ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

FINAL REPORT //

Territorial impacts of COVID-19 and policy answers in European regions and cities

Territorial impacts of COVID-19 and policy answers in European regions and cities (TERRCOV)

Final report // June 2022

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Coordination
Michaela Gensheimer, Andreea China, Stefania Rigillo, ESPON EGTC (Luxembourg)
Sebastién Bourdin, Mohamed Hachaichi, EM Normandie Business School (France)

Authors
Sébastien Bourdin, Mohamed Hachaichi, EM Normandie Business School (France)
John Moodie, Nora Sánchez Gassen, Nordregio (Sweden)
András Igari, Hajnalka Lőcsei, HÉTFA Research Institute (Hungary)
Mounir Amdaoud, Giuseppe Arcuri, Nadine Levratto EconomiX (France)

Advisory group
Luisa Pedrazzini, ESPON Monitoring Committee member (Italy), Terézia Somhegyi, ESPON Monitoring Committee member (Hungary), Francesco Molica, Conference of Peripheral Maritime Regions – CPMR, Igor Caldeira, Committee of the Regions – COR, Nicolas Reynes, European Confederation of Local Intermediate Authorities – CEPLI, Quentin Delhaye, CEPLI, Association des Provinces Wallonnes – APW (Belguim), Andreas Listing, CEPLI, Region Hannover (Germany)

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Contact: info@espon.eu

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Glossary

Term	Definition
Excess mortality	Excess mortality refers to the number of fatalities from all causes reported during a crisis over what might be considered a 'normal' regime compared to a historical base from the year before the pandemic. Excess mortality is a more comprehensive measure of the total impact of the pandemic on deaths than the confirmed COVID-19 death count alone. It captures not only the confirmed deaths, but also COVID-19 deaths that were not correctly diagnosed and reported, as well as deaths from other causes that are attributable to the overall crisis conditions.
Death rate	Used interchangeably 'death rate' or 'mortality rate' in the scientific literature. The mortality rate is a measure of the number of deaths (in general or due to a specific cause) in a particular population, scaled to the size of that population, per unit of time. Mortality rate is typically expressed in units of deaths per 1,000 individuals per year.
Case fatality ratio	In epidemiology, the case fatality rate, also known as case fatality risk or case fatality ratio, is the proportion of persons who die from a particular illness among all individuals diagnosed with the condition during a given period. The case fatality rate is often employed as a measure of disease severity and is frequently used for prognosis (predicting illness course or outcome), with higher rates indicating unfavourable outcomes. The case fatality rate is derived by dividing the number of deaths from a specific disease during a given time by the number of people diagnosed with the condition during that period; the resultant ratio is then multiplied by 100 to obtain a percentage.
Response measures	Also referred to as non-pharmaceutical interventions represent the set of measures taken by countries or regions to control a given crisis. These response measures can take different forms, such as total lockdown or stay at home recommendation for the vulnerable population, especially the elderly (including those with chronic health issues, and physically disabled people); gathering cancellation (of specific events, shops, and sports); closure of public spaces (restaurants, entertainment, sports,); closure of educational institutions (including nursery or day-care, and primary schools, secondary schools, higher education, and universities); obligation of the use of protective masks in public spaces and public transport.
Proactive measure/approach	Are defined as policy actions driven by the unique contextual and socioeconomic circumstances of the pandemic in order to advance specific regional and local spatial planning and territorial policy goals related to just, green and smart transitions. These proactive actions are long-term actions that aim to anticipate possible future crises.
Window of opportunity	A window of opportunity, often known as the crucial window, is a brief period of time (regardless of the presence of a crisis) during which some action can be made to accomplish the desired outcome. Once this period has expired or the 'window has closed', the option to seize it is no longer available, or it will take a longer time to achieve the desired outcome.
COVID-19 determinants	A set of regional socioeconomic (income, unemployment, youth unemployment, at risk of poverty, GDP per capita, population density, poverty, education, governance index, medical doctors, hospital beds, etc.) and geographical (urban, rural, border, coastal, metropolitan) attributes that may explain the propagation and the spread of the virus and highlight why some regions were hit more than others.
Spatial econometrics	A field of research where econometric and spatial analysis intersect. Spatial econometrics models can be used to assess neighbourhood effects (spatial spillover effects) for example. Such methodology is used in regional science, real estate economics, education economics, housing and many other fields.
Exploratory Spatial Data Analysis (ESDA)	Exploratory spatial data analysis (ESDA) is an extension of exploratory data analysis (EDA) to the challenge of finding geographic features of data sets with locational data for each attribute value. This geographic data refers to the point or area to which the attribute relates.
Local Indicators of Spatial Association (LISA)	The method can trigger the existence of clusters on the spatial arrangement of a given variable. The technique is widely used in studying geographical patterns of various phenomena (income disparities, homicide rates, urban segregation, etc.).
Deprivation index (DI)	The Deprivation Index (DI) is a composite measure of area level deprivation based on many socioeconomic parameters that are gathered and used to evaluate socioeconomic heterogeneity between regions. This index is usually used to spot areas with 'social disadvantage', highlighting the idea that poverty is a multi-faceted issue.

Term	Definition
Just transition	A set of policies aiming to provide social support to different population groups during the pandemic focused on target groups such as children, the elderly, people at risk of poverty, immigrants, the homeless, and women. It also concerns policies that support different types of businesses to avoid bankruptcies and safeguard jobs, including investments in infrastructure leading to business opportunities and job creation.
Green transition	A set of policies aiming at the protection of the environment including reducing greenhouse gases by promoting active mobility modes such as cycling and walking, reducing the dependence on private cars. It also concerns supporting business in the transition to a green economy by promoting sustainable and efficient waste management and integrating the circular economy principles within the production/consumption processes.
Smart transition	A set of policies aiming to promote and improve the digitalisation of the administration and public services including administration (E-governance), education, healthcare, transport (e-ticketing and mobile apps). It also concerns producing the tools and skills required to analyse big data.

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1 Introduction

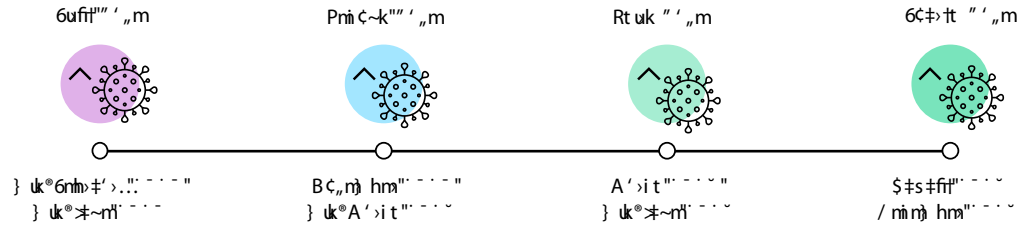
Background and context of the study

The COVID-19 pandemic had a major impact on all facets of life. As of May 16, 2022, there were 521 million COVID-19 cases and 6.26 million deaths worldwide (WHO, 2022a). In the past two years (2020–2022), the global health crisis has driven considerable changes in global supply chains, the labour market, eating habits, communication approaches, travelling patterns, education traditions and working methods, influencing practically every element of our daily living. In the European space, European regions and municipalities are placed on the frontline in facing the pandemic and they have seen substantial changes where the impactions of human capital may have long-term ramifications considering physical and mental health. Aside from COVID-19's health and human catastrophes, the pandemic has precipitated the worst economic crisis since World War II (OECD, 2020a). While assessing the full impacts of COVID-19 is still premature, examining the first consequences of the pandemic can reveal some regional disparities between and within European countries. Examining such regional disparities can help in orchestrating a set of proactive policies to better manage the current pandemic, but also to develop resilience for future pandemics.

During the initial wave of the pandemic across European regions, an ESPON study on COVID-19 (ESPON GEOCOV)[1] aimed to identify factors to explain why some territories were hit more than others. This study showed **(i)** how the circulation of the virus affected healthcare systems during the first months of the outbreak and **(ii)** the kinetics of the epidemic across European regions. This study identified links between the spread of the disease and variables likely to influence it, such as density, types of territories (urban/rural), the structure of the population, and regional socioeconomic characteristics. Based on 35 case studies, the results showed how public authorities have been called upon to provide emergency services to the population and mitigate as far as possible the impact of COVID-19 on economies and societies.

The ESPON TERRCOV project takes the analysis a step further by studying subsequent waves, highlighting social consequences at the sub-regional level and producing an in-depth study of local policy responses to mitigate the effects of the pandemic. However, EU Member States are still experiencing several waves, especially with the spread of the novel coronavirus mutated forms – namely, Alpha in September 2020 (Stadtmüller et al., 2021), Beta in May 2021, Gamma in November 2021, Omicron in November 2021, and Delta in October 2021 (ECDPC, 2022; WHO, 2022b)[2]. Overall, by June 2022, there have been four major waves in Europe. As illustrated in Figure 1, excess mortality refers to the number of fatalities from all causes reported during a crisis over what might be considered a 'normal' regime and compared to a historical base of a year prior to the pandemic. The indicator displays the magnitude of the pandemic, and it is currently being used within the European Statistical Recovery Dashboard.

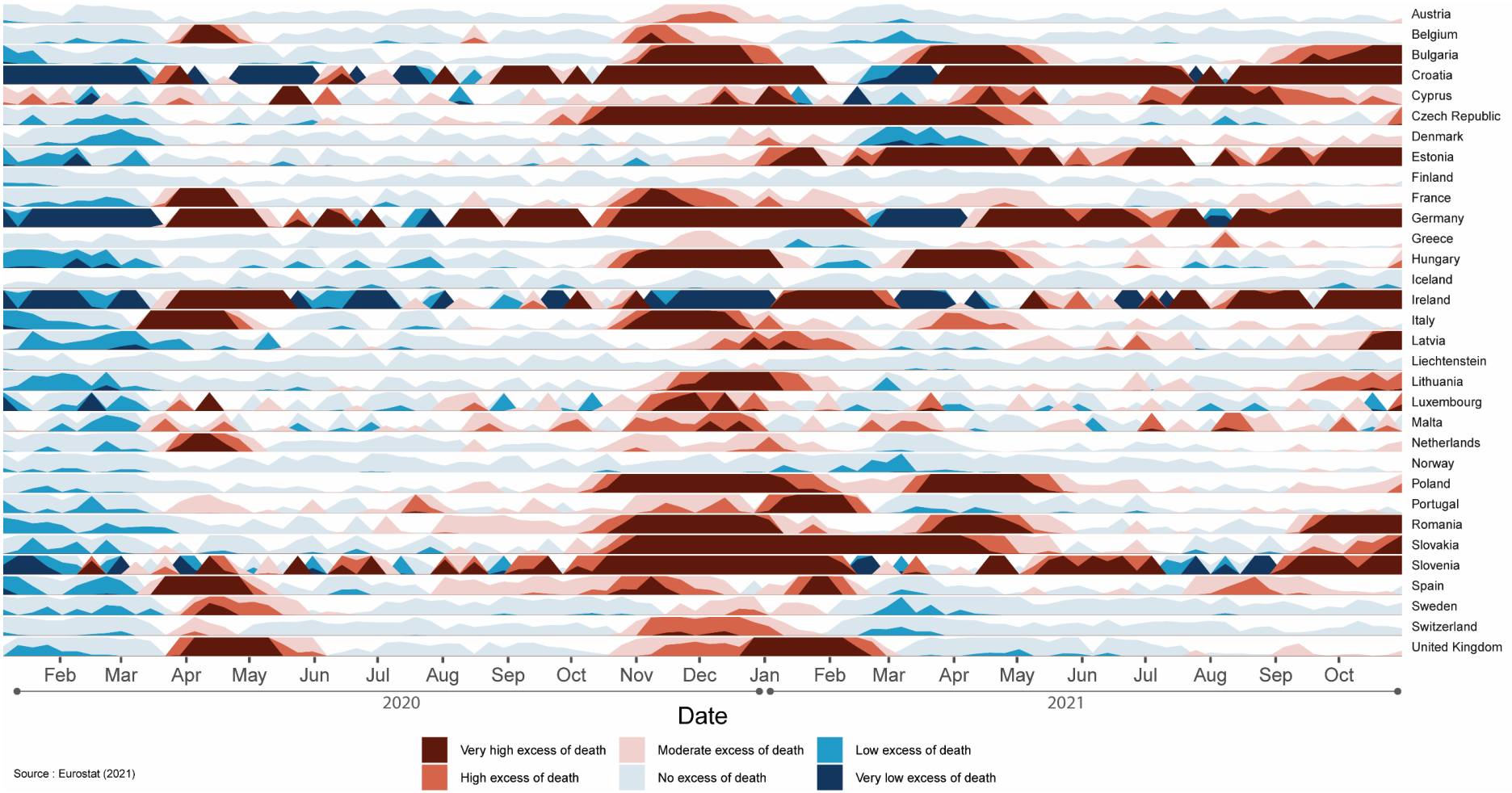
Throughout this report, we use the following timeframes to indicate the pandemic's waves across European space. Noticed that our study focusses only on the first three waves namely first, second and third wave.



[1] GEOCOV: Geography of COVID-19 outbreak and first policy answers in European regions and cities (https://www.espon.eu/geocov).

[2] European Centre for Disease Prevention and Control.

Figure 1 Evolution of excess mortality across European countries (Excess mortality per 10,000 inhabitants)

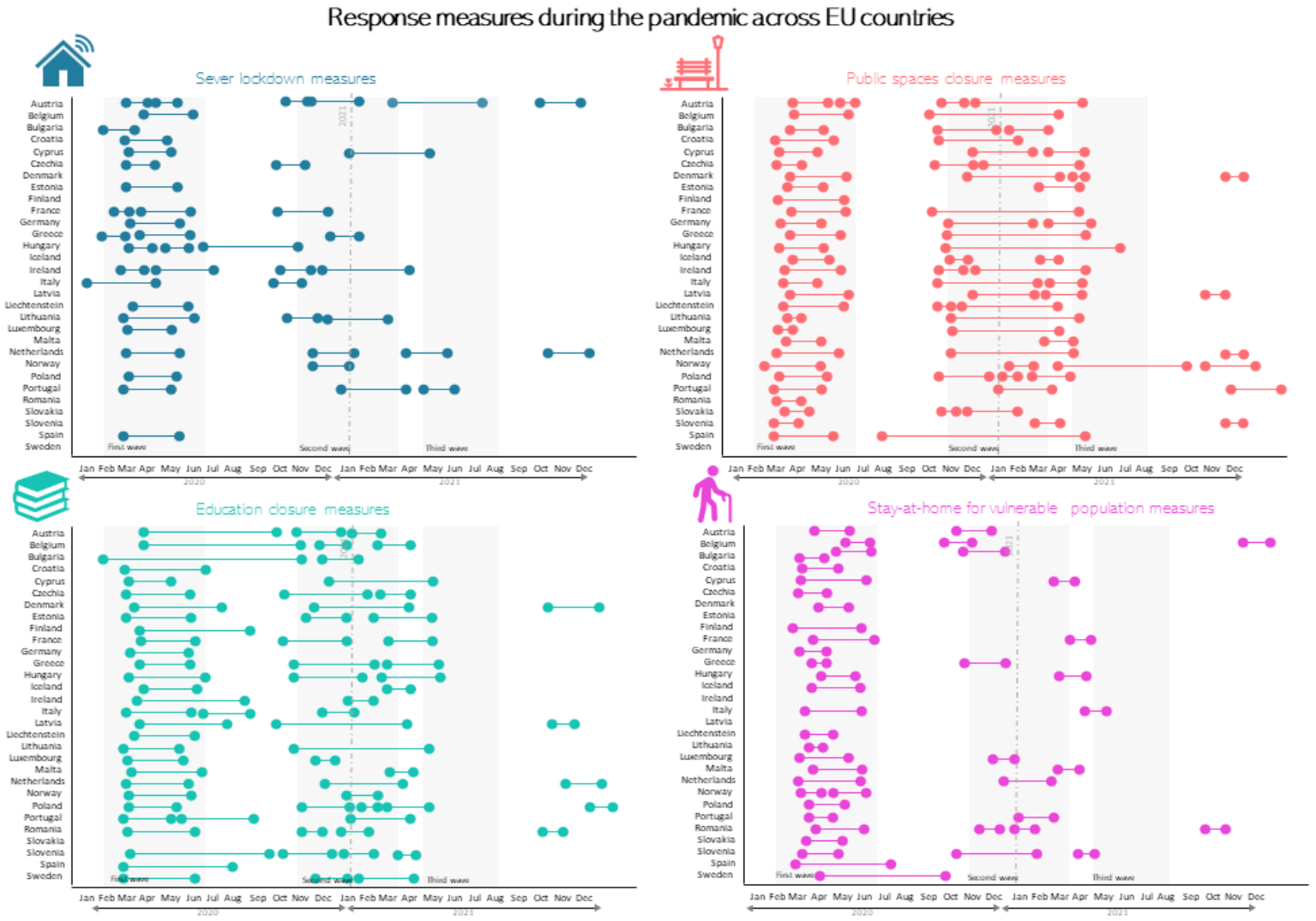


The risk of infection and the risk of developing serious forms of illness or dying are unequally distributed between territories (Jeanne et al., 2022). Preliminary findings show that COVID-19 has affected European regions differently, both in terms of magnitude and duration. Consequently, European regions have faced the pandemic distinctively and responded via a series of local lockdown measures[3] and policies while considering their geographical and institutional diversity. Italy – the first country to be massively affected by COVID-19 – confined its population (Figure 2) on 9 March 2020. Most other European countries gradually followed suit, adopting social distancing policies, the closure of nonessential businesses and border closures to limit the circulation of the virus (Bourdin et al., 2022).The idea that *the coronavirus affects us all equally* is certainly helpful for garnering support for the necessary prevention measures. However, this is patently false because this crisis has generated social and territorial inequalities[4]. Recent literature on this topic has highlighted different types of impacts (e.g. Bourdin et al., 2021; ESPON, 2020; Jeanne et al., 2022; Zhang and Schwartz, 2020). The socioeconomic impacts have also been analysed. The Nobel Price winner in economics Joseph Stiglitz (2020) states that 'COVID-19 is not an equal opportunity killer', and this is what we have tried to investigate by taking the European regions as an example.

[3] Data on country response measures to COVID-19: https://www.ecdc.europa.eu/en/publications-data/download-data-response-measures-COVID-19.

[4] Key findings of the Eurofound Living, Working and COVID-19 survey also support this claim regarding the first wave (https://www.eurofound.europa.eu/publications/report/2020/living-working-and-COVID-19). McKinsey & Co. Well-being in Europe: Addressing the high cost of COVID-19 on life satisfaction (https://www.mckinsey.com/featured-insights/europe/well-being-in-europe-addressing-the-high-cost-of-COVID-19-on-life-satisfaction).

Figure 2 Country-level response measures to COVID-19



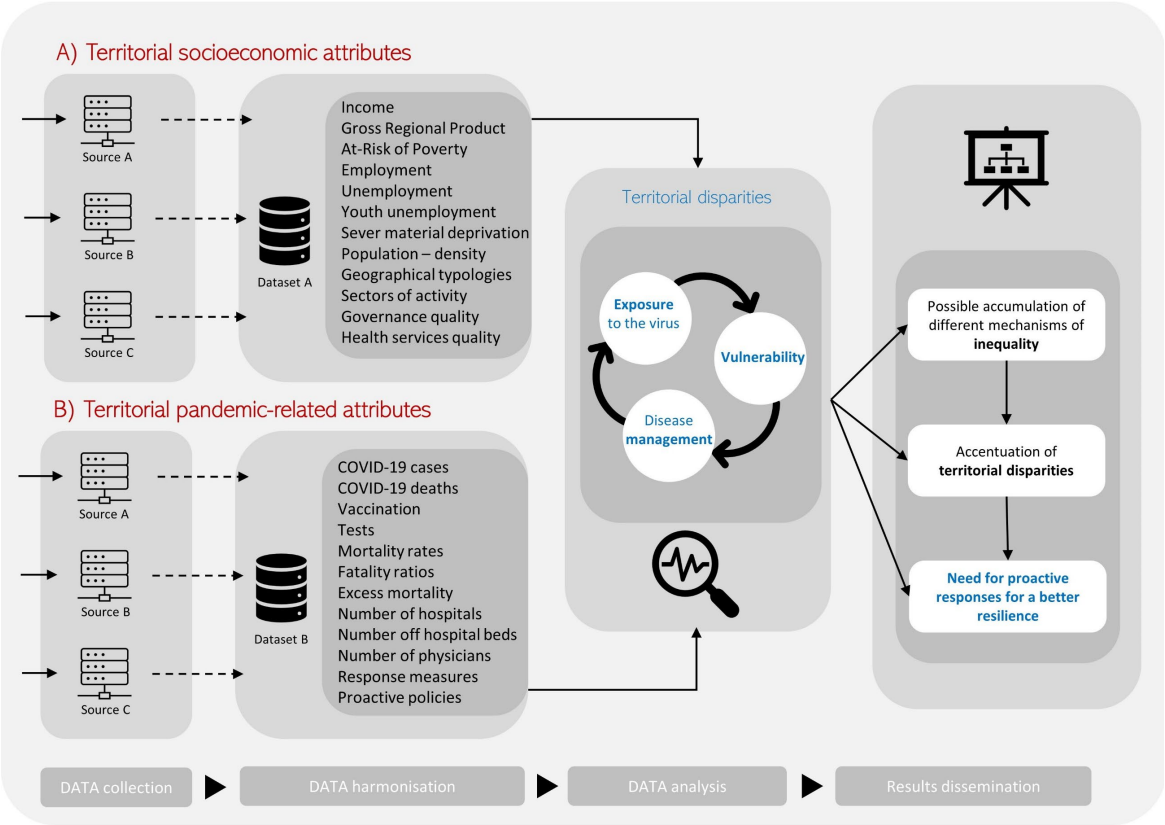
COVID-19 and the health measures established to contain its spread are having a variety of disruptive impacts on people's lives and on the functioning of cities, metropolitan areas and regions. Containment measures have led to abrupt changes in the way people work, study, shop, socialise and travel. The results of these measures have been detrimental in many ways, including people losing their jobs or having to make ends meet with reduced incomes. However, the pandemic has also had potentially positive effects on e-governance. Initial interim analyses showed that the digital transition could be accelerated, as increased digital service provision can lead to long-term innovation. On the other hand, the pandemic appears to have stimulated the development of soft and sustainable mobility where containment measures were in place. Therefore, it is highly important to maintain such green mobility pattern in a post-containment period.

Therefore, to help repair the economic and social damage caused by the pandemic, boost European recovery, and protect and create jobs, the European Commission proposed NextGenerationEU[5] in May 2020, a major recovery plan for Europe based on tapping the full potential of the EU budget. Its main instrument, the Recovery and Resilience Facility, is designed 'to mitigate the economic and social impact of the coronavirus pandemic and to make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions'. Most European regions benefit from this recovery plan, as well as national plans. The regions have put in place measures focused on four priorities: (i) limiting the spread of the virus, (ii) ensuring the supply of medical equipment, (iii) promoting research into treatments and vaccines and (iv) combating social inequalities, thereby supporting employment, businesses and the economy. The ESPON GEOCOV study shows that EU cities and regions generally reacted to the COVID-19 crisis via a dominance of emergency measures designed for the short term, such as those targeted at supporting the local economic fabric. Only a few measures can be described as 'long term' or 'proactive'. These proactive actions aim to anticipate possible future crises. Following the previous ESPON GEOCOV study based on case studies, we analysed the initiatives taken at the regional and local levels to use and capitalise on the COVID-19 crisis as a 'window of opportunity'. This includes analyses of the direct and indirect social consequences of containment measures and, more generally, of the results and added value of 'proactive measure' policy approaches.

Hence, we designed a conceptual framework that guided this study (Figure 3). To draw up the geography of the COVID-19 pandemic, Quinn (2014) recommends mobilising different socioeconomic factors to explain territorial disparities in terms of exposure to the virus. It is also possible to mobilise data relating to the health system (hospital beds, physicians), as they may be a determining factor in the management of the pandemic crisis. The accumulation of socioeconomic inequalities due to the pandemic and containment measures make the current health crisis a strong indicator of territorial and socioeconomic inequalities (Amdaoud et al., 2020a), with the possibility of accumulation of different mechanisms of inequality (Bourdin et al., 2021). In this context, it is crucial to be able to develop proactive responses to counter the negative effects of the pandemic and to improve the resilience of cities and regions. A key point is to ascertain whether identified good practices can be upscaled and transferred to other regions and cities.

[5] https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en

Figure 3 Conceptual framework to analyse pandemic geography across European regions



2 COVID-19 in the EU: Geography and drivers

2.1 The spatiotemporal diffusion patterns of COVID-19

In the following chapter, two main aspects of the spatial pattern of the COVID-19 pandemic are examined. While the first examines the spatiotemporal pattern and geographical aspects of COVID-19 diffusion, the second looks at the European-level inequalities of mortality of each wave separately.

The spatiotemporal pattern of the COVID-19 pandemic varies considerably among the different major regions and regional typologies of Europe. Europe was divided into six **major regions** for analysis:

- North (Denmark, Finland, Iceland, Norway, Sweden)
- The British Isles (Ireland, United Kingdom)
- West (Belgium, France, Luxembourg, Netherlands)
- South (Cyprus, Greece, Italy, Malta, Spain, Portugal)
- West-Central (Austria, Germany, Liechtenstein, Switzerland)
- East-Central (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia)

We analysed the outermost territories separately (French Overseas Territories, Canary Islands, Madeira and the Azores).

As far as **regional typologies** are concerned, we examined nine types of regions of the regional typologies in Eurostat's methodology, the predominantly urban, intermediate, predominantly rural, metropolitan, border, coastal, mountainous regions and islands. Sparsely populated areas were also included in the study due to their special geographical situation. Eurostat (2019) defines these typologies at the NUTS 3 level based on geographical and social characteristics[6].

2.1.1 The spatiotemporal dynamics of COVID-19 based on number of reported cases

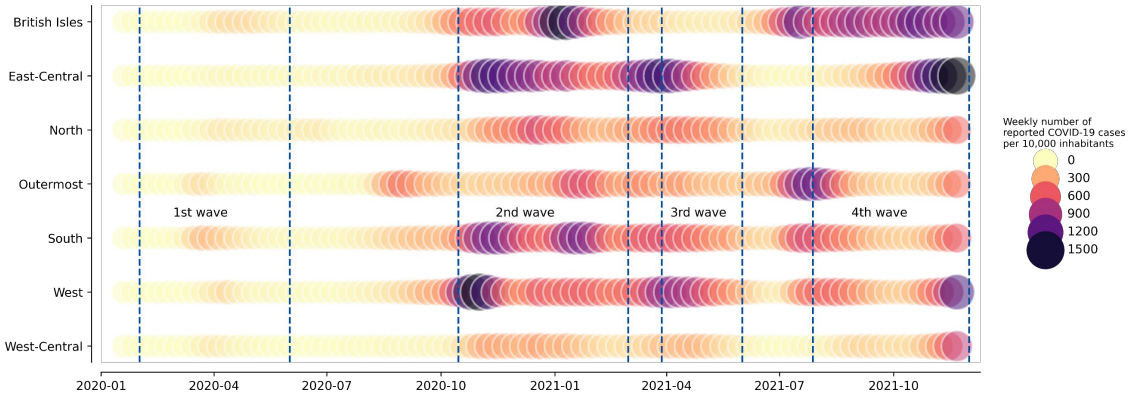
As COVID-19 spreads from person to person, its diffusion adapts to population flows and human mobility, first, in major transport hubs (major airports and other logistic/mobility hubs, capitals, tourist areas), then smaller centres, and finally, rural or peripheral areas (according to the so-called hierarchical diffusion model). The model of hierarchical diffusion is spotted during the first wave, where metropolitan regions were the first affected; peripheral areas were only affected later at the European and national levels (Amdaoud et al., 2021; Bogoch et al., 2020; Bourdin et al., 2021; Brockmann, 2021; Gatto et al., 2020). However, later in the first wave, the neighbourhood effects[7] became more important (this is the so-called contagious-type diffusion) (Childs et al., 2015; Haggett, 2001; Igari, 2021; Kincses and Tóth, 2020; Morrill et al., 2020).

Taking the models of hierarchical and contagious-type diffusion as a starting point, we examined how (when and how heavily) COVID-19 hit each major European region and regional typology based on the **number of reported cases**. Despite the fact that the collection of these data has been widely criticised and the number of reported cases depends largely on the testing policy in each country, we still use this indicator. This is because it is the only objective way to capture the regional inequalities in the spatial diffusion of the pandemic, since other indicators may depend on several other characteristics and further explain the vulnerability of a region and the resilience of the health sector rather than just the spatial diffusion of the pandemic. However, to respond to criticisms about the number of cases reported, the analysis below does not focus on comparing the pandemic curves of different countries and major regions, but on the spatiotemporal dynamics of the spread of the pandemic in Europe.

[6] https://ec.europa.eu/eurostat/fr/web/products-manuals-and-guidelines/-/ks-gq-18-008

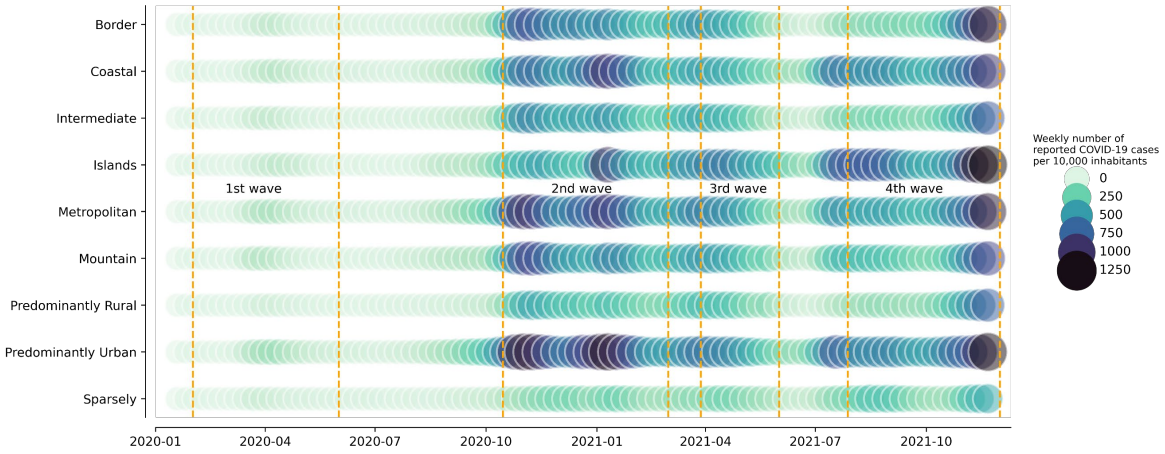
[7] In economics, social and regional sciences, the “neighbourhood effects” supposes that neighbours (regions in this study) can have an influence on local behaviours whether directly or indirectly which means that the neighbours have similar values and characteristics. In this study, this means that in neighbouring regions the spatiotemporal pattern of the spread of the novel coronavirus is similar.

Figure 4 Weekly reported cases of COVID-19 per 10,000 inhabitants in the major regions of Europe (3rd week of 2020–46th week of 2021)



As shown in the Figure 4 major regions in Europe were hit by the pandemic at different times. In fact, the waves overlapped in time: in the British Isles, the third wave of the pandemic peaked in January 2021, while in East-Central Europe, the second wave was still in its declining phase. Likewise, the fourth wave reached the British Isles and the southern and western parts of Europe much earlier than the eastern regions. At the European level, we found that the pandemic first appeared in the central part of Europe (the British Isles and Southern and Western Europe), which are the most connected to global networks. In contrast, in the peripheral regions of Europe – mainly East-Central and Northern Europe – there was a delay of several weeks before the onset of an outbreak.

Figure 5 Weekly reported cases of COVID-19 per 10,000 inhabitants in the types of regions in Europe (3rd week of 2020–46th week of 2021)



There was a tendency for the infection rates to fluctuate differently during the pandemic, not only among the major regions of Europe but also among each regional typology (Figure 5). The island, coastal, mountain, border, predominantly urban and metropolitan regions were the most infected regional typologies at different times. In particular, the pandemic touched faster predominantly urban and metropolitan regions than those of the predominantly rural and sparsely populated regions. This means that more urbanised regions tend to be affected by pandemic waves earlier than rural and peripheral areas. The time shift between urban and rural areas is not only meaningful at the European level, but also within countries: the COVID-19 waves appeared first in the main cities and then in their agglomerations, followed later by rural areas.

Nevertheless, it should be noted that there is a connection between the regional typologies and the major European regions: Each wave of COVID-19 appeared first in the most urbanised western regions (the British Isles and Southern and Western Europe). This has also affected coastal and island regions, as these parts of Europe have many of these types of regions. In contrast, the East-Central European countries (where there is an above-average number of predominantly rural regions) were hit later by the pandemic waves, while in the north, presumably not independently of the low population density, COVID-19 not only appeared

later but also caused fewer cases. All in all, this means that the pandemic waves first appeared in the central regions and then spread from there to the peripheral areas both, on a European and a national scale.

It is well established in the scientific literature that European countries and regions have experienced different COVID-19 waves, considering their geographical location and their local dynamics (tourism, transport infrastructure, population density, regional typologies, etc.). While setting the initial parameters at a continental scale (timeframe for each wave) can help to reduce the complexity and harmonise the analysis of the pandemic in a cross-country comparative approach, several limitations are to be encountered: (i) aggregating microdata (NUTS3 level) to the national scale (NUTS0 level) can lead to flattening regional representativeness, (ii) setting timeframe at the national level can lead to false allocation (i.e. some regions have experienced a delayed and/or less intense COVID-19 waves, as the vast majority of regions have experienced COVID-19; therefore, there will be a false allocation to regions that had experienced a different COVID-19 pattern). However, national-level analysis is highly recommended to discern the attributes of regional local behaviour.

