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INEQUALITY OF SPANISH HOUSEHOLD EXPENDITURE FOR THE 2006–2016 PERIOD — ARE WE CONVERGING?[1]

The depth and persistence of the Great Recession that started in 2008 had a considerable impact on income distribution and inequality. Therefore, studies of living standards and evolution of income inequality are trend topics nowadays.

Our goal was to estimate the impact of the economic crises on household expenditure and the trends and evolution of regional inequality. We applied our analysis to the Spanish case based on Household Budget Survey data from Instituto Nacional de Estadística (INE, the National Statistics Institute) and the period of eleven years between 2006 and 2016. A model that showed good results in modelling income was the biparametric gamma model, which is further very useful to estimate inequality. First, we tested the validity of the model, which allowed us to obtain the inequality data. Second, we extended our analysis studying the evolution of inequality, as well as household living standards, by examining the impact of the Great Recession on household expenditures. For the second part of the paper, we conducted longitudinal and transversal studies. The main results show that, in general, expenditure inequality reduces during the period studied. Moreover, given that average spending decreases in most regions, the tendency is for them to equalize on the downside, especially for the period of the economic crisis (2008–2013).

Keywords: household expenditure, inequality, regional data, Autonomous Communities, biparametric Gamma, longitudinal analysis, transversal studies

1. Introduction

Having a suitable income explanatory model is key for policy makers when designing policies for improving social welfare at both the regional and national level. Relative to income, inequality is one of the dimensions that directly affects policy makers' performance, as more inequality is usually associated with more economic, political and social instability. Income modelling has been widely studied in literature [1] and [2] Singh and Maddala, [3] and [4] Dagum, 1977 and 1980; 1976 and 1978; [5] Baró, 1982; [6] Esteban et al., 1994; [7] Callealta et al., 1996; [8] Herrerías et al., 1996; [9] Klein et al., 2015, [10] Nartikoev and Peresetsky, 2019, as well as the economic interpretation of the parameters of the proposed model [11] Dagum, 1980; [12] Rojo, 1993; [13] Lafuente, 1995; [14] Martín-Guzmán, 1996; [15] López Rodríguez, 1997; [16] García et al., 2006. The main reason for such interest lies in the fact that when finding a proper model which can explain the evolution of income, we will be able to make comparisons between regions and among time that can help design more accurate economic policies. Moreover, modelling income also allows us to better analyse inequality, which is key in the study of the evolution of social welfare.

Studying income evolution also helps to identify inequalities and their evolution over time. In this topic, regional disparities have been in the spotlight of much research. For instance, [17] Díez-Minguela et al. (2018) analyse Spanish long-term income evolution for the period 1860–2015 using GDP per capita. They find the well-known inverted U shaped curve with an initial period of increasing inequality between 1860 and 1930.This is followed by a converging period until 1980 and an increasing polarization between the north and the regions of the south and south-west. [18] De la Fuente, 2019, also focuses on regional inequalities through GDP per capita, but for the period 1955–2016. A similar pattern with a reduction in regional disparities was found at the beginning of the period, that smoothens afterwards and even reverts in the last decade.

The present work follows this line of analysis and the main questions that this study aims to answer are: What has been the evolution of household expenditure, bearing in mind that the period includes the recent Great Recession? Is inequality increasing or decreasing among the regions? And finally, what is the relative evolution of expenditure in the different regions, that is,

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has the regional inequality undergone changes in composition or have their relative positions been maintained?

Relationships between income inequality and consumer inequality are not always clear, and there is no consensus on which variables are more accurate to better identify inequalities among people or regions. Decisions on choosing income or consumption (expenses) can rely on different aspects.

On the one hand, their capacity to estimate a utility function:

"Much of the debate over the rising levels of inequality in the United States and other developed countries is phrased in terms of income, or in terms of components of income like wages and earnings. But for economists, a basic utility function of individuals typically refers to consumption and leisure, not income." ([19] Attanasio and Pistaferri, 2016, p. 3)

On the other hand, the availability and data quality. Apparently, income analysis can underestimate inequality and the opposite happens when the chosen variable has to do with expenses. This can be due to different patterns in savings and credit access within groups ([20] Aguiar and Bils, 2015, [21] Krueger and Perri, 2006), but according to [22] Brewer and O'Dea, 2012, a household's long-term standard of living should be better predicted by current consumption rather than current income. Additionally, as we are focusing on regional and not individual inequalities, these differences attributed to the variable choice might be attenuated.

We applied this analysis to the evolution of income on the side of the expenses of Spanish households for the 2006–2016 period. Data are obtained from the Household Budget Survey of Instituto Nacional de Estadística (INE, the National Statistics Institute), and inequality is analysed at the regional level. Spain has a decentralized unitary state with 17 Autonomous Communities (AA. CC.) plus two autonomous cities, which are Ceuta and Melilla. The regional study is interesting because the Autonomous Communities have a certain level of self-government and have some distinctive particularities.

The methodology proposed to explain the expenses of Spanish households in recent years is the biparametric gamma model. The main advantage of this model is that it has a remarkable property, that is, it allows to parameterize the evolution of inequality. Is the biparametric gamma model always adequate for modelling income? In the literature there is no consensus. This model was proposed by [23] Salem and Mount, 1974, rejected by [24] Dagum, 1991, then validated for the Spanish case by [27] Rojo, 1993, who considered the data on income provided by the Household Budget Survey (H.B.S.) for the period 1980–81, aggregated in deciles. Later, the model was also validated by [25] Lafuente, 1998 and [15] López Rodríguez, 1997, who considered as empirical information the aggregated data from the same 1990–91 income survey, and for disaggregated income and expenses of 1980–81 and 1990–91, respectively. More recently [26] López Rodríguez, 2016 and [27] López Rodríguez, 2016, also ratified the model regarding the information of expenses provided by the H.B.S. (base 2006).

