# Urban–rural population trends in Europe, 2011,2021

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Although the literature suggests that Europe is experiencing a general demographic decline, a closer look reveals a different picture. In terms of European population trends, we cannot speak of a widespread, general population decline, and although there are marked differences in the urban–rural relationship, it is still a very complex and diverse phenomenon. A deeper analysis of this can only be done with grids that do not conflict with administrative boundaries. This analysis attempts to perform a spatial statistical analysis of 2 km$^2$ grids compiled based on 2011 and 2021 data. In our work, we demonstrate how complex phenomenon can be observed from a demographic perspective in Europe. Population concentration is already very significant and is expected to increase in the future, further deepening urban–rural disparities in Europe.

## Introduction

According to the analysis published in the literature, Europe will experience a widespread population decline in the coming period (Newsham–Rowe 2023). As a general trend, we can see that Eastern Europe will experience a significant population decline due to emigration, aging, and low birth rates. In contrast, Western and Northern Europe will experience moderate but stable growth, often due to net migration (Pinkus–Ruer 2025). Several analyses focus on depopulating rural areas and growing urban areas (e.g., Cuadrado-Roura 2023). Most studies frame these processes at the NUTS 2 or possibly NUTS 3 level (Nicolini–Roig 2024, Newsham–Rowe 2023, Deimantas et al. 2024).

The aim of this paper was to examine the issue in more depth and to map current processes. Our analysis is not without precedent. There are analyses in the literature (Batista e Silva et al. 2013, Grommé−Ruppert 2019, Leyk et al. 2019, Catney−Lloyd 2020, Batista e Silva et al. 2020) that use a 1 km$^2$ grid to analyse the temporal and spatial changes of population at a deeper level than the settlement or other administrative level.

## Data and method

In our work, we used Eurostat data to examine the change in the European population (EU27+ Switzerland and Norway). We used a distinction that avoids the problem of modifiable territorial units (Openshaw 1984), which would have arisen with data grouped according to administrative boundaries. Therefore, we did not use data grouped according to any administrative system, but data from a 2 km$^2$ grid. (Although there was a chance to use a 1 km$^2$ grid, due to its size it wasn't workable with the software we used.)

We converted the 2011 and 2021 grids into box maps after downloading. A box map (Anselin 1994) is the mapping equivalent of the idea behind box plots. The starting point is a quantile map, or more precisely, a quartile map. However, in this case the four categories are expanded to five bins to separately identify the upper outliers. The definition of outliers is a function of the multiple of the interquartile range (IQR), the difference between the 75$^{th}$ and 25$^{th}$ percentile values.

The 5 groups (first, second, third, and fourth quartiles and upper outliers) formed based on population density were further broken down according to whether the given grid experienced population decline or population growth from 2011 to 2021. The resulting groups are depicted in Appendix Figures A1 and A2. It is important to note, on the one hand, that the population decline characteristic of Europe is a general phenomenon, i.e., not region-specific. On the other hand, it is important to see that, despite significant differences – which our analysis analyses at length – there are regions characterized by population growth or population decline, even with high or low population density.

## Population distribution, population change

Just over 43% of the European population lives in areas where there was a population decline from 2011 to 2022, while 57% live in areas where there was a population increase. The most striking difference between the two categories of upper outliers, including metropolitan grids, in that the advantage of grids characterized by population growth is almost 15 percentage points (see in Appendix Figures A1–A2).

Table 1

**Distribution of the population of the countries studied by population density and population change categories, 2021**

| Categories | First | Second | Third | Fourth | Upper outliers | Total |
|---|---|---|---|---|---|---|
| | quarter | | | | | |
| Population loss | 0.2 | 1.1 | 4.0 | 7.9 | 30.0 | 43.2 |
| Population growth | 0.2 | 0.8 | 3.0 | 8.0 | 44.8 | 56.8 |

In the following, we look at the role of each group within the countries examined. First, we start with the grids that suffer population decline.

The first quartile is particularly significant for the Nordic countries. The largest population proportions of the given country's population can be seen in Latvia (2.3%), Finland (2.1%), and Estonia (1.6%). The second quartile is also significant for a similar range of countries. Lithuania (4.7%), Latvia, and Finland (4.6–4.6%) can be highlighted here. The third quartile, which is in a more favourable position than the median, is primarily significant for the eastern countries of the continent. The largest population proportions can be seen in Croatia (11.4%), Poland (9.8%), and Lithuania (9.1%). Peripheral countries can also be highlighted in the fourth quartile: Croatia (20.8%), Romania (17.2%), and Portugal (15.5%). The role of large cities experiencing population decline, i.e., upper outliers, is significant in the case of Latvia (59.9%), Bulgaria (56.6%), and Lithuania (52.7%).

The role of the grids affected by population growth in terms of the population of a given country requires the highlighting of other countries somewhat.

Similar to the population decline, the grids of the first quartile are the most decisive in terms of the population of the country in the case of the Nordic countries. The highest rates are seen in Finland (1.6%), Latvia (1.2%), and Estonia (1.1%). The role of the second quartile is prominent in Ireland (4.5%), Sweden (3.7%), and Estonia (3.1%). In the case of the third quartile, Ireland (14.9%) is also the most decisive, followed by Slovenia (8.0%) and the Czech Republic (5.9%). In the case of the fourth quartile, it is the most decisive in Slovenia (19.2%), Slovakia (15.9%), and Austria (15.1%). Finally, turning to the metropolitan grids experiencing population growth, i.e., upper outliers, it can be highlighted that here we see units that already share a very large proportion of the population of each country. 95.8% of Malta's population lives in such areas, but we can also see very high proportions in the case of Switzerland (78.5%) and Luxembourg (73.2%).

In the following, we examined the population change, i.e., the population in 2021 as a percentage of 2011. The total population of the 29 countries examined – based on grid data – increased by 1.6%. This did not mean a general increase typical of all countries, as the population of 10 countries decreased during the examined period. The countries that suffered the decrease are primarily those that joined in 2004, but we can also include Greece, Italy, and Portugal. The most significant decrease is in Bulgaria (–12.8%), followed by Croatia (–10%) and Latvia (–8.9%). In contrast, the largest increases are seen in Luxembourg (+25.8%), Norway, (+20.1%) and Malta (+18.3%).

The rate of population decline is inversely proportional to population density, i.e., the higher the population density, the lower the population decline. On the other hand, the opposite is true for population growth: the lower the population density of a given grid, the higher the rate of population growth. If we examine this in more depth (Table 2), we see that the absolute population change (both positive and negative) of more densely populated areas is much larger than that of less densely populated areas. However, these densely populated areas also have a major weakness. The relative change of the areas compared to the base population is much smaller.

Table 2

**Average population change and average relative change of grids by population density and population change categories, 2011, 2021**

| Categories | Average population change | Average population change in percent of 2011 population |
|---|---|---|
| First quarter – population loss | –8.1 | –39.6 |
| First quarter – population growth | 3.3 | 51.6 |
| Second quarter – population loss | –15.6 | –19.8 |
| Second quarter – population growth | 11.3 | 57.7 |
| Third quarter – population loss | –31.9 | –13.4 |
| Third quarter – population growth | 30.5 | 48.6 |
| Fourth quarter – population loss | –74.3 | –9.8 |
| Fourth quarter – population growth | 92.4 | 40.2 |
| Upper outlier – population loss | –429.2 | –7.3 |
| Upper outlier – population growth | 533.2 | 21.6 |
| Average | 11.2 | 11.2 |

If we examine the 2021 population of the grids as a function of 2011 using a linear regression function, we can observe a very close relationship ($R^2$=0.98). Due to the indicated close relationship, we considered it important to examine the population change from 2011 to 2021 according to the population density categories and compare the real changes with the rate estimated by the linear regression.