All of these limitations can lead to distorted results. To avoid such false conclusions, we analysed the pandemic dynamics within some selected countries (Box 1 to Box 6) from different European major regions (for further detailed insights of all the countries, see annex 1 – Spatial diffusion of COVID-19[8]) to capture how regions of the same country have experienced the pandemic waves. In our analysis, we found that different countries have experienced different COVID-19 waves, for instance, while Ireland (Box 2), France (Box 3), Italy (Box 4), Austria (Box 5) all experienced a first wave peak in late March 2020, Romania (Box 6) experienced the first peak in late October 2020. We also found that not all the countries were subject to the same hierarchical diffusion of the pandemic across regions of the same country, where the most hit regions were predominantly urban, then intermediate and predominantly rural regions.

On the one hand, France (Box 3) experienced a hierarchical diffusion of the pandemic where urban/metropolitan regions were hit earlier than rural or peripheral regions. The predominantly urban regions in France counted – across the three first waves – 43% of the total number of COVID-19 infections, followed by intermediate regions with 35%, and predominantly rural areas with 22% of the total number of COVID-19 cases across all French regions. However, when considering regional characteristics and population, we found that, while French predominantly rural regions represent 55% of the total regions, they only host 29% of the French total population. Although French predominantly urban areas represent only 15% of the total regional structure of France, they host the highest share of the country's population (estimated to 35% in 2020).

On the other hand, Austria (Box 5) has not experienced a hierarchical diffusion from urban to intermediate and rural regions, where the first hit regions with the highest COVID-19 infection cases during the first wave were spotted in rural areas such as Tiroler Unterland, Tiroler Oberland, and Pinzgau-Pongau. Contrary to France and during the three first waves, Austrian rural regions were the most hit by the virus, accounting for 44% of the total infections, while urban regions accounted for 28%. Again, population dynamics and typological regional dominance in a given country play a significant role in defining the spatial diffusion of the pandemic across European regions.

The local development of COVID-19 infections across European countries did not follow the same trend across the three pre-defined waves. While the vast majority of countries such as Sweden (Box 1), and France (Box 3) have experienced downward trends in the number of COVID-19 infection cases from the second to the third wave, other countries such as Ireland (Box 2), and Austria (Box 5) experienced an upward trend in total infection cases. Such findings corroborate the fact that each European country has experienced different waves but during different timeframes and for a fully comprehensive analysis, countries should be analysed internally, where comparability among European countries will not be possible.

Some general conclusions can be drawn from these case studies. First, not all European countries were affected by the pandemic at the same magnitude and during the same timeframe. Second, not all European countries share the same diffusion pattern of the virus. Third, not all urban European regions were severely hit by the virus. To summarise, the COVID-19 infection cases are more dependent on the regional population and regional dynamics (economic structure, tourism, etc.) than on regional typologies (urban, rural and intermediate).

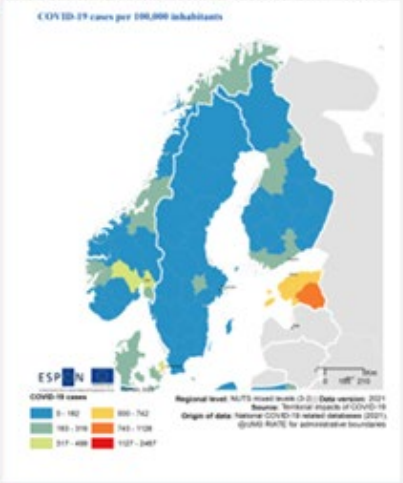
[8] In each box below, the figure on the right side of the box represents the number of cases per type of region and wave.

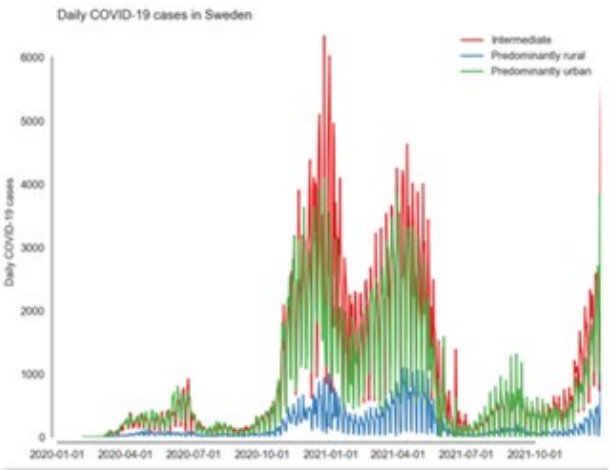
Box 1 Spatial diffusion of COVID-19 in the Northern regions (Sweden)

COVID-19 cases during the first wave

COVID-19 cases during the second wave

COVID-19 cases during the third wave





The figure shows the daily COVID-19 cases evolution by types of regions (urban, intermediate, and rural). During the study timeframe, Sweden saw mainly **four COVID-19 waves**; in which the first reached the peak on June, 16, 2020, the second on January, 11, 2021, the third on April, 17, 2021 and the fourth on November, 23, 2021.

During the first wave, both predominantly urban regions (e.g., Stockholms län and Västra Götalands län counting the highest number of COVID-19 infections) and intermediate regions (e.g., Östergötlands län, Södermanlands län, and Örebro län) were hit almost with the same magnitude; however, predominantly rural areas were less hit by the virus compared to other types of regions (e.g., Dalmas län and Jämtlands län).

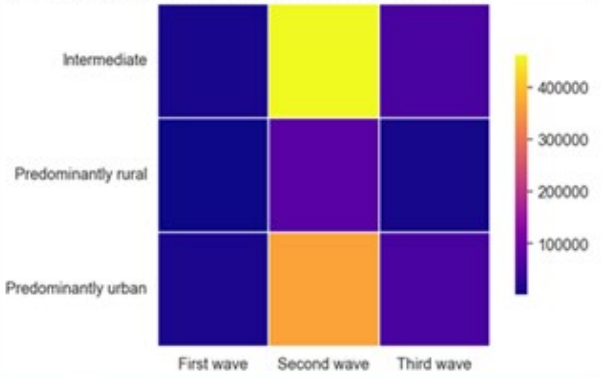
During the second wave, the virus spread to all Swedish regions. Intermediate regions (e.g., Skane län, Hallands län. and Jököpings län) were hit more than urban regions.

During the third wave, the infection number across regions decreases mostly because of the implementation of severe lockdown measures where urban and intermediate regions are hit almost with the same magnitude.

When taking population dynamics and regional characteristics into account, we found that urban areas represent 9% of Swedish regions and host 41% of the total Swedish population, while intermediate regions represent 70% and host 51% of the total population, and rural areas represent 24% and host only 8% of the total population. Therefore, intermediate regions are more likely to get hit by the virus considering their number and share of the total Swedish population.

Figure down below (the cube) shows COVID-19 cases magnitude during the three waves and disaggregated by types of regions.

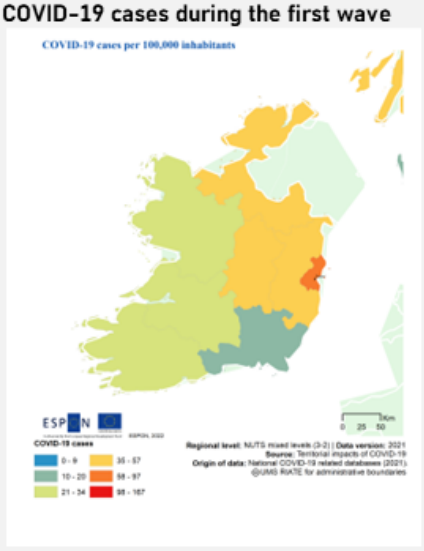
Overall, Swedish intermediate regions were the most hit by the virus (50.76% of the total cases), followed by predominantly urban (41.22%) and predominantly rural areas (8%), respectively.



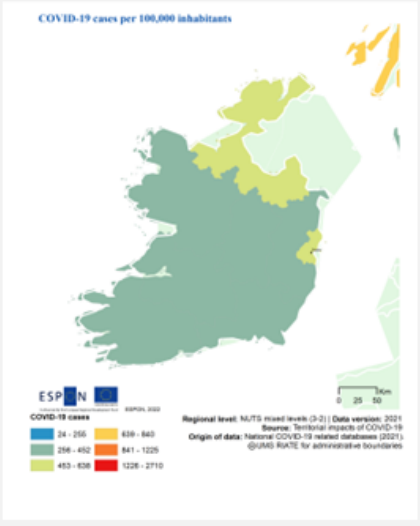
Total COVID-19 cases	Sweden	Number of regions	Data source
22-06-2022 2.51M		21 regions NUTS3 (2021)	COVID-19 European Regional Tracker

Box 2 Spatial diffusion of COVID-19 in the British Isles regions (Ireland)

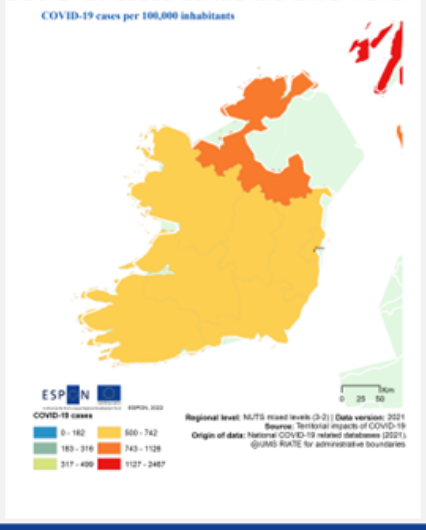
COVID-19 cases during the first wave

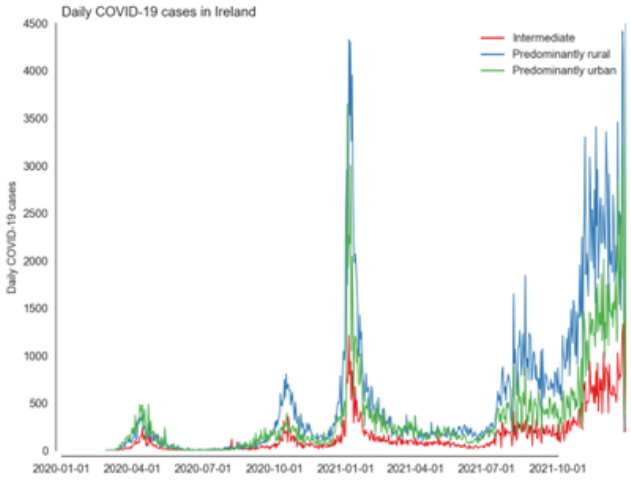


COVID-19 cases during the second wave



COVID-19 cases during the third wave





The figure shows the daily COVID-19 cases evolution by types of regions (urban, intermediate, and rural). During the study timeframe, Ireland saw mainly **five COVID-19 waves**; in which the first reached the peak on April, 05, 2020, the second on October, 08, 2020, the third on January, 21, 2021, the fourth on August, 13, 2021, and the fifth on November, 13, 2021.

During the first wave, both predominantly urban regions (e.g., Dublin) and predominantly rural regions (e.g., Border, South-West, and Mid-West) were hit almost with the same magnitude; however, intermediate regions were less hit by the virus compared to other types of regions (e.g., Mid-East).

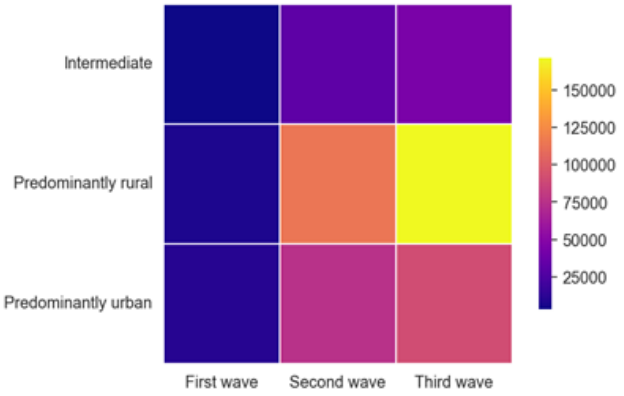
During the second wave the virus spread to all Irish regions. However, while the first wave touched severely urban regions, the second wave hit more rural regions (e.g., Border, South-West, Mid-West, and Midland).

During the third wave, and contrary to Sweden and France, the infection number in Ireland continues to increase following the same infections pattern of the second wave, meaning that rural regions (e.g., Border, South-West, and Mid-West) are still counting the highest infections numbers, followed by urban regions (e.g., Dublin).

While taking population dynamics and regional characteristics into account, we found that rural areas represent 75% of Irish regions and host 57% of the total Irish population, while intermediate regions represent 12.5% and host 15% of the total population, and urban areas represent 12.5% and host only 28% of the total population. Therefore, rural regions are more likely to get hit by the virus considering their number and share of the total Irish population.

Figure down below (the cube) shows COVID-19 cases magnitude during the three waves and disaggregated by types of regions.

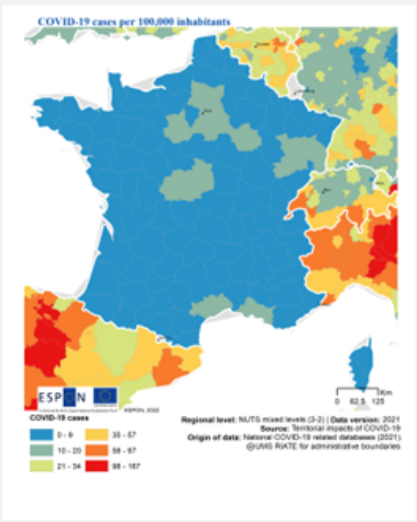
Overall, Irish predominantly rural regions were the most hit by the virus (counting 53% of the total cases), followed by predominantly urban regions (32%) and intermediate regions (14%), respectively.



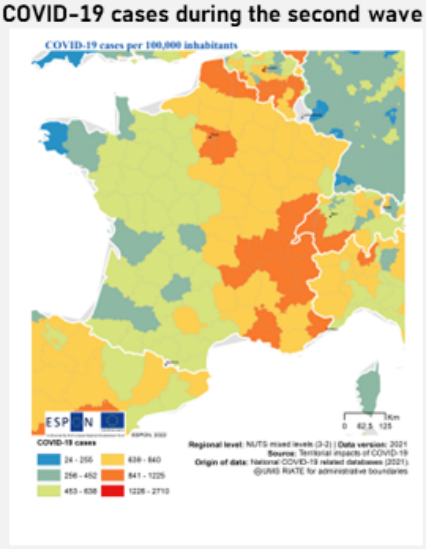
Total COVID-19 cases		Number of regions	Data source
22-06-2022	**Ireland**	8 regions	COVID-19 European
1.58M		NUTS3 (2021)	Regional Tracker

Box 3 Spatial diffusion of COVID-19 in the Western regions (France)

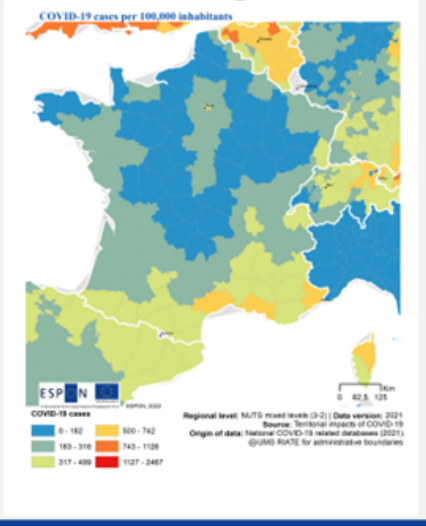
COVID-19 cases during the first wave

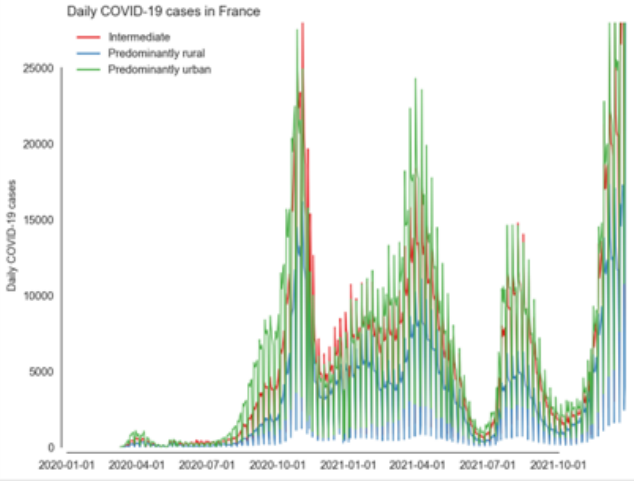


COVID-19 cases during the second wave



COVID-19 cases during the third wave





The figure shows the daily COVID-19 cases evolution by types of regions (urban, intermediate, and rural). During the study timeframe, France saw mainly **five COVID-19 waves**; in which the first reached the peak on April, 07, 2020, the second on November, 03, 2020, the third on April, 11, 2021, the fourth on August, 08, 2021, and the fifth on November, 28, 2021.

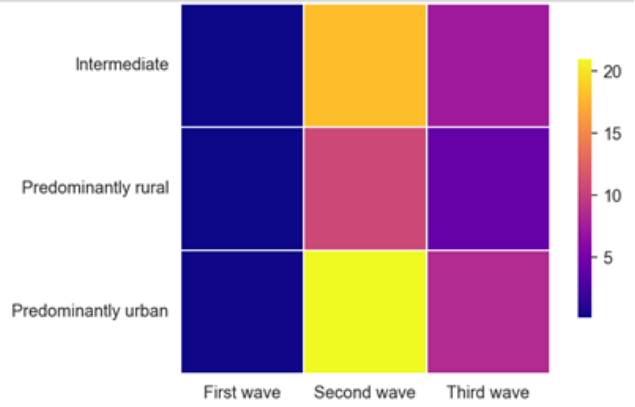
During the first wave, predominantly urban regions (e.g., Paris, Bouches du Rhône, Hauts de Seine, and Val d'Oise) were the most effected by the pandemic, followed by intermediate regions (e.g., Seine et Marne, Oise, and Hérault) counting the highest number of COVID-19 infection cases. Predominantly rural regions were less hit by the pandemic (e.g., Eure et Loir, Eure, Somme, and Aisne).

During the second wave, the infection number continues to increase following the same types of regions, meaning that urban areas are still experiencing the highest number of infection cases, followed by intermediate and rural regions.

During the third wave, the infection number in France decreases following the same infections pattern of the first and second wave, meaning that predominantly urban regions (e.g., bouche du Rhône, Paris, and Rhône) are still experiencing the highest COVID-19 infection cases compared to intermediate and predominantly rural regions.

When taking population dynamics and regional characteristics into account, we found that rural areas represent 55% of the French regions and host 29% of the total French population, while intermediate regions represent 30% and host 36% of the total population, and urban regions represent 15% and host 35% of the total population. Therefore, urban and intermediate regions are more likely to get hit by the virus considering their number and share of the total French population.

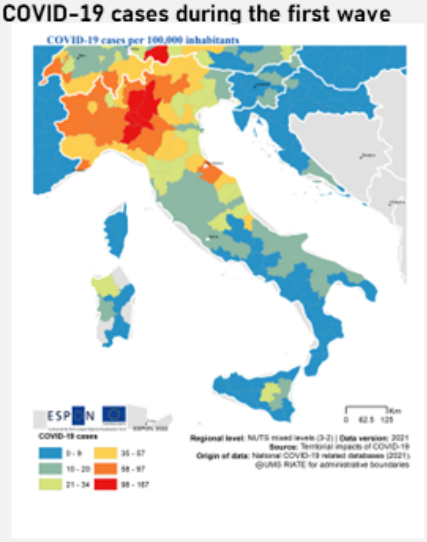
Overall, French urban regions were the most hit by the virus (counting 43% of the total cases), followed by intermediate regions (35%) and predominantly rural regions (22%), respectively.



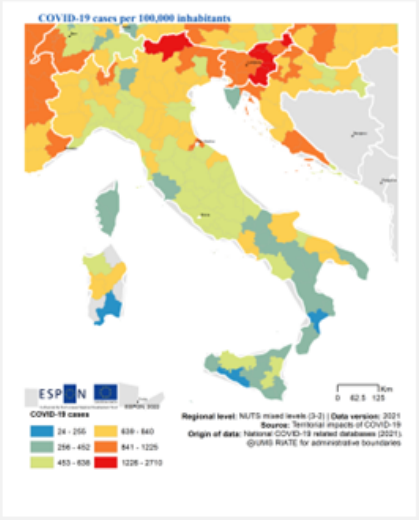
Total COVID-19 cases	France	Number of regions	Data source
22-06-2022 29.4M		96 regions NUTS3 (2021)	COVID-19 European Regional Tracker

Box 4 Spatial diffusion of COVID-19 in the Southern regions (Italy)

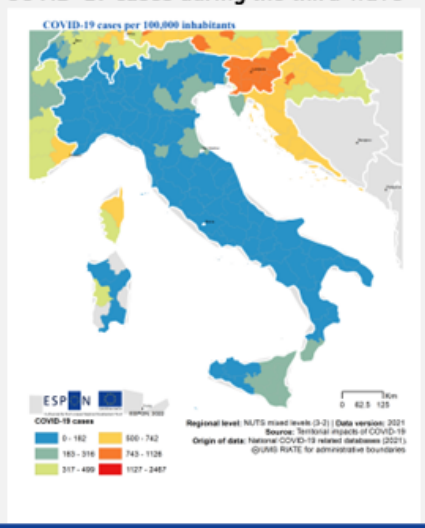
COVID-19 cases during the first wave

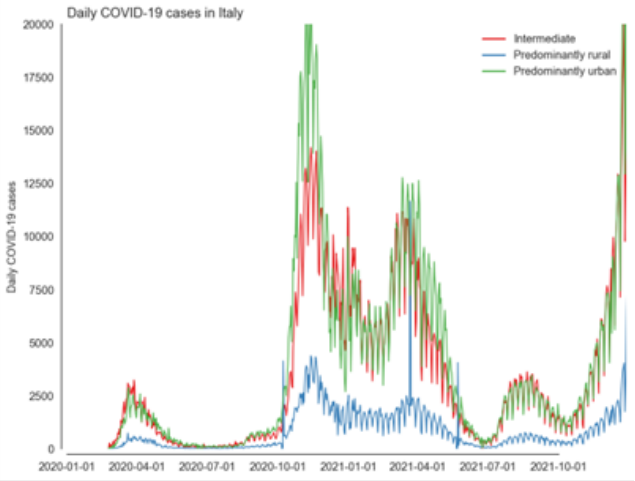


COVID-19 cases during the second wave



COVID-19 cases during the third wave





The figure shows the daily COVID-19 cases evolution by types of regions (urban, intermediate, and rural). During the study timeframe, Italy saw mainly **five COVID-19 waves**; in which the first reached the peak on March, 25, 2020, the second on October, 16, 2020, the third on March, 04, 2021, the fourth on August, 19, 2021, and the fifth on November, 23, 2021.

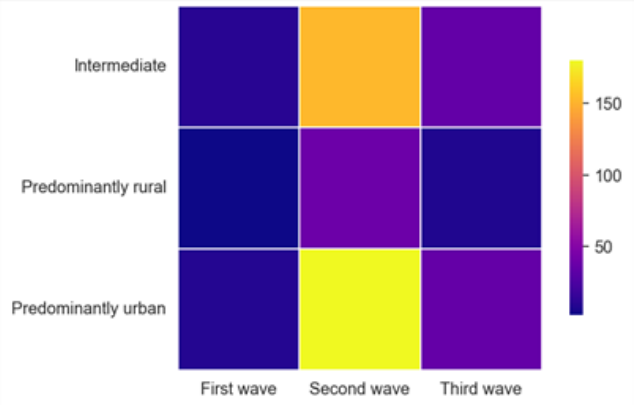
During the first wave, predominantly urban regions (e.g., Milano, Torino, and Bergamo) were the most affected by the pandemic, followed by intermediate regions (e.g., Brescia, Cremona, and Verona) counting the highest number of COVID-19 infection cases. Predominantly rural regions were less hit by the pandemic (e.g., Alessandria, Mantova, Bolzano-Bozen, and Cuneo).

During the second wave, the infection number continues to increase in all of the Italian regions following the same typological pattern, meaning that urban areas are still experiencing the highest number of infection cases, followed by intermediate and rural regions.

During the third wave, the infection number in Italy decreases significantly, both predominantly urban (e.g., Roma, Napoli, and Milano) and intermediate regions (e.g., Padova, Treviso, Verona, and Bologna) were experiencing the same COVID-19 infection cases magnitude.

When taking population dynamics and regional characteristics into account, we found that intermediate regions represent 54% of the total Italian regions and host 42% of the total Italian population, while urban regions represent 28% and host 50% of the total population, and rural regions represent 18% and host 10% of the total population. Therefore, urban and intermediate regions are more likely to get hit by the virus considering their number and share of the total Italian population.

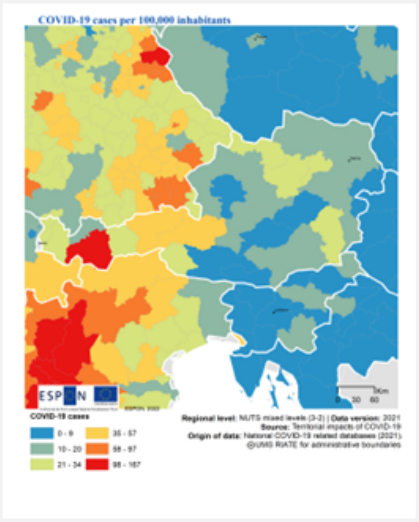
Overall, Italian urban regions were the most hit by the virus (counting 48% of the total cases), followed by intermediate regions (42%) and predominantly rural regions (10%), respectively.



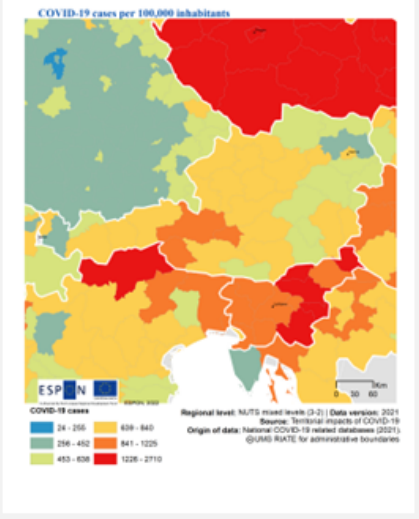
Total COVID-19 cases		Number of regions	Data source
22-06-2022 18M	**Italy**	106 regions NUTS3 (2021)	COVID-19 European Regional Tracker

Box 5 Spatial diffusion of COVID-19 in the West-Central regions (Austria)

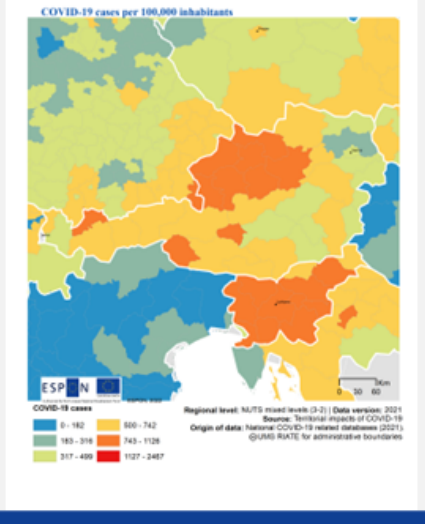
COVID-19 cases during the first wave

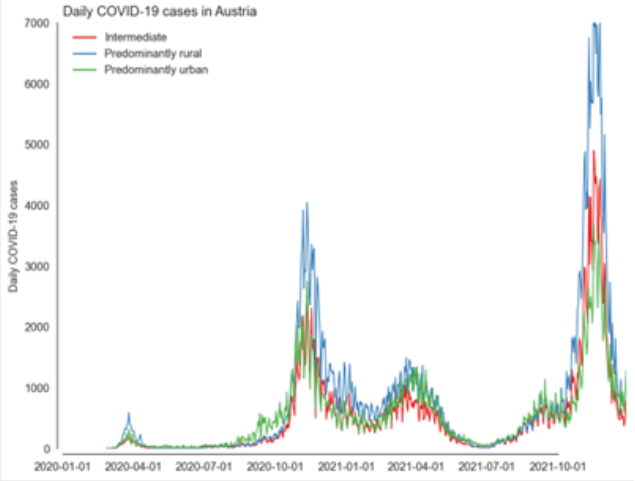


COVID-19 cases during the second wave



COVID-19 cases during the third wave





The figure shows the daily COVID-19 cases evolution by types of regions (urban, intermediate, and rural). During the study timeframe, Austria saw mainly **four COVID-19 waves**; in which the first reached the peak on March, 26, 2020, the second on November, 23, 2020, the third on March, 24, 2021, and the fourth on December, 04, 2021.

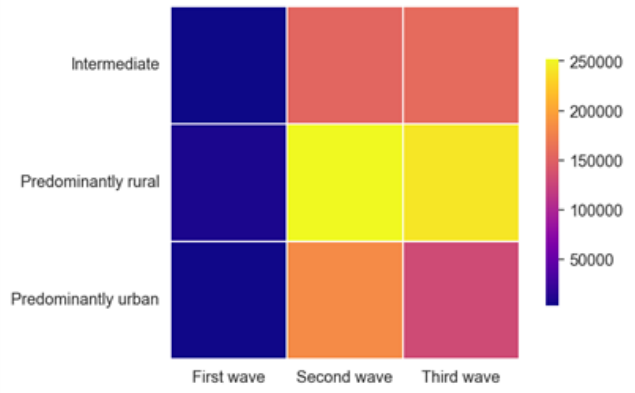
During the first wave, in total, predominantly rural regions (e.g., Tiroler Unterland, Tiroler Oberland, and Pinzgau-Pongau) were the most affected by the pandemic, followed by urban regions (e.g., Wien, Innsbruck, and Rheintal Bodenseegebiet) counting the highest number of COVID-19 infection cases. Predominantly rural regions were less hit by the pandemic compared to urban and intermediate regions.

During the second wave, the infection number continues to grow and propagate into all of the Austrian regions following the same typological pattern, meaning that rural areas are still experiencing the highest number of infection cases in total, followed closely by urban and intermediate regions.

During the third wave, the infection number stagnates for rural regions (e.g., Innviertel), increase for intermediate regions (e.g., Linz-Wels), and decrease for urban regions (e.g., Wien, Innsbruck).

When taking population dynamics and regional characteristics into account, we found that rural regions represent 67% of the total Austrian regions and host 40% of the total Austrian population, while intermediate regions represent 20% and host 28% of the total population, and urban regions represent 11% and host 32% of the total population. Therefore, rural and intermediate regions are more likely to get hit by the virus considering their number and share of the total Austrian population.

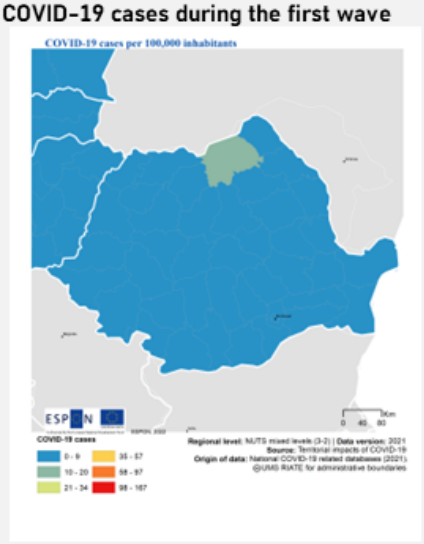
Overall, Austrian rural regions were the most hit by the virus (counting 44% of the total cases), followed simultaneously by urban regions (28%) and intermediate regions (28%).



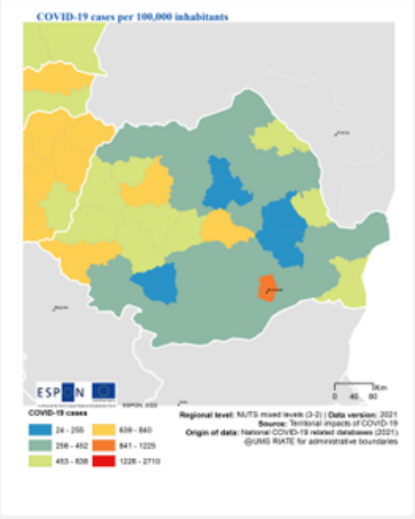
Total COVID-19 cases		Number of regions	Data source
22-06-2022 4.37M	**Austria**	35 regions NUTS3 (2021)	COVID-19 European Regional Tracker

Box 6 Spatial diffusion of COVID-19 in the East-Central regions (Romania)

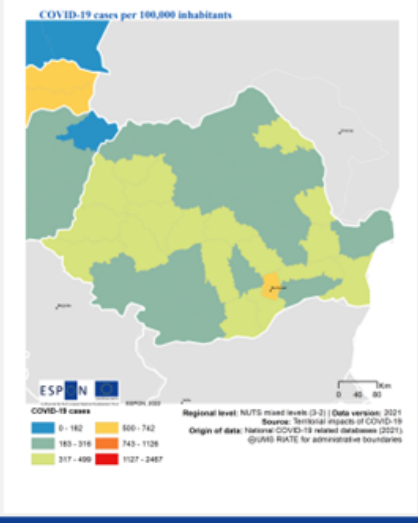
COVID-19 cases during the first wave

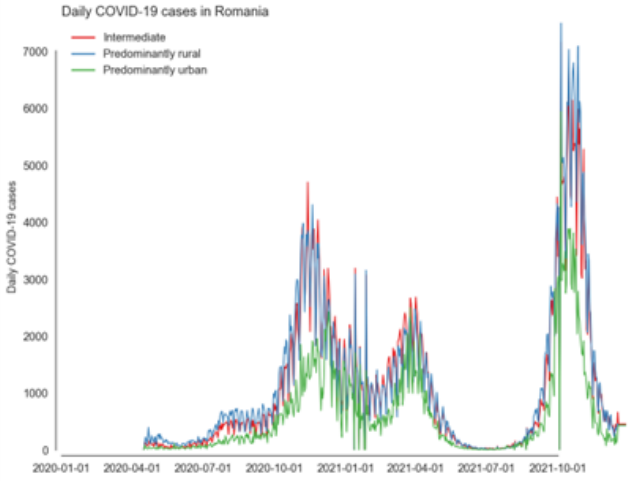


COVID-19 cases during the second wave



COVID-19 cases during the third wave





The figure shows the daily COVID-19 cases evolution by types of regions (urban, intermediate, and rural). During the study timeframe, Romania saw mainly **three COVID-19 waves**; in which the first reached the peak on October, 21, 2020, the second on March, 17, 2021, the third on October, 11, 2021.