The article is structured in the following way. The first section presents the justification of the methodology used in the paper, that is, the biparametric model applied on household expenditure, and the study of the correlation between model parameters and the well-known Gini's inequality index. The next section, section 2, sets the results of the analysis by validating the adequacy of the model chosen, and once inequality is estimated we can apply longitudinal and transversal studies. The first studies explore the annual evolution of inequality and average expenditure. The evolution of household expenditure reflects the same trend as experienced by the economic cycle during the period. The second studies are aimed at establishing clusters within the AA. CC. regarding its relative position in household expenditure, and extending the results from the sample to the population level. The last section concludes.

2. Data and Methods

The empirical analysis is based on more than 225.000 data from the H.B.S. of INE for eleven years that make up the period 2006–2016 [28]. Thus, table 1 contains the sample size for each Autonomous Community and year. In the same table, it can be seen that the information collected by the INE about Ceuta and Melilla appears aggregated between 2006 and 2010, and broken down as of 2011. In order to properly perform the longitudinal analyses, we will proceed to deflate the expenses. For this we will use the Consumer Price Index (CPI) for each AA.CC with base 2016, also provided by the INE.

With regard to statistical techniques, and taking into account what was stated in the introduction, the model proposed to explain family expenses will be the biparametric Gamma, with density function:

$$f(x)=\frac{\lambda^{\alpha}e^{-\lambda x}x^{\alpha-1}}{\Gamma(\alpha)},\forall x\in\left]0,\infty\right[,\alpha>0,\lambda>0, \quad (1)$$

Table 1

Sample sizes of Expenditures by community and year. Period 2006-2016

AA.CC.	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Andalusia	2106	2274	2336	2379	2379	2403	2436	2451	2424	2410	2417
Aragon	849	885	927	915	935	956	969	992	964	986	989
Asturias	649	801	820	824	829	825	839	868	875	889	879
Balearic Islands	793	809	809	801	794	815	824	807	780	777	763
Canary Islands	907	960	986	1016	1026	996	1015	1039	1066	1018	983
Cantabria	531	704	750	763	757	768	773	776	768	762	761
Castille and León	1376	1416	1441	1449	1436	1422	1441	1464	1471	1482	1449
Castille-La Mancha	1160	1103	1101	1168	1181	1175	1202	1204	1206	1221	1195
Catalonia	1949	1989	2050	2048	1982	1969	1939	2009	2008	2028	2016
Valencian Com.	1564	1644	1646	1701	1685	1727	1722	1718	1723	1712	1694
Extremadura	902	942	949	962	944	973	984	1002	993	1002	983
Galicia	1311	1317	1369	1368	1327	1322	1322	1352	1361	1350	1355
Madrid	1172	1380	1461	1585	1550	1565	1571	1568	1634	1643	1653
Murcia	874	991	1002	971	942	917	905	904	893	910	912
Navarre	676	1409	1436	1407	1391	1183	766	757	766	740	747
Basque Country	1783	1995	2058	2018	2093	2136	2123	2167	2222	2220	2237
La Rioja	623	705	706	733	718	718	730	733	737	732	739
Ceuta and Melilla/Ceuta	209	218	228	235	234	117	116	119	120	122	118
Melilla						130	129	124	129	123	118

where $\Gamma(\alpha)$ is Euler's Gamma function, and the estimation method used to obtain the estimators $\hat{\alpha}$ and $\hat{\lambda}$ will be the maximum-likelihood method. The use of the maximum-likelihood method leads to the need to solve the following system of equations:

$$\begin{cases} \hat{\lambda} = \dfrac{\hat{\alpha}}{\overline{X}}, \\ \ln(\hat{\alpha}) - \Psi(\hat{\alpha}) = \ln\left(\dfrac{\overline{X}}{\tilde{X}}\right), \end{cases} \quad (2)$$

where $\Psi(\alpha) = \dfrac{\Gamma'(\alpha)}{\Gamma(\alpha)}$ is the digamma function, and $\overline{X}$ and $\tilde{X}$ are the arithmetic and geometric means of the sample data. Since this system has no analytical solution, the Newton-Raphson and Gauss-Laguerre methods will be used in combination for its resolution. As for the goodness-of-fit test, the Kolmogorov-Smirnov test will be used, whose statistic is:

$$D = \max_{i \in \{1,2,.....n\}} \left\{ \left| F_{o_i} - F_{T_i} \right| \right\} \quad (3)$$

with n being the sample size and F_{o_i} and F_{T_i} the functions of the empirical and the theoretical distribution, respectively.

