

**THE SPATIAL DISTRIBUTION OF POPULATION IN SPAIN**

As discussed in the main text, Spain is markedly idiosyncratic, from a European perspective, as regards population concentration patterns and the prevalence of uninhabited areas, even after accounting for the country's geo-climatic particularities. This box explores this issue in detail.<sup>1</sup>

Eurostat provides data for 2011 on the spatial distribution of population based on 1-km<sup>2</sup> grid cells covering the whole of Europe. As this level of spatial resolution is not dependent on administrative boundaries, we can more accurately capture the relevant economic density in which individuals and firms interact. Conversely, traditional indicators, such as the ratio of the number of inhabitants resident in an administrative division to the surface area of that division, may convey a distorted picture of the level of population concentration if the division has a large natural or uninhabited surface area.<sup>2</sup>

Eurostat data (GEOSTAT 2011) reveal two differentiating patterns in the distribution of the Spanish population with respect to other European countries. First, Spain has a very large uninhabited surface area. Only 13% of the 1-km<sup>2</sup> grid cells in Spanish territory are populated, the lowest percentage in the European Union and some distance off countries such as France, Italy, Germany and Portugal, where 68%, 57%, 60% and 47% of the grid cells have a positive number of inhabitants (see Chart 1).

Second, the Spanish population is highly concentrated. Specifically, each populated grid cell hosts, on average, 737 inhabitants, the second highest value in the European Union and well above the levels of the above-mentioned countries, all of which are below 400 inhabitants per populated square kilometre. Significantly, the proportion of inhabitants to total surface area in Spain is 94 inhabitants per square kilometre, similar to the European average and close to the values for France and Portugal, with 114 and 119 inhabitants per square kilometre, respectively.

One aspect determining the spatial distribution of population and, therefore, a factor which might explain the high prevalence of uninhabited territory in Spain is the country's climatic and orographic features. In particular, Spain stands out in terms of its climatic diversity, the extreme temperatures reached in certain areas, its high average altitude and its extensive mountainous terrain.

To assess to what extent these climatic and geographic particularities may justify low settlement density in Spain and the high spatial concentration, we estimate a regression model to explain population density and concentration in the European regions (NUTS3, provinces in the case of Spain) as a function of their geo-climatic features and of a region fixed effect.

We measure the two dependent variables —density and concentration—at 250-km<sup>2</sup> grid cell level. We define settlement density as the percentage of 10-km<sup>2</sup> cells inhabited within each 250-km<sup>2</sup> grid cell. We calculate spatial concentration as the percentage of the population living in the most populated one percent of the surface area in each grid cell. The geographic and climatic factors included in the model (at cell level) are temperature, rainfall, altitude, ruggedness of terrain, soil quality and distance from the coast. The inclusion of these explanatory variables would allow the region fixed effect to be interpreted as the portion of population density and concentration in that region which cannot be accounted for by its geo-climatic features. This fixed effect can therefore be used as a proxy for certain anomalies in the distribution of population.

Chart 2.1 confirms Spain's unique characteristics in terms of settlement density. The vertical axis shows the value of the region fixed effect in the model without controlling for geo-climatic factors, i.e. the average settlement density in the grid cells within each region with respect to the omitted category (the Paris region). The chart shows that a large share of the Spanish provinces (marked with red dots) exhibit the lowest levels of settlement density, along with

1 This box summarises part of the analysis published in E. Gutiérrez, E. Moral-Benito, D. Oto-Peralías and R. Ramos (2020): "The spatial distribution of population in Spain: An anomaly in European perspective", *Working Paper* No 2028, Banco de España.

2 See G. Duranton and D. Puga (2020): "The economics of urban density". *Journal of Economic Perspectives*, 34 (3), pp. 3-26.

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other regions in the Nordic countries, such as Iceland, Norway and Sweden.

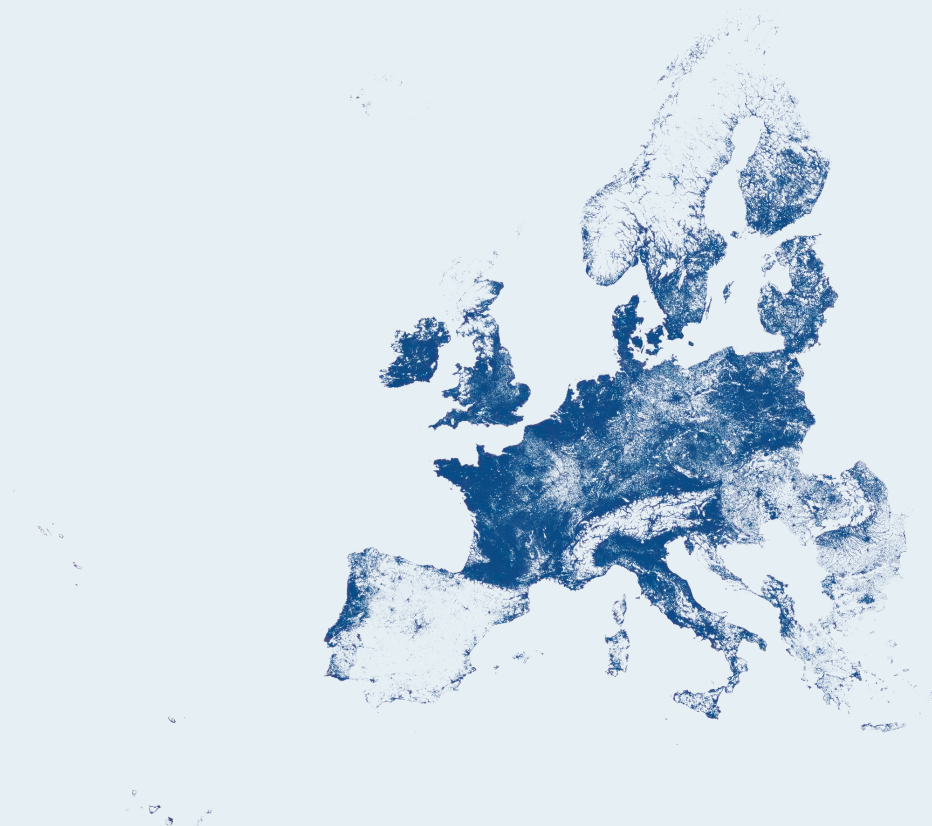
When controlling for geo-climatic factors (horizontal axis), the value of the fixed effect stands above the omitted category in the case of these Nordic regions and, therefore, their low settlement density can be fully explained by their climatic and orographic features. Conversely, many Spanish provinces, after accounting for the effect of geo-climatic factors, continue to show an extraordinarily low settlement density. In particular, 16 of the 20 regions with the largest share of empty territory, after taking into account their geographic and climatic particularities, are located in Spain.

