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ORIGINAL RESEARCH

Analysis of the Educational Poverty in Spain by Subjects, Regions and Gender

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Abstract
Quality education is a key factor to improve people's lives and to achieve sustainable development. Using data from PISA 2009, 2012 and 2015, in this paper the level of educational poverty of the Spanish regions is calculated by applying the Adjusted Bourguignon Chakravarty index, BC^a (Sánchez-García et al. in Soc Indicat Res 145(2): 479–501). A descriptive analysis of the differences in educational poverty by gender and the contribution of each region and subject to the national level of educational poverty is also provided. This information could certainly be considered a *starting point* to tackle educational poverty in Spain.

Keywords Educational poverty · PISA 2015 · Multidimensional adjusted poverty measurement

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1 Introduction

As it has been widely noted in education research since the report *Our Common Future by the World Commission on Environment and Development* in 1987, quality education is a key factor to improve people's lives and to achieve sustainable development. In this line, in 2013 the European Commission called on Member States to prioritize child-friendly social investment to achieve affordable quality childcare and education and prevention of early school leaving. The adoption of *The 2030 Agenda for Sustainable Development*, approved by the Heads of State and Government at a historic United Nations Summit in 2015, implies to ensure inclusive and equitable quality education at all levels, as its Goal 4 reads.

Regardless of gender, age, race, ethnic group, immigration, and disabilities, among others, all children and young people should have access to quality education to help them to acquire the knowledge and skills needed to participate in the labour market. Educational performance is one of the dimensions of educational quality (UNESCO, 2005). High educational level has to do with self-satisfaction, self-esteem, working realization, self-confidence, higher earnings, and status, meanwhile low educational performing is closely tied to unfulfillment, self-doubt, humbleness, failure, passivity, and inferiority (Atkinson et al., 2002; Cutler & Lleras-Muney, 2010; Lochner & Moretti, 2004; Milligan et al., 2004; Oreopoulos & Salvanes, 2011). Therefore, low educational achievements should be analysed in order to address a fair, inclusive and quality system that guarantees the right to education.

Nowadays, in the scientific literature on education, there are two clearly differentiated approaches to the concept of educational poverty: (1) that which focuses exclusively on academic achievements, and therefore defines educational poverty as low performing on education, and (2) that which identifies educational poverty with educational deprivation, the measure of which is based on a "mixture of problems of material, relational, cultural, and environmental kind, which can limit the abilities of youngsters to live in a complex society" (Pratesi et al., 2021).

In this paper we follow the first approach, in which it is argued that the indices commonly used in the analysis of inequality and poverty can be also appropriate for this context (Agasisti et al., 2017; Agasisti et al., 2021; Barbieri & Cipollone, 2007; Battilocchi, 2020; Checchi, 1998; Denny, 2002; European Commission 2014, 2015; Lohmann & Ferger, 2014; Minzyuk & Russo, 2016; Sánchez-García et al., 2019; Thomas et al., 2000; Villar, 2016). Our goal is to evaluate and analyse the differences in educational poverty by gender and the contribution of each region and subject to the Spanish national level of educational poverty.

In Spain, the responsibility for the management of educational resources and, therefore, the design of educational policies, lies with the regional governments. For this reason, it is necessary to know the educational reality of each Spanish region in the different subjects to understand the Spanish educational system. Gender perspective is another key aspect that should be considered in the analysis of educational poverty (European Commission, 2000, 2014, 2015; Karam, 2014). As stated in article 23 of the Charter of Fundamental

Rights of the European Union (European Commission, 2000) "equality between men and women must be ensured in all areas".

Using data from PISA 2009, 2012 and 2015,[1] in this paper the level of educational poverty by subjects and gender of the Spanish regions is analysed by applying the Adjusted Bourguignon Chakravarty index, BC^a (Sánchez-García et al., 2019). PISA data have been widely used in educational research since they allow to examine several education aspects in an unprecedented way cross-nationally. Most importantly, PISA results have become highly influential in the design of educational policies in many European countries (Schnepf & Volante, 2017).

The BC^a index is an extension of the class of poverty indices introduced by Foster et al. (1984) to the multidimensional context adding some kind of adjustment in the line of Permanyer (2014), which makes it really suitable for its application to education. Particularly, under the BC^a index: (1) a student is considered poor if their score in any subject is less than the level of sufficiency, and (2) their educational poverty level is adjusted taking into account the scores they get in those subjects in which they do not have deficiencies. These characteristics differentiate our proposal to measure educational poverty from other contributions in this line (Agasisti et al., 2021; Minzyuk & Russo, 2016).

As the BC^a index satisfies the *Subgroup Decomposability*, *Factor Decomposability* and *Principle of Population* properties, the differences by gender and the contributions by subject and region to the national level of educational poverty can be calculated.

In the scientific literature some studies can be found that analyse for Spain and its regions what socioeconomic factors influence the educational performance based on PISA data from 2015 (Fernández et al., 2018; Lahiguera et al., 2019; López et al., 2018; Martínez et al., 2016; Sicilia & Rodríguez, 2018). However, these works analyse educational performance focusing only on the results obtained in Science (subject studied in a more exhaustive way in this PISA wave) and do not consider jointly the results achieved in the three subjects assessed by PISA. In line with our paper, Sicilia and Rodríguez (2018) compute some indicators related to educational poverty in the different Spanish regions, although, as in the above-mentioned works, they only use data on educational performance in Science.

The fundamental contribution of our paper is to offer an overview of educational poverty at the regional level, differentiating by subject and gender and considering educational performance in all subjects assessed by PISA. As mentioned above, educational poverty is not only important as a measure of educational underperformance, but also of exclusion. In this regard, the use of the BC^a index to carry out our analysis allows policy makers' decisions to benefit from the identification of population subgroups or relevant elements (regions, gender, subjects…) in this context. Therefore, the analysis presented could certainly be considered an important *starting point* to tackle educational poverty in Spain.

The paper is organised as follows. Section 2 provides the methodology with the notation and basic definitions in order to present the *Adjusted Bourguignon Chakravarty* index. Section 3 shows the level of educational poverty in Spain by regions, subjects and gender in 2015 when the BC^a index is applied. Section 4 summarises the main conclusions. Calculations for 2009 and 2012 are relegated to the Appendix.

[1] Spain's performance results in PISA 2018 have not been considered due to a possible downward bias in the data. In fact, the OECD considers that "the comparability of PISA 2018 data for Spain with those from earlier PISA assessments cannot be fully ensured" (OECD, 2020).

2 Methodology

We consider a population of $n \geq 2$ individuals, $N = \{1, 2, \ldots, n\}$ and a set of k attributes, $J = \{1, 2, \ldots, k\}$, where k is given and fixed, which are relevant to assess educational poverty. We assume that each attribute is representable by a continuous variable. For all $i \in N$, $j \in J$, let $x_{ij} \in \mathbb{R}_+$ denote the individual i's achievement of attribute $j \in J$. Let $\mathcal{M}$ denote the set of real $n \times k$ matrices. So, a multidimensional distribution among the population is represented by an $n \times k$ real matrix $\mathbb{X} \in \mathcal{M}$ where $\mathbb{X} = \left(x_{ij}\right)_{1 \leq i \leq n, 1 \leq j \leq k}$, $x_{ij} > 0 \quad \forall i, j$. The i-th row of $\mathbb{X}$, denoted by $x_i = \left(x_{ij}\right)_{1 \leq j \leq k}$, represents the individual i's achievement vector.

To identify the poor, we compare the individual i's achievement with a specific poverty line. For any $j \in J$, let $z_j > 0$ the threshold level of attribute j, that is, z_j is the minimal level considered acceptable for attribute j, the subsistence level. So, we denote by $z = \left(z_j\right)_{1 \leq j \leq k} \in \mathbb{R}^k_+$ the vector of threshold for all the attributes, the poverty line. Whenever an individual i's achievement for an attribute j, x_{ij}, is below the corresponding threshold level, we say that this individual i is deprived in that attribute. Following Bourguignon and Chakravarty (2003), we consider that a person is poor if they are deprived in any attribute.

Let $\rho : \mathbb{R}^k_+ \times \mathbb{R}^k_+ \rightarrow [0, 1]$ be *the poverty indicator variable function* (Chakravarty, 2009) which is defined by setting

$$\rho\left(x_i, z\right) = \begin{cases} 1 & \text{if } \exists j \in \{1, 2, \ldots, k\} : x_{ij} < z_j \\ 0 & \text{otherwise} \end{cases}$$

Therefore, an individual $i \in N$ is poor if and only if $\rho\left(x_i, z\right) = 1$ and the number of poor is given by $q = \sum_{i=1}^{n} \rho\left(x_i, z\right)$.

The multidimensional index applied to analyse the educational poverty is the *Adjusted Bourguignon Chakravarty* index, BC^a, introduced by Sánchez-García et al. (2019). This index allows adjustments of the individual poverty level using the scores in the attributes which do not fall below the corresponding threshold level, without changing the identification of an individual as poor.

As an example, consider two students who have achieved the following scores in two different subjects: $x_1 = (4, 5)$ and $x_2 = (4, 10)$. As usual in some educational systems, students are considered to need at least 5 points (over 10) to pass the subject, so the poverty line is $z = (5, 5)$. Both students have the same gap of insufficiency level in the first subject, but do they have the same level of educational poverty? Our answer is no, because to measure appropriately the educational poverty level it is important to consider the scores they get in the non-deprived subjects, and they are considerably different.

To define the *Adjusted Bourguignon Chakravarty* index, we need to introduce the *Adjusted Individual Educational Poverty* index, BC^a_i, which is based on both, the individual deprivation level, $\phi_i(G(\mathbb{X}, z))$, and the individual non-deprivation level, $\phi_i(R(\mathbb{X}, z, m))$.

The individual deprivation level, $\phi_i(G(\mathbb{X}, z))$, is the θ-norm ($\theta > 0$) of the usual normalised poverty gaps considered in the literature (Chakravarty, 2009) for the individual's deprived attributes, $g_{ij}(\mathbb{X}, z)$, that is, for any $i \in N, j \in J$,

$$\phi_i(G(\mathbb{X}, z)) = \left[\frac{1}{k}\left(\sum_{1 \leq j \leq k} g^{\theta}_{ij}(\mathbb{X}, z)\right)\right]^{1/\theta}$$

with $g_{ij}(\mathbb{X}, z) = \max\left\{0, \frac{z_j - x_{ij}}{z_j}\right\}$.

