

The impact of the economic crisis on Spanish income polarization

Rosa M^a García Fernández

Department of Quantitative Methods for Economics & Business
University of Granada

Carmen M^a Llorca Rodríguez

Department of International & Spanish Economics
University of Granada

Federico Palacios González

Department of Quantitative Methods for Economics & Business
University of Granada

Abstract

This paper tests the impact of the Spanish economic evolution on income polarization according to different features of the main breadwinner of the household. The approach to polarization of Palacios-González and García-Fernández (2012) is applied to data of the Spanish Household Budget Survey conducted by the Spanish National Statistics Institute for 2006, 2008 and 2010.

The results show an increase of polarization for all the selected features except for the regional one due to the countercyclical behavior of the Spanish regional labour markets. The education level and the branch of activity were the characteristics with highest level of polarization and, therefore, the main factors of population fractures.

Keywords: Income distribution, Polarization, ANOVA Model, Coefficient of Determination.

AMS Classification: 62J05; 62J10; 62P29.

El impacto de la crisis económica en la polarización de la renta en España

Resumen

Este trabajo analiza la polarización de la renta en la economía española atendiendo a diferentes características del sustentador principal del hogar. Para ello, se aplica la metodología de Palacios-González y García-Fernández (2012) a

datos procedentes de la Encuesta de Presupuestos Familiares elaborada por el Instituto Nacional de Estadística para 2006, 2008 y 2010.

Los resultados muestran un incremento de la polarización en todas las características seleccionadas, con la excepción de la regional, debido al comportamiento contracíclico de los mercados laborales autonómicos. El nivel de educación y la rama de actividad son las características con mayores niveles de polarización y, por tanto, los mayores factores de ruptura social.

Palabras clave: Distribución de la renta, Polarización, Modelos ANOVA, Coeficiente de determinación.

Clasificación AMS: 62J05; 62J10; 62P29.

1. Introduction

Topics such as poverty, inequality, and polarization are normally accentuated in a recession scenario since all of them deal with distributional aspect of income and their worsening could have serious implications for social well-being. Nevertheless, there are clear differences between these concepts. As it is well-known, poverty deals with the dissatisfaction of the basic needs of a part of society, inequality focuses on the convergence to the global mean of the income distribution and polarization focused on the grouping around local means.

The notion of income polarization is linked to the extent to which the population is clustered around a small number of distant poles (Esteban and Ray, 1994). There have been defined measures that focus on the grouping of the population into two poles (see, for instance, Foster and Wolfson, 1992; Wolfson 1994; Tsui and Wang, 2000; Silber *et al.*, 2007). Additionally, there have been proposed measures that capture the clustering of the population around any number of poles (see among others Esteban and Ray, 1994; Zhang and Kanbur, 2001; Gradín, 2000; Duclos *et al.* 2004; Palacios-González and García-Fernández, 2012). Some of these measures have been applied to analyze polarization by sub-populations (see, for instance, Gasparini *et al.*, 2008; Poggi and Silber, 2010). In any case, polarization studies the existence of fractures between antagonist groups. So, if income polarization increases, there could be a higher risk of social instability owing to the widening of social fractures and, therefore, the traditional welfare programs could be strained (Kuhn, 1995), above all in a time of economic crisis.

Spain has been plunged into a deep economic crisis destroying employment massively, and jeopardizing the social support measures for most disadvantaged population due to the increasing restriction to the public budget. Thus, social fractures could be deepened in this country. Nevertheless, as far as we know, the impacts of the current economic crisis on Spanish income polarization and on its effect by sub-populations have not yet been evaluated. Thus, the aims of this paper are, firstly, to test the impact of the abrupt change in the macroeconomic situation on Spanish income polarization. That is, if the economic downturn has accentuated the divergences in the income distribution of the Spanish households, thereby increasing the risk of social unrest. Secondly, we want to identify the major factors of income fractures between the Spanish households.

We focus on the approach to polarization recently proposed by Palacios-González and García-Fernández (2012) that defined an index increasing with the income differences across groups and decreasing with income differences within group. This index is equivalent to the coefficient of determination of an ANOVA model that explains the household income as a function of any feature of the population such as gender, occupation, region of residence, etc. This result supplies an alternative tool to focus on polarization by sub-populations. Comparing the coefficients of the ANOVA models, we can elaborate polarization profiles that show the households worst placed and most harmed in terms of income by the crisis in order to guide the government policy decisions.

We utilize the information provided by the Household Budget Survey conducted by the Spanish National Statistics Institute which started in January 2006 and replaces the Household Continuous Survey. This survey provides, among other things, information on monthly household income and different features related to the main breadwinner of the households for the available years (2006, 2008 and 2010). We focus on the following economic and demographic characteristics of the main breadwinner of the households: gender, level of education, work status, branch of economic activity, activity status and region of residence.

