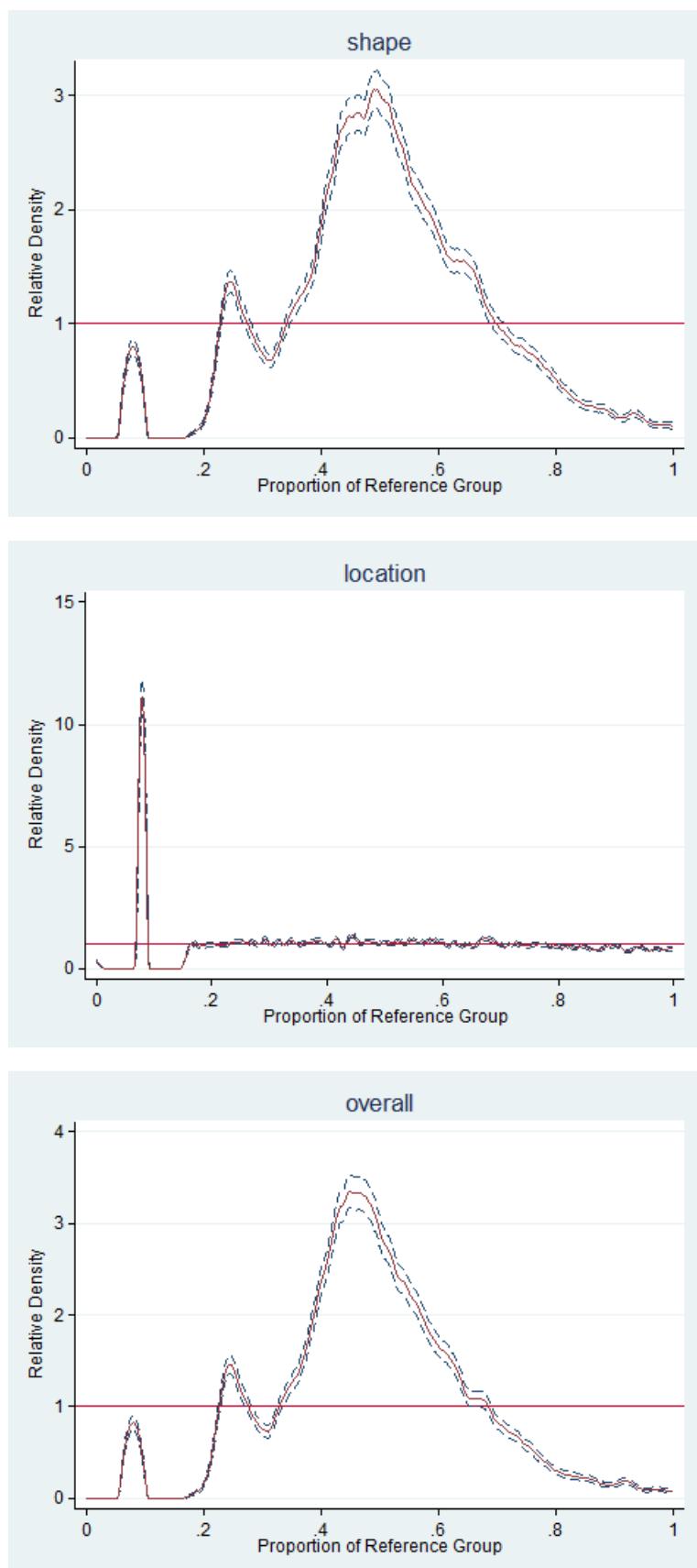
APPENDIX C1: RELATIVE DISTRIBUTION GRAPHS, EX-ANTE INCOME