Symmetrically, the individual non-deprivation level, $\phi_i(R(\mathbb{X}, z, m))$, is the θ-norm ($\theta > 0$) of the normalised surplus gaps, introduced by Sánchez-García et al. (2019) for the individual's non-deprived attributes, $r_{ij}(\mathbb{X}, z, m)$, that is, for any $i \in N, j \in J$,

$$\phi_i(R(\mathbb{X}, z, m)) = \left[\frac{1}{k}\left(\sum_{1 \le j \le k} r_{ij}^{\theta}(\mathbb{X}, z, m)\right)\right]^{\frac{1}{\theta}}$$

with $r_{ij}(\mathbb{X}, z, m) = \max\left\{0, \frac{x_{ij} - z_j}{m_j - z_j}\right\}$, being m_j the maximum level that an individual could achieve in the j-th attribute and denoting by $m = \left(m_j\right)_{1 \le j \le k} \in \mathbb{R}_+^k$ the vector of maximum level for all attributes, the top line.

The *Adjusted Individual Educational Poverty* index, BC_i^a, is the real valued function $BC_i^a : \mathcal{M} \times \mathbb{R}_+^k \times \mathbb{R}_+^k \to [0, 1]$ given for any $i \in N$, by

$$BC_i^a(\mathbb{X}, z, m) = \phi_i(G(\mathbb{X}, z)) \times A_i(\mathbb{X}, z, m)$$

, where $A_i(\mathbb{X}, z, m)$, called Adjustment Factor, is defined by

$$A_i(\mathbb{X}, z, m) = \left(\frac{\phi_i(G(\mathbb{X}, z))}{\phi_i(G(\mathbb{X}, z)) + \phi_i(R(\mathbb{X}, z, m))}\right).$$

Following with the previously mentioned students with achievement vectors $x_1 = (4, 5)$ and $x_2 = (4, 10)$ and poverty line $z = (5, 5)$, if $\theta = 2$, it is obtained $g_1 = g_2 = \left(\frac{1}{5}, 0\right)$; $r_1 = (0, 0)$; $r_2 = (0, 1)$; $\phi_1(G) = \phi_2(G) = \frac{1}{5\sqrt{2}}$; $\phi_1(R) = 0$ and $\phi_2(R) = \frac{1}{\sqrt{2}}$. Therefore, $BC_1^a(\mathbb{X}, z, m) = \frac{1}{5\sqrt{2}}$ and $BC_2^a(\mathbb{X}, z, m) = \frac{1}{30\sqrt{2}}$. The *Adjustment Individual Educational Poverty* indices are different due to, as we noted before, students have different scores in subject 2, in which they do not have deficiencies. Moreover, the first student, who has achieved a worse score in subject 2, is educational poorer than the second one, although both have the same score in subject 1.

Finally, the Adjusted Bourguignon Chakravarty index, BC^a, is the real valued function, $BC^a : \mathcal{M} \times \mathbb{R}_+^k \times \mathbb{R}_+^k \to [0, 1]$

$$BC^a(\mathbb{X}, z, m) = \frac{1}{n}\sum_{i=1}^{n}\left(BC_i^a(\mathbb{X}, z, m)\right)^{\alpha}$$

where $\alpha > 0$. For $\alpha = 0$, $\left(BC_i^a(\mathbb{X}, z, m)\right)^0$ denotes the poverty indicator variable function.

Next, we explain the choice of the parameters α and θ to analyse the educational poverty level in the Spanish regions. To set the value of the parameter α, we consider, following Sen (1976), that a poverty index should combine the three essential aspects of poverty: *incidence, intensity, and inequality.*

The incidence is measured by the proportion of poor people, $H = \frac{q}{n}$, and the intensity by the poverty per capita in the whole population, $\frac{1}{n}\sum_{i=1}^{n} BC_i^a(\mathbb{X}, z, m)$, which can be expressed by $H \times I$, where $I = \frac{1}{q}\sum_{i=1}^{n} BC_i^a(\mathbb{X}, z, m)$ represents the poverty intensity among the poor. Finally, to consider inequality among the poor, more weight to the poorest of the poor should be given, which implies that α is strictly greater than 1. Among all the possibilities, we set the most common value, that is, $\alpha = 2$.

On the other hand, the value of $\theta = \alpha$ ensures that the BC^a index satisfies Factor Decomposability (see Proposition 3 in Sánchez-García et al., 2019), an important property which demands a poverty index to be additive across attributes and allows to determine what each of them contributes to total poverty, therefore $\theta = 2$. Moreover, this value of θ implies that inequality in scores of the different subjects also affects the level of individual poverty, characteristic that seems to be appropriate in the educational context. Finally, when $\theta = 2$, both the individual deprivation level and the individual non-deprivation level have a clear geometric interpretation, the Euclidean distance. All these reasons have led us to choose $\alpha = \theta = 2$.

It is worth noting that the BC^a index satisfies some other standard properties in the literature, including Strong Focus Identification, Weak Focus, Symmetry, Normalization, Monotonicity, Continuity, Scale Invariance, Subgroup Decomposability, and Principle of Population (see Sánchez-García et al., 2019 for formal definitions).

Focusing on the last two properties, Subgroup Decomposability makes it possible to measure the contributions of different subgroups to aggregate poverty, and Principle of Population enables to compare, from an educational poverty perspective, groups with different number of individuals. Thus, Factor Decomposability in conjunction with Subgroup Decomposability and Principle of Population allows to identify the subgroup-attribute combinations that are more susceptible to educational poverty. This possibility is highly relevant in designing antipoverty policies when a society has limited resources.

In the following section, in order to offer a novelty overview of educational poverty at the regional level in Spain, we apply the BC^a index using data from PISA 2009, 2012 and 2015.

3 Empirical Application: Educational Poverty in Spain and its Regions

3.1 Data

The Programme for International Student Assessment (PISA) is an initiative of the OECD which aims to evaluate at international level different skills of 15-year-old students, who are in their last year of compulsory education. This programme was developed at the end of the 1990s. It is carried out periodically, every three years, and nowadays involves a large number of the OECD countries and other partners, which together make up close to 90% of the world economy. Through it, three subjects are evaluated: mathematics and problem solving (Mathematics), reading comprehension (Reading) and comprehension of scientific texts (Science). In each wave, one of these subjects is studied in a more exhaustive way.

The present empirical application is aimed at analysing educational poverty in Spain and its regions and it is based on data from PISA 2015 (OECD, 2016), which was focused on Science, with Mathematics and Reading as minor areas of assessment. The total number of Spanish students that make up the sample in this wave is just over 32,000 and it is considered information from all the Spanish regions, but not from the cities of Ceuta and Melilla, for which data are not available. PISA 2015 results are compared with those ones obtained in PISA 2012 and 2009. Data from 2018 PISA wave have not been considered because, as mentioned before, the OECD considers that "the comparability of PISA 2018 data for Spain with those from earlier PISA assessments cannot be fully ensured" (OECD, 2020).

PISA obtains data concerning different explanatory factors of students' academic results, such as family characteristics and home and school environments (Ministerio de Educación, 2010). The present study only focuses on the information related to the educational output, represented by the result obtained by the students in a standardised test or "test scores". At this point, it is important to point out that the results of these tests only reflect a portion of the training that students receive in the educational centres, leaving out the non-cognitive dimensions. Despite this, its use is widely supported by the specialised literature (Hanushek, 2003) and recognised by all agents involved in the educational process, such as teachers, parents, students, politicians, etc.

In addition, PISA reports have the advantage of not evaluating the students' abilities with a single score. Particularly, in 2015, 10 plausible values, extracted from the result distribution, are randomly estimated for each student. These values are interpreted as a representation of the range of abilities that each student has. This is intended to correct possible measurement errors associated with random factors that are beyond the student's control such as illness, nervousness, family problems, etc. (Martínez Arias, 2006). A continuous scale score is given for each test, allowing the creation of a distribution (which is assumed to be normal) with a large number of results for each individual.

The resulting indicator considers an average value of 500 points, with a maximum of 1,000 points in each subject and a standard deviation of 100 points. All items, for each subject, are distributed in six proficiency levels identified by their lower cut scores. They facilitate interpretation by assuming that if the student's score is close to a point on the scale, it is likely considered to be able to answer successfully the items that are at that level and below.

PISA defines low-performing students in a subject as those who are scored below level 2 in the tests corresponding to it. It is considered that such level represents the basic knowledge that the students need to reach in order to be able, in the future, to participate fully in a modern society and to face successfully its professional development (Botezat, 2016). According to the PISA 2015 report, 22% of Spanish students had poor performance in Mathematics, 16% in Reading and 18% in Science.

For PISA 2015, the cut-off scores that mark the educational poverty line for Mathematics, Reading and Science are given by the vector $z = (420.07; 407.47; 409.54)$, which corresponds to the minimum level of the score range of the tests that allow to classify the students in the level 2 in each one of the subjects. According with our definition, a "poor student" or an "educationally poor individual" is a student that do not get these values in all the subjects.

3.2 The Adjusted Bourguignon Chakravarty Index, BC^a

In this section the level of educational poverty in Spain and its regions in 2015 is analysed using the BC^a index.

Table 1 shows the index for the different Spanish regions, presented in alphabetical order, together with the corresponding 95% confidence level, calculated from the standard error. If confidence intervals have a common intersection, the difference in their indices is not statistically significant. Therefore, the exact order is limited by statistical uncertainty.