By presenting the absolute and relative deviations from the trend by category, we can see that in absolute numbers the population of more densely populated grids deviates more from the trend, while in relative terms the change in less densely populated areas is greater.

It is important to note that categories 9 and 10 (upper outliers) contain ¾ of the European population. This is why we prepared Figure A3 (see in Appendix) for 2021. We only depicted the upper outlier grids, the ones with a decreasing population, and the ones with a growing population. The reason for this was that in 2011, 74.4% of the population of the countries under study lived in these two grid groups, while in 2022, 75.1% of the population lived in these two grid groups.

As can be seen in Appendix Figure A3, the upper outlier grids, characterized by population growth, are essentially spatially concentrated, while those suffering population loss show a much more significant spatial dispersion.

Table 3

**Details of population change of grids relative to trend by population density and population change categories**

| Categories | Population, 2011 | Population distribution, 2011 (%) | Population, 2021 | Population distribution, 2021 (%) | Population change, 2021–2011 | The difference between trend and actual population change | Relative difference between trend and actual population change (%) |
|---|---|---|---|---|---|---|---|
| First quarter – population loss | 1,524,180 | 0.3 | 804,586 | 0.2 | –719,594 | 1,692,432 | 210.3 |
| First quarter – population growth | 449,759 | 0.1 | 729,493 | 0.2 | 279,734 | 653,481 | 89.6 |
| Second quarter – population loss | 6,550,578 | 1.5 | 4,995,703 | 1.1 | –1,554,875 | 2,649,012 | 53.0 |
| Second quarter – population growth | 2,902,688 | 0.6 | 3,758,740 | 0.8 | 856,052 | –23,934 | –0.6 |
| Third quarter – population loss | 21,342,110 | 4.7 | 18,156,145 | 4.0 | –3,185,965 | 4,288,110 | 23.6 |
| Third quarter – population growth | 11,424,633 | 2.5 | 13,700,644 | 3.0 | 2,276,011 | –1,452,452 | –10.6 |
| Fourth quarter – population loss | 39,882,105 | 8.9 | 35,726,582 | 7.8 | –4,155,523 | 4,781,702 | 13.4 |
| Fourth quarter – population growth | 31,367,517 | 7.0 | 36,419,899 | 7.9 | 5,052,382 | –4,442,257 | –12.2 |
| Upper outlier – population loss | 149,487,024 | 33.2 | 138,349,911 | 30.2 | –11,137,113 | 11,466,972 | 8.3 |
| Upper outlier – population growth | 185,492,354 | 41.2 | 205,576,330 | 44.9 | 20,083,976 | –19,614,594 | –9.5 |
| Total | 450,422,948 | 100.0 | 458,218,033 | 100.0 | 7,795,085 | –1,529 | 0.0 |

On the one hand, certain metropolitan areas (Paris and its region, the Essen–Dortmund–Cologne triangle, and the Milan and Turin agglomerations) are neighbours of grids with population growth and decline. Here we are faced with the decline of some urban areas and the rise of others. The reasons for the population decline within dynamic metropolitan areas can be diverse. In the case of Paris, these include the decline in birth rates after Covid-19, the reduction in external migration, and the renting out of small downtown apartments for the off-season. In parallel, we can see families moving out of small downtown apartments in search of idealsized apartments (Cazi 2024). In the case of Rome, the population decline of the inner city core has been taking place since 1970, although after the bursting of the real estate bubble in 2008, we are now witnessing a period of re-urbanization (Crisci 2022). Among the eastern member states of the European Union, perhaps in the case of Katowice and its region in Poland, we see a significant concentration of grids with high population density but decreasing population. The negative processes characteristic of the region can be interpreted as the combined effect of the decline of heavy industry, emigration, and suburbanization. In addition, the depopulation of certain city districts also had serious social and real estate market effects (Spórna et al. 2025).

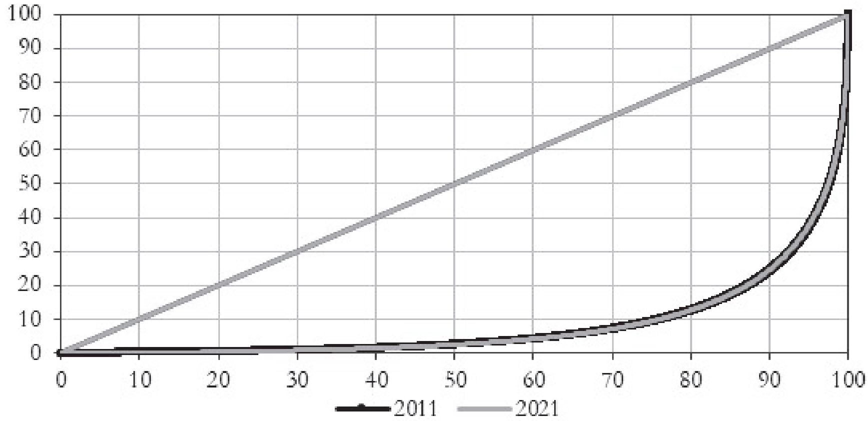
The situation is different away from metropolitan agglomerations. We can see examples of this in essentially every country studied. Here, the weakening of the central urban level is observed to the advantage of huge metropolitan agglomerations. This essentially confirms that depopulation is not only generally experienced in rural areas but also in small and medium-sized rural towns in Europe, especially due to the emigration of young, highly educated people (González-Leonardo et al 2019). We can see relatively many such grids in Central and Eastern Europe (e.g., Poland, Romania, Bulgaria), in the central and eastern provinces of Germany, and in Southern Europe (e.g., Spain). Previous research sees the cause of these phenomena in the aging of cities, emigration from them, and the lack of public services (Wolff et al. 2021, Józefowicz 2025, Ayuda et al. 2024).

These examples alone demonstrate several different reasons for the decline of small and medium-sized towns. Agreeing with Rob Atkinson (2019), we believe that due to the diversity of small and medium-sized towns, a single universal development strategy cannot be applied to them. Each settlement has its own challenges and opportunities; therefore, tailor-made solutions at the local level are needed to counteract the negative demographic trends so far.

It gives a more accurate picture if we illustrate the concentration of grids on a Lorenz curve (Figure 1). The concentration of the population by area, the differences between them, and their dynamics can be illustrated by Lorenz curves (Lorenz 1905). These are curves depicted in a unit-sided square (in this case 100 units), which illustrate the cumulative relative value sums as a function of the cumulative relative frequencies of the quantitative characteristic under examination. If there is no concentration, then the examined units have the same share of the total value, the cumulated relative frequencies and the cumulated total values are the same, so the function is a straight line with a slope of unity (diagonal). However, if there are some among the area units that contain a large proportion of the sum of the examined attribute, then the relative frequencies and the total values differ significantly from each other, so the Lorenz curve is far from the straight line with a slope of unity. The:further the curve is from the diagonal, the greater the concentration. By performing grid-level calculations, we find that the population of Europe according to grids is highly concentrated based on the Lorenz curves, but no significant change in concentration occurred during the 10 years examined (Figure 1).