C1.1 United Kingdom

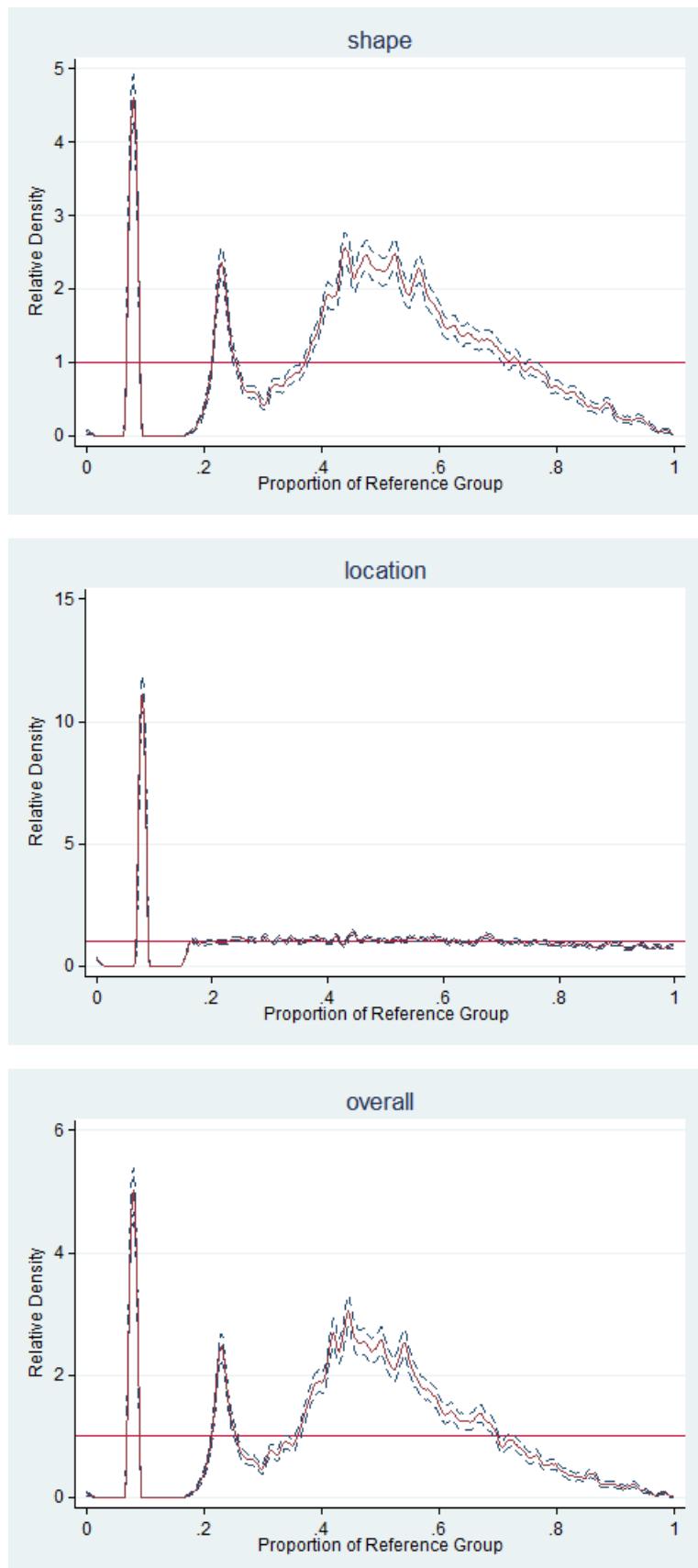
1969



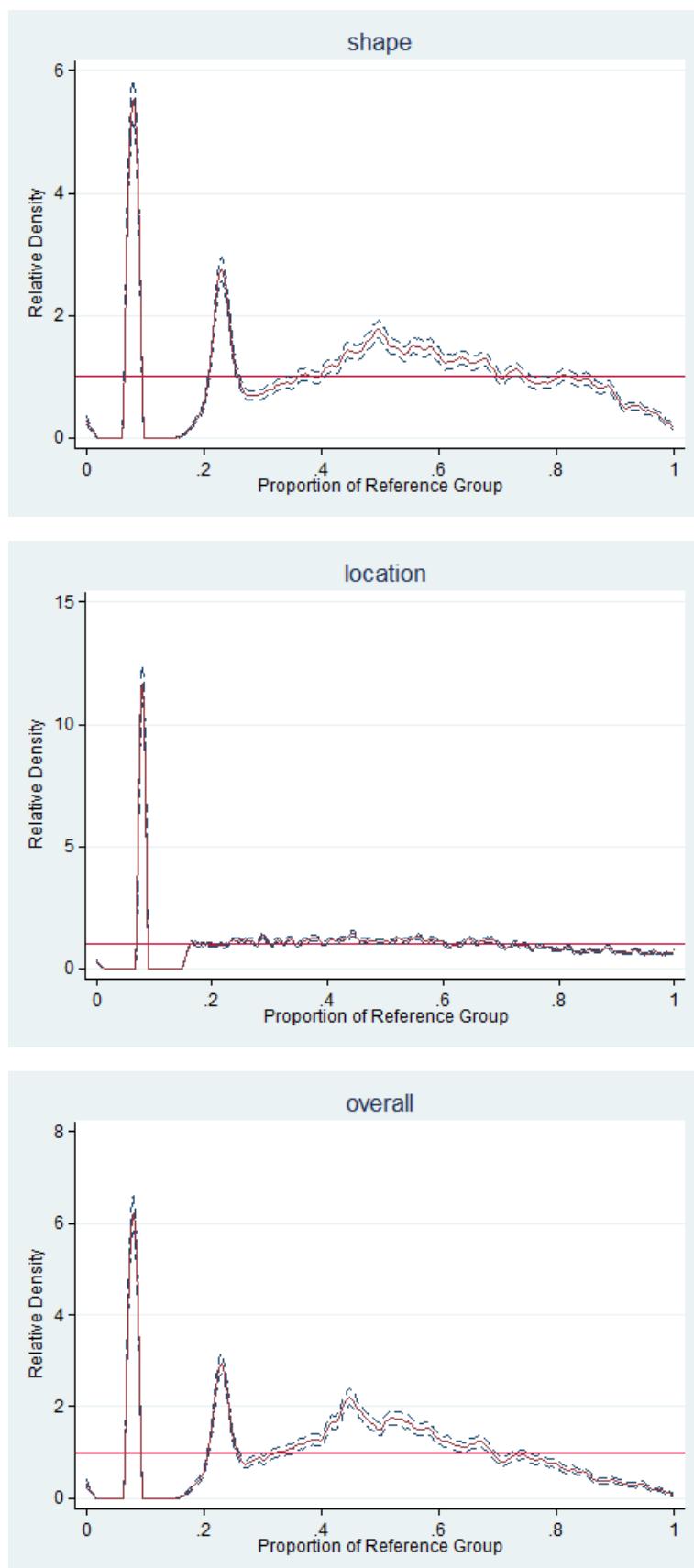
1974



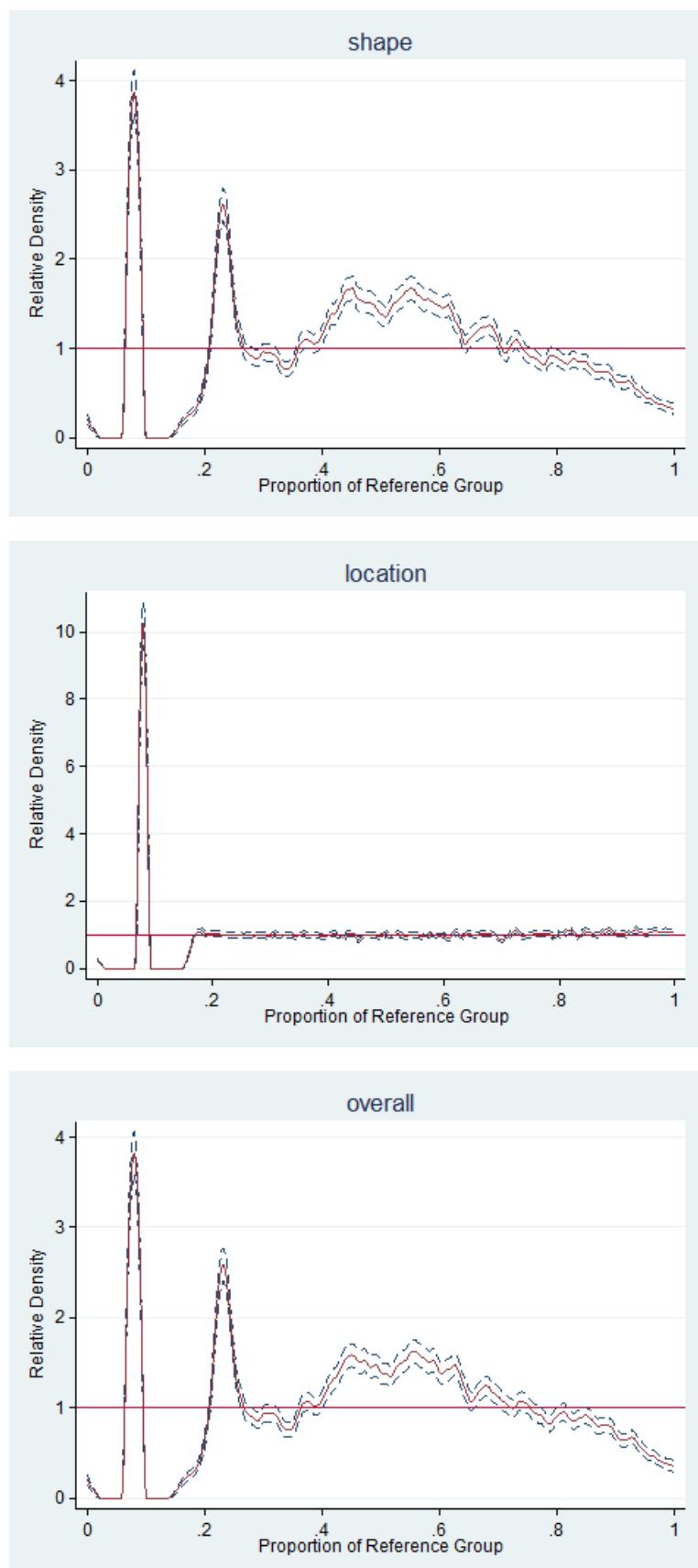
1979



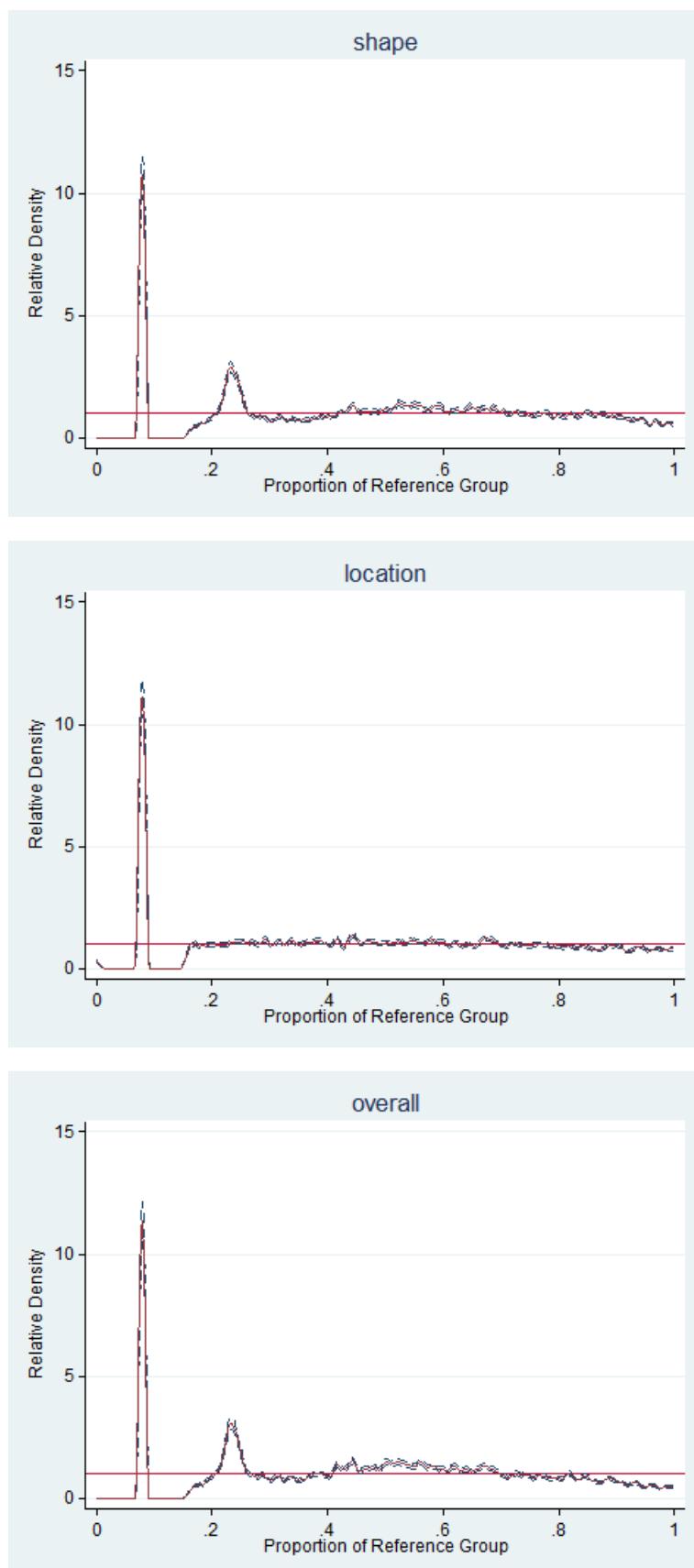
1986



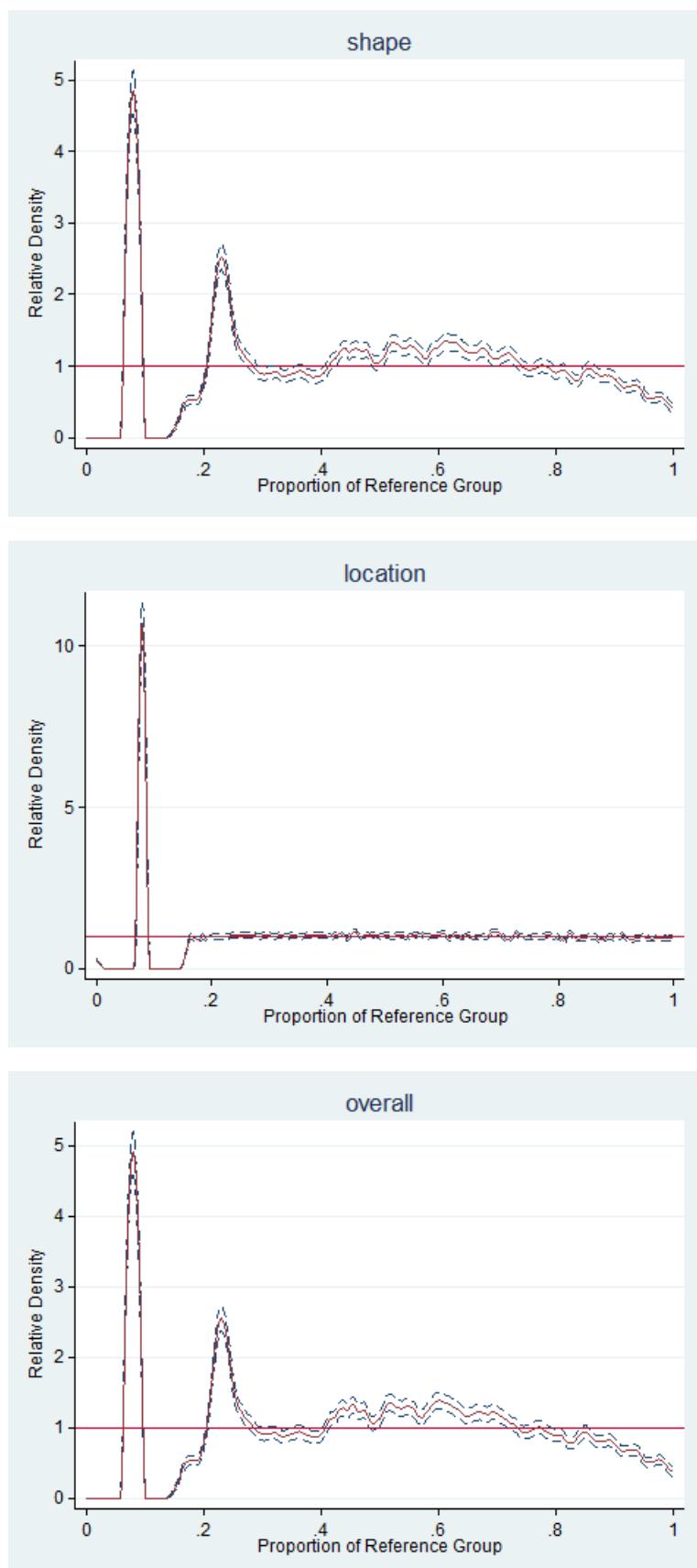
1991



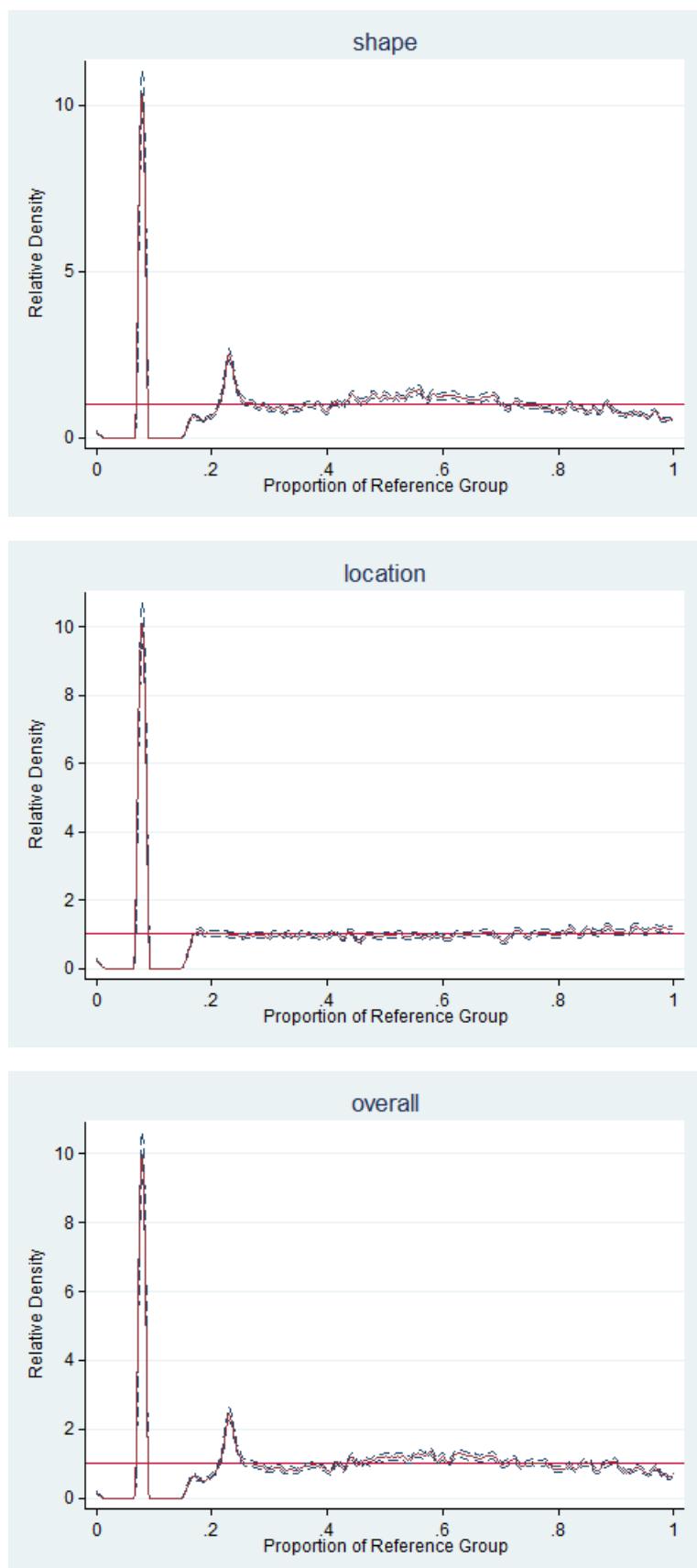
1994



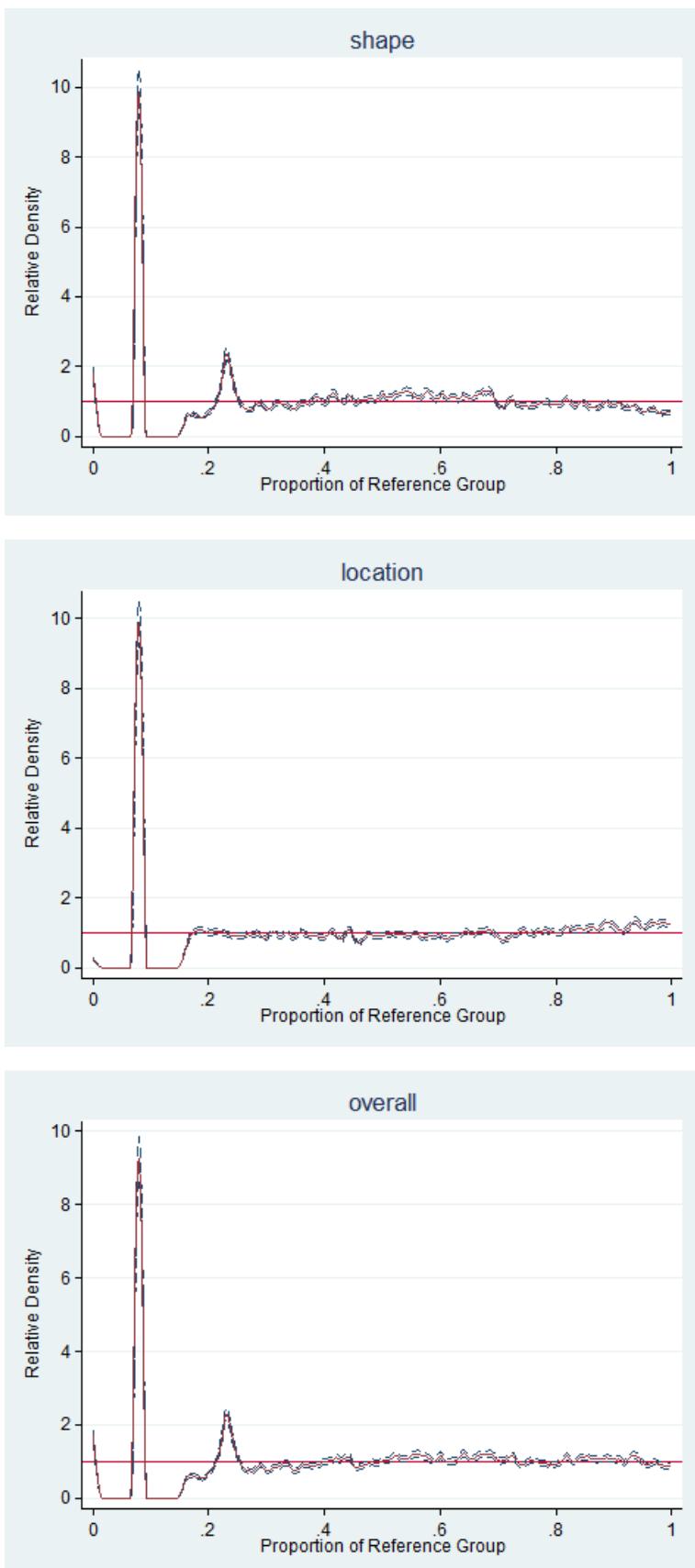
1995



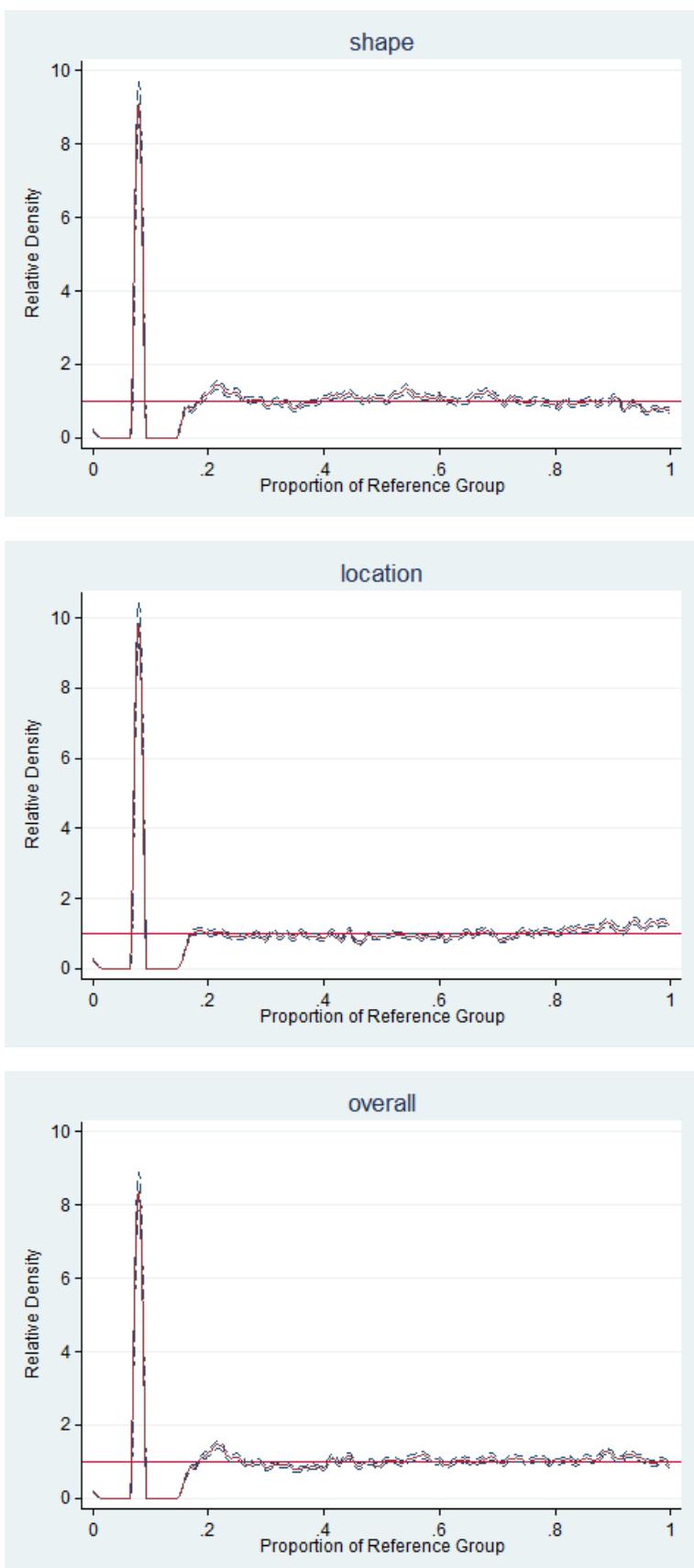
1999



2004

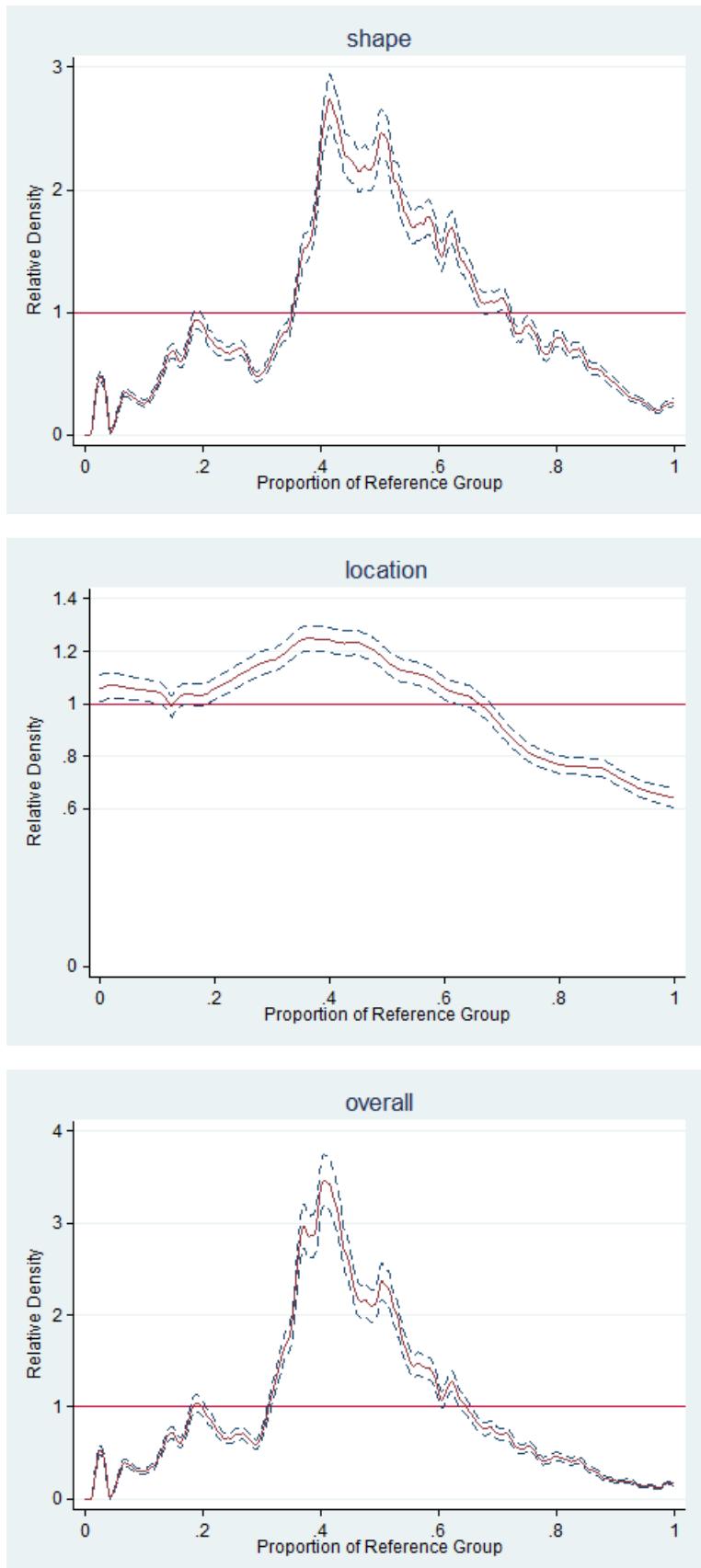


2007

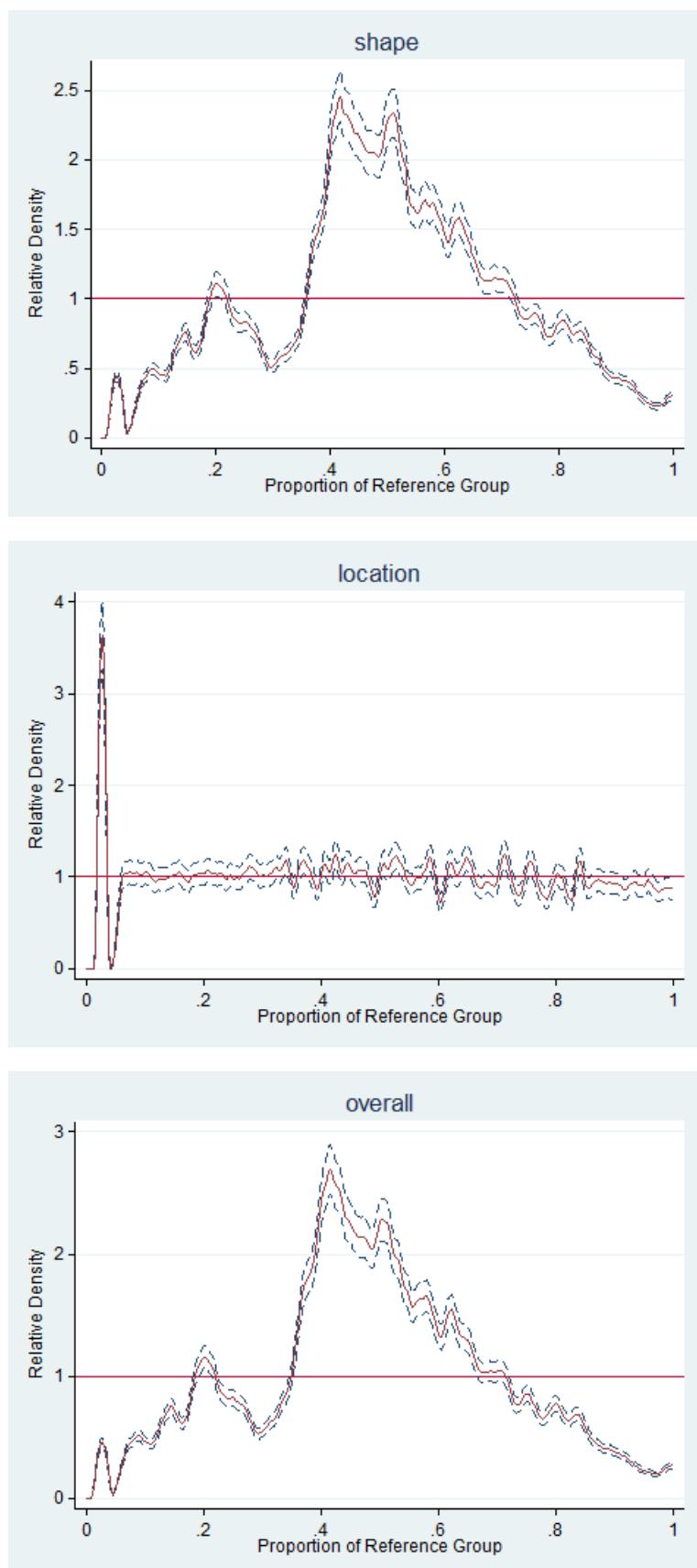


C1.2 Germany

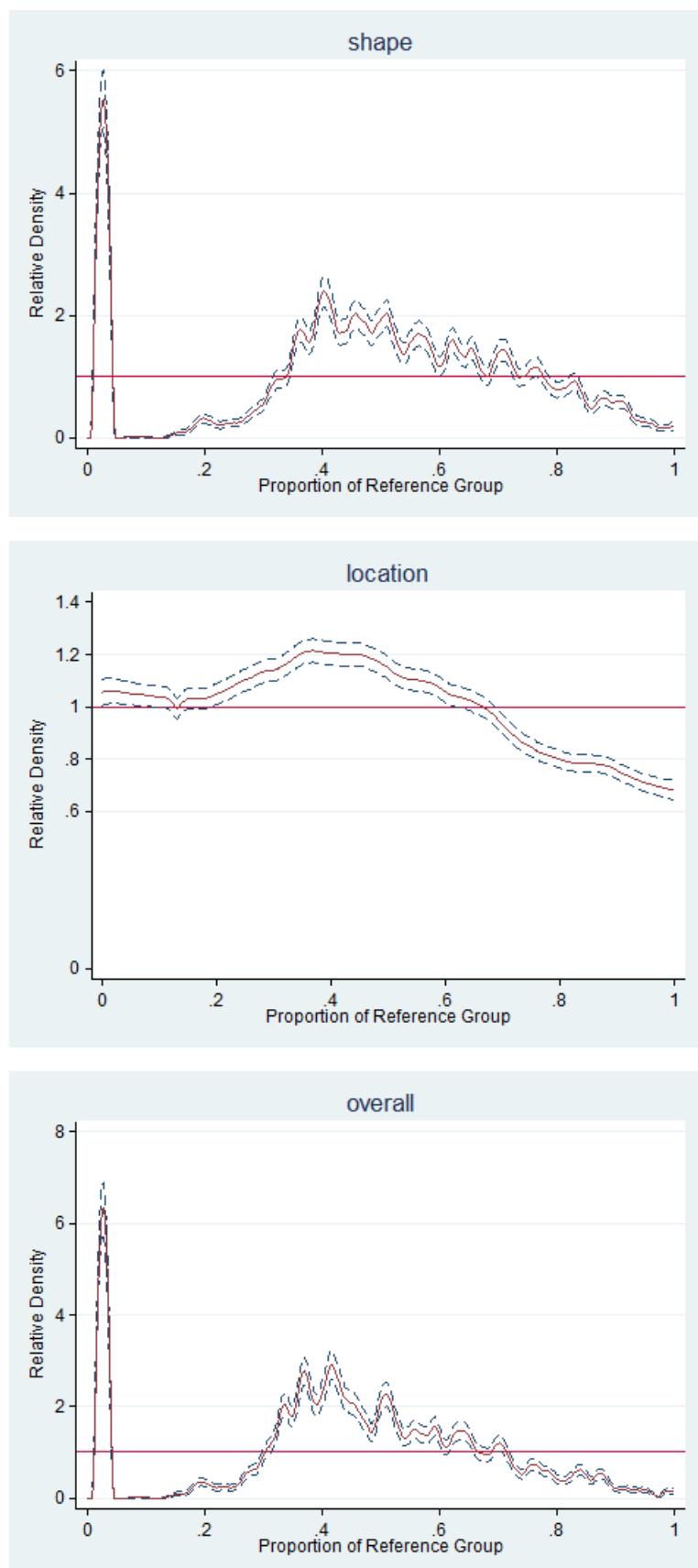
1973



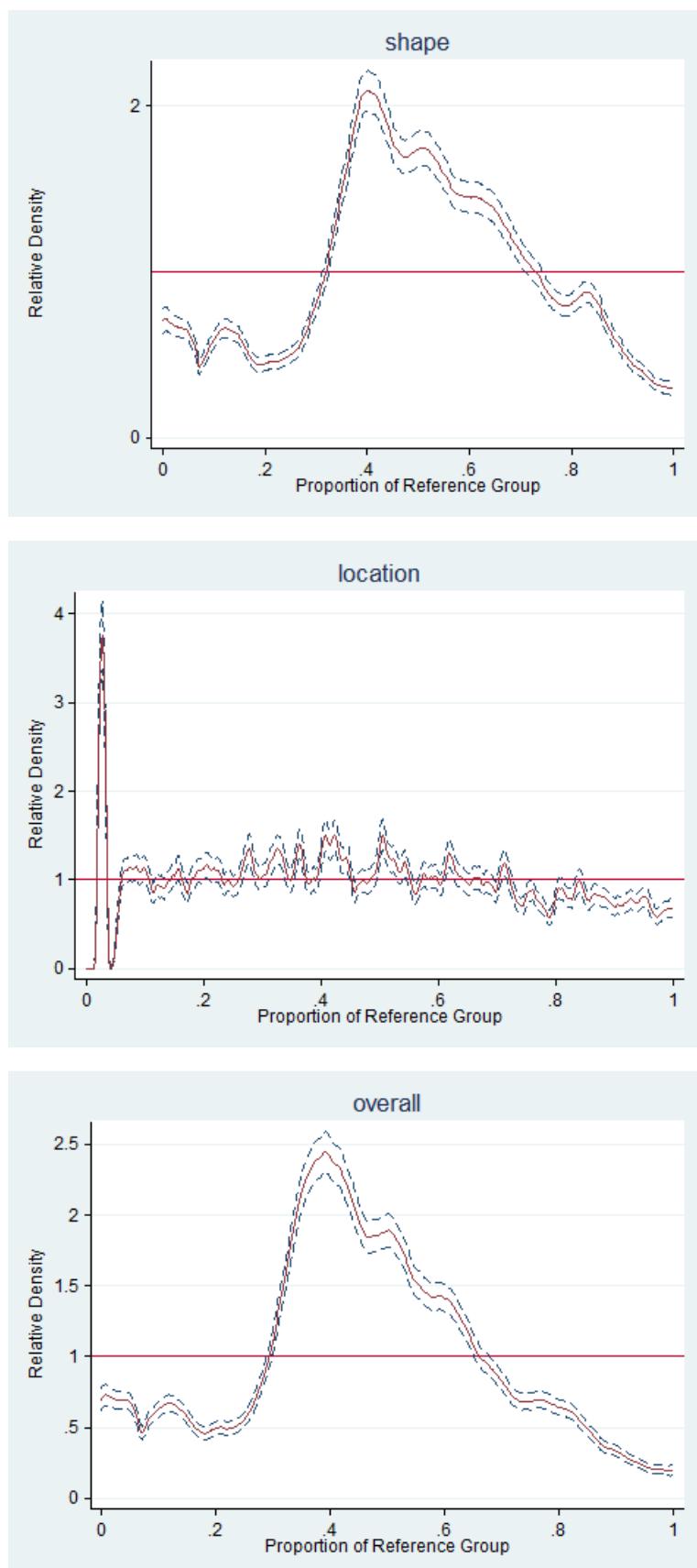
1978



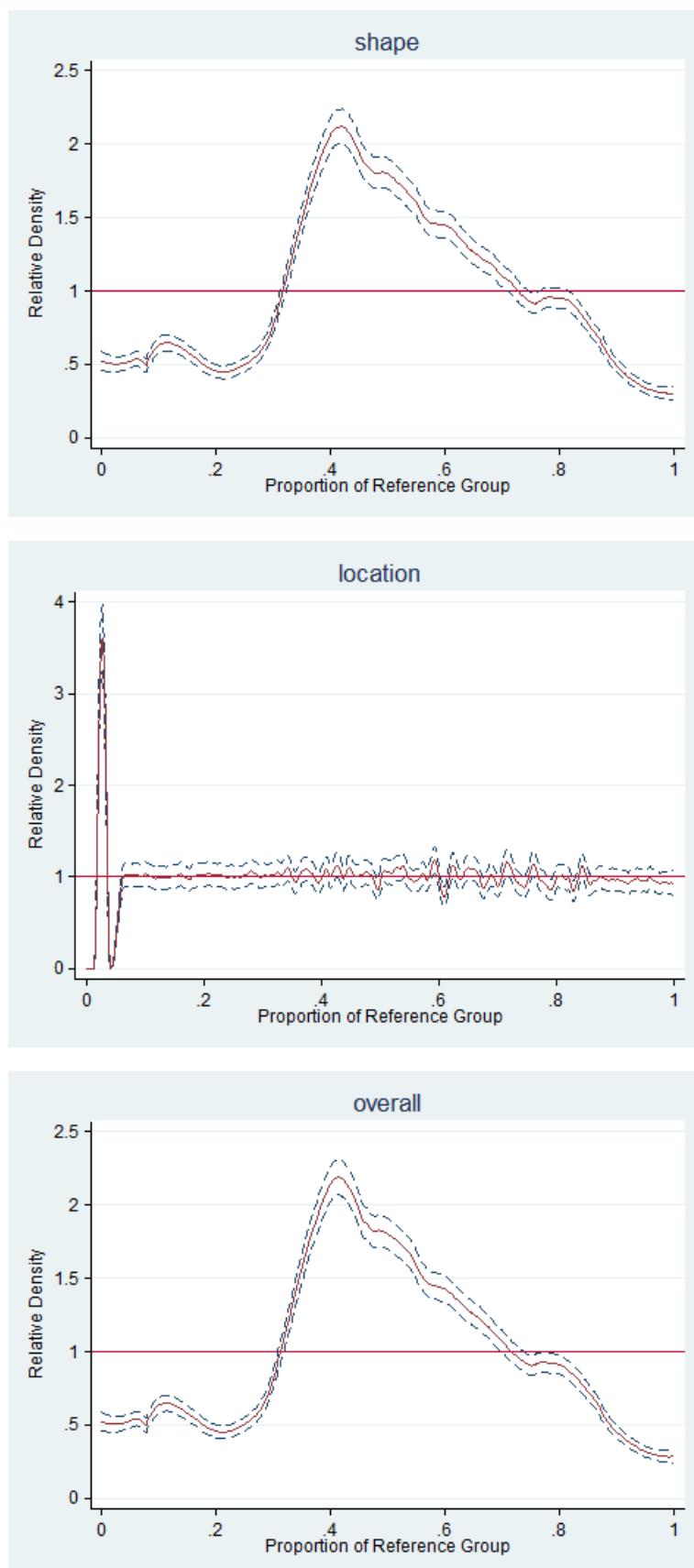
1981



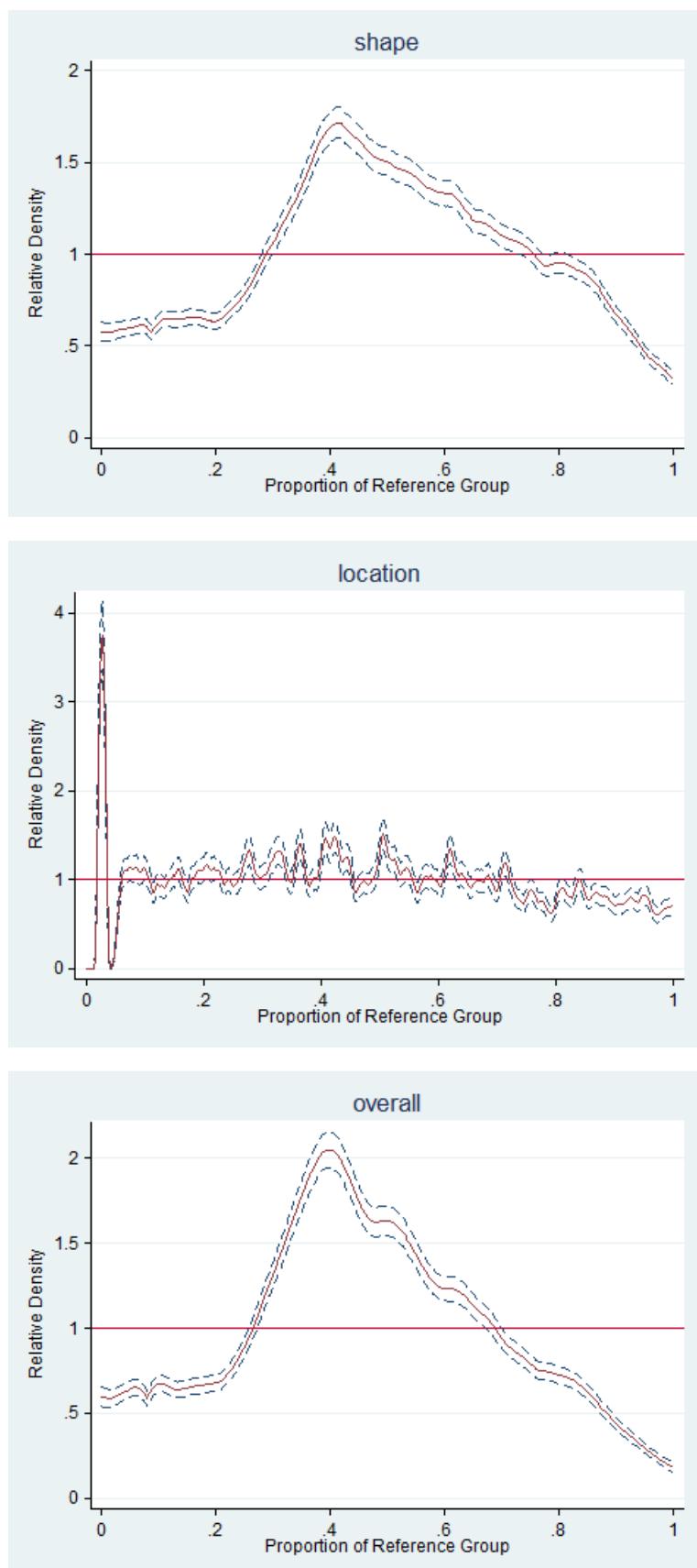
1983



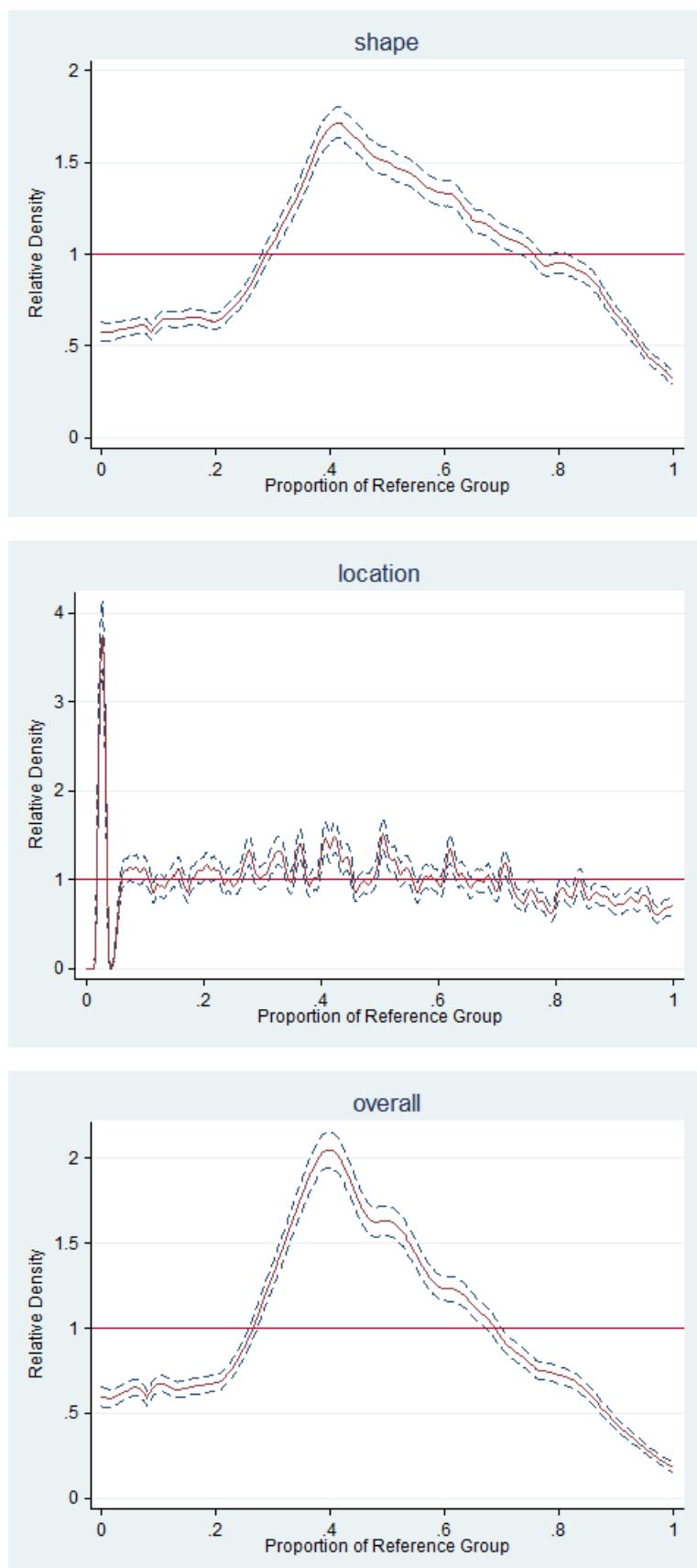
1984



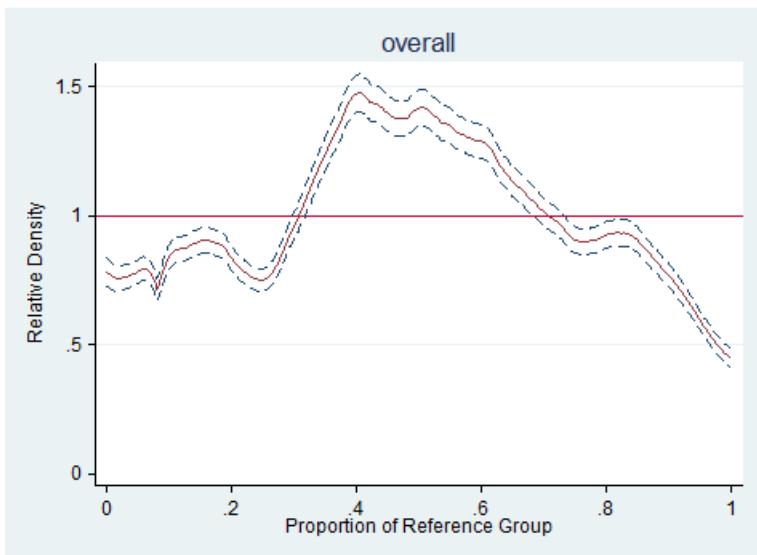
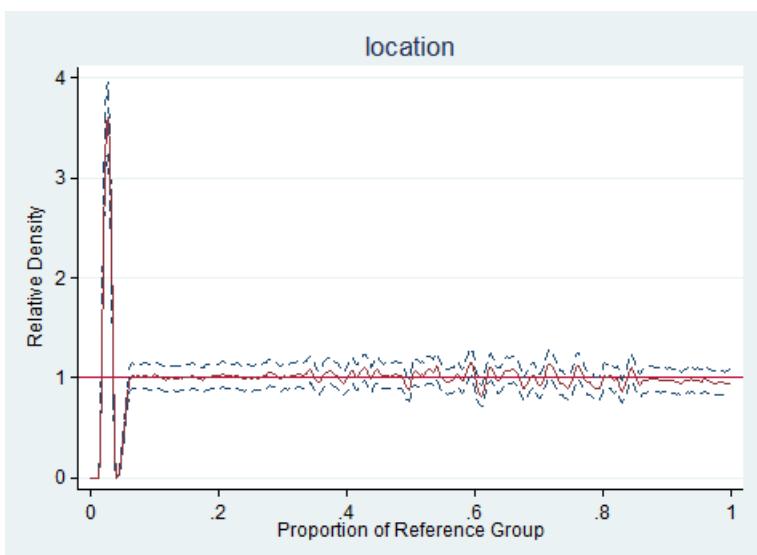
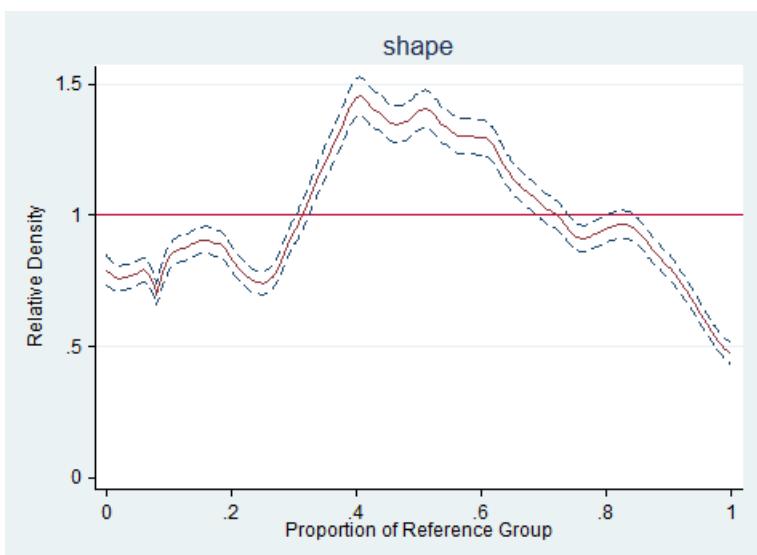
1989



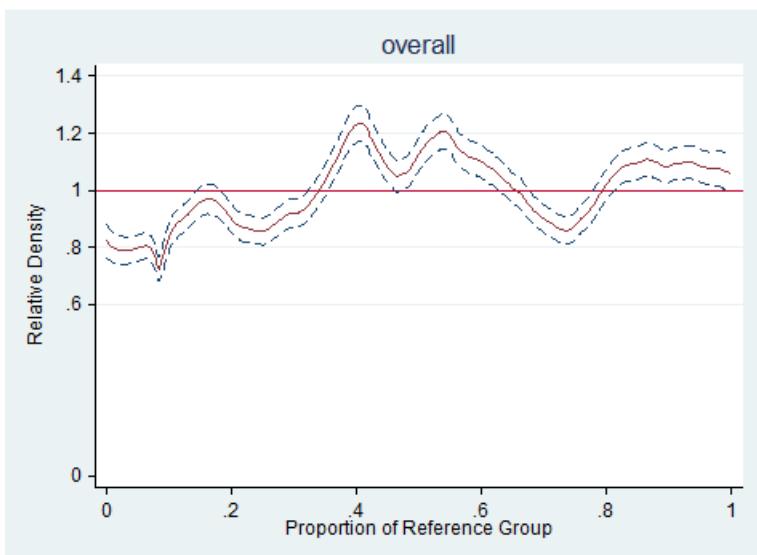
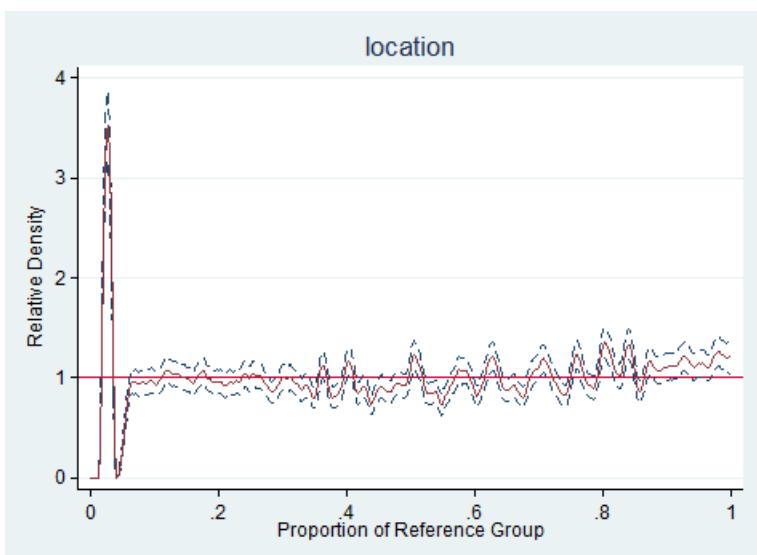
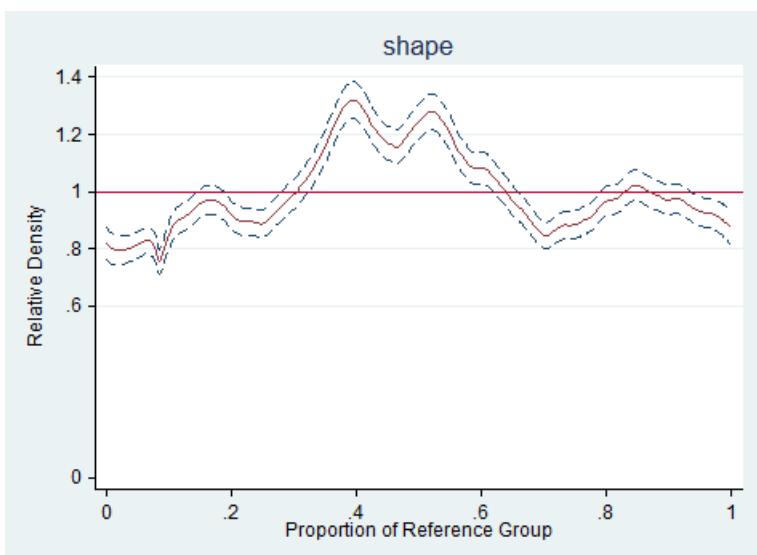
1994