On the other hand, the critical value, for a level of significance α, responds to the following expression:

$$D_\alpha = \sqrt{\frac{-\ln(\alpha/2)}{2n}}. \quad (4)$$

2.1 Properties of the Estimators and Inequality Indicator

As a result of the method applied to obtain the model estimators, the properties of the maximum-likelihood estimators are applicable, that is:

a) They are asymptotically normally distributed, and it can be demonstrated that

$$\begin{pmatrix} \hat{\alpha} \\ \hat{\lambda} \end{pmatrix} \xrightarrow{L} N\left(\begin{pmatrix} \alpha \\ \lambda \end{pmatrix}, \begin{pmatrix} \dfrac{\alpha}{n(t\alpha - 1)} & \dfrac{\lambda}{n(t\alpha - 1)} \\ \dfrac{\lambda}{n(t\alpha - 1)} & \dfrac{t\lambda^2}{n(t\alpha - 1)} \end{pmatrix} \right), \quad (5)$$

where

$$t = \frac{\partial^2 \ln \Gamma(\alpha)}{\partial \alpha^2} \quad (6)$$

which would allow us to elaborate tests about the parameters.

b) They are invariant, that is, taking into account that the mean, variance, mode and median of a biparametric gamma respond to the following expressions:

$$\mu = \frac{\alpha}{\lambda};\ \sigma^2 = \frac{\alpha}{\lambda^2};\ Mo = \frac{\alpha - 1}{\lambda};\ Me = \frac{3\alpha - 1}{3\lambda}. \quad (7)$$

The maximum-likelihood estimators of said measures will be:

$$\hat{\mu} = \frac{\hat{\alpha}}{\hat{\lambda}};\ \hat{\sigma}^2 = \frac{\hat{\alpha}}{\hat{\lambda}^2};\ \widehat{Mo} = \frac{\hat{\alpha} - 1}{\hat{\lambda}};\ \widehat{Me} = \frac{3\hat{\alpha} - 1}{3\hat{\lambda}}. \quad (8)$$

Regarding the selection of the inequality indicator, taking into account the "desirable compliance properties" of the indices used for this purpose ([29] Kakwani, 1980; [7] Callealta et al., 1996 and [14] Martín-Guzmán, 1996) and the classification that is usually made of them ([29] Kakwani, 1980; [5] Baró, 1982; [7] Callealta et al., 1996 and [14] Martín-Guzmán, 1996) the indicator of inequality selected for the present study will be the parameter α of the gamma model.

The advantages of this indicator are several. First, it is dimensionless, so easily comparable among years and regions. Second, given its high negative correlation with the index of Gini ([30] Esteban et al., 2000), it is easy to interpret and therefore helps us answer our research questions. Third, as α is one of the parameters of the model that explains household expenditures, it verifies that when considered as an estimator it has (in asymptotic terms) a known distribution, and as previously exposed, it is asymptotically Normal. This last property will allow us to conduct hypothesis testing that will let us compare inequalities between different geographical areas and/or different periods of time.

3. Results

First of all, we need to prove the validity of the gamma biparametric model as an explanation of household expenses of the AA. CC., with the data provided by the INE for the 2006–2016 period. The Kolmogorov — Smirnov test is used as a methodological tool. Due to the fact that no option has been found in the commercial statistical software which would allow this validation to be carried out, it has been necessary to develop specific programs that solve both the manipulation of the data and the calculations necessary to obtain the results. In the elaboration of these programs, it has been taken into account that the maximum-likelihood estimation of the parameters of the model were not analytically deductible, so numerical calculation techniques have been used, specifically, a combination of the Newton-Raphson and Gauss-Laguerre methods.

Thus, Table 2 shows the results in detail (value of the level of significance, statistic and estimated parameters of the model) corresponding to the 11 years considered (2006–2016) and for each AA. CC. Except for the years of the cells marked in black, that is, 2010 for Andalusia, 2013 for the Valencian Community, 2016 for Madrid, 2014 and 2015 for Navarre and 2010 and 2011 for the Basque Country, the adherence test is supported for levels of significance within the valid range in any data analysis (between 1 % and 10 %). Therefore, in general, the biparametric gamma model fits with our data.

3.1. Inequality Evolution of Household Expenditure for the Period 2006–2016

To examine the evolution of inequality, the α parameter on household expenditure was estimated. Taking into account that this parameter

Table 2

Adhesion contrast of expenses to the biparametric gamma model. Period 2006–2016

AA.CC.	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Andalusia	0.4033	0.1863	0.1442	0.1279	0.0028	0.1770	0.031	0.0113	0.0211	0.0148	0.0271
Aragon	0.8714	0.6013	1.0259	1.3114	0.2834	0.5807	0.5011	0.8798	0.5169	0.3558	0.2421
Asturias	0.2004	0.5306	1.2583	0.2866	0.7650	0.7384	0.1240	0.2339	0.7732	0.2181	0.5413
Balearic Islands	0.9803	0.1681	0.7694	0.3089	0.8647	0.9257	0.8019	0.0833	0.1424	0.1999	0.3799
Canary Islands	0.3316	0.2515	0.1569	0.7393	0.3828	0.0250	0.0373	0.4025	0.5299	0.6191	0.3911
Cantabria	0.1019	1.1954	0.7082	1.1393	0.6292	0.2013	0.2421	0.4921	0.4669	0.3839	0.1258
Castille and León	0.5348	0.2787	0.8563	1.1370	0.5203	0.4676	0.1798	0.3822	0.0412	0.0130	0.3166
Castille-La Mancha	0.7047	0.7461	0.76755	0.1759	0.09619	0.57218	0.2464	0.1645	0.2242	0.3508	0.7881
Catalonia	0.3309	0.4971	0.6686	0.3348	0.31359	0.2963	0.0695	0.12848	0.0376	0.0510	0.0527
Valencian Com.	0.4122	0.0120	0.2454	0.0398	0.31316	0.0774	0.04346	0.00155	0.05778	0.1755	0.0144
Extremadura	0.5771	0.5248	0.4279	0.0411	0.2466	0.1327	0.1089	0.2731	0.0819	0.7634	0.5868
Galicia	0.4508	0.2126	0.3364	0.5347	0.4903	0.4629	0.2182	0.4299	0.3634	0.0212	0.0421
Madrid	0.2866	0.4089	0.0541	0.0428	0.0853	0.0622	0.4821	0.1205	0.0551	0.0228	0.0068
Murcia	0.6787	0.0957	0.4097	0.5048	0.0654	0.2664	0.1114	0.3924	0.6436	1.1149	1.2334
Navarre	0.5684	1.3027	1.0805	0.6404	0.6941	0.6844	0.8321	0.5514	0.0071	0.0061	0.3333
Basque Country	0.9364	0.4961	0.0491	0.4877	0.0008	0.0063	0.0482	0.0264	0.0890	0.0127	0.0169
La Rioja	0.8194	0.3300	0.2565	0.5746	0.2918	0.4941	0.3385	0.3248	0.1710	0.7151	0.5515
Ceuta and Melilla/ Ceuta	0.0442	0.3705	0.5414	0.7830	0.6024	0.2307	0.8913	0.0948	0.1340	0.1436	0.7274
Melilla	n.a.	n.a.	n.a.	n.a.	n.a.	1.4629	0.2831	0.2913	1.0895	0.4560	0.2651