The remainder of the paper is organized as follows: section 2 describes the methodology, section 3 presents the results and policy implications and section 4 concludes.

2. Polarization measurement and data

The approach to polarization developed by Palacios-González and García-Fernández (2012, PG henceforth) considers, following Zhang and Kanbur (2001, ZK henceforth), that polarization is generated by two tendencies. Given that a number of groups determinate exogenously, they assumed that the income difference within the group decreases when the income of the individuals are closer to the average income of the group to which they belong. The smaller the distance, the higher the homogeneity within the group and the greater the contribution of this tendency to polarization. They presumed that heterogeneity is linked to the distance between the mean incomes of the groups. The larger the distance, the higher the heterogeneity between groups and the greater the contribution of this tendency is to polarization. According to the previous arguments, a global measure of income homogeneity within a group should be inversely proportional to the intra-group variance (V_W). On the other hand, a global measure of income heterogeneity between individuals belonging to different groups, should be proportional to the variance between groups (V_B). Formally, polarization can be computed by the expression¹

¹ Observe that P* resembles the measure of polarization of ZK. Indeed PG reformulated the measure of ZK using the intra-group and the inter-groups variances instead of the intra-group and the inter-groups inequality. They utilized the variance mainly because the notion of polarization is linked with dispersion and the variance is more appropriate than the concentration indices to compute dispersion (see, for instance, Fisher, 1958).

$$P^* = \frac{V_B}{V_W} \hat{1} [0 + \forall].$$

Note that P^* is not normalized which makes understanding it more difficult. Nonetheless, taking into account the decomposition of the variance of the overall population (V) into the intra-group variance plus the variance inter-groups, P^* can be normalized obtaining the following expression

$$P = \frac{V_B}{V} = 1 - \frac{V_W}{V} \hat{1} [0,1]$$

P is the measure of polarization used in this paper which, multiplied by 100, can be interpreted as a percentage of polarization.

One of the main advantages of P is that it allows us to connect the more recent topic of the polarization with the highly developed topic of regression via the coefficient of determination, R^2 . It is demonstrated (see Palacios-González and García-Fernández, 2012) that P is equal to the coefficient of determination of an ANOVA model (see for example Gujarati, 1997, p. 490) in which the income is explained by the dummy variables that assign each individual to a group.

Let us consider the ANOVA Model [1] that explains the variable Y , that in our case is the household income, in relation to the group to which each individual belongs²:

$$Y_j = \sum_{i=1}^k \beta_i D_i(j) + u_j \quad [1]$$

where β_i $i = 1, 2, \dots, k$ are the regression parameters, D_i , $i = 1, 2, \dots, k$, is a dummy variable that is equal to one if, and only if, the individual of the sample belongs to the group, and zero in other cases, and u_j is the error term which verifies that $E[u_j] = 0$, $V(u_j) = \sigma^2$ and $Corr(u_i, u_j) = 0$ for all $i \neq j$.

As has been pointed out, the polarization measure P is the coefficient of the determination of the ANOVA model [1].

To assess the impact of the current economic downturn on the income polarization of Spanish households, we have applied the approach described previously. To enrich the analysis, we have obtained the measures of Esteban, Gradín and Ray (see Gradín 2000, EGR henceforth), Zhang and Kanbur (2001) and a normalized expression of the latter (ZKN). The expressions of these measures are referred to appendix 2. All these measure have been obtained by bunching the sample into two groups. The dividing line between two groups is the mean income. Households with equalized net income below the

² In the empirical applications it is more interesting to eliminate a dummy variable instead of the constant term to avoid collinearity. In this way the coefficients of the model show the difference between the expected income of the groups included in the model, and the omitted group. So, in section 3 we estimated an ANOVA linear intercept model equivalent to [1].

mean belong to the group of “poor” or less favoured in terms of income and, those above belong to the group of “rich” or more favoured in term of income.

In addition, to identify the characteristics of the worst placed households we have focused on the estimated coefficients of the ANOVA model [1]. The approach applied is summarized as follows. Firstly, the households are classified into groups according to the different categories related with the main economic and demographic characteristics of the main breadwinner of the household. To do this, the economic and demographic variables are transformed into dummy variables. To avoid exact collinearity a reference category, which appears in italics in Chart 1 of the appendix 1, is chosen for each classification. Secondly, an ANOVA linear intercept model equivalent to the non-intercept model given by [1] is estimated for each classification of the households. Thirdly, we obtain the coefficient of determination of each fitted model, which is equal to the measure of polarization proposed.

