

IBERIAN SOCIO-ECONOMIC CHARACTERISATION IN 2019 BASED ON POPULATION AND GROSS DOMESTIC PRODUCT DATA.

FLORES-POLAN, María Gema*
DE LA MACORRA, Luis Fernando

Abstract. Our study addresses a clustering procedure that allows consistent results to be obtained on the basis of the variables investigated. We infer that the large disparities in area and population are congruent with those in production. Population is evenly distributed by region and area, especially within the clustered regions, which supports the desirability of regional groupings. In our analysis of intra-group and inter-group inequalities with respect to GDP per capita for the regional groupings analysed, the total relative redundancy indicator suggests that GDP per capita is very similar for the different regional areas, as its value is close to zero. The within-area disparity is greater than the between-area disparity, although the values are low and there is not much difference between the two. The institutional and administrative map has an impact, as well as the asymmetry of the individual distribution of each variable in the territory.

Keywords: regional inequalities, Iberian economy, inter-group and intra-group disparities.

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Caracterización socioeconómica ibérica en 2019 a partir de datos de población y producto interior bruto¹

Resumen: Nuestro estudio aborda un procedimiento de agrupación, caracterizado por regiones, grupos de regiones y estados en el conjunto ibérico, que permite la obtención de resultados consistentes sobre la base de las variables investigadas. Inferimos que las grandes disparidades en área y población son congruentes con las de la producción. La población está distribuida uniformemente por regiones y áreas, especialmente dentro de las regiones conjuntadas, lo que respalda la conveniencia de las agrupaciones regionales. En nuestro análisis de las desigualdades intragrupo e intergrupo, con respecto al PIB per cápita para las agrupaciones regionales analizadas, el indicador de redundancia relativa total sugiere que el PIB per cápita es muy similar para las distintas áreas regionales, ya que su valor es cercano a cero. La disparidad dentro del área es mayor que la disparidad entre áreas, aunque los valores son bajos y no hay mucha diferencia entre ambos. Incide el mapa institucional y administrativo, así como la asimetría de la distribución individual de cada variable en el territorio. Palabras clave: desigualdades regionales, economía ibérica, disparidades intergrupales e intragrupales.

*María Gema Flores-Polan, E-mail: gflores@unex.es; Luis Fernando de la Macorra y Cano, e-mail jmacorra@unex.es. Faculty of Economics and Business Administration, University of Extremadura, Badajoz, Spain

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1.Introduction

The Regional Economy reviewed² for the work presented offers us an independent spatial vision by states, on the one hand, Spain, on the other, Portugal and, in isolation, Andorra. Our study shows an integrated analysis based on the aggregation of all the regions as a whole. This aggregation is materialised through the formation of six adjoining spatial areas, for linguistic, geographical and cultural reasons.

Once the different groupings have been delimited at NUTS3 level, we proceed to contrast the virtual population that each and every one of these areas and regions should have if they obeyed an average pattern of demographic density, with the real populations. We also compare the virtual GDP with the real GDP, at national, area and regional level.

1.1 Objectives

Our main objectives are, firstly, to reorganise the Iberian space universe by regions, groups of regions and states, in favour of Iberianism. And, secondly, to measure inter-group and intra-group inequalities in the regional areas considered.

1.2 Methodology

The Iberian spatial universe is made up of three scales: state, where we distinguish the Kingdom of Spain, the Portuguese Republic and, as a novelty, the Principality of Andorra. The different regional groups and areas make up the second scale. And thirdly, we find each of the Iberian regions, which make up the third scale.

The different regional groups and areas are agglomerated according to their geographical contiguity. The cultural identity and the linguistic richness of the indigenous or co-official languages spoken in these regions are also determining factors in the formation of the different areas. Namely:

- Galician-Portuguese area: West of the Iberian Peninsula. The Spanish región of Galicia and the Portuguese regions of Alentejo, Lisbon Metropolitan Area, Norte , Centro, Algarve.
- Castile and neighboring regions: Center of the Iberian Peninsula including Castile-La Mancha, Castile and Leon, Extremadura, Community of Madrid, and Northern regions situated in Central-Western area (Cantabria, Principality of Asturias and La Rioja).

² From the reviewed articles, we have identified different regional, provincial-district and state spatial scales (Vázquez-Varela, Martínez-Navarro, 2020; Coimbra; Ramos, 2008; Serrano Martínez, 1987); different time periods (Silva, 2011; Serrano Martínez, 2001); different explained variables, such as economic growth, productivity or disposable income (Guisán, 2017; Cuadrado Roura, Garrido Yserte y Mancha Navarro, 1999; Melchor-Ferrer, 2017 and 2020; Silva, 2011, clau y Perugini, 2010; Ezcurra, 2010); analyses with different methodologies (Pachura, 2010), such as absolute or conditional convergence (Cuadrado Roura, Garrido Yserte y Mancha Navarro, 1998 and 1999; Viegas, 2003; Rodríguez López, et al., 2009), either by statistical procedures, spatial econometrics (Márquez y Lasarte, Domingues, 2014; Vázquez-Varela et al., 2020; Melchor-Ferrer, 2017; Ezcurra, 2004; Oliveira Soares, 2001) or clustering (Pachura, 2010; Melchor-Ferrer, 2017), and others that also consider EU regional state policy (López Frías, 2021; Lima da Silveira, 2020, Ezcurra, 2010; Gomis-Porqueras y Garcilaso, 2003) or even construct a synthetic development index (Holgado Molin,a et al., 2014; Mourao, 2004).

- Levante Area. East of the Iberian Peninsula: Andorra, Catalonia, Aragon, Community of Valencia, and the Eastern Islands (Balearic Islands).
- Iberian Macaronesia: Far West islands of Spain (Canary Islands) and Portugal (R.A. of Madeira, R.A. dos Açores)
- Southern: Region of Murcia, Andalusia.
- Vasco-Navarra: Northern regions situated in Central-Eastern area of the Iberian Peninsula: País Vasco, Comunidad Foral de Navarra.