Table 3

Estimating α parameter on household expenditure. Period 2006–2016

AA. CC.	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Andalusia	1.9099	2.17971	2.28689	2.47752		2.5432	2.4521	2.3864	2.4117	2.5477	2.6052
Aragon	2.0363	2.05827	2.61065	2.54666	2.69340	2.6699	2.5562	2.7332	2.6035	2.4903	2.5612
Asturias	1.8554	1.83550	2.19750	2.13977	2.33080	2.4546	2.3979	2.5098	2.4430	2.3307	2.5841
Balearic Islands	2.5398	2.3967	2.5352	2.7635	2.6477	2.8276	2.9063	3.0824	2.8691	2.7532	3.0493
Canary Islands	2.0241	1.9833	2.4037	2.4894	2.6515	2.1615	2.3490	2.4748	2.2268	2.2550	2.3538
Cantabria	1.9174	2.1327	2.3056	2.5037	2.4893	2.4614	2.3380	2.4170	2.1754	2.1654	2.7188
Castille and León	1.8667	1.7465	2.0436	2.3157	2.2219	2.4391	2.4823	2.4930	2.4975	2.4192	2.5238
Castille-La Mancha	1.8433	1.9521	2.0107	2.2802	2.4968	2.6032	2.6478	2.3032	2.3598	2.3003	2.3011
Catalonia	2.1828	2.2993	2.4160	2.4631	2.6330	2.6732	2.8116	2.6039	2.5299	2.5117	2.6325
Valencian Com.	1.9657	2.1760	2.4499	2.6107	2.6040	2.6622	2.4687		2.3462	2.4037	2.4689
Extremadura	1.6789	1.7912	2.1960	2.0542	2.0991	2.2522	2.2173	2.2255	2.1326	2.0468	2.1427
Galicia	1.8991	2.1603	2.2069	2.1473	2.2001	2.1862	2.1869	2.2582	2.3311	2.0899	2.1074
Madrid	2.4282	2.4182	2.6482	2.8146	2.6556	2.7205	2.7669	2.6922	2.4993	2.6615	
Murcia	2.0068	2.1037	2.2622	2.3845	2.4389	2.4884	2.4501	2.3424	2.4736	2.5154	2.6080
Navarre	2.2321	2.2891	2.4422	2.5102	2.5951	2.7281	2.5781	2.784			2.9235
Basque Country	2.4479	2.4196	2.5863	2.8365			2.6678	2.7660	2.7558	2.6172	2.5775
La Rioja	2.0955	1.9187	2.4509	2.5407	2.6764	2.4338	2.4911	2.7265	2.6838	2.6834	2.3953
Ceuta and Melilla/Ceuta	2.1532	2.1848	2.02972	2.0754	2.2563	2.3636	2.6764	2.3389	1.9091	2.2499	2.4067
Melilla	n.a.	n.a.	n.a.	n.a.	n.a.	2.0342	1.8815	1.9707	2.5381	2.8250	2.6531