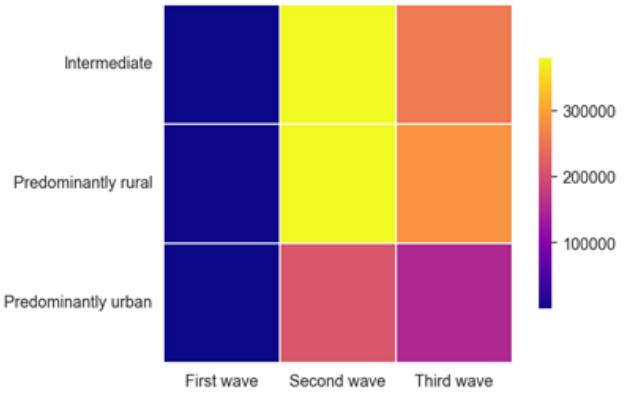
During the first wave, predominantly rural regions (e.g., Suceava, Bihor, and Bacau) were the most effected by the pandemic, followed by intermediate regions (e.g., Arad, Brasova, and Hunedoara) counting the highest number of COVID-19 infection cases. Surprisingly, urban regions were less hit by the pandemic (e.g., Bucuresti, Ilfov).

During the second wave, the infection number of COVID-19 infections grows dramatically and infiltrates into all of the Roman regions. Both intermediate regions and predominantly rural regions were hit by the pandemic with the same magnitude. Notice that during the second wave Bucuresti (urban region) accounts the highest number of COVID-19 cases across all Romanian regions.

During the third wave, the infection number in Romania across all regional typologies decreases following the same infections pattern, meaning that predominantly rural regions are still experiencing the highest COVID-19 total infection cases.

When taking population dynamics and regional characteristics into account, we found that rural regions represent 67% of the total Romania regions and host 53% of the total Romanian population, while intermediate regions represent 29% and host 35% of the total population, and urban regions represent 5% and host 12% of the total population. Therefore, rural and intermediate regions are more likely to get hit by the virus considering their number and share of the total Romanian population.

Overall, Romanian rural regions were the most hit by the virus (counting 40% of the total cases across the three waves), followed by intermediate regions (38%) and predominantly urban regions (22%).



Total COVID-19 cases		Number of regions	Data source
22-06-2022	**Romania**	42 regions	COVID-19 European
2.92M		NUTS3 (2021)	Regional Tracker

2.1.2 Geography of COVID-19 mortality: Three waves, three stories

While the indicator of reported cases was useful for describing the spatial diffusion of COVID-19, the impact of the pandemic on human lives could be described with mortality indicators. We used the number of COVID-19-related deaths and excess mortality. These indicators are subject to different criticisms, and the level of spatial detail available varies (the number of COVID-19-related deaths is available at the NUTS 3 level only from 13 countries, while excess mortality is available at the NUTS 3 level in each country, except for Germany, Croatia, Slovenia, Estonia and Ireland), so we used them in a complementary way. Both indicators were normalized by computing the density of each indicator by 10,000 inhabitants.

The available data were analysed, and conclusions drawn in different spatial (major regions of Europe, NUTS 1–3 regional patterns, regional typologies) and temporal frameworks (by weeks and by waves) and with different methodologies (graphs, maps). However, the dynamic maps from the beginning of the pandemic to October 2021 included allow for a comparative approach. Map 1 shows the death rate per 10,000 inhabitants across European regions[9] during the first three waves.

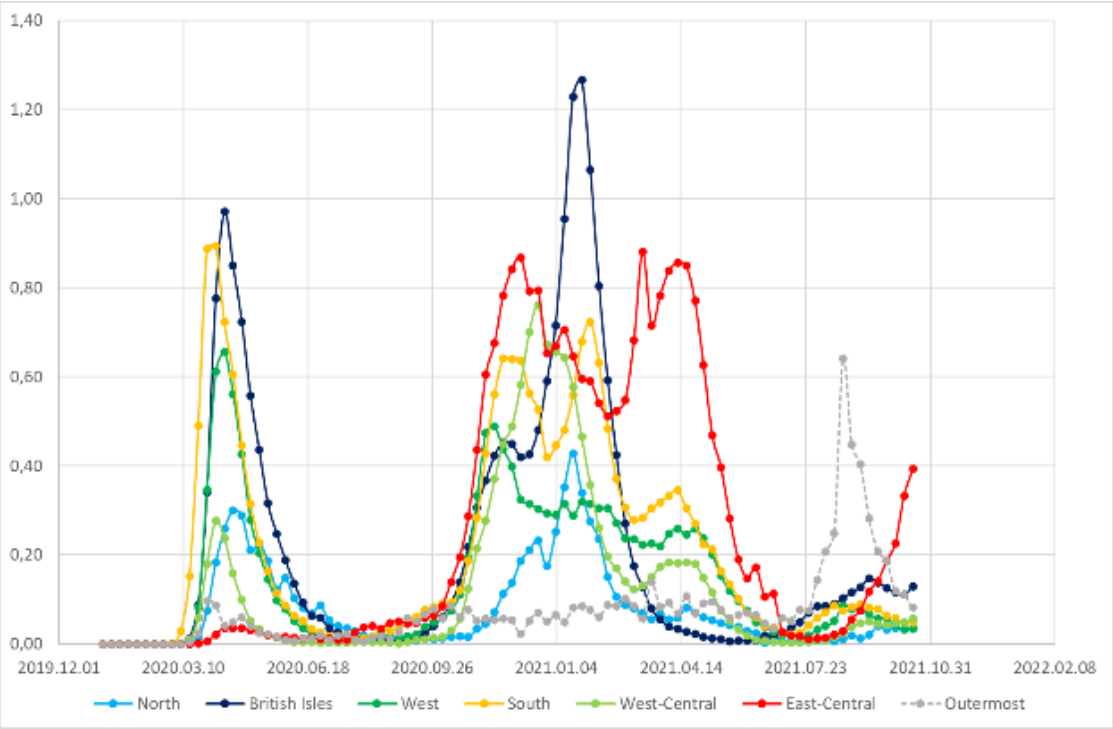
Which territories had the highest mortality rates for the three waves?

Different regions of Europe have been affected by the pandemic at different times and to different degrees, as the figures below show regarding the values of the number of COVID-19-related deaths and excess mortality. During the first wave, excess mortality started to rise first in Southern Europe (Figure 6), followed by the British Isles and Western Europe. It can be observed that the values for Northern Europe, West-Central Europe and the outermost regions barely increased during this period, while the values for East-Central Europe were very low. The first wave was followed by a calmer period during summer 2020, but the increased contact numbers during this period and a partial recovery of cross-border migration and international tourism led to an intensification of the pandemic in July and August, triggering the second wave.

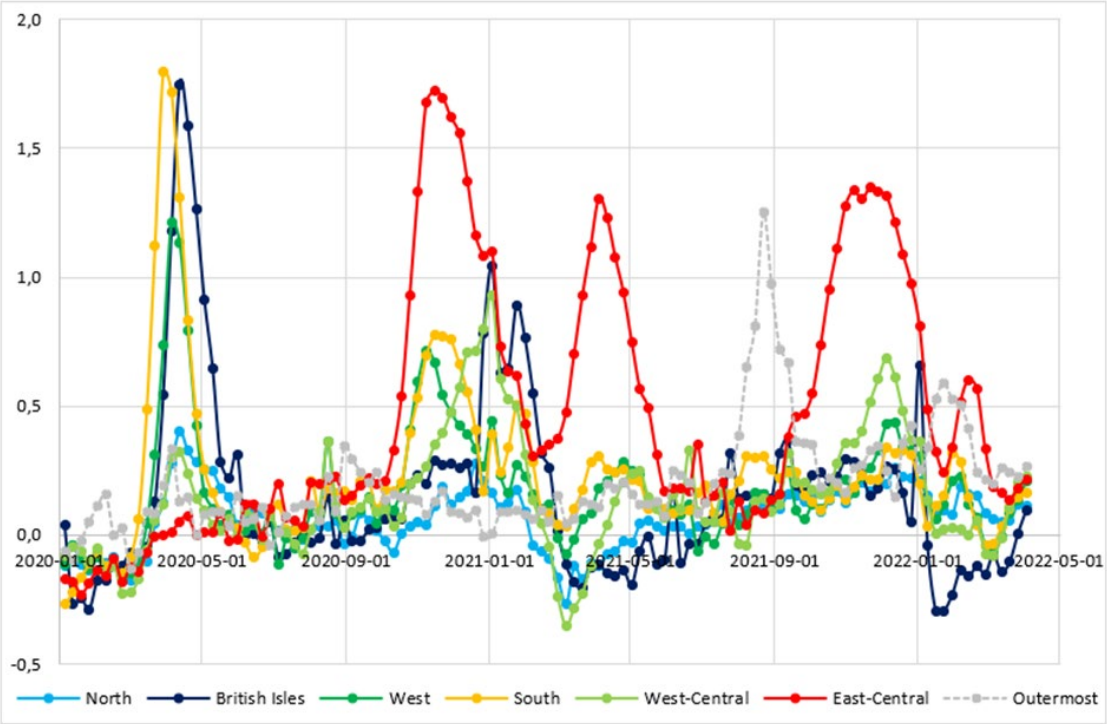
During the second wave, East-Central Europe became the worst-affected major region in Europe. Other major regions also experienced significant excess mortality, but at a lower rate. The second wave overlapped with the third wave, which again caused significant mortality in the British Isles and then severely affected East-Central Europe. The excess mortality rate in the other major regions was significantly lower. Finally, the fourth wave resulted in only a slight increase in excess mortality in most major regions – with the exception once again of East-Central Europe, where this period also caused a high level of mortality. A particular highlight is the outlier in the outermost regions of August 2021; the background to this is a severe COVID-19 wave that hit Guadeloupe and Martinique.

[9] Notice that some regions are identified as 'neighbourless' such as the Azores and Madeira (Portugal), the Canary Islands (Spain), French Guiana (France) and thus not included in the analysis, however in reality they have strong connections to other regions (ferry connections, etc.). But due to the construction of the spatial weight matrix, it is not possible to include these types of connections in our study. Proceeding with the chosen scope, we provide a cross-regional analysis of 353 regions across 31 countries.

Figure 6 Weekly number of COVID-19-related deaths and excess mortality per 10,000 inhabitants in the major regions of Europe (1st week of 2020–43rd week of 2021)



Source: National COVID-19 related databases (2021)

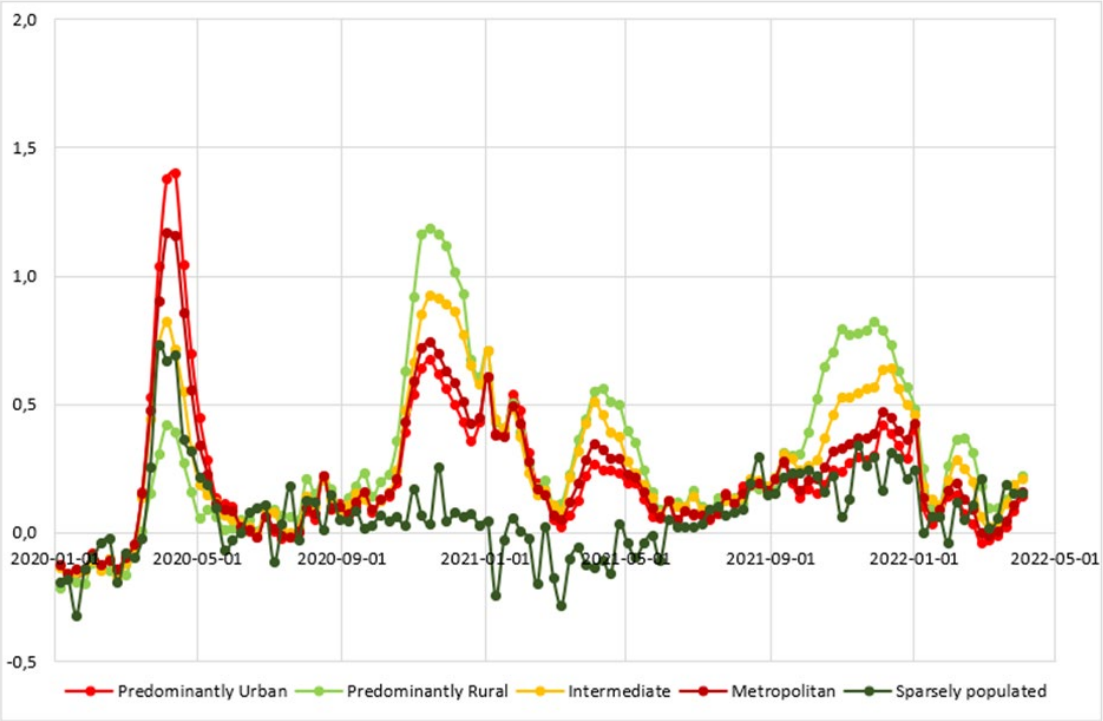


Source: Eurostat (2021)

At the same time, mortality rates were unequal not only in the major regions, but also in different types of regions, exhibiting particularly notable urban-rural differences. As shown in Figure 7, the first wave had a much greater impact on urban areas and metropolitan regions, while the predominantly rural areas were less affected. In contrast, the second, third and fourth waves caused above-average excess mortality in predominantly rural regions. However, for the pandemic as a whole after the first wave, a levelling off was

observable between urban and rural areas regarding excess mortality. Furthermore, Figure 7 shows that mortality in sparsely populated areas only increased slightly during the first wave, but then remained markedly low during subsequent waves of the pandemic.

Figure 7 Weekly excess mortality per 10,000 inhabitants in some examined regional typologies of Europe (1st week of 2020–43rd week of 2021)



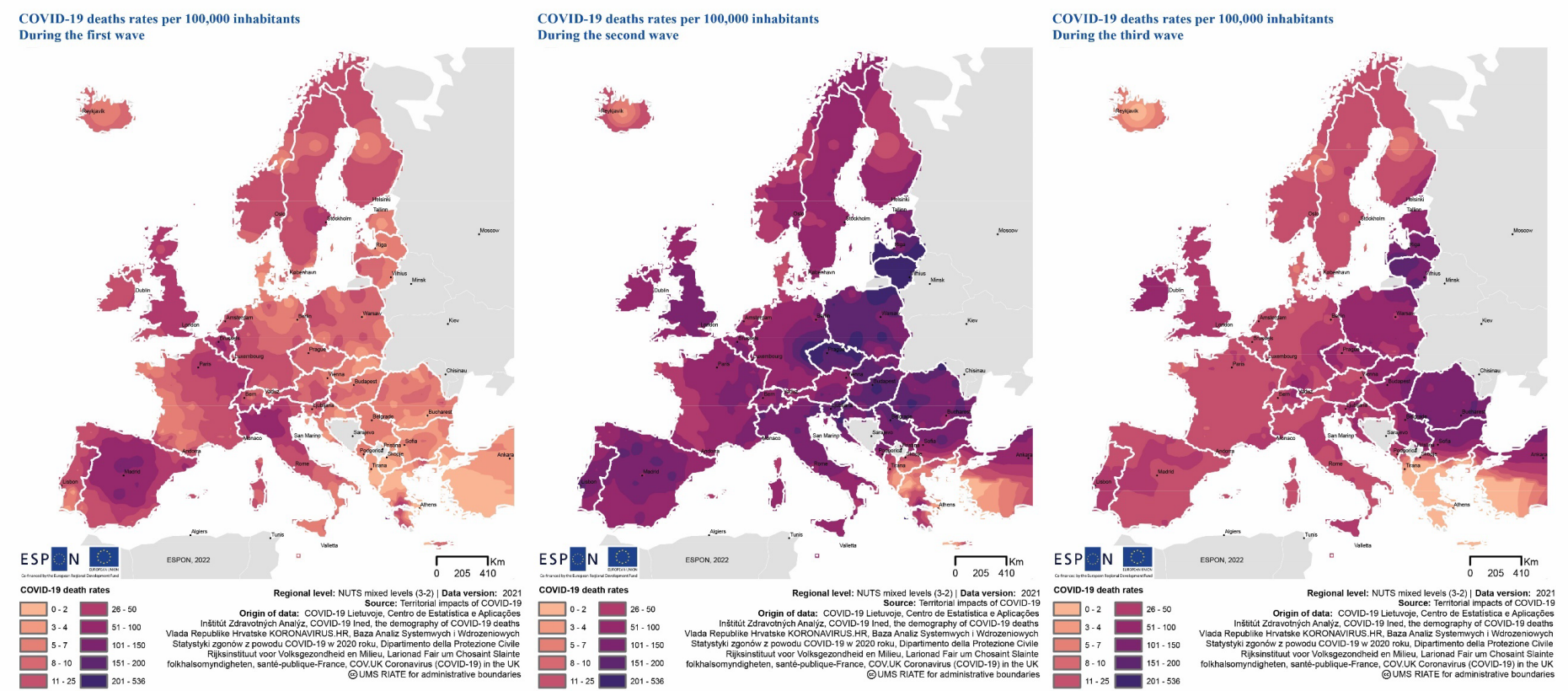
Source: Eurostat (2021)

To clarify the spatial pattern of deaths, mortality data were summarised and mapped by wave. Scrutinising the COVID-19 mortality rate during the first three waves across EU regions shows that during the first wave (Map 1.a), the virus severely affected a limited number of EU countries (with the highest level of death rates recorded in Italy and Spain) while hitting the major vibrant centres of Europe and their surrounding areas, such as Madrid (Spain), Paris (France), London (the UK) and Milan (Italy). During the first wave, regions hosting major European cities were impacted the first because of their international dynamics such as those hosting megacities (e.g., Italy, Lombardy; Spain, Madrid; the UK, London; France, Paris and Val-de-Marne; and Sweden, Stockholms län), global nodes (e.g., Paris and London), European engines (e.g. Madrid, Barcelona, Brussels and Milan) and strong MEGAs (e.g. Bilbao and Turin). In contrast, the regions of East-Central Europe were less hit by the virus because the virus started to spread from Western Europe to Eastern Europe and timely strict measures (lockdowns) prevented the spread of the virus in East-Central Europe during the first wave.

During the second wave (Map 1.b), we noticed that the virus transitioned from Western to Eastern European countries (e.g. Poland, Mazowiecki; and Czechia, Střední Čechy and Moravskoslezsko). Thus, in the second wave, areas that had previously been less affected by the pandemic became the main hotspots. This might be explained by the capacity of Western European regions to initiate and deploy policies and maintain lockdowns, while East-Central European countries displayed difficulties in managing and controlling the pandemic.

During the third wave (Map 1.c), the pattern of the second wave persists (except for the UK), meaning that regions affected during the first wave still showed a significant coping capacity in managing the pandemic, while Eastern European countries were still experiencing the highest COVID-19 death rates (e.g. Romania, Bulgaria, Poland, Latvia and Lithuania).

Map 1 COVID-19 death rates per 10,000 inhabitants across different waves



What was the spatial concentration of the virus?

Using exploratory spatial data analysis, we determined the presence of a spatial concentration of COVID-19 death rates across European regions and highlighted the clusters' geographical dispersion. The method was widely used to investigate infectious disease clusters, as well as to examine the spatiotemporal features of COVID-19, e.g. in mainland China (Zhang et al., 2020) or to analyse the French healthcare system and social trust in tackling the pandemic (Zhang et al., 2020; Amdaoud et al., 2021b). Local indicators of spatial association intent to identify local pockets of spatial association. When regions are red (Map2), this means that they and their neighbours have high mortality rates (spatial concentration of high mortality). When regions are blue on the map, this means that they and their neighbours have low mortality rates (spatial concentration of low mortality).

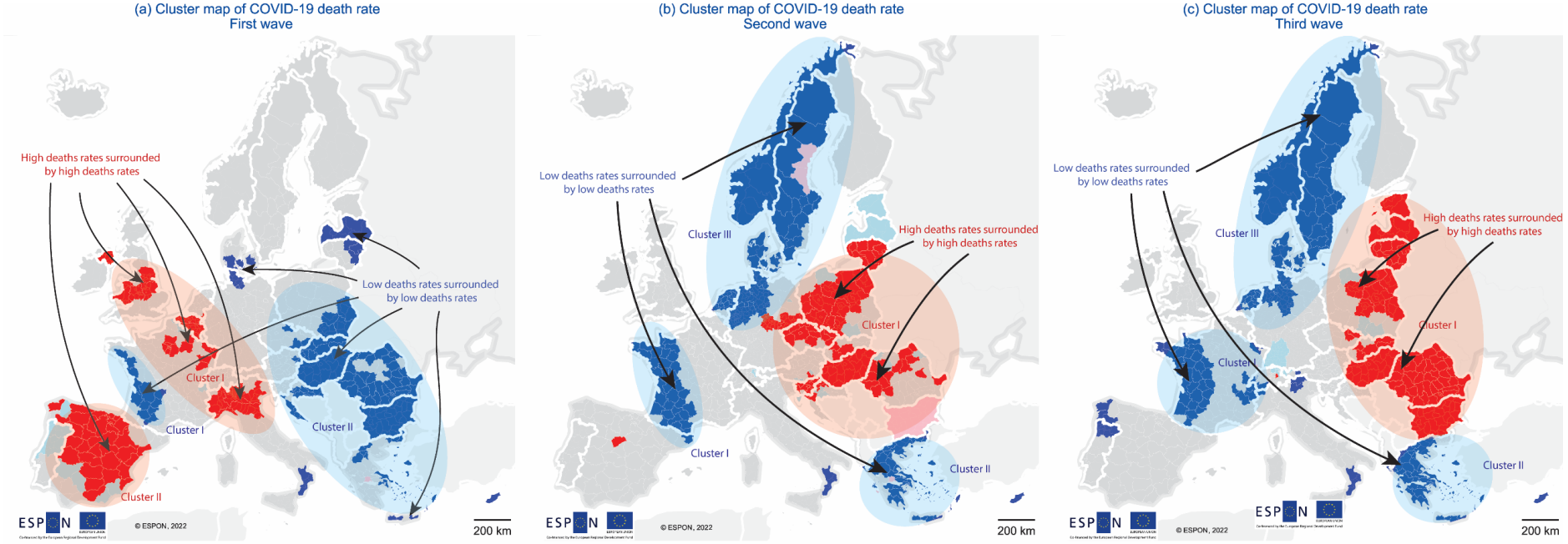
The study results showed that during the first wave of the pandemic (Map 2.a) there were four clusters with high COVID-19 death rates surrounded by high COVID-19 death rates located mainly in Central Spain, Eastern France, Northern Italy and the UK, whereas in Eastern European regions, Southern Italy, and western French regions, there was a remarkably lower death rate compared to the other EU regions. Hence, we notice the presence of the cluster of low COVID-19 death rates surrounded by regions with low COVID-19 death rates. During the second wave (Map 2 b), we noticed one massive cluster with high COVID-19 death rates surrounded by regions with high COVID-19 death rates located in Eastern Europe (encompassing border regions located in North-Eastern regions of Slovenia, Northern Croatia, Southern Austria, Hungary, Czechia, German regions [Saxony and Saxony-Anhalt], Poland and Lithuania).

From the first to the second wave (Map 2 b), we noticed that the cluster previously spotted in Spain with high death rates shrank. On the other hand, three clusters of low COVID-19 death rates surrounded by regions with low COVID-19 death rates were spotted mainly during the first wave: the cluster in France, which was expanding compared to the first wave; a grouping of northern EU countries (the Netherlands, Denmark, Sweden, Norway, Finland and North-Western regions of Germany); and a Mediterranean Europe cluster, including the vast majority of regions of Greece, Cyprus and Calabria (Italy).

During the third wave (Map 2 c), while results show that the clusters with low COVID-19 death rates surrounded by regions with low COVID-19 rates, more or less remained the same, the cluster with previous high COVID-19 death rates surrounded by regions with high COVID-19 death rates were divided into two small clusters: the first is located in Slovenia, Romania, Hungary and the second is located in Northern Polish regions, Lithuania and Latvia.

Taken together, we found that, during the first three waves of the pandemic, a spatial shift from the European centre to the peripheries took place. While the first wave mainly affected Western Europe and, in particular, the metropolitan areas, the second and third waves had an increasing impact on the Eastern countries, especially on predominantly rural areas. For the pandemic as a whole, the worst-affected regions were the United Kingdom and East-Central Europe (mainly rural areas), while other parts of Western Europe and Southern Europe, after an initial shock, were hit less by the later waves. Finally, the sparsely populated northern periphery of Europe was hit the least by the pandemic.

Map 2 Cluster map of COVID-19 death rate across different waves



Regional level: NUTS mixed levels (LAU & NUTS3-2) | Data version: 2021
Source: Territorial impacts of COVID-19
Origin of data: Statistik Austria, STATBEL Belgium in figures, National Statistical Institute of Bulgaria, Croatian Bureau of Statistics, Cyprus Statistical Service, CZECH STATISTICAL OFFICE STATISTICS DENMARK, STATISTICS ESTONIA, Statistics Finland, Insee France, DESTATIS Statistisches Bundesamt, Hellenic Statistical Authority, HUNGARIAN CENTRAL STATISTICAL OFFICE, An Phriomh-Oifig Staidrimh, Istituto Nazionale di Statistica, Office statistics portal Official statistics of Latvia, Statistics Lithuania, STATISTICS PORTAL GRAND DUCHY OF LUXEMBROUG, NATIONAL STATISTICS OFFICE – MALTA, Statistics Netherlands, Statistics Poland, INSTITUTO NACIONAL DE ESTATISTICA – STATISTICS PORTUGAL, National Institute of Statistics – Romania, Statistical office of the Slovak Republic, Statistični urad RS, Insituto Nacional de Estadistica, Statistics Sweden.
UMS RIATE for administrative boundaries

How effective was the health infrastructure?

Map 3 a, b and c show the case fatality ratios across European regions during the first three waves. In epidemiology, the case fatality rate (referred to as the case fatality risk or case fatality ratio[10]) is typically used to assess disease severity, lethality and prognosis. If the analysis of COVID-19 cases shows the effectiveness of lockdown measures, the COVID-19 case fatality rate displays the effectiveness of the healthcare infrastructure across European regions. However, it is important to highlight that fewer cases are reported than are actually active. Hence, the results may not be fully conclusive. This is a major limitation of the case fatality rate, yet it is still a relevant indicator that can provide a wider panoramic view of the pandemic across EU regions and highlight potential territorial disparities – in terms of healthcare infrastructure robustness – between and within EU countries.

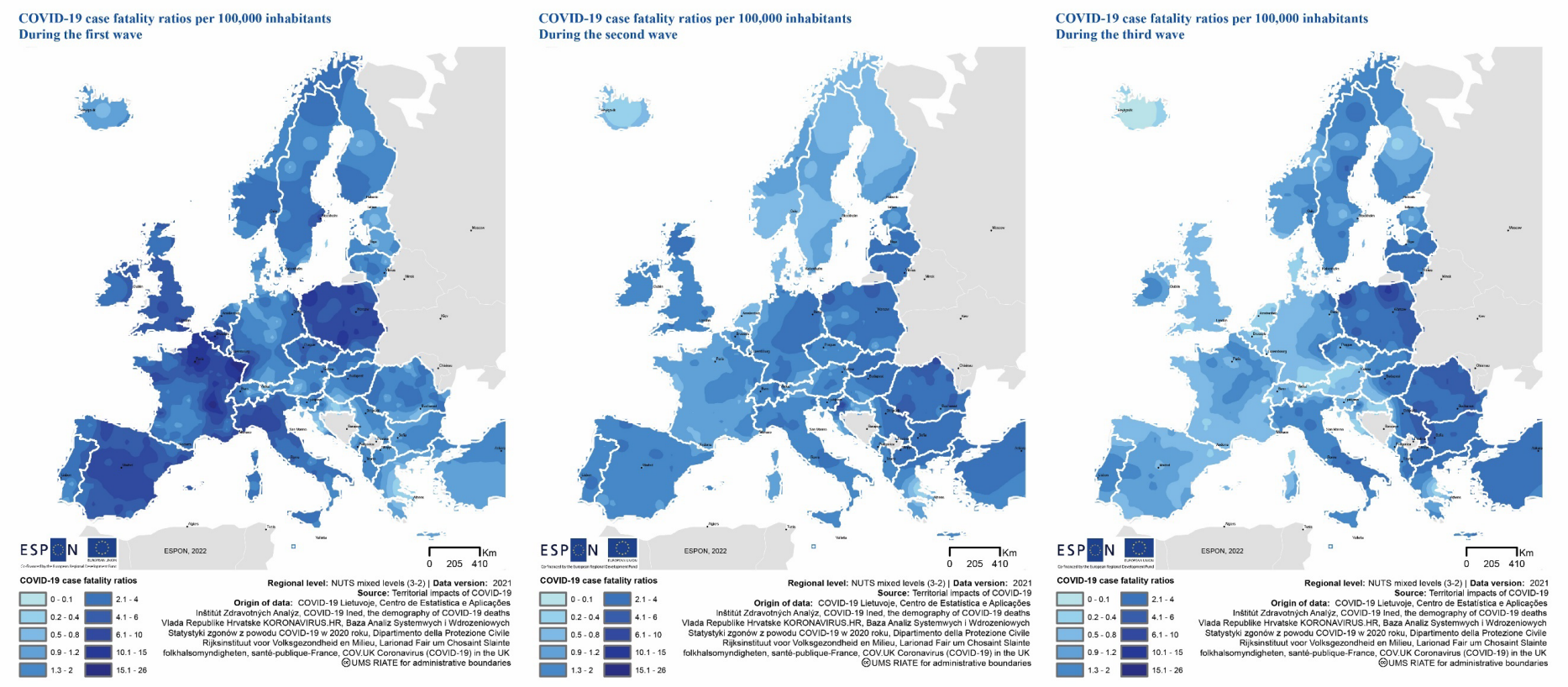
During the first wave (Map 3.a), the case fatality ratio was very high for the North-Eastern French regions (e.g. Moselle, Rhône, Haut-Rhin and Val-de-Marne), Northern Italian regions (e.g. Calabria, Emilia-Romagna and Piemonte), Central Spanish regions (e.g. Ciudad Real, Toledo and Zaragoza), UK regions (e.g. London, the West Midlands, the East and Northwest of England). Not surprisingly, the regions that were affected first by the virus had the highest deaths, considering it was a novel virus and the healthcare system was not fully prepared.

During the second wave (Map 3.b), we noticed that the case fatality ratio shifted from Western parts of Europe (e.g. France, Spain and the UK) to Eastern European countries (including Eastern regions of Germany, Poland, Lithuania, Bulgaria, Romania and Hungary). However, while effective resistance to the virus (probably due to a more robust healthcare system) was observed in France and Spain, the virus kept spreading across Italy and causing death.

During the third wave (Map 3.c), the map depicts that the virus kept spreading to Eastern European countries while re-emerging in France and Spain (mainly with the spread of the new mutated COVID-19 variants: Alpha, Beta, Gamma and Delta). Nevertheless, Italy and Portugal kept experiencing the highest case fatality rates, which means that the healthcare systems could not develop effective resistance or may have reached their tipping points because they were no longer resilient in managing and controlling the pandemic during the subsequent waves.

[10] Case fatality ratio (CFR) or more precisely case-fatality risk (CFR) is the percentage (%) of persons diagnosed with a disease (COVID-19 in this case) and who die from it. CFRs are usually used to assess diseases with discrete and limited time courses.

Map 3 Case fatality ratio per 10,000 inhabitants across different waves



2.2 Explaining the spatial variation of regional COVID-19 waves

To capture the diffusion effect between European regions and identify the territorial drivers of the COVID-19 pandemic, spatial regression models were used (Tables 1 and 2).

Both the COVID-19 death rate and excess mortality rate were used as the dependent variables for this analysis. Territorial variables are considered to be determinants of the COVID-19 spread only if they are statistically significant[11] for both input-dependent variables.

Table 1 Empirical results for COVID-19 death rate determinants

COVID-19 death rate	First wave	Second wave	Third wave
Population density	N.S.	N.S.	N.S.
Share of the population aged 65 and over	N.S.	N.S.	N.S.
GDP per capita	Positive	N.S.	N.S.
Poverty	N.S.	Negative	Negative
Hospital beds	Negative	N.S.	N.S.
Medical doctors	N.S.	N.S.	Negative
Governance index	Negative	N.S.	Negative
Education	N.S.	Negative	Negative
Intermediate region	N.S.	N.S.	Positive
Predominantly urban region	N.S.	Positive	N.S.
Hit (first wave)	-	Positive	Positive
Neighbourhood effects	Positive	Positive	Positive

N.S.: Not significant

[11] Statistical significance, or significance level, is the threshold at which the results of a test are considered reliable. In other words, this threshold determines the confidence in the correlation between a test performed and the results obtained.

Table 2 Empirical results for excess mortality determinants

Excess mortality	First wave	Second wave	Third wave
Population density	N.S.	N.S.	N.S.
Share of the population aged 65 and over	N.S.	N.S.	N.S.
GDP per capita	N.S.	Positive	N.S.
Poverty	N.S.	N.S.	N.S.
Hospital beds	Negative	N.S.	N.S.
Medical doctors	Negative	N.S.	Negative
Governance index	Negative	Negative	Negative
Education	N.S.	N.S.	N.S.
Intermediate region	N.S.	Positive	Positive
Predominantly urban region	Positive	Positive	Positive
Hit (first wave)	-	N.S.	N.S.
Neighbourhood effects	Positive	Positive	Positive

Both wealth and income dimensions play a major role in driving the spread of COVID-19 and increasing death rates worldwide (Antonietti et al., 2021), especially in Europe (Amdaoud et al., 2021). GDP per capita is a common metric used in modelling health outcomes, health system performance and mortality trends (Markowitz et al., 2019). This relationship was found to be positive and significant during the first wave of the pandemic in the case of COVID-19 (Veldkamp and Fogli, 2018). For our study, we found the same results, with a positive effect of GDP per capita on mortality rate for the first wave (Table 2). In a connected and integrated world, rich regions are more open to international trade and the movement of people. Consequently, they are more likely to be hit by a pandemic because of their international openness. For example, as mentioned in the ESPON GEOCOV report, the fact that Northern Italy was the first European region to be particularly affected is logical, given the importance of Chinese diaspora and mobility between Milan and China. It should be noted that Milan Malpensa Airport, the second Italian airport after that of Fiumicino in Rome, has above all become the FedEx hub in Southern Europe and is an important freight airport well connected to China, the world's leading exporter. Milan is also directly connected to China through rail freight, with the inauguration of the first direct link between Chengdu and Milan on February 12, 2019, thus contributing to the structuring of the new Silk Roads. This could explain why Lombardy was hit earlier than other regions. Southern Italy, much further away from globalisation, found itself somewhat protected. For the second wave, both highly developed and less developed territories were affected (see. Annex 3 of the Final Report). This explains the non-significance of GDP per capita in terms of the mortality rate. For example, Northern Italy (affluent regions) has similar mortality rates to Bulgarian regions (among the less developed regions of Europe).