Chart 2.2 shows the same analysis using population concentration as a dependent variable. As can be seen, a large amount of Spanish provinces (highlighted in red) exhibit the highest concentration levels among European regions, even after accounting for the effect of the above-mentioned geo-climatic factors.

We may thus conclude that Spain shows a spatial distribution of population that is unique in Europe. On the one hand, a large proportion of its territory is uninhabited. On the other, inhabited surface areas are characterised by a high level of population concentration. Further, although Spain's geo-climatic features impact the territorial distribution of the population, they cannot alone explain

Chart 1  
 SPAIN HAS A SINGULARLY LOW SETTLEMENT DENSITY COMPARED WITH THE REST OF EUROPE

Only 13% of the 1-km<sup>2</sup> grid cells of Spanish territory are populated (depicted by the blue points on the map). This percentage is the lowest in the European Union and is some distance off other Member States such as France, Italy, Germany and Portugal.



SOURCE: Eurostat.

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these idiosyncratic patterns. In this connection, the literature has highlighted some possible reasons. In particular, it has been documented that the scarcity of

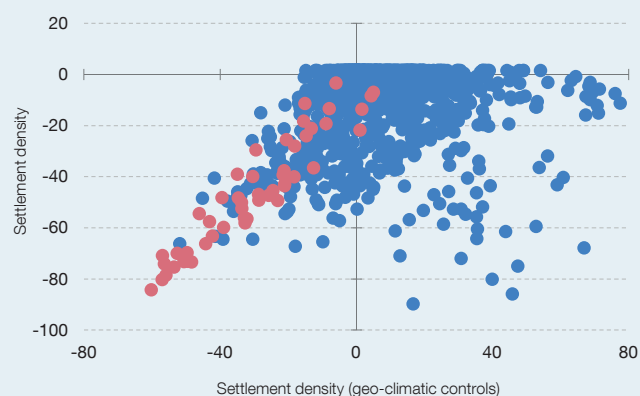
inhabited territory is not a recent phenomenon. For example, in the 17th century there were already accounts attesting to the scarcity of settlements in Spanish territory.<sup>3</sup>

Chart 2

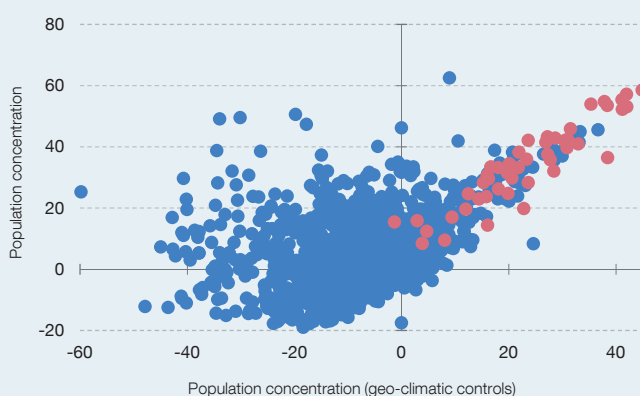
**GEO-CLIMATIC FACTORS CANNOT ALONE EXPLAIN THE LOW SETTLEMENT DENSITY AND HIGH POPULATION CONCENTRATION IN SPAIN**

The Spanish provinces, highlighted in red, show a bigger proportion of unpopulated territory and a greater concentration of population compared with other regions in Europe, even after taking into account the influence of geo-climatic factors.

1 SETTLEMENT DENSITY (a)



2 POPULATION CONCENTRATION (a)



**SOURCE:** Gutiérrez et al. (2020).

a Each point refers to the difference in settlement density (or population concentration) of each European province relative to the Paris region, which is considered as the omitted category in this exercise. For example, a value of -20 indicates that settlement density or population concentration in a specific province stands 20 pp below Paris. See Gutiérrez et al. (2020) for more details on this methodology.

3 See G. Brenan (1950): "The Spanish labyrinth: An account of the social and political background of the Spanish Civil War". Cambridge. Cambridge University Press. In this respect, some studies have pointed out that the mediaeval conflict between the Christian kingdoms and Al-Andalus, characterised by frontier instability and the requirement to occupy large land masses with few people, is a historical event that might have shaped, at least in part, current settlement patterns. For more details on this hypothesis, see D. Oto-Peralías and D. Romero-Ávila (2016): "The economic consequences of the Spanish Reconquest: The long-term effects of medieval conquest and colonization." *Journal of Economic Growth*, 21, pp. 409-464 and D. Oto-Peralías (2020): "Frontiers, warfare, and economic geography. The case of Spain." *Journal of Development Economics*, 146, pp. 1-19.