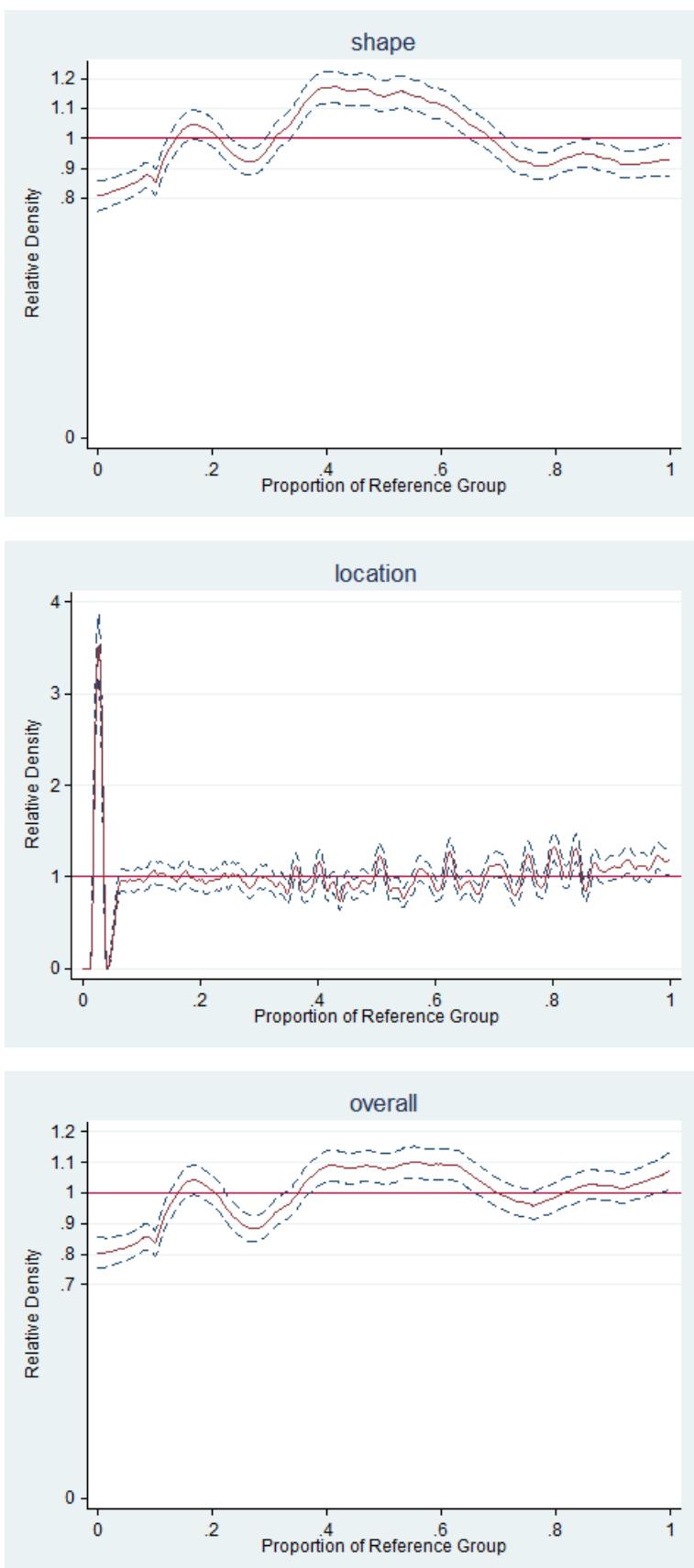
2000



2004

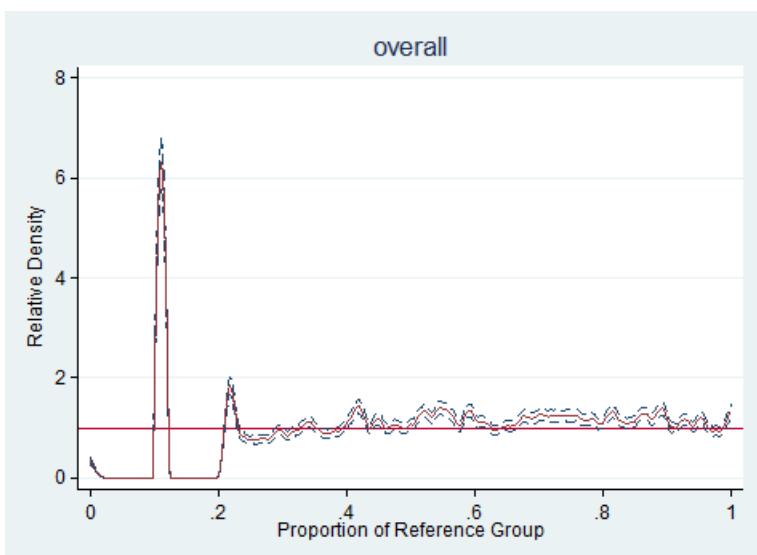
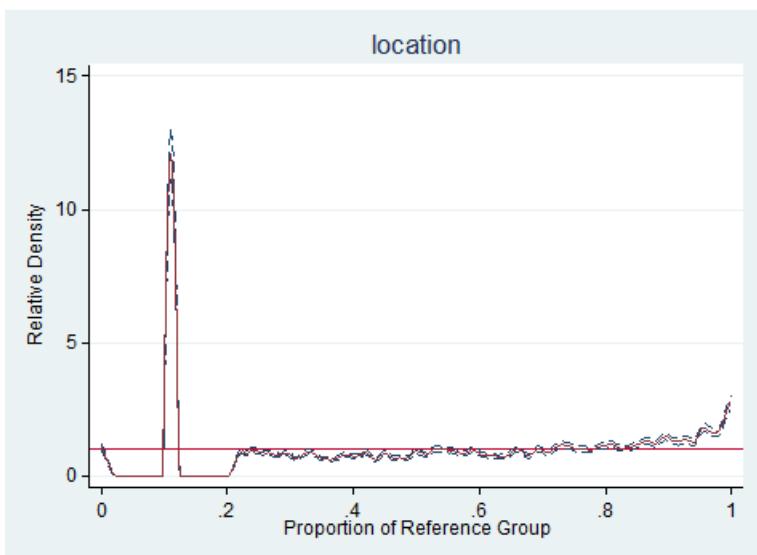
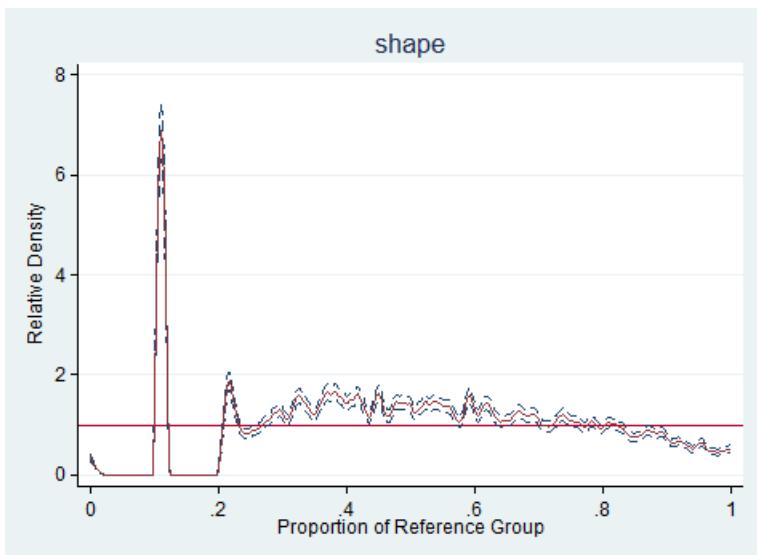


2007



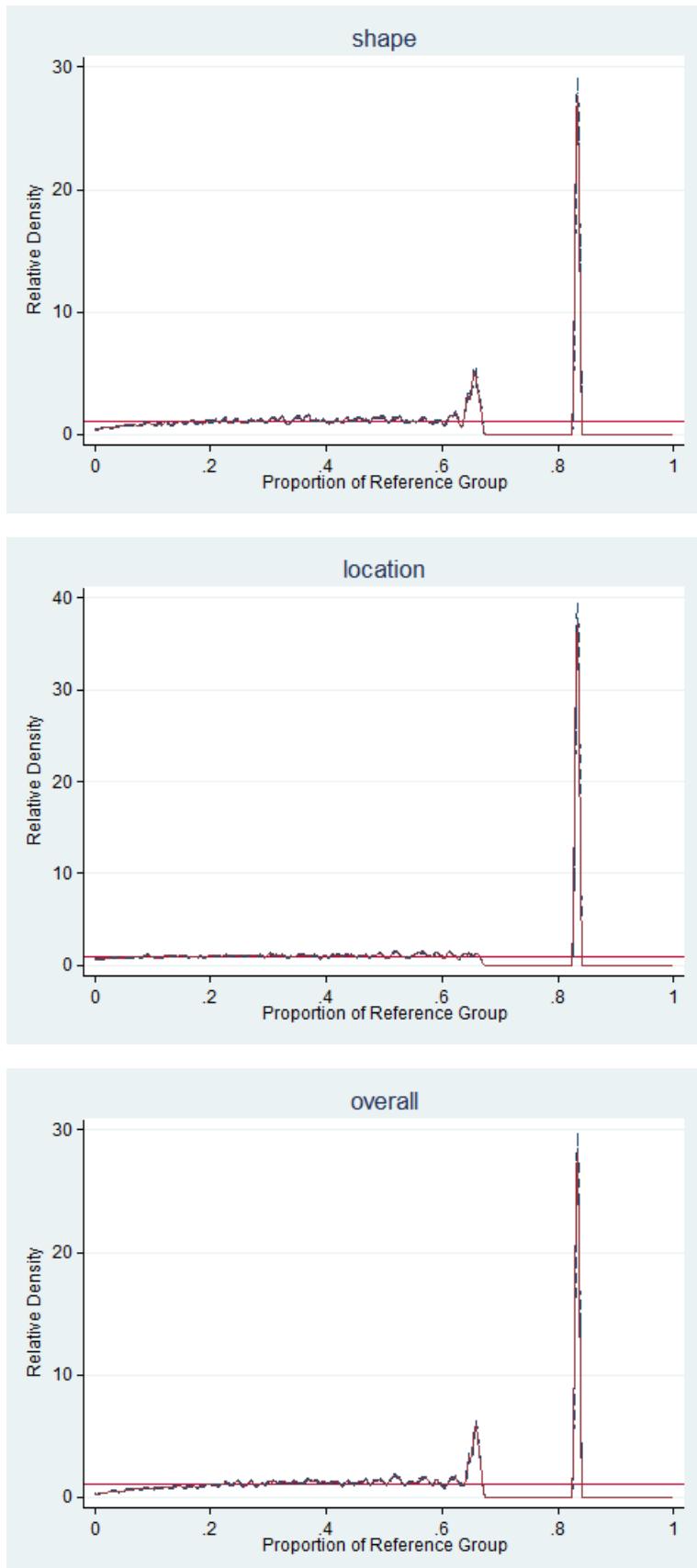
C1.3 Spain

2007

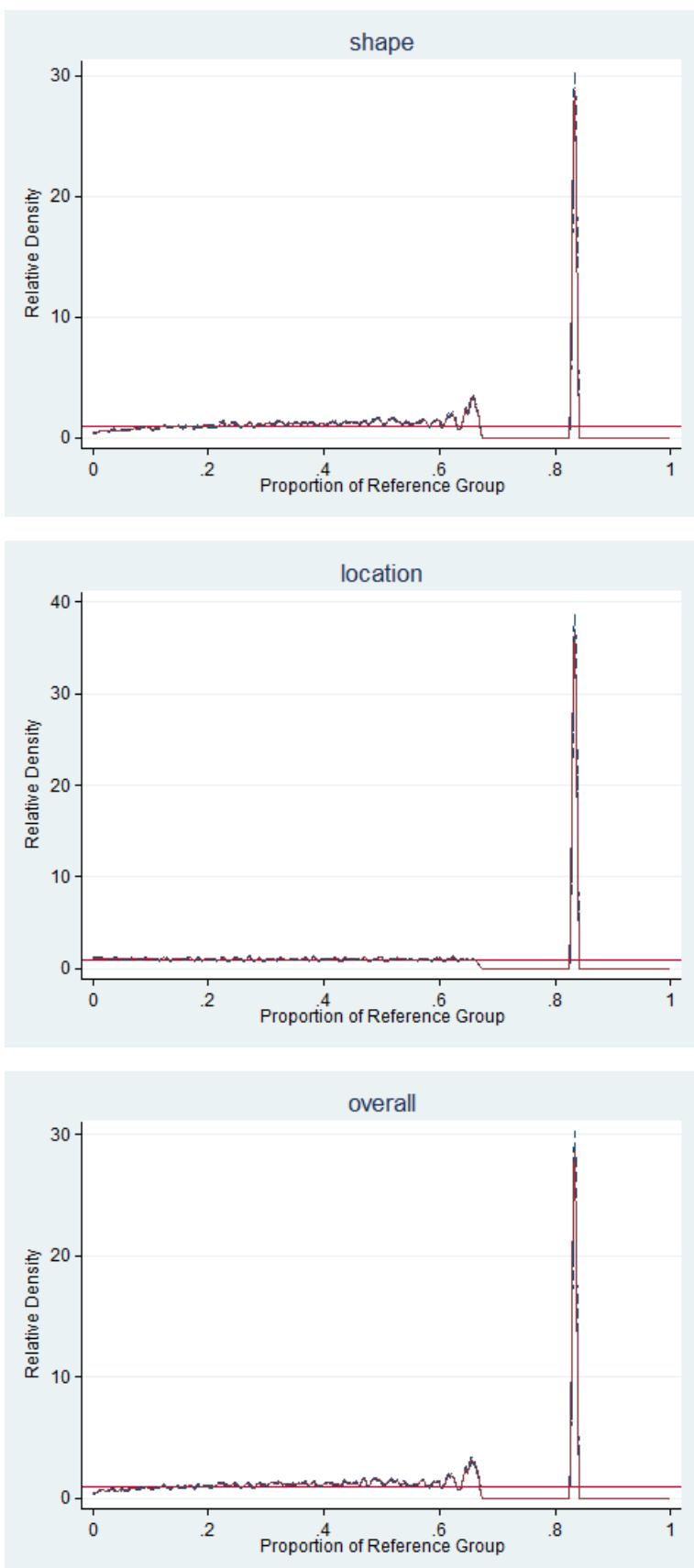


C1.4 Poland

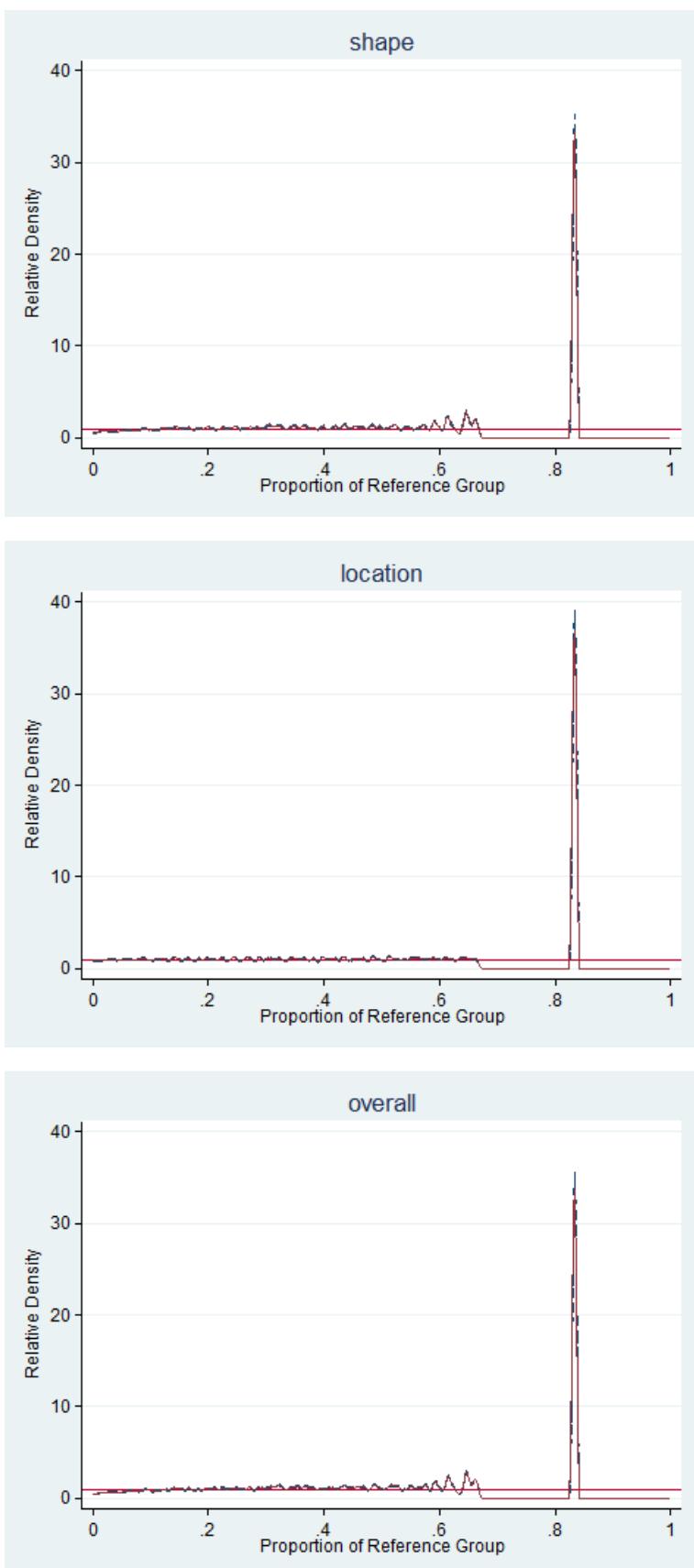
1999



2004



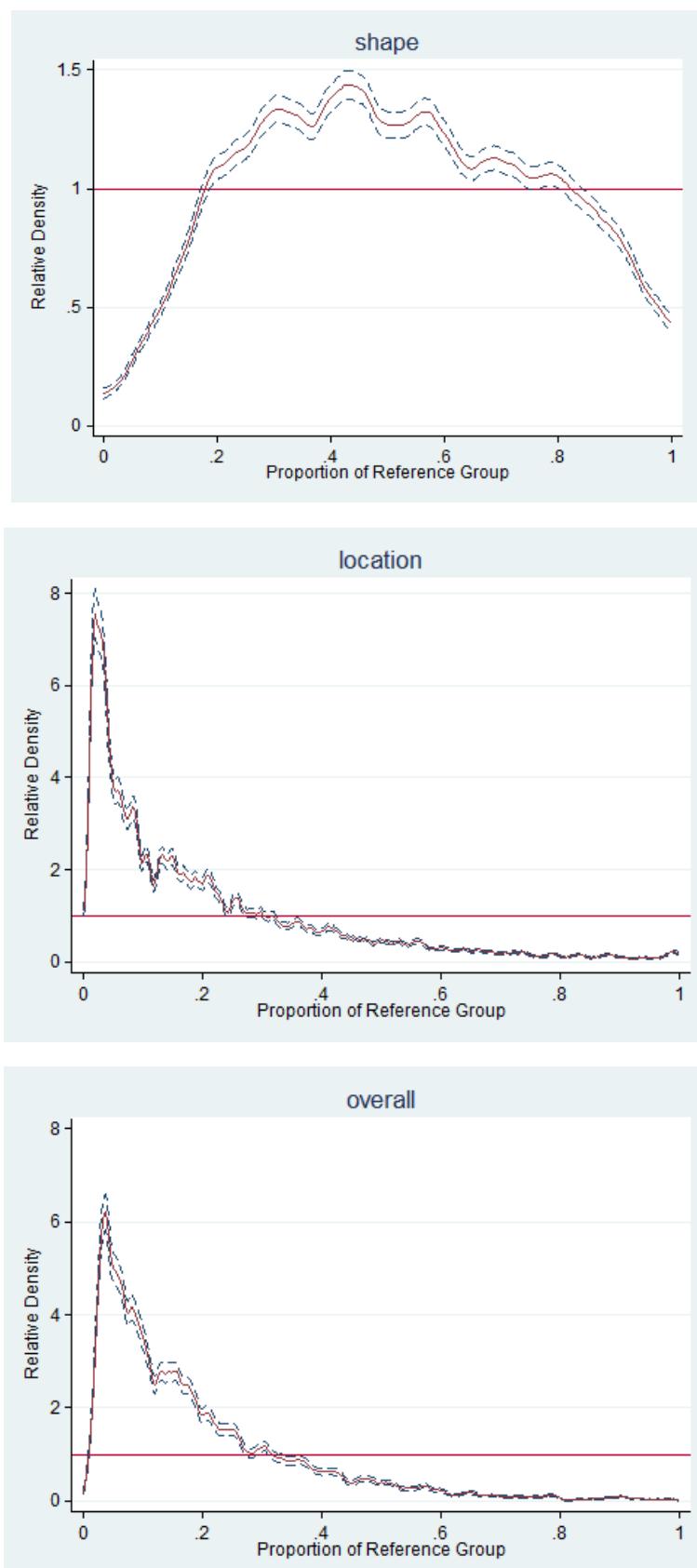
2007



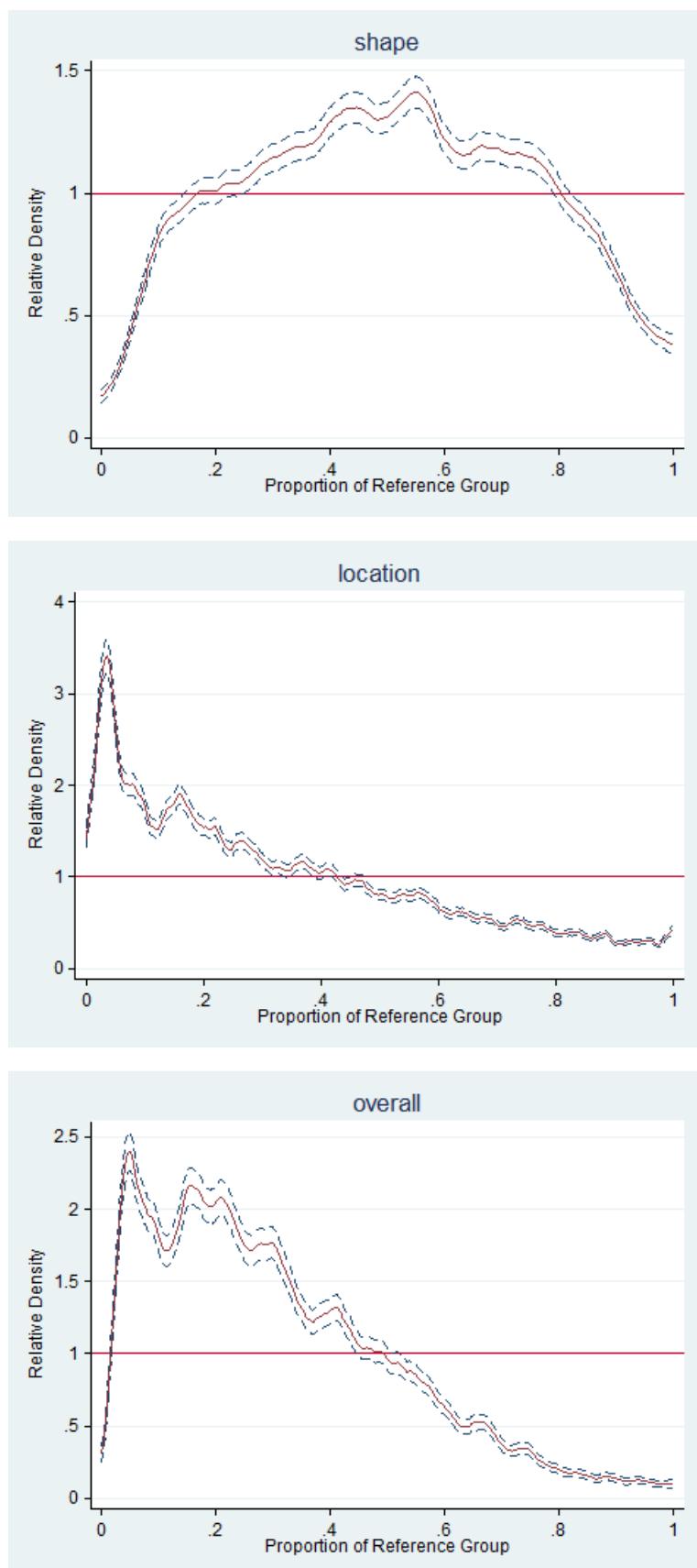
APPENDIX C2: RELATIVE DISTRIBUTION GRAPHS, EX POST INCOME