The temporal reference of analysis in our work is the relatively recent date of 2019, for which official regional statistical information is available.

1.3

1.4 Structure

The objectives will be achieved through the completion of a systematic approach, structured in seven sections.

Sections 2 to 5 report the Iberian characterisation and the analysis of inequalities at the most recent date for which information is available (2019). Section 6 will measure intra and inter group inequalities in 2019.

The different sections consecutively delimit a structural characterisation of the baseline spatial universe following a classical geographical and socio-economic approach. Therefore, Section 2 considers the surface area divergences on the different scales. Section 3 addresses population inequalities, and, in Section 4, we go on to infer what the virtual populations would be if the spatial distribution was to remain unchanged. In Section 5, we look at the divergences of the basic magnitudes summarizing economic activity: GDP and the GDP per capita. Finally, section 6 makes a distinction between intra-group and inter-group inequalities, depending on the different regional areas.

2. Surface Area

The Iberian states (the Portuguese Republic, the Principality of Andorra and the Kingdom of Spain) are located in southwestern Europe, occupying most of the Iberian Peninsula, three Atlantic archipelagos (the Autonomous Region of Madeira, the Autonomous Region of the Azores and the Canary Islands), one Mediterranean archipelago (the Balearic Islands) and some autonomous cities such as Ceuta and Melilla, including islets and rocks. Our analysis does not account for either the territory of Gibraltar, despite Spain's fin-de-siècle claim against the United Kingdom, or the autonomous cities of Ceuta and Melilla, not as an affront to Spanish sovereignty, but because they could, due to their small size, distort the statistical calculations.

With the above exceptions, the surface area occupied by the three Iberian States is 598,653.61 square kilometres. Of this surface area, 84.5% corresponds to the Kingdom of Spain, 15.4% to the Portuguese Republic and a tiny percentage, of less than 1%, to the Principality of Andorra, the land area of the Portuguese Republic being almost a fifth of that of the Kingdom of Spain (see Table 1).

Table 1. Surface area of the Iberian States. 2019.

STATES	Area (km²)	Percentage (%)
Spain	505960.00	84.52
Portugal	92225.61	15.40
Andorra	468.00	0.08
IBERIAN TOTAL	598653.61	100

Source: INE Spain, INE Portugal, Departament d'Estadística de Andorra and own elaboration.

These state surface areas are unevenly distributed taking into account each and every one of the Iberian regions, plus the Principality of Andorra (where, with a value of 0.3968, the complement to unity of relative redundancy by states corroborates that their surface areas are very unequal)³ (see Table 2).

Table 2. Surface area of Iberian regions: Andorra, Spain and Portugal. 2019.

IBERIAN REGIONS	Área (km²)	Percentage (%)
Alentejo	31604.90	5.28
Algarve	4996.79	0.83
Andalusia	87600.00	14.63
Andorra	468.00	0.08
Aragon	47720.00	7.97
Lisbon Metropolitan Area	3015.24	0.50
Canary Islands	7447.00	1.24
Cantabria	5321.00	0.89
Castile and León	94224.00	15.74
Castile La Mancha	79462.00	13.27
Catalonia	32113.00	5.36
Central Region of Portugal	28199.35	4.71
Madrid (Community)	8028.00	1.34
Navarre(Chartered Community)	10391.00	1.74
Valencian Community	23255.00	3.88
Extremadura	41635.00	6.95
Galicia	29575.00	4.94
Balearic Islands	4992.00	0.83
Rioja (La)	5045.00	0.84
Northern Region of Portugal	21285.86	3.56
Basque Country	7234.00	1.21
Principality of Asturias	10604.00	1.77
Madeira (AR)	801.51	0.13
Azores (AR)	2321.96	0.39
Murcia (Region of)	11314.00	1.89
IBERIAN TOTAL	598653.61	100.00

Source: INE Spain, INE Portugal, Departament d'Estadística de Andorra and own elaboration. Note: AR = Autonomous Region of Portugal.

³ The bounds of the complement to unity of relative redundancy are zero and one, where maximum inequality is achieved as the value gets closer to zero and maximum equality as it approaches unity.

As Table 2 above shows, three Spanish autonomous communities (Castile and León, Andalusia and Castile La Mancha) alone account for the largest share (44%) of the total. If we add Aragon and Extremadura, which are the next largest autonomous communities, together they would represent 60% of the total Iberian surface area. Finally, by adding, in order of size, Catalonia, Alentejo, Galicia and the Central Region of Portugal, we would have 80% of the totality. The remaining 20% is distributed across other autonomous communities and regions and the Principality of Andorra.

According to our calculations, the regions and autonomous communities are fairly equal in terms of surface area, with the complement to unity of the relative redundancy yielding a value of 0.8339, which, of course, is very close to one (maximum equality)⁴. The exceptions are the Autonomous Communities of Castile and León, Andalusia and Castile La Mancha, which are larger, and the regions of Lisbon, the Azores, Madeira and the Principality of Andorra, which are smaller.

Table 3 shows the results of our calculations for the regions aggregated, as detailed in Section 1, by Iberian areas.

Table 3. Surface area by areas. 2019.

AREAS	Area (km²)	Percentage (%)
Galician-Portuguese area	118677.14	19.82
Castile and neighbouring regions	244319	40.81
Levante area	108548	18.13
Iberian Macaronesia	10570.47	1.77
South	98914	16.52
Basque-Navarre	17625	2.94
IBERIAN TOTAL	598653.61	100.00

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

Three regional areas account for a similar percentage of the total surface area (the Galician-Portuguese, South and Levante areas). Another two areas, namely Iberian Macaronesia, which includes all the Atlantic archipelagos, and the Basque-Navarre area, which represents a small percentage of the mainland surface area, account for less than 5% of the total surface area, whereas the area of Castile alone accounts for almost 41% of the total Iberian land area. Although the equalities are clearly still quite high, they are slightly lower in this case. According to our calculations, the complement to the unity of relative redundancy is now calibrated at a value of 0.8197, again close to one.