In our study, the variable related to a 'predominantly urban region' can explain the spatial differentiation of COVID-19 mortality. This variable is related to the level of wealth of the regions; the richest European regions are often metropolitan ones. The degree of urbanisation is the subject of frequent analyses to explain the international (Hu and Goldman, 1990) and regional (Frohlich and Mustard, 1996) differences in COVID-19 deaths. The role of urbanisation in explaining the spread of COVID-19 has been widely discussed from the beginning of the pandemic in China, and the role of this variable is all the more critical as it is linked to the reproductive number, known as R0. This was confirmed in a wide study based on data from 138 countries (Hradsky and Komarek, 2021). Furthermore, predominantly urban regions include national/regional commuting patterns. For example, for Brussels, although its international connection has played a role in the spread of COVID-19, the high number of commuters working in Brussels and moving to another Belgian region (almost 50% of Brussels workers are commuters) has contributed significantly to spreading the virus. This may also explain why we found this variable to have a positive and significant effect.

Density appeared to be nonsignificant in the different models. This is because it is not so much the density, but rather the physical proximity interactions between people that matter. A sparsely populated area where the inhabitants are in close daily contact, is an ideal playground for the virus, just as much if not more than a densely populated area where there is little contact between the inhabitants. Moreover, this nonsignificance for the first wave can also explain that the places of emergence of COVID-19 in Europe are not only based on the metropolitan logic of globalised regions, but also based on purely random logic. Indeed, the virus found favourable conditions for its development through super-propagation events that had an accelerating effect, such as a religious conference in Eastern France, a football match in Northern Italy, carnival festivities in Western Germany and a night-time event in a ski resort in the Austrian Alps. Some of these events led to large regional outbreaks – which largely explain the uneven distribution of deaths across regions in some countries, regardless of whether they were in densely populated or rather rural areas. For example, a religious event attended by 2,500 people on a weekend in February 2020 was the cause of the first massive COVID-19 outbreak in France. By 1 April 2020, one-third of the country's COVID-19 deaths were from that region. Four months later, they still represented 22%.

Comparing the results obtained for the first wave in Table 2 and 3, it is possible to state that government and regional health spending – proxied by the number of hospital beds – exerts a negative influence on COVID-19 prevalence. This result confirms that regions with a less robust health system infrastructure are more likely to experience higher mortality associated with COVID-19. We conclude that the health system is critical for managing and amortising undesirable outcomes of the pandemic. Our findings corroborate Tkalec's (2020) results – according to which, at the macro level, the decrease in public health expenditures in the last 10 years caused by austerity policies reduced the adaptation capacity of the health system and intensified the tragic consequences of the pandemic in some countries. Another study, led by Zhu et al. (2021), focused on comparing pandemic responses in BRIC (Brazil, Russia, India, China and South Africa) countries and highlighted the role of health system resources in curbing health emergencies.

The global spread of COVID-19 has been accompanied, especially during the first wave, by a trend of disinformation undermining policy responses and amplifying distrust and concern among citizens. In this context, building trust in public institutions is key. Hence, governance quality at the subnational level is a fundamental indicator that could deeply influence the prevalence of the pandemic. Our findings confirm the hypothesis that a higher quality of governance at the subnational level has significantly reduced both death and excess mortality rates in European regions. The governance index (quality of institutions) negatively and significantly influenced COVID-19 mortality, specifically for the first and third waves. In a survey of social and behavioural results to support the COVID-19 pandemic response, Bavel et al. (2020) highlighted how most containment measures needed are, by their very nature, difficult to enforce directly. This, in turn, makes trust in public authorities and among citizens all the more relevant. Thus, the negative impact of COVID-19 pandemic can be mitigated by trust in institutions and among citizens. Putnam (1995) defined the basic component of social capital as 'features of social organisations, such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit'. Amdaoud et al. (2021a) tested this hypothesis on French *départements*, an administrative level equivalent to the NUTS 3 areas. Their results confirm that social trust factors influence the rate of mortality and that citizens adapt their confidence according to the intensity of the crisis.

Furthermore, the determinant *Education* was nonsignificant when we considered the COVID-19-related deaths for the first wave to be the dependent variable. However, the determinant had a significant and negative effect on subsequent waves. For the first wave, this can be explained by the fact that nobody really knew the virus; therefore, the level of education did not play any role. For the following waves, however, the level of education was a strong predictor of the death rate. This can be explained by the fact that, as the pandemic crisis progressed, numerous scientific publications highlighting the importance of barrier measures were published. Thus, more educated people tend to follow the recommendations of scientific studies. This was less the case for less educated people, who may have been influenced by social networks and the fake news circulating on them (Melki et al., 2021). For the second wave, for example, we found that a 10% increase in the share of the population with tertiary education corresponds, on average, to a 6.9% lower mortality rate. People with higher education diplomas are also likely to have the option of working remotely due to the specificity of their work (Özgüzel et al., 2020[12]). These results imply that information and education should be seriously considered in nonmedical policies to combat the COVID-19 pandemic.

Finally, our model shows a positive and very significant effect of geographical spillover effects. This indicates that neighbourhoods have a direct effect on the individual mortality rates of regions. This confirms previous health geography works indicating spatial diffusion effects (the contagious diffusion model). From this point of view, only strict containment measures can limit the spread of the virus between different regions (Bourdin et al., 2021).

[12] Potential for remote working across different places (https://voxeu.org/article/potential-remote-working-across-different-mais -places).

3 Analysing the social consequence of COVID-19 containment measures

3.1 Mapping the social consequences of COVID-19 containment measures in EU regions

The COVID-19 pandemic caused a global health crisis and placed a primary and direct burden on the health system. These effects, along with the restrictive measures taken to contain the pandemic, have profound complex implications for economic and social progress, as well as direct and indirect effects in the short, medium and long terms. According to live surveys and national-scale analyses, the following themes of social consequences have so far been highlighted and considered profound:

- *Health, healthcare and mental health*. Beyond increasing COVID-related mortality, further difficulties are expected in the medium and long-term concerning the health aspects of wellbeing and quality of life. Cancelling non-urgent outpatient visits and delaying diagnoses could lead to health deterioration and even avoidable death, further jeopardising the sustainability of healthcare systems. The pandemic has also had a severe and long-lasting impact on mental health.
- *Labour market and working conditions.* Closing or limiting economic activities had a far-reaching effect on the labour market, with a sharp decline in employment and working hours in 2020. Furthermore, government measures requiring physical distancing have led to long-lasting effects on working conditions: teleworking has become widespread for those workers whose jobs allowed it.
- *Education and training.* COVID-19 disrupted education provision at an unprecedented scale in all levels of the education system, being impacted by complete or targeted school closures, restrictions in educational facilities, and abrupt changes to normal school operations. Learning losses have been large and inequitable, and the damage could last long.
- *Poverty and social exclusion.* The number of people at risk of poverty or social exclusion has not increased significantly in Europe, but both the health- and non-health-related stresses of the COVID crisis have exacerbated existing social inequalities. Mortality and morbidity, job loss, income loss and learning loss put pressure on vulnerable social groups disproportionately.

Many social impacts are difficult to predict or are not yet known. It is also difficult to present and analyse territorial aspects of foreseeable social consequences due to a lack of territorially detailed data. We have selected three socioeconomic indicators to highlight territorial implications. The maps below (Map 4, Map 5 and Map 6) depict the evolution of unemployment, youth unemployment rates and ARoP rates between 2019 and 2020 at the LAU & NUTS 2/3 levels across EU countries.

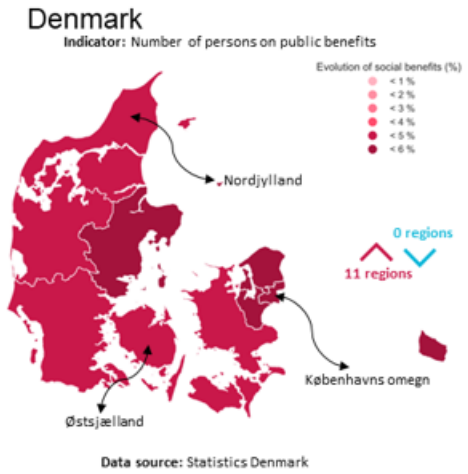
3.1.1 Social benefits

The COVID-19 pandemic placed an extra burden on all segments of the European population, particularly those living in already vulnerable situations, including older people, people with disabilities, people living in poverty, and mostly people who are living in rural areas. Such burden can be multidimensional and could potentially deploy unexcepted outcomes such as maintaining or even exacerbating regional inequalities and social exclusion in the medium or long term. Therefore, such social consequences should be deeply analysed and monitored to ensure responsible allocation of social aid to those who are in need, as stated by the Secretary-General of the United Nations on COVID-19 Global Humanitarian Response Plan '*We must come to the aid of the ultra-vulnerable – millions upon millions of people who are least able to protect themselves. This is a matter of basic human solidarity. It is also crucial for combating the virus. This is the moment to step up for the vulnerable*' (UN, 2020). One approach is to examine the spatial distribution of these 'social aids' (number of people or households that have received social aid in monetary or non-monetary form) for each European country (from Box 7 to Box 11) and scrutinise such allocations in concordance with the regional typologies (predominantly urban regions, predominantly rural regions, or intermediate). Spatialising such allocation can provide a better analytical overview of the first social impacts of the pandemic, hence leading to robust management of the current as well as guidelines for future crises.

In Denmark, the number of people who received social benefits and pensions increased by 5% (between 2019 and 2020). The country has put in place measures during Covid-19 to facilitate access to them (facilitation of online administrative procedures), enabling people to mobilise these benefits. In France, except for the department of Pas-de-Calais (which has the highest number of social assistance recipients)– where the number has decreased – everywhere in France, there has been an increase in the number of applications for social assistance. In the Paris region, many employees lost their jobs due to confinement, especially in the restaurant and hotel sectors. The departments on the eastern border also recorded the highest

increases. This can be explained by the fact that many French people are border workers in these areas. With the confinement and closure of the borders, these people may have lost their jobs. In the Netherlands, it is very clear that the most densely populated areas are those where the number of recipients of social aid has increased the most. In these regions, the Covid-19 crisis has had deleterious effects, bringing part of the economy to a standstill. In Germany, because of the impact of Covid-19 on the costs of everyday life, especially for people on low incomes, the Bundestag introduced the Hartz IV bonus, a financial aid package to alleviate the particular hardship caused by the pandemic. Recipients of social benefits received increased support for the Hartz IV bonus. This support has prevented many Germans from falling into poverty. This can probably explain why the number of beneficiaries decreased between 2019 and 2020. In Switzerland, the very high geographical heterogeneity in the evolution of beneficiaries can be explained by the fact that each canton has its own social policy. Therefore some have helped vulnerable populations more than others.

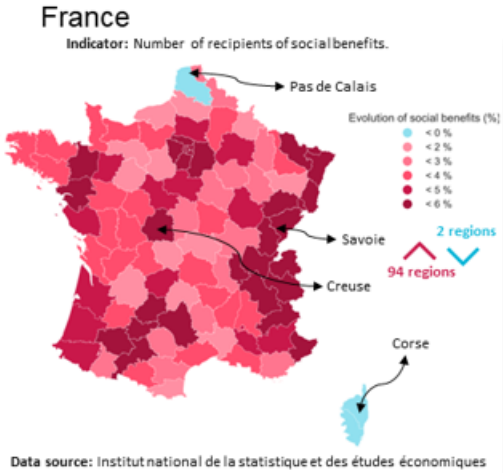
Box 7 COVID-19 social consequences: Social benefits in the Northern regions (Denmark and Finland)



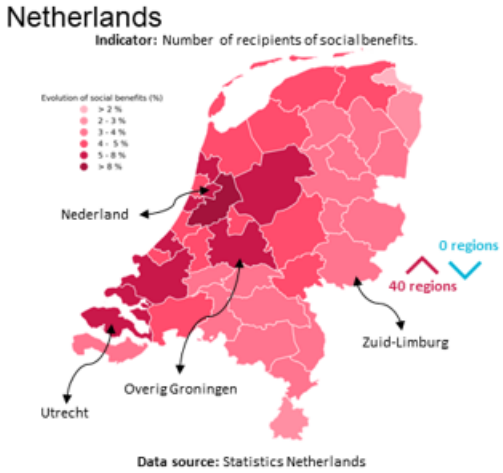
The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic increased in Denmark by 5%. Predominantly urban regions have the highest increase estimated at 6% with the highest decrease reported in Byen København. Predominantly rural regions accounted for the lowest decrease estimated at -0.32%. The most affected regions were Provide Byen København (with 6.2%), followed by Province Københavns omegn (with 5.79%), and Province Bornholm (with 5.77%). On the other hand, Province Vestjylland accounted the lowest increase in the number of social benefits with a growth estimated at 4.12%, followed by Province Vest- of Sydsjælland with 4.23%.

The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic has increased in Finland by 1.7%. However, not all the Finish regions have experienced such growth, two finish regions have experienced a decrease in number of people who received social benefits such as Aland with a rate estimated at -25%, followed by Kainuu with a rate estimated at -1.42%. On the other hand, Uusimaa province had the highest growth estimated at 8.2%, followed by Southwest Finland and Pirkanmaa with 6.2%, 5%, respectively. North Savo (0.9%), and Kymenlaakso (%1.9) have experienced the lowest increase.

Box 8 COVID-19 social consequences: Social benefits in the Western regions (France and the Netherlands) COVID-19

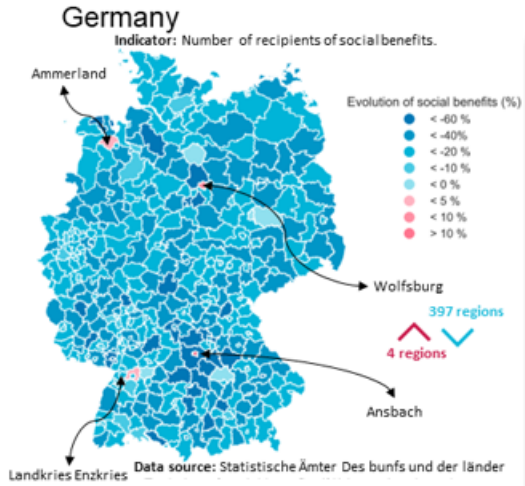


The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic increased by 4.55%. Through a regional typology lens, we discerned that predominantly urban regions were the most affected with an average growth estimated at 7.41%, followed by intermediate regions with 5%, and rural regions by 3.5%. The most affected French regions were Savoie province with 18.12%, Haut-Savoir with 17.62%, and Yvelines with 10.24%. On the other hand, such regions as Corse-du-Sud (-1.3%), Haute-Corse (-0.76), Pas de Calais (0.32), and Creuse (1.19) have experienced the smallest growth rates compared to all French regions.

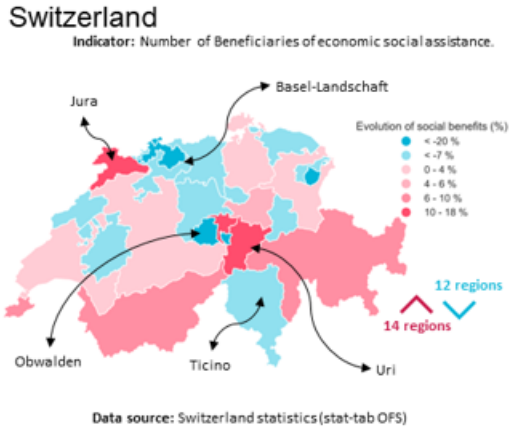


The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic increased by 3.48% in the Netherlands. Results showed that predominantly urban areas were the most affected areas in which the growth rate was estimated at 5%, followed by predominantly rural regions (3.9%) and intermediate regions (3.6%). The most affected regions were Groot-Amsterdam (12.5%), Flevoland (7.99%), Gravenhage (6.1%). On the other hand, Delfzijl en omgeving (1.71%), Oost-Groningen (2.28%), Zuid-Limburg (2.82%), and Noord-Drenthe (3%) were the least affected regions compared to the rest of regions in the Netherlands.

Box 9 COVID-19 social consequences: Social benefits in West-Central regions (Germany and Switzerland)

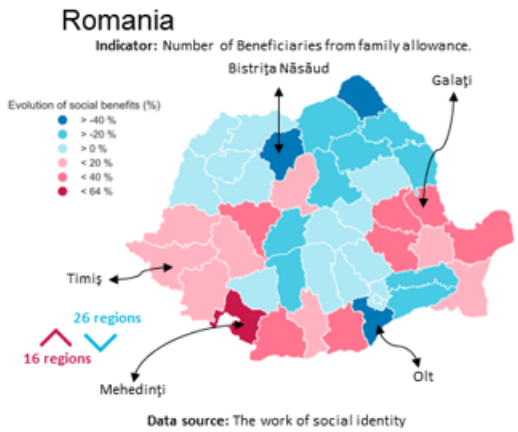


The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic has decreased by -78% across all German regions. Overall, almost all regional typologies were affected with the same magnitudes. Rural areas have experienced the highest decrease (-44.38%), followed by intermediate regions (-40%), and urban areas (-36%). Ansbach (15.5%), Wolfsburg (7.4%), Landkries Enzkreis (4.1%), and Ammerland (3.2%) were the only regions that have experienced a increase of the number of social beneficiaries. On the other hand, Erlagen-Höchstadt (-78%), Kulmbach (-77.8%), Roth (-77) known a shape decrease.

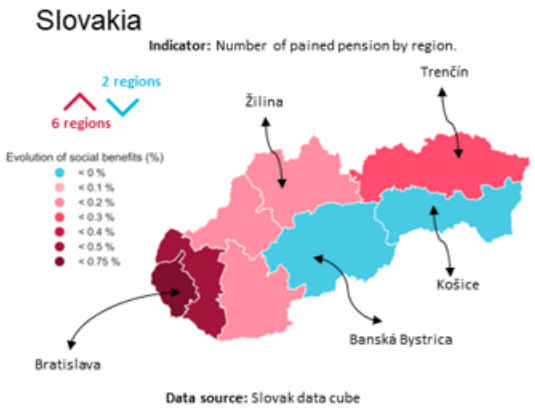


The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic has decreased by 0.20% in Switzerland. From a regional les, only predominantly rural areas have experienced an increase in social benefits (10%), while predominantly urban regions have experienced a decrease estimated at -1.7%, also as intermediate regions with a decrease estimated at -0.15%. Obwalden (-18,2%), Appenzell Innerrhoden (-17%), and Basel-Stadt (-7%) have experienced the highest decrease. On the other hand, Uri (17.8), Nidwalden (14.6%), Jura (13%), Wallis (9.4%) have known the highest increase.

Box 10 COVID-19 social consequences: Social benefits in East-Central regions (Romania and Slovakia)

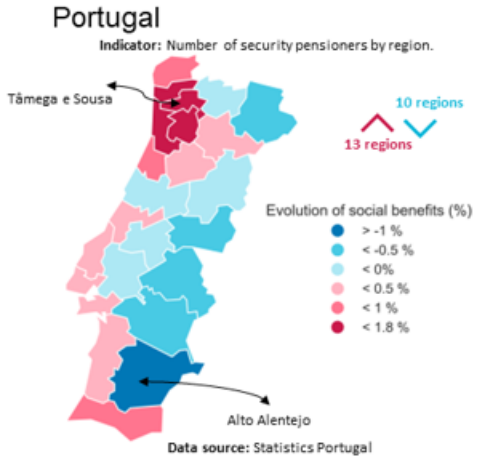


The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic has decreased by -4.2%. Results show that only intermediate regions have experienced a increase in the number of families that received social benefits during the pandemic (0.75%), while both urban and intermediate regions have experienced a decrease estimated at -8.3%, -6.1% respectively. Overall, 16 Romanian regions have experienced an increase (e.g., Mehedinti 63%, Alba 35%, Buzau 34%, Dolj 29%) while 26 regions (e.g., Botosani -60%, Giurgiu -43%, Bistrita Nasaud -40%, Iasi -35%, Suceava -35%, Calarasi -29%) have experienced a decrease.

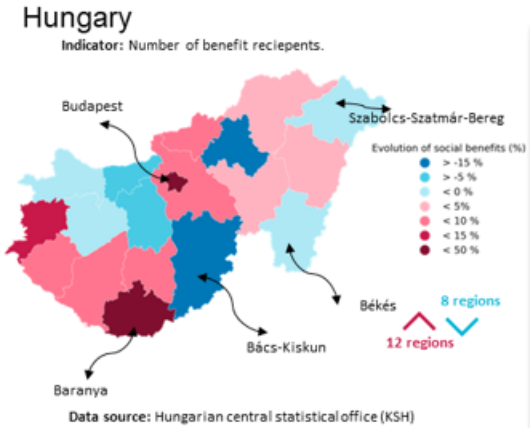


The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic has decreased by 0.22% in Slovakia. From a regional lens, predominantly urban regions experienced the highest growth estimated at 0.74%, followed by predominantly rural regions with 0.21%, et intermediate regions 0.07%. The region of Bratislava (0.74%), Trnava (0.49%), and West Slovakia (0.24%) have experienced the highest growth rates. On the other hand, only two Slovak regions have experienced a decrease in the number of people who received social benefits such as the region of Banska Bytrica (-0.08%) and Ko˘sce (-0.08).

Box 11 COVID-19 social consequences: Social benefits in Southern regions (Portugal) and East-Central regions (Hungary)



The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic has decreased by 0.26%. Only predominantly rural areas have experienced a decrease in the number of people who received social benefits (-0.2%), whereas, intermediate regions have experienced the highest growth rates (1.3%), followed by predominantly urban areas (0.59%). Tâmega e Sousa (1.76%), Ave (1.67%), Cavado (1.62%), Regiao Autinoma dos Acores (1.17%), Area Metropolitana do Porto (1.12%). On the other hand, Alto Alentejo (-1.4%), Beira Baixa (-0.8%), Terras de Tras-os-Montes (-0.72%), A4lentejo (-0.6%) compared to other regions.



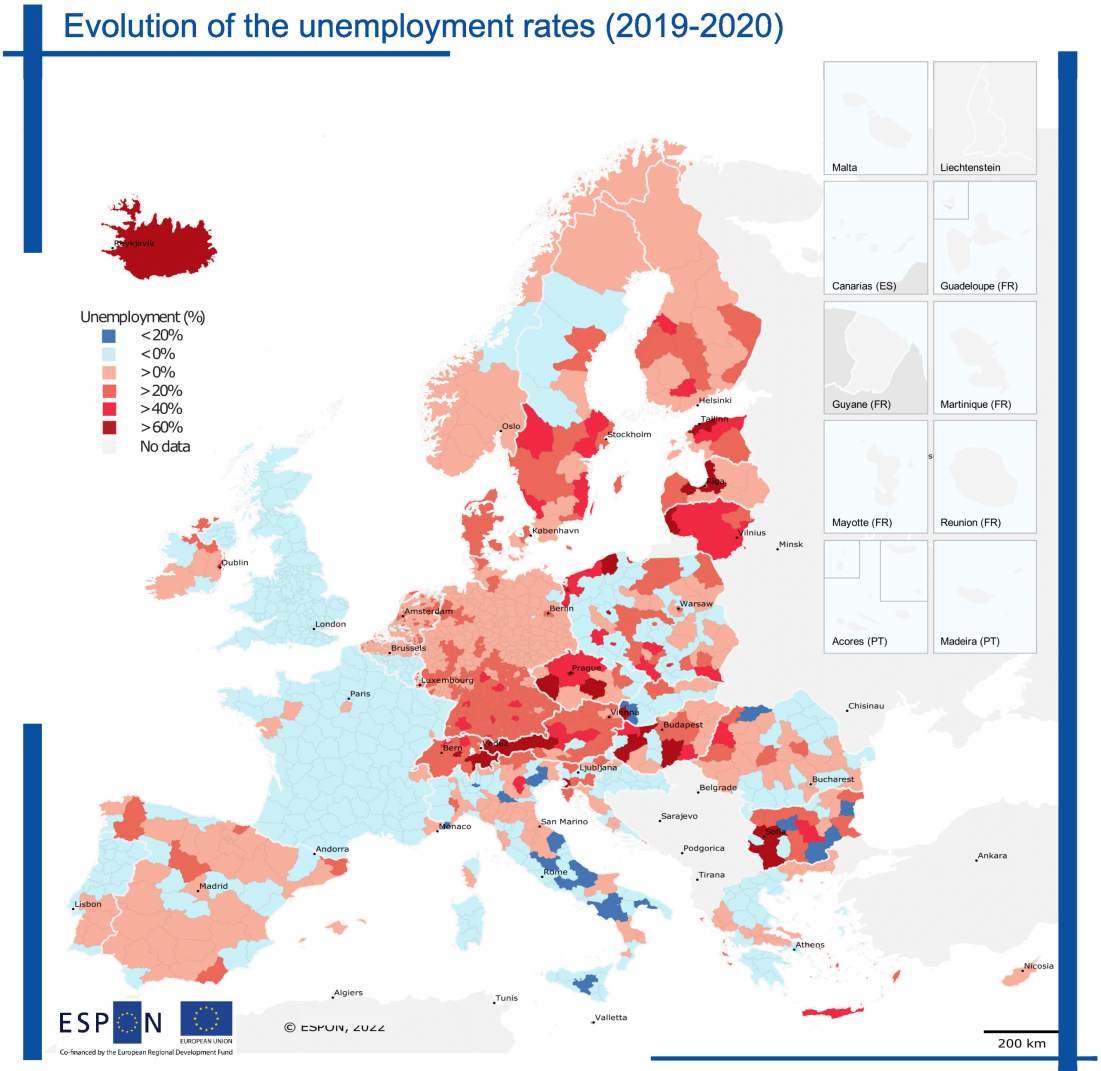
The number of people who received social benefits and pensions before (2019) and during (2020) the pandemic has decreased by 3.22% in Hungary. Overall, predominantly urban regions have experienced the highest growth rates estimated at 48.5% on average, while predominantly rural region (1.14%) and intermediate regions (0.88%) have known a slightly increase. Where Heves (-21.3%), Bacs-Kiskun (-16.8), Komarom-Esztergom (-6.9%) have experienced the highest decrease compared to other regions, whrease Budapest (48.5%), Baranya (23%), Vas (11.9%) have known the highest growth rates of people who received social benefits.

3.1.2 Employment

The COVID-19 pandemic and the recession that followed hit the labour market extremely in 2020. A total of 5.7 million EU workers were made redundant in the first six months of 2020. The number would certainly have been higher without government schemes designed to maintain employment. The decrease in the number of working hours was even more significant as the share of furloughed workers increased. Furthermore, most of those who lost their jobs became not only unemployed in the second quarter of 2020 but also inactive (not seeking work and having left the labour market) (Eurofound, 2021b). Although the decline tapered off subsequently, the impacts on the labour market and working conditions are far-reaching.

The short-term labour market effects of the crisis can be captured by the sudden and temporary drop in employment in 2020 (Map 4). Territorial disparities are the result of differences in the structure of the economy and occupational structure, as well as differences in support policies between countries.

Map 4 COVID-19 social consequences: Unemployment growth rates (%) from before (2019) and during (2020) the pandemic



Regional level: NUTS mixed levels (LAU & NUTS3-2) | Data version: 2021
Source: Territorial impacts of COVID-19
Origin of data: Statistik Austria, STATBEL Belgium in f gures, National Statistical Institute of Bulgaria, Croatian Bureau of Statistics, Cyprus Statistical Service, CZECH STATISTICAL OFFICE STATISTICS DENMARK, STATISTICS ESTONIA, Statistics Finland, Insee France, DESTATIS Statistisches Bundesamt, Hellenic Statistical Authority, HUNGARIAN CENTRAL STATISTICAL OFFICE, An Phriomh-Oif g Staidrimh, Istituto Nazionale di Statistica, Of ce statistics portal Of cial statistics of Latvia, Statistics Lithuania, STATISTICS PORTAL GRAND DUCHY OF LUXEMBROUG, NATIONAL STATISTICS OFFICE – MALTA, Statistics Netherlands, Statistics Poland, INSTITUTO NACIONAL DE ESTATISTICA – STATISTICS PORTUGAL, National Institute of Statistics – Romania, Statistical of ce of the Slovak Republic, Statistični urad RS, Insituto Nacional de Estadistica, Statistics Sweden.

On average, unemployment growth rates (from 2019 to 2020) across EU regions increased by 12.13% compared to the pre-COVID-19 period (2019). The spatial pattern of this evolution is not equally distributed across EU regions. In a cross-country comparison, Iceland had the highest increase in unemployment (66.17%), followed by Lithuania. Klaipėda county (Lithuania) had the highest unemployment increase across the Lithuanian regions (estimated growth rate of 63%), followed by Marijampolė county (estimated growth rate of 55%). Both Panevėžys county and Telšiai county ranked third, with a growth rate estimate of 54%. Some countries, such as in the Baltic States (48.21%) and Czechia (32.74%), were hit hard by the crisis. According to an OECD analysis[13], the latter has experienced numerous bankruptcies and job losses, breaking with the prepandemic years of strong economic growth.

On the other hand, Italy and France experienced a decreased trend in unemployment (6.5% and 4%, respectively). 74% percent of Italian regions (mostly from the south) experienced a decrease in unemployment rates; only 25% of regions experienced increased values (mostly those hit by the COVID-19 pandemic). The ban on dismissing employees, a unique measure introduced by Italy after the outbreak of the pandemic, may explain these results. This measure expired in July 2021 for large companies and at the end of October 2021 for small- and medium-sized enterprises, particularly in the services, textile, fashion and footwear industries.

Regarding sectoral effects, the most severe declines were recorded in the accommodation and food and beverage sectors, as well as the transportation and storage sectors. The main affected areas were closed sectors linked to tourism and non-teleworkable (such as service and sales jobs), elementary and blue-collar occupations. All in all, regional economies with a higher share of workers employed in travel- or tourism-related sectors had a greater decline in employment rates – notably in South-Western Europe (Spain and Portugal), which was disproportionately hit by the crisis. Furthermore, temporary workers were disproportionately affected, and in terms of demographic group, low-paid women and younger workers suffered the sharpest employment declines during the early, most severe period of the pandemic (Eurofound, 2021c; Eurofound and ECJRC, 2021).

Regarding government policies to mitigate job losses during the pandemic and guarantee the additional social protection of workers in 2020, 35 million people benefited from short time working schemes in the EU (European Commission, 2021), mainly during the second quarter of 2020. Several Member States introduced new short-time working schemes (Estonia, Greece, Hungary, Ireland, Latvia, Lithuania, the Netherlands, Poland and Slovenia) or adjusted their existing short-time working or wage-subsidy schemes (Austria, Belgium, Czechia, France, Germany, Italy, Malta and Spain) (Eurofound, 2021a). The generosity of the governments varied. In France, the average evolution of the unemployment rate across all regions decreased by 0.35%, and only five departments experienced a limited increase in unemployment rates. This means that the French NUTS 3 regions were not severely impacted by the pandemic. The government's 'whatever it takes' policy certainly helped cushion the effects of the crisis. This massive and unprecedented aid policy (€100 billion) is part of the National Recovery and Resilience Plan, which is based on EU funding of around €40 billion (out of the €100 billion). One of the aims of this national plan was to help companies maintain their economic activities and finance partial unemployment (to avoid firing staff). As far as allocations of these governmental schemes concerned, they often correspond to the spatial structures of the economy and spatial distribution of workplaces, thereby solidifying existing spatial divisions (e.g. Hungary; Czirfusz, 2021). This means that more resources have been allocated to the more developed, more prosperous and more resilient regions.

As a long-term effect, spatial patterns of employment can change slightly, as severe disruptions in global supply chains have unequal consequences on localities and regions plugged into the global production networks in different ways (Yeung, 2021). Furthermore, urban-rural differences might change: Remote working grows when the crisis abates, with workers and employers' preference for a hybrid mix of working from home and from the workplace (Lund et al., 2020). Barrero et al. (2021) estimate a three- to four-fold increase in home-worked hours in the US. The rise has and will have an impact on the distribution of workplaces, in suburbs and towns closer to metropolitan areas with a concentration of teleworkable jobs, making metropolitan areas more attractive.

3.1.3 Youth

Young people are disproportionately disadvantaged in many ways during economic downturns: emerging joblessness, financial insecurity and mental health problems are typical recurring consequences of crisis for young age groups. As the pandemic hit in 2020, unemployment and NEET rates (the share of young people

[13] https://www.oecd.org/newsroom/czech-republic-actively-support-business-and-employment-to-strengthen-COVID-19-recovery.htm

who are not in employment, education or training) among 15- to 29-year-olds increased. Young workers are more likely to be affected by a moderate increase in the At-Risk of Poverty rate for half of the EU countries (Eurostat, 2021). According to a live survey conducted by Eurofound (2021b) in spring 2021, almost two-thirds of participants in the youngest age group (18–34 years) were at risk of depression; a deterioration in mental health was especially evident among those who had lost their jobs.