C2.1 United Kingdom

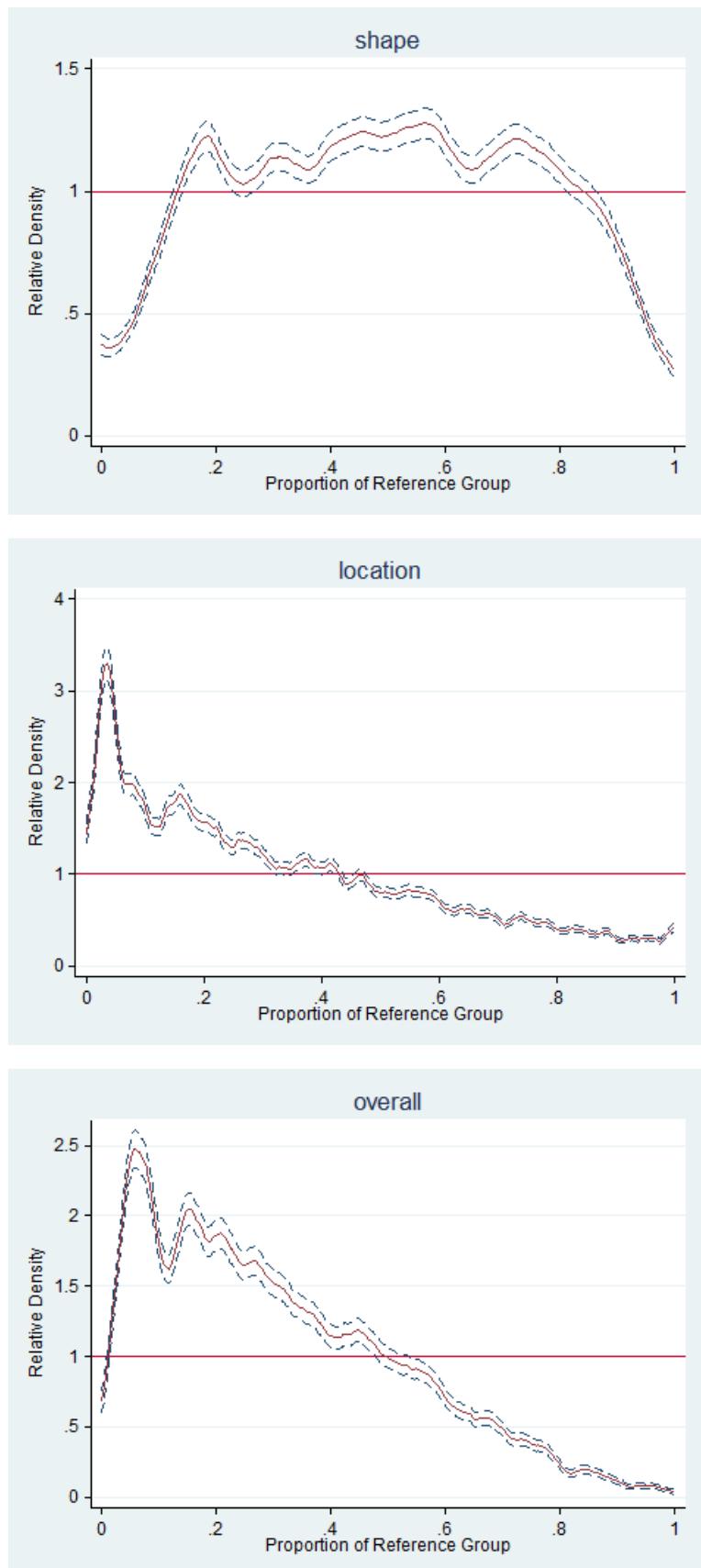
1969



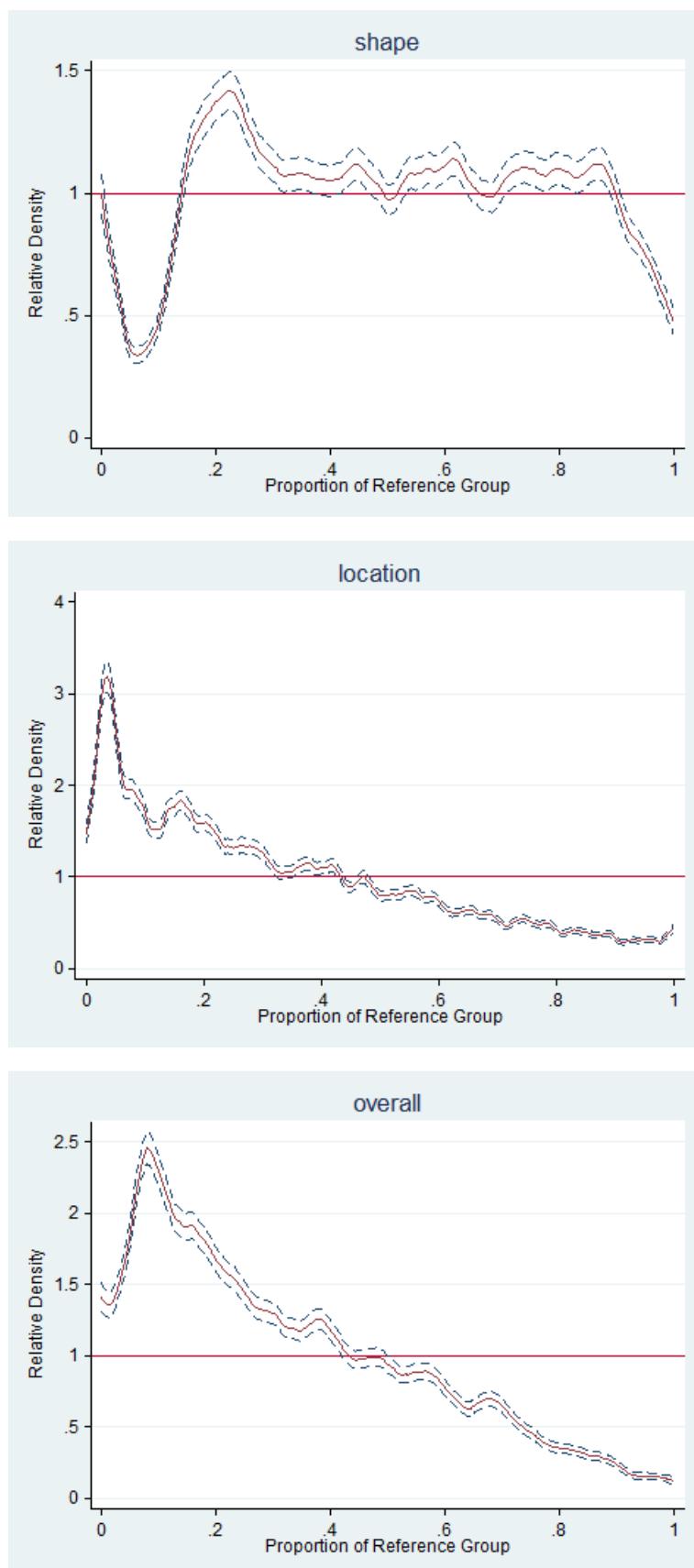
1974



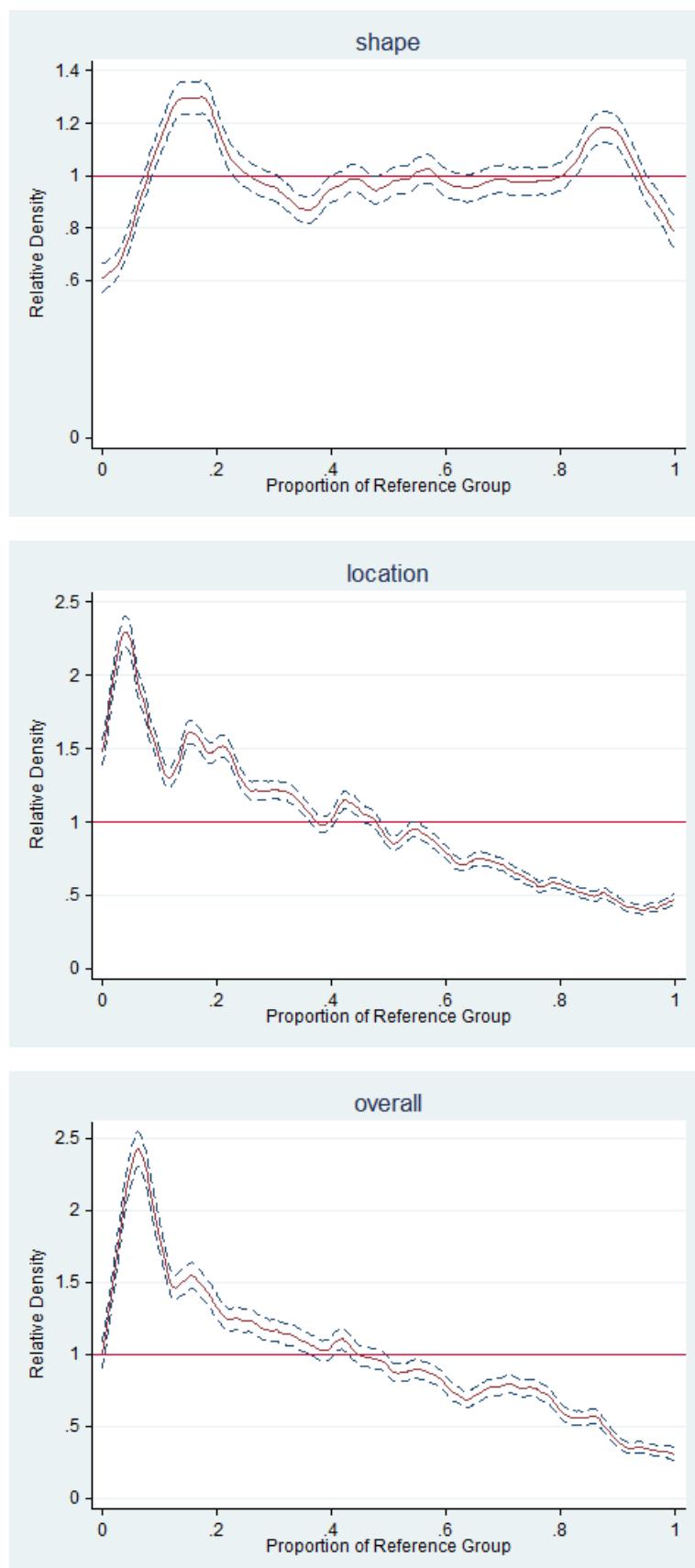
1979



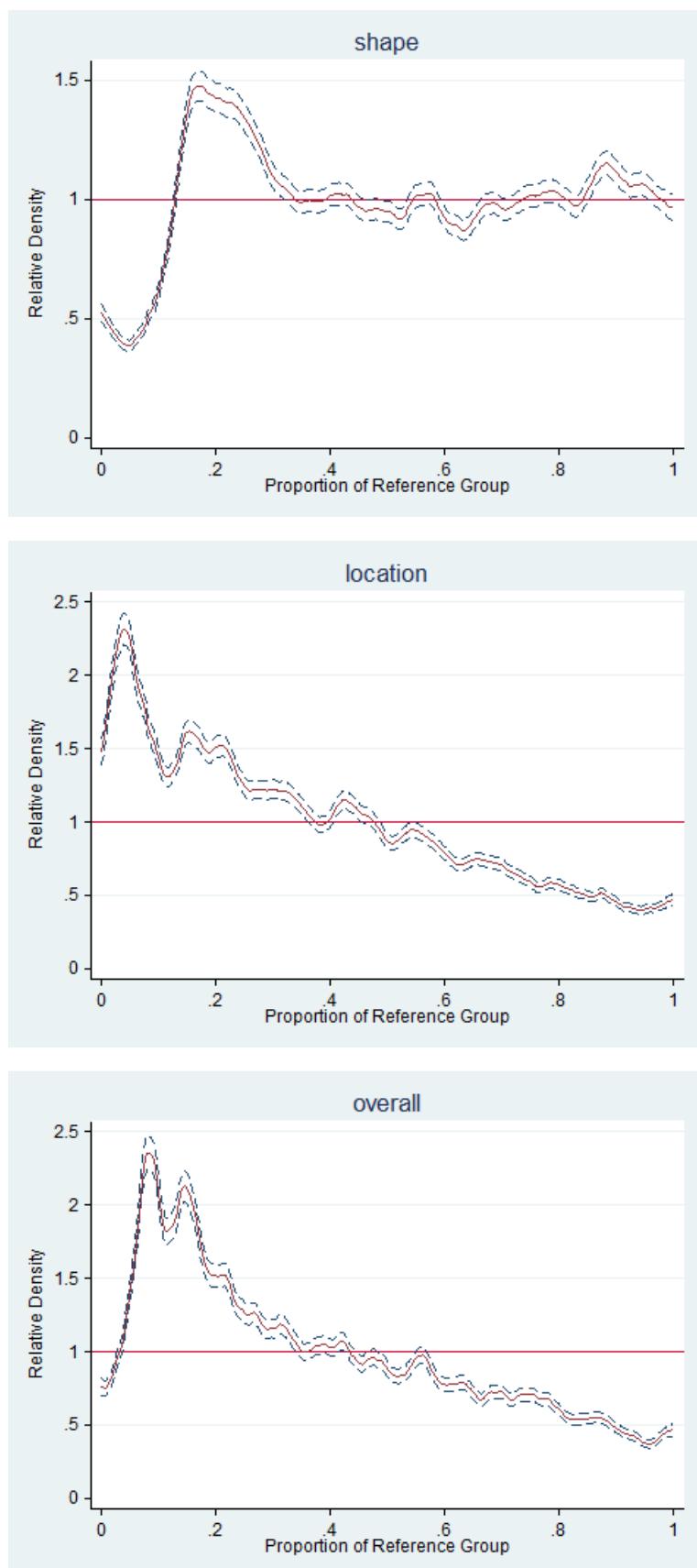
1986



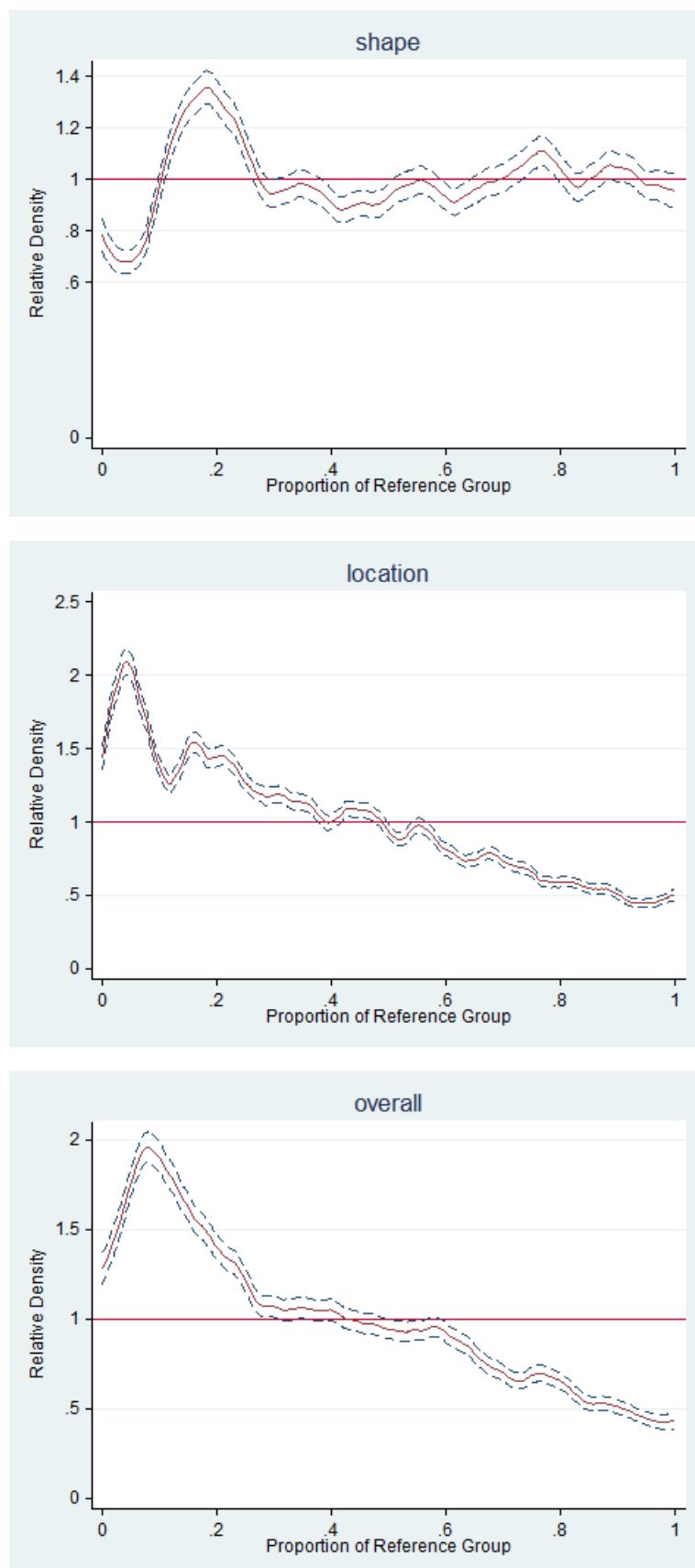
1991



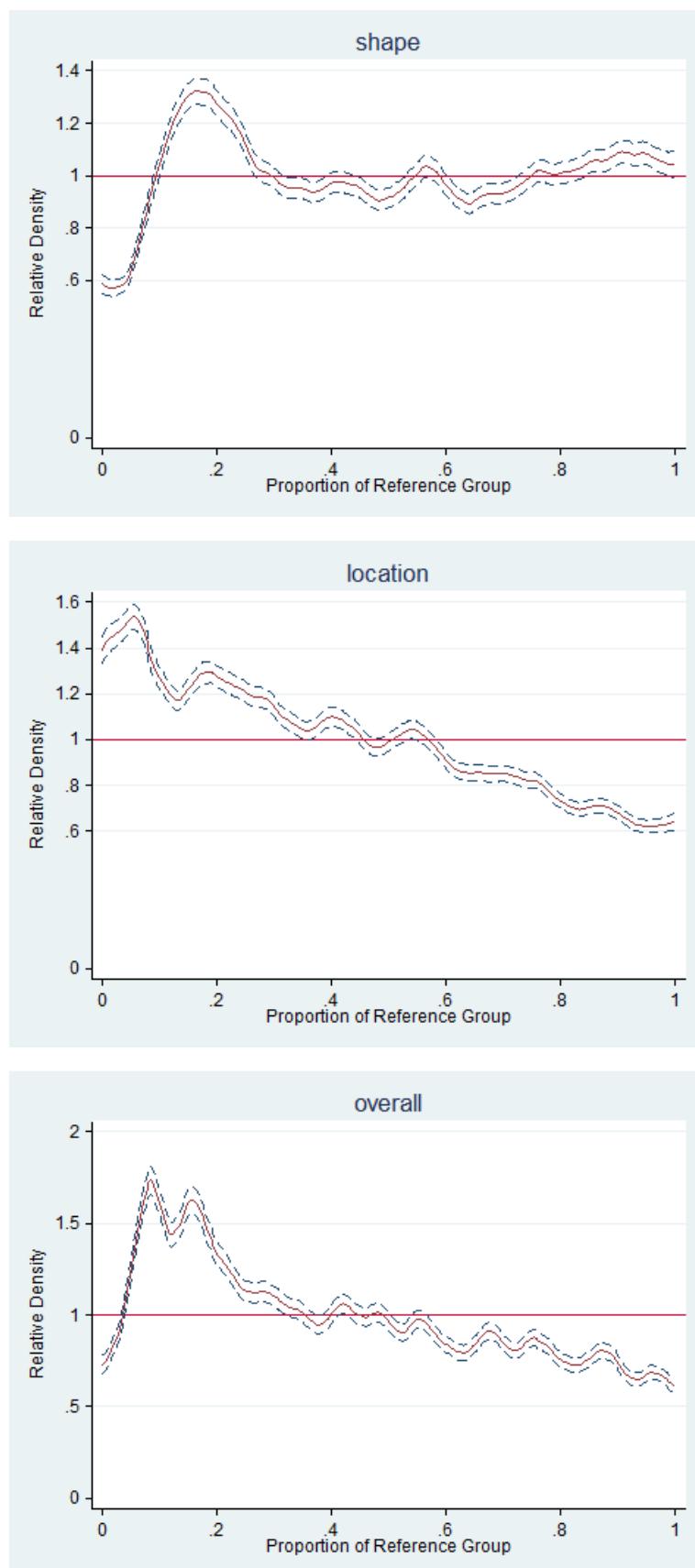
1994



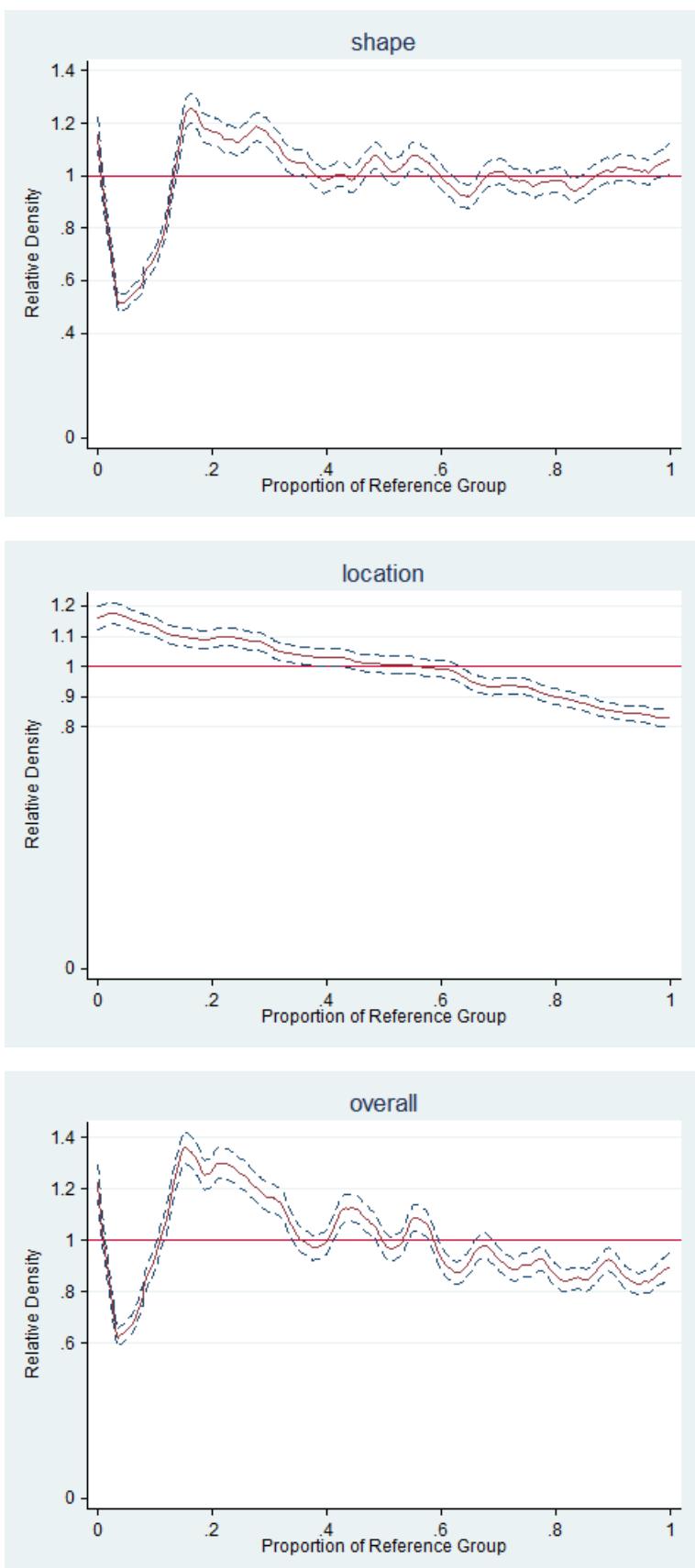
1995



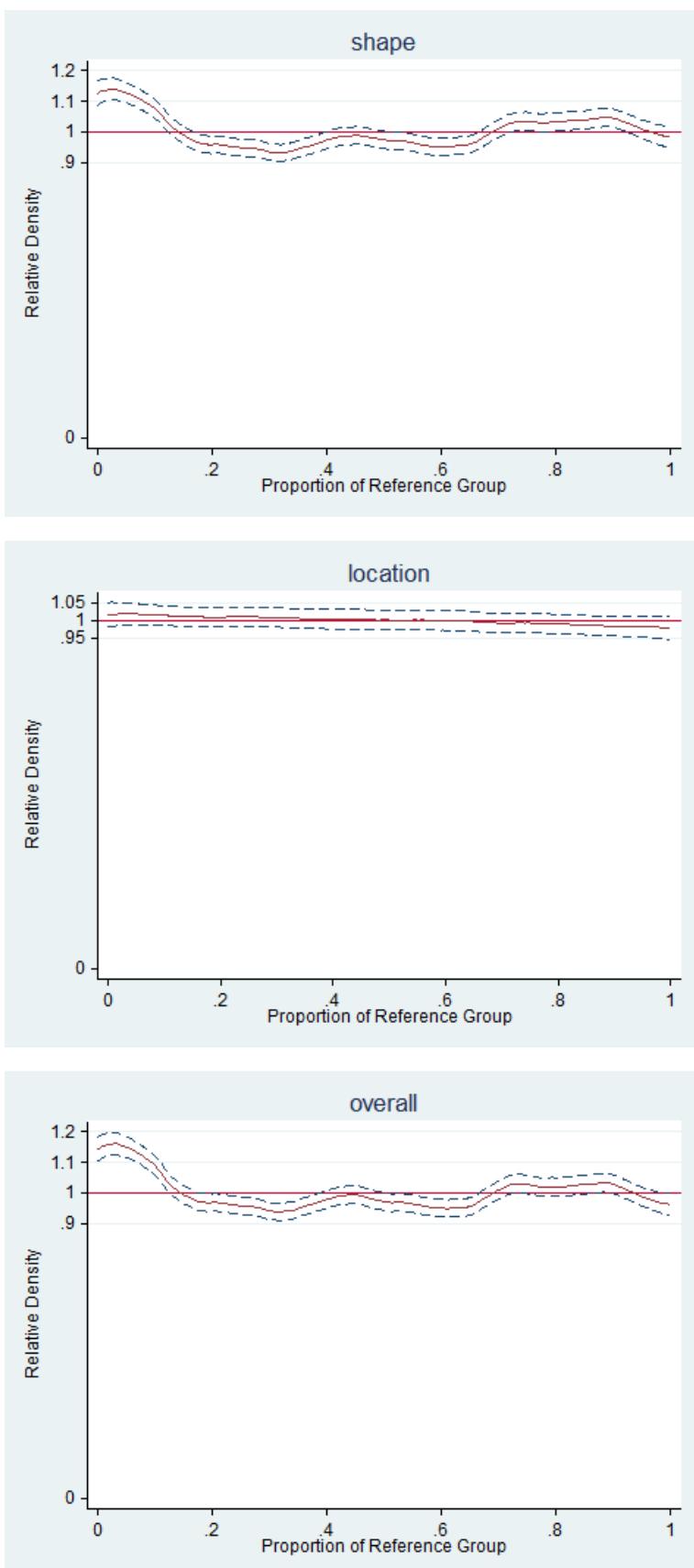
1999



2004

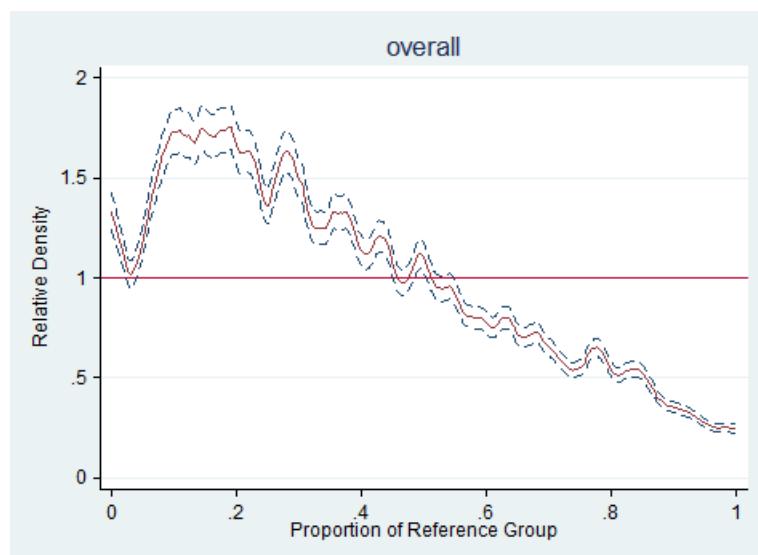
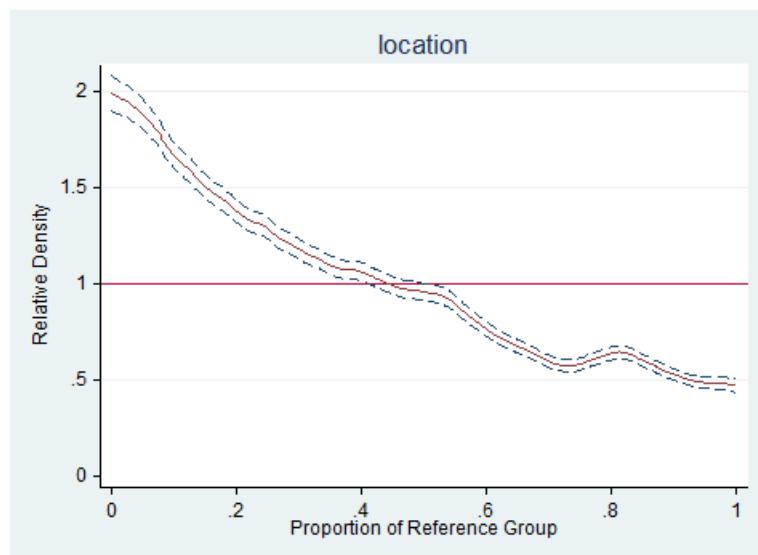
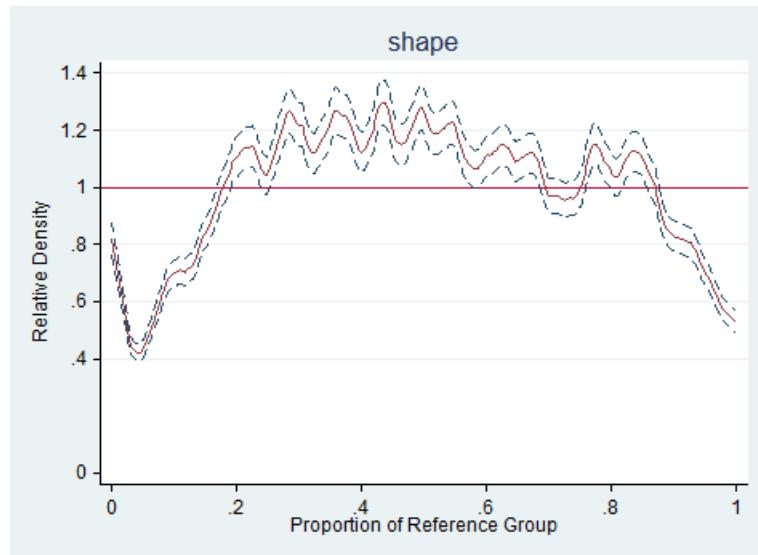