3. Population

The Iberian states had a population of 57,121,702 in 2019, of which practically 82% lived in Spain, almost 18% resided in Portugal, and only 77,543 inhabitants dwelled in the Principality of Andorra, as shown in Table 4. Clearly, this is a very uneven

⁴ Ibid.

population distribution, and the result of 0.4381 that we calculated for the complement to the unity of the relative redundancy is logical.

Table 4. Population of the Iberian states. 2019.

STATES	Population	Percentage (%)
Spain	46767542	81.87
Portugal	10276617	17.99
Andorra	77543	0.14
IBERIAN TOTAL	57121702	100.00

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

Table 5. Population of the Iberian regions. 2019.

IBERIAN REGIONS	Population	Percentage (%)
Alentejo	705478	1.24
Algarve	438864	0.77
Andalusia	8427405	14.75
Andorra	77543	0.14
Aragon	1320586	2.31
Lisbon Metropolitan Area	2846332	4.98
Canary Islands	2206901	3.86
Cantabria	581641	1.02
Castile and León	2407733	4.22
Castile La Mancha	2034877	3.56
Catalonia	7566431	13.25
Central Region of Portugal	2216569	3.88
Madrid (Community of)	6641649	11.63
Navarre (Chartered Community)	649946	1.14
Valencian Community	4974969	8.71
Extremadura	1065424	1.87
Galicia	2700441	4.73
Balearic Islands	1188220	2.08
Rioja (La)	313571	0.55
Northern Region of Portugal	3572583	6.25
Basque Country	2177880	3.81
Asturias (Principality)	1022205	1.79
Madeira (Autonomous Region)	253945	0.44
Azores (Autonomous Region)	242846	0.43
Murcia (Region of)	1487663	2.60
IBERIAN TOTAL	57121702	100

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

State populations are distributed differently across Iberian regions (see Table 5), with just three Spanish autonomous communities (Andalusia, Catalonia and Madrid) accounting for almost 40% of the total population. If we add Valencia, the Northern region and Lisbon, which are the next largest in terms of population, they together account for 60% of the

Iberian population. They are home to the major Iberian cities, namely Madrid, Barcelona, Valencia, Lisbon, Seville and Oporto. Then if we add Galicia, Castile and León, Central Spain, the Canary Islands and the Basque Country, again in order of size, we would have accounted for 80% of the total population. The remaining 20% is distributed across other autonomous communities and regions and the Principality of Andorra. Regional population inequality is low, as the complement of redundancy yields a value of 0.8672.

Table 6. Population of the Iberian areas.

AREAS	Population	Percentage (%)
Galician-Portuguese area	12480267	21.85
Castile	14067100	24.63
Levante area	15127749	26.48
Iberian Macaronesia	2703692	4.73
South	9915068	17.36
Basque Country	2827826	4.95
IBERIAN TOTAL	57121702	100.00

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

If we distribute the population by study areas for analysis, we find that there are four areas with relatively close percentage population values, namely the Galician-Portuguese, Castile, Levante and South areas, which, together, account for almost all (about 90%) of the population of the Iberian states, whereas the remaining 10% is redistributed between the Iberian Macaronesia and Basque-Navarre areas with a significantly smaller population. These areas are very equal in terms of population, as the complement to the unity of relative redundancy is very close to one (0.9077). We believe that this result supports our proposal to group the regions by areas, as they are fairly homogeneous in terms of population.

4. Virtual population

Virtual populations are calculated by redistributing the total population for all Iberian states (57,121,702) by states, regions and regional areas, according to the percentage of surface area that they represent with respect to the total Iberian land area. This would output a virtually homogenous population density for the Iberian territory corresponding to the total average population density, namely, 95.42 inhabitants per square kilometre. We compared the resulting virtual populations with the real populations for both states, regions and regional areas, where values greater than one mean that the respective territory should be more or much more populated, and values less than one signify that this territory is overpopulated, and population should move out to other underpopulated or practically empty territories (see Tables 7, 8 and 9). To round out our analysis, we again run through the results for the different scales of analysis addressed.

4.1.Virtual state populations. As Table 7 shows, Spain is slightly underpopulated⁵, and Portugal is slightly overpopulated⁶ within the Iberian context. Finally, the Principality of Andorra has an oversized population, since the ratio of the virtual to the real population of the Principality of Andorra is 0.57.

Table 7. State virtual populations.

STATES	Population	Virtual population	Virtual pop. /Real pop.
Spain	46767542	48277160.38	1.0322
Portugal	10276617	8799886.484	0.8563
Andorra	77543	44655.13293	0.5758
TOTAL STATES	57121702	57121702	

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

4.2.Virtual populations by region

The state virtual populations are redistributed into regional virtual populations as shown in Table 8.

Looking at the results, we find that some regions, like Alentejo, Castile and León, Extremadura, Castile La Mancha and Aragon, are in need of a massive population increase because their virtual to real population ratios are 3.4 and above. These regional territories, and especially some subregions, which are practically empty or extremely underpopulated, require public system operating costs and offer very few incentives for private investment.

On the other hand, regions like La Rioja, Navarre and Central Portugal have need of only a slight increase of their population. The population of another group of five regions, such as Algarve, Galicia, Andalusia, Asturias and the Azores, could remain more or less unchanged, since the ratio of their virtual to real population is very close to one. This also applies to Cantabria and Murcia, albeit to a lesser extent.