Table 4

Annual difference on expenditure inequality. Period 2006–2016

AA. CC.	2007–2006	2008–2007	2009–2008	2010–2009	2011–2010	2012–2011	2013–2012	2014–2013	2015–2014	2016–2015	No. / % Δ
Andalusia	0.270	0.107	0.191			–0.091	–0.066	0.025	0.136	0.058	6/75.0
Aragon	0.022	0.552	–0.064	0.147	–0.024	–0.114	0.177	–0.130	–0.113	0.071	5/50.0
Asturias	–0.020	0.362	–0.058	0.191	0.124	–0.057	0.112	–0.067	–0.112	0.253	5/50.0
Balearic Islands	–0.143	0.139	0.228	–0.116	0.180	0.079	0.176	–0.213	–0.116	0.296	6/60.0
Canary Islands	–0.041	0.420	0.086	0.162	–0.490	0.188	0.126	–0.248	0.028	0.099	7/70.0
Cantabria	0.215	0.173	0.198	–0.014	–0.028	–0.123	0.079	–0.242	–0.010	0.553	5/50.0
Castille and León	–0.120	0.297	0.272	–0.094	0.217	0.043	0.011	0.004	–0.078	0.105	7/70.0
Castille-La Mancha	0.109	0.059	0.269	0.217	0.106	0.045	–0.345	0.057	–0.060	0.001	8/80.0
Catalonia	0.117	0.117	0.047	0.170	0.040	0.138	–0.208	–0.074	–0.018	0.121	7/70.0
Valencian Com.	0.210	0.274	0.161	–0.007	0.058	–0.194			0.058	0.065	6/75.0
Extremadura	0.112	0.405	–0.142	0.045	0.153	–0.035	0.008	–0.093	–0.086	0.096	6/60.0
Galicia	0.261	0.047	–0.060	0.053	–0.014	0.001	0.071	0.073	–0.241	0.017	7/70.0
Madrid	–0.010	0.230	0.166	–0.159	0.065	0.046	–0.075	–0.193	0.162		5/55.6
Murcia	0.097	0.159	0.122	0.054	0.050	–0.038	–0.108	0.131	0.042	0.093	8/80.0
Navarre	0.057	0.153	0.068	0.085	0.133	–0.150	0.206				6/85.7
Basque Country	–0.028	0.167	0.250				0.098	–0.010	–0.139	–0.040	3/42.9
La Rioja	–0.177	0.532	0.090	0.136	–0.243	0.057	0.235	–0.043	0.000	–0.288	5/50.0
Ceuta and Melilla/Ceuta	0.032	–0.155	0.046	0.181	0.107	0.313	–0.337	–0.430	0.341	0.157	7/70.0
Melilla	n.a.	n.a.	n.a.	n.a.	n.a.	–0.153	0.089	0.567	0.287	–0.172	3/60.0

is negatively correlated with the index of Gini, we are going to study how it progresses through the period studied to find the evolution on inequality. In table 3, we show the α estimates. As we are analysing expenditure and not income, we are expecting to find that inequality reduces in economic crises, but should increase in expansive periods.

Observing table 4 we find that, in general, the parameter α increases. That is, the levels of inequality decrease, especially for the case of Andalusia, Castille-La Mancha, Murcia and Navarra. In all AA. CC., the inequality decreases in half of the period studied at least, except for the Basque Country where there is more evidence of a decrease in α, i.e. increase in inequality. The effect of α growth is more regular among AA. CC. for the beginning of the crisis, so in 2008 and 2009, but also in the last year 2016. However, in the period associated with the economic recovery (2014 and 2015) we can find more evidence of intensification of inequality in terms of expenditure of Spanish families. The evidence seems to show that at the beginning of the economic shock, the negative impact on expenditures was quite uniform. However, as the policy makers adopted measures to recover growth, the impact of these measures has not had an even effect on different regions, showed by the increase in inequality.

3.2 Average Expenditure Evolution for the Period 2006–2016

In this subsection we carry out a longitudinal, as well as a transversal study of the evolution of the average household expenditure. The first aims to study the evolution of average expenditure of households in the AA. CC. throughout the time period considered. To this end, the data have been deflated to 2016 constant euros before obtaining the differences in average expenditures by region. It can be seen in Table 5 that, in the periods where household expenditure declined, cells are marked in grey and otherwise in white.

Table 5

Annual difference on average expenditure (in 2016 constant euros). Period 2006–2016

AA.CC.	2007–2006	2008–2007	2009–2008	2010–2009	2011–2010	2012–2011	2013–2012	2014–2013	2015–2014	2016–2015	% Δ
Andalusia	478.41	−879.22	−2021.45	−1018.89	−1868.12	−2246.56	−1548.61	170.64	175.95	1520.25	60
Aragon	−325.38	−1142.27	−1171.72	−815.65	−827.45	−890.68	−723.32	−430.05	653.65	1089.04	80
Asturias	−196.20	91.82	−907.99	223.70	−3890.05	−2602.92	−505.05	389.35	1139.78	0.32	50
Balearic Islands	1374.67	−3326.75	−3591.84	−3.52	−1722.49	−1198.04	−888.28	1217.98	597.85	2229.52	60
Canary Islands	628.93	−2520.96	−2066.18	−1558.22	−221.38	−2665.17	−771.83	1124.57	139.80	720.38	60
Cantabria	1811.22	−1862.67	−456.52	−1692.17	−1819.40	−1779.28	−2032.94	−14.27	1180.53	−185.84	80
Castille and León	747.96	−932.89	−2587.55	−907.66	−914.33	−1677.11	−919.60	346.97	1023.20	253.59	60
Castille-La Mancha	1122.35	−1860.70	−1042.38	−209.54	−1396.41	−2440.52	−166.05	175.50	777.68	70.94	60
Catalonia	−560.77	−1741.95	−1079.94	−1574.98	−1201.35	−2235.22	−630.39	556.86	509.76	537.23	70
Valencian Com.	581.23	−2781.73	−1557.57	−1527.51	−1431.64	−656.95	−1424.80	−156.53	584.44	1071.02	70
Extremadura	383.57	−1698.38	−847.30	−453.76	−1380.94	−2550.23	−174.94	62.05	−124.43	412.27	70
Galicia	56.01	−614.17	−1257.24	−1263.41	−733.21	−1798.01	−1347.32	−269.99	613.02	339.29	70
Madrid	689.96	−1382.53	−2059.87	−454.60	−685.08	−1793.87	−2259.40	−613.12	290.27	1415.36	70
Murcia	1134.71	−3182.99	−3153.97	−715.98	−982.61	−426.30	−1451.40	−101.46	496.36	1764.93	70
Navarre	−227.87	−327.86	−1635.30	−770.45	−2271.42	−1849.75	−1239.86	884.22	352.64	906.92	70
Basque Country	−471.06	−1748.85	−1254.31	421.66	−1538.28	−927.06	−745.47	−717.11	1230.08	590.02	70
La Rioja	1552.98	−1641.12	−111.73	−1064.35	−597.03	−2972.09	−213.05	51.61	524.14	626.76	60
Ceuta and Melilla/ Ceuta	1623.27	−1585.59	−135.60	−1425.75	873.65	−1261.60	−5488.83	4190.35	−3153.30	3683.17	60
Melilla	n.a.	n.a.	n.a.	n.a.	n.a.	−4989.61	1342.39	−1905.07	3581.34	675.48	40