We utilize the information provided by the Household Budget Survey conducted by the Spanish National Statistics Institute which started in January 2006 and replaces the Household Continuous Survey. This survey provides information on monthly households income and different features related to the main breadwinner of the households for the available years which are 2006, 2008 and 2010. We focus on the net monthly income and on the following economic and demographic characteristics of the main breadwinner of the household: gender, level of education, work status, branch of economic activity, activity status and autonomus region of residence. The monthly incomes are normalized using the modified OECD equivalence scale. To make comparisons we express the equivalized net household income in constant euros at 2006 prices.

3. Results

Despite the Spanish economy slowing down in 2008, data in table 1 show that the Spanish average monthly net equivalized income had grown 15.9 percent since 2006 and the inequality had fallen by a 1.7 percent and 1.32 percent attending to the Gini and Theil indices, respectively (see table 1). At this point it should be note that, according to Adiego and Ayala (2013), the rate of reduction of inequality in the distribution of income had held back in 2006 and the level of education had less importance in explaining the inequality whilst the space variable had a higher contribution to it. If we pay attention to the results of table 2, it can be observed that our polarization measure decreased in 2008 compared to 2006, because, on the one hand, the mean incomes of the two groups are closer and hence the heterogeneity among groups is smaller; and on the other hand, the groups become less homogeneous, and their contribution to polarization was minor (see table A1 of Appendix 1). The polarization measures of ZK, ZKN and EGR also reflect a decrease of polarization from 2006 to 2008. In 2010, our measure of polarization changed its trend and experienced an increase as did the measures of ZK, ZKN and EGR.

Attending to the analysis of income polarization by sub-populations, we find that the education level and the branch of activity of the main breadwinner are the categories

with the highest level of polarization (table 3). Thus, a higher educational level implies a better position in the income distribution (table 4). Indeed, higher educational level acts as protection factor against poverty in Spain, despite the fact its effectiveness was weakened in the period previous to the crisis since the wage premium of tertiary education had fallen and wage differences among the different level of education had narrowed (Ayala, 2008 and Adiego and Ayala, 2013). So, it is crucial to pay attention to the education system in order to prevent and reduce social fractures in Spain. Bearing in mind that almost 45 % of the Spanish workforce has no more than the compulsory education level³, the importance of its reform is vital in order to keep people within the education system and to adapt it to the labour market needs.

If we pay attention to the sectorial perspective, *Financial* and *Real Estate* were the branches of economic activity with the greater average income in 2006 (see Table 5). Furthermore, the households with their head of family working in *Transport* activities or *Manufacturing* also had higher incomes than our reference branch, *Other activities and services*, which compile, among other branch of activities, the *Public Administration and Services*. We must highlight that the coefficient obtained for the *Agriculture* sector runs contrary to the above sectors. These results are in line with those of the Spanish National Accounts since the average rate of growth of the employee compensation, the main component of our equivalized net household income, in the period 2000-2006 was 4.74 percent, 4.08, 4.01 and 3.19 for *Manufacturing*, *Public Administration* and *Financial* and *Real Estate* activities. Wage incomes increased by a 3.25 percent in the same period in the *Agriculture* sector.

The measure of polarization by gender of the head of family shows the small homogeneity within the group of females. This fact leads to a weakening of the identification intra group involving a diminishing in polarization. Nonetheless, there are differences in average income by gender favourable to men, as is shown by the estimated coefficients of the ANOVA model (see table 6). This disadvantaged position of women is also reflected by the report of the OECD⁴ that quantified the Spanish gender wage gap as 10.4 percent in 2006. Along the same lines, the Global Gender Gap index⁵(World Economic Forum, 2006), ranked Spain 11th among 115 countries; but according to the economic participation and opportunity sub index, which includes earned income, Spain ranked 85th⁶.

With respect to the work status, the ANOVA model shows that the self-employed maintained the lower distance with respect to the category of reference (*Other situations* that is households receiving social subsidies such as Family Help). The categories of employees and employers are above it (table 7). Behind this result there is the fact that households in the bottom percentage of the Spanish income distribution (the income-poorest) are mostly headed by self-employed (see, among others, Budría and Díaz-

³ Data available at <http://www.ine.es> (Labour Force Survey)

⁴ Data available at <http://www.oecd.org/gender/equality> (Gender Data Browser)

⁵ This index examines the gender gap by four categories: economic participation and opportunity, educational attainment, health and survival and political empowerment.

⁶ The distribution of female wage discrimination has recently drawn attention in the literature (see, for example, De la Rica *et al.*, 2008 and Pena *et al.*, 2010).

Giménez, 2007). For a better understanding of this result, the weakness of self-employed in the Spanish economy should be considered because of, among other factors, the low level of social coverage they suffer. Nevertheless, at this time, the Spanish institutions are encouraging individuals to be entrepreneurs and start their own businesses as a solution to the high unemployment. Obviously, our results reveal that additional measures should be taken in advance in order to reduce the vulnerability of this group and to turn self-employment into an attractive option.