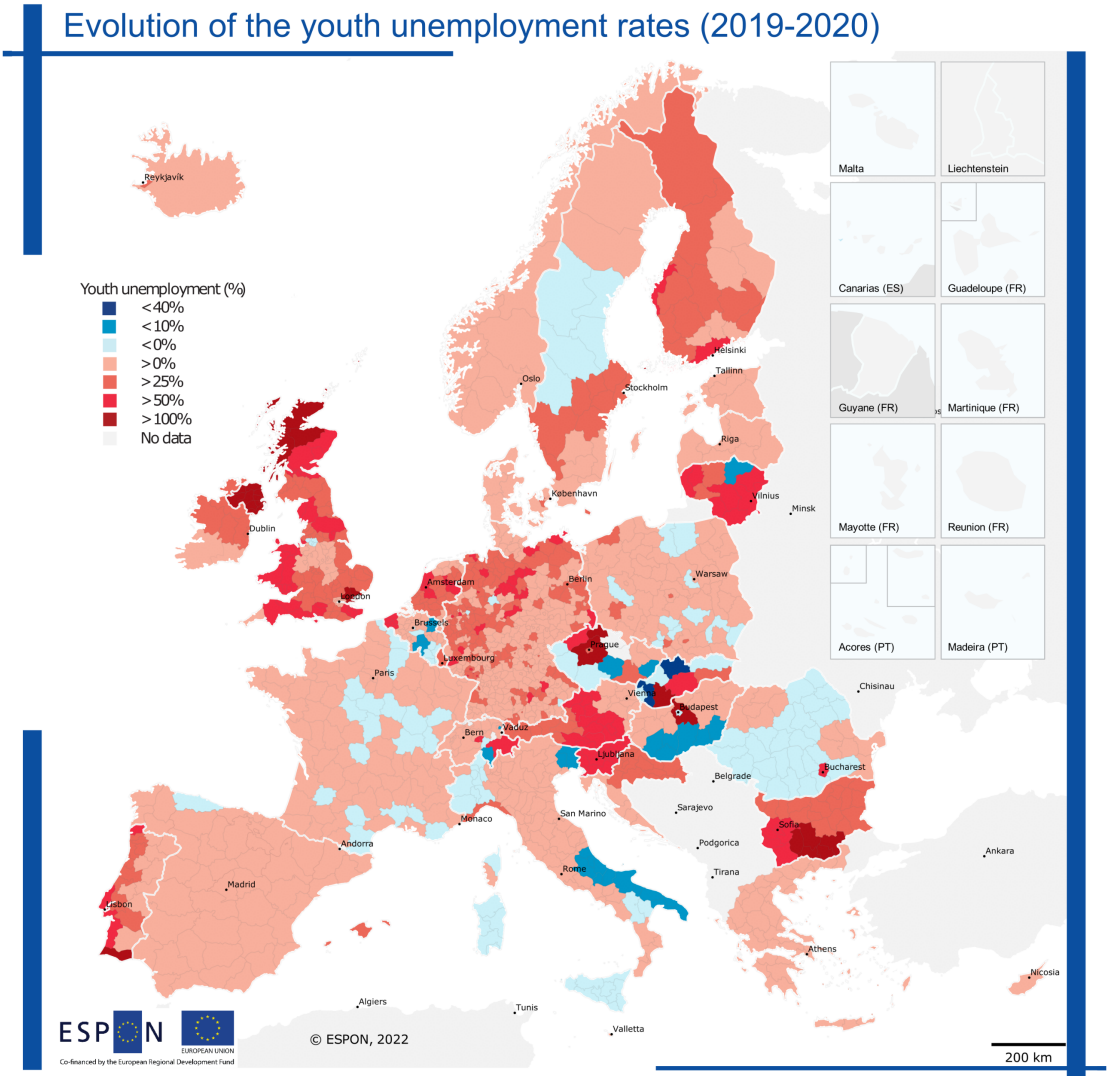
Overall, the percentage change in youth unemployment across the EU regions increased by 21.81% in 2019 compared to the pre-COVID-19 times (2019) (Map 5). The social consequences of the COVID-19 crisis are even more important for youth unemployment, as an above-average proportion of young people are working in sectors affected by restrictions. Most young people (13%) were employed in accommodation and food service activities (13%, while this ratio was 5% for the 30+ cohort) and in wholesale and retail (11%) (Eurofound, 2021c). Consequently, regions that were more oriented to these sectors had a higher probability of experiencing strong growth in the youth unemployment rate.

Similar to the regional distribution of unemployment rates (shown in Map 5), the youth unemployment rates are not evenly distributed across EU countries and regions. Despite the evident regional variation across EU countries, the most significant distinctions appear to be within countries (regions/counties/municipalities of the same country). The results show that the capital regions were severely hit by the pandemic. These capital regions are often home to major universities. However, young people had more difficulties accessing a job in 2020 when they left school due to the health crisis.

Some countries particularly experienced a significant increase in youth unemployment rates (e.g. Slovenia by 76.8%, Lithuania by 68.5% and Bulgaria by 63.2%). Nonetheless, Map 5 shows that some spatial patterns should be taken into consideration. For instance, several tourist regions experienced a higher increase in youth unemployment rates. In these regions, young people often have a limited duration contract (fixed-term, temporary) and were therefore more exposed to redundancy[14] – for example, in the case of Algarve (Portugal).

[14] https://www.oecd.org/coronavirus/policy-responses/what-have-countries-done-to-support-young-people-in-the-COVID-19-crisis-ac9f056c/

Map 5 COVID-19 social consequences: growth rates of youth unemployment (%) from before (2019) and during (2020) the pandemic



Regional level: NUTS mixed levels (LAU & NUTS3-2) | Data version: 2021
Source: Territorial impacts of COVID-19
Origin of data: Statistik Austria, STATBEL Belgium in f gures, National Statistical Institute of Bulgaria, Croatian Bureau of Statistics, Cyprus Statistical Service, CZECH STATISTICAL OFFICE STATISTICS DENMARK, STATISTICS ESTONIA, Statistics Finland, Insee France, DESTATIS Statistisches Bundesamt, Hellenic Statistical Authority, HUNGARIAN CENTRAL STATISTICAL OFFICE, An Phriomh-Oif g Staidrimh, Istituto Nazionale di Statistica, Of ce statistics portal Of cial statistics of Latvia, Statistics Lithuania, STATISTICS PORTAL GRAND DUCHY OF LUXEMBROUG, NATIONAL STATISTICS OFFICE – MALTA, Statistics Netherlands, Statistics Poland, INSTITUTO NACIONAL DE ESTATISTICA – STATISTICS PORTUGAL, National Institute of Statistics – Romania, Statistical of ce of the Slovak Republic, Statistični urad RS, Insituto Nacional de Estadistica, Statistics Sweden.

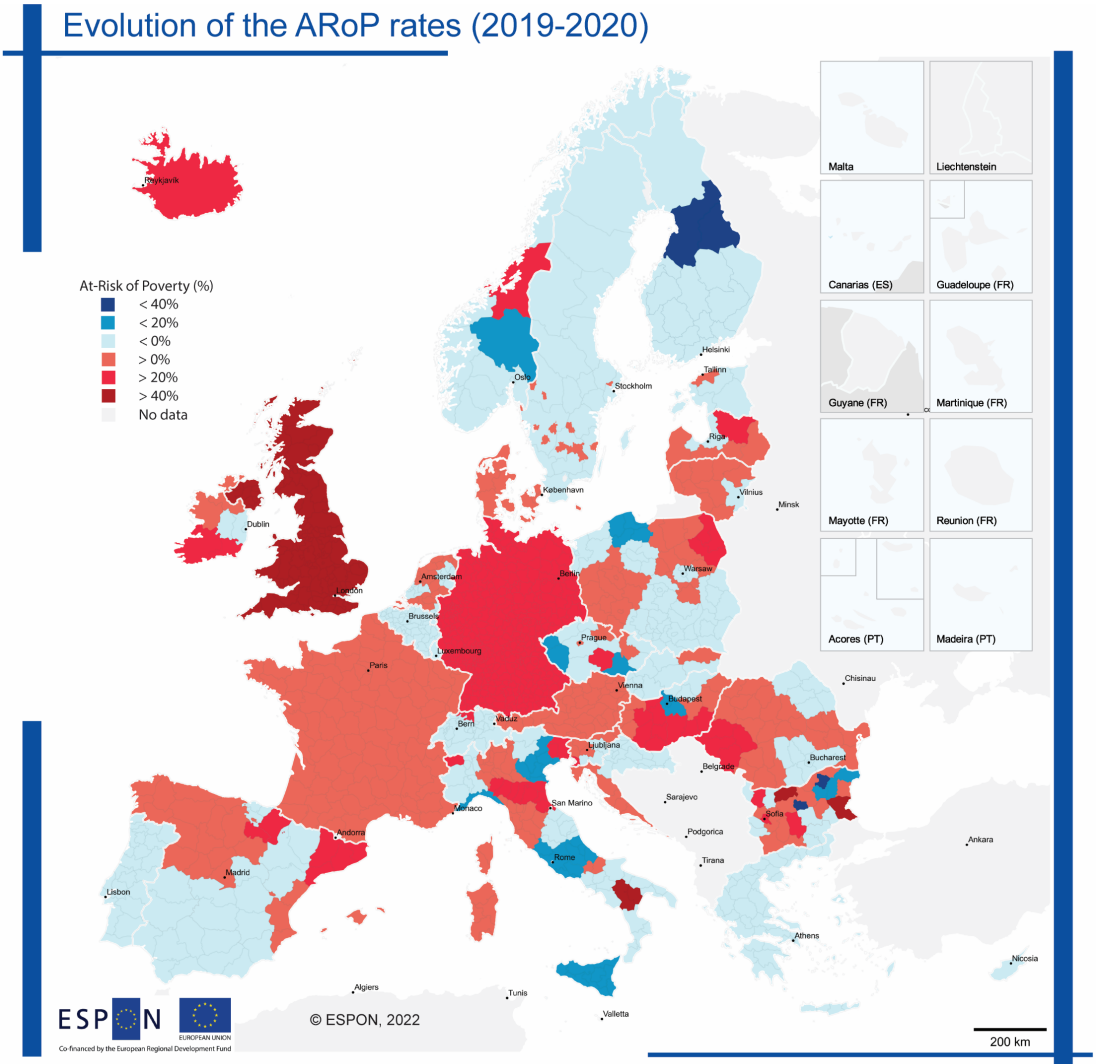
3.1.4 At risk of poverty

Although downward economic performance and increased unemployment are typically associated with emerging poverty and a fall in income, early estimates for 2020 at the EU level show that social benefits and national short-term work schemes are likely to alleviate the effects of the pandemic on disposable income and the poverty rate (Eurostat, 2021). Poverty remains stable at the EU level, but with a high heterogeneity across countries and different segments of the population. Due to government support and measures during the pandemic, inequalities across income distribution have been even reduced in European countries (Stantcheva, 2022). However, without governmental support, the pandemic would have hit lower income groups even harder, and estimated income losses might have been particularly heavy for the most vulnerable subgroups of the working population, with more significant differences across and within countries.

Overall, the evolution of people's At Risk of Poverty across the EU regions decreased by 1.21% on average compared to the pre-COVID-19 period (2019) (Map 6). The UK had the highest change of people living in households with income below the risk-of-poverty threshold (with a growth rate estimated at 85.4%), followed by Iceland (32.6%), Germany (25%) and Latvia (9.9%). In these countries, the COVID-19 pandemic has led to an increase in poverty. On the other hand, about half of the EU member states do not show particular differences compared with 2019.

This can be explained by the fact that, in many countries, regions have the administrative competence to manage social aspects. Some regions have thus put in place specific regional and local policies to help the poorest households cushion the crisis, notably through direct financial aid to maintain or increase their purchasing power.

Map 6 COVID-19 social consequences: Growth rates of At Risk of Poverty (%) from before (2019) and during the pandemic (2020)



Regional level: NUTS mixed levels (LAU & NUTS3-2) | Data version: 2021
Source: Territorial impacts of COVID-19
Origin of data: Statistik Austria, STATBEL Belgium in figures, National Statistical Institute of Bulgaria, Croatian Bureau of Statistics, Cyprus Statistical Service, CZECH STATISTICAL OFFICE STATISTICS DENMARK, STATISTICS ESTONIA, Statistics Finland, Insee France, DESTATIS Statistisches Bundesamt, Hellenic Statistical Authority, HUNGARIAN CENTRAL STATISTICAL OFFICE, An Phriomh-Oifig Staidrimh, Istituto Nazionale di Statistica, Office statistics portal Official statistics of Latvia, Statistics Lithuania, STATISTICS PORTAL GRAND DUCHY OF LUXEMBROUG, NATIONAL STATISTICS OFFICE – MALTA, Statistics Netherlands, Statistics Poland, INSTITUTO NACIONAL DE ESTATISTICA – STATISTICS PORTUGAL, National Institute of Statistics – Romania, Statistical office of the Slovak Republic, Statistični urad RS, Insituto Nacional de Estadistica, Statistics Sweden.

3.1.5 A deprivation index to track the social consequence of COVID-19 containment measures

Map 7 represents the evolution of the deprivation index (DI) between 2019 and 2020. Herein, the deprivation index is built by combining the following three indicators: unemployment rate, youth unemployment rate and poverty rate. The DI was then calculated using the traditional formula for the Human Development Index (HDI). The formula for calculating the component indicators of the DI is (Actual value − minimum value) / (Maximum value − minimum value). The closer the indicator is to 1, the more social difficulties there are in the region; the closer it is to 0, the less social difficulties there are in the region (for further details on the methodology, consult the methodology annex under section 1.4.3). Overall, the map shows a fairly strong 'country effect'. In other words, we observe a relative homogeneity of the regions within the country and a heterogeneity between countries, indicating that the socioeconomic impacts depend largely on the extent of national policies to mitigate the effects of the crisis.

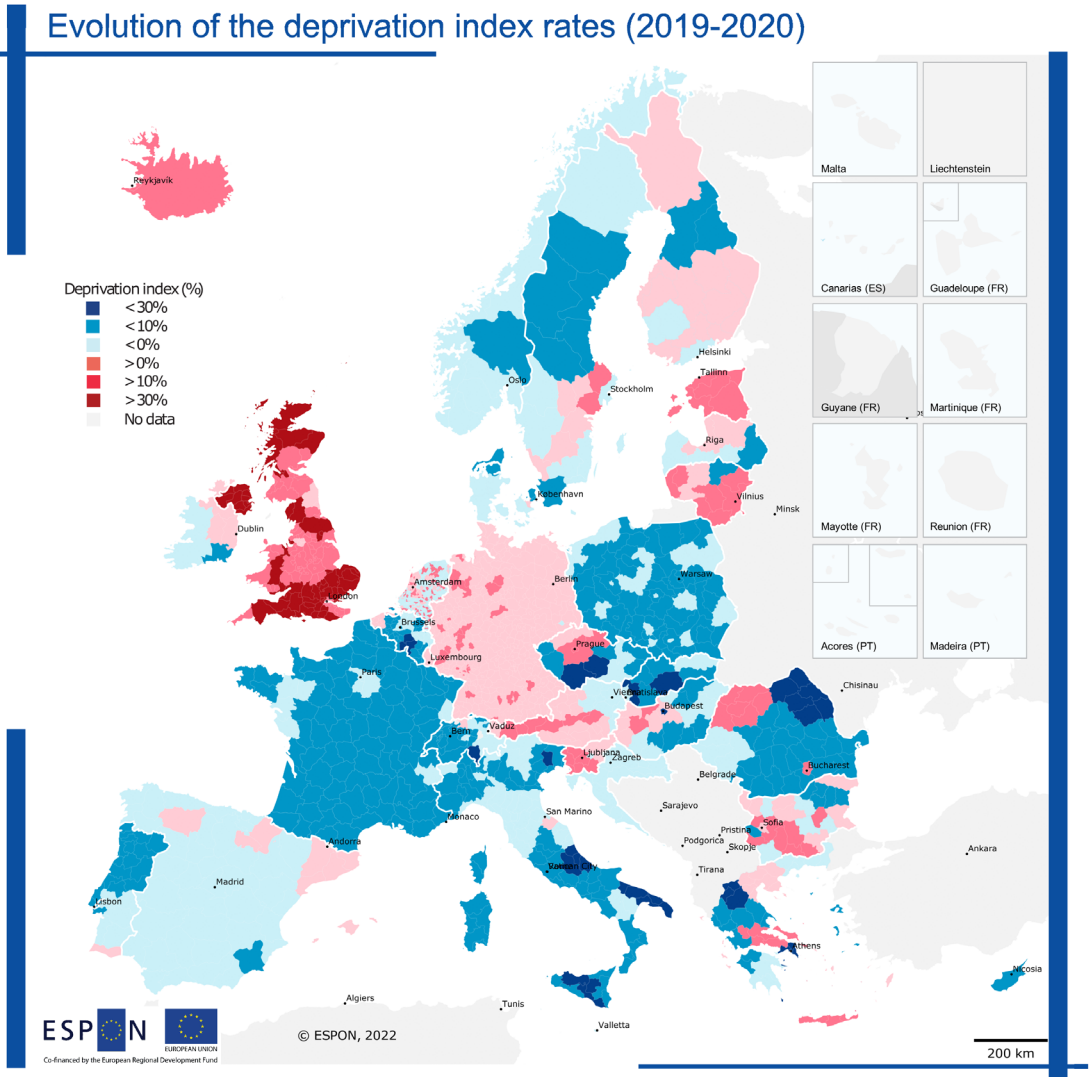
The regions in red were the most negatively affected by the pandemic (rise of their DI) (Map 7). In these areas, the COVID-19 pandemic had a negative impact on social indicators. This is particularly the case in the UK and the Baltic countries. In the UK, the first lockdown (March to June 2020) led to a significant increase in unemployment. This is particularly true for low-income households, leading to an increase in poverty. Before the crisis, in 2019, more than half of the people living below the poverty line were in precarious employment[15]. However, the COVID-19 crisis has led to increased rates of unemployment (Matilla-Santander et al., 2021). This may explain why in the UK, the DI between 2019 and 2020 is largely aggravated. For the Baltic countries, a recent study by the European Economic and Social Committee[16] highlights the lack of targeted measures to limit the effects of the crisis for people experiencing social difficulty. The result is the aggravation of unemployment, youth unemployment and At-Risk of Poverty rates, both in urban and rural areas.

Furthermore, in most countries, the most economically developed regions experienced the largest declines in their DIs (for example, Hungary – North Transdanubia; Romania – Bucharest; Spain – Catalonia; the Netherlands – Randstad; Sweden – Stockholm). In these regions, the social consequences of the crisis have been weak. On the other hand, less developed areas seem to have experienced a smaller decline (within countries) – for example, Italy and Romania. This may reflect the fact that the pandemic mainly affected the more developed, mainly urban, areas during the first wave, so the socioeconomic impacts may have been more significant.

[15] https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/bulletins/coronavirusandthesocialimpactsongreatbritain/previousReleases

[16] https://www.eesc.europa.eu/en/our-work/publications-other-work/publications/economic-and-social-situation-baltic-countries-lithuania-study

Map 7 Evolution of the deprivation index across European regions before and during the COVID-19 pandemic



Regional level: NUTS mixed levels (LAU & NUTS3-2) | Data version: 2021
Source: Territorial impacts of COVID-19
Origin of data: Statistik Austria, STATBEL Belgium in f gures, National Statistical Institute of Bulgaria, Croatian Bureau of Statistics, Cyprus Statistical Service, CZECH STATISTICAL OFFICE STATISTICS DENMARK, STATISTICS ESTONIA, Statistics Finland, Insee France, DESTATIS Statistisches Bundesamt, Hellenic Statistical Authority, HUNGARIAN CENTRAL STATISTICAL OFFICE, An Phriomh-Oif g Staidrimh, Istituto Nazionale di Statistica, Of ce statistics portal Of cial statistics of Latvia, Statistics Lithuania, STATISTICS PORTAL GRAND DUCHY OF LUXEMBROUG, NATIONAL STATISTICS OFFICE – MALTA, Statistics Netherlands, Statistics Poland, INSTITUTO NACIONAL DE ESTATISTICA – STATISTICS PORTUGAL, National Institute of Statistics – Romania, Statistical of ce of the Slovak Republic, Statistični urad RS, Insituto Nacional de Estadistica, Statistics Sweden.

3.2 A regional typology of the social consequences of the pandemic

Map 8 represents a classification of European regions according to their characteristics. We can distinguish four main typologies using a hierarchical agglomerative clustering algorithm (Müllner, 2011). Several variables were introduced to achieve this classification: unemployment growth rates, youth unemployment growth rates, at-risk-of-poverty growth rates, territorial characteristics (predominantly urban and rural and intermediate regions on the one hand, and border regions, on the other hand; see Eurostat, 2019[17]) and epidemiological characteristics (total number of COVID-19 death rates). The methodology used resulted in four classes. The results show that there is a strong country effect, meaning that there is more heterogeneity between countries than within countries. This is in line with the idea that the way in which countries handle the pandemic can explain its greater or smaller impact on the regions.

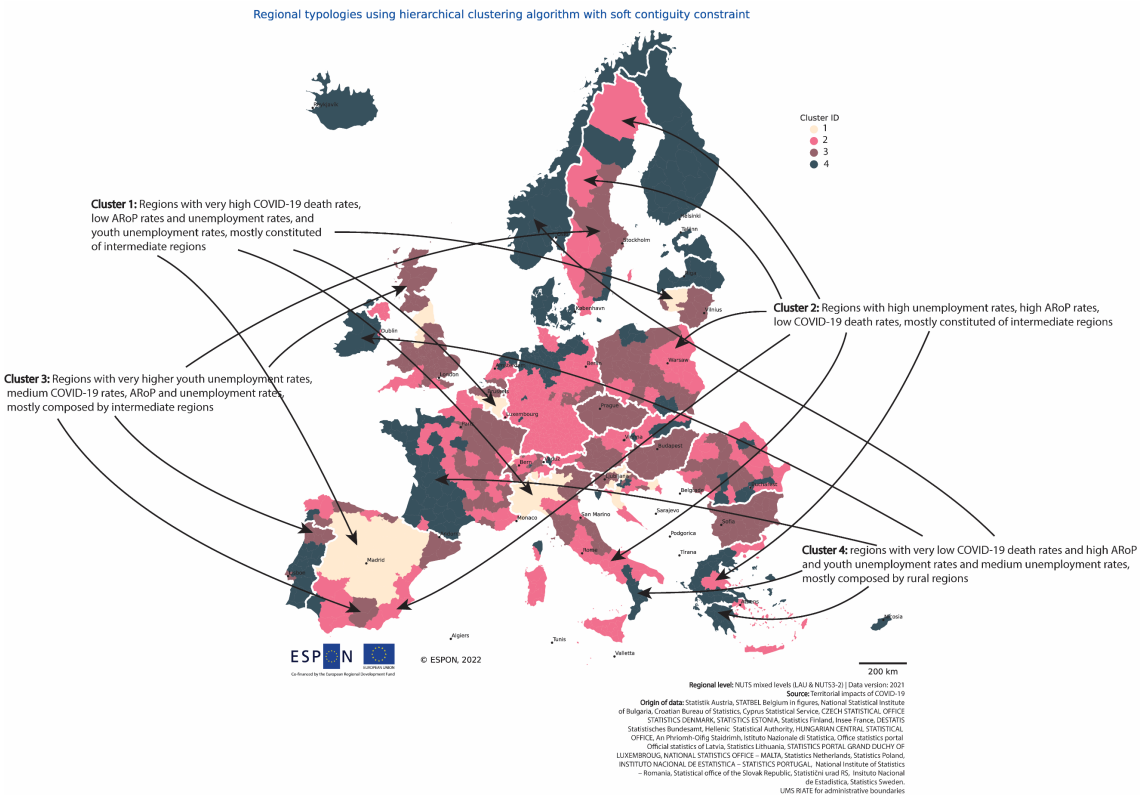
The first cluster "Regions doing well despite the pandemic" (regions with very high COVID-19 death rates, low ARoP rates and unemployment rates, mostly constituted of intermediate regions): the cluster encapsulates the most hit region during the first COVID-19 wave, including the vast majority of Spanish regions (e.g. Navarra, Avila, Madrid, Guadalajara, Soria), Italian regions (Milano, Mantova, Pavia, Savona, Alessandia), Lithuanian regions (Šiauliai, Tauragė, and Telšiai), and Belgian regions (e.g. Région Wallone, and Luxembourg). Regional attributes assert that the cluster contains intermediate regions (49%) that are located along a national border (48%) and non-metropolitan (76%).

The second cluster "Regions that were less affected by the pandemic but experienced significant social consequences" (regions with high unemployment rates, high ARoP rates and low COVID-19 death rates, mostly constituted of intermediate regions): includes the vast majority of regions in Germany (Saalekreis, Wittenberg, Böblingen), alongside some regions from Spain (Lugo, Cantabria, València, Castelló), France (Creuse, Haut-Loire, Haute-Savoie, Loir-et-Cher), Poland (Mazowieckie, Dolnoslaskie, Podlaskie), and Romania (Satu Mare, Botosani, Constanta, Mehedinti). The exposure to the virus was higher in these regions.

The third cluster "Regions where youth have been particularly affected by the pandemic" (regions with very high youth unemployment rates, medium COVID-19 rates, ARoP and unemployment rates, mostly composed of intermediate regions): corresponds to the Spanish regions (Asturias, Gipuzkoa, Barcelona, Granada), French (Paris, Val-de-Marne, Saone-et-Loire), UK (Derbyshire and Nottinghamshire, Lincolnshire, Oxfordshire), Poland (Świętokrzyskie, Podkarpackie, Lódzkie), Romania (Alba, Sibiu, Prahova, Gorj), and all regions from Czechia and Bulgaria. These regions were affected by the pandemic but have not been able to contain its effects. Metropolitan regions are present in this category (34%) as well as border regions (39%).

The fourth cluster "Regions with a very low level of Covid-19 but which have experienced social consequences" (regions with very low COVID-19 death rates and high ARoP and youth unemployment rates and medium unemployment rates, mostly composed of rural regions): the cluster incapsulates most regions of Portugal (Algarve, Centro, Alentejo) and Greece (Ionia Nisia, Ipeiros), it is present in Western French regions (Calvados, Sarthe, Gironde, Correze), Southern Italian regions (Potenza, Cosenza, Vibo Valentia), and Northern German regions (Bremerhaven, Bremen, Wesermarsch). Predominantly rural regions are the most common regional typologies (50%), the cluster contains non-border regions (75%), but metropolitan regions are present (41%).

Map 8 A regional typology of COVID-19 social consequences before (2019) and during (2020) the pandemic

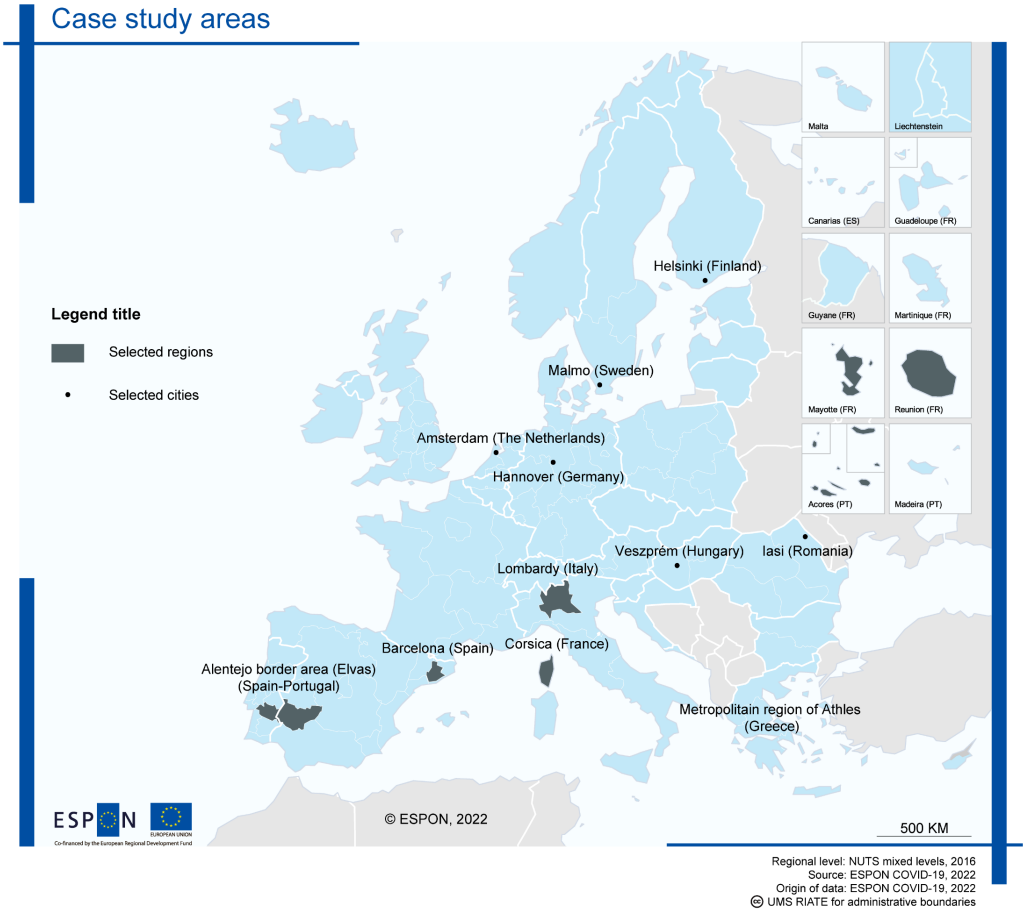


4 Examining regional policy responses for tackling the socioeconomic effects of COVID-19

4.1 Introducing survey, case studies and key conceptions

A core focus of the study was to examine the regional and local policy responses for tackling the socio-economic effects of COVID-19 containment measures. This element of the research was developed through two main research methods: firstly, a survey targeted at regional and local policymakers was designed and implemented to provide an overarching European-wide insight into how regions and cities responded to the crisis. The survey focused on 25 European countries and received a total of 475 answers. Secondly, 14 case studies (Map 9) were conducted to provide an in-depth analysis of regional and local level policies introduced during the pandemic, based on documentary analysis and semi-structured interviews with key stakeholder (e.g. public representatives, sectoral actors, and civil society groups). The case study regions were selected to reflect a balanced geographical distribution across Europe (based on the United Nations geoscheme: Eastern Europe, Northern Europe, Southern Europe and Western Europe). The case areas are visualized in Map 9, including: Amsterdam, Athens, Azores, Barcelona, Corsica, Elvas, Hannover, Helsinki, Iasi, Malmo, Lombardy, Mayotte, Reunion, and Veszprem.

Map 9 Case study regions



The case study regions covered a variety of territorial contexts, such as urban, rural, intermediate, cross-border, and island regions. The cases also included regions in both centralized and decentralized national governance systems, with different types of regional/local level governance structures where roles and responsibilities are dispersed across multiple local level authorities (e.g. municipal authorities, metropolitan authorities and regional authorities). Heterogeneity across cases was considered important to explore how

COVID-19 has impacted on regions with different territorial, governance and socio-economic characteristics, as outlined in Table 3 below.

Table 3 Overview of case studies' geographic, socioeconomic and governance characteristics

Region	European Location	Type of Region	Social Characteristics	Economic Characteristics	Governance Structure
Amsterdam (NL)	North	Urban	Growth in population leading to housing challenges. Generally high levels of education but growing unemployment among less-educated groups.	Highly specialised economy focused on information and communication technology (ICT), commercial services and culture/tourism sectors.	Centralised
Athens (EL)	South	Urban	Declining and aging population. High levels of unemployment rates and poverty. High levels of tertiary education of the population compared to the country average.	Economy based on tertiary sector with specialisation in culture and tourism, ICT services, financial & insurance activities and real estate.	Centralised
Azores (PT)	South	Island	High levels of unemployment, poverty and social exclusion. Low levels of education compared to the national average.	Economy based on public administration, agriculture, fisheries, tourism and retail trade.	Centralised
Barcelona (ES)	West	Urban	Growing population trend and high levels of employment. Children, women and migrants are considered the most vulnerable groups pre-pandemic.	Diverse economy with strong industry base and high levels of innovation.	Decentralised
Corsica (FR)	South	Island	Population growth three times higher than the national average; one household in five living below the poverty line.	The tertiary sector is the main employer on the island.	Centralised
Elvas (PT)	West	Rural Cross-border	Population decline and ageing society. High levels of poverty, unemployment and low education levels compared to national averages.	Economy based on tertiary sector and local SMEs working in tourism and retail trade. Low levels of innovation and closure of large industries.	Decentralised
Hannover (DE)	Central	Urban	Ageing population and low birth rates. High levels of immigration and youth unemployment. Mortality rates higher than national average.	Mixed economy based on tertiary, industry and agriculture sectors.	Decentralised
Helsinki (FI)	North	Urban	Growing population. High employment and income levels. High education levels and consistently high scores on quality-of-life indexes.	Economy based on service sector and ICT - based industries.	Decentralised

Iasi (RO)	East	Inter-mediate Cross-border	High poverty rates and low levels of education. Growing population rates.	Economy based on tertiary sector and automobile industry. Low innovation levels and labour shortages in the ICT sector.	Centralised
Malmo (SE)	North	Urban Cross-border	Growing population. Mixed education levels. High unemployment among youths and immigrants. Lower income levels.	Diverse economy in chemical industry, ICT, life sciences, engineering, food, and construction. Extremely high levels of innovation	Decentralised
Mayotte (FR)	South	Island	Growing population (strong surplus of births over deaths). Younger population than elsewhere in France (the average age is 23, compared to 41 in mainland France). The median standard of living is seven times lower than at the national level, and poverty is very high.	The non-market sector is underdeveloped, the economic base is still very informal.	Centralised
Milan (IT)	South	Urban	High levels of employment and education. High population growth and low levels of poverty	Diverse economy including manufacturing industries, agriculture, fashion and banking. High levels of innovation, ICT and biotechnology.	Decentralised
Reunion (FR)	South	Island	Demographic growth driven by the natural balance, young population; high poverty and median living standards below the national average.	A highly developed non-market tertiary sector.	Centralised
Veszprem (HU)	East	Inter-mediate	Decreases in population and ageing society. High education levels and low unemployment. Limited poverty and social exclusion.	Diverse economy largely based on manufacturing and service specialization in culture and tourism sectors. Growing R&D infrastructure.	Centralised

The survey and case studies were designed to assess whether the COVID-19 pandemic presented a 'window of opportunity' for regional and local authorities to promote 'proactive' spatial planning and territorial policies. **Proactive policies** were defined as "measures that try to make best use of the particular socio-economic circumstances to further a specific regional policy and planning goal". In meeting this goal, the survey and case studies followed the same structure serving to (i) Explore the socioeconomic and governance trends before and during the pandemic, taking into account education level, income, employment and youth unemployment; (ii) Unveil the regional policy progress of Just, Green and Smart transition policies during the first three consecutive COVID-19 waves; (iii) Analyse the most common forms of collaboration between local authorities; (iv) Assess how the pandemic affected local authorities' financial resources; and (v) Gather the successful practices implemented by different regions to tackle the pandemic.