Figure 1

**European population concentration by grid**




Lorenz curves are graphical representations, which basically only allow for visual comparisons. The Gini coefficient, on the other hand, provides a concrete measure of concentration: it measures the area between the quantitative characteristic under consideration and the diagonal of the square in a way that compares the average deviation of the proportion of each observation unit from all the others to the average. The higher its value, the higher the concentration. Its maximum value is unity. In the absence of concentration, the Lorenz curve coincides with the diagonal, and the value of the Gini coefficient is zero.

$$\mathrm{G} = \frac{1}{2 * \bar{x} * n^2} \sum_i \sum_j |x_i - x_j|$$

In our case, n is the number of grids, $\bar{x}$ is the average of the resident population per grid, while $x_i$ is the corresponding population of grid *i*. The calculations were performed on the data for 2011 and 2021, as well as on the data estimated by us for 2031, 2041, and 2051 (Table 4).

Table 4

**Population concentration**

| Years | Gini index |
|---|---|
| 2011 | 0.847 |
| 2021 | 0.848 |
| 2031 | 0.851 |
| 2041 | 0.853 |
| 2051 | 0.856 |

We see a slow but steady concentration in Europe, where the role of densely populated areas (grids) is decisive.

Table 5

**Distribution of the population of the countries studied by population density and population change categories, 2021 (2011=100%)**

| Categories | First | Second | Third | Fourth | Upper outliers | Total |
|---|---|---|---|---|---|---|
| | quarter | | | | | |
| Population loss | 53.5 | 76.8 | 85.3 | 89.7 | 92.6 | 90.6 |
| Population growth | 161.9 | 128.8 | 119.2 | 115.6 | 110.6 | 112.6 |

In the detailed examination of the change, we first look at the grids that suffered population decline (Table 5). The largest population declines of the grids in the first quartile are seen in Bulgaria (–76.8%), Spain (–76.4%), and Cyprus (–69.2%). Regarding the negative trends in the second quarter, Luxembourg (–39.4%), Bulgaria (–36.2%), and Spain (–36.1%) can be highlighted. In the third quarter, the grids of Bulgaria (–30.3%), Spain (–28.1%), and Italy (–24.2%) suffered a significant decline. Among the grids in the fourth quartile, the declines are the largest in Malta (–24.1%), Bulgaria (–22.1%), and Greece (–18.0%). Finally, in the case of upper outliers, we see significant declines in Bulgaria (–14.5%), Romania (–13.6%), and Poland (–12.0%).

Among the grids in the first quartile showing population growth, the most significant growth can be seen in Spain (+505.5%), Cyprus (+187.5%), and Hungary (+181.9%). In the second quartile, Spain (+135.3%), and Cyprus (+112.3%) are also the most significant, which are complemented by Luxembourg (+91.5%). In the third quartile, there were large significant increases in Malta (+159.0%), Spain (+73%), and Cyprus (+49.9%). Regarding the grids classified in the fourth quartile, there are large population dynamics in Spain (+42.1%), Luxembourg (+34.0%), and Malta (+33.8%). Finally, in the case of upper outliers, the growth of Luxembourg (+30.3%), Romania (+27.2%), and Norway (+26.1%) is significant.

If we project the actual population changes between 2011 and 2021, grid-level population projections can be made for the years 2031, 2041, and 2051 as follows:

$$N^i_{2021+n*10} = N^i_{2021} + n * (N^i_{2021} - N^i_{2011})$$

where $N^i_t$ is the population of the i-th grid at time t. The calculations performed are presented in the Appendix. Due to the available data, we therefore only extrapolate the changes from 2011 to 2021 and do not take into account natural increase or the consequences of migration. Our analysis therefore assumes that if everything develops as it did from 2011 to 2021, then this spatial picture can be observed (see figures in the Appendix).

Our results are partly in line with other literature sources (Curtale et al. 2025). We also see that urban regions continue to be the engines of demographic growth within the EU. In contrast, population decline in rural areas is expected to continue in the coming decades, which will be even more significant in remote rural regions. Our own calculations draw a spatial picture very similar to the forecast presented by Curtale et al. (2025). According to our results, in contrast to the indicated source, a significant population growth is expected for Northwest Spain, and we do not see the Italian, Czech, and Slovak trends as so gloomy.

## Population density change

Next, we analysed the population density of the populated grids and their changes. The change in population density from 2011 to 2021 is shown in Appendix Figure A4.

We further analysed the change in population density using the previously presented categorization. Our most important finding is that the average population density of grids experiencing population decline is somewhat higher than those characterized by growth, mainly due to the upper outliers. Thus, the change in the most densely populated grids of large cities is the most significant restructuring factor.

Table 6

**Distribution of population density of the populated grids of the studied countries by population density and population change categories, 2021 (average of studied countries = 100%)**

| Categories | First | Second | Third | Fourth | Upper outliers | Total |
|---|---|---|---|---|---|---|
| | quarter | | | | | |
| Population loss | 0.10 | 0.45 | 1.61 | 5.75 | 143.17 | 101.14 |
| Population growth | 0.10 | 0.45 | 1.62 | 5.94 | 123.10 | 98.22 |

The change in population density is even more drastic than the population change (see Table 7). The smaller the population density of the grid group, the more significant the change.

Table 7

**Population density change of the inhabited grids of the countries studied by population density and population change categories, 2021 (2011 = 100%)**

| Categories | First | Second | Third | Fourth | Upper outliers | Total |
|---|---|---|---|---|---|---|
| | quarter | | | | | |
| Population loss | 17.3 | 55.4 | 81.2 | 89.3 | 93.9 | 92.9 |
| Population growth | 117.7 | 115.3 | 112.5 | 111.9 | 105.3 | 106.1 |

## Conclusion

While the world population is set to reach 10 billion by 2061 (UN 2024), Europe's population is growing only slightly (1.6% between 2011 and 2021), so Europe's weight among the continents is continuously decreasing. Beneath the macro-surface of slight population increases (at a 2 $km^2$ grid level), we find a very exciting, variable, and dynamic microworld. Population concentration is constantly increasing and is expected to continue to do so in the future, further strengthening the urban–rural divide in Europe. The more densely populated areas are home to ¾ of the population of the 29 European countries studied. The absolute population change of these areas (both positive and negative) is much larger than that of the other areas, but at the same time they are also characterized by a high degree of inertia. These upper outlier areas play a key role in the spatial distribution of Europe's population, a role that will strengthen in the future.

## Appendix

Figure A1

2 km² grids of the countries studied by population density for grids with increasing population compared to 2011–2021

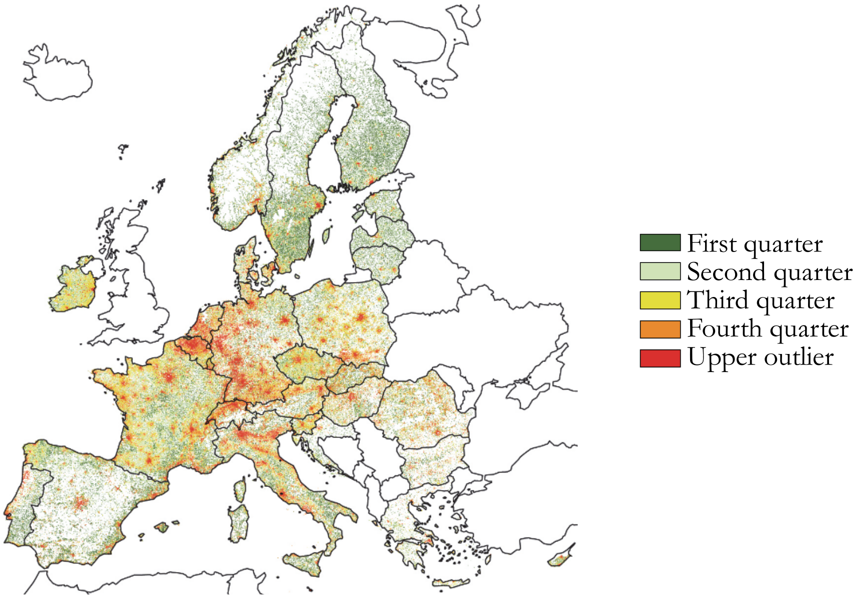



Figure A2

2 km² grids of the countries studied by population density for grids with decreasing population compared to 2011–2021