In Table 1, three areas are shown shaded in column 3 to identify regions with educational poverty significantly lower (area I), around (area II) and higher (area III) than the Spanish BC^a index. In 2015, ten regions belong to area I: Aragon, Basque Country,

Table 1 BC^a index, 95% confidence intervals, intensity and incidence of educational poverty in Spain by regions in 2015

2015

Region	Ranking	Index	95% Confidence interval		Intensity	H = q/n
Andalusia	16	0.005118	0.005011	0.005225	0.030402	0.331108
Aragon	5	0.002231	0.002056	0.002407	0.015325	0.189313
Asturias	11	0.002960	0.002702	0.003218	0.018888	0.228760
Balearic Islands	12	0.003529	0.003276	0.003783	0.022282	0.271861
Basque Country	10	0.002891	0.002726	0.003056	0.019117	0.245206
Canary Islands	17	0.005185	0.004976	0.005394	0.031528	0.361379
Cantabria	6	0.002301	0.002036	0.002565	0.016334	0.220551
Castile and Leon	1	0.001193	0.001105	0.001282	0.009309	0.147278
Castile-La Mancha	8	0.002533	0.002387	0.002679	0.016909	0.229595
Catalonia	9	0.002611	0.002528	0.002693	0.016983	0.209145
Ceuta and Melilla						
Comunidad Valenciana	4	0.002037	0.001954	0.002120	0.014803	0.226095
Extremadura	15	0.004584	0.004312	0.004855	0.027790	0.309256
Galicia	7	0.002518	0.002363	0.002674	0.015646	0.190462
La Rioja	13	0.003797	0.003217	0.004377	0.020456	0.211255
Madrid	3	0.001967	0.001890	0.002044	0.012819	0.172588
Murcia	14	0.003924	0.003707	0.004140	0.024606	0.287719
Navarre	2	0.001314	0.001129	0.001499	0.009524	0.149539
Rest of the country						
SPAIN		**0.003153**	**0.003116**	**0.003190**	**0.019946**	**0.243423**
Area I: Significantly lower than the Spanish BC^a index						
Area II: Around the Spanish BC^a index						
Area III: Significantly higher than the Spanish BC^a index						

Source: Own elaboration from PISA 2015 data. *Note* The value 1 in the ranking column indicates the lowest educational poverty in relation to the rest of regions

Cantabria, Castile and Leon, Castile-La Mancha, Catalonia, Comunidad Valenciana, Galicia, Madrid, and Navarre; six regions belong to area III: Andalusia, Balearic Islands, Canary Islands, Extremadura, La Rioja and Murcia; while only Asturias belongs to area II. Although these positions hold in 2009 and 2012 in most of the regions, it is worth pointing out that, in 2015 and 2009, Aragon is in area I, whereas it belongs to area II in 2012. Finally, Murcia and La Rioja are in area III in 2015 and 2012, whereas they are, respectively, in area I and area II in 2009.

As it can be observed in Table 1 and Fig. 1 the regions with smaller educational poverty level are Castile and Leon, with a value of 0.001193, followed by Navarre (0.001314) and Madrid (0.001967). As Fig. 1 shows, the difference is statistically not significant between Castile and Leon and Navarre, although it is statistically significant between these regions and Madrid. On the other hand, the difference between Madrid and Comunidad Valenciana is not statistically significant. However Canary Islands is the region with the highest value

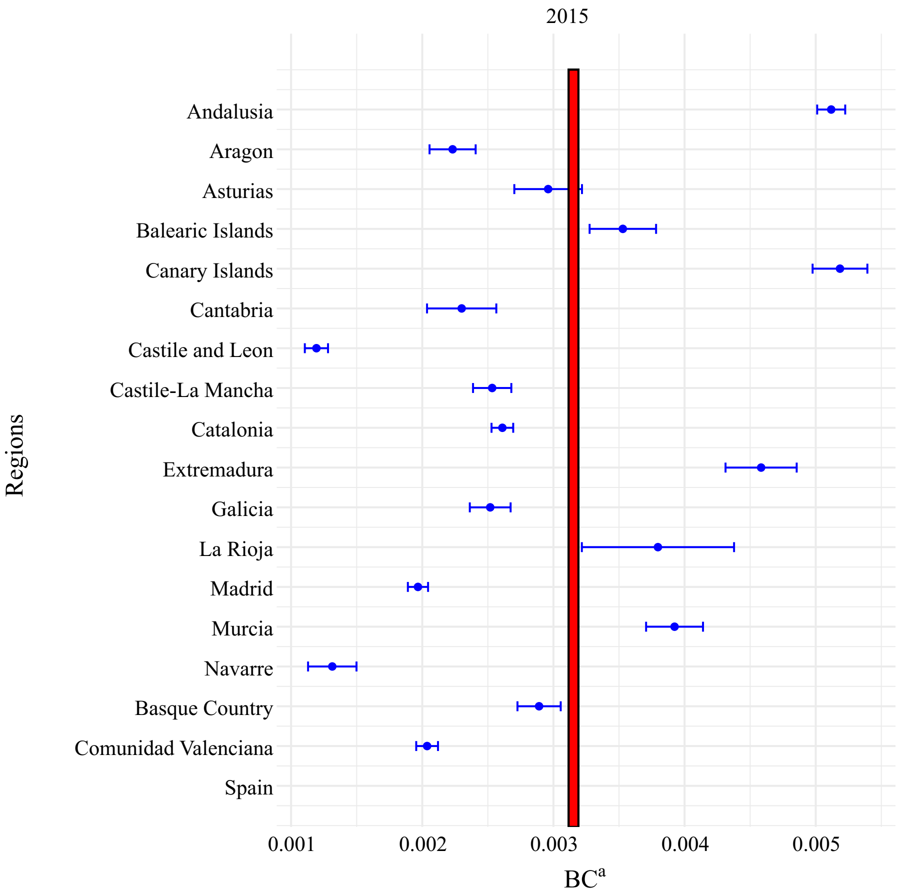

Fig. 1 BC^a index with 95% confidence intervals in Spain by regions in 2015. Source: Own elaboration from PISA 2015 data

of the index (0.005185) followed by Andalusia (0.005118) and Extremadura (0.004584). If we compare the confidence intervals of Canary Islands and Andalusia reflected in Fig. 1, we see that they overlap so the difference in their indices is not statistically significant, although it is significant with respect to Extremadura.

It is worth noting that, in general, the regions with the lowest and the greatest values in the index are the same in the 2015, 2012 and 2009 waves. It must be highlighted that the educational poverty level decreases in all the regions from 2009 to 2015.[2] If the values of the 2009 and 2015 BC^a indices and their respective 95% confidence intervals are compared, it is observed a significant decrease in all Spanish regions, except in Basque Country and Murcia. Indeed, in Spain educational poverty falls in this period by 43.13%, since it goes from 0.005544 to 0.003153. In terms of ranking positions, it is remarkable the case of Basque Country. This region held the second place in 2009, while ranks tenth in 2015.

[2] See Tables 5, 6 and Fig. 6 in the Appendix, for information on 2012 and 2009 respectively.

This can be explained because it is the region that has reduced less the value of the index in this period, only by 5.30%, whereas others, such as Balearic Islands, Castile and Leon and Navarre, have experienced a great decline (-64.76%, -61.34% and -55.55%, respectively).

In Table 1, it is also shown interesting information related to educational poverty to know better the behaviour of this educational poverty index in the 2015 wave.[3] In this sense, the value of the per capita poverty or intensity of poverty, and the Headcount ratio, proportion of poor people or incidence of educational poverty, are provided. In general, it is observed that the Spanish regions with higher both per capita poverty and proportion of poor people are the same as those that have greater values of the BC^a index, and vice versa. However, if Galicia and Cantabria are compared, the intensity and incidence indicators are smaller in the former (0.015646 and 0.190462, respectively), than in the latter (0.016334 and 0.220551, respectively). Nevertheless, the poverty level in Galicia (0.002518) is greater than in Cantabria (0.002301). This result implies a higher level of inequality in Galicia. Analogously, this fact also happens comparing Asturias with Basque Country and La Rioja with Balearic Islands.

If the intensity and incidence indicators of 2015 are compared to those of 2009, it can be observed that both have decreased, in general. Only, these indicators have increased in Basque Country, which means a decrease in the inequality of the educational poverty from 2009 to 2015, since the BC^a index has declined. Likewise, in the analysed period, an increase in the per capita poverty appears in Murcia, while the proportion of poor people is reduced. It implies that there are less educational poor people in Murcia, but they are poorer.

In the literature, some papers have addressed the measure of different educational aspects by considering their relationship with the socio-economic environment and the resources allocated to education in each region. By following this approach, Lahiguera et al. (2019) obtain, from 2015 data, a classification of the Spanish regions in three different groups (named A, B and C), with A being the group of best positioned regions with respect to these conditioning factors and C being the worst one. However, when this classification is compared with that obtained in this paper from the values of the BC^a index (areas I, II and III), according to which the more inclusive regions are in area I (levels of educational poverty lower than the Spanish average), and the least inclusive regions are in area III, it can be seen that, a priori, there is no a clear relationship. To this regard, it is worth noting that all the regions of group A belong to area I, with significantly lower educational poverty than the Spanish BC^a index, but Castile-La Mancha and Comunidad Valenciana are classified as inclusive regions (area I), whereas they are characterised by weaknesses in both, the socio-economic environment and the resources devoted to education (group C). On the other hand, there are several regions in group B that, at the same time, belong to area I (Aragon, Cantabria, Castile and Leon) and one region in group B (La Rioja) which also is in area III. Therefore, it can be concluded that having favourable (less favourable) conditions for the functioning of the education system is not necessarily associated with better (worse) educational poverty levels.

[3] The same information is shown in Tables 5 and 6, in the Appendix, for 2012 and 2009 respectively.

3.3 Contribution of the Spanish Regions to National Educational Poverty

The decomposability property of the BC^a index makes it possible to calculate the contribution of each region to national poverty.

In Fig. 2 it can be observed that, in 2015, the regions that have the greatest influence on national educational poverty are Andalusia (33.68%), Catalonia (13.28%), Madrid (8.44%), and Canary Islands (8.13%), while the regions that contribute less to it are Navarre (0.58%), La Rioja (0.84%), and Cantabria (0.85%). This regional contribution to national educational poverty remains very similar in the waves of 2012 and 2009 (see Figs. 7 and 8, in the Appendix).

The previous results show that the region which contributes more to national educational poverty is not necessarily the one with the highest BC^a index, since this contribution also depends on the proportion of students in that region, with respect to the total population of Spain. For example, Madrid is the third region with the lowest poverty level in Spain in 2015. However, when the poverty index is weighted by the percentage of students from Madrid, it is obtained that its contribution to Spanish educational poverty is one of the highest. On the contrary, La Rioja, which is one of the regions that contributes less to educational poverty in Spain in 2015, has one of the highest values of the educational poverty index.

Accordingly, although the level of educational poverty is important in each region to guide the educational policy, with the aim of reducing the national educational poverty, it is also very important to take into account the number of inhabitants in each region, in order to ensure that these policies will be more effective.