The results reached by the ANOVA model show the clear and persistent income differences between autonomous regions existing in Spain (see, among others, Alcaide Inchausti, 1980; Pena *et al.*, 1996; Pascual and Sarabia, 2007; Ahamdanech *et al.*, 2010). In fact, despite the recurrence of common features in the sectorial breakdown, the wage incomes differ from one region to another, even in the same branch of activity (see, for instance, Simón, 2009). Moreover, as it is well known, the labour markets of the autonomous regions records distant rates of unemployment in some cases and the results of the ANOVA model for activity status of the breadwinner of the household show the disadvantage of those in unemployment with respect to those in employment or in other situations as the retirement (see table 9). Therefore, with regard to the regional perspective, the coefficients of Extremadura, Murcia, Castile-La Mancha, Andalusia and Galicia are the most striking ones owing to their marked disadvantage with respect to Madrid (table 8).

We can observe that polarization decreased in 2008 for gender, education, work status and branch of activity approaches. If we pay attention to the latter, the estimated coefficients of the ANOVA models behave in a different way to 2006 in some classifications of the activity branches. If the main breadwinner worked in *Trade* or *Transport* activities, the household average incomes were closer to the reference category (table 5, column 4). Therefore, our results reflect the slowing down of the Spanish economy in 2008 revealing the onset of the current crisis.

Special attention should be paid to the regional differences, as well. The distance of the most disadvantaged regions with respect to the reference category had increased in 2008 again; even though Murcia had improved its relative position. La Rioja and the Basque Country had reversed its relation with respect to Madrid and now had a higher average income. Moreover, we must stress the Balearic Islands and Navarre in which households registered a lower average income than those located in Madrid. In fact, the polarization index for this criterion of our analysis grew by 20.43 percent (table 7, column 4). It should be taken into account, once again, that the main source of the equalized net household income is the wage income and that the Spanish labour market shows sizable and persistent differences between regions (López-Bazo *et al.*, 2002 and 2005) in terms of activity sector and occupation status of workers. These differences have a countercyclical behavior in terms of regional unemployment disparities (Bande *et al.*, 2007 and 2008) affecting the regional wage income divergences. In fact, our ANOVA model for activity status shows a worsening of the disadvantage of households with the breadwinner in unemployment. The fall in polarization according to this perspective in 2008 is explained by a higher raise in the

heterogeneity within the groups than among the groups (see table A1 of Appendix 1). So, the decentralization of active measures of employment has not been able to reduce Spanish territorial fractures or, at least, to avoid their widening. In other words, uncertainty about the long-term effects on well-being of social policy decentralization in Spain arises (see, for instance, Ayala 2008).

In 2009, the Spanish economy contracted 3.7 percent in volume terms. All the autonomous regions suffered the downturn, but Valencia, Asturias, Murcia, La Rioja, Castile-La Mancha and the Balearic Islands were the worst hit. If we pay attention to the economic sectors, *Manufacturing* and *Construction* were the most affected branches of activity in 2009. In 2010, the *Construction* collapse continued pulling down the whole economy which registered a fall of -0.1 percent. In fact, *Construction* was the main employment destructive sector due to its greater labour intensity. *Real Estate* activities and *Manufacturing* suffered a significant destruction of jobs, as well. Obviously, this job destruction was more intense for men owing to the high percentage of male workers in the activity branches more affected by crisis.

In this recession context, the average monthly net equivalized income fell 9.64 percent; inequality increased by a 1.7 percent and by 0.67 percent according to the Gini and Theil indices respectively (table 1) and the polarization index had increased for all the selected criteria excepting the territorial perspective. By gender, the average income gap got closer but women remained in a worst position. It should be taken into account that temporary contracting, part-time work and unemployment have had a greater impact on the female workforce, which has a low skill level and, therefore, faces the economic disruption with a greater weakness (Centro de Estudios del Cambio Social, 2011, p. 322). So, even though the advances highlighted by OECD (2012) in the narrowing of educational gender gap for younger groups, Spain should strengthen the female skill and reinforce the gender equality initiatives as for instance pay equity.

According to the education perspective, the polarization increased 17.85 percent. However, they revealed an income fall in all the categories as a consequence of the economic crisis. The average income of the lowest levels of education clusters, compiled in table 4 (column 6), got closer together; while the difference maintained by the group of tertiary education level fell with a lower intensity. We must point out that people with Middle School and High School education were the most hit by unemployment in Spain between 2008 and 2010: their unemployment rates grew by almost 90 percent. In fact, the previously mentioned weakening of the link between education and higher income during the upward period has been reversed with the economic crisis.

The increase of polarization attending to the work status classification is especially striking. Again the distances between the groups and the reference category fell, especially for self-employed, which in part is due to the diminishing of the overall income, even though the positive differences are maintained.