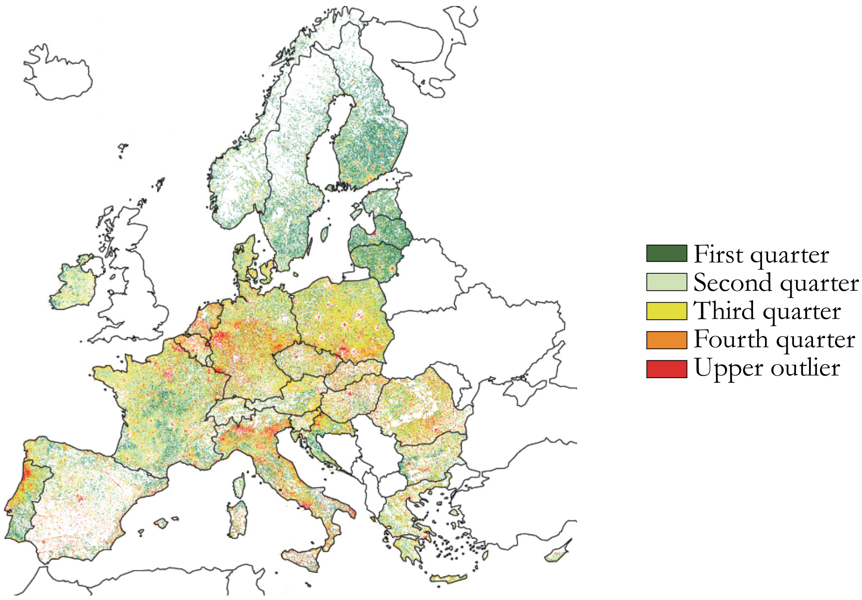


Figure A3

**Spatial location of upper outlier population density grids**

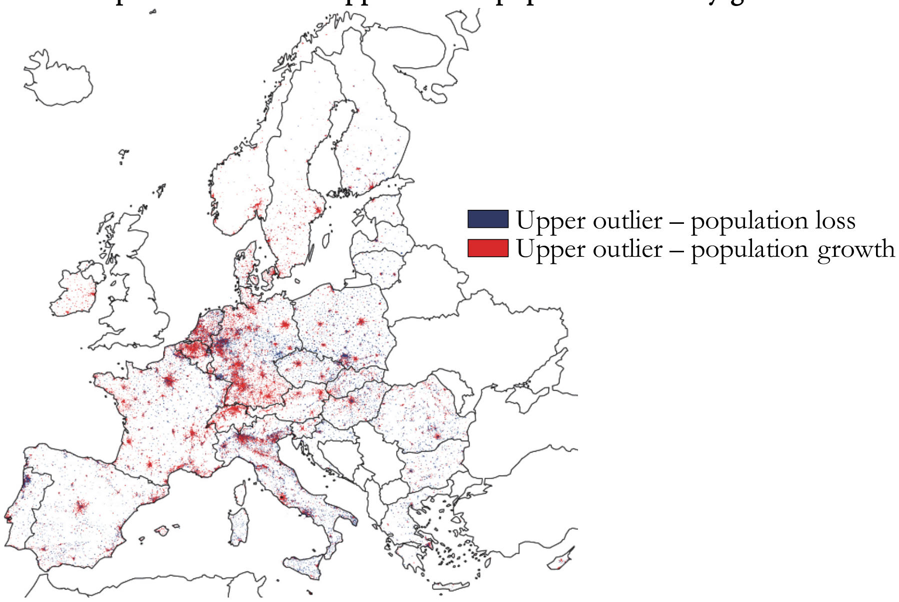



Figure A4

**Change in population density in 2 km² grids of the countries studied, 2021–2011**

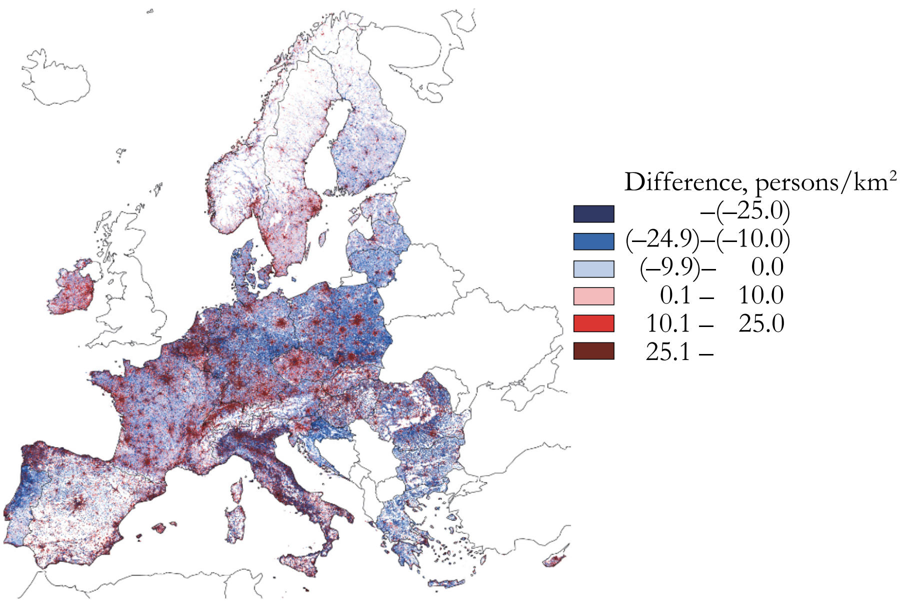


Table A1

**Distribution of population of the inhabited grids of the countries studied by population density and population change categories, 2021**

| Country code/name | | Population loss | | | | |
|---|---|---|---|---|---|---|
| | | first | second | third | fourth | upper outliers |
| | | quarter | | | | |
| AT | Austria | 0.1 | 1.1 | 5.8 | 7.2 | 7.5 |
| BE | Belgium | 0.0 | 0.1 | 1.1 | 5.3 | 12.7 |
| BG | Bulgaria | 0.3 | 1.5 | 6.0 | 12.2 | 56.6 |
| CH | Switzerland | 0.0 | 0.3 | 1.4 | 2.7 | 3.8 |
| CZ | Czech Republic | 0.1 | 0.8 | 3.7 | 8.3 | 43.3 |
| CY | Cyprus | 0.1 | 0.4 | 1.6 | 3.0 | 15.9 |
| DE | Germany | 0.1 | 0.6 | 3.2 | 7.9 | 18.3 |
| DK | Denmark | 0.2 | 2.8 | 5.4 | 7.5 | 9.6 |
| EE | Estonia | 1.6 | 3.8 | 4.7 | 6.9 | 26.3 |
| EL | Greece | 0.2 | 1.5 | 6.0 | 10.5 | 46.4 |
| ES | Spain | 0.1 | 0.6 | 1.8 | 3.7 | 42.4 |
| FI | Finland | 2.1 | 4.6 | 5.3 | 9.3 | 21.5 |
| FR | France | 0.2 | 1.7 | 4.3 | 6.6 | 22.9 |
| HR | Croatia | 0.5 | 2.8 | 11.4 | 20.8 | 48.0 |
| HU | Hungary | 0.1 | 0.7 | 3.4 | 10.7 | 43.8 |
| IE | Ireland | 0.2 | 2.9 | 5.4 | 1.9 | 2.2 |
| IT | Italy | 0.1 | 0.5 | 2.2 | 8.1 | 40.3 |
| LT | Lithuania | 1.5 | 4.7 | 9.1 | 9.0 | 52.7 |
| LU | Luxembourg | 0.1 | 0.2 | 1.2 | 3.5 | 3.3 |
| LV | Latvia | 2.3 | 4.6 | 6.9 | 9.4 | 59.9 |
| MT | Malta | 0.0 | 0.0 | 0.0 | 0.3 | 2.1 |
| NL | Netherland | 0.0 | 0.2 | 1.2 | 3.1 | 26.0 |
| NO | Norway | 0.7 | 2.5 | 3.6 | 3.3 | 2.7 |
| PL | Poland | 0.1 | 1.6 | 9.8 | 11.3 | 45.1 |
| PT | Portugal | 0.2 | 1.4 | 6.5 | 15.5 | 35.8 |
| RO | Romania | 0.1 | 1.0 | 6.4 | 17.2 | 45.0 |
| SE | Sweden | 0.8 | 2.5 | 2.5 | 3.3 | 7.1 |
| SI | Slovenia | 0.1 | 1.0 | 6.6 | 9.4 | 17.3 |
| SK | Slovakia | 0.1 | 0.6 | 3.5 | 10.4 | 39.6 |
| Average | | 0.2 | 1.1 | 4.0 | 7.9 | 30.0 |