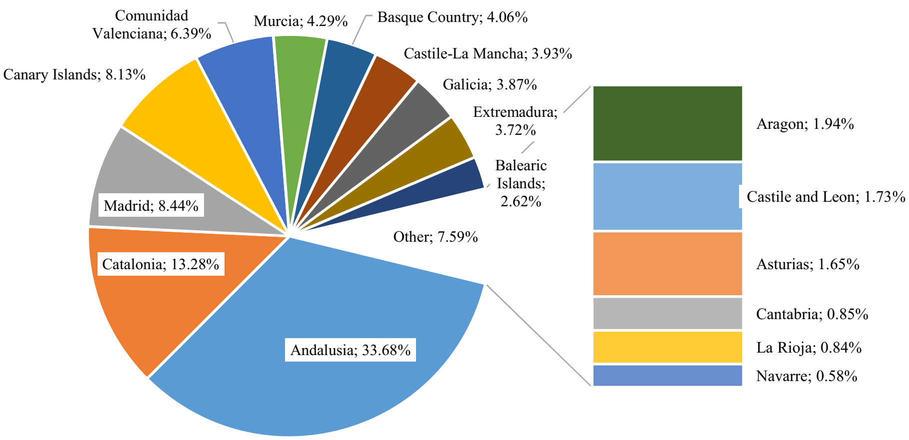

Fig. 2 Decomposition of national educational poverty in Spain by regions in 2015. Source: Own elaboration from PISA 2015 data

3.4 Contribution of Subjects to Educational Poverty

The analysis about the contribution of each subject to educational poverty is possible because the BC^{a} index is also decomposable into dimensions. In this way, we can identify the subject which more attention should be paid to in order to reduce the level of educational poverty. According to the data of Fig. 3, the main contribution to educational poverty in 2015 comes from Mathematics (35.73%), followed by Reading (32.75%) and, in last position, Science (31.52%). Science is also the subject that contributes the least to Spanish educational poverty in the two previous waves analysed, with weights of 24.21% in 2012 and 27.28% in 2009, whereas Mathematics contributes the most both in 2009 (37.45%) and 2015, and Reading in 2012 (40.93%).

The decomposition of regional educational poverty by subject is shown in Table 2 for 2015. In general, Mathematics is the subject that contributes the most to educational poverty in a larger number of regions. In particular, Canary Islands, Madrid, and Castile-La Mancha are the regions where Mathematics presents the highest contribution to educational poverty with respect to the other regions, 46.06%, 41.69% and 41.38%, respectively. On the contrary, La Rioja, Basque Country, Extremadura, Navarre, and Cantabria, are the ones where Mathematics has the smallest weight in the educational poverty, with contributions of 25.71%, 26.68%, 28.79%, 29.25% and 30.76%, respectively.

In this year, Reading is the subject with the greatest weight in educational poverty only in La Rioja (40.49%), Extremadura (37.45%), Cantabria (36.26%), Asturias (35.77%) and Andalusia (34.69%). In the same way, Science contributes more to the educational poverty, than the other subjects, only in Basque Country (37.17%), Navarre (36.05%) and Catalonia (34.90%). On the contrary, in 2015 Science is the subject that contributes less to educational poverty with respect to the other disciplines in the majority of regions, among which stand out Canary Islands (27.35%), Comunidad Valenciana (29.21%), Aragon (29.59%) and Galicia (29.65%).

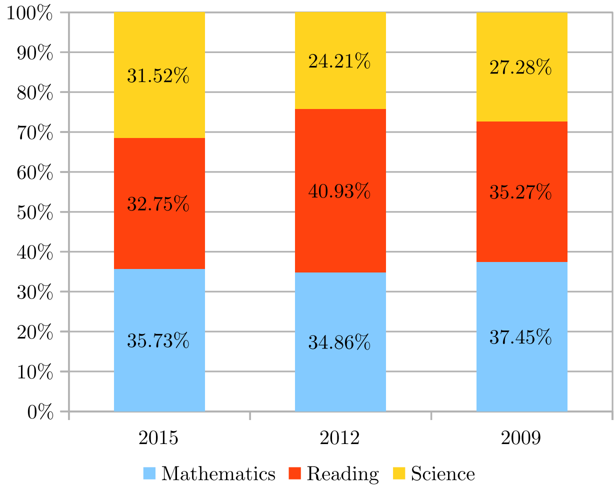

Fig. 3 Decomposition of national educational poverty in Spain by subjects Source: Own elaboration from PISA 2009, 2012 and 2015 data

Table 2 Contribution of each subject to the regional and national educational poverty in Spain in 2015

2015			
Region	Maths %	Reading %	Science %
Andalusia	34.16	34.69	31.15
Aragon	35.84	34.58	29.59
Asturias	32.21	35.77	32.02
Balearic Islands	33.97	33.48	32.55
Basque Country	26.68	36.14	37.17
Canary Islands	46.06	26.59	27.35
Cantabria	30.76	36.26	32.98
Castile and Leon	37.52	32.03	30.45
Castile-La Mancha	41.38	28.29	30.32
Catalonia	32.99	32.11	34.90
Ceuta and Melilla			
Comunidad Valenciana	36.95	33.84	29.21
Extremadura	28.79	37.45	33.76
Galicia	36.03	34.32	29.65
La Rioja	25.71	40.49	33.80
Madrid	41.69	27.22	31.10
Murcia	38.10	31.10	30.81
Navarre	29.25	34.69	36.05
Rest of the country			
SPAIN	35.73	32.75	31.52

Source: Own elaboration from PISA 2015 data

It is worth pointing out the increase in the contribution of Science to educational poverty of 4.34 percentage points (p.p.) (from 27.04% to 31.38%) in Spain from 2009 to 2015,[4] while Reading and Mathematics decrease their contribution by 2.74 p.p. (from 35.20% to 32.46%) and 1.60 p.p. (from 37.76% to 36.16%), respectively. By regions, Science increases its contribution to educational poverty in almost all regions, in this period, especially in Basque Country (13.98 p.p., from 23.15% to 37.13%) and Navarre (11.50 p.p., from 24.50% to 35.99%). Only in Canary Islands the contribution of this subject to educational poverty decreases (−0.71 p.p., from 27.77% to 27.06%). With respect to Reading, Canary Islands is where the contribution of this subject to educational poverty experiences the greatest decline (−9.94 p.p., from 36.06% to 26.12%). Likewise, La Rioja and Basque Country are the regions where Mathematics further reduces its contribution to educational poverty (−19.35 p.p., from 45.06% to 25.71%, and −12.41 p.p., from 39.25% to 26.84%, respectively).

[4] In Table 7 in the Appendix, it is shown the contribution of each subject to the regional educational poverty for PISA 2012 and 2009 data.

3.5 Educational Poverty by Gender

In this section the differences found by gender in educational poverty, considering both, regions, and subjects, are analysed.

Tables 3 and 4 present the BC^a index at the regional level in 2015 for the male and female students, respectively, as well as the regional ranking derived from the index value and the corresponding 95% confidence intervals (represented in Fig. 4). According to this information, three areas are shown shaded in column 3 of Tables 3 and 4 to identify regions with educational poverty by gender significantly lower (area I), around (area II), and higher (area III) than the national average.

In 2015, and for both genders, eight regions belong to area I: Aragón, Cantabria, Castile and Leon, Castile-La Mancha, Galicia, Madrid, Navarre, and Comunidad Valenciana; four regions are in area III: Andalusia, Canary Islands, Extremadura, and Murcia; and two regions, Asturias and La Rioja, are in area II. In 2009 and 2012, all the above mentioned regions in areas II and III hold their positions, but only Castile and Leon, Madrid, Navarre, and Comunidad Valenciana remain in area I.[5] Moreover, it is worth pointing out that, in

Table 3 BC^a index, 95% confidence intervals, intensity and incidence of educational poverty of the male students in Spain by regions in 2015

Male		2015				
Region	**Ranking**	**Index**	**95% Confidence interval**		**Intensity**	**H = q/n**
Andalusia	15	0.005426	0.005270	0.005582	0.031302	0.320384
Aragon	7	0.002736	0.002456	0.003015	0.017679	0.201533
Asturias	10	0.003155	0.002794	0.003517	0.020703	0.235371
Balearic Islands	13	0.003757	0.003400	0.004115	0.023923	0.283365
Basque Country	11	0.003367	0.003111	0.003624	0.021512	0.264480
Canary Islands	16	0.005568	0.005261	0.005875	0.032632	0.354736
Cantabria	6	0.002682	0.002275	0.003089	0.018159	0.223135
Castile and Leon	2	0.001645	0.001497	0.001792	0.012070	0.159067
Castile-La Mancha	9	0.002965	0.002726	0.003203	0.018203	0.230387
Catalonia	4	0.002064	0.001976	0.002151	0.015202	0.195449
Ceuta and Melilla						
Comunidad Valenciana	5	0.002356	0.002229	0.002482	0.016289	0.215461
Extremadura	17	0.005638	0.005212	0.006065	0.032292	0.326080
Galicia	8	0.002853	0.002621	0.003085	0.017438	0.196293
La Rioja	12	0.003754	0.003030	0.004479	0.021216	0.219273
Madrid	3	0.001816	0.001715	0.001916	0.011971	0.155401
Murcia	14	0.004324	0.003995	0.004653	0.026806	0.309883
Navarre	1	0.001514	0.001230	0.001797	0.010499	0.155275
Rest of the country						
SPAIN		**0.003292**	**0.003240**	**0.003344**	**0.020605**	**0.238468**
Area I: Significantly lower than the Spanish BC^a index						
Area II: Around the Spanish BC^a index						
Area III: Significantly higher than the Spanish BC^a index						

Source: Own elaboration from PISA 2015 data

[5] See Tables 8, 9, 10 and 11, in the Appendix, for information on 2012 and 2009.

Table 4 BC^a index, 95% confidence intervals, intensity and incidence of educational poverty of the female students in Spain by regions in 2015

Female			**2015**			
Region	**Ranking**	**Index**	**95% Confidence interval**		**Intensity**	**H = q/n**
Andalusia	17	0.004820	0.004674	0.004967	0.029532	0.341478
Aragon	3	0.001631	0.001438	0.001824	0.012522	0.174765
Asturias	10	0.002755	0.002387	0.003124	0.016989	0.221845
Balearic Islands	12	0.003291	0.002932	0.003650	0.020565	0.259826
Basque Country	9	0.002422	0.002214	0.002629	0.016758	0.226230
Canary Islands	16	0.004798	0.004515	0.005081	0.030416	0.368076
Cantabria	5	0.001914	0.001579	0.002249	0.014482	0.217929
Castile and Leon	1	0.000740	0.000644	0.000836	0.006537	0.135445
Castile-La Mancha	6	0.002106	0.001937	0.002275	0.015629	0.228812
Catalonia	11	0.003206	0.003062	0.003350	0.018919	0.224040
Ceuta and Melilla						
Comunidad Valenciana	4	0.001700	0.001594	0.001806	0.013230	0.237342
Extremadura	13	0.003403	0.003085	0.003720	0.022749	0.290422
Galicia	8	0.002185	0.001978	0.002393	0.013865	0.184666
La Rioja	15	0.003842	0.002927	0.004756	0.019660	0.202862
Madrid	7	0.002121	0.002004	0.002237	0.013675	0.189960
Murcia	14	0.003513	0.003232	0.003795	0.022353	0.265017
Navarre	2	0.001106	0.000872	0.001340	0.008507	0.143564
Rest of the country						
SPAIN		**0.003011**	**0.002959**	**0.003063**	**0.019272**	**0.248498**
Area I: Significantly lower than the Spanish BC^a index						
Area II: Around the Spanish BC^a index						
Area III: Significantly higher than the Spanish BC^a index						

Source: Own elaboration from PISA 2015 data

2015, Catalonia is in area I (ranked fourth) for the male students, whereas it belongs to area II (eleventh position) for the female collective. The inverse situation is presented in Basque Country, which is in area II for the male group (ranked eleventh) and in area I for the female one (ranked nineth). Finally, Balearic Islands, whose order differs only by one position between the male and female students, belong to area III for the male collective (ranked thirteenth) whereas it is in area II for the female one (position twelfth). In 2012, some regions belong to distinct areas for males and female students (Andalusia, Asturias, Cantabria, Galicia, and La Rioja) but in none of them the order differs by more than three positions between these two collectives. In 2009, the regions with the most pronounced variations in educational poverty between the male and female collectives are Murcia and Galicia. Murcia is in area I (ranked third) for the male students and in area II (eleventh position) for the female one, and the opposite occurs in Galicia, which is in area II (ranked tenth) for the male collective and in area I (fourth position) for the female one.