2007

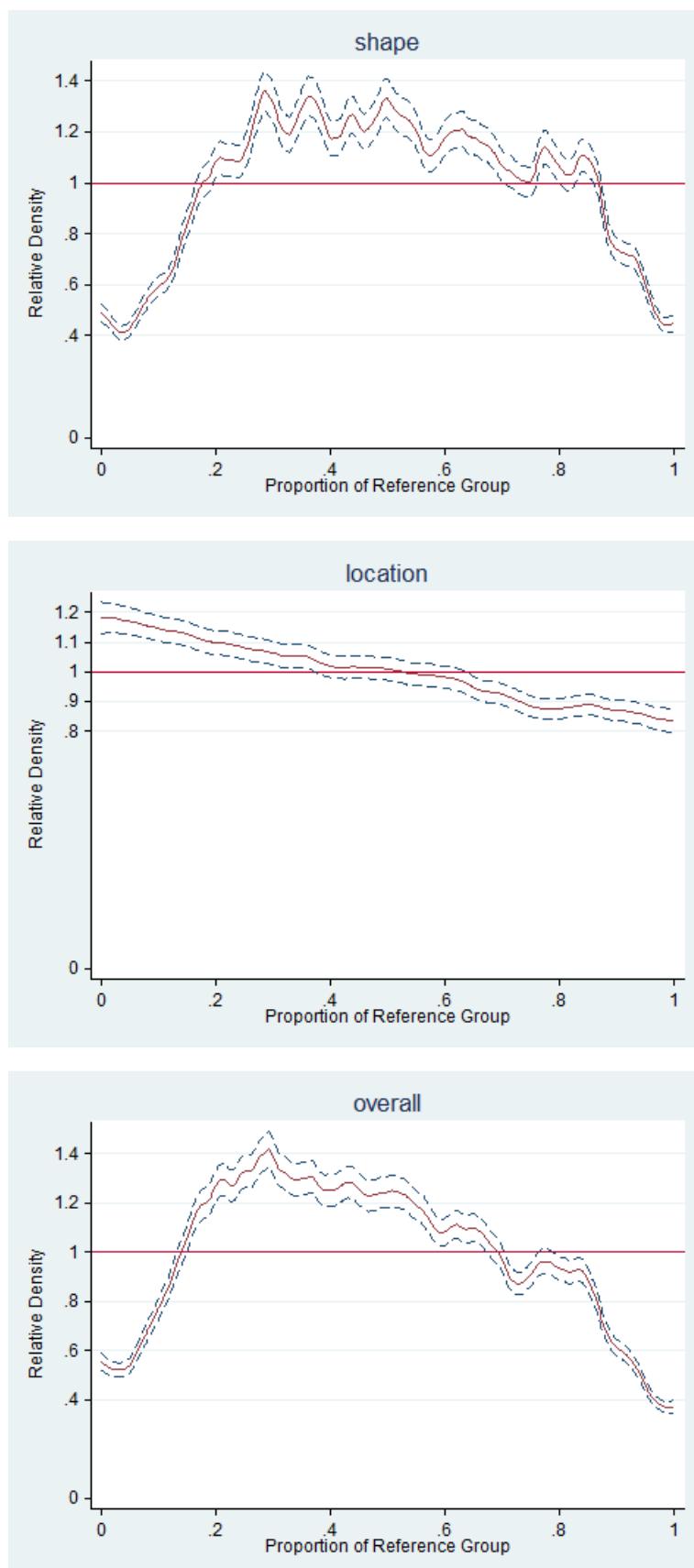


C2.2. Germany

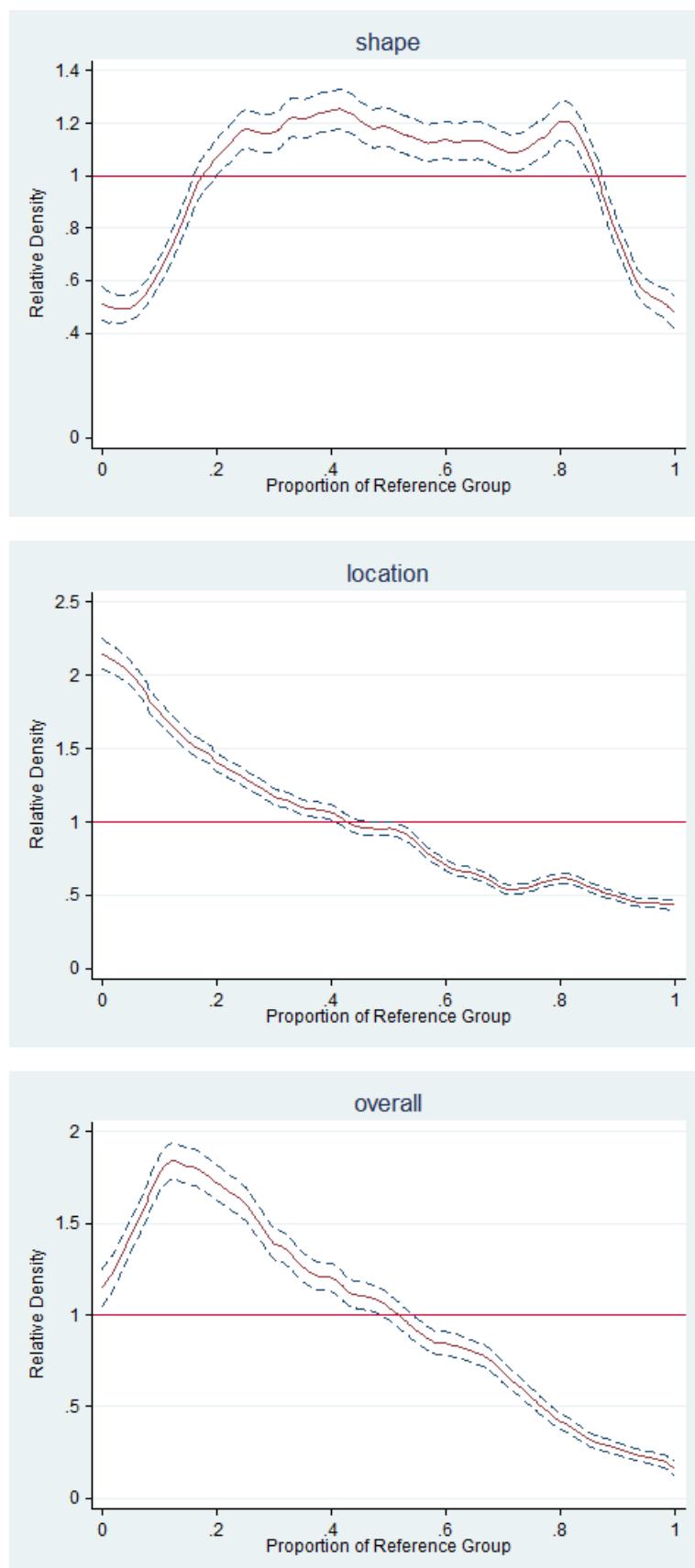
1973



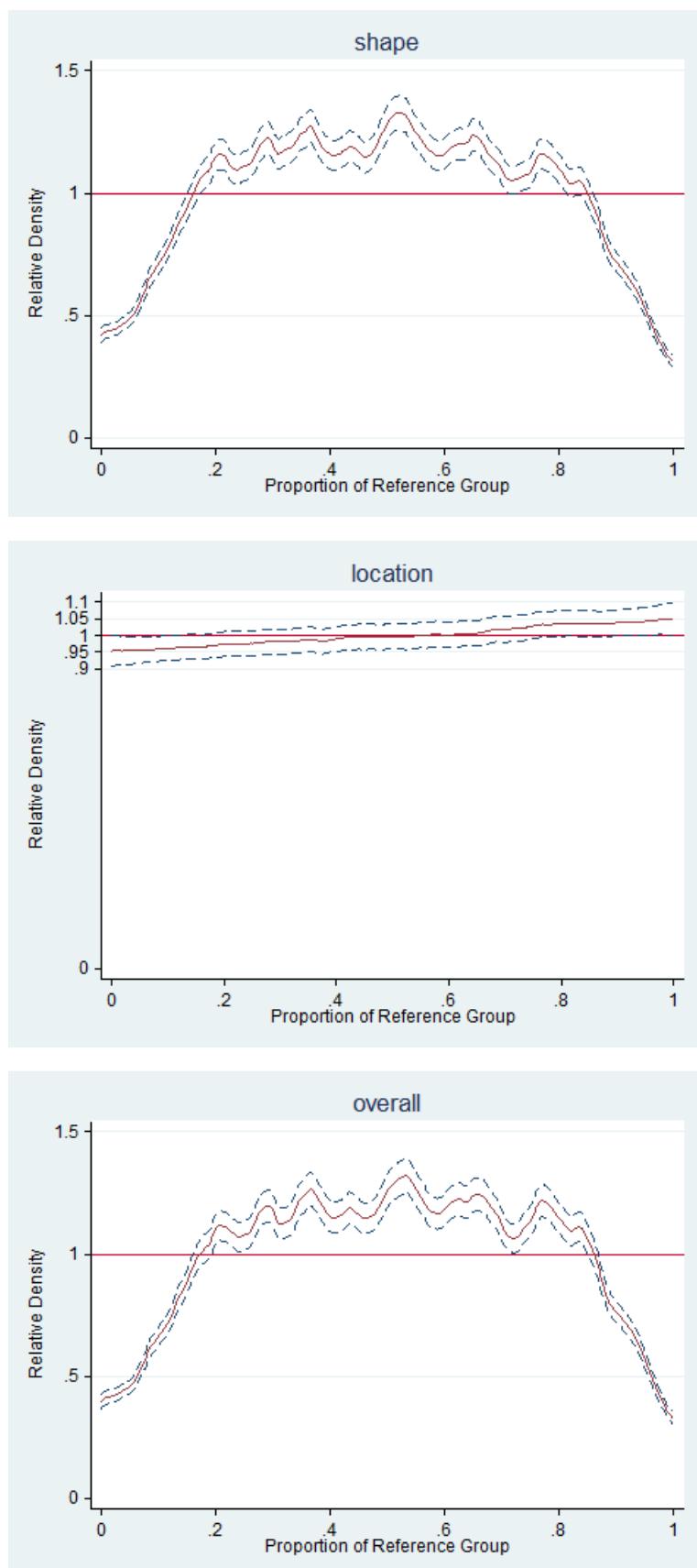
1978



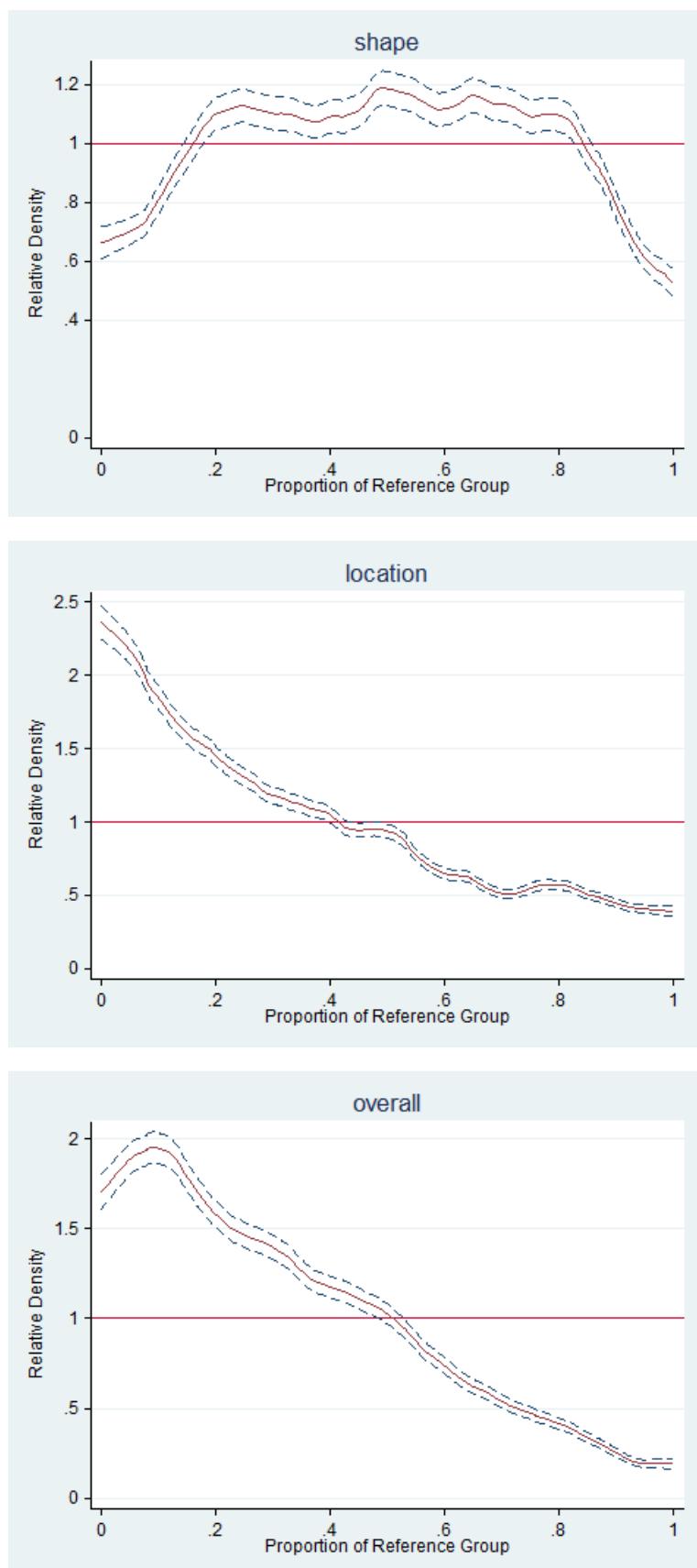
1981



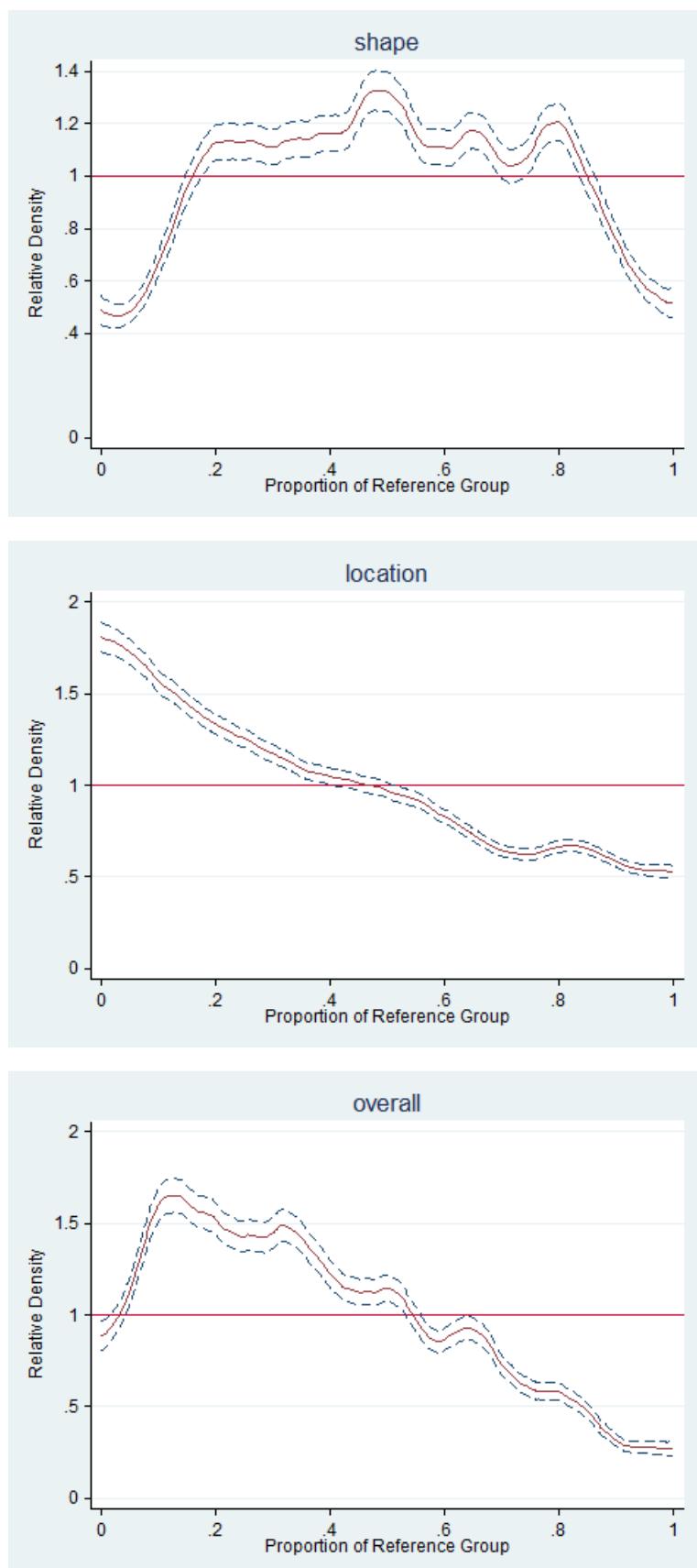
1983



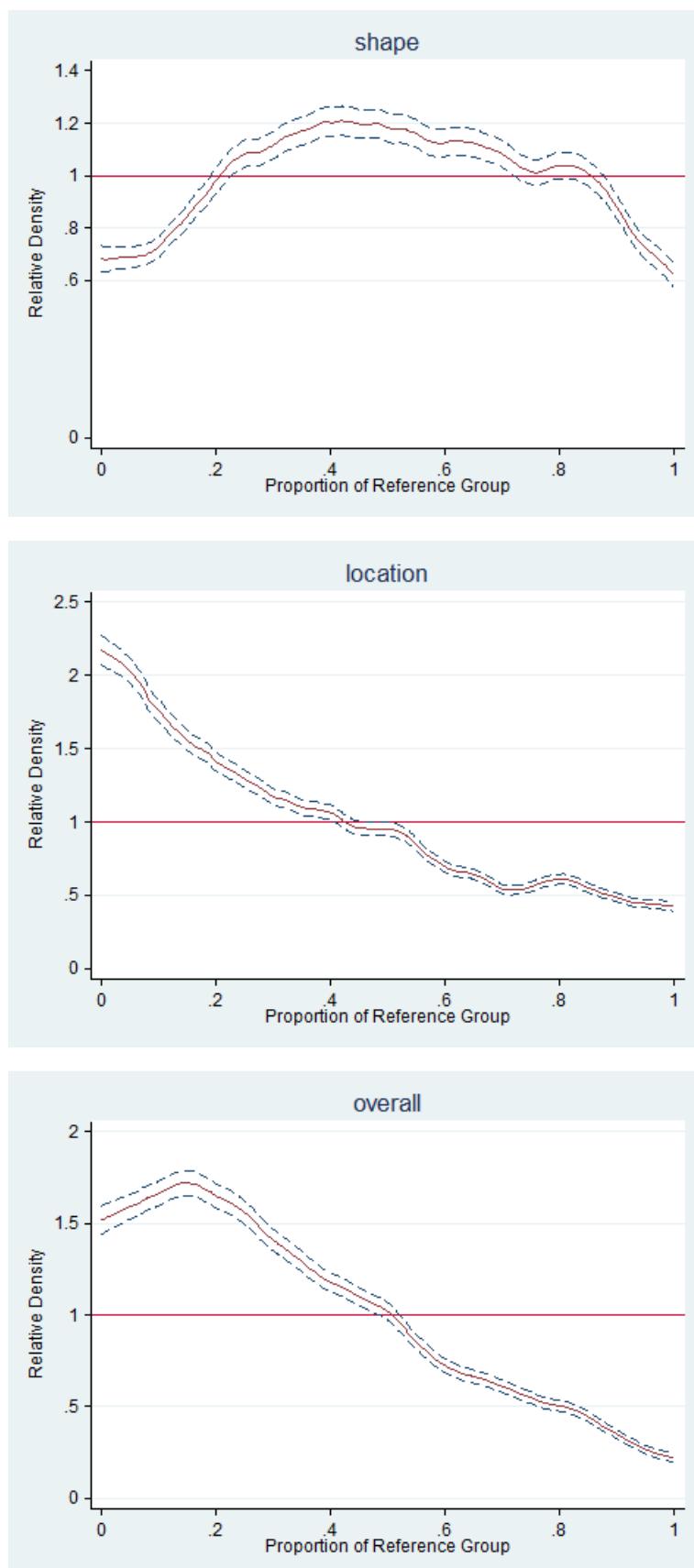
1984



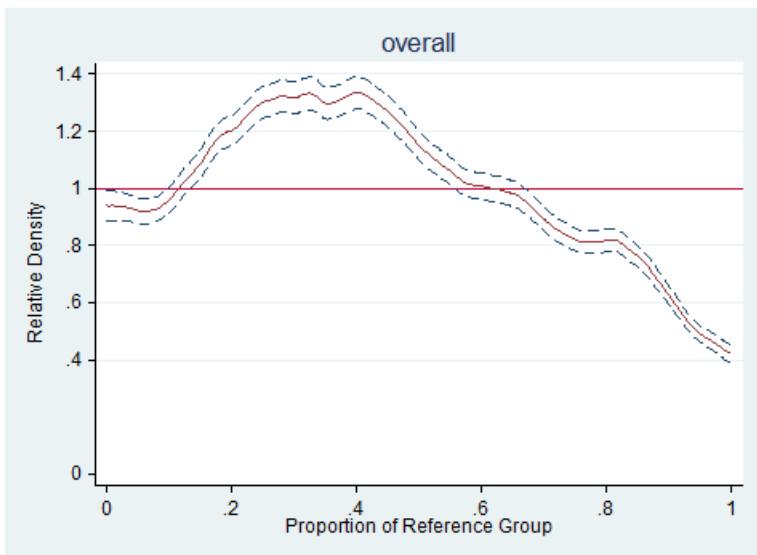
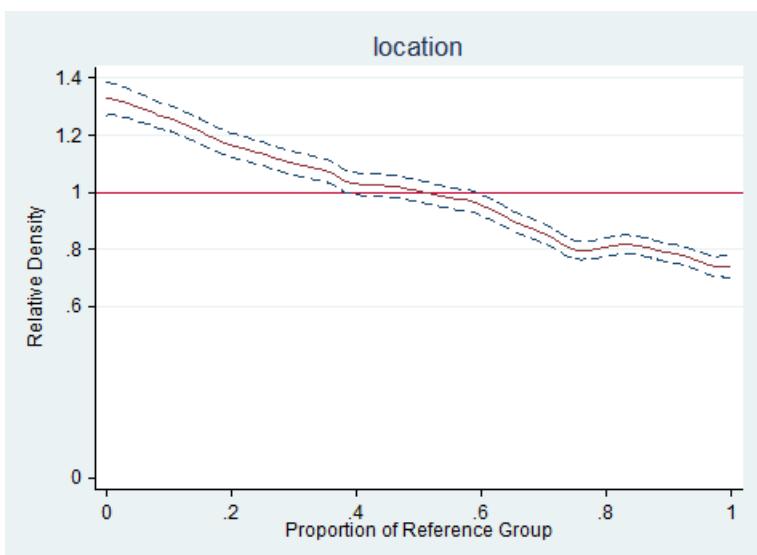
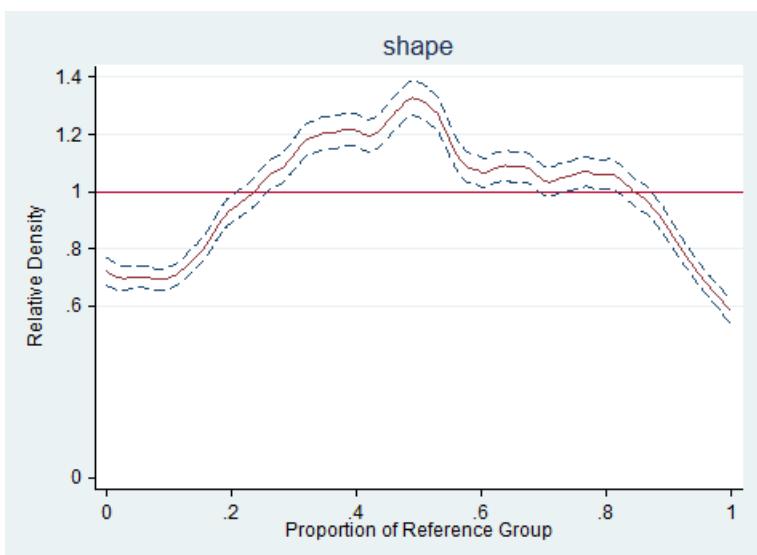
1989



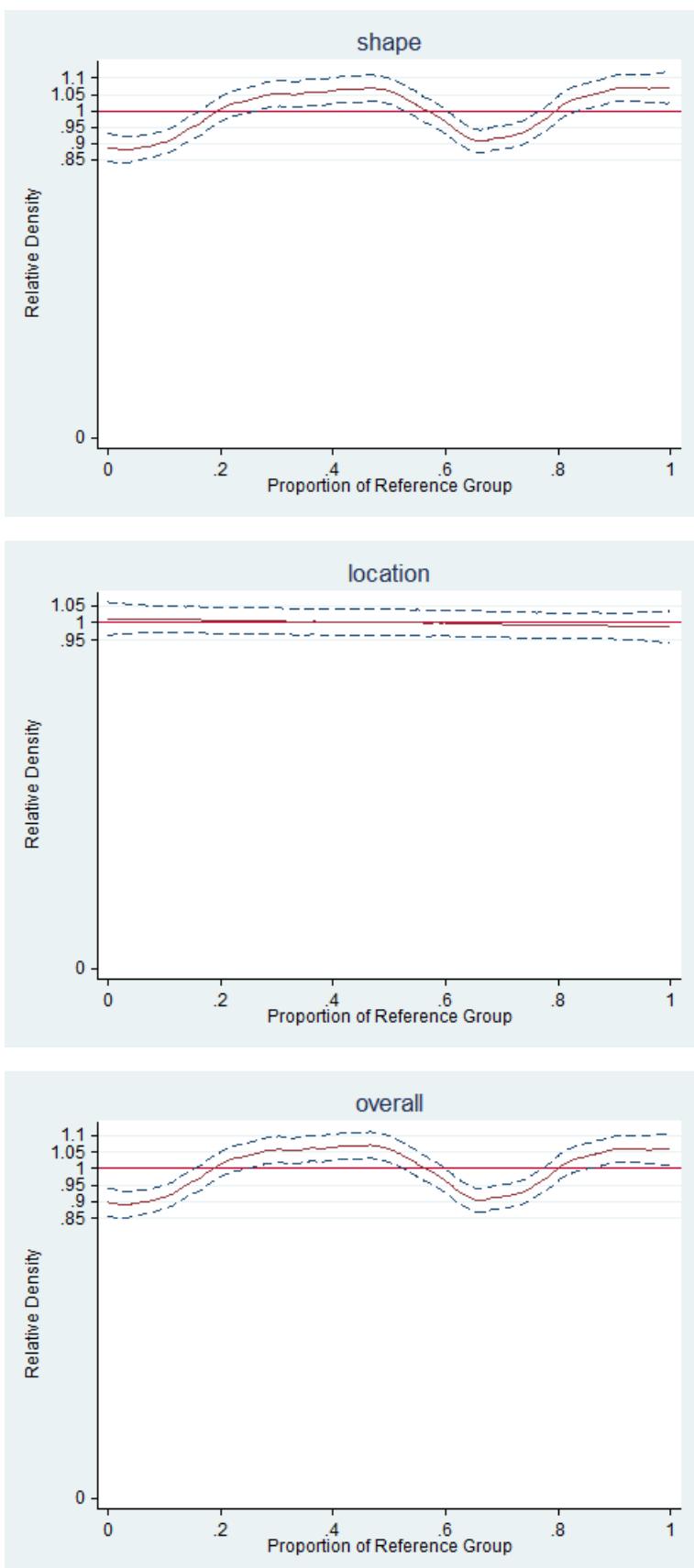
1994



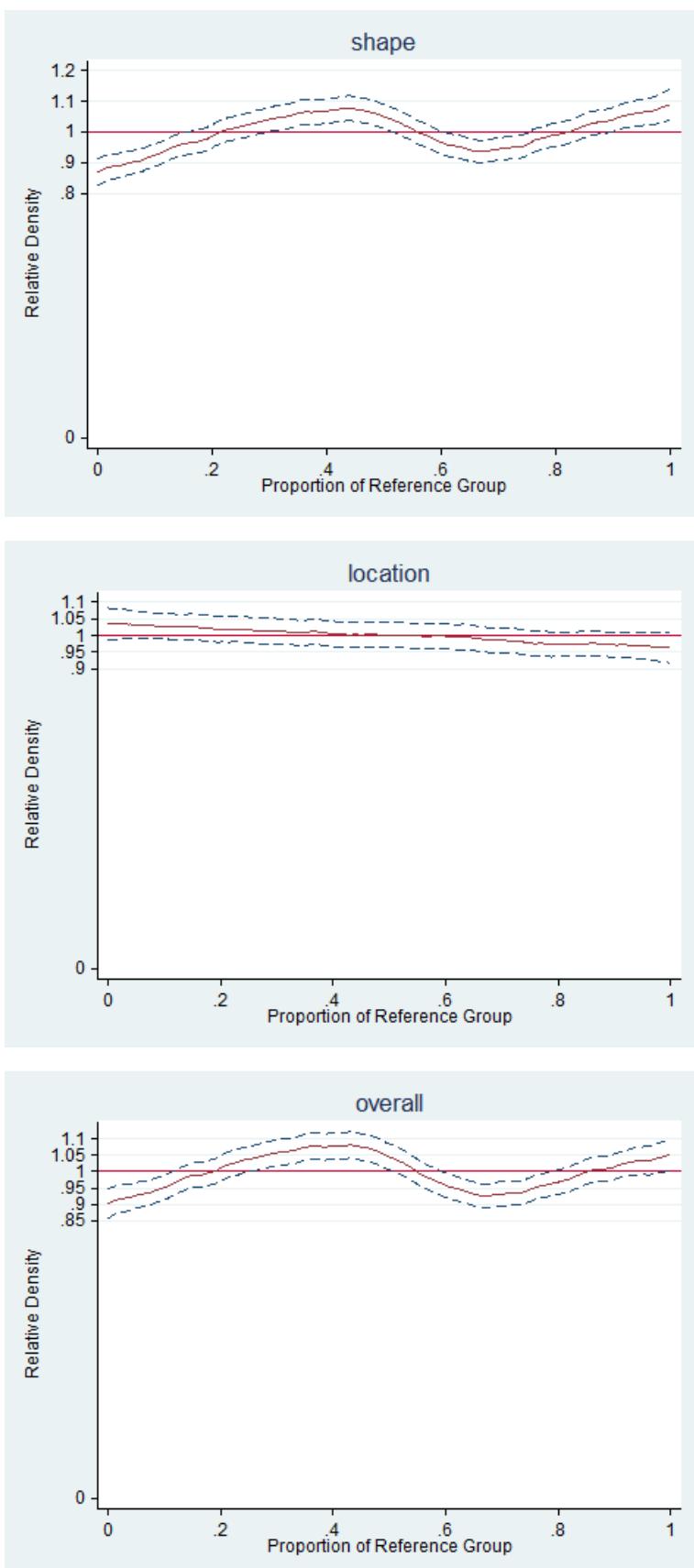
2000



2004

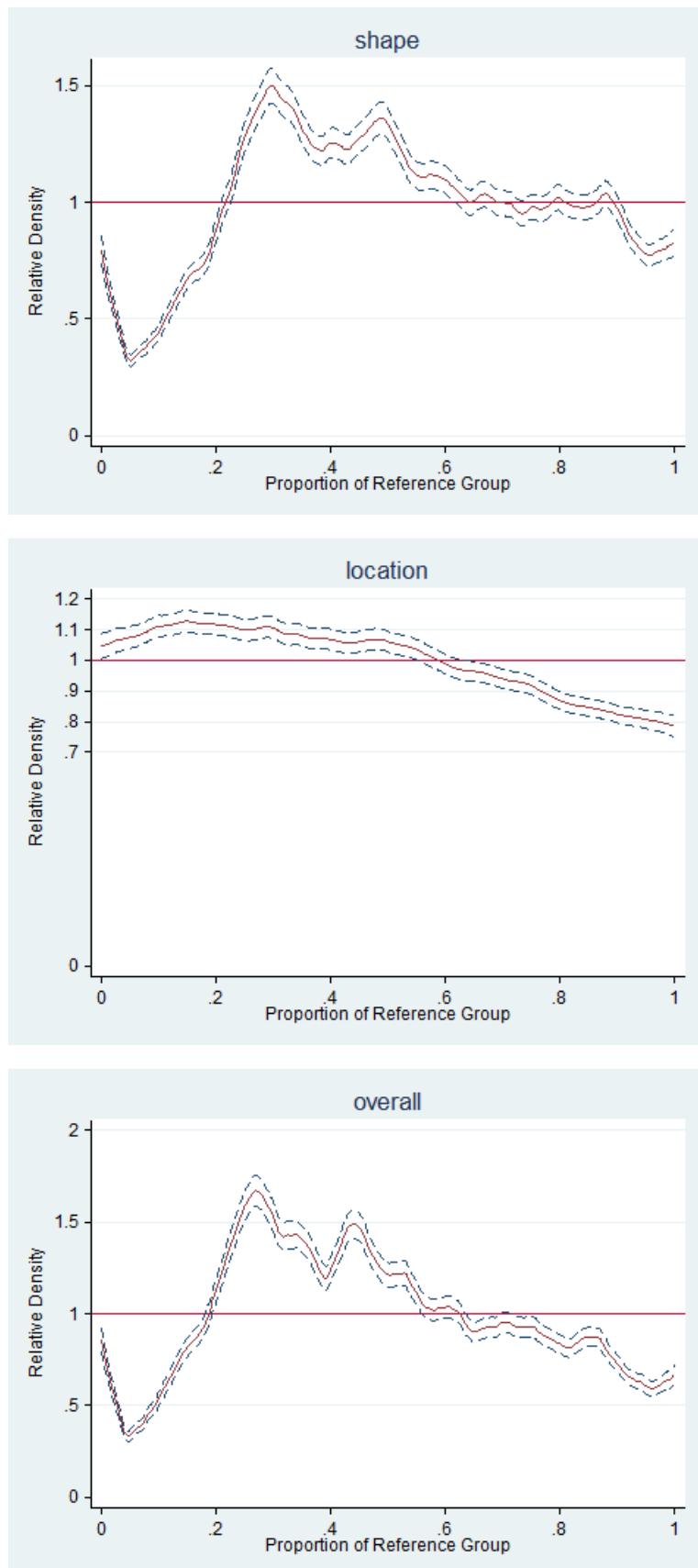


2007

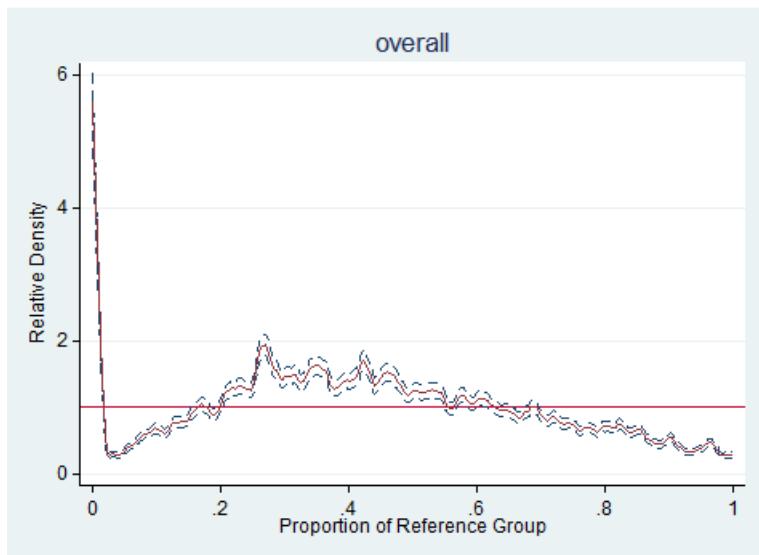
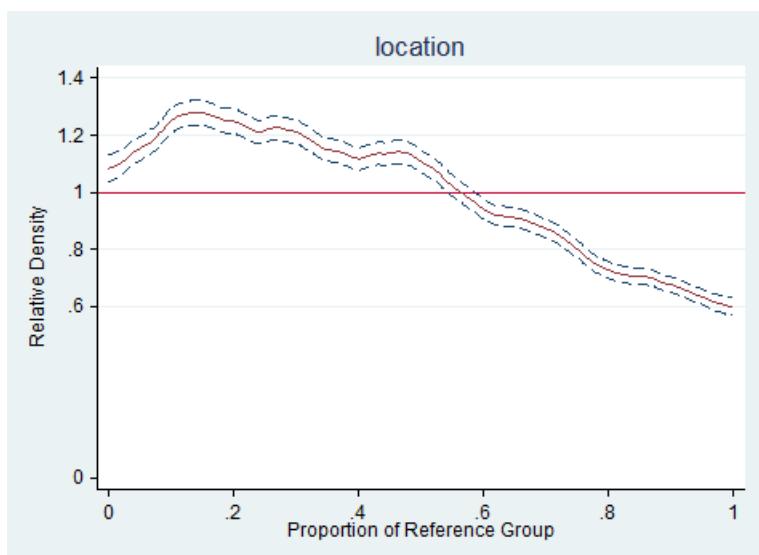
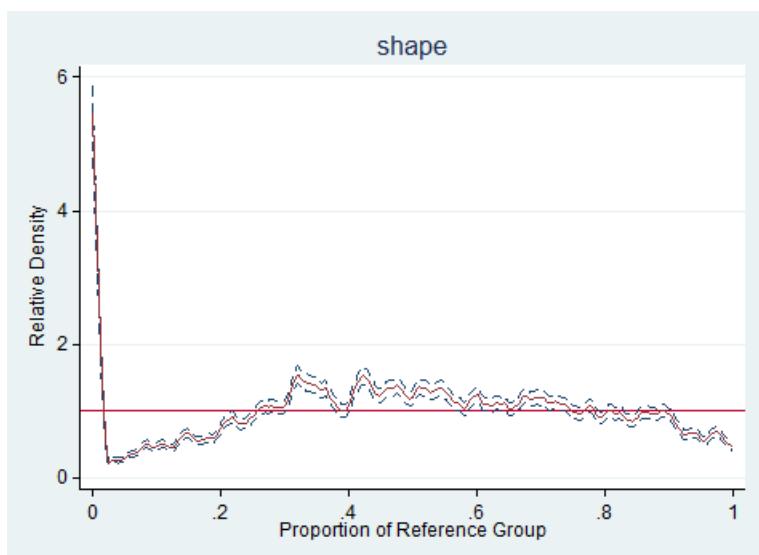