*(Table continues on the next page.)*

*(Continued.)*

| Country code/name | | Population growth | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | first | second | third | fourth | upper outliers | |
| | | quarter | | | | | |
| AT | Austria | 0.1 | 0.6 | 4.4 | 15.1 | 58.1 | 100.0 |
| BE | Belgium | 0.0 | 0.2 | 1.6 | 10.0 | 69.1 | 100.0 |
| BG | Bulgaria | 0.1 | 0.5 | 2.0 | 4.5 | 16.3 | 100.0 |
| CH | Switzerland | 0.0 | 0.2 | 1.8 | 11.2 | 78.5 | 100.0 |
| CZ | Czech Republic | 0.1 | 1.2 | 5.9 | 12.9 | 23.7 | 100.0 |
| CY | Cyprus | 0.2 | 1.0 | 2.7 | 9.3 | 65.8 | 100.0 |
| DE | Germany | 0.0 | 0.3 | 1.8 | 7.2 | 60.6 | 100.0 |
| DK | Denmark | 0.1 | 1.2 | 3.0 | 7.7 | 62.4 | 100.0 |
| EE | Estonia | 1.1 | 3.1 | 3.8 | 6.2 | 42.4 | 100.0 |
| EL | Greece | 0.1 | 0.6 | 1.7 | 3.3 | 29.8 | 100.0 |
| ES | Spain | 0.2 | 0.7 | 1.7 | 4.0 | 45.0 | 100.0 |
| FI | Finland | 1.6 | 2.8 | 2.6 | 4.5 | 45.8 | 100.0 |
| FR | France | 0.1 | 1.3 | 5.3 | 11.5 | 46.0 | 100.0 |
| HR | Croatia | 0.1 | 0.6 | 1.9 | 3.3 | 10.6 | 100.0 |
| HU | Hungary | 0.1 | 0.6 | 2.6 | 8.8 | 29.1 | 100.0 |
| IE | Ireland | 0.2 | 4.5 | 14.9 | 10.6 | 57.1 | 100.0 |
| IT | Italy | 0.1 | 0.5 | 2.0 | 6.0 | 40.3 | 100.0 |
| LT | Lithuania | 0.6 | 1.6 | 2.5 | 4.0 | 14.3 | 100.0 |
| LU | Luxembourg | 0.1 | 0.4 | 4.0 | 14.2 | 73.2 | 100.0 |
| LV | Latvia | 1.2 | 2.9 | 2.2 | 3.2 | 7.2 | 100.0 |
| MT | Malta | 0.0 | 0.0 | 0.1 | 1.7 | 95.8 | 100.0 |
| NL | Netherland | 0.0 | 0.2 | 1.1 | 3.6 | 64.5 | 100.0 |
| NO | Norway | 0.8 | 2.9 | 5.7 | 12.1 | 65.7 | 100.0 |
| PL | Poland | 0.1 | 0.7 | 3.9 | 9.1 | 18.4 | 100.0 |
| PT | Portugal | 0.2 | 0.4 | 1.2 | 4.2 | 34.6 | 100.0 |
| RO | Romania | 0.1 | 0.6 | 3.0 | 10.4 | 16.3 | 100.0 |
| SE | Sweden | 1.1 | 3.7 | 5.2 | 8.4 | 65.4 | 100.0 |
| SI | Slovenia | 0.1 | 1.1 | 8.0 | 19.2 | 37.2 | 100.0 |
| SK | Slovakia | 0.2 | 0.6 | 3.5 | 15.9 | 25.8 | 100.0 |
| Average | | 0.2 | 0.8 | 3.0 | 8.0 | 44.8 | 100.0 |

Table A2

## Population change in the inhabited grids of the countries studied by population density and population change categories, 2021 (2011 = 100%)

| Country code/name | | Population loss | | | | |
|---|---|---|---|---|---|---|
| | | first | second | third | fourth | upper outliers |
| | | quarter | | | | |
| AT | Austria | 70.0 | 86.0 | 91.9 | 95.1 | 96.3 |
| BE | Belgium | 67.7 | 85.4 | 92.3 | 96.2 | 97.3 |
| BG | Bulgaria | 23.2 | 53.8 | 69.7 | 77.9 | 85.5 |
| CH | Switzerland | 68.1 | 83.8 | 91.8 | 95.2 | 96.9 |
| CZ | Czech Republic | 59.2 | 84.6 | 91.0 | 93.9 | 94.4 |
| CY | Cyprus | 30.8 | 60.8 | 81.7 | 87.6 | 96.4 |
| DE | Germany | 70.2 | 84.7 | 90.4 | 93.6 | 95.9 |
| DK | Denmark | 72.7 | 84.9 | 90.8 | 94.7 | 97.0 |
| EE | Estonia | 64.0 | 81.2 | 88.6 | 91.4 | 95.3 |
| EL | Greece | 47.8 | 68.7 | 76.4 | 82.0 | 95.2 |
| ES | Spain | 23.6 | 53.9 | 71.9 | 82.4 | 93.6 |
| FI | Finland | 65.8 | 83.2 | 88.7 | 90.6 | 94.7 |
| FR | France | 67.0 | 83.6 | 90.0 | 92.4 | 93.9 |
| HR | Croatia | 53.5 | 70.3 | 82.5 | 87.1 | 90.0 |
| HU | Hungary | 38.8 | 61.5 | 78.7 | 87.4 | 90.4 |
| IE | Ireland | 67.6 | 86.2 | 92.5 | 95.2 | 98.0 |
| IT | Italy | 31.5 | 60.4 | 75.8 | 86.4 | 94.0 |
| LT | Lithuania | 55.1 | 74.6 | 81.9 | 86.5 | 90.1 |
| LU | Luxembourg | 38.8 | 59.4 | 76.4 | 83.0 | 91.3 |
| LV | Latvia | 56.9 | 77.7 | 84.7 | 87.5 | 89.7 |
| MT | Malta | 41.7 | – | – | 75.9 | 94.5 |
| NL | Netherland | 67.5 | 83.8 | 89.4 | 93.2 | 96.3 |
| NO | Norway | 68.9 | 85.8 | 91.6 | 95.1 | 96.8 |
| PL | Poland | 64.3 | 80.5 | 86.9 | 90.4 | 88.0 |
| PT | Portugal | 62.5 | 78.0 | 85.2 | 90.5 | 95.6 |
| RO | Romania | 41.8 | 68.0 | 81.0 | 87.2 | 86.6 |
| SE | Sweden | 70.8 | 86.9 | 92.6 | 94.5 | 96.7 |
| SI | Slovenia | 74.1 | 87.6 | 93.2 | 95.1 | 96.2 |
| SK | Slovakia | 57.5 | 80.5 | 90.1 | 93.7 | 92.2 |
| Average | | 53.5 | 76.8 | 85.3 | 89.7 | 92.6 |