In Fig. 4, it can be observed, for each gender, whether there are significant differences in the 2015 BC^a index for any pair of regions or not.[6] In this regard, it is worth highlighting that in 2015, for males there are not significant differences in educational poverty neither

[6] Analogously, Figs. 9 and 10, in the Appendix, show the same information for 2012 and 2009, respectively.

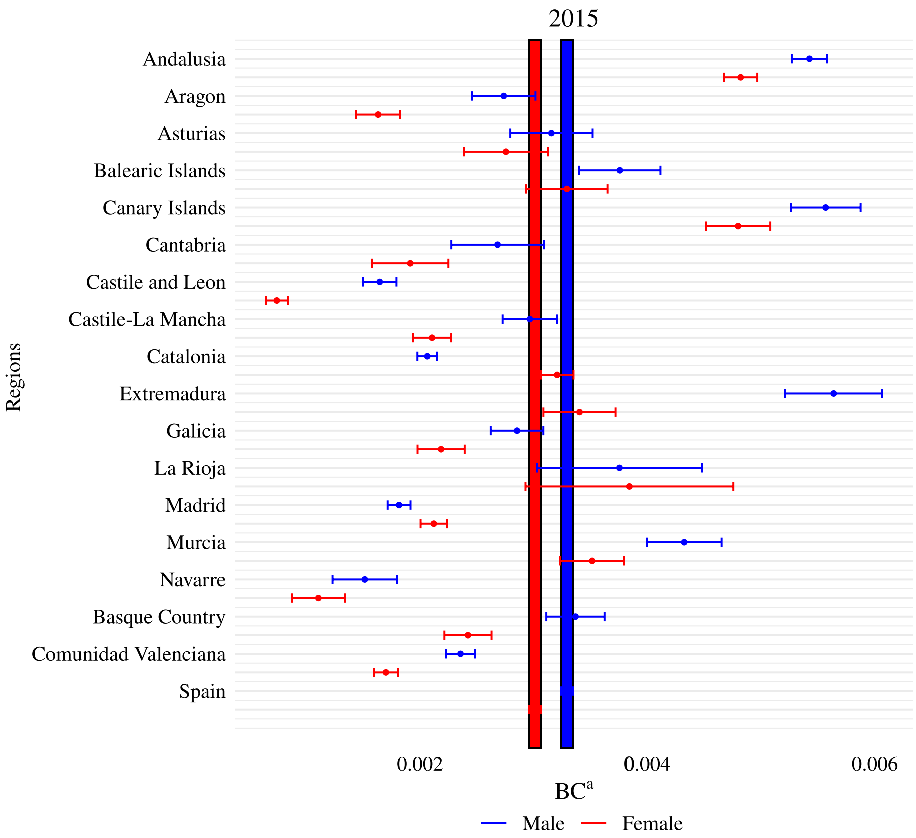

Fig. 4 BC^a index with 95% confidence intervals in Spain by gender and regions in 2015. Source: Own elaboration from PISA 2015 data

among the regions ranked in the three first positions, Navarra, Castile and Leon, and Madrid, nor among the regions ranked in the three last ones, Extremadura, Canary Island and Andalusia, but the first group of regions presents BC^a values significantly different from those of Catalonia (fourth position), and the educational poverty of the second group is significantly different from that of Murcia (fourteenth position). On the contrary, in 2015 for female students, although there are no significant differences in educational poverty neither between the regions ranked in the two first positions, Castile and Leon, and Navarra, nor between the regions ranked in the two last ones, Andalusia and Canary Island, the first group of regions presents BC^a values significantly lower than that of Aragon (ranked third), and the educational poverty of the second group is significantly higher than that of La Rioja (ranked fifteenth).

If the values of the BC^a index for the male and female students, and their respective 95% confidence intervals, are compared from 2009 to 2015, it is observed a significant decrease in most Spanish regions for both genders. This implies a significant reduction in the national educational poverty for the male and female students by 44.17% and 41.87%, respectively. The only exceptions in this period are, among male students, Basque Country and Murcia, and, among female students, Basque Country and La Rioja.

Comparing the national educational poverty level between the male and female collectives, it can be observed that the Spanish educational poverty level is significantly greater for male than for female students in all PISA waves. Particularly, this gap[7] is 8.53% in 2015, 36.90% in 2012 and 12.15% in 2009. In 2015, only four regions, Asturias, Balearic Island, La Rioja, and Navarre, do not present significant differences in the educational poverty between males and females. Among the regions with educational poverty level significantly greater for male than for female students, the ones that present a higher gap (greater than 30%) are Castile and Leon (55.01%), Aragon (40.38%) and Extremadura (39.65%), while this gap is smaller (less than 20%) in Murcia (18,75%), Canary Islands (13,83%) and Andalusia (11.16%). On the contrary, there are two regions where the educational poverty of female students is significantly higher than that of the male ones in the 2015 wave. They are Catalonia and Madrid, where the gender educational poverty gap reaches the values -55.35% and -16.82%, respectively.

Next, we focus on values of different indicators related to educational poverty and describe the main characteristics of the trend of the gender gap, intensity, incidence, and contribution of each subject to educational poverty for the male and female students.

It is worth noting the great increase in the Spanish gender educational poverty gap from 2009 to 2012 of 24.75 p.p., which is more than compensated with its reduction from 2012 to 2015 by 28.73 p.p., providing a moderate reduction of 3.62 p.p. in the period 2009–2015. However, the trend of this gap is very diverse across regions. Comparing 2009 and 2015, the gap turns from positive to negative in Catalonia, Madrid, and La Rioja, while the opposite happens in Murcia and Andalusia. Among the other regions, which keep the sign of the gender gap, an important reduction is registered in Galicia (−27.51 p.p.) and Basque Country (−17.91 p.p.), while this gap rises considerably in Castile and Leon (28.54 p.p.) and Navarre (18.21 p.p.).

Tables 3 and 4 also present the values of the intensity and the incidence of the educational poverty in 2015 for the male and female students, respectively. In general, for both genders, the Spanish regions with higher both per capita poverty and proportion of poor people are the same as those that have greater levels of the BC^a index, and vice versa. However, in Galicia, Asturias and La Rioja, the intensity and incidence indicators are smaller, for both genders, than in other regions, such as Cantabria, Basque Country, and Balearic Islands, respectively, while their poverty educational indices are greater than in the latter regions. These values imply a higher level of inequality in the educational poverty in the former regions for both genders. This higher inequality is also registered, but only for the male individuals in Madrid, Aragon, Galicia, La Rioja, and Extremadura with respect to, for instance, Castile and Leon, Cantabria, Aragon, Basque Country, and Canary Islands respectively. In the female collective the inequality in educational poverty is greater, for instance, in Madrid, Murcia, La Rioja and Andalusia, with respect to Castile-La Mancha, Extremadura, Murcia and Canary Islands, respectively.

If the per capita poverty and proportion of poor people indicators in 2015 are compared with those of 2009,[8] it can be observed that, in general, and for the male and female students, both indicators have been reduced. Only, they have been increased in Murcia, for the male collective, and in Basque Country, for the female one, as it happens with theirs BC^a indices. Likewise, it can be observed an increase in both indicators in Basque Country, for the male students, despite the reduction of its educational poverty level. It implies a decrease in inequality among the male students in this region from 2009 to 2015, which offsets the increase in the former indicators.

[7] The gender educational gap is defined as the difference between the educational poverty level of male and female students as a percentage of the educational poverty level of male students.

[8] See Tables 10 and 11, in the Appendix, for 2012 and 2009, respectively.

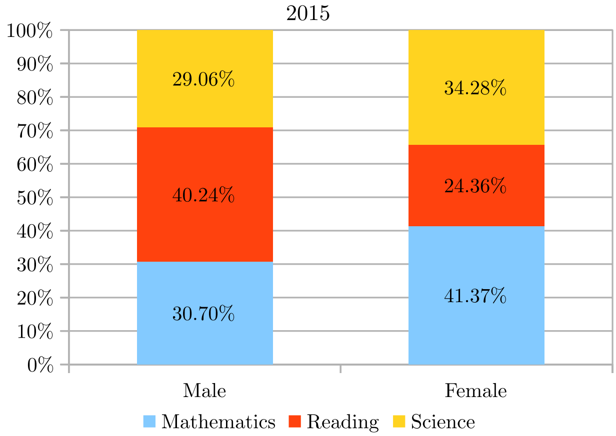

Fig. 5 Decomposition of national educational poverty in Spain by subjects and gender in 2015. Source: Own elaboration from PISA 2015 data

It is also possible to calculate the contribution of each subject to educational poverty for the male and female students. In Fig. 5, it is shown that Reading is the subject which contributes the most to educational poverty among the male collective in 2015 (40.24%), while this subject is the one that contributes the least in the female group (24.36%). On the contrary, Mathematics and Science are the subjects that contribute the most to the educational poverty in the female students (41.37% and 34.28%, respectively), whereas these are the ones that contribute the least in the male group (30.70% and 29.06%, respectively). A very similar outcome is obtained if data corresponding to 2012 and 2009 waves are considered (see Figs. 11 and 12 in the Appendix, respectively).

4 Conclusion

In this article an in-depth analysis of educational poverty in Spain has been carried out at the regional level, differentiating by subject and gender, and considering educational performance in all subjects assessed by PISA. The information presented could certainly be considered a starting point to tackle educational poverty in Spain.