C2.3 France

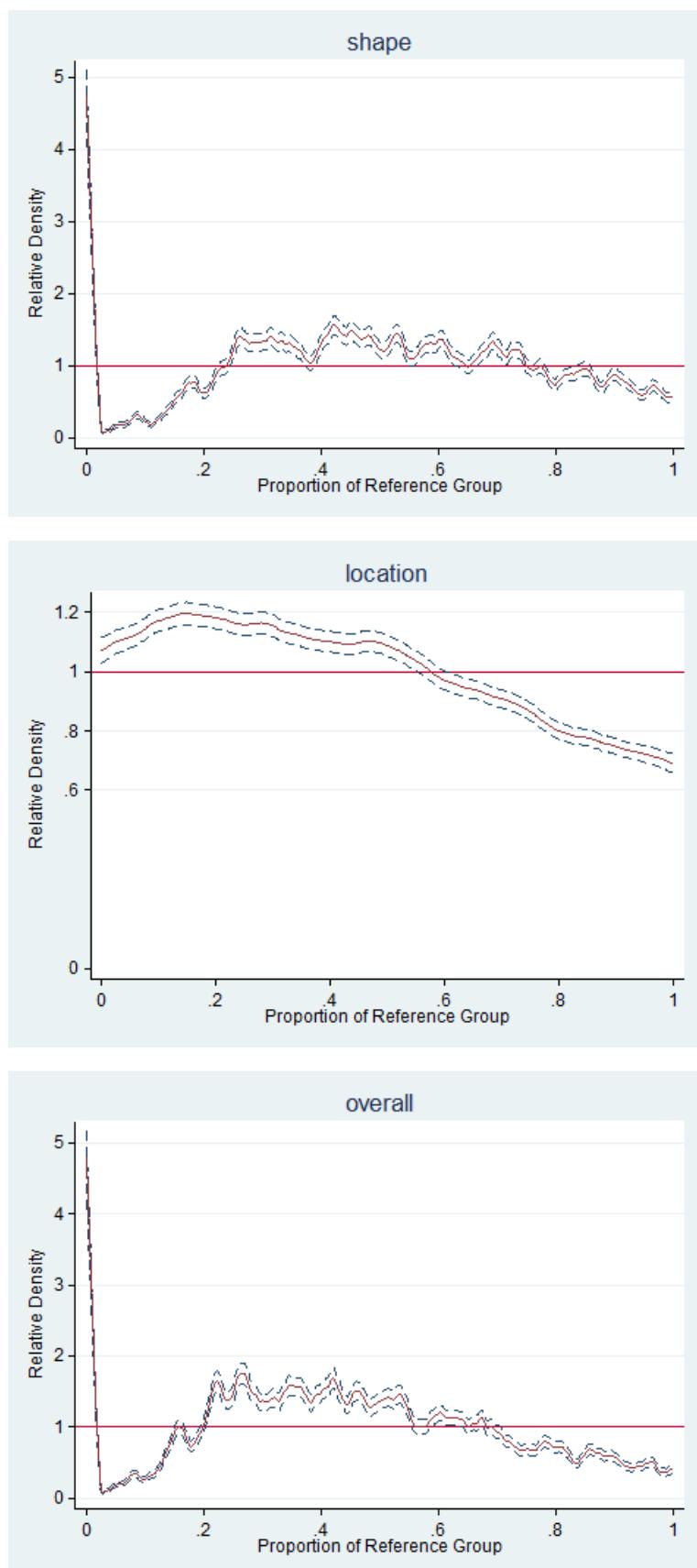
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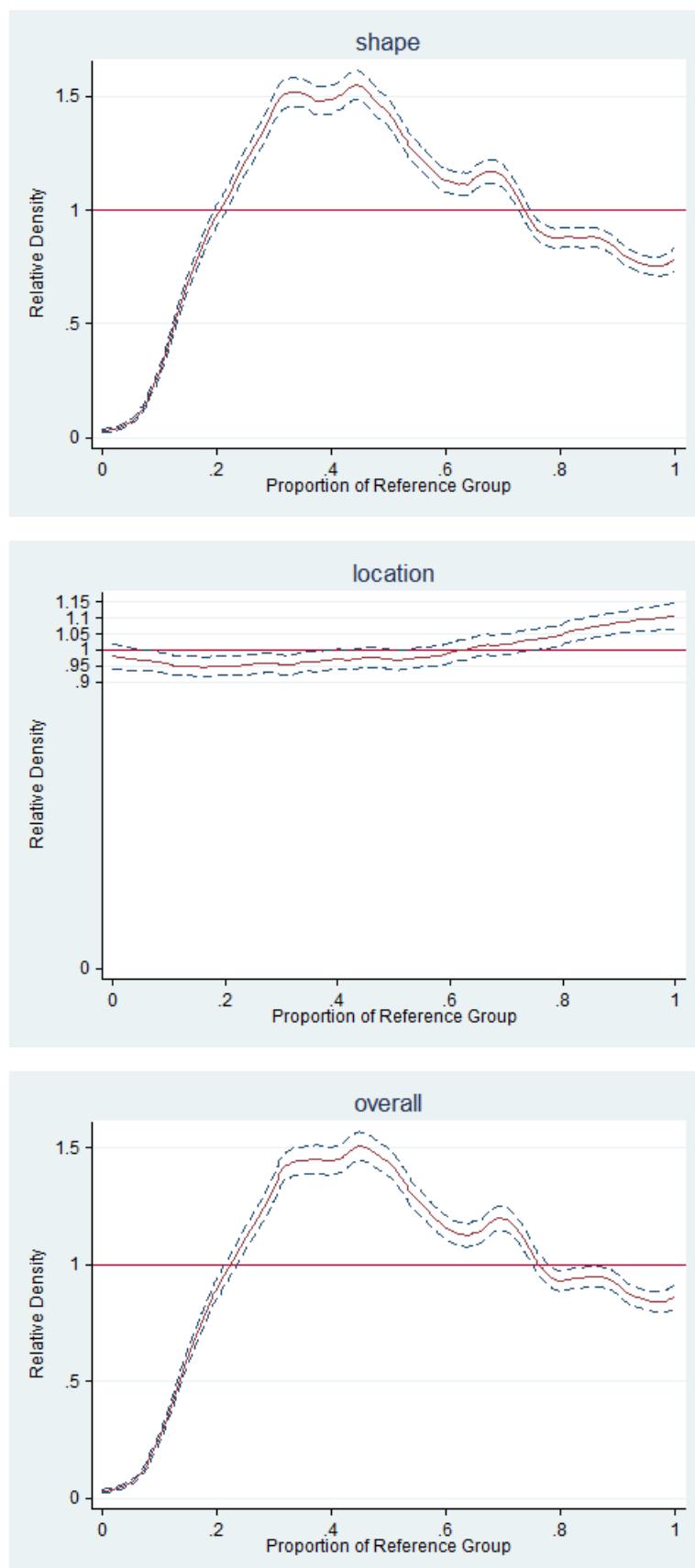
1984