It can be concluded that, in general, the annual rate of variation has been positive in the pre-crisis period from 2006 to 2007 and the post-crisis period from 2013 to 2016. The AA. CC. where expenditure tends to decrease in at least seven over ten periods (at least 70 % of the cases) are Aragon, Cantabria, Catalonia, Valencian Community, Extremadura, Galicia, Madrid, Murcia, Navarre and the Basque Country. The "reversed J" shape of the evolution of average household expenditure (except for Melilla) can be observed in Figure 1. Therefore, when the economic recovery started, from 2013 onwards, average household expenditure also began to grow in many AA. CC., following a parabolic form. Despite the recovery, the average expenditure in levels is still low and far from the levels achieved by the AA. CC. at the beginning of the period studied (in the pre-crisis period). In any case, if the trend continues as it has been up to now, it seems that, unfortunately, it will take a long time to reach the standards of living that households enjoyed at the beginning of the period.

Table 6

Ranking of the AA. CC. by its average household expenditure. Period 2006–2016

2006	2007	2008	2009	2010	2011
Madrid	Madrid	Madrid	Madrid	Madrid	Madrid
Navarre	Balearic I.	Navarre	Navarre	Navarre	Ceuta
Catalonia	Navarre	Catalonia	Catalonia	Basque C.	Melilla
Balearic I.	Catalonia	Balearic I.	Ceu.-Mel.	Catalonia	Navarre
Basque C.	Murcia	Ceu.-Mel.	Cantabria	Ceu.-Mel.	Basque C.
Murcia	Cantabria	Cantabria	Basque C.	Asturias	Catalonia
Ceu.-Mel.	Ceu.-Mel.	Basque C.	Asturias	Cantabria	Cantabria
Andalusia	Basque C.	Andalusia	Andalusia	Balearic I.	La Rioja
Val. Com.	Andalusia	Murcia	La Rioja	Andalusia	Galicia
Cantabria	Val. Com.	Asturias	Galicia	La Rioja	Balearic I.
Canary I.	Canary I.	Galicia	Balearic I.	Galicia	Aragon
Asturias	Galicia	C. León	Aragon	Aragon	Andalusia
Galicia	Asturias	Val.Com.	Murcia	Murcia	Asturias
Aragon	La Rioja	Aragon	Val. Com.	C.Mancha	Murcia
C. León	C. León	Canary I.	Canary I.	Val.Com.	C. Mancha
La Rioja	Aragon	La Rioja	C. León	C. León	C. León
C. Mancha	C. Mancha	C. Mancha	C. Mancha	Extremad.	Val.Com.
Extremad.	Extremad.	Extremad.	Extremad.	Canary I.	Canary I.
					Extremad.

The Continion of Table 6

2012	2013	2014	2015	2016
Madrid	Madrid	Ceuta	Basque C.	Madrid
Ceuta	Basque C.	Navarre	Melilla	Navarre
Navarre	Navarre	Madrid	Navarre	Melilla
Basque C.	Melilla	Catalonia	Madrid	Balearic I.
Catalonia	Catalonia	Basque C.	Catalonia	Basque C.
Cantabria	Aragon	Balearic I.	Balearic I.	Ceuta
Murcia	Balearic I.	Melilla	Cantabria	Catalonia
Melilla	Murcia	Aragon	Aragon	Murcia
Balearic I.	Cantabria	Murcia	Ceuta	Aragon
Aragon	La Rioja	Cantabria	Murcia	La Rioja
Galicia	Ceuta	La Rioja	Asturias	Cantabria
La Rioja	Galicia	Asturias	La Rioja	Asturias
Val. Com.	Asturias	Galicia	Galicia	Galicia
Andalusia	Val. Com.	C. León	C. León	Andalusia
Asturias	C. León	Andalusia	C. Mancha	Val.Com.
C. León	C. Mancha	C. Mancha	Val.Com.	C. León
C. Mancha	Andalusia	Val.Com.	Andalusia	C.Mancha
Canary I.	Extremad	Canary I.	Canary I.	Canary I.
Extremad	Canary I.	Extremad.	Extremad.	Extremad.