By following the approach of educational poverty which focuses on low educational performance, the application of the Adjusted Bourguignon Chakravarty index allows us to provide a novelty overview of educational poverty in Spain by using not only data on educational performance in one subject, but in the main ones assessed by PISA (Mathematics, Science and Reading). Moreover, this index evaluates educational poverty from a different point of view, that is, by considering not only subjects in which a student does not reach the minimum, but also those subjects in which they do not have deficiencies. Therefore, we offer a multidimensional measure of educational poverty which is more complete than the unidimensional ones used in previous works in the literature that study educational performance from PISA data, and so our results are not comparable with them.

From our application it can be concluded that, in general, the regions with the lowest and the greatest values in the index, are the same in the 2015, 2012 and 2009 waves. In the 2015 wave, Castile and Leon, Navarre, and Madrid are the ones with the lowest index, while Canary Islands, Andalusia and Extremadura are at the other extreme. Additionally, it is noted that the educational poverty level decreases significantly in most regions from 2009 to 2015 and that the Spain educational poverty goes down by 43.13% in this period.

In relation to the contribution of each region to national poverty in 2015, Andalusia, Catalonia, Madrid and Canary Islands are the regions that have the greatest influence on national educational poverty, while Navarre, La Rioja and Cantabria are the ones that contribute least. This contribution pattern is very similar to that of 2012 and 2009. It is important to point out that the contribution to national educational poverty depends not only on the index value, but also on the proportion of students in that region with respect to the total population of Spain.

With respect to the contribution of each subject to national poverty, our results indicate that Mathematics is, in general, the subject that contributes the most to the educational poverty in 2015, followed by Reading and finally Science, as also observed in 2009, while Reading is the major contributor in the 2012 wave. However, it does not occur in all the regions. On the one hand, Reading is the subject with the greatest weight in educational poverty in La Rioja, Extremadura, Cantabria, Asturias and Andalusia; while Science contributes more in Basque Country, Navarre and Catalonia.

From the analysis of educational poverty by gender, we found that there are more regions with educational poverty significantly lower than the national average for both genders in 2015 than in 2009 and 2012. Aragon, Cantabria, Castile-La Mancha, and Galicia are the regions that become part of this group in 2015. Striking cases in 2015 are Catalonia, Basque Country, and Balearic Island, because their position with respect to the national average is significantly different for the male and the female collectives.

Comparing the educational poverty level between genders, it can be concluded that the Spanish educational poverty level is significantly higher for male students than for female students in all PISA waves. Focusing in 2015, among the regions that follow this pattern, the highest gender gaps are found in Castile and Leon, Aragon, and Extremadura; in Catalonia and Madrid the educational poverty of female students is significantly higher than that of the male ones, and Asturias, Balearic Island, La Rioja, and Navarre, do not present significant differences in the educational poverty between the male collective and the female one. Moreover, although the Spanish gender gap has experienced a moderate reduction of 3.62 p.p. in the period 2009–2015, the trend of this gap has been very different across regions. Particularly, in Castile and Leon and Navarre the gender gap has increased considerably.

Finally, regarding the contribution of each subject to the educational poverty by gender, Reading is usually the subject that contributes more to educational poverty in the male collective, while Mathematics and Science are the subjects that contribute the most to the educational poverty in the female students.

As mentioned at the end of the Sect. 3.2, the fact that the Spanish regions have favourable (less favourable) conditions for the functioning of the education system is not necessarily associated with better (worse) educational poverty levels. A new analysis should be carried out to determine the causes of educational poverty. Therefore, this paper can be regarded as a first step in this direction leaving open the possibility of future research in this line.

Appendix

Calculations in this Appendix are based on data from PISA 2009 (OECD, 2010) and 2012 (OECD, 2014). The total number of Spanish students that make up the sample in 2009 is approximately 26,000 and in 2012 something above 25,000. In the evaluation of PISA

2009, the regions of Balearic Islands, Canary Islands, Madrid, Murcia and the autonomous cities of Ceuta and Melilla participate, for the first time, with an enlarged sample, joining the ten regions that already had enlarged samples in previous editions: Andalusia, Aragon, Asturias, Cantabria, Castile and Leon, Catalonia, Galicia, La Rioja, Navarre and Basque Country. In PISA 2012, Extremadura joins, although Canary Islands and Ceuta and Melilla leave the regions with a sufficiently representative sample. Students belonging to regions without representative sample are categorised as "rest of the country" in both 2009 and 2012 waves. As in PISA 2015, the resulting indicator for PISA 2009 and 2012 considers an average value of 500 points, with a maximum of 1,000 points in each subject and a standard deviation of 100 points and the cut-off scores that mark the educational poverty line for Mathematics, Reading and Science are given by the vector z=(420.07, 407.47, 409.54), which corresponds to the minimum level of the score range of the tests that allow to classify the students in the level 2 in each one of the subjects. PISA 2009 was focused on Reading and PISA 2012 on Mathematics, with the rest of subjects as minor areas of assessment (See Tables 5, 6, 7, 8, 9, 10 and 11).

Table 5 BC^a index, 95% confidence intervals, intensity and incidence of educational poverty in Spain by regions in 2012

2012

Region	Ranking	Index	95% Confidence interval		Intensity	H = q/n
Andalusia	10	0.005659	0.005496	0.005823	0.028310	0.314594
Aragon	9	0.004658	0.004308	0.005009	0.024636	0.260894
Asturias	8	0.004447	0.003929	0.004965	0.020352	0.223697
Balearic Islands	11	0.005917	0.005456	0.006378	0.030095	0.331582
Basque Country	5	0.003486	0.003238	0.003734	0.017700	0.199500
Canary Islands						
Cantabria	7	0.003868	0.003359	0.004376	0.021797	0.265350
Castile and Leon	1	0.002229	0.002048	0.002409	0.013077	0.185000
Castile-La Mancha						
Catalonia	4	0.002845	0.002750	0.002939	0.018032	0.242630
Ceuta and Melilla						
Comunidad Valenciana						
Extremadura	15	0.010100	0.009497	0.010703	0.043729	0.377509
Galicia	6	0.003862	0.003629	0.004095	0.020948	0.244753
La Rioja	13	0.007049	0.005757	0.008342	0.027266	0.240360
Madrid	2	0.002495	0.002382	0.002607	0.014138	0.198185
Murcia	14	0.008269	0.007851	0.008687	0.038919	0.351326
Navarre	3	0.002754	0.002337	0.003170	0.014420	0.185849
Rest of the country	12	0.006185	0.006040	0.006331	0.031071	0.337507
SPAIN		**0.004705**	**0.004644**	**0.004766**	**0.024253**	**0.276084**
Area I: Significantly lower than the Spanish BC^a index						
Area II: Around the Spanish BC^a index						
Area III: Significantly higher than the Spanish BC^a index						

Source: Own elaboration from PISA 2012 data. *Note:* The value 1 in the ranking column indicates the lowest educational poverty in relation to the rest of regions

Table 6 BC^a index, 95% confidence intervals, intensity and incidence of educational poverty in Spain by regions in 2009

2009

Region	Ranking	Index	95% Confidence interval		Intensity	H = q/n
Andalusia	13	0.009010	0.008803	0.009217	0.039780	0.373287
Aragon	6	0.004051	0.003721	0.004381	0.020481	0.228372
Asturias	12	0.006091	0.005499	0.006682	0.027411	0.243780
Balearic Islands	14	0.010013	0.009286	0.010739	0.043212	0.386548
Basque Country	2	0.003053	0.002829	0.003276	0.016849	0.198946
Canary Islands	15	0.010576	0.010167	0.010986	0.052984	0.490834
Cantabria	10	0.004593	0.004073	0.005113	0.024043	0.272132
Castile and Leon	3	0.003086	0.002870	0.003302	0.016229	0.188894
Castile-La Mancha						
Catalonia	5	0.003915	0.003783	0.004047	0.020949	0.229885
Ceuta and Melilla	16	0.029117	0.026144	0.032089	0.102008	0.586784
Comunidad Valenciana						
Extremadura						
Galicia	7	0.004225	0.003981	0.004469	0.021958	0.256967
La Rioja	11	0.005226	0.004387	0.006064	0.024610	0.232068
Madrid	4	0.003289	0.003117	0.003460	0.017683	0.232754
Murcia	9	0.004404	0.004106	0.004703	0.024395	0.289121
Navarre	1	0.002956	0.002536	0.003376	0.016522	0.213388
Rest of the country	8	0.004402	0.004292	0.004513	0.025570	0.298660
SPAIN		**0.005544**	**0.005475**	**0.005614**	**0.027512**	**0.290820**
Area I: Significantly lower than the Spanish BC^a index						
Area II: Around the Spanish BC^a index						
Area III: Significantly higher than the Spanish BC^a index						

Source: Own elaboration from PISA 2009 data. *Note* The value 1 in the ranking column indicates the lowest educational poverty in relation to the rest of regions

Table 7 Contribution of each subject to the regional and national educational poverty in Spain in 2012 and 2009

Region	2012			2009		
	Maths %	Reading %	Science %	Maths %	Reading %	Science %
Andalusia	33.09	42.87	24.03	36.07	36.80	27.13
Aragon	34.76	34.73	30.50	43.28	31.20	25.52
Asturias	42.13	37.48	20.39	39.12	36.64	24.23
Balearic Islands	34.82	44.33	20.84	36.08	36.76	27.16
Basque Country	30.06	41.58	28.36	39.41	37.36	23.22
Canary Islands				35.52	36.43	28.05
Cantabria	38.65	36.77	24.57	39.02	33.41	27.57
Castile and Leon	34.87	44.48	20.65	37.07	36.96	25.97
Castile-La Mancha						
Catalonia	35.82	35.84	28.34	39.39	29.97	30.64
Ceuta and Melilla				32.62	33.19	34.19
Comunidad Valenciana						
Extremadura	33.85	47.34	18.81			
Galicia	36.99	43.25	19.76	32.57	41.52	25.91
La Rioja	30.76	45.27	23.97	44.75	30.02	25.23
Madrid	40.52	33.93	25.55	37.77	33.82	28.41
Murcia	36.52	41.89	21.60	45.45	28.21	26.34
Navarre	26.76	38.57	34.67	40.80	34.47	24.73
Rest of the country	34.58	40.85	24.56	39.52	35.00	25.48
SPAIN	34.86	40.93	24.21	37.45	35.27	27.28

Source: Own elaboration from PISA 2012 and 2009 data

Table 8 BC^{a} index, 95% confidence intervals, intensity and incidence of educational poverty of the male students in Spain by regions in 2012