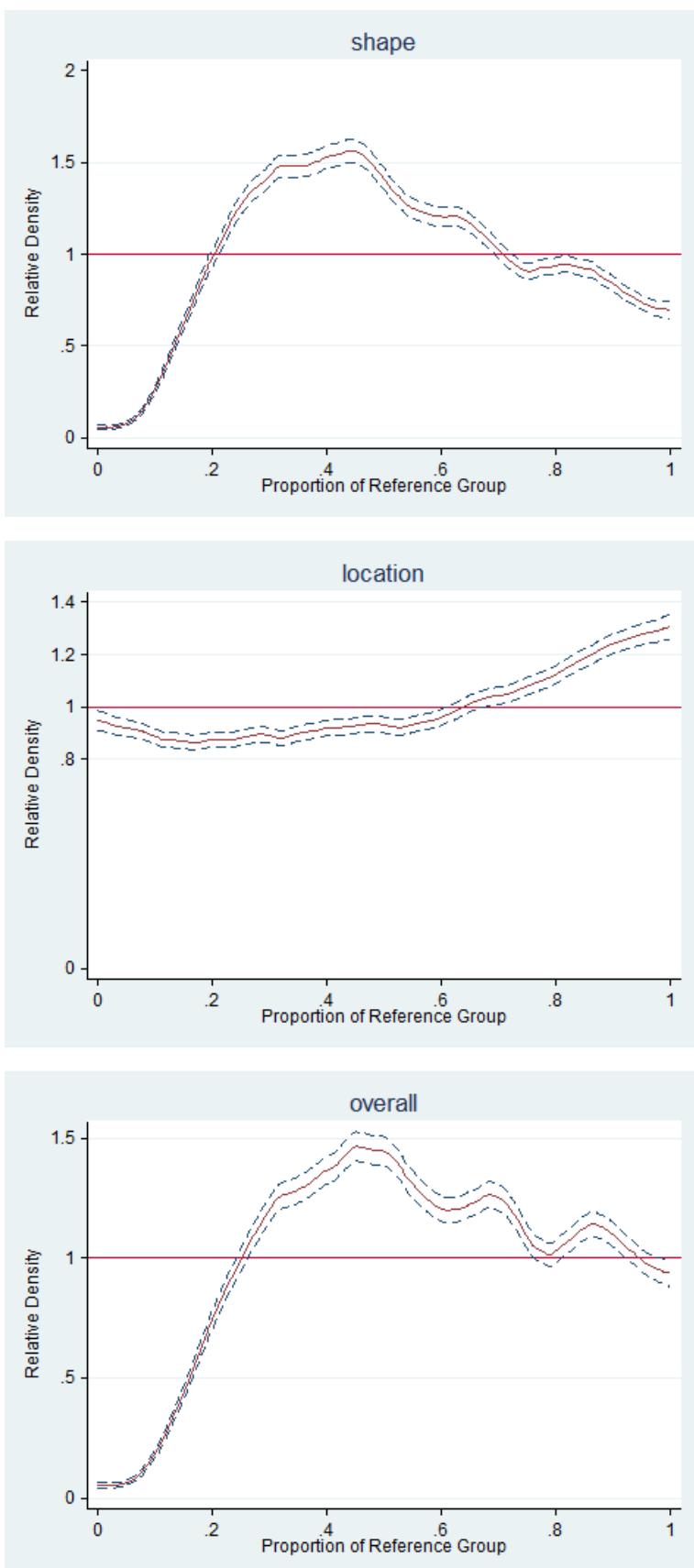
1989



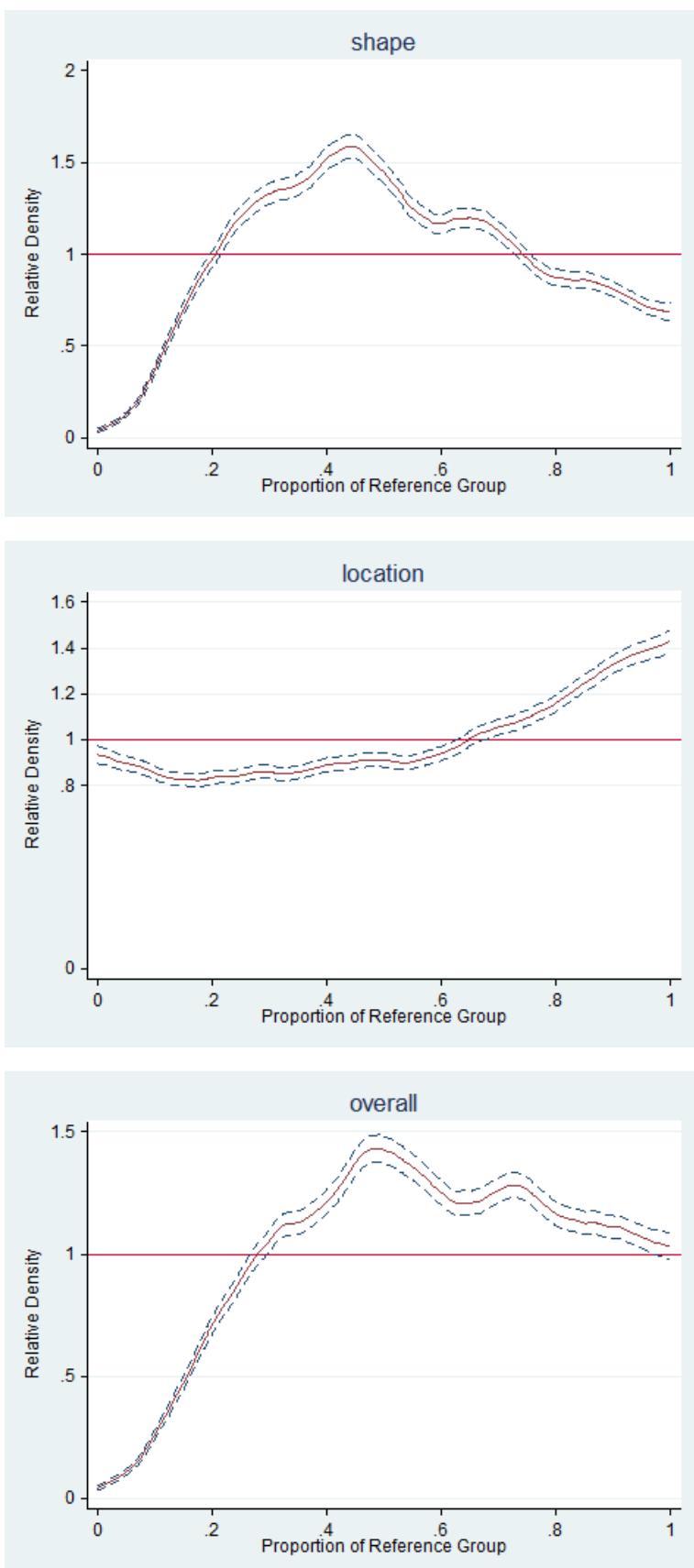
1994



2000

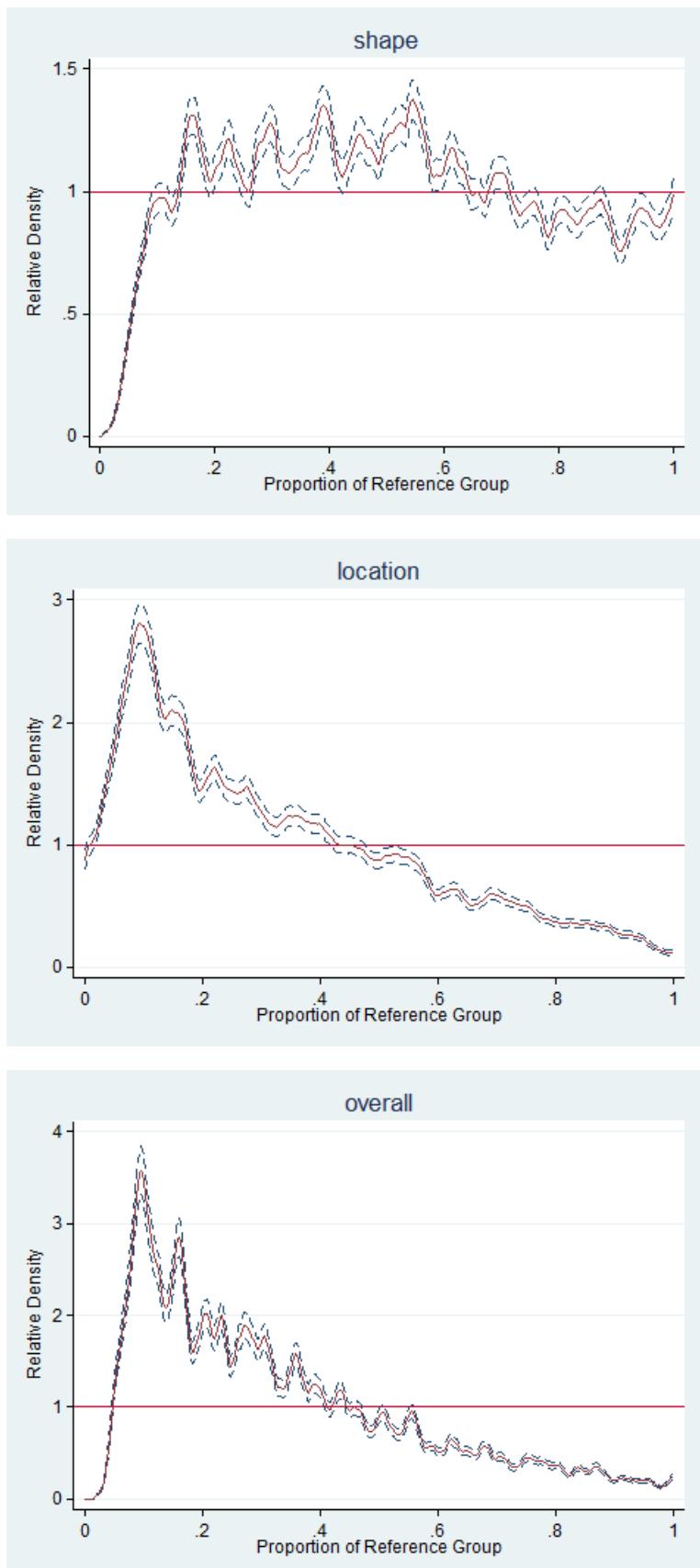


2005

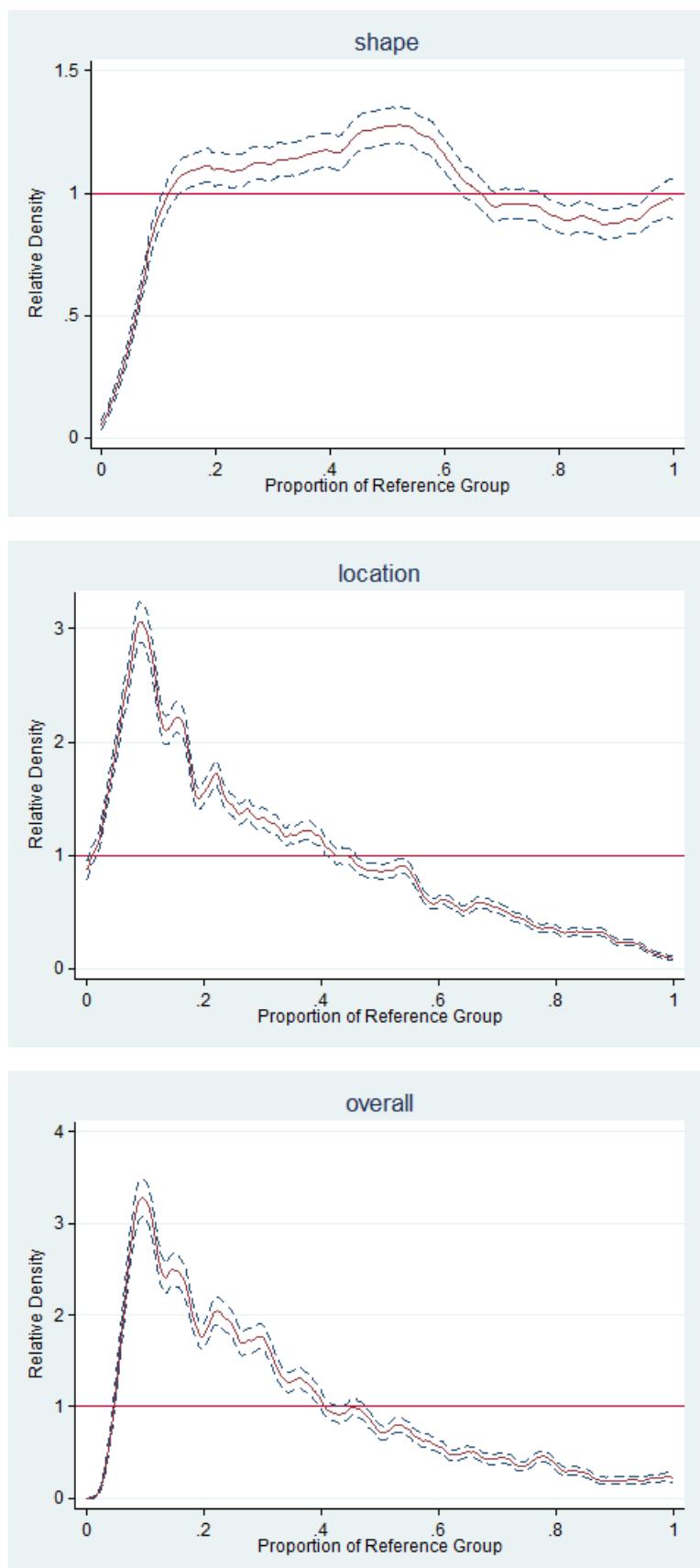


C2.4 Spain

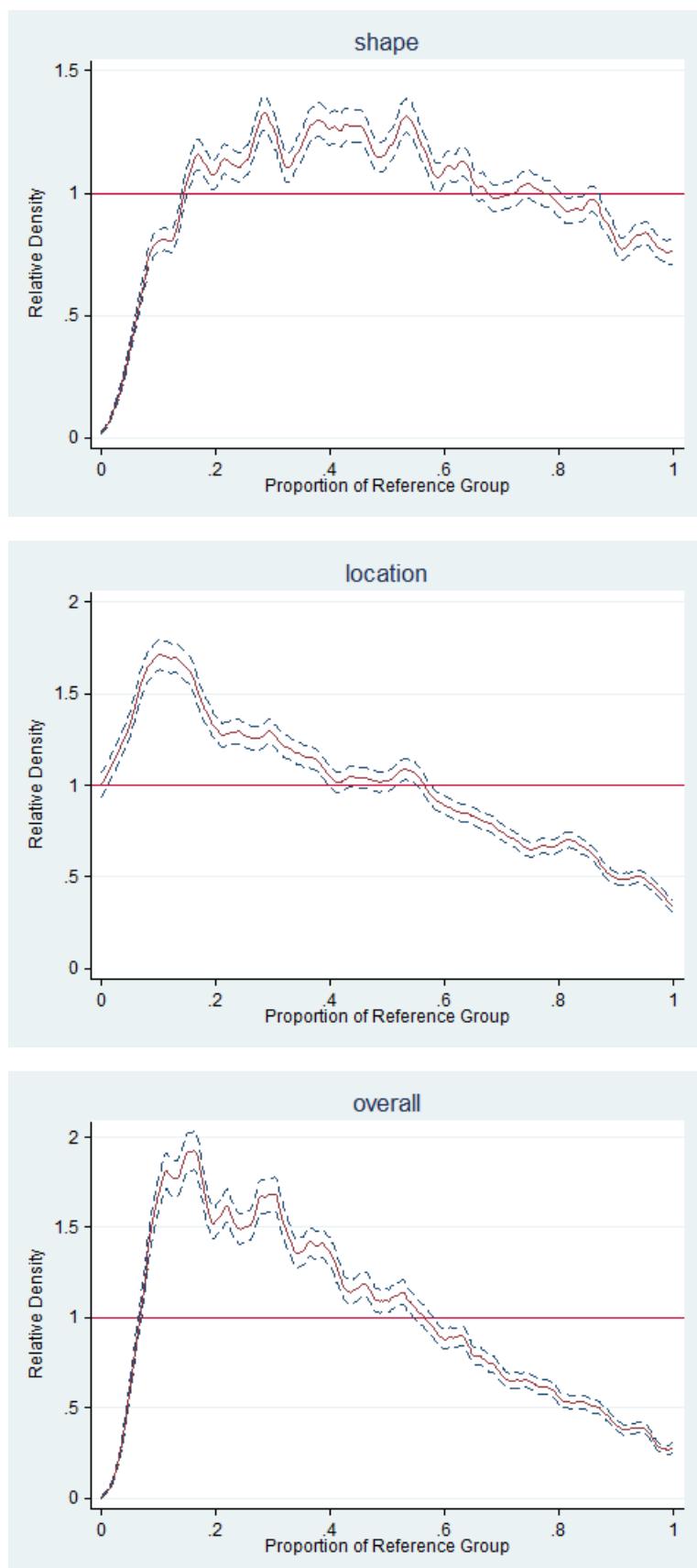
1980



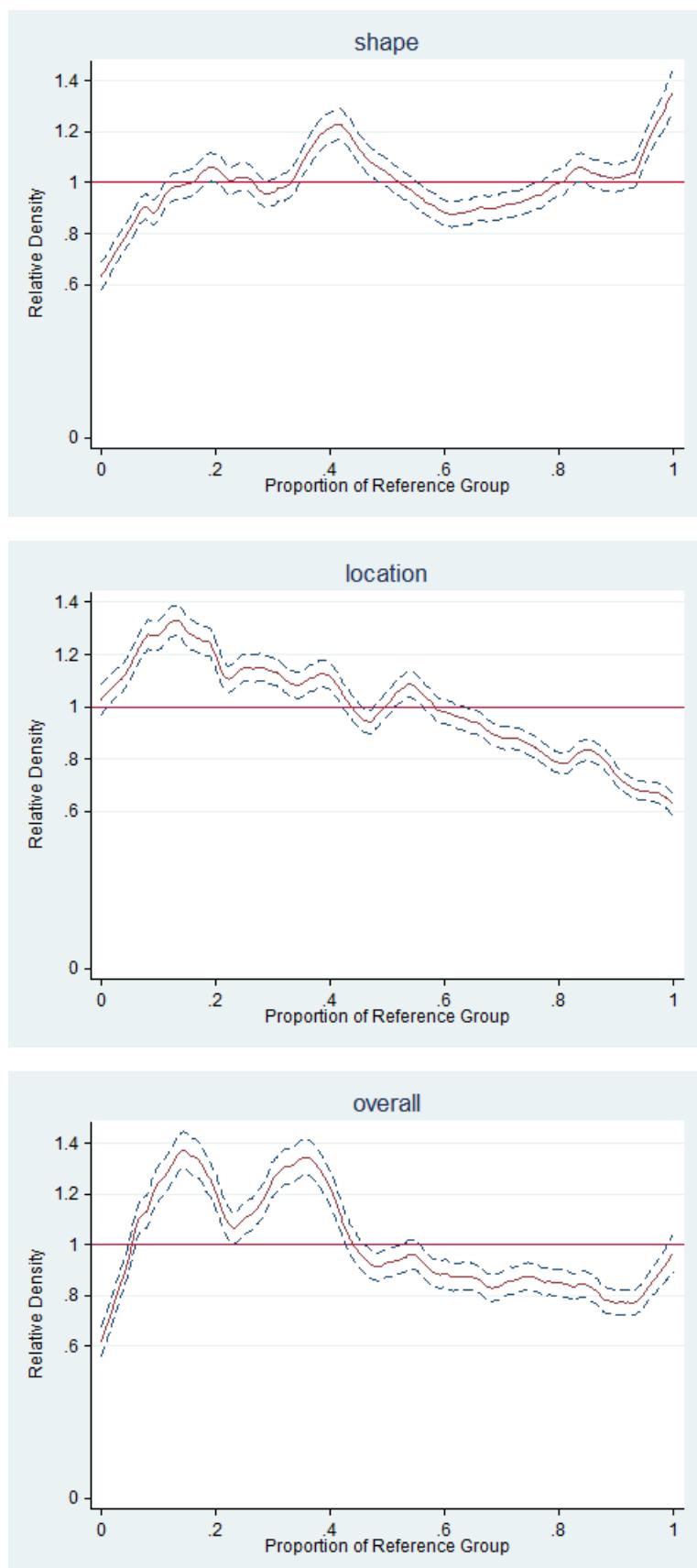
1985



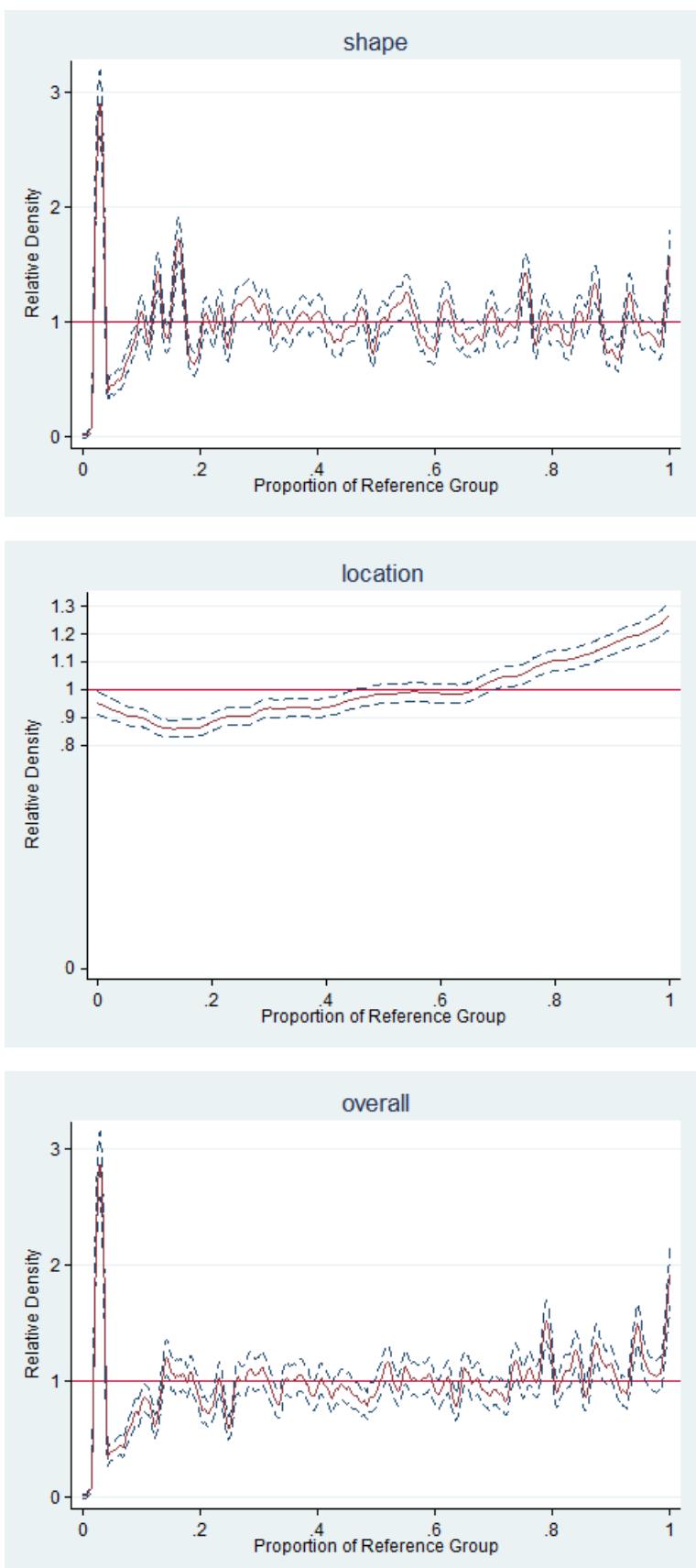
1990



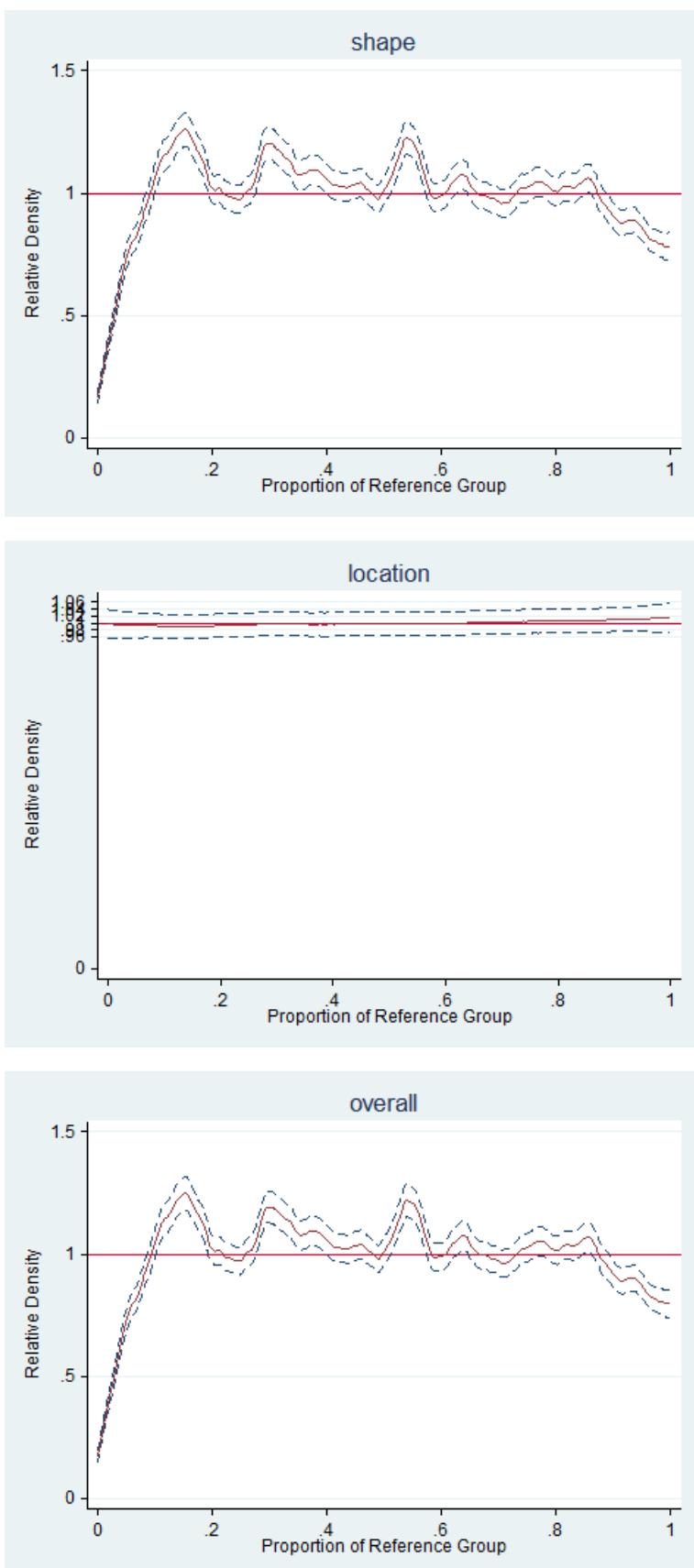
1995



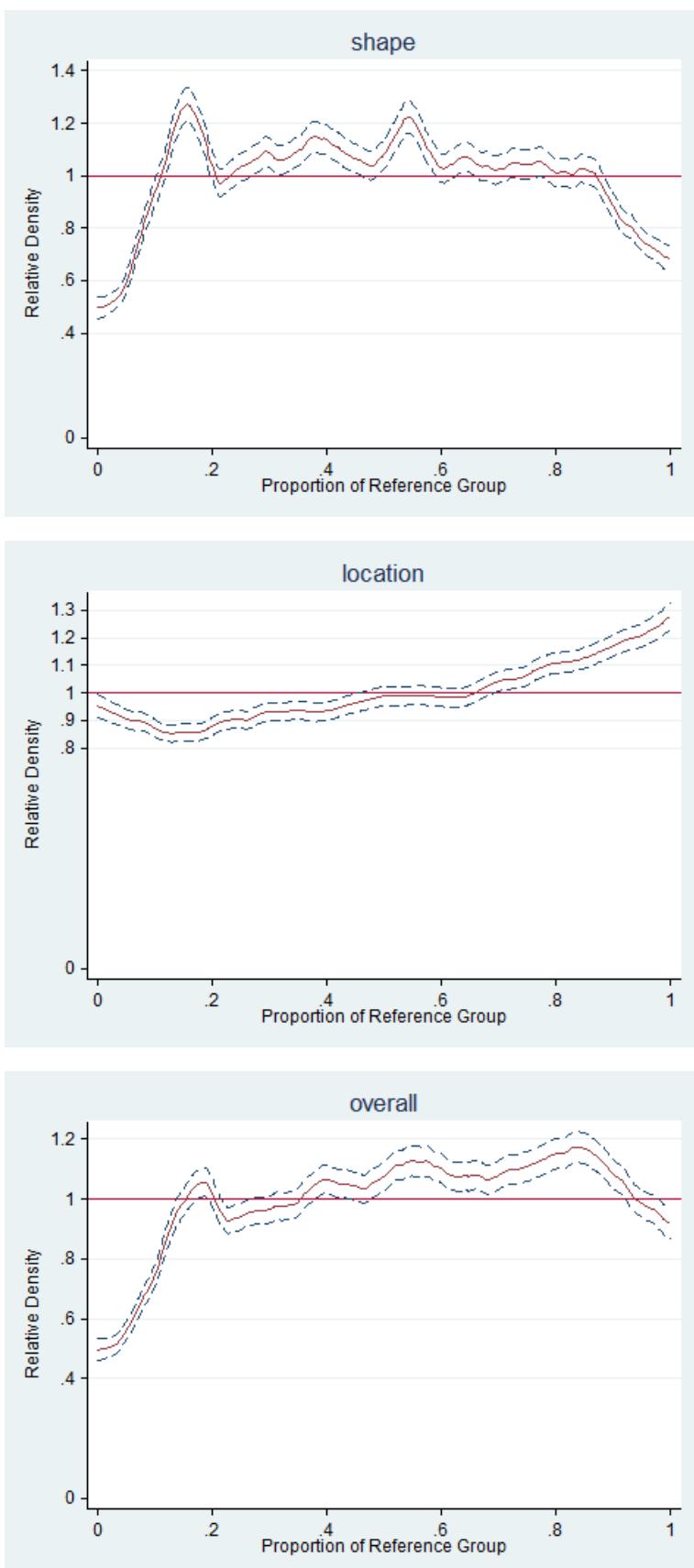
2000



2004

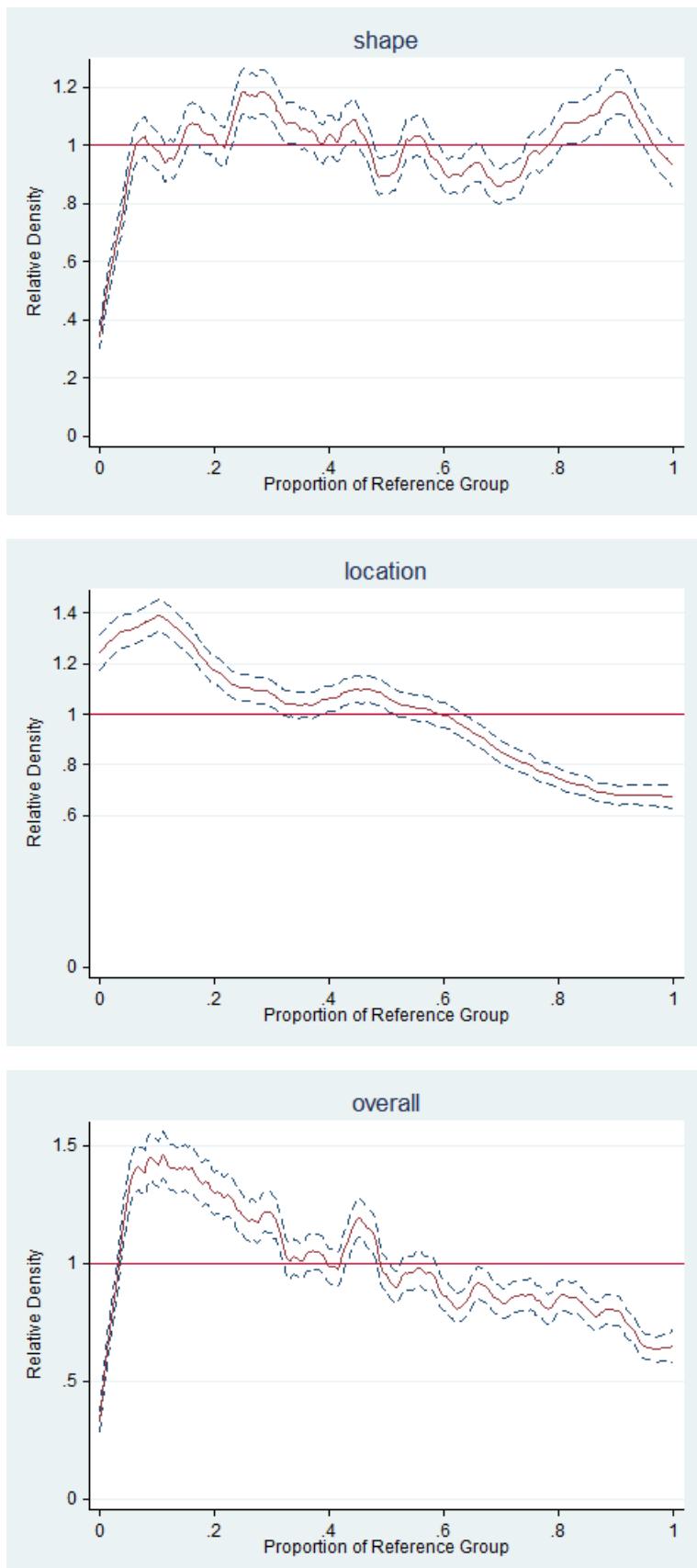


2007

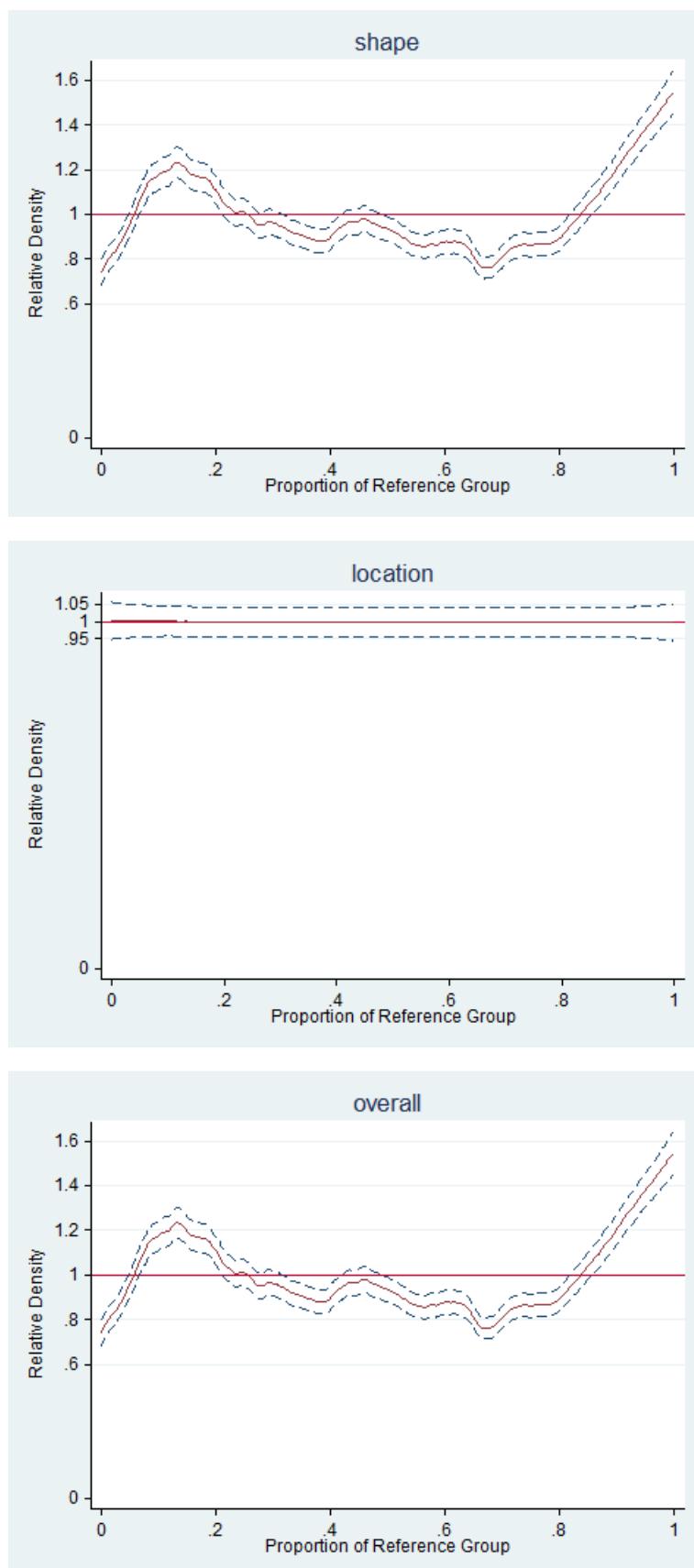


C2.5 Italy

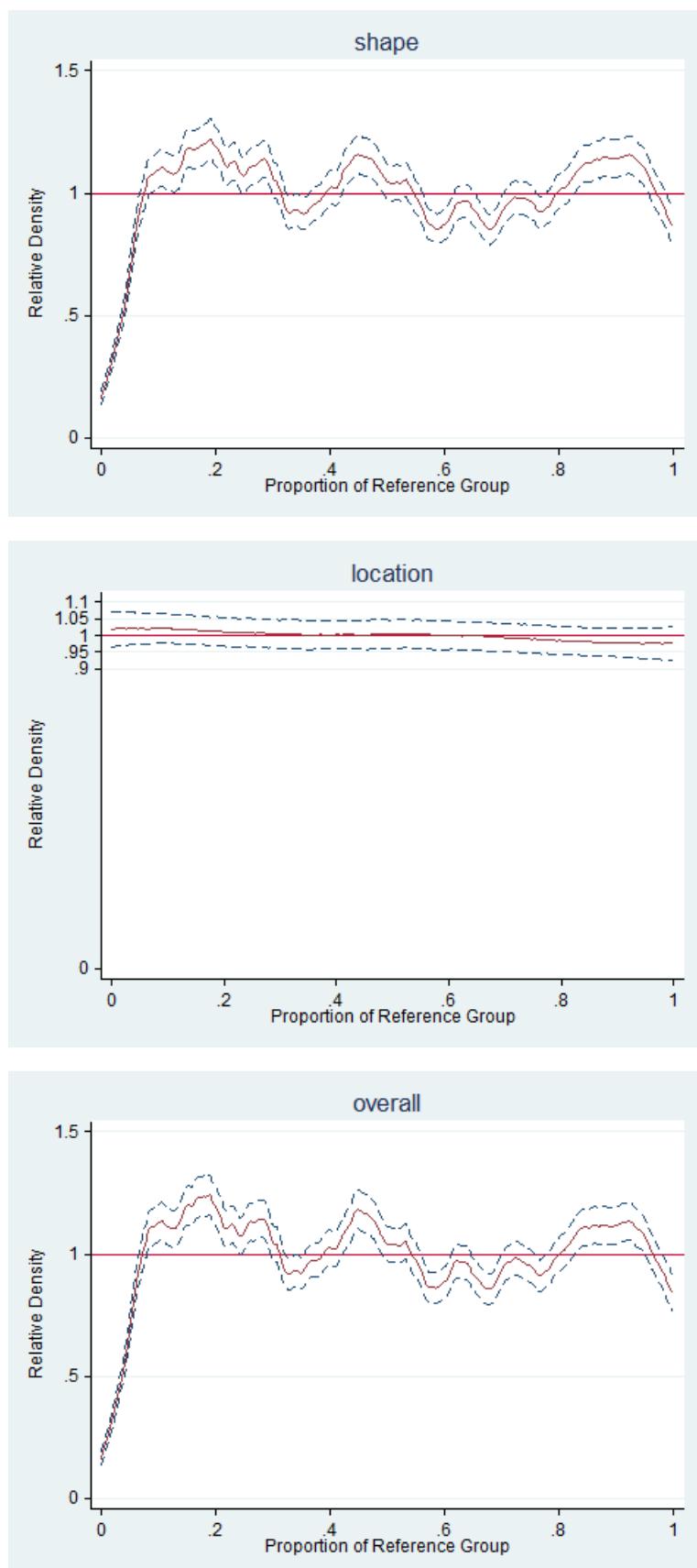
1986



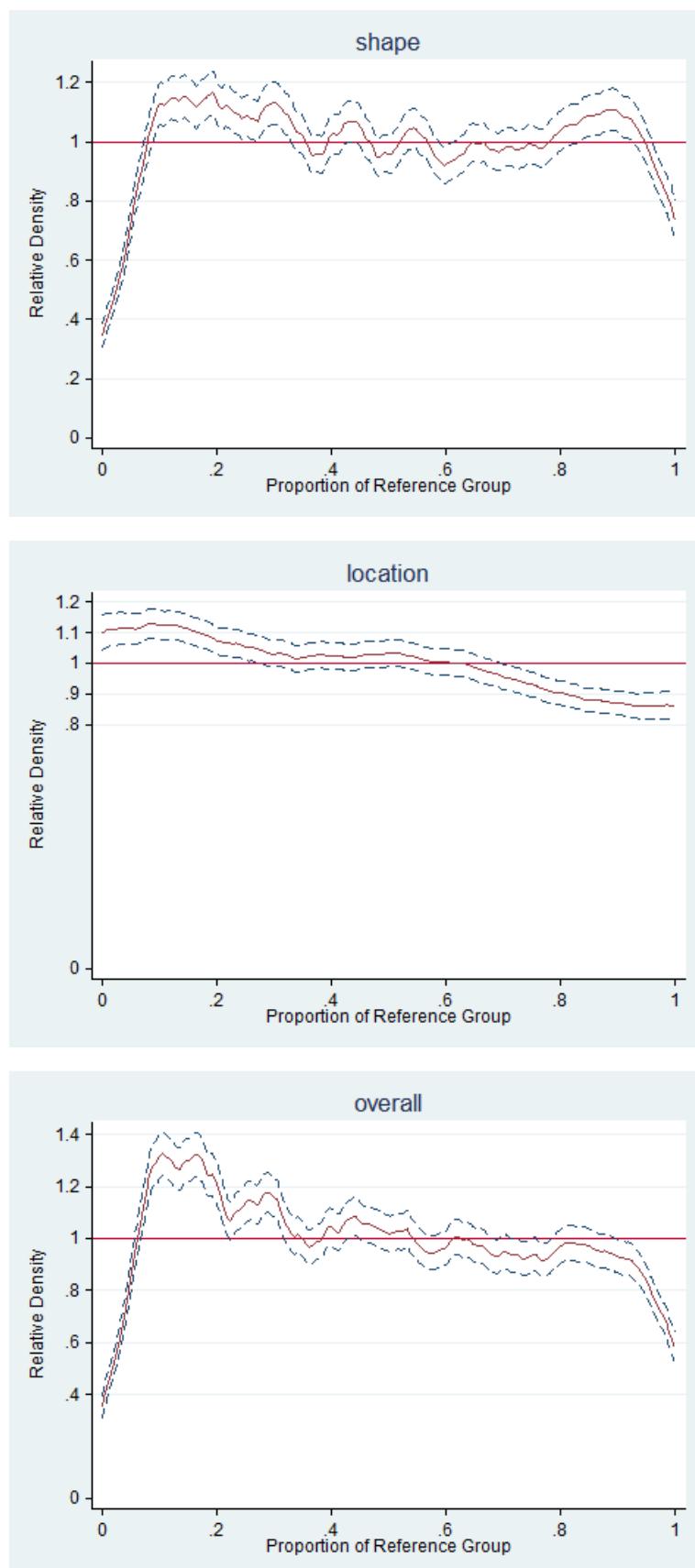
1987