In the case studies, the assessment of proactive policy responses to the crisis was broken down into three core thematic areas: 1) just transition policies; 2) green transition policies; 3) smart transition policies. The term '*just transition'* is used in reference to the shift towards a climate-neutral economy and ensuring that this move occurs in a fair way, so any of the potentially negative social impacts of transition leave no one behind. In this study, **just transition** was used more broadly to examine any social policies introduced during the pandemic which aim to improve human welfare and meet the needs of citizens, particularly the most vulnerable groups in society. Under this theme, social policies are extended to include economic policies (e.g., furlough schemes, tax reductions, increased welfare benefits) intended to limit bankruptcies, save jobs,

and mitigate social challenges caused by unemployment and poverty. **Green transition** was defined as policies aimed to enhance climate neutrality, environmental sustainability, and the shift to a carbon neutral economy. Leaning on the EU definition of smart cities, **smart transition** was defined as policies that promote innovation and entrepreneurship, by focusing on making industries, businesses, networks and services more effective for the benefit of citizens through the use of digital solutions. The definition was extended to include the concept of smart specialization and policies related to increasing innovation and facilitating the development of innovative startups, entrepreneurial businesses and companies. Table 4 provides an overview of the types of policies that the case study research team explored in relation to each theme.

Table 4 Proactive COVID-19 Policy Examples

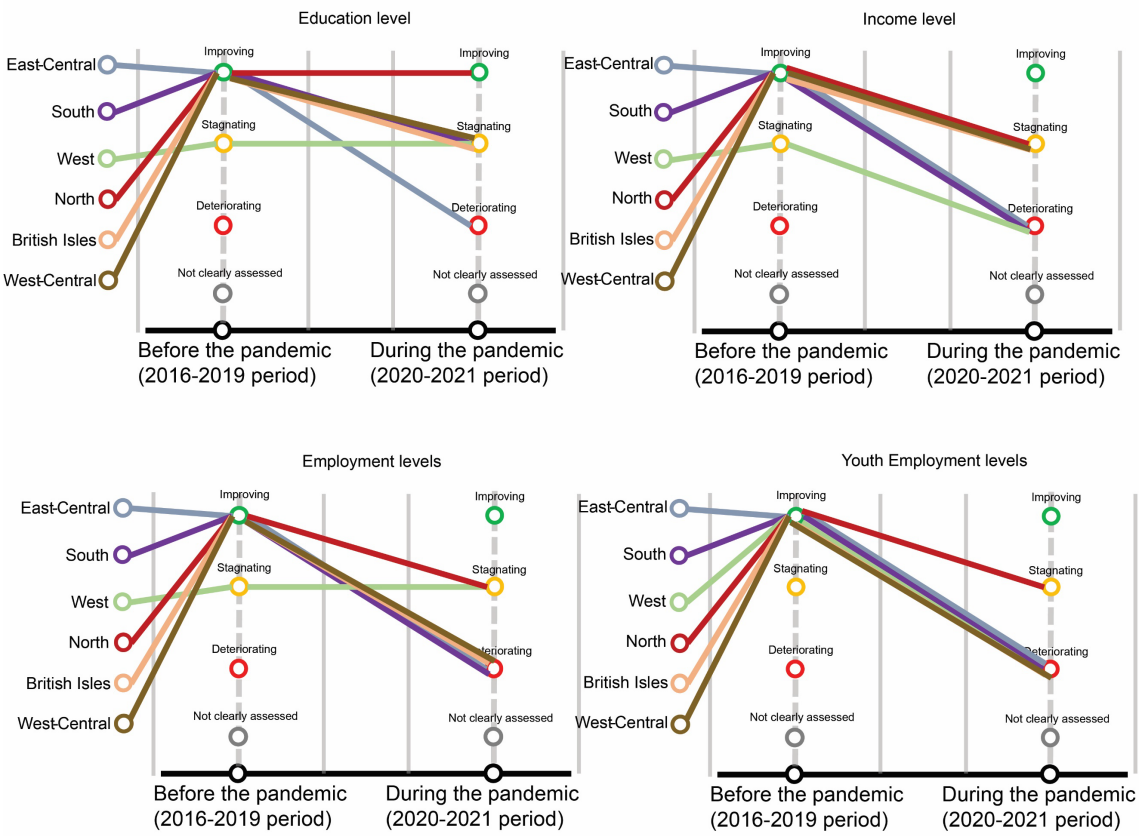
Policy Theme	Type of Policies
Just Transition	Policy measures supporting youth, older adults, taxation and unemployment, poverty, social exclusion, housing and living conditions, education and training, culture and sports activities, wealth inequalities, health and working conditions, business support
Green Transition	Policy measures supporting mobility, public space and green areas, city centres and business districts management, land-use changes, waste management and the circular economy, green tourism, climate mitigation and adaptation
Smart Transition	Policy measures supporting digitalisation of public services, e-governance, start-ups, entrepreneurial innovation, e-learning, digital access and competencies, multi-locality working, big data, smart transport

The following sections provide a synthesis of key policy related findings from the regions covered in the European-wide survey and the case studies.

4.2 Findings from the survey and case studies

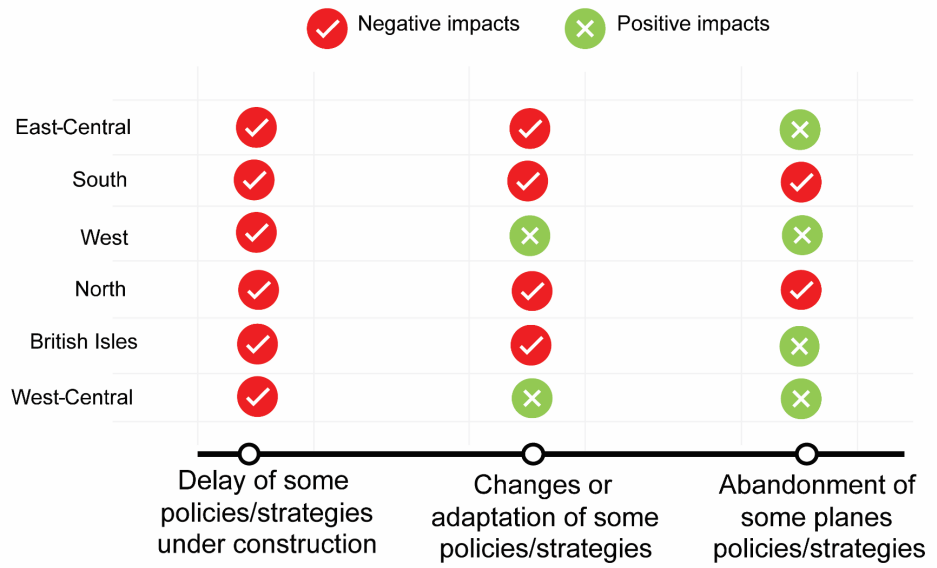
The pandemic resulted in a severe socioeconomic crisis on a global scale (Jackson, 2021) and within Europe (OECD, 2020b). Figure 8 highlights that, before the pandemic, almost all European regions (except western regions) were experiencing an improvement in education, income, employment and youth unemployment; however, the pandemic had major effects on different socioeconomic trends, whereby almost all regions (except the northern region in the case of education) experienced a stagnation or deterioration in education levels (Grek and Landri, 2021), income (Darvas, 2020), and employment (Fana et al., 2020). On the other hand, Southern European regions were the most impacted regions by the pandemic and regardless of the numerous public policy measures taken by local authorities, they were unable to cushion the pandemic's consequences.

Figure 8 Socioeconomic trends before and during the pandemic



The pandemic's effects on existing local policies and/or strategies in the European space is still blurry. The survey revealed that the pandemic resulted in a delay in the implementation of some policies/strategies across all European regions (Figure 9) Figure 9. Nevertheless, it is noteworthy that almost all regions (except western and west-central regions) experienced changes or adaptations of policies/strategies as a result of the disruptions imposed by the global health crisis. Moreover, the pandemic did not lead to an abandonment of planned policies/strategies, except in some southern and northern regions.

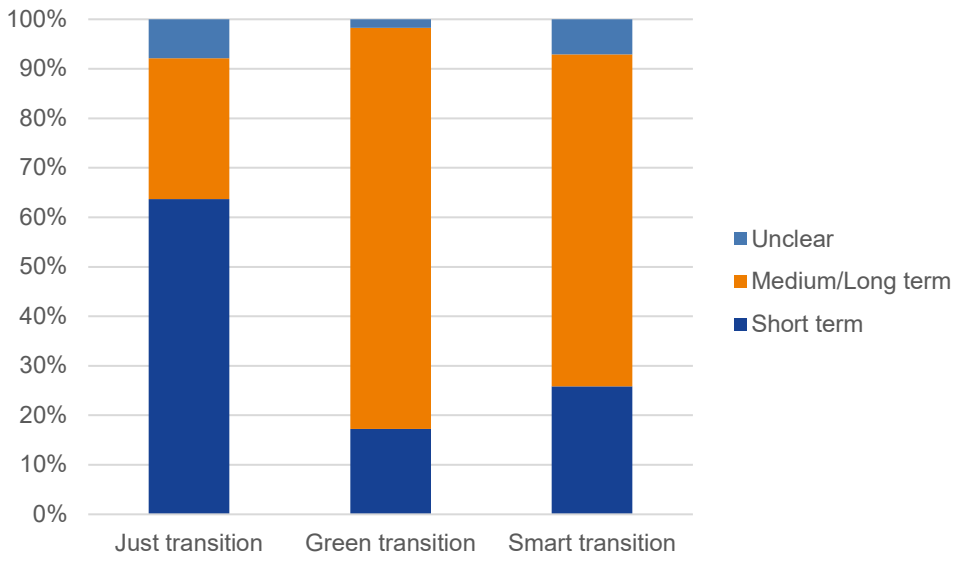
Figure 9 COVID-19 impact on policies of European regions



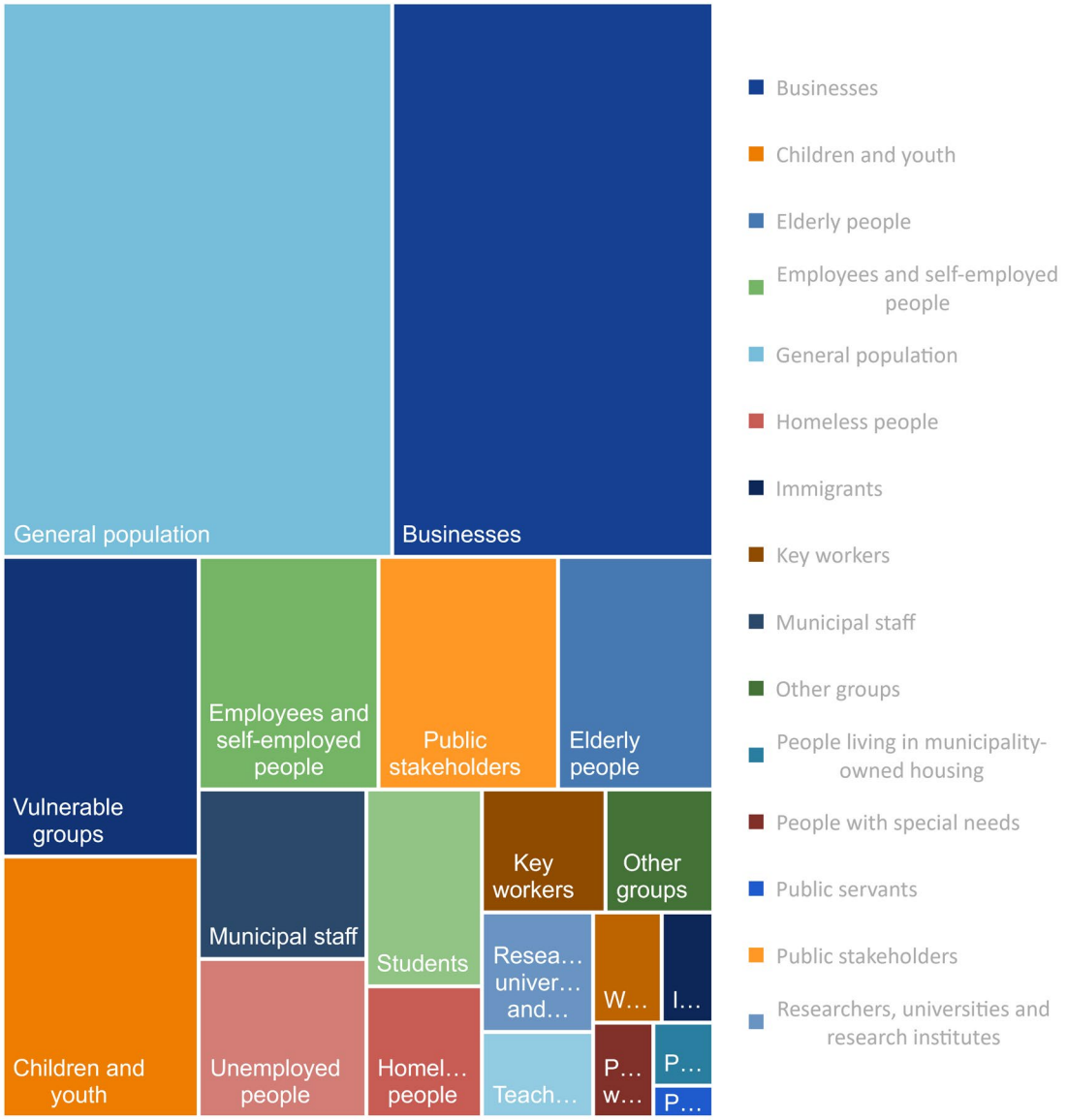
A small portion of local authorities responding to the survey (20%) indicated that some of the locally initiated policies were applied in other neighbour municipalities, or had multi-scale outcomes, e.g., policies implemented at the local level (municipality or a region scale) and being afterwards implemented at the national level (Bottom-Up approach) or vice-versa (Top-Down approach). Overall, policy exchange processes were established within EU countries and not between EU countries.

At the policy level, a breakdown of the individual proactive policies identified across the 14 case study regions is visualised in Figure 10 below. The figure shows that most policies introduced during the pandemic fall under the just transition theme (57%), followed by smart transition (26%) and green transition policies (17%). The policies are predominantly aimed at the general population and businesses; however, some prominent target groups emerge from the analysis of just transition policies specifically targeted at vulnerable groups, including the elderly, children, homeless people and the unemployed. Across Europe, policymakers have focused, from an early stage, on mitigating the biggest social consequences of the pandemic. All case study regions implemented various types of social protection measures to buffer income loss caused by temporary layoffs and unemployment. These measures appear to have had positive effects, even though they could not prevent increases in poverty rates in all cases. In Lombardy, Corsica and Helsinki, for example, the number of families experiencing economic difficulty and in need of benefits or aid increased at least initially during the pandemic. Veszprém and Elvas, in contrast, did not report increases in poverty levels. On the Azores, levels of extreme poverty even seem to have declined, thanks to generous social protection measures. Nonetheless, new poverty pockets may have appeared that include people who depend on the informal economy and were not entitled to social support. In similar terms, interview partners from almost all case study regions pointed to the risk that existing inequalities in terms of income, education or health have exacerbated during the pandemic.

Figure 10 Breakdown of proactive policies identified according to theme, time scale and target group



Policies by target group



4.3 Policy description and best practices for the just, green and smart transition themes

The following subsections provide a thematic breakdown of the different types of policies emerging under each transition area. Individual policies are presented in more detail in Annex 1 of this report, and full policy descriptions are included in the individual case study reports. For further best practice examples from the case studies see the cross-case synthesis report.

4.3.1 Just transition policies

Just transition policies were the most prominent type of policy identified across the case study regions. The social policies developed were a direct response to the socioeconomic challenges that emerged during the pandemic or were exacerbated by the crisis. The case studies indicate that many of the social policies introduced have long-term development potential and could help manage some of the medium- and long-term socioeconomic impacts of the pandemic for vulnerable groups. The COVID-19 pandemic has also served as a catalyst for regional authorities to be more proactive in restructuring health and social care infrastructures. Table 5 below provides a breakdown of the social policies identified across the cases by thematic area.

The social policies researched can be broadly placed into two main categories: first, economic policies designed to mitigate the worst potential socioeconomic challenges of the pandemic by keeping people in employment and providing sufficient welfare support for citizens to cope with unemployment or temporary layoffs; secondly, focused social policies that respond directly to the social challenges and inequalities faced by vulnerable groups. A range of economic and business support measures were introduced across the case regions to prevent closures and bankruptcies, including compensation for loss of earnings and business tax breaks. In response to job losses, several regions introduced career guidance, training and reskilling courses for the unemployed to help them quickly return to the job market. Across all cases, a range of social support measures emerged to protect and improve the living conditions of some of the most vulnerable groups in society, including the elderly, children, the homeless and immigrant communities. For example, there were increased mental health services for children, home checks and deliveries for the elderly, additional shelters for the homeless, and support for vulnerable families.

In addition to these social support policies, regional authorities attempted to increase communication with citizens through the creation of information centres providing knowledge and guidance on COVID-19 rules and vaccination provisions, amongst others, for immigrant communities that had yet to fully acquire local language skills. Measures designed to enhance citizens' mental and physical health have also been commonplace, including the development of COVID-19-safe physical recreation areas and online access to cultural activities. The economic and business support measures introduced across the case regions are short term in nature, as national and regional authorities cannot continue incurring high levels of public spending and debt over a long period. The case findings do suggest, however, that the social support measures introduced may need to be continued in the medium and long term, as it is predicted that the socioeconomic effects of the pandemic on vulnerable groups will continue after it will have ended.

Table 5 Thematic breakdown of just transition policies across case study regions

Just Policy Themes	Type of Policies
Business support	Policies that support different types of businesses to avoid bankruptcies and safeguard jobs, including investments in infrastructure leading to business opportunities and job creation.
Income support	Measures that aim at replacing lost income during the crisis or reducing household expenses by suspending taxes or loans.
Food, medical and housing support	Measures to provide practical support for vulnerable groups by covering costs related to housing (rent, energy, water), providing shelter, and by ensuring access to food, medicine, personal hygiene products and other basic essentials.
Social support	Policies aimed at providing social support to different population groups during the pandemic (e.g. via facilitating social contacts and activities). Focus is placed on target groups such as children, older adults, immigrants, homeless people, and women. This category also includes policies and campaigns to support the victims of gender violence during the pandemic.
Physical activities	Measures which support sports facilities and encourage physical activity among the population.
Cultural offers	Policies designed to sustain cultural activities and artists, including open-air events organized by theatres, museums, and libraries.
Mental health services	Measures aimed at offering psychological support to different population groups during the pandemic.
Communication and knowledge sharing	Measures to help disseminate information and knowledge about the pandemic, vaccinations, personal protection, labour rights, etc. to the local population. The category also includes measures that encourage knowledge sharing between key workers, such as health-care professionals, during the pandemic.
Education and training	Training programmes for the unemployed, and support for struggling students, including summer camps and tutor programmes.

Business support: The pandemic was a challenging period for many businesses who struggled with disrupted global supply chains, lockdowns, a drop in customers, social distancing and hygiene requirements. In order to protect viable businesses from bankruptcy and safeguard jobs, public authorities at local, regional and national level adopted various support measures. These included subsidies, one-time payments, loans, and grants. Some case study areas such as Amsterdam or Athens also postponed deadlines for the payment of fees and taxes and did not charge rent from businesses in publicly owned properties. In several case

study areas, for example Malmö and the Réunion Islands, businesses receiving financial support were encouraged to use the pandemic period for structural adaptations and investments in digital services and more sustainable practices and solutions. Finally, local authorities supported local businesses by trying to engage new customers. Case study areas like Corsica and Barcelona, for example, implemented campaigns to raise awareness of the importance of buying local. Several of these initiatives have the potential to be implemented even after the pandemic to reach sustainability goals and support the local economy.

Business Support Best Practice

Electronic Apps for Lombardy restaurants and cafes: The Municipality of Bergamo, together with the tourism promotion company VisitBergamo and the shopkeepers' association Ascom, has introduced a series of measures to provide answers to economic challenges related to the pandemic and to better manage the flow of individuals, avoiding contagion. For this reason, a web-app, "Prenota Bergamo", was developed. The application made it possible to book services from the web or from smartphones in offices, shops, and premises in the Bergamo municipal area.The policy is one of several digitalisation initiatives and is aimed primarily at supporting businesses and shops, and for the benefit of consumers, to cope with the restrictions caused by the COVID-19 health emergency. This policy was highly successful, and the application was developed and expanded to manage access and booking of municipal office services (registry, document management, tax, and land registry services, etc.). The measure - adopted at municipal level - was introduced after the first pandemic wave and has been maintained in subsequent waves. Given the wide resonance of the initiative, it can be assumed that it will remain active in the medium to long term in the post-pandemic period. This assumption is corroborated by the high user numbers and the constant expansion of app content.

Income support: Some sectors such as tourism, retail, and culture were more strongly hit by the pandemic and the mitigation measures that were quickly put in place. People working in these sectors had a higher risk of becoming unemployed. In order to buffer income losses and avoid increases in poverty among these groups, public authorities in the case study areas implemented a range of instruments and measures. These included financial support to self-employed people, freelancers or those who work on flexible contracts and do not qualify for unemployment benefits. Several case study areas such as Athens or Veszprém also extended or supplemented unemployment benefits or suspended the payment of tax obligations for employees whose contracts were suspended.

Income Support Best Practice

Financial support for the self-employed in Amsterdam: The TOZO (*Tijdelijke overbruggingsregeling zelfstandig ondernemers*) policy is a temporary economic measure designed to soften the blow to a particular segment of society. It supported self-employed people during the COVID-19 crisis, either as direct income support (similar to welfare) or as loans (capital injection) to the business. It is a national programme, but administered by municipalities who were also responsible for preventing or sanctioning improper use (e.g. persons with working partners were ineligible). Amsterdam had more claims than the next four large cities combined because so many of its citizens work in sectors like arts and culture, tourism, and hospitality. Almost €5b have been paid out via this scheme. As of 1 January 2021, anticipating a phasing-out, the TOZO was modified to guide self-employed people to reinvent themselves to increase their employability. Amsterdam decided to double its capacity to help self-employed people struggling with debt and allowed them to get a business coach and support to help them orient themselves towards labour market opportunities. The scheme has now been discontinued.

Food, medical and housing support: As unemployment increased during the pandemic, a growing number of people and families experienced challenges in paying bills and affording basic necessities. Several case study regions developed measures to support these groups and alleviate some of the most immediate challenges. This included, for example, financial support to pay for medical expenses in Amsterdam, delivery of meals and food packages in Elvas and on the Azores, postponement of water and energy bills in Barcelona and home support services in Athens. Many vulnerable families also struggled to pay rent and were at increased risk of experiencing homelessness. Public authorities in different case study areas, for example in Barcelona, supported these groups by reducing or suspending rent payments and creating temporary shelters.

Food, medical and housing support best practices

Réunion food support: The crisis has affected the vulnerable populations of the island and there was an urgent need for action. The Regional and General Council of Réunion distributed food vouchers and parcels to the most deprived inhabitants and students, as well as fresh food baskets to the elderly. This policy was implemented during the different waves of the COVID-19 pandemic to fight poverty. Local level actors, such as Communal Social Action Centers (Centre communal d'action sociale, CCAS), were also involved in the implementation of the policy. This was a new type of policy in Réunion as it targeted large

population groups (vulnerable, students, elderly). This measure will not be extended beyond the pandemic but it has had the merit of having positive effects.

Social support: Many people experienced feelings of loneliness during the pandemic. Public authorities implemented a range of activities and programmes to support population groups that were identified as being particularly vulnerable. For example, older people were identified as being at risk of experiencing isolation. As a result, different types of measures were implemented in the case study areas to keep them engaged and meet their care needs. Public authorities increased aid at home programmes (e.g., in Helsinki), engaged volunteers to support elderly quarantined people (e.g., in Vesprém), and set up telephone helplines where older adults could get information and support (e.g., in Barcelona). Regional and local governments also adopted a range of measures to address the needs and interests of children and young people during the pandemic. Authorities, e.g., in Amsterdam and Malmö, offered summer camps which allowed children and youth to participate in different kinds of activities, but also online workshops and digital activities. Young adults received support in several case study areas such as Helsinki to master the transition between education and a first job during the pandemic. In Barcelona, the Provincial Council designed a campaign to raise public awareness of the signs of gender violence. It also spread information on how to get help to potential victims of gender violence. In the municipality of Auderghem (Belgium), local authorities encouraged social solidarity networks.

Social Support Best Practice

Hannover youth organisations: The City of Hannover granted financial support to youth welfare organisations to secure their existence and to enable them to deliver free services to those in need. Amongst others, the city took over the full payment of the expense allowances for trainers, non-disposable cost shares of the facilities, and support for cancellation costs for events that could not be carried out during the pandemic. A similar measure was taken at regional level by the Hannover Region: the regional authorities granted similar financial support for welfare organisations to secure their existence. The financing was exclusively from public funding and was aimed to cover especially the first pandemic period. This was mainly a short-term measure, however its impact was not negligible, as it ensured the survival and functioning of actors dealing with vulnerable populations. This type of measure represents an easy-to-replicate and high-impact (although short-term) solution during the first stages of a health crisis. Possibilities for replication in other territories exist even though they depend on the financial prowess of that territory.

Physical activities: Public health decreased during the pandemic, as people spent more time indoors, moved less and were more limited in engaging in sports and recreation activities. Some regional and local authorities adopted measures to encourage local residents to remain active and conscious of personal health. For instance, at the Norwegian capital (Oslo), local authorities ensured a limited access to green areas within and around Oslo.

Physical Activities Best Practice

Access to sports infrastructure in Barcelona: The policy "UN, DOS, TRES, JA!" had the goal to ensure the access to sports and leisure activities for the general population. In the province of Barcelona there are 4,420 municipal sports facilities, excluding those in the city of Barcelona, that were among the first facilities to close to the public due to the COVID-19 pandemic. Now, in the post pandemic context, the Provincial Council has offered its support to the municipal councils for the safe reopening of all these facilities and, also, the use of outdoor places which allow practising sports and enjoying nature. To implement this policy, the Barcelona Provincial Council worked hand in hand with the City Councils of the different municipalities of the province to adapt the equipment and sports practice to the pandemic context and sanitary requirements. Even if the policy had a short-term nature, its application for the long term and other regions would be useful to be considered, especially in future pandemic contexts.

Cultural offers: The cultural sector was heavily affected by the pandemic and the various mitigation measures that were adopted. Theatres, museums, libraries and concert halls were among the first which had to close during the pandemic, and if concerts, plays or other cultural activities could take place, the number of people in the audience usually had to be very limited. Many local and regional authorities, for example in Barcelona and Hannover therefore adopted measures to financially support cultural institutions and those working in the cultural sector. Policy makers also encouraged artists to move their performances and exhibitions online or outdoors where old and new audiences could enjoy them even during the pandemic.

Cultural Offers Best Practice

Culture Vouchers Helsinki: In the midst of the pandemic, all employees within the City of Helsinki organisation were granted an annual culture or sports voucher. This was in order to incentivise continued participation of the city's employee's as customers of the cultural, entertainment and sports sectors that were struggling particularly with the insecurities and restrictions induced by the pandemic. The targeted group and motivation was therefore dual; on the one hand, supporting the mental and physical well-being of city employees through increased culture and sports opportunities, and on the other hand, indirectly supporting the struggling culture sector's providers by incentivising increased user and audience numbers. The measure was carried out internally within the City of Helsinki organisation. The measure proved to be very popular and may be continued even after the end of the COVID-19 pandemic.

Mental health services: Across Europe, an increasing number of people experienced signs of anxiety and depression during the pandemic. Public authorities in the case study areas reacted by developing new psychological support services or even establishing emergency centers. These measures all had the goal of making psychological support more accessible to wider population groups and reduce waiting times. For example, in Athens a telephone service was developed to offer psychological support during the pandemic. The city of Helsinki introduced a 'mental healthcare guarantee' whereby all residents should be guaranteed access to free mental healthcare services by 2022 with a maximum waiting period of two weeks.

Mental Health Services Best Practices

Psychological support Iasi: The pandemic has isolated many people. To avoid such isolation, Iasi decided to implement a specific measure. A "Social Emergency Center" was created at the initiative of the Federation of Non-Governmental Organizations for Social Services (a federation of 40 local and regional NGOs). The centre served as a point of contact and humanitarian assistance for citizens from Iasi County during the COVID-19 pandemic. It offered both psychological support and urgent material assistance (including food, medical services and medicines) for people in need. Several thousand residents have benefited from this support measure. This initiative was stopped in January 2022.

Communication and knowledge sharing: During the pandemic, public authorities undertook exceptional efforts to reach out to local populations and inform them how to lower personal risks of becoming infected and how to protect themselves and others. In order to reach out to all groups in society, authorities in the case study areas provided information in various languages, engaged representatives of different minority groups and closely cooperated with civil sector organisations, for example in Malmö and Lombardy. Public authorities also focused on providing key workers and municipal staff with all the necessary information and training they needed to fulfil their roles and tasks during the pandemic. In the Netherlands, for example, a newly created web portal assisted Dutch policy makers in improving their health policies during the pandemic. In Barcelona, a new programme supported professionals working for the local women's services to deal with more complex cases caused by the pandemic and confinement measures.

Communication and Knowledge Best Practices

Malmo Digital Communication Platform: The city of Malmö created a digital platform with 35 non-profit organisations within social work during the pandemic. The aim of the policy was to promote dialogue between the organisations and to handle common challenges that arose for the organisations during the pandemic. The idea was also to increase cooperation between civil organisations to see if they could share resources and join forces in supporting vulnerable groups. The policy was coordinated and started by the City of Malmö when they saw the need for closer cooperation with civil society actors to reach vulnerable groups. The policy was implemented during the pandemic with the goal of addressing acute needs, but it was not intended to continue the platform in the long term. The meetings started when there was a need for extra cooperation and was dissolved when contacts between organisations had been made. In different ways, the city of Malmö tried to create meeting places for companies and civil society during the pandemic, to reach as many people as possible and make the most of public funding.

Education and training: Across Europe, education and training programmes for children and adults were held online during large parts of the pandemic. The transition from classroom to digital learning created challenges both on the side of education providers and teachers, and on the side of children and adults who participated in classes. Public authorities in the case study areas implemented various measures and instruments to facilitate the transition to digital learning. Examples include initiatives to help children and youth who were at risk of falling behind as a result of digital education. These were implemented, for example, in Barcelona, Malmö and Amsterdam. Some public authorities also set up targeted training programmes during

the pandemic. These were designed to swiftly train people so that they would be able to work in sectors with urgent labour demand, such as the care and health sectors.

Education and Training Best Practices

Social care training in Elvas: The municipality of Elvas entered into a partnership with the Employment Institute (Instituto de Emprego e Formação Profissional) to train around 50 employees capable of supporting nursing homes and the Red Cross during the pandemic. Elvas municipality contributed with 10% of the funding and the rest (90%) was provided by the Employment Institute. This action had a positive impact in the city in providing crucial health assistance to an ever-increasing elderly population. The main policy goal was to adjust the local personnel needs for supporting elderly population in health services during the pandemic via training sessions. The policy was implemented successfully and helped to support the elderly population of the municipality. No information was provided in how long this policy will be maintained. Considering the increasing demographic ageing process in this border municipality, one would expect that this policy measure could benefit the elderly population even in post-pandemic times. Furthermore, this measure could be extended to similar EU regions facing demographic challenges. Similar initiatives could have had similar positive impacts in other depopulated and relatively socioeconomic deprived regions.

4.3.2 Green transition policies

The survey findings show that green policies were not treated with higher priority during the healthcare crisis. However, the pandemic did not prevent European regions from pushing environmental agenda policies. For instance, because of the pandemic, policymakers introduced new transport lanes e.g. for cyclists to foster the implementation of the *Sustainable and Smart Mobility Strategy – putting European transport on track for the future*[17]. The results showed that almost all European regions implemented public transport policies such as *'implementing new non-motorised lanes'* and *'Enhance public transport (availability, accessibility, security, and hygiene)'*. However, there are some regional disparities between northern and western regions; for instance, northern regions promoted green consumption choices only during the first wave, while western regions implemented green transition policies only during the second and third waves. Another major regional difference is that the British Isles did not advance the green transition policies to the same degree as southern, east-central and northern regions.

Across the case study regions, findings indicate that the green transition policies introduced in response to the pandemic are less prominent in number and scope. However, the pandemic served as a catalyst for speeding up the implementation of existing environmental policies and strategies. Table 6 provides an overview of the type of green transition policies introduced in the case study regions by policy theme. The crisis has highlighted the need for more green spaces in urban areas, thereby providing further impetus to the recent trend for better green space planning and policies. The pandemic has also accelerated the implementation of existing green transport and mobility policies, such as increasing the number of available bike lanes and pedestrian areas to help reduce the number of citizens commuting and using public transport to control infection rates. The closure of borders during the pandemic has given further momentum to local green tourism. Regional and local governments have been keen to maximize the opportunities presented by increased local tourism resulting from foreign travel restrictions and reverse migration trends of citizens moving away from cities to rural areas. During the crisis, policies have also emerged for educating citizens on sustainable living by advertising and investing in local products and businesses and educating citizens on biodiversity. The green transition policies identified across the cases have largely been driven and supported by regional and local authorities. As there is little direct causality between the pandemic and green transition policies introduced, the case findings suggest that many of these policies have strong medium- and long-term trajectories, as climate-related issues predate and will postdate the pandemic.