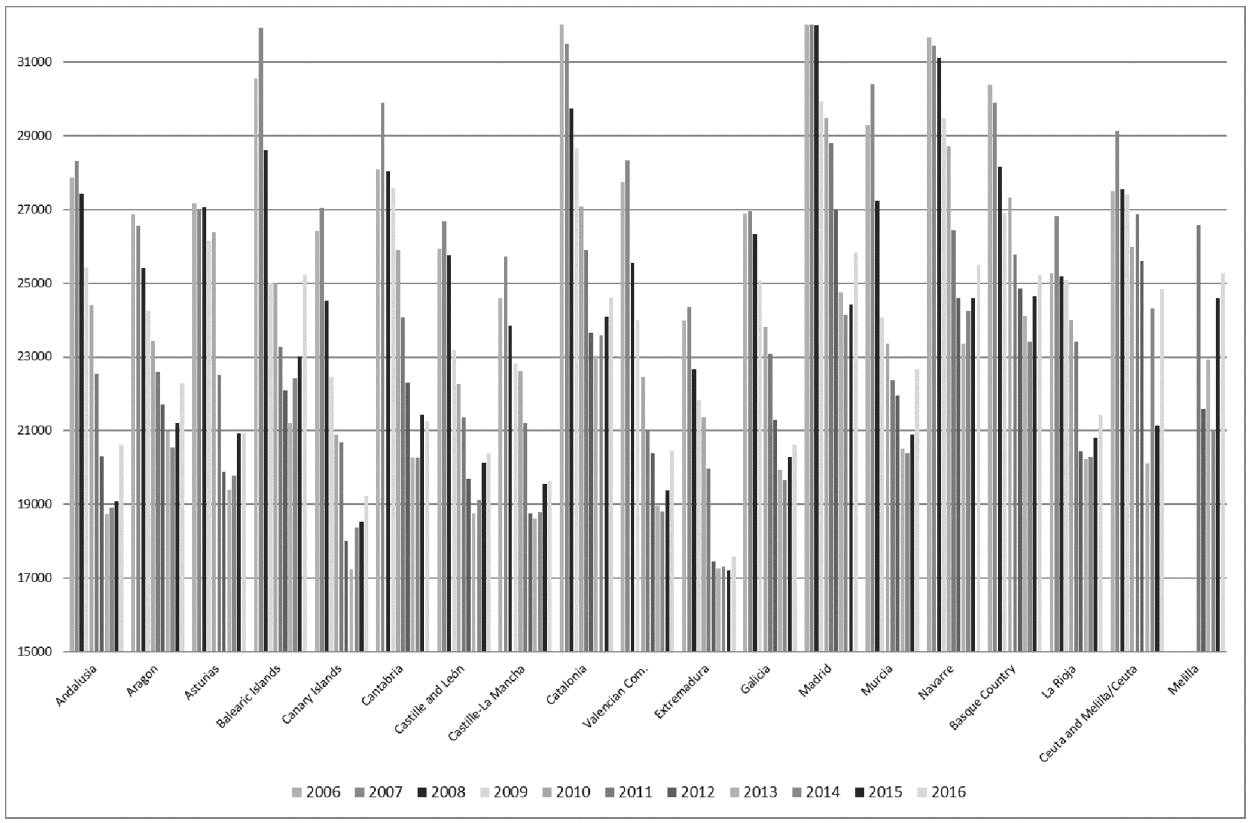

Fig. 1. *Average household expenditure evolution. Period 2006–2016*

Regarding the transversal analysis, this is useful in exploring which Autonomous Communities are among the best placed in terms of average expenditure and which are in a worse position, that is, the "richest" and the "poorest". Moreover, it is interesting to check the impact of the Great Recession on their relative positions. Thus, a ranking of the Autonomous Communities has been established based on the average expenses (in this case we use no deflated data, as it is a cross-sectional analysis). In table 6 we can see the AA. CC. ordered from highest to lowest average expenditure for each of the 11 years, and the results show two well-differentiated clusters that are maintained throughout the whole period. Among the best situated we find Madrid, Navarra and Catalonia, that is, in more than half of the period they are situated between the four best positioned, and for the whole period they are never situated in the lower half of the ranking. Among the worst positioned, we meet the Canary Islands, Castille and León, Castille-La Mancha and Extremadura (opposite to the best situated, these AA. CC. can be found in at least 6 of the ten years between the four last positions, and they are not situated in the first half of the ranking during the period). In this analysis we cannot have a clear picture of the effects of economic crises, as some positions such as Madrid on the top or Extremadura on the bottom, are quite stable. However, the Canary Islands seems to lose positions through the period, worsening its performance. A more extended analysis that considers particular economic policies conducted by the AA. CC. should be done to obtain clearer implications of these results.

3.3. Evolution of Variability at the Population Level. Period 2006–2016

To close the analysis, a study of the representativeness of average expenditure at the population level is carried out. For this purpose, the Pearson variation coefficient is used (estimated by applying the invariance property of the estimators of the model parameters). Thus, Table 9 contains the value of said coefficient for the years of the period of time considered. In order to quantify this variation, table 7 reflects the absolute variation rates between each pair of Pearson coefficients of consecutive years, where negative rates are emphasized in grey. From this analysis, we infer that in most periods the variation rates have been negative, implying a decrease in the population variation coefficient. In other words, for each AA. CC. except for the Basque Country, in at least half of the cases the average expense grew in representativeness.