Despite the fact that the increment of polarization according to the activities branches criterion had been of a lesser amount (1.76 percent), the economic downturn has

modified the relation between these groups significantly. In 2010 only *Financial* and *Real Estate* activities maintained positive differences with respect to the reference category, even though they had decreased. At this point we must remember that our reference category in this model was *Other Activities and Services* that compiled *Public Administration and Services* in which wage incomes had stayed more stable in the analysed period. The most harmed households were those in which their main breadwinner worked in *Trade, Hotel* and *Manufacturing* activities (table 5, column 6).

In contrast with these results, as table 3 shows, polarization index had decreased by Autonomous Regions in 2010 with respect to 2008 (8.20 percent). The regions with the worst income position, excepting Murcia, had reduced their distance with respect to Madrid and those ones with better situation, that is the Basque Country, Catalonia and the Balearic Islands, had worsened their status. We must point out that Catalonia and the Balearic Islands are placed between the Autonomous Regions which suffered a greater increment of the unemployment rate in the period 2008-2010, reaching rates of change of 97.22 and 100.1 percent respectively. In addition, we should note that households with the breadwinner in unemployment worsen their situation with respect to other situations as retirement although they improve it in comparison with the households with a breadwinner in employment. The heterogeneity within the groups fall more than the heterogeneity among groups (see table A1 of Appendix 1), so polarization increase in 2010 according to the activity status (Table 9). Nevertheless, Extremadura, Castile-La Mancha, Murcia, Andalusia and the Canary Islands maintained the greater negative income differences with respect to Madrid (table 7, column 6). The countercyclical behavior of the Spanish labour market in terms of regional unemployment disparities is again revealed. Nonetheless, polarization by regions is still higher in 2010 than in 2006.

4. Conclusions

Economic recession awakens the researcher's interest on inequality and poverty owing to the fact they have an influence on social instability. In this sense, polarization highlights the social tension risk since it pays attention to the clustering of population around antagonistic distant poles. Our analysis focuses on testing the impact of the last economic downturn on the Spanish polarization and identifying the households most harmed by the crisis.

Our results point out that polarization, as well as inequality, decreased in Spain between 2006 and 2008 in the overall population. The economic recession caused a fall in the average monthly net equivalized income in Spain and an increase of inequality and polarization for the overall of population in 2010.

From 2006 to 2008 polarization by sub-populations decreased for all the households' characteristics considered in our analysis except for the regional aspect. Polarization increased in this category owing to the countercyclical behavior of the Spanish regional labour markets in terms of unemployment rates. Nevertheless, the onset of the economic downturn could be inferred, in part, from the fact that income of *Trade* and *Transport*

branches approached the income of the *Public Administration* sector. This pattern shows the slowing down of these key activities in the productive system and, therefore, it can be considered as an alert signal of the reverse of economic situation for the whole of the Spanish economy.

The trend of income polarization changed in 2010, increasing for all the sub-population analysis criteria, except the regional one owing to the worsening of the richest areas. Thus, the social tension risk rose in Spain. The most harmed cluster were the households with a main breadwinner with any of the following characteristics: medium level of education, self-employed, working in *Trade, Hotel* or *Manufacturing* activities and from Basque Country, Catalonia and Balearic Islands.

These findings show the existence of clear social fractures and should encourage the adoption of deep reforms in Spain in the educational system, labour market regulation, productive specialization, regional development and social policies, such as the unemployment protection system. In addition, gender equality initiatives should be reinforced.

Tables

Table 1

Summary measure of montly equivalized net income in Spain

	<i>Mean</i>	<i>Median</i>	<i>Gini index</i>	<i>Theil index</i>	<i>Sample Size</i>
2006	983.741	850.000	0.301	0.151	19,435
2008	1,140.155	1,000.000	0.296	0.149	22,077
2010	1,030.230	887.299	0.301	0.150	22,203

Table 2

Measures of Polarization

	<i>P</i>	<i>ZKN</i>	<i>ZK</i>	<i>EGR</i>
2006	0.521	0.639	1.768	0.214
2008	0.488	0.616	1.601	0.209
2010	0.525	0.684	1.733	0.213

Table 3

Polarization measure-Coefficient of determination

	<i>Gender</i>	<i>Education</i>	<i>Work status</i>	<i>B.activity</i>	<i>Regions</i>	<i>Activity</i>
2006	0.000530	0.209489	0.016199	0.115817	0.043676	0.080307
2008	0.000399	0.182176	0.008467	0.093001	0.052598	0.073214
2010	0.000463	0.214700	0.012069	0.094637	0.048283	0.086673