Since the values of the ratio of the virtual population to real population are less than 0.57, the population of the remaining Iberian regions and autonomous communities and the Principality of Andorra need to be reduced by a large or very large amount. In some very extreme cases, like the Autonomous Community of Madrid or the Lisbon Metropolitan Area, the ratio values are 0.11 or 0.10, which gives an idea of just how oversized their populations are and is an indicator of the very high congestion costs in these regions.

⁵ It has a value 1.0322, which means that its population should be increased slightly from 46,767,542 to 48,277,160 inhabitants.

⁶ It has a value of 0.856, which indicates that its population should be reduced from 10,276,617 to 8,799,886 inhabitants.

Table 8. Virtual populations by region. 2019.

REGIONS	Population	Virtual populations	Virt. Pop. /Real Pop.
Alentejo	705478	3015643.1856	4.2746
Algarve	438864	476778.4652	1.0864
Andalusia	8427405	8358524.8825	0.9918
Andorra	77543	44655.1329	0.5759
Aragon	1320586	4553296.8881	3.4479
Lisbon Metropolitan Area	2846332	287705.0065	0.1011
Canary Islands	2206901	710570.0320	0.3220
Cantabria	581641	507713.5947	0.8729
Castile and León	2407733	8990566.7641	3.7340
Castile La Mancha	2034877	7582021.7376	3.7260
Catalonia	7566431	3064124.5383	0.4050
Central Region of Portugal	2216569	2690695.9891	1.2139
Madrid (Community of)	6641649	766007.2803	0.1153
Navarre (Chartered Community)	649946	991477.5349	1.5255
Valencian Community	4974969	2218921.1888	0.4460
Extremadura	1065424	3972684.7430	3.7287
Galicia	2700441	2821956.3174	1.0450
Balearic Islands	1188220	476321.4180	0.4009
Rioja (La)	313571	481378.5164	1.5351
Northern Region of Portugal	3572583	2031031.8545	0.5685
Basque Country	2177880	690246.2215	0.3169
Asturias (Principality of)	1022205	1011801.3454	0.9898
Madeira (AR)	253945	76477.6402	0.3012
Azores (AR)	242846	221554.3429	0.9123
Murcia (Region of)	1487663	1079547.3804	0.7257
IBERIAN TOTAL	57121702	57121702	

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

4.3. Virtual populations by regional areas

We grouped the regional results by different areas to compile Table 9, which reports the analysis on a different scale.

Table 9. Virtual populations by area. 2019.

AREAS	Population	Virtual populations	Virt. pop./real pop.
Galician-Portuguese	12480267	11323810.82	0.9073
Castile and neighbouring	14067100	23312173.98	1.6572
Levante	15127749	10357319.17	0.6847
Iberian Macaronesia	2703692	1008602.015	0.3730
South	9915068	9438072.263	0.9519
Basque-Navarre	2827826	1681723.756	0.5947
IBERIAN TOTAL	57121702	57121702	

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

With the exception of Asturias and Cantabria, regions whose population could remain practically unchanged, and, of course, Madrid, whose population needs to be reduced considerably, Castile is an empty area. Although there is slight overpopulation, the population of South area is very much aligned with its potential population. The Galician-Portuguese area as a whole has a slightly larger population than it should have, although there are areas, like Alentejo, which are very underpopulated, others, like Central Portugal, which are slightly underpopulated, and others again are overpopulated, for example, Northern Portugal, especially along the coast. With the exception of the region of Aragon, Levante is an overpopulated area. There is overpopulation in the Basque-Navarre area, more so in the Basque Country than in Navarre. Finally, as far as Macaronesia is concerned, the Canary Island and Madeira archipelagos are overpopulated, while the population density in the Azores is near perfect.

5. Production and production per capita

5.1. Production

Gross domestic product is the magnitude that summarizes the economic activity of any territory in a given year. As Table 10 shows, the value of total production for the three Iberian states is 1.456 billion euros, of which 85% corresponds to the state with the largest surface area and population, namely, Spain, at 85.17%, whereas Portugal's stake is also in line with its share of the population and surface area, accounting for 14.64% of total production. Lastly, at under 2 thousandths of total production, the Principality of Andorra has a negligible portion (which is again proportional to its relative population weight).

Table 10. Production of the Iberian states. 2019.

STATES	GDP (millions)	Percentage (%)
Spain	1240198.704	85.17
Portugal	213150.5197	14.64
Andorra	2818.222792	0.19
TOTAL STATES	1456167.446	100

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

According to our calculations, these production values are redistributed by areas as follows: Castile and Levante each account for about a third. Added together, the Galician-Portuguese area and the South would amount to almost another third. On the other hand, the share the Basque-Navarre area is smaller, at 6.5%, and Macaronesia is even smaller, at less than 4% (see Table 11).

Table 11. Production in Iberian areas. 2019.

AREAS	GDP (millions)	Percentage (%)
Galician-Portuguese	268041.9332	18.41
Castile and neighbouring regions	410240.823	28.17
Levante	427491.1497	29.36
Iberian Macaronesia	56702.70027	3.89
South	198221.3108	13.61
Basque-Navarre	95469.52925	6.56
IBERIAN TOTAL	1456167.446	100

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

The regions within the different areas have a very unevenly distributed share of GDP. Accordingly, the Lisbon Metropolitan Area, the Northern region and Galicia account for the largest, more or less evenly split, shares of the Galician-Portuguese area, whereas the share of Central Portugal is somewhat lower, and the Algarve and Alentejo have a more or less negligible share (see Table 12).

For its part, the area of Castile benefits from the huge contribution of the Autonomous Community of Madrid, which boasts the largest share of the Iberian regions, at 16.5% of total production, while the shares of Castile and León and less so Castile La Mancha are quite substantial, with the remaining regional shares being insignificant.

In the Levante area, Catalonia is another region with a major share in the Iberian GDP with a hefty 16.2%. The Valencian Community also accounts for a sizeable portion at 8%, whereas other regions, such as Aragon and the Balearic Islands, have a more modest stake. Finally, the Principality of Andorra's cut is negligible.