4. Conclusions

Based on the proposed objectives and regarding the evolution of inequality, it can be concluded

Table 7

Variation of the estimated population Pearson coefficient. Period 2006–2016

AA.CC.	2007–2006	2008–2007	2009–2008	2010–2009	2011–2010	2012–2011
Andalusia	–0.046	–0.016	–0.026			0.012
Aragon	–0.004	–0.078	0.008	–0.017	0.003	0.013
Asturias	0.004	–0.064	0.009	–0.029	–0.017	0.008
Balearic Islands	0.018	–0.018	–0.027	0.013	–0.020	–0.008
Canary Islands	0.007	–0.065	–0.011	–0.020	0.066	–0.028
Cantabria	–0.037	–0.026	–0.027	0.002	0.004	0.017
Castille and León	0.025	–0.057	–0.042	0.014	–0.031	–0.006
Castille-La Mancha	–0.021	–0.011	–0.043	–0.029	–0.013	–0.005
Catalonia	–0.017	–0.016	–0.006	–0.021	–0.005	–0.015
Valencian Com.	–0.035	–0.039	–0.020	0.001	–0.007	0.024
Extremadura	–0.025	–0.072	0.023	–0.008	–0.024	0.005
Galicia	–0.045	–0.007	0.009	–0.008	0.002	0.000
Madrid	0.001	–0.029	–0.018	0.018	–0.007	–0.005
Murcia	–0.016	–0.025	–0.017	–0.007	–0.006	0.005
Navarre	–0.008	–0.021	–0.009	–0.010	–0.015	0.017
Basque Country	0.004	–0.021	–0.028			
La Rioja	0.031	–0.083	–0.011	–0.016	0.030	–0.007
Ceuta and Melilla/Ceuta	–0.005	0.025	–0.008	–0.028	–0.015	–0.039
Melilla	n.a.	n.a.	n.a.	n.a.	n.a.	0.028

The End of Table 7

AA.CC.	2013–2012	2014–2013	2015–2014	2016–2015	% Δ
Andalusia	0.009	–0.003	–0.017	–0.007	75.0
Aragon	–0.021	0.015	0.014	–0.009	50.0
Asturias	–0.015	0.009	0.015	–0.033	50.0
Balearic Islands	–0.017	0.021	0.012	–0.030	60.0
Canary Islands	–0.017	0.034	–0.004	–0.014	70.0
Cantabria	–0.011	0.035	0.002	–0.073	50.0
Castille and León	–0.001	–0.001	0.010	–0.013	70.0
Castille-La Mancha	0.044	–0.008	0.008	0.000	80.0
Catalonia	0.023	0.009	0.002	–0.015	70.0
Valencian Com.			–0.008	–0.009	75.0
Extremadura	–0.001	0.014	0.014	–0.016	60.0
Galicia	–0.011	–0.010	0.037	–0.003	70.0
Madrid	0.008	0.023	–0.020		55.6
Murcia	0.015	–0.018	–0.005	–0.011	80.0
Navarre	–0.023				85.7
Basque Country	–0.011	0.001	0.016	0.005	42.9
La Rioja	–0.028	0.005	0.000	0.036	50.0
Ceuta and Melilla/Ceuta	0.043	0.070	–0.057	–0.022	70.0
Melilla	–0.017	–0.085	–0.033	0.019	60.0

that the inequality of household expenditure has decreased in most of the regions during the Great Recession, as a generalised tendency towards an increase in equality has been detected (except for the Basque Country). Additionally, this tendency has been more intense in the worst years of the economic crisis: 2008–2009, 2011, as well as in the last period, with 2016 changing this trend in the recovery period 2013–2015. This trend is probably a consequence of the loss of purchasing power of the population caused by high unemployment, and the policy of wage devaluation carried out by the Government as a measure to recover price competitiveness during the Great Recession. These results are obtained by fitting household expenditures to the biparametric Gamma model for the period 2006–2016 and using the parameter α as an estimator of inequality.

By using a descriptive longitudinal analysis, a similar decreasing trend was found in av-

erage expenditure at the beginning of the crisis, which coincides with the second year of our study. This is the case in most Autonomous Communities, especially Aragon, Cantabria, Catalonia, Valencian Community, Extremadura, Galicia, Madrid, Murcia, Navarre and the Basque Country. However, as the recovery period begins from 2013 onwards, the trend is reversed, although we are still far from the levels of expenditure that we had at the end of the expansive cycle. Data show a convergent trend produced at the bad cycle period, where heterogeneity reduction is due to a quite general lowering in households' expenditure. As for the "intergroup" changes, two differentiated clusters are observed throughout the period: Madrid, Navarre and Catalonia as the best positioned Autonomous Communities, and Extremadura, the Canary Islands, Castille and Leon and Castille-La Mancha as the worst positioned. Despite the apparent convergence found in the previous analyses, looking at the dichotomy between the north and centre on one side, and periphery on the other, heterogeneities seem to be persistent to cyclical income variations. Consequently, further research should be conducted to connect economic policy decisions and structural characteristics with the final relative position of the different regions.

Finally, to analyse the strength of the conclusion obtained, the representativeness of the average expenditure of the population is studied by an inferential analysis through the Pearson coefficient of variation value. It should be pointed out that dispersion decreased in most of the AA. CC., especially in Andalusia, Canary Islands, Castille and León, Castille-La Mancha, Catalonia, Galicia, Murcia, Navarre and Ceuta and Melilla/Ceuta. Therefore, the lower variability of expenditure means that the average expenditure better represents the expenditure of all households for these regions, which, together with the fact that said average expenditure tended to decrease, allows us to infer that for these Autonomous Communities, most households have tended to spend less. On the other hand, for the Autonomous Communities which have a percentage of cases with greater variability (less representativeness of the average), such as the Basque Country, the conclusions of the study at the population level are weaker. Further extension will require a deeper analysis of the political-economic causality between the evolution and the results of household expenditure.

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