***, **, * significant at 1%, 5% and 10% respectively

Table 4

Estimated coefficients of the ANOVA Model for Education

	2006		2008		2010	
	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>
Middleschool	182.589***	18.5575	197.208***	17.7306	151.393***	21.1207
High school	370.706***	31.2955	394.513***	29.3334	336.555***	32.7422
Tertiary	708.121***	70.1468	786.02***	67.7304	742.394***	66.0883
Constant	720.823***	115.4796	824.144***	105.2793	729.983***	145.6393

***, **, * significant at 1%, 5% and 10% respectively

Table 5

Estimated coefficients of the ANOVA Model for Activity Branch

	2006		2008		2010	
	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>
Agriculture	-168.065***	-7.3676	-192.101***	-7.5152	-536.72***	-42.0088
Manufacturing	133.508***	6.4428	163.192***	7.2445	-180.246***	-14.9405
Construction	-6.57227	-0.3010	-21.1038	-0.8793	-399.112***	-30.9730
Trade	106.192***	4.7178	99.2652***	4.0724	-247.779***	-17.6831
Hotel	44.6349*	1.6718	16.1062	0.5464	-357.627***	-20.3520
Transport	193.492***	7.8885	183.851***	6.8669	-119.674***	-7.0000
Financial	616.997***	19.4446	747.022***	21.0175	375.09***	10.8703
Real Estate	450.814***	21.6324	450.898***	20.0168	85.6088***	0.4885
Constant	843.239***	44.6668	987.224***	48.4373	1224.24***	132.9773

***, **, * significant at 1%, 5% and 10% respectively

Table 6

Estimated coefficients of the ANOVA Model for Gender

	2006		2008		2010	
	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>
Female	-32.5773***	-3.2105	-32.3803***	-2.9689	-29.836***	-3.3143
Constant	991.33***	202.4013	1148.36***	209.2065	1038.45***	208.7713

***, **, * significant at 1%, 5% and 10% respectively

Table 7

Estimated coefficients of the ANOVA Model for Work Status

	2006		2008		2010	
	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>
Employee	406.025***	5.2912	443.771***	4.8302	333.8***	6.6776
Self-employed	289.106***	3.7378	348.29***	3.7613	185.475***	3.6458
Employer	634.09***	8.0661	645.006***	6.8731	491.392***	8.8320
Constant	598.515***	7.8159	713.463***	7.7791	719.929***	14.4640

***, **, * significant at 1%, 5% and 10% respectively

Table 8

Estimated coefficients of the ANOVA Model for Autonomous Regions

	2006		2008		2010	
	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>
Andalusia	-292.965***	-11.8941	-357.831***	-14.0536	-303.618***	-13.4337
Aragon	-186.209***	-6.7360	-209.921***	-7.4603	-238.962***	-9.8003
Asturias	-82.0935***	-2.6426	-106.531***	-3.3049	-24.2629	-0.8612
Balearic Islands	5.86026	0.1925	-1.47283	-0.0418	-100.649***	-3.5299
Canary Islands	-206.107***	-7.1666	-325.146***	-11.3312	-300.907***	-11.0064
Cantabria	-142.046***	-4.0960	-240.55***	-7.7147	-124.081***	-4.2435
Castile-Leon	-198.107***	-7.9027	-234.577***	-8.5229	-201.963***	-8.5994
Castile-La Mancha	-302.865***	-12.2715	-352.883***	-13.1785	-333.474***	-14.0802
Catalonia	-26.3254	-1.0553	-37.7217***	-1.3951	-73.5759***	-3.1376
Valencia	-156.497***	-6.0866	-204.095***	-6.9126	-226.829***	-9.7798
Extremadura	-389.764***	-15.2541	-451.055***	-15.7408	-427.81***	-18.0820
Galicia	-258.27***	-10.3475	-296.719***	-11.0306	-238.054***	-10.0176
Murcia	-319.908***	-11.4393	-296.664***	-10.1718	-331.506***	-12.8445
Navarre	12.1548	0.3861	-39.0459	-1.3966	-5.13277	-0.2070
Basque Country	-16.2537	-0.6565	118.768***	4.0383	29.6276	1.2599
La Rioja	-225.444***	-8.2644	-207.646***	-6.5335	-147.342***	-5.3171
Constant	1145.16***	55.4371	1314.56***	59.3751	1198.83***	64.3298

***, **, * significant at 1%, 5% and 10% respectively

Table 9

Estimated coefficients of the ANOVA Model for Activity Status

	2006		2008		2010	
	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>	<i>Coeff.</i>	<i>t-Stat.</i>
Worker	524.213***	29.5349	650.125***	44.3418	612.873***	59.9794
Other	199.122***	11.1642	309.112***	20.1667	348.63***	33.5031
Constant	591.233***	35.1653	631.976***	47.3130	552.697***	65.1981