As far as Iberian Macaronesia is concerned, the Canary Islands has the largest share, with the Autonomous Regions of Madeira and Azores having a very small stake.

In the South, Andalusia stands out by sheer size and population, with a substantial share of 11.4%, which highlights its importance within the Iberian GDP, where the figure for Murcia is considerably lower.

Finally, it is the Autonomous Community of the Basque Country that accounts for the biggest share of GDP in the Basque-Navarre area.

Clearly, the internal composition of each and every one of these Iberian areas varies from one region to another.

Table 12. Production in the Iberian regions. 2019.

REGIONS	GDP (millions)	Percentage (%)
Alentejo	13408.42774	0.92
Lisbon Metropolitan Area	76767.59494	5.27
Northern Region	63279.16203	4.35
Central Region	39999.20672	2.75
Algarve	10157.63894	0.70
Galicia	64429.90283	4.42
Castile La Mancha	42820.22194	2.94
Castile and León	59794.82111	4.11
Extremadura	20676.91796	1.42
Madrid (Community)	240129.7494	16.49
Cantabria	14187.41054	0.97
Asturias (Principado de)	23765.12138	1.63
Rioja (La)	8866.580632	0.61
Andorra	2818.222792	0.19
Catalonia	236814.3844	16.26
Aragon	38044.03575	2.61
Valencian Community	116015.2323	7.97
Balearic Islands	33799.27437	2.32
Madeira (AR)	5069.440549	0.35
Canary Islands	47164.21093	3.24
Azores (AR)	4469.048797	0.31
Murcia (Region of)	32356.07518	2.22
Andalusia	165865.2356	11.39
Basque Country	74496.01881	5.12
Navarre (Chartered Community of)	20973.51044	1.44
IBERIAN TOTAL	1456167.446	100

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

5.2.Virtual gross domestic product

To further our research, we also calculated virtual GDPs for the Iberian states, areas and regions. To do so, we multiplied the respective virtual populations by the average Iberian GDP per capita (25,492.368 euros per inhabitant).

According to our calculations, Spain's GDP should be slightly lower and Portugal's slightly higher than they really are. However, the Principality of Andorra's real GDP far exceeds its virtual GDP. Banking secrecy within its financial system has undoubtedly favoured this excess.

These virtual populations are distributed differently by Iberian areas and regions, as shown in Table 13. There are some areas, such as Iberian Macaronesia, Levante or the Basque-Navarre area, whose GDP should be lower. On the other hand, others, such as the South, and especially Castile, should have a higher GDP. Finally, the value of the real GDP of the Galician-Portuguese area is more or less equal to its virtual GDP.

Table 13. Virtual GDP by Iberian regions grouped by areas. 2019.

IBERIAN REGIONS (by areas)	Virtual GDP	Virtual GDP/Real GDP
Galician-Portuguese	288670.7521	1.08
Alentejo	76875.88574	5.73
Lisbon Metropolitan Area	7334.28189	0.10
Northern Region	51775.81138	0.82
Central Region	68592.21224	1.71
Algarve	12154.21207	1.20
Galicia	71938.34882	1.12
Castile	594282.5172	1.45
Castile La Mancha	193283.6881	4.51
Castile and León	229190.8362	3.83
Extremadura	101273.1413	4.90
Community of Madrid	19527.33945	0.08
Cantabria	12942.82178	0.91
Principality of Asturias	25793.2122	1.09
La Rioja	12271.47827	1.38
Levante	264032.5913	0.62
Andorra	1138.36508	0.40
Catalonia	78111.79022	0.33
Aragon	116074.3197	3.05
Valencian Community	56565.55543	0.49
Balearic Islands	12142.56086	0.36
Iberian Macaronesia	25711.6537	0.45
Autonomous Region of Madeira	1949.596144	0.38
Canary Islands	18114.11272	0.38
Autonomous Region of the Azores	5647.944833	1.26
South	240598.811	1.21
Region of Murcia	27520.21906	0.85
Andalusia	213078.592	1.28
Basque-Navarre	42871.12081	0.45
Basque Country	17596.01066	0.24
Chartered Community of Navarre	25275.11015	1.21
IBERIAN TOTAL	1456167.446	1

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

A more detailed analysis of the regions reveals a wider diversity, and we find regions, such as Alentejo, Castile La Mancha, Castile and León or Extremadura, whose real GDP falls a very short of their virtual GDP, whereas the real GDP of others, such as the Lisbon Metropolitan Area or the Community of Madrid, is considerably higher than their virtual

GDP. Between these two extremes, there is a wide diversity of values, as shown in Table 13 above.

Table 14. Virtual GDP by Iberian States. 2019.

STATES	Virtual GDP	Virtual GDP/Real GDP
Spain	1230699.14	0.99
Portugal	224329.944	1.05
Andorra	1138.36508	0.40
TOTAL STATES	1456167.45	1

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

5.3. Production per capita

GDP per capita is an economic measure for comparing the status and level achieved by different territories. According to our calculations, the Iberian average GDP per capita is 25,492 euros, ranging from such huge values as 36,344 euros for the Principality of Andorra, to lower and more average values for Portugal and Spain (see Table 15).

Table 15. GDP per capita by Iberian States. 2019.

STATES	GDP per capita
Spain	0.026518364
Portugal	0.020741312
Andorra	0.036344
TOTAL STATES	0.025492368

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

We now analyse the different Iberian areas (see Table 16). The highest values are for the Basque-Navarre area, Levante and Castile. The Autonomous Community of Madrid has a large bearing on the values for Castile, and the high values of Catalonia and the Principality of Andorra, on Levante.

The figures for the other areas (South, Iberian Macaronesia or the Galician-Portuguese area) are lower, as shown in Table 16. The most developed region in the latter areas would be the Lisbon Metropolitan Area⁷.