*(Table continues on the next page.)*

*(Continued.)*

| Country code/name | | Population growth | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | first | second | third | fourth | upper outliers | |
| | | quarter | | | | | |
| AT | Austria | 129.3 | 112.1 | 109.3 | 110.8 | 111.0 | 106.7 |
| BE | Belgium | 151.5 | 120.6 | 111.8 | 107.8 | 107.1 | 105.1 |
| BG | Bulgaria | 211.4 | 145.3 | 130.9 | 125.8 | 117.2 | 87.8 |
| CH | Switzerland | 140.5 | 118.6 | 112.0 | 113.3 | 111.2 | 109.9 |
| CZ | Czech Republic | 160.6 | 125.1 | 114.8 | 112.3 | 110.0 | 100.9 |
| CY | Cyprus | 287.5 | 212.3 | 149.9 | 132.6 | 110.3 | 108.8 |
| DE | Germany | 132.6 | 114.8 | 110.4 | 109.4 | 108.3 | 103.8 |
| DK | Denmark | 122.5 | 111.1 | 110.8 | 113.5 | 114.3 | 107.9 |
| EE | Estonia | 138.2 | 120.8 | 113.5 | 116.6 | 113.8 | 103.0 |
| EL | Greece | 191.5 | 143.4 | 126.9 | 120.0 | 106.1 | 95.7 |
| ES | Spain | 605.5 | 235.3 | 172.3 | 142.1 | 109.9 | 101.3 |
| FI | Finland | 131.8 | 115.0 | 113.0 | 118.7 | 114.1 | 102.7 |
| FR | France | 138.0 | 117.1 | 114.2 | 114.3 | 112.0 | 104.5 |
| HR | Croatia | 138.3 | 115.2 | 110.0 | 108.3 | 108.3 | 90.0 |
| HU | Hungary | 281.9 | 172.4 | 132.7 | 117.2 | 111.0 | 97.6 |
| IE | Ireland | 150.0 | 118.1 | 114.2 | 116.9 | 114.7 | 111.5 |
| IT | Italy | 260.7 | 184.8 | 144.5 | 119.0 | 106.6 | 99.3 |
| LT | Lithuania | 137.4 | 123.2 | 128.7 | 128.6 | 121.4 | 92.9 |
| LU | Luxembourg | 199.1 | 191.5 | 149.3 | 134.0 | 130.3 | 125.8 |
| LV | Latvia | 131.9 | 120.6 | 119.5 | 126.8 | 114.7 | 91.1 |
| MT | Malta | – | 25.2 | 259.0 | 133.8 | 118.9 | 118.3 |
| NL | Netherland | 137.1 | 117.9 | 113.1 | 114.5 | 109.7 | 105.1 |
| NO | Norway | 139.7 | 121.7 | 123.6 | 127.2 | 126.1 | 120.1 |
| PL | Poland | 142.8 | 120.2 | 114.3 | 117.1 | 122.5 | 96.2 |
| PT | Portugal | 155.5 | 118.3 | 111.8 | 108.0 | 105.9 | 97.6 |
| RO | Romania | 223.1 | 149.2 | 126.7 | 120.5 | 127.2 | 94.8 |
| SE | Sweden | 139.7 | 119.3 | 116.6 | 117.0 | 115.2 | 111.3 |
| SI | Slovenia | 142.4 | 115.8 | 110.5 | 108.9 | 106.7 | 103.1 |
| SK | Slovakia | 247.4 | 140.7 | 117.7 | 113.0 | 113.1 | 101.0 |
| Average | | 161.9 | 128.8 | 119.2 | 115.6 | 110.6 | 101.6 |

Table A3

## Distribution of population density of the inhabited grids of the studied countries by population density and population change categories, 2021 (average of studied countries = 100%)

| Country code/name | | Population loss | | | | |
|---|---|---|---|---|---|---|
| | | first | second | third | fourth | upper outliers |
| | | quarter | | | | |
| AT | Austria | 0.10 | 0.47 | 1.60 | 5.37 | 73.62 |
| BE | Belgium | 0.10 | 0.47 | 1.74 | 6.13 | 102.27 |
| BG | Bulgaria | 0.10 | 0.45 | 1.67 | 5.63 | 166.92 |
| CH | Switzerland | 0.10 | 0.45 | 1.67 | 5.46 | 48.35 |
| CZ | Czech Republic | 0.10 | 0.47 | 1.62 | 5.77 | 91.80 |
| CY | Cyprus | 0.09 | 0.44 | 1.57 | 4.98 | 69.11 |
| DE | Germany | 0.10 | 0.48 | 1.65 | 5.82 | 46.19 |
| DK | Denmark | 0.12 | 0.46 | 1.49 | 5.57 | 31.47 |
| EE | Estonia | 0.10 | 0.38 | 1.59 | 5.48 | 79.43 |
| EL | Greece | 0.11 | 0.45 | 1.64 | 5.52 | 316.04 |
| ES | Spain | 0.10 | 0.45 | 1.60 | 5.91 | 289.96 |
| FI | Finland | 0.09 | 0.39 | 1.51 | 5.77 | 30.42 |
| FR | France | 0.11 | 0.45 | 1.55 | 5.59 | 192.32 |
| HR | Croatia | 0.10 | 0.45 | 1.62 | 5.59 | 98.49 |
| HU | Hungary | 0.10 | 0.45 | 1.69 | 5.99 | 110.44 |
| IE | Ireland | 0.11 | 0.48 | 1.35 | 4.99 | 45.62 |
| IT | Italy | 0.10 | 0.46 | 1.69 | 6.09 | 107.00 |
| LT | Lithuania | 0.10 | 0.41 | 1.55 | 5.45 | 113.86 |
| LU | Luxembourg | 0.10 | 0.43 | 1.71 | 6.03 | 14.93 |
| LV | Latvia | 0.10 | 0.37 | 1.63 | 5.50 | 104.16 |
| MT | Malta | 0.12 | 0.30 | 0.00 | 6.26 | 51.17 |
| NL | Netherland | 0.12 | 0.46 | 1.62 | 6.15 | 67.21 |
| NO | Norway | 0.10 | 0.42 | 1.45 | 5.41 | 25.50 |
| PL | Poland | 0.11 | 0.48 | 1.60 | 5.31 | 113.70 |
| PT | Portugal | 0.10 | 0.46 | 1.67 | 5.68 | 92.46 |
| RO | Romania | 0.10 | 0.46 | 1.71 | 5.72 | 170.60 |
| SE | Sweden | 0.10 | 0.40 | 1.47 | 5.55 | 43.80 |
| SI | Slovenia | 0.11 | 0.47 | 1.65 | 5.42 | 52.84 |
| SK | Slovakia | 0.10 | 0.46 | 1.71 | 5.88 | 75.34 |
| Average | | 0.10 | 0.45 | 1.61 | 5.75 | 143.17 |