Male			2012			
Region	**Ranking**	**Index**	**95% Confidence interval**		**Intensity**	**H = q/n**
Andalusia	12	0.007445	0.007166	0.007724	0.033567	0.309378
Aragon	8	0.005547	0.005012	0.006081	0.028254	0.289906
Asturias	9	0.006015	0.005181	0.006848	0.026119	0.256889
Balearic Islands	11	0.007097	0.006357	0.007836	0.034582	0.354492
Basque Country	5	0.003791	0.003424	0.004159	0.019283	0.217500
Canary Islands						
Cantabria	6	0.004964	0.004112	0.005816	0.026439	0.276773
Castile and Leon	2	0.003053	0.002724	0.003382	0.015588	0.202774
Castile-La Mancha						
Catalonia	3	0.003065	0.002922	0.003209	0.019089	0.239135
Ceuta and Melilla						
Comunidad Valenciana						
Extremadura	15	0.013245	0.012220	0.014270	0.052721	0.418088
Galicia	7	0.005265	0.004853	0.005677	0.026228	0.284240
La Rioja	13	0.009770	0.007335	0.012206	0.033572	0.259919
Madrid	1	0.002919	0.002746	0.003092	0.016264	0.204459
Murcia	14	0.010514	0.009839	0.011188	0.046551	0.366034
Navarre	4	0.003651	0.003001	0.004300	0.019275	0.214091
Rest of the country	10	0.007089	0.006862	0.007316	0.033457	0.345209
SPAIN		**0.005750**	**0.005649**	**0.005850**	**0.027667**	**0.284483**
Area I: Significantly lower than the Spanish BC^{a} index						
Area II: Around the Spanish BC^{a} index						
Area III: Significantly higher than the Spanish BC^{a} index						

Source: Own elaboration from PISA 2012 data

Table 9 BC^a index, 95% confidence intervals, intensity and incidence of educational poverty of the female students in Spain by regions in 2012

Female			2012			
Region	**Ranking**	**Index**	**95% Confidence interval**		**Intensity**	**H = q/n**
Andalusia	9	0.003709	0.003556	0.003861	0.022565	0.320294
Aragon	10	0.003788	0.003334	0.004243	0.021092	0.232478
Asturias	7	0.002882	0.002271	0.003493	0.014598	0.190577
Balearic Islands	12	0.004762	0.004208	0.005315	0.025698	0.309128
Basque Country	8	0.003181	0.002848	0.003515	0.016123	0.181574
Canary Islands						
Cantabria	6	0.002720	0.002189	0.003251	0.016939	0.253395
Castile and Leon	1	0.001388	0.001246	0.001529	0.010515	0.166864
Castile-La Mancha						
Catalonia	5	0.002604	0.002483	0.002726	0.016882	0.246431
Ceuta and Melilla						
Comunidad Valenciana						
Extremadura	15	0.006912	0.006295	0.007528	0.034612	0.336360
Galicia	4	0.002455	0.002241	0.002669	0.015652	0.205142
La Rioja	11	0.004572	0.003501	0.005642	0.021525	0.222556
Madrid	3	0.002058	0.001914	0.002202	0.011952	0.191732
Murcia	14	0.006027	0.005537	0.006516	0.031296	0.336635
Navarre	2	0.001901	0.001375	0.002426	0.009801	0.158983
Rest of the country	13	0.005295	0.005113	0.005476	0.028720	0.329915
SPAIN		**0.003628**	**0.003559**	**0.003697**	**0.020733**	**0.267424**
Area I: Significantly lower than the Spanish BC^a index						
Area II: Around the Spanish BC^a index						
Area III: Significantly higher than the Spanish BC^a index						

Source: Own elaboration from PISA 2012 data

Table 10 BC^a index, 95% confidence intervals, intensity and incidence of educational poverty of the male students in Spain by regions in 2009

Male	2009					
Region	**Ranking**	**Index**	**95% Confidence interval**		**Intensity**	**H = q/n**
Andalusia	13	0.008574	0.008315	0.008833	0.039118	0.372544
Aragon	8	0.005048	0.004515	0.005581	0.023971	0.233872
Asturias	12	0.006650	0.005858	0.007442	0.030032	0.256595
Balearic Islands	15	0.010860	0.009911	0.011809	0.046805	0.381076
Basque Country	4	0.003930	0.003571	0.004288	0.021010	0.235220
Canary Islands	14	0.010853	0.010269	0.011436	0.053671	0.482423
Cantabria	9	0.005117	0.004349	0.005886	0.026779	0.278719
Castile and Leon	2	0.003567	0.003277	0.003857	0.019687	0.210601
Castile-La Mancha						
Catalonia	7	0.004417	0.004214	0.004620	0.022830	0.229586
Ceuta and Melilla	16	0.034896	0.029982	0.039810	0.112657	0.588539
Comunidad Valenciana						
Extremadura						
Galicia	10	0.005657	0.005231	0.006082	0.026812	0.288014
La Rioja	11	0.005902	0.004645	0.007159	0.026478	0.240989
Madrid	5	0.004092	0.003792	0.004392	0.020916	0.241101
Murcia	3	0.003888	0.003480	0.004296	0.022487	0.280393
Navarre	1	0.003084	0.002486	0.003682	0.017655	0.236990
Rest of the country	6	0.004405	0.004254	0.004556	0.025640	0.286439
SPAIN		**0.005897**	**0.005797**	**0.005996**	**0.029127**	**0.294643**
Area I: Significantly lower than the Spanish BC^a index						
Area II: Around the Spanish BC^a index						
Area III: Significantly higher than the Spanish BC^a index						

Source: Own elaboration from PISA 2009 data

Table 11 BC^a index, 95% confidence intervals, intensity and incidence of educational poverty of the female students in Spain by regions in 2009

Female			2009			
Region	**Ranking**	**Index**	**95% Confidence interval**		**Intensity**	**H = q/n**
Andalusia	14	0.009494	0.009166	0.009823	0.040515	0.374112
Aragon	6	0.003031	0.002647	0.003414	0.016908	0.222741
Asturias	12	0.005470	0.004584	0.006356	0.024501	0.229560
Balearic Islands	13	0.009164	0.008064	0.010265	0.039616	0.392027
Basque Country	1	0.002122	0.001864	0.002380	0.012434	0.160463
Canary Islands	15	0.010272	0.009700	0.010844	0.052226	0.500100
Cantabria	8	0.004049	0.003351	0.004747	0.021206	0.265305
Castile and Leon	3	0.002623	0.002305	0.002941	0.012900	0.167996
Castile-La Mancha						
Catalonia	7	0.003385	0.003219	0.003551	0.018966	0.230200
Ceuta and Melilla	16	0.023514	0.020150	0.026877	0.091685	0.585083
Comunidad Valenciana						
Extremadura						
Galicia	4	0.002776	0.002544	0.003009	0.017049	0.225567
La Rioja	10	0.004518	0.003417	0.005619	0.022655	0.222732
Madrid	2	0.002487	0.002321	0.002652	0.014454	0.224421
Murcia	11	0.004916	0.004480	0.005351	0.026286	0.297775
Navarre	5	0.002815	0.002226	0.003404	0.015275	0.187384
Rest of the country	9	0.004400	0.004240	0.004560	0.025504	0.310481
SPAIN		**0.005180**	**0.005083**	**0.005277**	**0.025843**	**0.286870**
Area I: Significantly lower than the Spanish BC^a index						
Area II: Around the Spanish BC^a index						
Area III: Significantly higher than the Spanish BC^a index						

Source: Own elaboration from PISA 2009 data

See Figures 6, 7, 8, 9, 10, 11 and 12.

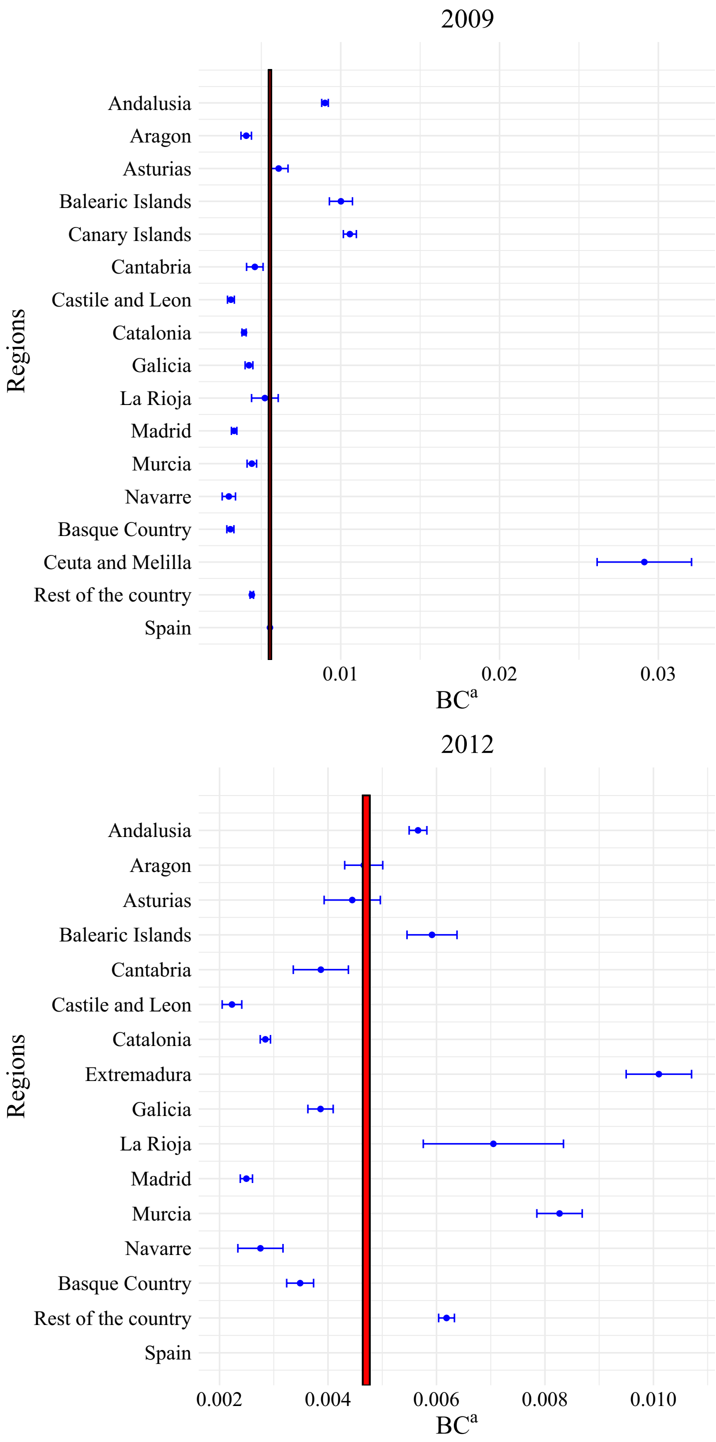

Fig. 6 BC^a index with 95% confidence intervals in Spain by regions in 2012 and 2009 Source: Own elaboration from PISA 2012 and PISA 2009 data