⁷ As pointed out by Juan José Salvador Barrios in the article: *Economic Integration and Regional Business Cycles: Evidence from the Iberian Regions, a process of Iberian economic integration in the EU*, has been at work since 2000, and the key factors explaining the regional business cycles are the relative size of the regions and their sectoral composition and distribution rather than the border effect between neighbouring regions of the countries, leading to a greater and better alignment of the pattern of these cycles.

Table 16. GDP per capita by Iberian regions. 2019.

IBERIAN REGIONS	GDP per capita
Galician-Portuguese	0.02147726
Alentejo	19006.16
Lisbon Metropolitan Area	26970.71
Northern Area	17712.44
Central Area	18045.55
Algarve	23145.30
Galicia	23859.03
Castile	0.029163141
Castile La Mancha	21043.15
Castile and León	24834.49
Extremadura	19407.22
Community of Madrid	36155.14
Cantabria	24392.04
Principality of Asturias	23248.88
La Rioja	28276.15
Levante	0.028258742
Andorra	36344.00
Catalonia	31298.03
Aragon	28808.45
Valencian Community	23319.79
Balearic Islands	28445.30
Iberian Macaronesia	0.020972322
Autonomous Region of Madeira	19962.75
Canary Islands	21371.24
Autonomous Region of the Azores	18402.81
South	0.02
Region of Murcia	21749.60
Andalusia	19681.65
Basque-Navarre	0.033760751
Basque Country	34205.75
Chartered Community of Navarre	32269.62
IBERIAN TOTAL	0.025492368

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

6. Intra- and inter-group inequalities in production per capita

In this section, we calculate several measures of inequality for the GDP per capita variable of the Iberian regions and areas, whose definition will successively help us to gauge the differences between these regions and areas better and more accurately.

First of all, Table 17 shows the results of calculating the general entropy⁸ without making a distinction between regional clusters. The result is 1.387239847. Assuming maximum

⁸ Entropy formula: $HN(x) = -\sum_{j=1}^N x_j \log x_j = \sum_{j=1}^N x_j \log \frac{1}{x_j}$, where, in our case, $N=25$, which represents the total number of Iberian regions.

equality between the Iberian regions, the maximum possible value would be would be $\log(25) = 1.39794$, already giving a good idea of just how close the Iberian regions are in terms of GDP per capita. However, as we see later, other indices will calculate this difference.

Table 17. Entropy of the Iberian regions. 2019.

IBERIAN REGIONS	Iberian GDP pc	Xj	Xj * log 1/Xj
Andalusia	19681.65	0.031644799	0.047457631
Extremadura	19407.22	0.031203566	0.046986198
Castile and León	24834.49	0.039929711	0.05584984
Castilla - La Mancha	21043.15	0.033833863	0.049757717
Galicia	23859.03	0.038361321	0.054323714
Region of Murcia	21749.60	0.034969713	0.05092667
Community of Valencia	23319.79	0.037494327	0.053468201
Aragon	28808.45	0.046319173	0.061800857
Principality of Asturias	23248.88	0.037380307	0.053355048
Cantabria	24392.04	0.039218318	0.055160997
Canary Islands	21371.24	0.034361371	0.050302625
Catalonia	31298.03	0.050322	0.065330139
La Rioja	28276.15	0.045463316	0.061027177
Chartered Community of Navarre	32269.62	0.051884149	0.066669331
Community of Madrid	36155.14	0.058131409	0.071826539
Basque Country	34205.75	0.054997124	0.069277679
Balearic Islands	28445.30	0.045735291	0.06127379
Alentejo	19006.16	0.030558731	0.046292342
Lisbon Metropolitan Area	26970.71	0.043364392	0.059099888
Northern Region	17712.44	0.028478644	0.044013194
A. R. of Madeira	19962.75	0.032096759	0.047937755
A. R. of the Azores	18402.81	0.029588648	0.04523734
Central Region	18045.55	0.029014221	0.044606146
Algarve	23145.30	0.037213774	0.053189509
Andorra	36344.00	0.058435072	0.072069518
	621955.25	0.941564928	1.387239847

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

Taking into account the grouping of the Iberian regions organised by areas, we calculate the difference between intra-group⁹ (or intra-area) and inter-group¹⁰ (or inter-area) entropy below. We observe that the differences between areas are greater than the differences between regions within the same area (0.7253... vs. 0.6619...). We also found that, as

⁹ Intra-group entropy = $\sum_{g=1}^k x_g H_g(Gg)$, where k is the total number of groups or areas (which is equal to six).

¹⁰ Inter-group entropy = $\sum_{g=1}^k x_g \log \frac{1}{x_g}$, where k is the total number of groups or areas (which is equal to six).

expected, the sum of the intra-group and inter-group entropies match the result of total entropy calculated and reported in Table 17 above for the unclustered regions.

Table 18.1. Intra-group and inter-group entropy of Iberian regions and areas. 2019