*(Table continues on the next page.)*

*(Continued.)*

| Country code/name | | Population growth | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | first | second | third | fourth | upper outliers | |
| | | quarter | | | | | |
| AT | Austria | 0.10 | 0.46 | 1.74 | 5.91 | 170.50 | 106.13 |
| BE | Belgium | 0.11 | 0.48 | 1.80 | 6.38 | 101.27 | 83.97 |
| BG | Bulgaria | 0.09 | 0.44 | 1.66 | 5.64 | 109.56 | 113.55 |
| CH | Switzerland | 0.10 | 0.46 | 1.78 | 6.36 | 84.26 | 68.75 |
| CZ | Czech Republic | 0.10 | 0.47 | 1.65 | 5.60 | 77.99 | 59.58 |
| CY | Cyprus | 0.10 | 0.48 | 1.66 | 6.25 | 80.49 | 64.81 |
| DE | Germany | 0.10 | 0.47 | 1.70 | 6.22 | 102.87 | 71.75 |
| DK | Denmark | 0.11 | 0.46 | 1.53 | 6.27 | 117.33 | 77.21 |
| EE | Estonia | 0.10 | 0.39 | 1.49 | 5.13 | 132.68 | 78.00 |
| EL | Greece | 0.10 | 0.44 | 1.64 | 5.79 | 170.98 | 198.47 |
| ES | Spain | 0.09 | 0.43 | 1.57 | 6.01 | 250.39 | 235.92 |
| FI | Finland | 0.09 | 0.38 | 1.45 | 6.08 | 82.25 | 45.16 |
| FR | France | 0.10 | 0.46 | 1.62 | 5.79 | 133.65 | 106.84 |
| HR | Croatia | 0.10 | 0.44 | 1.57 | 5.68 | 95.27 | 58.74 |
| HU | Hungary | 0.10 | 0.45 | 1.65 | 5.92 | 65.49 | 68.75 |
| IE | Ireland | 0.11 | 0.50 | 1.40 | 5.64 | 86.62 | 51.45 |
| IT | Italy | 0.10 | 0.44 | 1.63 | 6.11 | 109.22 | 87.96 |
| LT | Lithuania | 0.10 | 0.40 | 1.53 | 5.60 | 94.18 | 74.17 |
| LU | Luxembourg | 0.11 | 0.46 | 1.75 | 5.44 | 65.87 | 49.61 |
| LV | Latvia | 0.11 | 0.37 | 1.53 | 5.52 | 31.74 | 65.54 |
| MT | Malta | 0.00 | 0.00 | 1.35 | 7.63 | 130.73 | 126.22 |
| NL | Netherland | 0.11 | 0.46 | 1.63 | 6.14 | 126.48 | 99.33 |
| NO | Norway | 0.10 | 0.43 | 1.53 | 5.88 | 78.70 | 53.52 |
| PL | Poland | 0.10 | 0.47 | 1.67 | 5.71 | 89.05 | 69.00 |
| PT | Portugal | 0.08 | 0.44 | 1.61 | 6.21 | 98.22 | 68.27 |
| RO | Romania | 0.10 | 0.44 | 1.71 | 5.88 | 63.77 | 89.27 |
| SE | Sweden | 0.10 | 0.41 | 1.48 | 5.97 | 99.74 | 69.17 |
| SI | Slovenia | 0.10 | 0.48 | 1.69 | 5.71 | 70.96 | 37.44 |
| SK | Slovakia | 0.09 | 0.45 | 1.74 | 6.04 | 73.61 | 50.54 |
| Average | | 0.10 | 0.45 | 1.62 | 5.94 | 123.10 | 100.00 |

Table A4

**Changes in population density of the inhabited grids of the countries studied by population density and population change categories, 2021 (2011 = 100%)**

| Country code/name | | Population loss | | | | |
|---|---|---|---|---|---|---|
| | | first | second | third | fourth | upper outliers |
| | | quarter | | | | |
| AT | Austria | 73.0 | 86.5 | 92.4 | 95.5 | 97.3 |
| BE | Belgium | 69.2 | 85.9 | 92.4 | 96.2 | 96.2 |
| BG | Bulgaria | 4.4 | 25.1 | 57.7 | 71.6 | 91.7 |
| CH | Switzerland | 75.3 | 82.0 | 92.4 | 95.5 | 97.7 |
| CZ | Czech Republic | 56.4 | 84.8 | 91.1 | 93.9 | 95.2 |
| CY | Cyprus | 22.0 | 51.3 | 82.4 | 85.6 | 99.7 |
| DE | Germany | 58.7 | 81.2 | 90.9 | 93.8 | 96.9 |
| DK | Denmark | 75.0 | 85.6 | 91.4 | 95.2 | 96.3 |
| EE | Estonia | 66.1 | 79.8 | 88.0 | 91.6 | 96.5 |
| EL | Greece | 26.9 | 64.4 | 74.4 | 80.0 | 98.7 |
| ES | Spain | 6.0 | 33.9 | 66.7 | 80.5 | 97.2 |
| FI | Finland | 73.1 | 83.9 | 88.8 | 90.5 | 96.6 |
| FR | France | 62.4 | 83.7 | 90.2 | 92.3 | 93.6 |
| HR | Croatia | 51.4 | 16.3 | 82.5 | 87.3 | 92.3 |
| HU | Hungary | 21.0 | 45.1 | 75.2 | 87.3 | 91.6 |
| IE | Ireland | 74.1 | 80.4 | 92.8 | 95.3 | 99.1 |
| IT | Italy | 16.5 | 49.7 | 73.3 | 86.5 | 96.0 |
| LT | Lithuania | 58.5 | 74.6 | 82.2 | 87.4 | 91.2 |
| LU | Luxembourg | 29.1 | 51.2 | 78.6 | 80.9 | 91.3 |
| LV | Latvia | 62.5 | 78.2 | 84.3 | 87.1 | 92.3 |
| MT | Malta | 41.7 | 25.2 | – | 75.9 | 94.5 |
| NL | Netherland | 69.7 | 83.4 | 88.0 | 93.6 | 97.2 |
| NO | Norway | 74.2 | 86.8 | 92.0 | 95.6 | 97.3 |
| PL | Poland | 58.0 | 79.9 | 87.2 | 90.7 | 86.4 |
| PT | Portugal | 66.6 | 78.1 | 85.9 | 91.5 | 98.3 |
| RO | Romania | 13.8 | 50.0 | 78.8 | 87.4 | 84.5 |
| SE | Sweden | 72.5 | 86.9 | 93.1 | 93.0 | 96.7 |
| SI | Slovenia | 78.1 | 88.0 | 93.5 | 95.3 | 96.5 |
| SK | Slovakia | 37.6 | 76.8 | 90.7 | 93.7 | 91.4 |
| Average | | 17.3 | 55.4 | 81.2 | 89.3 | 93.9 |