***, **, * significant at 1%, 5% and 10% respectively

Appendix 1**Chart1. Household groups by economic and demographic characteristics**

<i>Gender</i>
Female
Male
<i>Education</i>
Up to elementary school
Middle school
High school
Tertiary
<i>Work status</i>
Employee
Self-employed
Employer
Employer
<i>Branch of Activity</i>
Agriculture
Manufacturing
Construction
Trade
Hotel
Transport
Financial
Real Estate
Other activities and services
<i>Autonomous Regions</i>
Andalusia
Aragon
Asturias
Balearic Island
Canary Islands
Cantabria
Castile-Leon
Castile-La Mancha
Catalonia
Valencia
Extremadura
Galicia
Murcia
Navarre
Basque Country
La Rioja
Madrid
<i>Activity Status</i>
Worker
<i>Unemployee</i>
Others

Table A1

Intra group and Inter groups variances

	<i>P</i>		<i>Gender</i>		<i>Education</i>		<i>Work Status</i>	
	<i>Vb</i>	<i>Vw.</i>	<i>Vb</i>	<i>Vw.</i>	<i>Vb</i>	<i>Vw.</i>	<i>Vb</i>	<i>Vw.</i>
2006	1.86E+05	1.71E+05	3.69E+06	6.95E+09	1.46E+09	5.50E+09	1.08E+08	6.54E+09
2008	2.42E+05	2.54E+05	4.39E+06	1.10E+10	2.00E+09	8.97E+09	9.05E+07	1.06E+10
2010	4.48E+09	4.05E+09	3.94E+06	8.51E+09	1.83E+09	6.68E+09	1.00E+08	8.20E+09

Intra group and Inter groups variances

(Continue)

	<i>Activity Branch</i>		<i>Regions</i>		<i>Activity Status</i>	
	<i>Vb</i>	<i>Vw.</i>	<i>Vb</i>	<i>Vw.</i>	<i>Vb</i>	<i>Vw.</i>
2006	7.70E+08	5.88E+09	3.04E+08	6.65E+09	5.58E+08	6.39E+09
2008	9.88E+08	9.64E+09	5.77E+08	1.04E+10	8.06E+08	1.02E+10
2010	7.86E+08	7.52E+09	4.11E+08	8.10E+09	7.37E+08	7.77E+09

Appendix 2.**Measures of Esteban and Ray and Zhang and Kanbur**

Esteban, Gradín and Ray (see Gradín, 2000) defined the following measure

$$EGR(a, g) = \frac{1}{n} \sum_{i=1}^n \frac{1}{\rho_i} \rho_i^{1+a} p_j |\eta_j - \rho_j| - g[G(f) - G(r)] \quad 1 \leq a \leq 1.6; g^3 \leq 1$$

where:

$$\rho_i = \int_{y_{i-1}}^{y_i} f(y) dy \quad \text{and} \quad \eta_j = \frac{1}{\rho_j} \int_{y_{j-1}}^{y_j} y f(y) dy$$

represent the relative frequency and the conditional mean in group i for a density f of the logarithm of income respectively. The term in brackets is the Gini index of the original distribution, $G(f)$, minus the Gini coefficient of the distribution that gives each individual in a group their representative income, $G(r)$, g is a free sensitivity parameter that measures the sensitivity within group cohesion and a is a degree polarization sensitivity parameters. In our calculations both are equal to one.

On the other hand, Zhang and Kanbur (2001) defined the following polarization index

$$ZK = \frac{\text{between groups inequality}}{\text{within group inequality}}$$

For the Theil index the above expression can be written as follows

$$ZK = \frac{T_B}{T_W} = \frac{\sum_{j=1}^k \frac{n_j}{N} \frac{m_j}{m} \ln \frac{\mu_j}{\mu}}{\sum_{j=1}^k \frac{n_j}{N} \frac{m_j}{m} T_j}$$

where:

$$T_j = \frac{1}{n_j} \sum_{j=1}^{n_j} y_j \ln \frac{y_j}{m_j}$$

k is the number of groups; N is the total population; n_j is the population of the j th group; μ is the total sample mean; μ_j is the mean of the j th group and y_j is the j th income.