IBERIAN REGIONS	GDP per capita	Xj	1/Xj	log(1/Xj)	log(1/Xj) * Xj	Xg
Galician-Portuguese						0.2070
Alentejo	19006.16	0.0306	32.7239	1.5149	0.0463	
Lisbon Metropolitan Area	26970.71	0.0434	23.0604	1.3629	0.0591	
Northern Region	17712.44	0.0285	35.1140	1.5455	0.0440	
Central Region	18045.55	0.0290	34.4659	1.5374	0.0446	
Algarve	23145.30	0.0372	26.8718	1.4293	0.0532	
Galicia	23859.03	0.0384	26.0679	1.4161	0.0543	
Castile						0.2852
Castile La Mancha	21043.15	0.0338	29.5562	1.4706	0.0498	
Castile and León	24834.49	0.0399	25.0440	1.3987	0.0558	
Extremadura	19407.22	0.0312	32.0476	1.5058	0.0470	
Community of Madrid	36155.14	0.0581	17.2024	1.2356	0.0718	
Cantabria	24392.04	0.0392	25.4983	1.4065	0.0552	
Principality of Asturias	23248.88	0.0374	26.7521	1.4274	0.0534	
La Rioja	28276.15	0.0455	21.9958	1.3423	0.0610	
Levante						0.2383
Andorra	36344.00	0.0584	17.1130	1.2333	0.0721	
Catalonia	31298.03	0.0503	19.8720	1.2982	0.0653	
Aragon	28808.45	0.0463	21.5893	1.3342	0.0618	
Valencian Community	23319.79	0.0375	26.6707	1.4260	0.0535	
Balearic Islands	28445.30	0.0457	21.8650	1.3397	0.0613	
Iberian Macaronesia						0.0960
A.R. of Madeira	19962.75	0.0321	31.1558	1.4935	0.0479	
Canary Islands	21371.24	0.0344	29.1024	1.4639	0.0503	
R.A. of Azores	18402.81	0.0296	33.7968	1.5289	0.0452	
South						0.0666
Region of Murcia	21749.60	0.0350	28.5962	1.4563	0.0509	
Andalusia	19681.65	0.0316	31.6008	1.4997	0.0475	
Basque-Navarre						0.1069
Basque Country	34205.75	0.0550	18.1828	1.2597	0.0693	
Chartered Community of Navarre	32269.62	0.0519	19.2737	1.2850	0.0667	
	621955.25	1.0000	1.0000	0.0000	1.3872	

Table 18.2. Intra-group and inter-group entropy of Iberian regions and areas. 2019

IBERIAN REGIONS	log(1/Xg)	Xg* log(1/Xg)	Xj/Xg	1/Xj/Xg	Log (1/Xj/Xg)	Log (1/Xj/Xg) *Xj/Xg	Xg* Hg(Gg)
Galician- Portuguese	0.6840	0.1416				0.7727	0.1599
Alentejo			0.1476	6.7735	0.8308	0.1227	
Lisbon Metropolitan Area			0.2095	4.7733	0.6788	0.1422	
Northern Region			0.1376	7.2683	0.8614	0.1185	
Central Region			0.1402	7.1341	0.8533	0.1196	
Algarve			0.1798	5.5622	0.7452	0.1340	
Galicia			0.1853	5.3958	0.7321	0.1357	
Castile	0.5449	0.1554				0.8366	0.2386
Castile La Mancha			0.1186	8.4283	0.9257	0.1098	
Castile and León			0.1400	7.1416	0.8538	0.1196	
Extremadura			0.1094	9.1387	0.9609	0.1051	
Community of Madrid			0.2039	4.9054	0.6907	0.1408	
Cantabria			0.1375	7.2711	0.8616	0.1185	
Principality of Asturias			0.1311	7.6286	0.8824	0.1157	
La Rioja			0.1594	6.2723	0.7974	0.1271	
Levante	0.6229	0.1484				0.6945	0.1655
Andorra			0.2452	4.0781	0.6105	0.1497	
Catalonia			0.2112	4.7356	0.6754	0.1426	
Aragon			0.1944	5.1449	0.7114	0.1383	
Valencian Community			0.1573	6.3558	0.8032	0.1264	
Balearic Islands			0.1919	5.2105	0.7169	0.1376	
Iberian Macaronesia	1.0175	0.0977				0.4763	0.0457
A.R. of Madeira			0.3342	2.9924	0.4760	0.1591	
Canary Islands			0.3578	2.7952	0.4464	0.1597	
R.A. of Azores			0.3081	3.2461	0.5114	0.1575	
South	1.1764	0.0784				0.3005	0.0200
Region of Murcia			0.5250	1.9049	0.2799	0.1469	
Andalusia			0.4750	2.1051	0.3233	0.1536	
Basque-Navarre	0.9711	0.1038				0.3008	0.0322
Basque Country			0.5146	1.9434	0.2886	0.1485	
Chartered Community of Navarre			0.4854	2.0600	0.3139	0.1524	
	Inter Entropy	0.7253		Total Entropy	1.3872	Intra Entropy	0.6619

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

Besides, based on the operational equation¹¹, we have calculated both intra-group¹² (intra-area) and inter-group (inter-area) Theil indices¹³, as shown in Table 19. The total value of the Theil index is the sum of the Theil intra-group and inter-group indices. Likewise, this value (0.01070016) is the result, by definition, of subtracting the value of the total entropy calculated above from log (25). Next, as all of the index values (total, inter- or intra-group) are close to zero, they likewise reflect a maximum equality within and between the defined areas grouping the Iberian regions.

Table 19. Intra-group and inter-group Theil indices of the Iberian regions and areas. 2019.

AREAS	N	Ng/ g	Xg	Hg(G g)	log Ng	Xg/ Ng/N	Log [Xg/Ng/ N]	Log [Xg/Ng/ N] *Xg	log Ng - Hg(G g)	[log Ng - Hg(Gg)]* Xg	Tota ls
Galician- Portugues e	6	0.24	0.207 0	0.772 7	0.778 2	0.862 5	-0.0643	-0.0133	0.005 5	0.0011	
Castile	7	0.28	0.285 2	0.836 6	0.845 1	1.018 4	0.0079	0.0023	0.008 5	0.0024	
Levante	5	0.2	0.238 3	0.694 5	0.699 0	1.191 5	0.0761	0.0181	0.004 4	0.0011	
Iberian Macarone sia	3	0.12	0.096 0	0.476 3	0.477 1	0.800 4	-0.0967	-0.0093	0.000 8	0.0001	
South	2	0.08	0.066 6	0.300 5	0.301 0	0.832 7	-0.0795	-0.0053	0.000 5	0.0000	
Basque Navarre	2	0.08	0.106 9	0.300 8	0.301 0	1.336 0	0.1258	0.0134	0.000 2	0.0000	
		1	1.000 0				Inter- group Theil index	0.0060	Intra- group Theil index	0.0047	0.010 7
							Inter Theil r. i.	0.0043	Intra Theil r. i.	0.0034	0.007 7

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

Finally, we also calculated the Theil redundancy index, making a distinction between intra-group and inter-group values¹⁴. This is the best index for gauging and comparing the inequality of any magnitude, since its range of variation is in the 0-1 interval, where maximum equality is achieved by the value 0 and maximum inequality by the value of 1.