[17] Sustainable and Smart Mobility Strategy: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0789

Table 6: Thematic breakdown of green transition policies across case study regions

Policy Theme	Type of Policies
Green and sustainable business support	Policies which support businesses in the transition to a green economy.
Green tourism	Measures aimed at increasing tourist numbers again in a sustainable manner after the drop in tourism during the pandemic.
Climate mitigation and adaptation	Policies which have the goal of reducing emissions and adapting cities to a changing climate.
Travel and mobility	Measures to promote public transport, walking and cycling and to reduce car use and travelling by plane.
Green spaces	Measures and initiatives to increase and maintain publicly accessible green space.
Waste management and circular economy	Policies and measures to promote more sustainable and efficient waste management and the circular economy.
Education, training and research	Policies to increase knowledge on sustainability and biodiversity as well as measures to support research on sustainability topics.

Green and sustainable business support: Regional and local authorities in Athens, Malmö, Reunion Islands, and Veszprém capitalized on the pandemic context by not only supporting businesses financially, but also setting incentives to encourage them to choose more green and sustainable practices, products or services. Public authorities in Athens also supported the transition to a green economy by raising awareness of locally and sustainably produced food products.

Green Business Support Best Practice

Veszprém Green processes support for businesses: A financial and knowledge support package was introduced to help entrepreneurs apply truly green solutions and help local companies in the Veszprem-Balaton region to contribute towards the green transition (e.g. encouraging food composting businesses, organising awareness-raising trainings for service providers). This measure is introduced at regional level, and implemented by the planner, organiser, and executor of project development (VEB 2023 JSc) of the European Capital of Culture (ECoC) Programme, taking place in the Veszprém-Balaton region in 2023. Although this measure is linked to the development of the ECoC Programme, the existing medium-term commitment of local stakeholders to promote green policies and the involvement of service providers has strengthened during the pandemic period. Continuing or implementing in other regions of this measure seems to be useful due to long-term and spill-over effects.

Green tourism: Tourism was one of the sectors most strongly affected during the pandemic. As high rates of infection, travel restrictions and quarantine measures made travelling difficult or impossible, the number of tourists dropped sharply in many destination areas. Several case study regions and municipalities implemented initiatives to revive tourism again after the most challenging times of the pandemic. Nonetheless, these initiatives did not necessarily pursue the goal of increasing tourist numbers to pre-pandemic levels, since these were considered to be unsustainable in some areas. Green tourism strategies introduced in Athens and Barcelona regions aimed at reviving tourism in an environmentally, socially and economically sustainable way that would not drain local resources and lead to overcrowding and pollution.

Green Tourism Best Practice

Zero Strategy Barcelona: The "Zero Strategy" is a tourism marketing strategy of the Barcelona Provincial Council that responds to the current needs of the sector. The strategy maintains the spirit of empowerment of tourism that values the destination and respects the local environment, guaranteeing its social, economic and cultural sustainability. It focused on supporting the tourism sector in the Barcelona region and carrying out communication and inspiration actions for the final customer, especially in the local market (Catalan, Spanish), always in collaboration with other public institutions such as the Catalan Tourism Agency, Turisme de Barcelona and local and regional tourism management agencies. The first phase was dedicated to the local market: the City of Barcelona, its metropolitan area, but also the rest of Catalonia region, trying to transform the need for short trips into opportunities for overnight stays. A second phase targeted nearby markets (Spain, southern France), focused on family tourism that can be done by car during short periods. A third stage, more commercially intense, is dedicated to short vacations in Europe. However, it is attentive to the recovery of other international markets.

Climate mitigation and adaptation: Interviewees in a small number of case study areas also reported that the pandemic context was used to promote climate mitigation or adaptation measures. Examples from Athens and Malmö regions include measures that promoted energy efficiency and energy savings, investments in renewable energy plants and sharpened goals for reductions in greenhouse gas emissions.

Climate Mitigation and Adaptation Best Practice

Athens energy saving programme: In Athens, the programme "Saving energy/Energy autonomous buildings", adopted at national level, aims at increasing energy savings and promoting the energy autonomy of households. New incentives were set to encourage the production and storage of energy from renewable energy sources and the installation of "smart" energy systems. With a total budget amounting to 632 million euros and mobilising total funds of over 1 billion euros, the Greek Energy Efficiency Programme is one of the highest funded ongoing projects of the public sector in Greece. Motivating various fields of the construction and the building materials sector which are connected to renovation and energy upgrade, the programme becomes even more relevant since the current energy crisis intensifies the need for less energy consumption. This initiative will continue in the long-term as energy provision represents a major issue for local authorities.

Travel and mobility: During the pandemic, mobility patterns changed. As quarantine rules and lockdowns were imposed, social distancing requirements and remote work and education were implemented, people spent more time at home, avoided public spaces and spent more time outside. In some areas, the number of public transport passengers decreased, and people more frequently chose to move by car or bike. Public authorities across all case study areas used this context to promote more sustainable mobility modes. For example, Amsterdam, Athens, Hannover, and Iasi regions extended bike paths and invested in more electric public transport vehicles; whereas Lombardy and Veszprém encouraged the use of electric scooters Some local authorities also revised internal travel guidelines and prioritized digital meetings over physical meetings that involve travelling. The local authority of Malmö stipulated that municipal staff should always consider digital meetings as the preferred solutions over travel going forward.

Travel and Mobility Best Practice

Iasi bike sharing initiative: The municipality of Iasi implemented the bike-sharing system VeloCity during the pandemic. The goal was to increase the use of bicycles as a means of travel. Through the project, 50 boarding and rental stations for bicycles were installed and 813 mechanical smart bicycles, 37 electric smart bicycles and 80 tricycles for seniors and people with disabilities were purchased. The project also included the implementation of an intelligent, energy-independent alternative urban mobility system using smart bicycles, to which docking systems and smart terminals were added. Finance was provided through the Regional Operational Programme 2014-2020. To date, the operation has been a success and further bike lanes will be constructed.

Green Spaces: Travelling was difficult or impossible during large parts of the pandemic and most people spent unusual amounts of time at home in quarantine, social isolation or lockdown. Under these conditions, local green spaces increased in importance as places for recreation and socialization. Local authorities tried to meet the growing demand by increasing investments into the maintenance and protection of green areas, but also by creating additional parks and green lanes. In Elvas, some of the municipalities' public green spaces were renovated to accommodate an increasing number of citizens interested in using such public spaces during the pandemic. The Equipment and Public Space Service (SEEP) of the Management of Equipment, Urban Infrastructures and Architectural Heritage (GSEIUPA) of the Diputación de Barcelona has incorporated the urban green master plans and the strategies for renaturalization of cities as one of the best tools to influence the quality of life in cities within the program "Renaturing cities". Urban green area have therefore become an essential infrastructure for improving the quality of life of our towns and cities as a key to addressing the COVID crisis. Green infrastructures are now a structural tool, from the perspective of sustainability to improve the habitability of urban conurbations and reduce the environmental footprint and also a basic strategy in the current COVID crisis.

Green Space Best Practice

Veszprém Parks Initiative: The municipality of Veszprém implemented several initiatives to increase the number of green spaces in the city and improve their quality, targeting the general population. Amongst other measures, the local authority created more parks and green spaces on the University Campus. Recognizing the growing need for a diverse natural environment in the city centre, the initiative also promotes the planting of fruit-bearing trees in wooded park areas to attract more birds. Local, large-scale housing estates could apply for raised beds to encourage community gardening. Three NGOs have been working closely with the municipality (represented mainly by the Public Utility Service of Veszprem) on

developing and implementing this policy, not only during the COVID-19 crisis, but based on the growing demands and resources available for developing green spaces.

Waste management and circular economy: Across the case study areas, a few initiatives focused on promoting the circular economy and improving waste management during the pandemic. Examples include the construction of new waste treatment plants in Athens and public information campaigns in Barcelona to improve the separation of waste by households. The pandemic context also required an adjustment of waste pick-up schedules in Amsterdam, as businesses produced less waste than usual, while private households produced more. Some regional and local authorities, including in the Helsinki case study area, introduced policies focused on bringing stakeholders together to develop and implement circular economy initiatives.

Waste Management and Circular Economy Best Practice

Helsinki circular economy cluster: A new cluster programme for the circular economy was initiated during the pandemic by the City of Helsinki in collaboration with both private and public sector partners. The goal was to enable new entrepreneurship and business opportunities around circularity in the Finnish capital region. The policy was put forward as an applied response to the pandemic-induced economic slowdown, seeking to build system-level competitiveness relative to other city regions by playing to Helsinki's strengths: Well-functioning infrastructure and networks, a safe urban environment, and closeness to nature. The cluster programme also focused on upskilling and leveraging new digital tools and integrated the pandemic-induced social policy dimension through a youth entrepreneurship element conducted in collaboration with regional institutions of higher education. A total of EUR 20 million were reserved in Helsinki's budget for these applied policy responses, EUR 10 million of which specifically for the circularity cluster programme and incubator activities, with the other half directed at speeding up digitalization at the city level.

Education, training, and research: Interviewees in the case study areas also highlighted some initiatives which aimed at increasing public knowledge of sustainability issues during the pandemic, as well as research projects related to sustainable development. The number of such initiatives was, however, small.

Education, Training, and Research Best Practice

Amsterdam regional resilience project: This concerns a research through design project to enhance resilience in the built environment, targeted at academics. The financing was set up by the national government. Within this scheme, the municipality of Amsterdam awarded a grant to the Hogeschool van Amsterdam (Amsterdam School of Applied Sciences) to investigate measures against the spread of COVID-19 in public space and assess their sustainability. The research found, for example, that if walls need to be built to physically separate people, this can be done cost effectively by using recycled or recyclable materials rather than plexiglass. In addition, involving at-risk youth in the process of building structures can contribute to social goals. Another goal of the project was to design a toolbox related to climate change and biodiversity loss which can be applied during pandemics and other future shocks and stressors so that these matters are not ignored. The researchers hope to valorise the findings via applications in public policy and communication. It is too early to tell the impact of this research (which should be completed by 2023), as it concerns awareness raising of potential synergies

4.3.3 Smart transition policies

In relation to smart transition policies, the survey data confirms other research that has shown that the pandemic resulted in fostering the implementation of e-governance and digitalisation across European regions (Cone et al., 2021). However, it is noteworthy that the rate and form of digital acceleration vary across regions. For instance, the survey results indicate that while the vast majority of European regions have orchestrated the creation of new online local marketplaces (such as *'Social Lojo'* in Portugal), the western regions seem to lag behind. The same applies to increasing digital delivery of public services, for which major advancements are accounted for in all EU regions (e.g. decentralisation of public services *'Esperança Porta a Porta'* example in Portugal). Western regions applied such initiatives only during the second wave.

The case studies reveal that the COVID-19 crisis has given significant momentum to smart transition policies (Table 7). The pandemic has forced national and regional authorities to speed up pre-existing digitalisation strategies. This specifically involves a focus on promoting policies that enhance citizen access to digital technologies and high-speed broadband services and prioritising ongoing processes to digitalise important public services. Digitalisation of public services was a common feature across all 14 case regions. The digitalisation of healthcare at the local level preceded the pandemic, but the crisis has served to increase the number of citizens now conducting online healthcare consultations with local doctors. The pandemic has also been a direct catalyst for the digitalisation of other public services, including mental health provision,

education, legal processes and cultural events. Similarly, e-governance processes have grown in scope – with citizens now using online platforms to communicate with local authorities or perform local administrative tasks, such as the payment of municipal taxes or online citizen registration forms.

The most novel and innovative smart transition during the crisis was in the field of education. The pandemic forced schools and universities to find new and innovative ways to digitalise education by moving teaching online during lockdown periods. This required local authorities to ensure that schoolchildren, particularly from lower-income backgrounds, had access to appropriate technologies and internet facilities. The pandemic has also given further impetus to multilocality work. This was a trend that was already growing before the pandemic, but the crisis accelerated policies that ensured employees had the digital tools and competencies to make their home office environments comfortable and productive. Enhancing digital competences was also important for teachers who were offered ICT training to run effective digital classes.

The use of big data to monitor society has become more prominent during the pandemic through the emergence of mobile track-and-trace systems and digital surveillance systems, which can monitor the number of citizens in highly populated urban areas. Most of the smart transition policies identified across the case regions have a high longevity potential, particularly digitalisation processes that will continue to be consolidated and expanded into new public service areas.

Table 7: Thematic breakdown of smart transition policies across case study regions

Smart Policy Themes	Type of Policies
Business digitalization support	Measures which support businesses in increasing their digital competence and digital offers.
E-governance	Measures which support remote access to municipal information and services (e.g. payments) and digitalise internal local authority management systems.
Digitalization of public services	Initiatives to digitalise key public services including healthcare, mediation, mental health services and cultural events.
Digital access and competencies	Policies that enhance broadband connections and offer IT support including the provision of computers, laptops or routers to keep people connected.
Smart transport	Measures that promote e-ticketing and mobile apps for public transport use.
Multi-locality working, education and training	Policies to facilitate remote working as well as to facilitate digital/remote education during the pandemic.
Big data	Tools that measure the number of pedestrians or users of public transport, and track economic trends, pollution levels, health parameters and other indicators through real-time data to help, for example, regulate citizen traffic and avoid crowded areas.
Research	Projects that support research on digitalization as well as measures to promote research networks and science hubs.

Business digitalization support: Local and regional authorities in the case study areas capitalized on the pandemic by encouraging local businesses to digitalize their offers and services. Authorities in Athens, Barcelona and Corsica, for example, established online platforms which connected local producers, shop and restaurant owners and allowed them to promote their products and services jointly to the local population. Some local authorities placed specific emphasis on supporting newly launched businesses during the pandemic. Helsinki region increased funding and measures targeted at sustainable business incubator activities, especially with regards to young people. Malmo municipality introduced the Almi Digital Score Card, which was used for businesses in the region. The tool is for businesses to measure their own digital maturity and to understand where they are lacking in competence.

Business Digitalization Support Best Practice

The digital city centre in Corsica: Local businesses have suffered a lot during the COVID-19 crisis with the acceleration of the digitalization of commerce and the spectacular growth of sales on e-commerce sites. The association of merchants of the Bastia region in Corsica has created a digital "city center" (www.compruinbastia.com) in order to support all local businesses. Their priority is to regain the confidence of their customers, proximity and allow them to find everything they are looking for without having to go to the giants of the net. This initiative is therefore aimed at both merchants and their customers. It has been supported by the City of Bastia, the Chamber of Commerce and Industry of Corsica and Haute Corse, the Agglomeration Community of Bastia, the Corsican Region, the Bank of Territories and the

Sporting Club of Bastia. This market place is a success because it allows to support the local traders and craftsmen of the city center of Bastia and the surroundings and to better serve the customers. Today, there are already more than 7000 products to discover, 40 merchants already connected, 25 restaurant owners in direct access as well as the possibility to be delivered at home or at the office. This project will continue after the pandemic and will even be further developed. A Click & Collect system, a network of relay points as well as a bicycle courier service will be set up soon. This type of initiative is very easy to implement in other cities, especially in small and medium-sized towns that suffer a lot from the decline of their city center businesses.

E-governance: Many local and regional authorities had already offered specific types of services and tasks via digital tools before the crisis. The pandemic, however, gave a new boost to these developments and spurred digitalization processes and the setup of e-governance systems. Helsinki, Hannover and Iasi regions developed tools which allow citizens, amongst others, to pay taxes, register, obtain signatures and certificates, and express their views on certain issues. Public authorities also digitalized their own internal management systems which made internal work processes more efficient.

E-governance Best Practice

Online Tax Payments in Iasi: In Iasi, the local government implemented an online system for tax payment. The goal was to allow people to avoid having to travel to complete administrative tasks like paying their taxes. The system allows taxpayers (individuals or legal entities) to get information and to pay local taxes through electronic payment instruments. Therefore, the operations can now be made without going to the physical office. This action is still going on and the city of Iasi has registered an increase in the number of users. In a context of digitalization of public services, this type of initiative could be applied in other regions.

Digitalization of public services: In addition to promoting e-governance systems, the pandemic also accelerated the digitalization processes of public services. This included a wide range of offers and services. Services and offers as diverse as court hearings, mental health support, health and social services, and cultural performances were now becoming available and accessible online. Regionally and locally developed online public health service tools to reduce pressure on healthcare providers and deal with challenges such as population ageing, particularly in more remote rural areas. For example, Athens, Iasi and Malmo regions developed online prescription processes during the pandemic to reduce the need for citizens to physically meet local health providers. The effects of the digitalization and customer satisfaction are often not clear yet, motivating individual research projects on the topic.

Digitalization of Public Services Best Practice

Amsterdam ethics of digital health project: This concerns a research project with the goal of investigating the ethics of e-health, a process which has been greatly accelerated by the pandemic. The financing was provided by the ongoing national ZonMw programme, which supports interdisciplinary research and its application in the area of public health. Stakeholders range from the Ministry of Health, Welfare and Sport (VWS) to researchers and healthcare providers on the ground. The 2020-2024 programme was drawn up in response to the COVID-19 pandemic, including the project on the ethics of e-health. Many healthcare meetings were moved online, such as patient/physician consultations. On the one hand, this raises the question whether patients should have the right to choose between physical and virtual consultations going forward. In some cases, anonymous online appointments with healthcare professionals may be preferred, such as in cases of psychological issues. On the other hand, it is unclear whether this creates a doctor-patient relationship in a legal sense. It also raises issues of accessibility as some groups may find it more difficult to participate in digital meetings. The project's findings will be available in 2023 and can help to enhance the just aspect of the smart transition.

Digital access and competencies: As public services were moved online during the pandemic, this increased the risk of new inequalities between population groups. Lack of access to stable and fast broadband connections, lack of equipment such as computers and laptops, as well as insecurities in handling new technologies could all potentially exclude certain groups from digital offers and services. In order to reduce the risk of deepening digital divides among local population groups, several regional and local authorities implemented targeted measures. In Athens, the government-issued vouchers of 200 euros addressed to low-income families for digital equipment (tablets). In Elvas, the city acquired and distributed 300 routers for all municipality residents which had a personal computer in their homes.

Digital Access and Competencies Best Practices

Azores computers for students drive: Local authorities on the Azores offered computers to children from socio-economically deprived households to provide them with the possibility to study from home. This policy action has also had a positive impact on accelerating the digitalization process of public services of the island of Terceira, by significantly reducing the need for socioeconomic deprived families to be physically present in the municipality services to take care of intended issues. The focus area was the Terceira Island of the Azores. The main goal of the policy was to bypass economic limitations from many families, which could not afford the acquisition of computers, by giving them this critical technological product which could be used by these families. With this, all students had the possibility to attend classes from home via an internet connection, even in strict lockdown phases. As expected, the computers were also available to the remaining family members. As such, persons of all ages benefited from this measure in, for instance, accessing public and private services via online connections. This policy was introduced in all the Island of Terceira (regional level). This initiative was promoted by the two municipalities of the Island, with the support of the Azores government. This initiative was quite successful, as it allowed for a relatively normal functioning of the school classes in the Island, even during the COVID-19 lockdown phases. Moreover, the equipment will continue to be available to the families with potential benefits for other activities like access to information and services. A similar initiative was implemented in Amsterdam and considered widely successful. Expectedly, this policy measure has a high level of medium and long-term potential to increase the digitalization processes in the Island in post pandemic times. This could be seen, for instance in increasing home-working and access to digital/online platforms to using public and private services, with all the associated positive impacts: reduced carbon footprint, improved access to information, etc. Similar initiatives could have had similar positive impacts in other depopulated and socio-oeconomically relatively deprived regions. Crucially, the increasing access to information and online shopping and services provided to the Azores Island dweller from all ages, has the potential to increase efficiency levels in several domains of their lives. These include not only improved education, but also improved access to health services in territories (islands) with limited physical accessibility, when compared with mainland territories.

Smart transport: In individual case study areas, the pandemic context was also used to implement digital tools in public transport. For example, in the Iasi and Lombardy case study regions, e-ticketing was introduced, as well as smart apps with real-time updates on public transport connections and the implementation of contactless payment.

Smart Transport Best Practice

Iasi e-ticketing infrastructures: E-ticketing inside public transport was initiated in Iasi. The objective was to limit contact in a pandemic context. The measure was started by the City Hall and the Public Transport Company. Funding is provided by the EU. E-ticketing had already been functioning (QR, apps, SMS, contactless payments) before the pandemic, but not in an integrated manner. The effects are expected to be positive in terms of increasing the attractiveness of public transportation. Beyond the health aspects, this service also allows for a better monitoring of the use of public transport and to provide mobility services that meet the needs of the population.

Online working, education and training: Across Europe, the COVID-19 pandemic had strong effects on the working life and education. From the onset of the pandemic, governments and health authorities encouraged all those who could work long-distance to work from home. In addition, large parts of youth and adult education were moved online. Public authorities at different levels of governance supported this transition with various measures. Regional and local authorities in Malmö or Iasi reacted by providing IT support for older people or offering courses to increase digital skills for other disadvantaged groups. Public authorities in the province of Barcelona used this opportunity and created educational programmes closely aligned with the demands on the labour market to upskill jobseekers and enable them to apply for jobs linked to the digital transition.

Online Working, Education and Training Best Practice

Lombardy new software and digital portals: The policies introduced in Italy related to **distance learning** are mainly directed at the adoption of digital infrastructures aimed at the safe continuation of school and university activities; specifically, hardware and software systems (new software and digital e-learning portals) were upgraded in order to allow (during the various periods of the emergency in total or partial form) the distance delivery of educational activities. The adoption of this measure allowed school and university activities to be conducted, respecting the teaching calendar. The measures, therefore, were taken to facilitate digital distance education during the pandemic and support students in difficulty, aiming to decrease the digital divide. The policies for overcoming the digital divide have been implemented by universities and educational institutions in collaboration with political institutions on a national scale and have led to a greater understanding of the potential offered by digital technologies in the sphere of

learning; this awareness in the student population and teaching staff, reconciled with the recognition of the fundamental role of face-to-face teaching, has led to its consolidation in the medium to long term throughout the country.

Big data: The pandemic also gave a boost in the use of big data by local and regional authorities. In Amsterdam, new tools and technologies allowed municipalities to monitor the number and density of pedestrians in crowded areas. Real time data was developed in Iasi and Lombardy to track numbers and capacity in public transport. Regions, including Athens, Barcelona and Helsinki, used big data to track the impact of the pandemic in terms of health, mobility, economic performance and pollution levels.

Big Data Best Practice

Amsterdam crowd monitoring system: This project seeks to curtail the spread of infectious diseases through the crowding of people. Amsterdam's Crowd Monitoring System Amsterdam (CMSA) uses counting cameras and Wi-Fi sensors to give insight into numbers and densities of pedestrians in public spaces. The municipality decided to set up this system itself, rather than leaving it up to the private sector, to ensure privacy, transparency and the public interest. An algorithm on the CMSA server analyses how many people are on the images and converts this into anonymous statistics. This is then forwarded to municipal officials to regulate traffic, if needed. The public are also informed about the level of crowdedness via signs (e.g. digital billboards) or online. The stakeholders include the municipal departments of traffic and public space and the businesses Tapp and Life-electronic (who developed and built the system). CMSA was originally used in 2015 during the international event SAIL Amsterdam and is now being used permanently at Dam square, Arena boulevard, and in the Red Light District. Although operational, practice has so far shown that it was not sufficient to provide people with adequate real-time information. Post-pandemic, the CMSA can be adapted to other uses, such as monitoring cycling traffic to improve infrastructure planning.

Research: Interviewees in a few case study areas also reported that research projects are being conducted on digitalization processes, the use of digital platforms in governance, and the future of the workplace. Local and regional authorities also increased connections and dialogue with research centers and science hubs to discuss solutions to new challenges.

Research Best Practice

Researcher dialogue platform in Helsinki: A 'Situation Room' for economic and social science research was established in the city of Helsinki during the pandemic. This entailed a joint research group that brought together leading experts from the Helsinki Graduate School of Economics (a research consortium between Helsinki's universities), the national VATT Centre for Economic Research, and other relevant stakeholders with expertise in statistics and policy monitoring at the local and national level. The aim of the new research group was to support local policymakers with regular reports to improve data-driven decision making. Researchers made use of a variety of available public and private data sources, as especially registry and administrative data is well documented in the Helsinki area and was made available for the purpose of policy analysis. Regular reports were published related to the pandemic-induced recession and its impacts on the labour market, households and firms.

4.4 Overall policy assessment and conclusions

A diverse range of social, green and smart transition policies have emerged in response to the crisis. Some general policy development trends can be identified across the survey and case study regions, which are outlined in more detail below.

Social policies focused on societies' most vulnerable groups: The pandemic has served to further highlight and exacerbate existing socio-economic inequalities across EU regions. The crisis has hit the most vulnerable groups in society hardest; consequently, many of the social policies introduced across the case study regions were targeted at groups most at risk from the effects of the pandemic, including the older adults, children, low-income families, and the homeless. Future national, regional, and municipal strategies/policies need to continue focusing on these target groups to help reduce regional socio-economic inequalities and ensure no one gets left behind by the short, medium, and long-term impacts of the crisis, especially citizens in low-income households, working in service sector jobs, and the long-term unemployed.

Social policies helped to mitigate the worst socio-economic effects of the crisis: Policymakers interviewed across the case study regions expressed the view that it is too early to judge the impact of the individual social policy measures introduced during the crisis. They also observed that it is too difficult to

measure causality between the social policy measures implemented and emerging socio-economic trends at the regional and local levels. There was, however, agreement that the social policies introduced did help to mitigate the worst socio-economic challenges presented by the crisis. Economic and business support measures kept businesses open and citizens employed, thereby limiting the socio-economic damage that would have been caused by widespread business closures and redundancies.

Social policies reactive to the socio-economic challenges presented by the pandemic: Policymakers in the Amsterdam case study region noted that the magnitude, scale, and urgency of the crisis meant that a swift and strong response to immediate health and social challenges was prioritized over medium and long-term policy goals. Those social policies that were introduced were largely reactive to the socio-economic challenges presented by the pandemic. The economic and business support policies identified across the case regions were short-term in nature, as policymakers noted that high levels of public expenditure cannot be sustained over a long period. Furthermore, many of the social policy measures introduced were halted once lockdowns were ended, such as additional home support for the elderly and vulnerable families.

Social policies have long-term potential: Many of the social policies introduced in response to the pandemic have long-term potential. The pandemic is still not over, and the threat of further life-threatening variants remains. Moreover, the short, medium, and long-term socio-economic consequences of the crisis may be intensified by austerity measures and tax rises introduced to offset the high levels of public spending debt incurred during the pandemic. In addition, the socio-economic challenges posed by COVID-19 have been further exacerbated by the cost-of-living crisis and energy crisis currently engulfing Europe. The most vulnerable groups in society will be hit hardest as these concomitant crises develop; consequently, it will be necessary for national, regional, and local authorities to consider reinstating, or continuing, many of the social policies introduced during the pandemic. Social policies targeted at society's most vulnerable citizens (e.g. the young, elderly, homeless and low-income families) will be particularly important. For example, policies introduced in Elvas, the Azores and Barcelona targeted at providing rent reductions and financial support for water and energy bills could also help vulnerable groups counter growing living costs.

COVID-19 has been a catalyst for renewal and reform of regional and local health and social care strategies: Years of austerity and underfunding prior to the pandemic left many regional and local health and social care providers ill-equipped, understaffed and lacking the infrastructure to cope with the scale of the crisis. In some of the case regions, the pandemic forced regional and local actors to develop new health and social care strategies and policies designed to reorganize existing infrastructure to be able to cope with future threats of this nature. For example, in the Barcelona region, a health care contingency plan was developed by local authorities so municipal public health care services would have access to the necessary procedures, organization and resources required to guarantee citizens the provision of effective health care services during future pandemics. In the Lombardy region, regional health laws are being rewritten to adapt the delivery of health and social care to the local context and offer services in closer proximity to citizens.

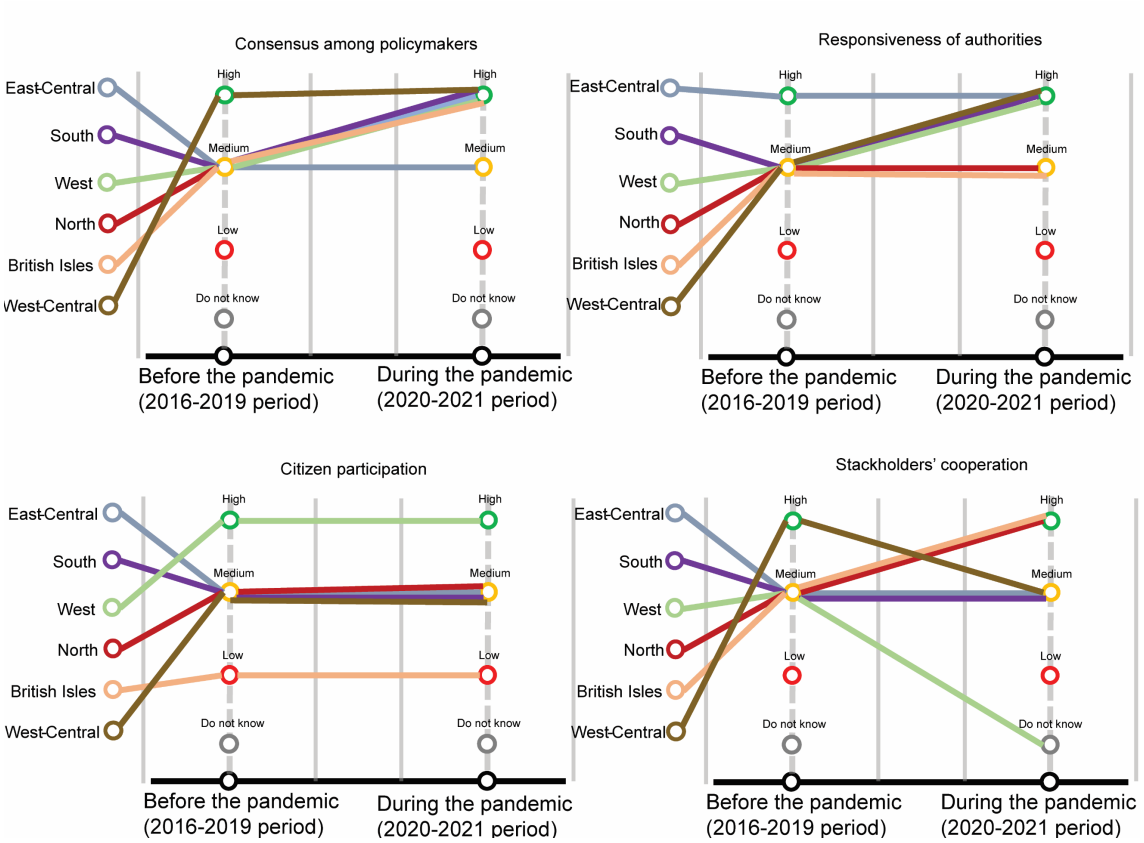
The crisis has given momentum to green and smart policy trends: Interviewees in the Lombardy and Amsterdam case study regions noted that the pandemic gave momentum to green and smart policies already under development or under consideration prior to the pandemic. Digitalisation and sustainable environmental policy trends have accelerated and gained higher prioritisation. The case studies highlight that the crisis further stimulated smart policies related to digitalisation processes focused on developing e-governance tools and the online delivery of key public services. Policymakers noted that these digitalisation processes will be consolidated, with increased multilocality working likely becoming a major long-term policy trend to emerge from the pandemic. The case studies also reveal medium and long-term potential in relation to certain green policies, including increases in green public spaces in urban areas, and the construction of more bike lanes and pedestrian areas in cities. The cases also point to a predicted growth in policies related to local green tourism, as well as the use of sustainable food production and other local business services and products.

Regional resilience and crisis management policies are becoming more prominent: Prior to the pandemic, the concept of regional resilience was becoming increasingly salient in policy and academic circles. Regional resilience examines how capable local and regional economies are of recovering from exogenous and endogenous (global and local) shocks and threats to ensure long-term policy development paths. The COVID-19 crisis has given this notion further impetus and relevance. In response to the crisis, many public authorities across the case regions developed regional resilience and crisis management plans to cope with the crisis or ensure that policymakers and practitioners are ready for future crises. A primary example of this came from the Barcelona region where the Generalitat de Catalunya developed the CORECO plan focused on public sector economic reactivation and social protection measures to overcome the socio-economic challenges of the pandemic. In Lombardy, a new regional law has been introduced that lays the preparation for a regional pandemic plan and the establishment of a Centre for the Prevention and Control of Infectious Diseases. Similarly, in Corsica, the Salvezza Plan outlined emergency actions needed to safeguard island businesses and economic activities and mitigate social challenges.

4.5 Overall governance assessment

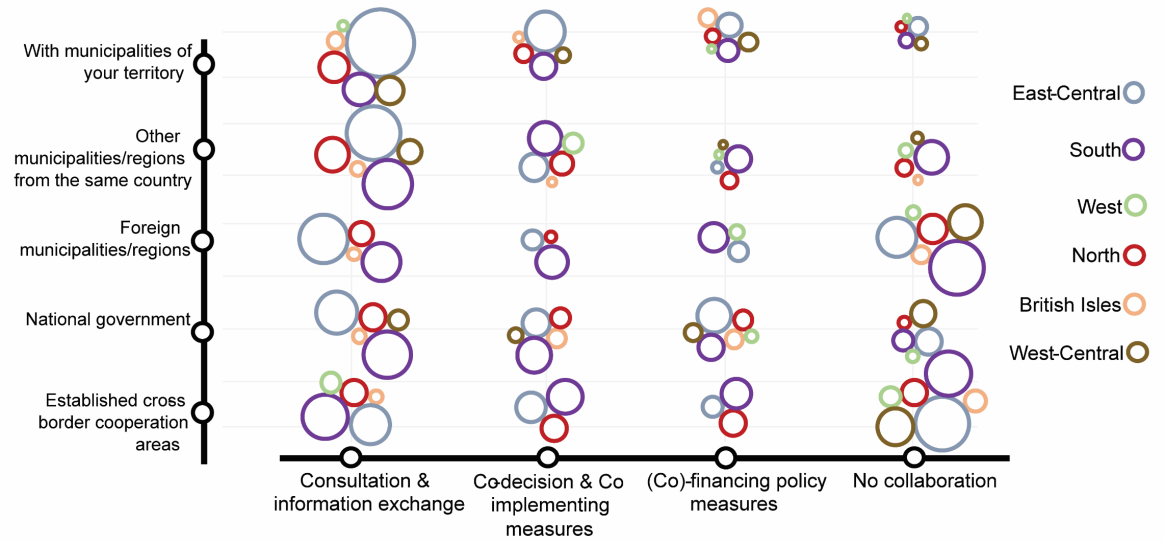
While it is well established that COVID-19 jeopardised all regional socioeconomic parameters, the pandemic had a positive impact on the governance sphere. Survey results (Figure 11) show that the pandemic increased consensus among policymakers, responsiveness of local authorities, and stakeholders' cooperation across all European regions. The pandemic resulted not only in deteriorating social and economic spheres but also in providing a harsh test to evaluate the resilience of local systems (e.g. governance, health care, economy, etc.) and their dynamics vi-a-vis unpredictable disturbances. Henceforth, regions that were able to resist and adapt their functioning to the pandemic are, hypothetically speaking, the most resilient regions and an in-depth analysis of those regions (e.g. regions of the North) is required to inspire new local policies or reshape existent ones.