Observe that the expression of ZK tends to infinite when the within-group inequality is equal to zero. This drawback can be corrected normalizing the measure taking into consideration that $T = T_W + T_B$. Proceeding in this way, we obtain the normalized index of Zhang and Kanbur which is given by

$$ZKN = 1 - \frac{T_W}{T}$$

where

$$T = T_W + T_B$$

References

- ADIEGO M, AYALA L (2013) «La estructura de la desigualdad de la renta en el largo plazo». *Revista de Economía Aplicada*, 62: 5-35.
- ALCAIDE INCHAUSTI J, (1980) «Distribución regional y espacial de la renta española». *Revista de Estudios Regionales* 2:340-370.
- AHAMDANECH Z I, GARCÍA P C, PRIETO A M (2010) «Convergencia regional de las distribuciones personales de la renta en España (1990-2003)». *Revista de Economía Aplicada* 52: 35-61.
- AYALA CAÑÓN L (COORD.) (2008) «Desigualdad, pobreza y privación» in Fundación FOESSA, VI Informe sobre exclusión y desarrollo social en España 2008. Madrid.
- BANDE R, FERNÁNDEZ M, MONTUENGA V (2007) «Regional disparities in the unemployment rate: the role of the wage setting mechanism in Spain, 1987-1992». *Reg Stud* 41: 235-251.

- BANDE R, FERNÁNDEZ M, MONTUENGA V (2008) «Regional Unemployment in Spain: Disparities, Business Cycle and Wage-Setting». *Labour Economics* 15: 885-914.
- BUDRÍA S, DÍAZ-GIMÉNEZ J (2007) «Economic inequality in Spain: the European Community Household Panel Dataset». *Spanish Economic Review* 9: 1-38.
- CENTRO DE ESTUDIOS DEL CAMBIO SOCIAL (2011) «Informe España 2011. Una interpretación de su realidad social». Fundación Encuentro.
- DE LA RICA S, DOLADO J, LLORENS V (2008) «Ceilings or floors? Gender wage gaps by education in Spain». *J Popul Econ* 21:751-776.
- DUCLOS J Y, ESTEBAN JM, RAY D (2004) «Polarization: Concepts, Measurement, Estimation». *Econometrica* 74:1337-1372.
- ESTEBAN J M, RAY D (1994) «On the Measurement of Polarization». *Econometrica* 62: 819-851.
- FISHER W D (1958) «On Grouping for Maximum Homogeneity». *Journal of the American Statistical Association* 53: 789-798.
- FOSTER J, WOLFSON M (1992) «Polarization and Decline of the Middle class: Canada and the US», Mimeo, Vanderbilt University.
- GASPARINI L, HORENSTEIN M, MOLINA E, OLIVIERI S (2008) «Polarización Económica, Instituciones y Conflicto». Uqbar, Chile.
- GRADÍN C (2000) «Polarization by sub-populations in Spain, 1973-91». *Rev Income Wealth* 46 (4): 457-474.
- GUJARATI D N (1997) «Econometria». McGraw-Hill Interamericana, Colombia.
- KUHN P (1995) «Labour Market Polarization: Canada in International Perspective». *The Bell Canada Papers on Economic and Social Policy* 4: 283-322.
- LÓPEZ-BAZO E, DEL BARRIO T, ARTÍS M. (2002) «The regional distribution of Spanish unemployment: A spatial analysis». *Papers in Regional Science* 81: 365-389.
- LÓPEZ-BAZO E, DEL BARRIO T, ARTÍS M (2005) «Geographical distribution of unemployment in Spain». *Reg Stud* 39: 305-318.
- OECD (2012) «Gender Equality in Education, Employment and Entrepreneurship: Final Report to the MCM 2012». C/MIN (2012)5. OECD Publishing Paris.
- PALACIOS-GONZALEZ F, GARCIA-FERNÁNDEZ R M (2012) «Interpretation of the coefficient of determination of an ANOVA model as a measure of polarization». *J Appl Stat* 39 (7):1543-1555.
- PASCUAL M, SARABIA JM (2007) «Modelización de la distribución personal de la renta en España: Un análisis regional». *Revista de Estudios Regionales* 13-41.
- PENA J B, CALLEALTA F J, CASAS J, MEREDIZ A, NUÑEZ J J (1996) «Distribución personal de la renta en España». Pirámide, Madrid.

- POGGI A, SILBER J (2010) «On polarization and Mobility: A look at polarization in the wage-career profile in Italy». *Rev Income Wealth* 56: 123-140.
- SILBER J, HANOKA M ,DEUTSCH J (2007) «On the Link Between the Concepts fo Kurtosis and Bipolarization». *Economics Bulletin* 4: 1-6.
- SIMÓN H (2009) «La desigualdad salarial en España: una perspectiva internacional y temporal». *Investigaciones Económicas* 33: 439-471.
- TSUI K, WANG Y (2000) «Ordering and New Classes of Polarisation Indices». *Journal of Public Economic Theory* 2: 349-363.
- WORLD ECONOMIC FORUM (2006) «The Global Gender Gap Report 2006». Geneva, Switzerland.
- WOLFSON M C (1994) «When Inequalities Diverge?». *Am Econ Rev* 84: 353-58.
- ZHANG X, KANBUR R (2001) «What Difference Do Polarization Measures Make? An Application to China». *J Dev Stud* 37 (3): 85-98.