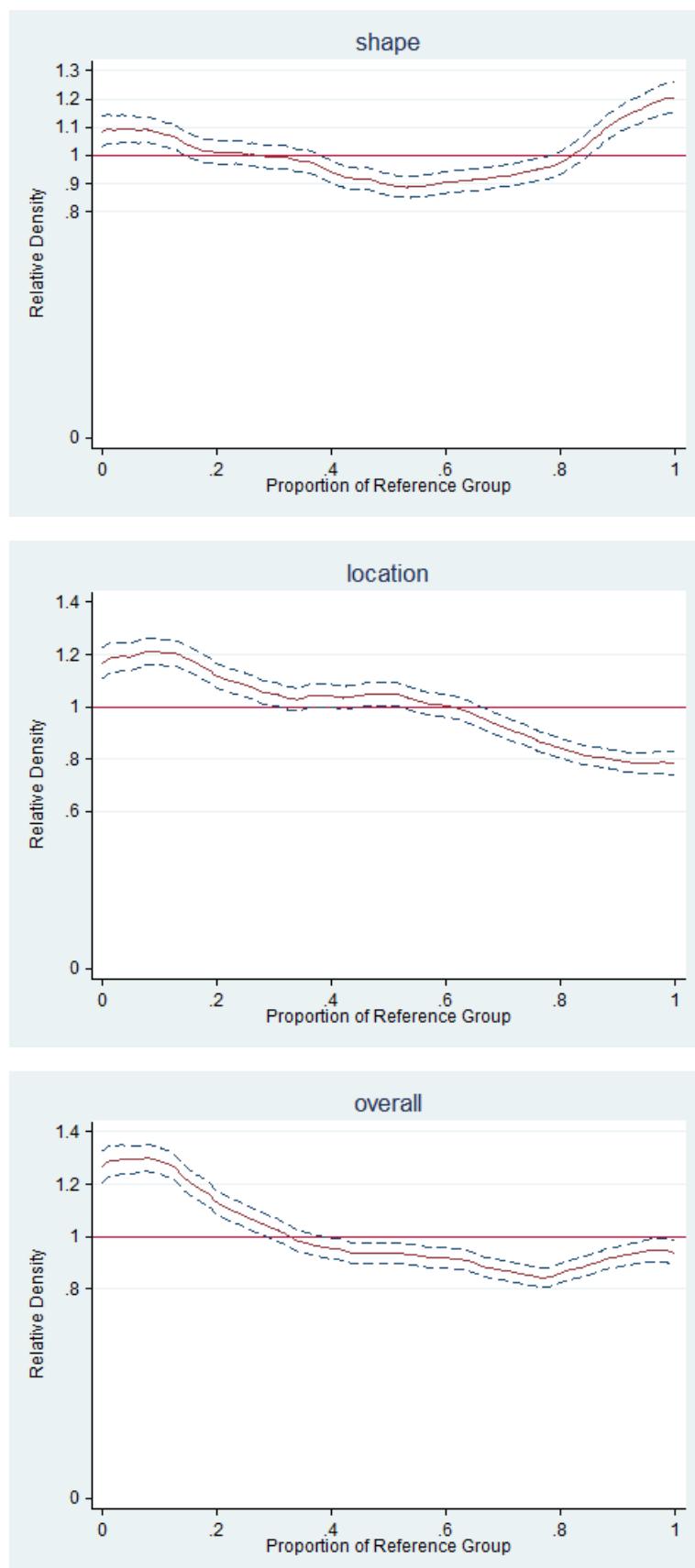
1989



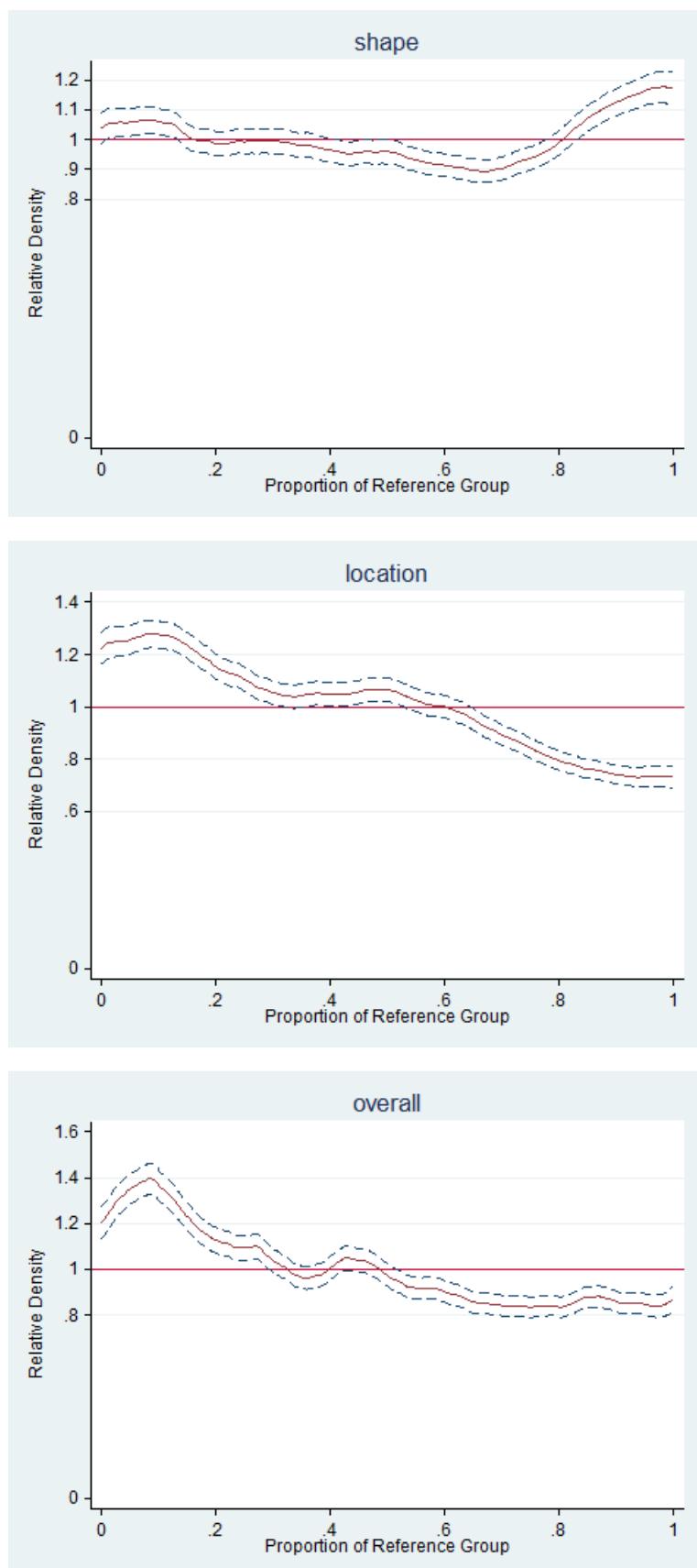
1991



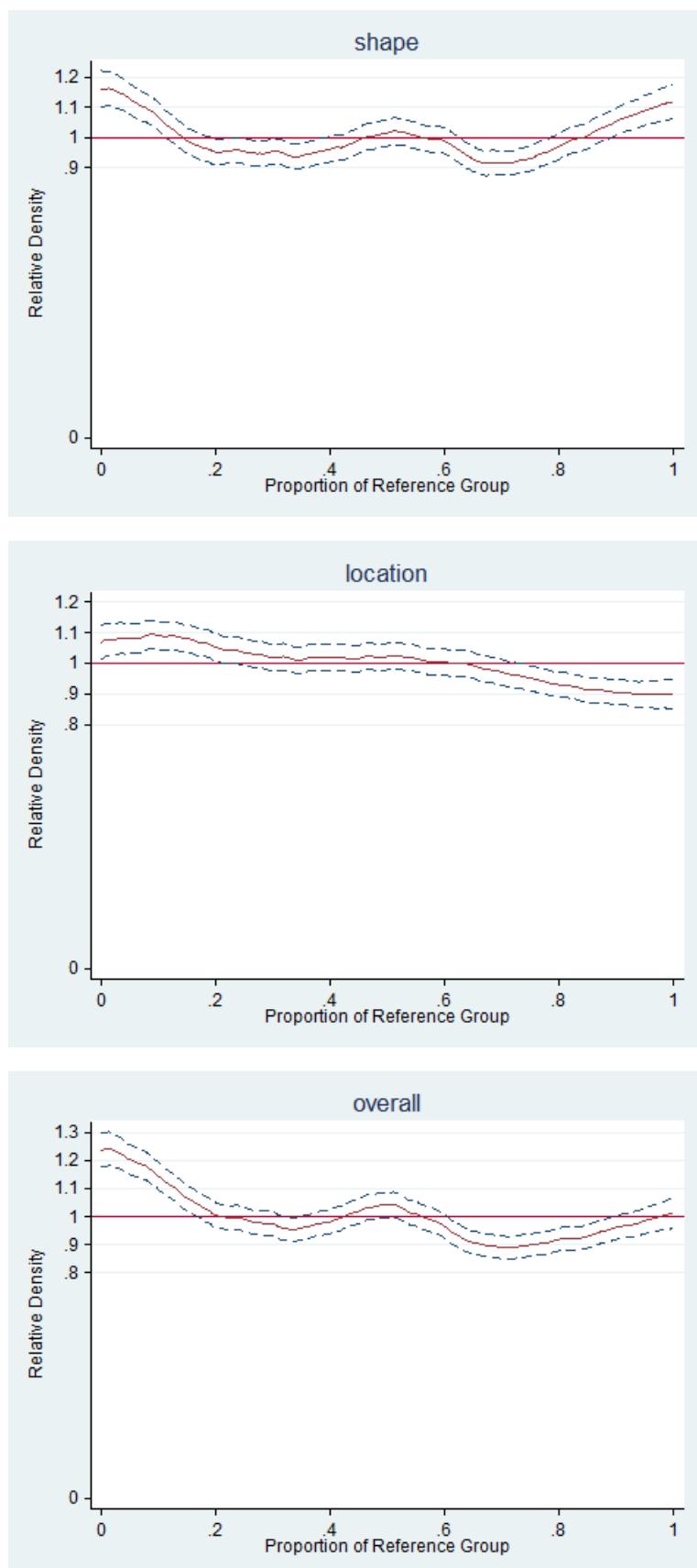
1993



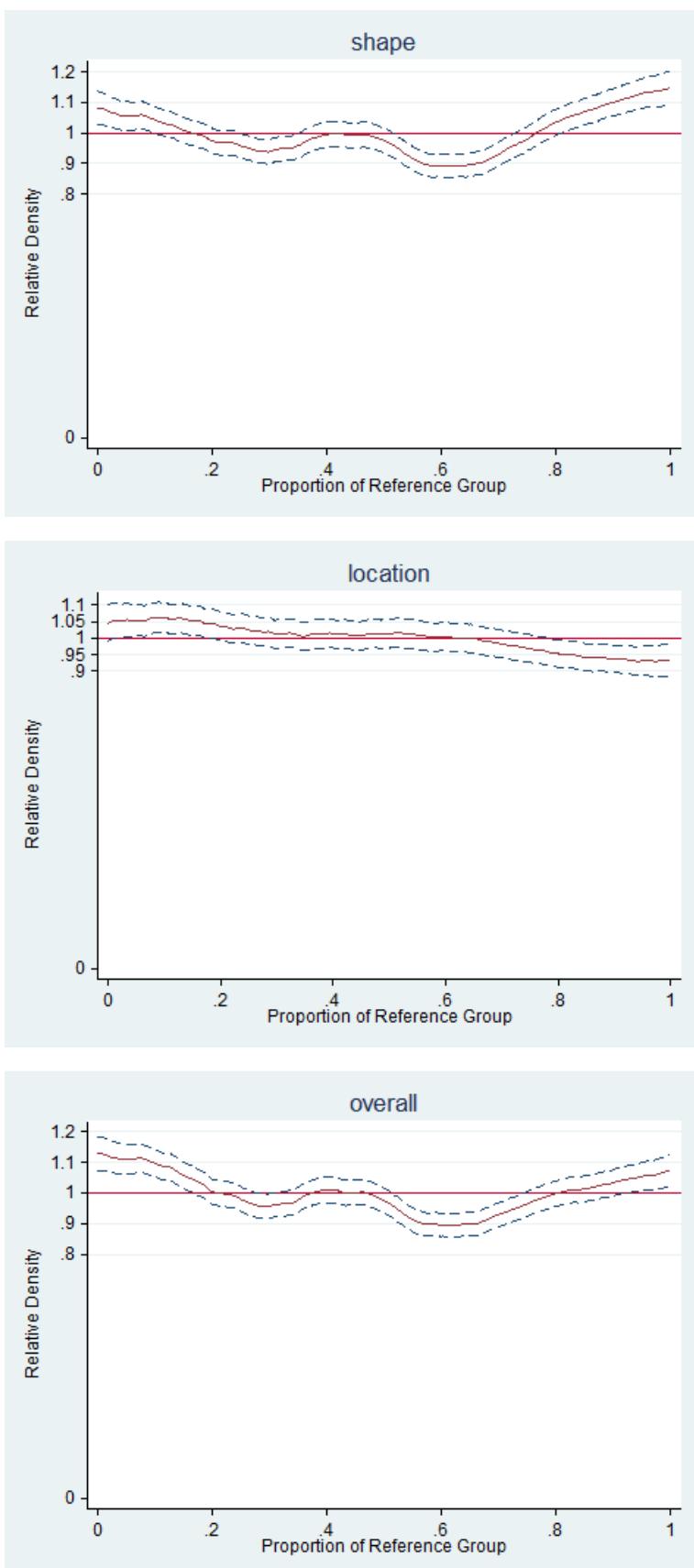
1995



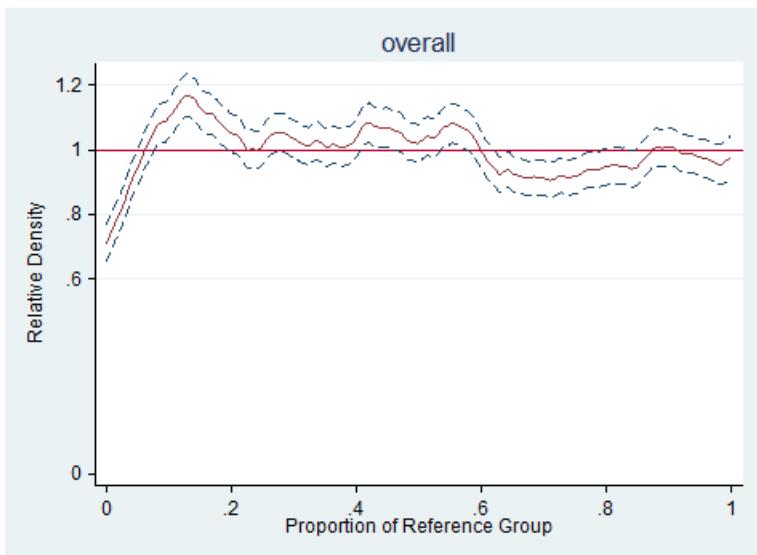
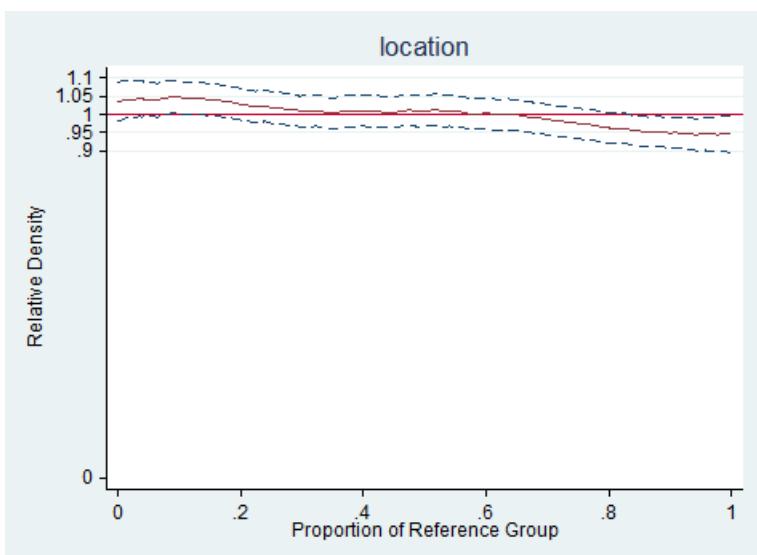
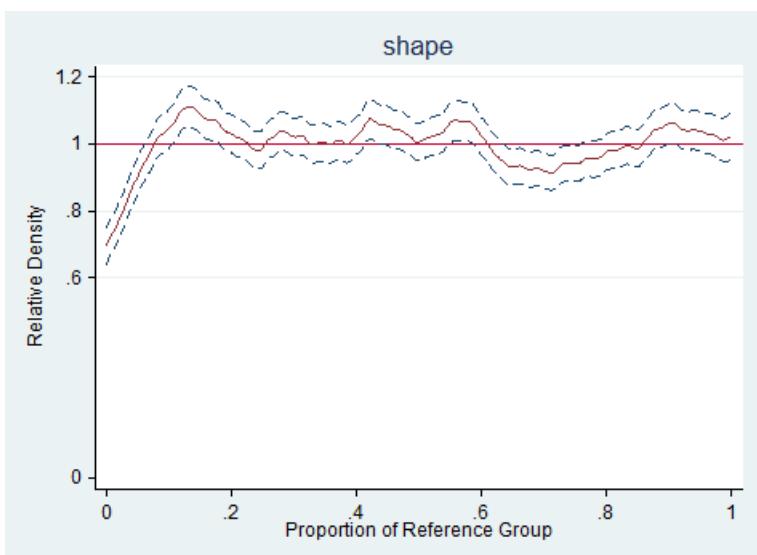
1998



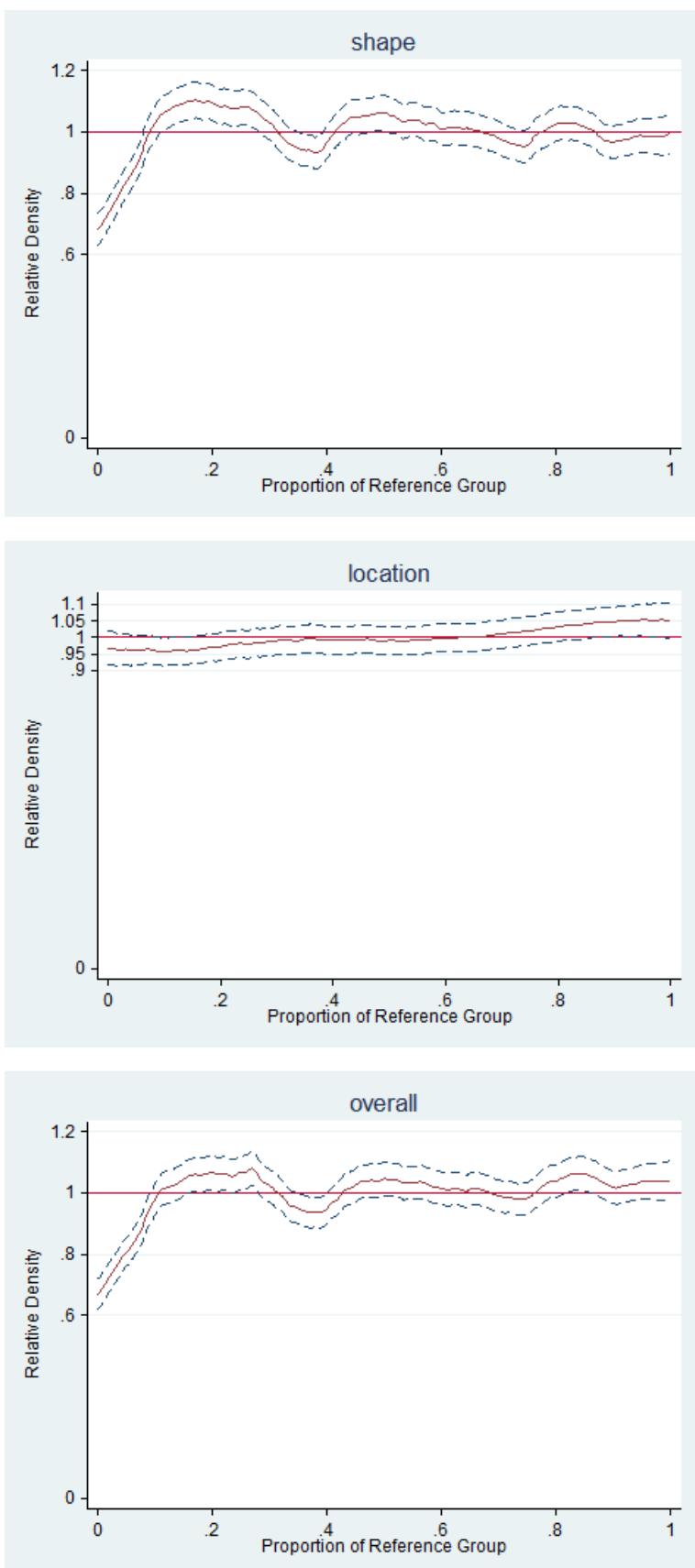
2000



2004

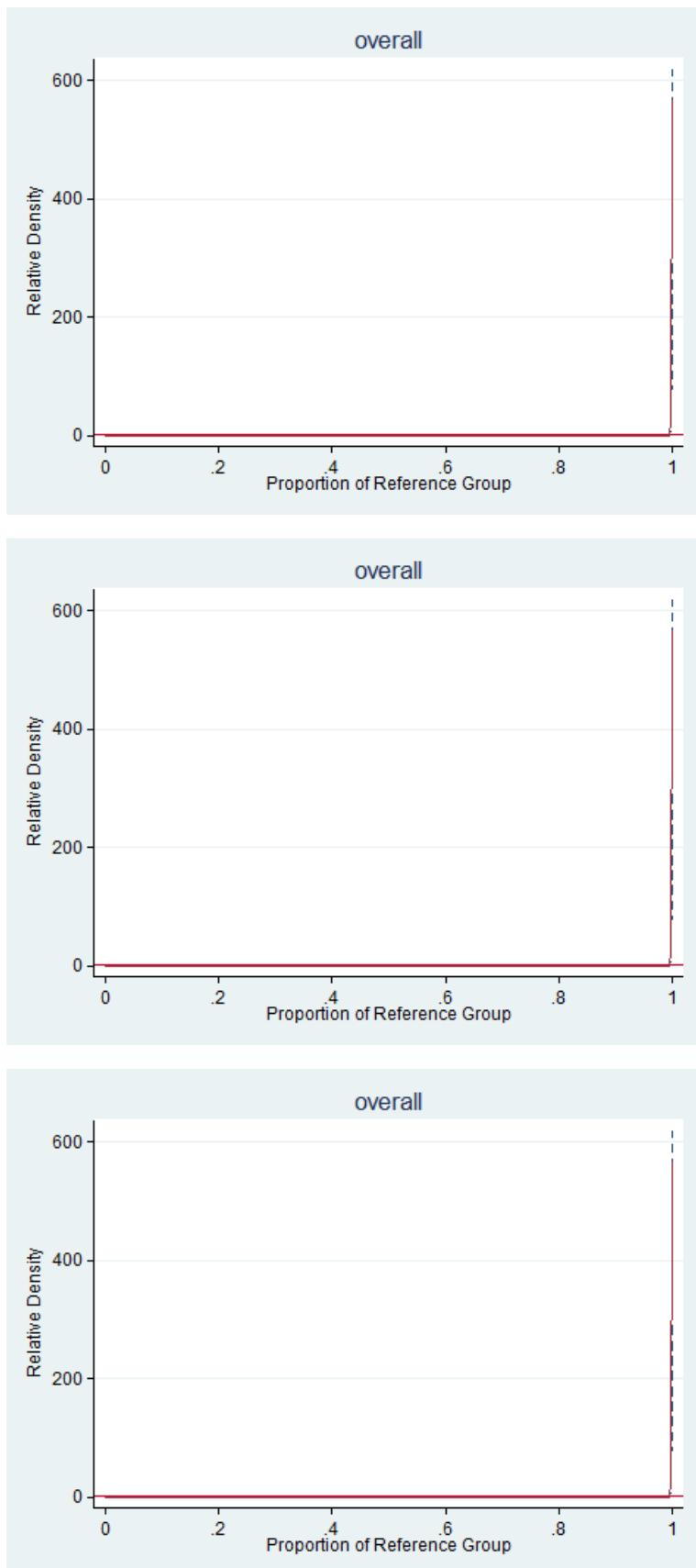


2008

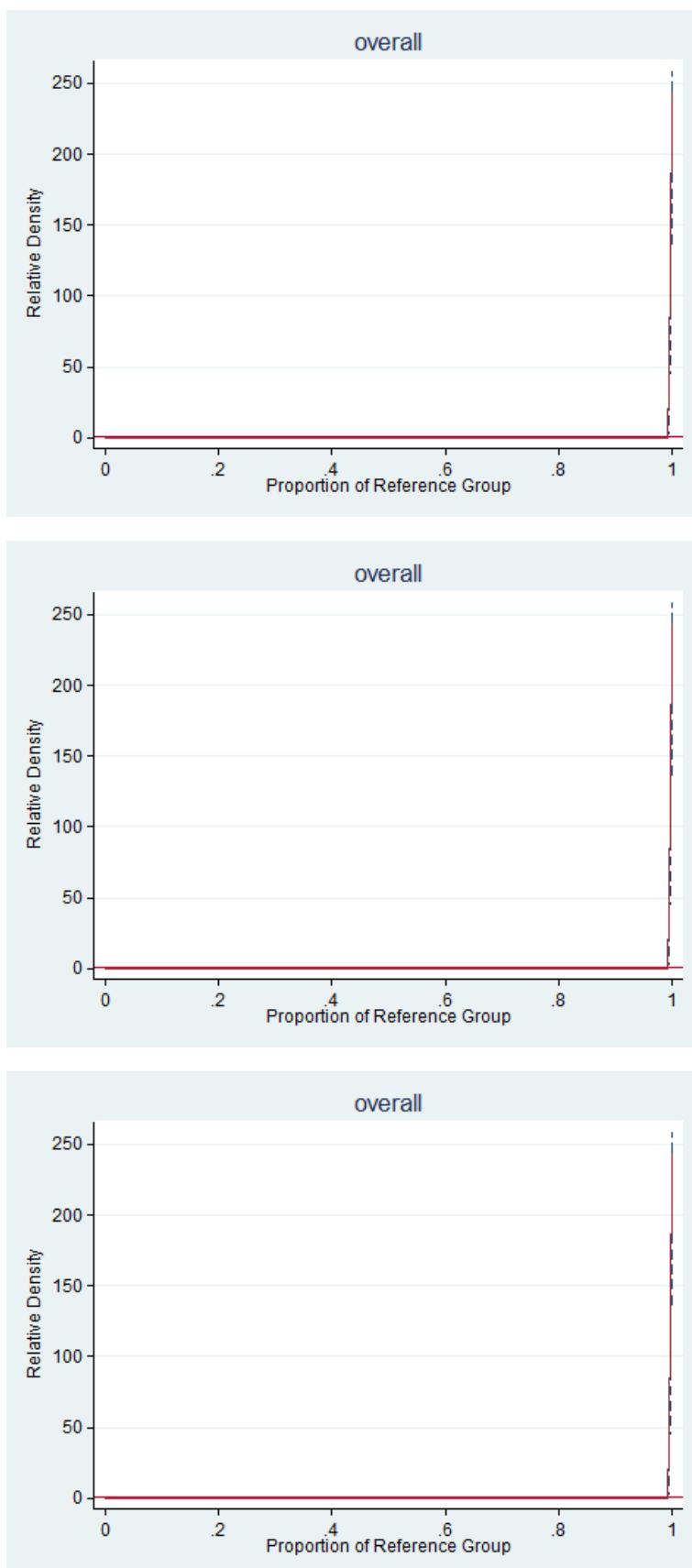


C2.6 POLAND

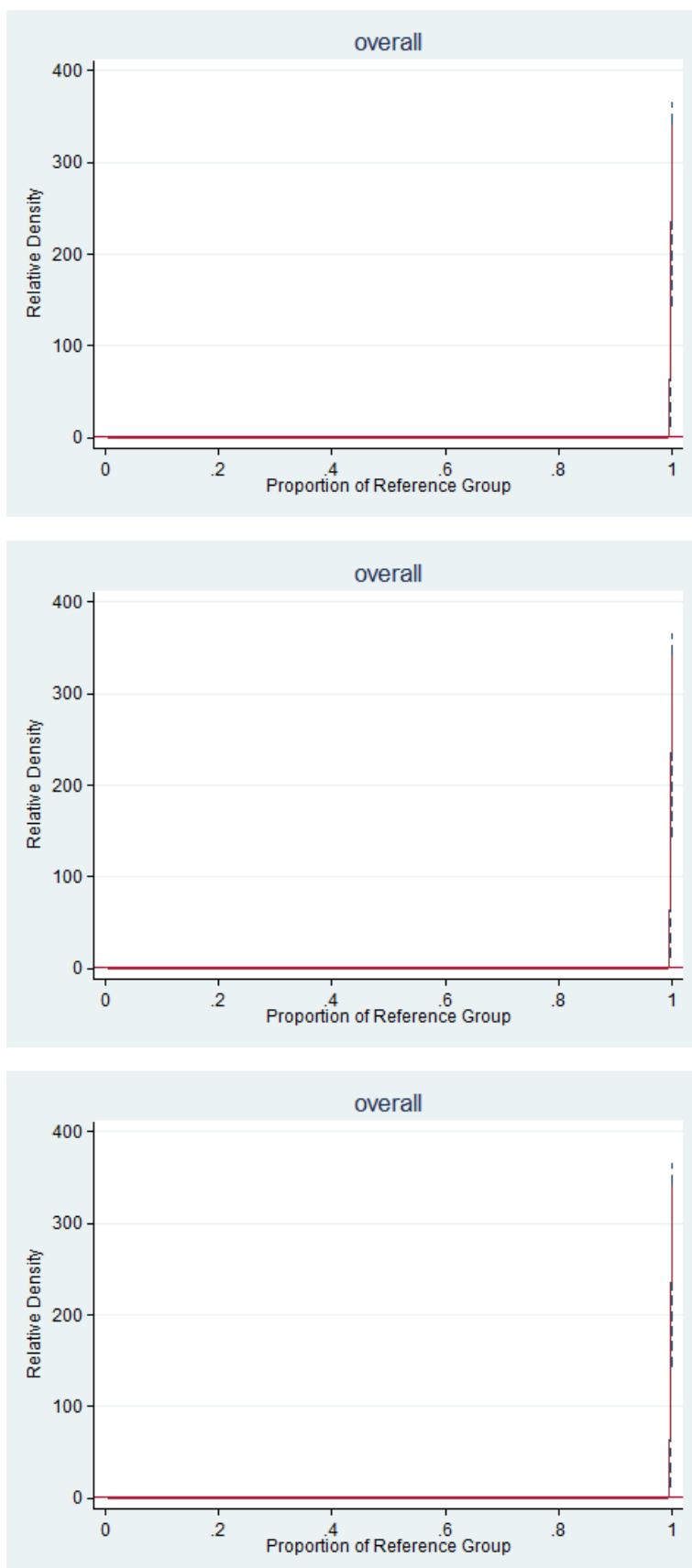
1986



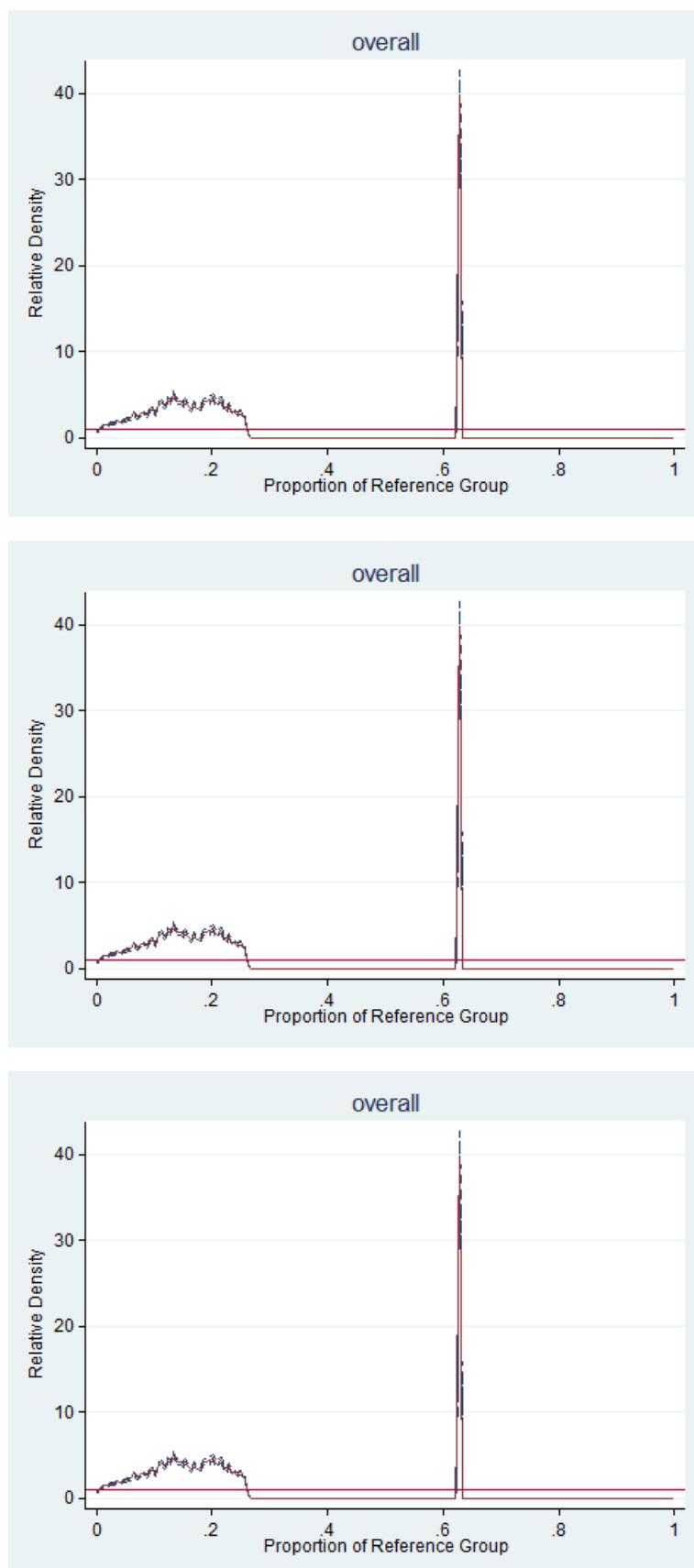
1992



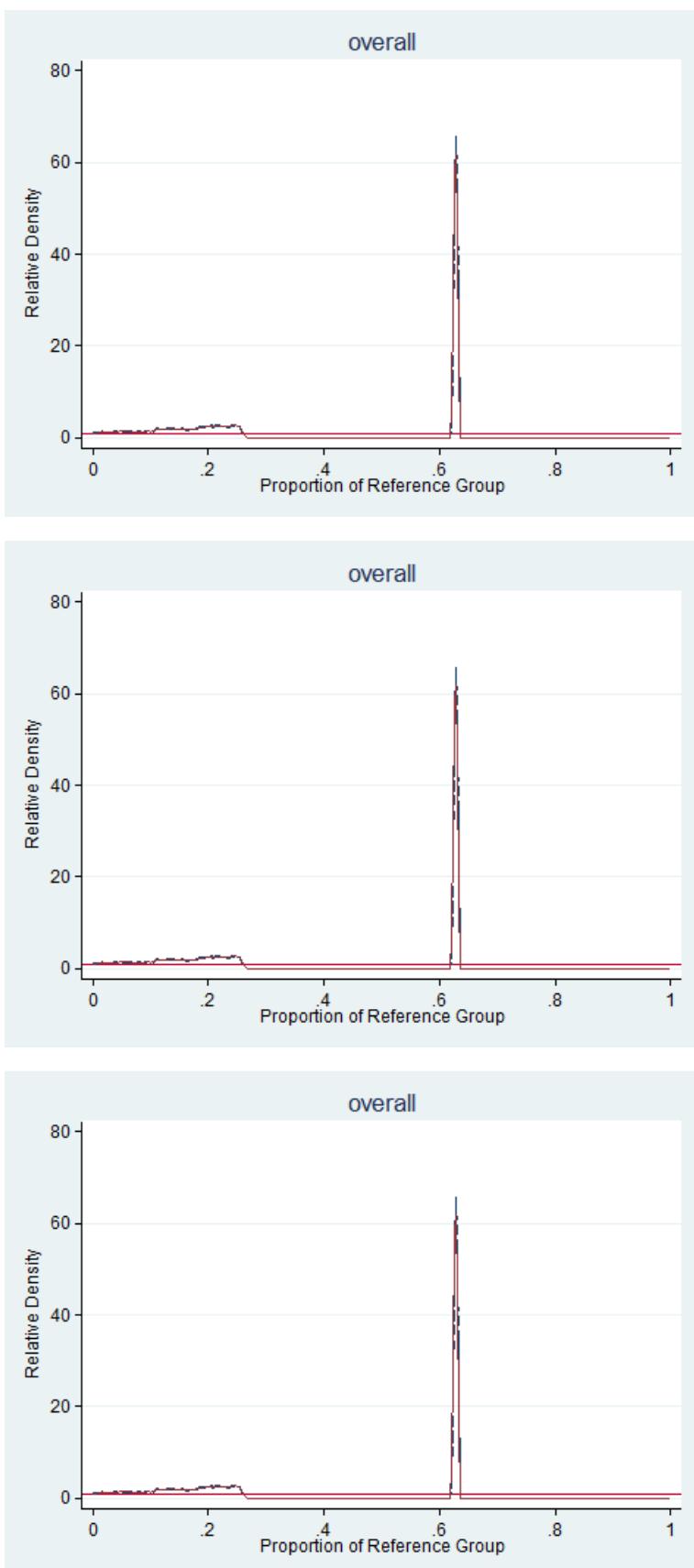
1995



1999



2004



2007