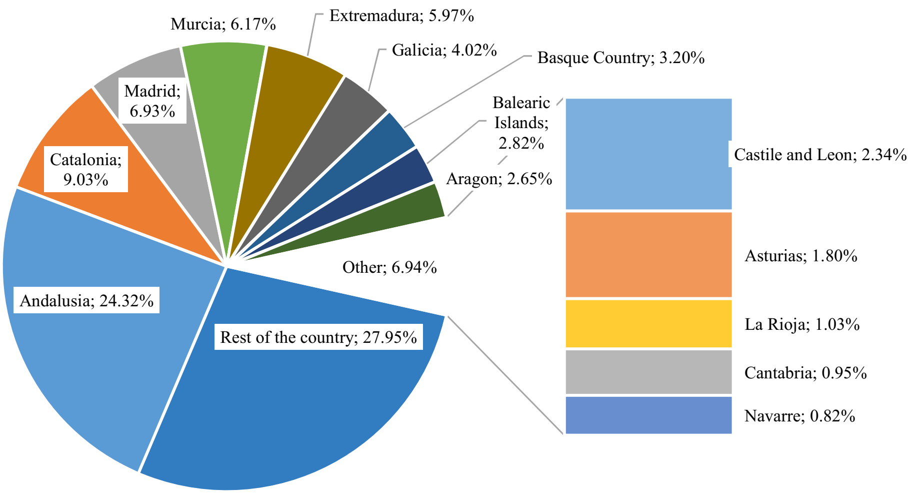

Fig. 7 Decomposition of national educational poverty in Spain by regions in 2012 Source: Own elaboration from PISA 2012 data

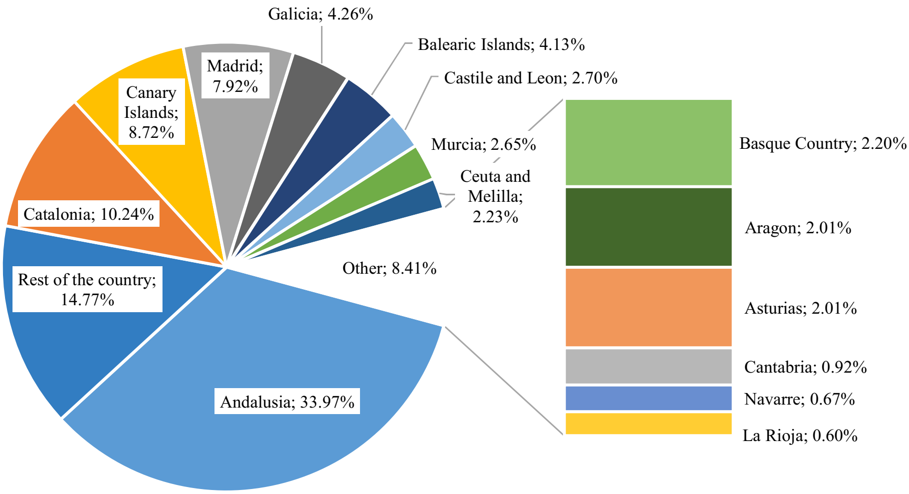

Fig. 8 Decomposition of national educational poverty in Spain by regions in 2009 Source: Own elaboration from PISA 2009 data

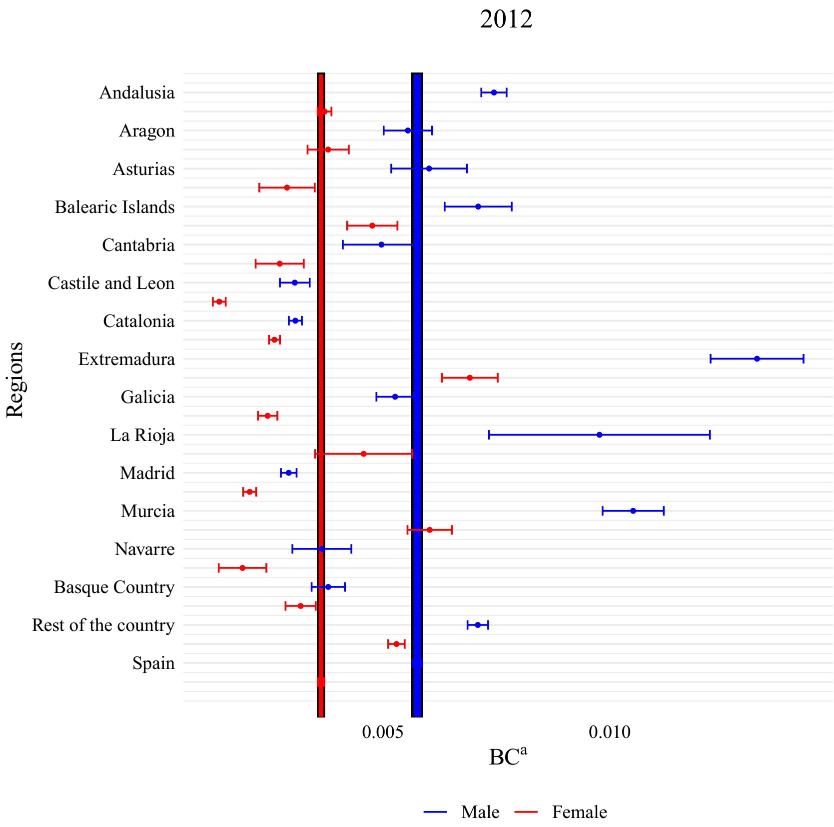

Fig. 9 BC[a] index with 95% confidence intervals in Spain by gender and regions in 2012 Source: Own elaboration from PISA 2012 data

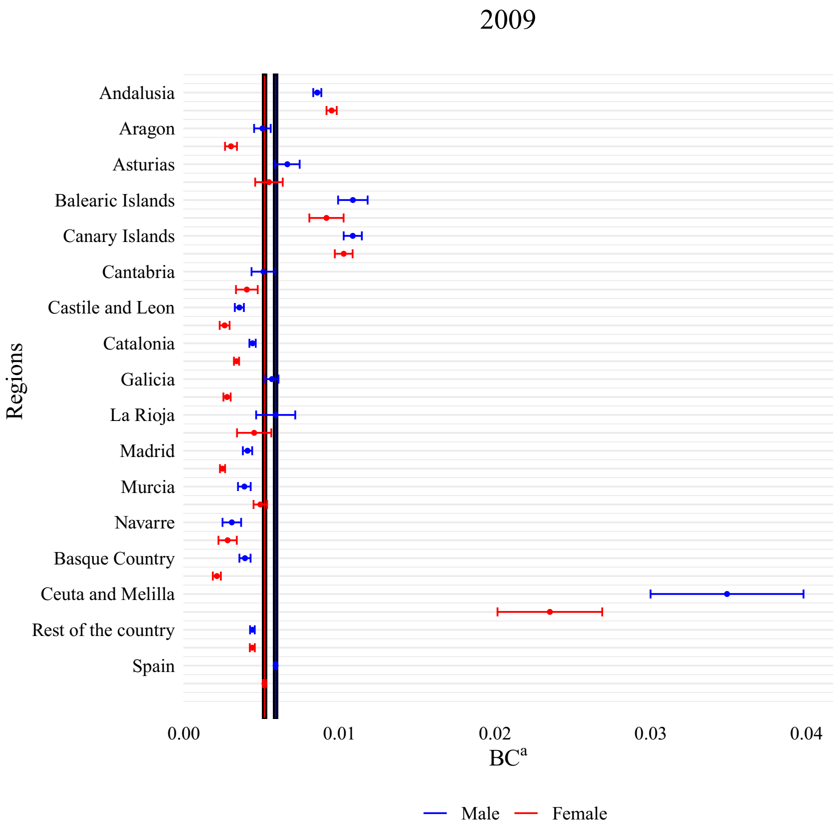

Fig. 10 BC[a] index with 95% confidence intervals in Spain by gender and regions in 2009 Source: Own elaboration from PISA 2009 data

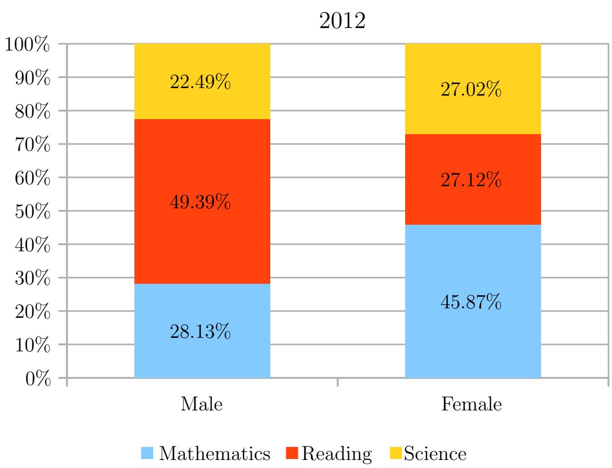

Fig. 11 Decomposition of national educational poverty in Spain by subjects and gender in 2012 Source: Own elaboration from PISA 2012 data

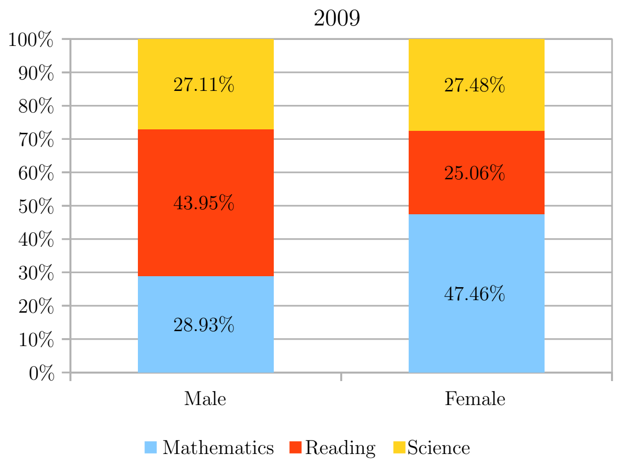

Fig. 12 Decomposition of national educational poverty in Spain by subjects and gender in 2009 Source: Own elaboration from PISA 2009 data

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