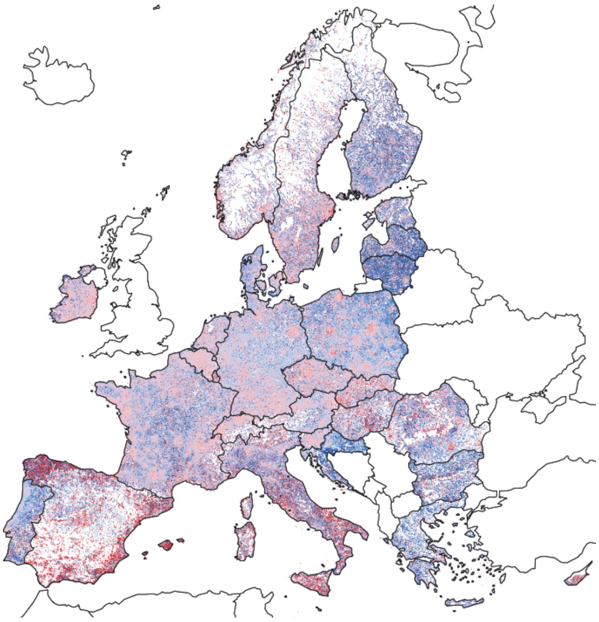
*(Table continues on the next page.)*

*(Continued.)*

| Country code/name | | Population growth | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | first | second | third | fourth | upper outliers | |
| | | quarter | | | | | |
| AT | Austria | 113.0 | 109.0 | 108.4 | 110.2 | 109.0 | 111.6 |
| BE | Belgium | 127.3 | 114.6 | 109.7 | 106.8 | 106.8 | 105.4 |
| BG | Bulgaria | 115.0 | 120.2 | 117.4 | 117.2 | 104.9 | 94.5 |
| CH | Switzerland | 119.1 | 114.7 | 110.3 | 112.5 | 108.3 | 108.4 |
| CZ | Czech Republic | 123.1 | 116.3 | 111.7 | 110.4 | 105.3 | 96.0 |
| CY | Cyprus | 145.9 | 143.5 | 122.7 | 121.4 | 103.3 | 101.7 |
| DE | Germany | 116.1 | 110.7 | 107.9 | 108.3 | 109.6 | 110.6 |
| DK | Denmark | 113.0 | 108.4 | 109.4 | 109.6 | 119.1 | 123.2 |
| EE | Estonia | 120.2 | 116.5 | 111.1 | 111.1 | 108.7 | 109.8 |
| EL | Greece | 118.2 | 119.1 | 115.9 | 113.9 | 102.4 | 101.8 |
| ES | Spain | 110.2 | 131.6 | 129.1 | 122.0 | 100.0 | 97.7 |
| FI | Finland | 116.7 | 111.3 | 110.9 | 114.1 | 111.4 | 116.7 |
| FR | France | 116.8 | 113.0 | 112.4 | 112.2 | 107.2 | 99.6 |
| HR | Croatia | 112.3 | 109.4 | 107.3 | 106.8 | 102.0 | 95.4 |
| HU | Hungary | 128.2 | 126.6 | 120.0 | 112.7 | 104.2 | 92.3 |
| IE | Ireland | 123.1 | 114.6 | 112.4 | 115.4 | 112.4 | 114.3 |
| IT | Italy | 136.2 | 131.9 | 121.7 | 112.6 | 104.0 | 100.3 |
| LT | Lithuania | 116.3 | 116.9 | 124.3 | 119.9 | 102.6 | 94.0 |
| LU | Luxembourg | 120.3 | 152.5 | 131.9 | 126.9 | 129.5 | 131.5 |
| LV | Latvia | 119.7 | 114.8 | 114.6 | 115.4 | 110.1 | 92.0 |
| MT | Malta | – | – | 141.6 | 128.0 | 118.7 | 118.2 |
| NL | Netherland | 113.8 | 112.7 | 110.7 | 110.5 | 107.6 | 107.0 |
| NO | Norway | 120.3 | 115.3 | 117.2 | 119.2 | 123.6 | 128.6 |
| PL | Poland | 117.4 | 113.7 | 111.4 | 114.5 | 110.1 | 88.7 |
| PT | Portugal | 116.1 | 110.9 | 108.6 | 107.0 | 103.0 | 103.2 |
| RO | Romania | 120.5 | 119.5 | 114.7 | 114.1 | 119.6 | 82.5 |
| SE | Sweden | 118.7 | 114.1 | 113.4 | 112.7 | 111.9 | 113.6 |
| SI | Slovenia | 115.0 | 111.5 | 109.4 | 108.7 | 103.1 | 102.2 |
| SK | Slovakia | 117.5 | 115.6 | 111.5 | 109.9 | 110.1 | 95.7 |
| Average | | 117.7 | 115.3 | 112.5 | 111.9 | 105.3 | 100.1 |

Figure A5

Population of Europe, 2031 (2021 = 100%)

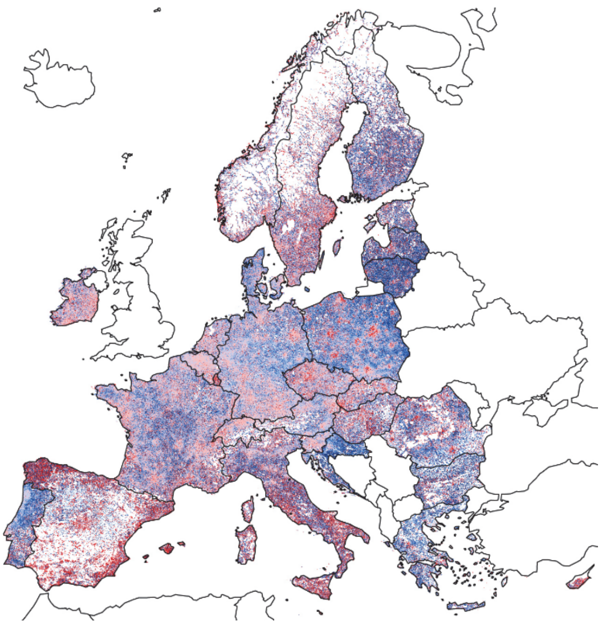


%

| | |
|---|---|
| | 0– 50 |
| | 51– 75 |
| | 76–100 |
| | 101–150 |
| | 151–200 |

Figure A6

Population of Europe, 2041 (2021 = 100%)

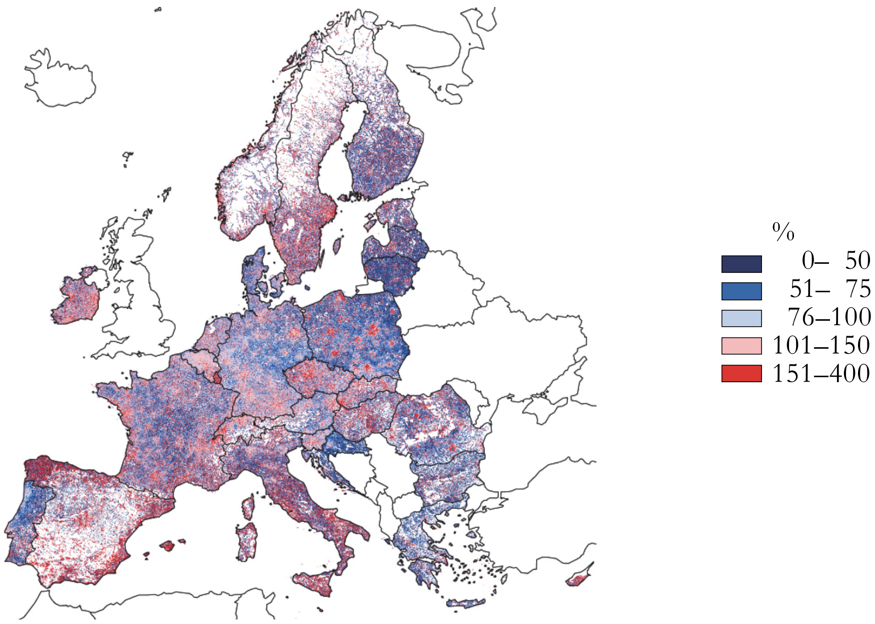


%

| | |
|---|---|
| | 0– 50 |
| | 51– 75 |
| | 76–100 |
| | 101–150 |
| | 151–300 |

Figure A7

Population of Europe, 2051 (2021 = 100%)

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