As the resulting total, intra-group and inter-group values (see Table 20) are quite close to zero, we are bound to infer that the GDP per capita between and within each of the different defined Iberian areas and regions is broadly equal.

¹¹ $T = \sum_{g=1}^k xg \log \frac{xg}{Ng/N} + \sum_{g=1}^k xg [\log Ng - Hg(Gg)]$, where the first summand is the inter-group Theil index and the second summand is the intra-group Theil index, and Ng is the number of regions in each area or group.

¹² Intra-group Theil index equation.

¹³ Theil index equation: $T = \log(N) - HN(x)$. Calculation of the Theil index based on entropy.

¹⁴ To calculate the Theil redundancy index, it suffices to divide the respective Theil indices by the logarithm of N, that is, in this case, by the logarithm of 25.

Table 20. Summary table of entropies, Theil indices and relative redundancies. 2019.

	Intra-group	Inter-group	Total
Entropy	0.66193963	0.725300217	1.387239847
Theil Index	0.005958808	0.004741354	0.010700162
Total redundancy	0.004262563	0.003391672	0.007654235

Source: INE Spain, INE Portugal, Departament d'Estadística d'Andorra and own elaboration.

6. Conclusions

Based on the objectives of this research, our conclusions will serve, firstly, to characterise the Iberian regions, areas and states and, secondly, to highlight the different intra-group and inter-group inequalities in the areas of Iberian regions.

The surface area of the three Iberian states is 598,653.61 square kilometres, which represents almost 6% of the total surface area of Europe and 14% of the expanse of the European Union¹⁵. The surface area of the Iberian states is rather unequal. The area of both the regions and the regional areas used in our study is more equal¹⁶. Six of the twenty-five regions alone account for 80% of the total surface area. As far as the areas are concerned, three (Galician-Portuguese, South and Levante) are very similar to each other, whereas the others are very unlike: Macaronesia and Basque-Navarre, are very small, and Castile, is very large, accounting for 40% of the total surface area.

The population of the three Iberian states in 2019 was 57,121,702 inhabitants, representing about 8% of the population of Europe, and almost 13% of the European Union¹⁷. The population of the states is, according to our calculations, uneven¹⁸. At 95 inhabitants per square kilometre, the average population density of the Iberian states is lower than the average for the EU, not including the United Kingdom (109 inhabitants per square kilometre), but greater than the average European population density (68 inhabitants per square kilometre). Clearly, the Iberian states are not among the most densely populated countries within the European Union, but are more densely populated on average than Europe as a whole. The population by region and by area is fairly equal¹⁹, even more so in the areas resulting from our regional groupings, which endorses their expediency²⁰.

¹⁵ European Union surface area: 4,237,473 and European land area: 10,530,751 (sources: Eurostat and www.cia.gov/the-world-factbook/ [06/02/2022] webpage, respectively), taking into account the European parts of Turkey and Russia and all of Cyprus.

¹⁶ Complement to the unity of relative redundancy: for states, 0.3968; for regions, 0.8339 and for areas, 0.8197.

¹⁷ We do not include the United Kingdom as part of the EU, because, although it left after 2019, it is now no longer a member country.

¹⁸ As the value of the Theil relative redundancy for the Iberian states is 0.5619.

¹⁹ The relative redundancy values for regions and areas are 0.1328 and 0.0923, respectively.

²⁰ Remember that the areas were clustered according to the criterion of geographical neighbourhood and linguistic and cultural proximity, including some nationalities and non-institutionalised nations within a pluri-state Iberia.

If we wanted to balance the population densities of the different Iberian areas even more evenly so that they all had the same average number of inhabitants²¹, there would have to be a huge increase in the populations of the Castile area. Others, such as the Macaronesia, Levante and Basque-Navarre populations, would have to be decreased, whereas the population of the remainder (Galician-Portuguese and South areas) could remain practically unchanged²².

The total production of the Iberian states is 1.456 billion euros, which is distributed very unequally across the three, again denoting the huge disparity in terms of surface area and population. By area, the Galician-Portuguese and South areas together account for a very similar percentage of production to that of Levante and Castile individually (around 30%). The remaining 10.5% is contributed by the Basque-Navarre and Macaronesia areas as a whole.

The improvement of inequalities between groups, with a consequent better level of development, would have been consolidated through the implementation of a sectoral, industrial and services policy that would have made more effective use of the enormous amount of European funds available to our states²³.

It is interesting to analyse the evolution of regional development in the Iberian regions and see a comparison with other European regions. Some links to interesting quantitative studies comparing GDP per capita, real wages, productivity of labour, employment rates and other indicators are included in Guisan and Aguayo(2022).

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²¹ This would mean that each and every area would have a population density of 95.41 inhabitants per square kilometre.

²² The ratios of virtual to real populations by areas is as follows: Galician-Portuguese area (0.9); Castile (1.65); Levante (0.68); Macaronesia (0.33); South (0.95) and Basque-Navarre (0.59).

²³ In this regard, see the work of Guisan, M. C. (2017). *Regional economic development in Spain, 1986-2013: 25 years of evolution*; and Pires, L. M. (2017). *30 Anos de fundos estruturais (1986-2015)*; and more recently the works of Forte de Campos, V., and Rojas Blaya, J. A. (2021). *Evolución histórica de los Fondos Estructurales y de Inversión Europeos*; and Marques, A. (2017).

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