Figure 11 Governance trends before and during the pandemic



To tackle the pandemic effectively, it was important to enlarge the sphere of influence of policymakers and ensure clear and instant communications with policymakers across multiple scales and sectors. So far, the most common forms of collaboration between local authorities with diverse categories of territorial stakeholders have not yet been studied across European regions. The survey tried to capture these communication and/cooperation channels and unveil common forms of collaboration (Figure 11); results showed that there is a general trend across all European regions where the vast majority of municipalities establish consultation and information exchange with municipalities in the same territory (mostly border municipalities/regions), and with less likelihood of communication channels being established with other municipalities/regions belonging to the same country. On the other hand, during the pandemic, European regions limited cooperation/communication with foreign municipalities/regions. This indicates that local authorities are not aware if a given local policy/action was replicated outside the country's national borders. Therefore, to be well prepared for the next health/economic crisis, which is multiscalar by nature, establishing communication channels across different scales (national, regional, subregional, local) is important, but also waving collaboration and communication channels with foreign regions is highly recommended. Initialising such transfer learning or mutual learning initiatives among European regions can help to increase resiliency to unpredicted crises.

Figure 12 Common forms of collaboration between stakeholders



Across the case study regions, the crisis had a major impact on multi-level governance policymaking processes, institutional structures and stakeholder collaboration practices. The pandemic served as a catalyst for promoting collaborative governance, as policymakers were required to work closely with experts and other key local stakeholder groups to develop and implement policies that met the needs of citizens. Different types of collaborative governance were identified in each case study region between various institutional levels (national, regional and local) and different stakeholders. These examples are outlined below and illustrated with best practice examples from the case studies. Further best practices can be found in the cross-case synthesis report.

Territorial collaboration: The crisis has given impetus to increased territorial collaboration and momentum in the recent trend of growing interregional and intermunicipal cooperation. For example, during the pandemic, collaboration between regional and local authorities was important for sharing healthcare provisions across administrative units. This was particularly the case in cross-border regions like Elvas and Malmo, where it was noted that the pandemic led to greater dialogue between regional- and municipal-level authorities to share cross-border healthcare responsibilities and avoid duplication of efforts. Such collaboration was also evident in the Azores case area, where the municipal authority Angra do Heroismo worked closely with 19 parishes to establish a joint action plan for dealing with the challenges presented by the pandemic. In the Iasi case region, the Social Emergency Centre was an interesting example of interregional collaboration in healthcare delivery beyond regional borders. The socioeconomic fallout of the pandemic and the cost-of-living crisis could potentially lead to further austerity and finance cuts, so any social capital built up between local governance levels during the pandemic will lay the foundation for more extensive and innovative interregional and intermunicipal collaboration in the future to help share costs and improve policy delivery.

Internal institutional cooperation: The pandemic has led to increased internal collaboration between regional and local authorities. The case studies indicate that the crisis created conditions in which different policy departments at the regional and local levels had to work together more closely and share resources to develop and implement effective policies to cope with the pandemic. This was particularly evident in the Helsinki case, where public authority representatives highlighted that the pandemic has led to a more holistic management approach based on cross-departmental collaboration and dialogue. The Elvas case region also noted that the crisis has resulted in increased cooperation across political parties, with traditionally politically opposed groups working together in the broader national, regional and local interests.

Collaboration between institutions and stakeholders: Enhanced collaboration between regional and local public authority institutions and other key sectoral groups and stakeholders has been a regular feature throughout the pandemic. In several case study regions, increased dialogue between local authorities, healthcare providers and civil society groups was considered essential for implementing healthcare measures and social policies for vulnerable groups. Increased dialogue between public authorities and experts at local universities in looking for solutions to challenges presented by the crisis was reported in other case study regions. For example, in the Amsterdam case, the Vitaal Gezond programme brought together municipal authorities, healthcare providers and insurance companies to devise measures to help meet increasing healthcare demands more effectively and efficiently. In the Malmo case, the regional development department worked closely with the industry cluster organisation IUC6 to support businesses that wanted to take their processes and productions in new directions as a result of the pandemic. Similarly, in the Iasi case region, the 'Taste of Iasi' B2C platform was established by academic and civil society organisations to enhance urban-rural linkages between local food producers.

Community-led action: The emergence of community-led actions and social innovation activities was a common feature across the case study areas. The crisis has enhanced the role of third-sector organisations and associations in policymaking, with the role of societal groups and voluntary initiatives viewed as important in supporting public authorities in the implementation of regional and local policies. For example, one initiative in the Helsinki case study region saw collaboration between private companies, NGOs and religious organisations in providing additional support for senior citizens. Community-led action has been especially significant in more centralised systems of governance, where the policy scope of regional and local authorities is weakened by predominantly top-down national policy structures. Ongoing third-sector involvement in policymaking will be essential moving forward to ensure that the most vulnerable groups in society are not left behind by green and smart transitions.

Regional leadership: The case studies show that regional and local institutions and stakeholders working within decentralised national governance structures have the mandate and responsibility to coordinate and adapt policy responses. Within highly centralised national governance systems, regional and local actors had little influence and scope regarding developing local policies but were still essential for the effective delivery of national policies. These findings indicate that a stronger role for subnational-level actors is needed at the agenda-setting stage within centralised governance structures to ensure that regional resilience and crisis policies meet the needs of local citizens. This requires an emphasis on promoting regional leadership and providing local actors with the capacity and resources needed to develop and implement a place-based response.

Cross-border cooperation challenges: Transnational cooperation has been challenged by the pandemic. The decision of national governments to shut down borders has posed significant obstacles for people living in cross-border regions such as Elvas, Iasi and Malmö. Regional and local authorities have been largely absent and neglected in these decision-making processes, and this has had a major impact on cross-border labour commuters and businesses that rely on the free flow of people, goods and services. During the pandemic, regional and local authorities in cross-border areas played an important role in trying to retain social capital between cross-border institutions and actors while attempting to put pressure on national governments to reduce the formal and informal barriers presented by border closures and other pandemic rules. This suggests that in future crisis periods, there is a need for greater dialogue between national governments and regional and local authorities in cross-border areas. This is required to ensure that any national policy measures introduced take into account and do not negatively impact cross-border citizens and businesses.

Regional resilience and crisis management units: A direct consequence of the pandemic has been the emergence of new regional resilience and crisis management policy departments and policy units at the regional and local levels. The new infrastructure brings together policymakers, regional stakeholders and researchers to develop future regional resilience and crisis management policies to help regions prepare for future crises. For example, in the Milan case study, the impact of the virus led to the creation of crisis units to strengthen cooperation between the municipal authorities, healthcare providers and other emergency services during crisis periods. Similarly, in the Barcelona case area, municipal authorities have developed crisis contingency plans to ensure that local healthcare authorities are better prepared for future pandemics.

Policy-expertise interface: The crisis has exposed tensions between the role of public authority representatives and policymaking experts. The relationship between politics and expertise has often been blurred during the pandemic, highlighting the need to reassess how scientific advice to policymakers is structured and used. Moving forward, it is imperative that expert bodies and scientific advisors retain independence and the ability to challenge political decisions on the basis of objective scientific advice. This is essential for ensuring the integrity of policies communicated to the public and limiting the potential spread of misinformation.

4.6 Overall financial assessment section

The survey results indicate that regions with high financial resources could can test and implement several policies to tackle the crisis, while regions with low financial resources had difficulties in implementing policies to control the pandemic. However, the pandemic ,;§ has significantly also impacted regional financial

resources (including functional expenses[18], investment expenses[19] and revenues[20]). Overall, survey results show that all regions have experienced an increase in 'functional expenses'. The same applies for 'investment expenses' where all regions have experienced a moderate increase (except Northern regions, which have witnessed a minor decrease). Contrary to functional expenses and investment expenses, regional 'revenues' by major European regional categories showed an even distribution where Northern, Western and regions from British Isles witnessed an improvement in financial revenues. Southern and Western-Central regions experienced a decrease in 'revenues' which reduced their financial resources to fight the pandemic and implement further policies.

Figure 13 COVID-19 impacts on regional financial resources

Across the case study regions, a number of financial measures were introduced to address the socio-economic challenges presented by the crisis, including:

EU funding: Several case study reports outlined the significance of the emergency funding provided by the EU NextGeneration Recovery Fund in helping regions bounce back from the crisis. The EU Just Transition Fund is also considered important for stimulating regional growth and development in the most deprived and vulnerable EU regions. Policymakers interviewed noted that it is essential that regional and local actors play a central role in determining what, where and how this money should be spent to ensure that the funding meets the most pressing needs of regional citizens.

National funding: Across all case regions, national funding was crucial for financing social policies, including economic and business support measures designed to mitigate the worst socioeconomic challenges of the pandemic. Only national governments had the mandate and financial clout to finance policies, such as furlough schemes, increases in welfare provision and unemployment benefits, and compensation for loss of earnings. However, these policy measures are not sustainable in the long term due to their impact on public debt. Policymakers pointed out that it is important that any future national-level pandemic recovery and regional levelling up of funds are targeted towards the most important regional challenges and vulnerable groups.

Regional/local funding: In many case study areas, regional and local authorities supplemented national financial grants/loans with additional economic and business support measures at the local level; this was mainly in the case regions with a decentralised national system of governance. Regional and local financial

[18] Functional expenses include staff costs, purchase of supplies, provision of services, contribution to the costs of external organisation, cleaning measures, social care and support, implementing COVID-19 related policies.

[19] Investment expenses include the purchase of durable goods, construction or rehabilitation of buildings, construction/maintenance of infrastructures, etc.

[20] Revenues include local tax, grant, and subsidies from the State or other public bodies, income from local authority's services/products, and property.

social support measures came in the form of rate relief, such as moratoriums on municipal taxes and rents. In Amsterdam, for example, the local authority delayed deadlines for the payment of taxes on large events until 2023. It also did not collect fees for using public land, e.g. from sidewalk cafés, during 2020–2022 and offered a postponement for the payment of municipal tax to taxis and car-sharing companies during the first months of the pandemic. Similarly, the municipalities of Elvas (Alentejo) and Terceira (Azores) supported businesses by eliminating or reducing the fees and taxes to be paid by commercial actors to the municipality. Helsinki supported struggling businesses by relieving rent payments for business properties owned by the city. In addition to supporting struggling businesses, the case study areas also implemented various measures to aid vulnerable families. This includes Barcelona, where a moratorium for rent payment of apartments was established for the months April and May 2020, with further measures planned to support families in case of need. Elvas removed the duty to pay water bills for the poorest families. These different financial support measures tended to be short term in nature and usually ended once societies reopened. The extent to which such measures could be taken up again in case of need is largely dependent on the long-term financial implications of the pandemic and the ongoing energy crisis, which will severely impact the availability of regional and local revenues.

Private funding: There are a few examples of private funding for policy initiatives across the case study regions. The current economic downturn and cost-of-living crisis across Europe will potentially lead to further cuts in public funds. Public authorities might need to consider innovative ways of incentivising private industries and businesses to finance important just, green and smart transition policies and strategies at the regional and local levels.

Community funding: In some case study regions, money was raised locally by community organisation groups, local associations and volunteer groups. Crowdsourcing and other public donation techniques were used in some case regions to raise funds for regional initiatives and support volunteers in their work with vulnerable groups. For example, in Barcelona, local authorities relied on additional funds raised by social associations in collaboration with their partners and other volunteer organisations. Facing budget cuts, the Veszprem municipal authority set up a public donations account with funding going towards measures to control the spread of the virus. The account received 15 000€ in 2020 and a further 1 260€ in 2021. Community-level funding of this nature may be considered a best practice for helping local authorities overcome revenue cuts. However, financial support from citizens may become increasingly difficult to obtain as the cost of living and energy crisis continues to engulf Europe. The Iasi case study also highlights the potential for using participatory budgeting tools to engage citizens in determining the overall direction of public expenditure in their local areas.

5 Policy, Governance and Financial Recommendations

Across Europe, a range of good policy, governance, and financial practices were developed and implemented in response to the pandemic. Many of these measures have the potential to be used beyond the pandemic context and/or in future crisis situations. This section synthesises key recommendations that emerged from the research and, where possible, these recommendations are illuminated with examples from across the case study areas.

5.1 Overarching Policy Recommendations

The pandemic has created both challenges and opportunities for policymakers. Some overarching policy recommendations have emerged from the research that policymakers should consider when developing, implementing, and communicating, policies that respond to the socio-economic challenges of the pandemic and meet the needs of citizens in future crises. These overarching policy recommendations are targeted at policymakers across all levels of governance.

- ***Continue to refine and implement good policies, governance and financial practices that were developed during the pandemic.*** Many of the policies introduced during the pandemic were halted once lockdowns were lifted and societies reopened. Rather than returning to business as usual, policymakers should assess the impact of the new policies, governance structures, and financial measures introduced during the crisis, and evaluate whether they have medium and long-term potential. Many of these practices could be retained, refined and updated to help cope with pandemic recovery processes and newly emerging crises. A number of the social policies identified in the project could help societies' most vulnerable groups to cope with the current cost of living and energy crises engulfing Europe (see just transition recommendations below).

- ***Reduce bureaucracy and simplify existing routines around the procurement of essential goods and services to ensure that the public sector can react faster and buy necessary goods in future crisis situations.*** Some case study regions such as Lombardy reported that existing rules and regulations slowed down public procurement processes and were not flexible enough to allow for a swift and pragmatic delivery of key public goods and services during the crisis. Case study interviewees argued that bureaucratic practices for the purchase of goods and provision of services need to be simplified to ensure smoother and quicker policy responses in future crises. For example, in Barcelona, a Mayoral decree on disruptions to municipal public procurement was approved when a national state of emergency was declared during the pandemic. This was to ensure the continuity of public contracts and the liquidity of providers, particularly regarding SMEs, to help maintain the efficient delivery of public services.

- ***Always consider a holistic approach when developing and implementing transition policies.*** Case study regions like Helsinki or Amsterdam found that proactive policies during the COVID-19 pandemic had the best and most far-reaching effects if they were planned in a holistic manner and addressed several transition themes at once. For example, in Amsterdam, the municipality invested €78m in the installation of solar panels and creation of green spaces, thus targeting green transition goals. Simultaneously, it also offered training and jobs to unemployed people as part of these activities, thereby supporting vulnerable groups and promoting just transition goals. In case study areas, holistic policies were often developed by communicating and collaborating across administrative sectors, pooling resources, and bringing stakeholders on board. Local and regional policy makers should aim at collaborating across sectoral divisions, including stakeholders and targeting different transition goals simultaneously also going forward in order to achieve more efficient and effective policy results.

- ***Across all governance levels, ensure that essential crisis policies and information is communicated clearly to all groups of citizens.*** The crisis highlighted weaknesses in the communication and dissemination of policies that required full public convergence, particularly within immigrant communities which struggled with the local language. In future crises, it is essential that policymakers communicate policies clearly through the dissemination of information in different languages so all citizens can understand and follow laws/recommendations. Policymakers can work closely with representatives from local communities and civil society organisations to spread important information in different languages amongst their networks, focusing on societies' most vulnerable groups. For example, in Malmo, the municipal authority created an information centre where citizens could come and receive information about COVID-19 in different languages. Iasi County authorities created the COVID-19 Medical Communication Center that functioned as a

communication centre for citizens regarding the status of COVID-19 measures and vaccination information.

Just Transition (Social) Policy Recommendations

The COVID-19 crisis has produced asymmetric social, health and economic impacts across European regions, affecting some population groups more strongly than others, such as the elderly, children, low-income families, and the homeless. Local and regional authorities developed different types of support systems and policies during the pandemic to support these groups. Such measures should be extended, where needed, to overcome the main economic, social, educational, and health-related setbacks that were caused by the pandemic, but also by the unfolding energy and cost of living crises. Concretely, the following social policy recommendations are targeted at regional and local policymakers to increase support for societies' most vulnerable groups of citizens during crisis periods.

- ***Set up dedicated centres or groups at local or neighbourhood level whose main priority it is to regularly contact elderly people and vulnerable individuals through phone and online check-ins.*** During the pandemic, several case study regions such as Barcelona or Helsinki made good experiences with setting up telephone operated home care services. Staff members contacted older and dependent persons on a daily basis to inform them about the state of the pandemic, how to protect themselves, and to ensure that their basic needs were met. The phone calls also helped to reduce loneliness and isolation. In some case study areas such as Veszprém, voluntary groups or neighbourhood initiatives were strongly involved in such initiatives. Telephone or digital check-in services should be maintained or set up where they currently do not exist. This would help foster feelings of belonging, reduce loneliness and increase quality of life of vulnerable individuals at a very local level after the pandemic. Regular calls and other types of contact can also allow authorities to detect if care needs of older people or vulnerable individuals increase and offer timely solutions.

- ***Consider extending rent freezes or reductions for the most vulnerable families living in municipal-owned buildings as well as assistance with paying energy or water bills.*** During the pandemic and the resulting economic fallout, unemployment increased. People working in particularly hard-hit sectors such as retail, tourism, or culture as well as those working on temporary contracts were especially likely to lose their job. This loss in income increased economic hardship for many vulnerable families. The number of those who faced difficulties paying essential household bills increased. Across many case study areas, for example in Elvas and Barcelona, public authorities supported the most vulnerable families by offering temporary rent reductions or moratoria to those living in municipality-owned buildings or by paying energy and water bills. Regional and local authorities should consider extending this support, if necessary, to avoid homelessness. In addition, authorities should consider providing direct support to vulnerable individuals and families that were evicted or are facing eviction especially in the context of the emerging energy and cost-of-living crisis. For example, authorities in Helsinki, Athens and on Terceira Island supported homeless people by providing shelter and meals during the pandemic, and such measures should be extended in case of need.

- ***Maintain policies focused on providing citizens with mental health support.*** Across Europe, the prevalence of anxiety, depression and insomnia increased during the pandemic. Several case study areas responded to the increasing need of mental health services by establishing telephone services (Athens, Barcelona) or by providing existing mental health care providers with increased funding (Malmö, Amsterdam). The city of Helsinki even introduced a mental healthcare guarantee with effect in 2022 which entitles all citizens to receive free mental healthcare within two weeks. The goal of these different measures was to allow a larger number of people to access psychological help and reduce waiting times. Regional and local authorities should consider keeping up the expanded services as long as demand for mental health support remains high.

- ***Maintain policies implemented during the pandemic to encourage people to live more active and healthier lifestyles.*** The pandemic has also taken a toll on the physical activity and health in Europe, as people moved and exercised less and spent more time at home. Many also experienced undesired weight gains due to eating more and consuming more alcohol. Several local and regional authorities in this project aimed at protecting and promoting public health to the extent that lockdowns, distance requirements and other mitigation measures permitted. For example, the Provincial Council of Barcelona worked with the city councils of the province to adapt the sports facilities, equipment, and courses to the sanitary requirements so that people could resume their sports and hobbies as soon as circumstances permitted. In Malmö, the regional authority provided additional funding to sports and leisure organisations to move activities online and allow people to exercise and practice their hobbies from the safety of their homes. Many people cancelled their membership in organisations and sport clubs during the pandemic. In order to increase public health after the

pandemic and reduce isolation, local and regional authorities should continue to maintain indoor and outdoor sports facilities at neighbourhood level and develop new activity centres as well as digital sports programmes which allow all population groups to resume and maintain active life-styles.

- ***Maintain pandemic practices that allowed service sector businesses to utilise outdoor public spaces***. During the pandemic, people were encouraged to avoid crowded spaces, keeping a physical distance from others, and refrain from meeting friends and family beyond household members in indoor spaces such as homes, bars and restaurants. In order to allow people to socialize in a safer manner, several case study areas such as Amsterdam, Veszprém or Athens allowed cafés, bars and restaurants to use parts of the pavement and other public space as seating area and to serve guests. This allowed people to meet outdoors where the risk of infection with the new virus was less acute. The measure also helped businesses in keeping clients and gaining income, and it protected jobs in the service sector. In addition, the measure helped to bring people back into public spaces, allowed for spontaneous social interactions and increased the quality of public life. These latter goals remain important even beyond the pandemic. Local authorities should therefore consider extending permits to use sidewalks and public space for catering establishments even after the pandemic, especially in places where these offers have been well received.

- ***Continue efforts to support children at risk of falling behind in their learning and educational programmes by organising after-school tutorials and summer camps.*** Throughout Europe, children have fallen behind in their learning as a result of school closures and distance learning during the pandemic. The impacts were however more severe for some groups than for others. Young children who are not able to focus for long time on digital education, children with disabilities, and those from less affluent families or living in overcrowded housing often experienced the biggest difficulties in keeping up their educational progress. By contrast, children with highly educated parents who could actively engage in the learning of their children, as well as those living in larger housing with quiet study environments were less likely to experience setbacks in their learning. In order to counteract these widening educational inequalities, local authorities such as Malmö or Amsterdam offered additional educational programmes to struggling pupils during school breaks or introduced tutor systems with older pupils helping younger pupils with their schoolwork. Recent research suggests that the negative effects of school closures on learning outcomes can be long-lasting. It is therefore important that local authorities maintain or create support programmes for pupils that have fallen behind during the pandemic. Such support systems should be planned for the long-term with the goal of helping struggling children to catch up and finalize school with the best possible outcomes, as well as to minimize educational inequalities between groups.

Green Transition Policy Recommendations

The pandemic has given significant momentum to the development of green transition policies. Policymakers were able to use the unique circumstances of the pandemic to introduce policies that aim to enhance climate neutrality and the shift towards a more sustainable, environmentally friendly, and carbon neutral economy. The research has revealed the medium- and long-term potential of certain green policies, including increases in green public spaces in urban areas, the construction of more bike lanes and pedestrian areas in cities, and the development of local green tourism and sustainable local food products. Green transitions require effective collaboration between a range of actors, so the following recommendations are targeted at both regional and local policymakers and other key stakeholders (e.g. industries, businesses, universities) to help accelerate the green transition and the delivery of sustainability goals across EU regions.

- ***Encourage regional and local authorities and planners to develop more open green spaces in dense urban areas.*** During the pandemic, people were forced to change many of their habits. Travel was difficult, meeting family and friends in indoor spaces was risky, and cinemas, restaurants and museums were either closed or had to implement strict public health requirements and hygiene measures. In this context, local green spaces such as parks, community gardens, fields or woodlands became increasingly important as spaces to socialize, relax or exercise. Local authorities in, e.g., Barcelona, Elvas and Veszprém reacted by investing in existing urban green spaces and creating new green areas at neighbourhood level, by planting trees and promoting community gardening. Research shows that access to green spaces in walking distance is beneficial for people's mental and physical health. Local authorities should therefore continue their practice of greening urban areas, for example by transforming vacant urban plots into community gardens, turning parking spaces into parklets or investing in green rooftops.

- ***Continue policies that provide funding support for businesses to introduce internal sustainable green processes.*** Many businesses struggled to stay afloat during the pandemic. Small and medium sized enterprises in the retail, tourism and the service industries were particularly affected when lockdowns and strict hygiene and social distancing requirements led to a drop of clients and customers. Public authorities at national, regional and local level in all countries supported

struggling businesses through a number of measures including grants, loans, rates waivers or tax measures. In some case study areas, public authorities tied these support measures to the condition to improve environmental sustainability. In the Netherlands, for example, government support for the struggling national airline KLM was tied to the condition to reduce CO_2 reductions per passenger by 50% until 2030. Other authorities, for example in Athens, Helsinki or Malmö, also created dedicated funding mechanisms for businesses to boost green transition processes and the circular economy. Public authorities should keep up this practice of tying financial support to companies to green transition requirements and thereby help to accelerate the transition to a green economy.

- **Increase support for local sustainable tourism businesses through targeted investment in advertising, marketing. and information campaigns.** During the pandemic, travelling became difficult. The number of people travelling abroad during their holidays declined sharply in Europe and remained at a low level during 2020 and 2021. This was a particular challenge for regions and cities that had been important tourism destinations before the COVID-19 pandemic. Many case study areas implemented measures and policies to support struggling businesses whose customer base had dwindled. In some cases, such as Athens, measures were targeted especially towards sustainable businesses. Several case study areas, for example Barcelona and La Réunion, also implemented information campaigns to encourage citizens to travel in the region, consume local products and thereby support the local business structure. Going forward, public support to tourism businesses and investment in tourism infrastructure should continue to prioritize sustainable and green products, services and solutions as one important tool to propel the green transition, protect local nature and avoid over tourism.
- ***Target policies and investments that continue to foster sustainable and environmental travel and mobility.*** In addition to private travel, business travel declined sharply during the pandemic. Instead of personal meetings and conferences, digital solutions soon became an established practice. The local authority of Malmö built on this experience by stipulating that municipal staff should always consider digital meetings as the preferred solutions over travel going forward. Local authorities across case study areas also used the pandemic context to encourage local populations to change mobility behaviours towards more sustainable solutions. Local authorities in Athens, Iasi and Veszprém, amongst others, invested in electric bus fleets and bike sharing systems, bike lanes and walking paths to promote walking and cycling. Such initiatives should be kept or even expanded going forward, especially in urban areas which have set a goal of reducing car use and greenhouse gas emissions from traffic.
- ***Create platforms for connecting different types of local industries and businesses to facilitate opportunities for more green and blue circular economy collaborations.*** During the crisis, some regional and local authorities introduced policies focused on bringing stakeholders together to develop and implement circular economy initiatives. For example, a new cluster programme for the circular economy was initiated during the pandemic by the City of Helsinki in collaboration with both private and public sector partners. The goal was to enable new entrepreneurship and business opportunities around circularity in the Finnish capital region. Circular economy activities can be further developed by mapping and identifying what green and blue industries and businesses at local or regional scale already exist or could be restored, enhanced or connected as part of a green infrastructure network. Furthermore, digital tools can be better utilised to look at green and blue growth synergies spatially across regions and better connect stakeholders.

Smart Transition Policy Recommendations

Regional and local authorities used the pandemic context proactively to further smart policy goals that promoted innovation and entrepreneurship by using digital solutions to make industries, businesses, networks and services more effective for the benefit of citizens. The crisis gave significant momentum to policies that enhanced digitalisation and e-governance processes in societies. The following smart transition policy recommendations are targeted at regional and local policymakers, in addition to other key stakeholders, including industries, businesses and public sector workers.

- ***Reduce the risk of digital exclusion through the implementation of policies that focus on increasing digital access for citizens.*** Across Europe, societal lockdowns presented a challenge for homes that lacked the digital prerequisites for home office and online schooling. To reduce the threat of digital inequality, policymakers needed to ensure that all citizens in the region have access to high-quality broadband and computer equipment (computers, screens, etc.), especially low-income families that may not be able to afford digital tools. In Athens, the government-issued vouchers of 200 euros addressed to low-income families for digital equipment (tablets). In Elvas, the city acquired and distributed 300 routers for all municipality residents which had a personal computer in their homes. Similarly, in the Azores, municipal authorities offered computers to school students (via schools) from socioeconomic deprived households to provide them possibility to study from

home. Such measures should be extended beyond the pandemic, if necessary, to prevent digital divides to emerge between more and less affluent population groups.

- ***Introduce new training and skills development programmes focused on improving the digital competencies of young and older people, reskill unemployed people and to increase their chances in the labour market.*** The demand for and use of digital tools to work, study, meet, shop, and enjoy cultural offers increased substantially during the pandemic. Public authorities and businesses digitized their information, products and services, workplaces, schools and universities held meetings and classes online and sports and culture providers tried to offer at least parts of their programmes and activities via the internet. As part of this process, digital skills became increasingly important and groups without such skills were at risk of marginalization. Regional and local authorities in, for example, Malmö or Iasi reacted by providing IT support for older people or offering courses to increase digital skills for other disadvantaged groups. The rapid digitalization process during the pandemic also provided new job opportunities, amongst others for those who became unemployed during the pandemic. Public authorities in the province of Barcelona used this opportunity and created educational programmes closely aligned with the demands on the labour market to upskill jobseekers and enable them to apply for jobs linked to the digital transition. Going forward, digital tools and services will remain important and the digital transition will continue. Local and regional authorities should therefore continue to offer courses and support for different population groups – from youth to the unemployed and older adults – to decrease digital divides in the population, avoid digital marginalization and boost employment.

- ***Continue to develop and refine e-governance and digital public service tools introduced during the pandemic to promote citizen engagement and improve the delivery of online public services.*** The crisis gave momentum to the development and use of online e-governance tools and the provision of some public services online, including healthcare. Regional and local policymakers should continue to develop online public health service tools to reduce pressure on healthcare providers and deal with challenges such as population ageing and providing care, particularly in more remote rural areas. For example, Athens, Iasi and Malmo regions developed online prescription processes during the pandemic to reduce the need for citizens to physically meet local health providers. Furthermore, there is a potential to expand options for remote access to key local services, for example, by following the examples of Helsinki, Hannover and Iasi regions in developing online systems for tax payments or the electronic issuance of forms or signatures. E-governance and other digital tools could also be explored as tools to proactively engage citizens in regional and local policymaking processes.

- ***Continue to provide investment to support transport providers with the digitalisation of public transport.*** The digitalisation of public transport has been speeded up during the crisis. Public authorities have worked closely with transport providers to support the development of digital ticketing processes. For example, in the Iasi and Lombardy case study regions, e-ticketing was introduced, as well as smart apps with real-time updates on public transport connections and capacity. In Iasi, the measure was adopted by the City Hall and the Public Transport Company with the effects expected to be positive in terms of public health and increasing the attractiveness of public transportation.

- ***Encourage businesses and cultural providers (museums, theatres, libraries, etc.) to continue to develop the use of digital tools to make public services and cultural events more widely available to citizens.*** Regional and local policymakers should increase support to small- and medium-sized businesses in developing their digital competence and the provision of digital offers and services for citizens. For example, in the region of Bastia on Corsica, authorities provided support for local businesses to develop joint digital platforms to offer their products and services to the local population online while the ability to purchase services physically was limited during lockdown periods. Similar platforms were also created in Athens and Lombardy. Across several case study regions, cultural providers (e.g. theatres, operas, orchestras, movies theatres) offered free online performances to keep citizens entertained during the crisis. Policymakers can work with cultural providers to continue this practice to ensure that cultural activities are open to all of society.

5.2 Governance recommendations

The pandemic has had a major impact on multi-level governance policymaking processes, institutional structures, and stakeholder collaboration practices. The crisis created governance challenges, particularly in more centralized national governance systems and cross-border regions where the role of sub-national level institutions and actors was constrained by top-down national government dominance over policies. At the same time, however, the crisis served as a catalyst for empowering sub-national actors in more decentralized national governance systems by creating the conditions for greater collaborative governance activities between regional and local level authorities and stakeholders. Improved governance coordination, practices, tools, and regulations will also allow policymakers to react more efficiently in future crisis situations. The

following governance recommendations are targeted at policymakers and stakeholders at the EU, national, regional, and local levels.

- ***Promote multi-level governance cooperation during crisis periods through existing EU, national, regional, and local level platforms and networks.*** A coordinated multi-level governance policy response is required to deal effectively with crisis situations. Enhanced dialogue and collaboration between EU, national, regional and municipal level authorities is needed to help identify policy synergies, allow for timely action, promote learning, and encourage the sharing of resources, expertise and best practice policies. The value of swiftly sharing knowledge about best practices is vital during crisis situations, such as the COVID-19 pandemic, where many regional and local authorities had little experience and routines to build on. Furthermore, the greater integration of regional/local authorities is needed within existing EU and national level platforms to make sure that policies better reflect local level perspectives, challenges, and opportunities. Similarly, the enhanced representation of non-profit societal groups and associations is also required within these platforms to ensure that EU and national policies meet the needs of society's most vulnerable groups at the regional and local levels. Existing platforms, such as the Council of European Municipalities and Regions, can play an important role in facilitating dialogue between regional and local actors.

- ***Enhance cooperation and collaboration both within and between regional and local level authorities.*** The crisis has highlighted the need for a holistic and integrated approach to regional and local policy development during crisis periods by: 1) establishing stronger links between departments within public authorities; and 2) identifying areas of potential policy overlap and synergies between regional and local authorities. This can be achieved by carefully mapping inter-departmental and inter-authority policy roles and responsibilities to identify areas of policy where development and implementation can be shared. In some case study regions (Azores, Barcelona) collaboration agreements or joint action plans were signed and developed between regional and local authorities for dealing with the challenges presented by the pandemic. Furthermore, inter-departmental and inter-authority dialogue and collaboration can be facilitated by continuing to develop and use new information-sharing regimes and digital communication platforms developed during the pandemic. For example, the City of Helsinki created a digital communication tool with the regional authority in Uusimaa to share responsibility for the delivery of health and social care measures during the crisis.

- ***Establish continuous collaboration between regional and local level institutions and stakeholders by creating permanent dialogue forums.*** Several regions created ad hoc crisis management units or task forces during the crisis; for example, the Lombardy Crisis Management Units and Iasi County Emergency Centre were created to provide a platform for dialogue in the delivery of crisis policies between local and regional policymakers, industries, business, universities, NGOs, societal groups and healthcare providers. In Malmo and Azores, regional and local authorities built stronger connections with Chambers of Commerce to find ways of maximizing business opportunities presented by the crisis. Similarly, a number of bi-lateral collaborative activities occurred between local authorities and businesses to deliver digital inclusion (Mayotte) or promote local tourism (Athens). Finally, third sector organisations, such as the Third Sector Board in Barcelona or the Lelekter Foundation in Veszprem, played important roles in facilitating collaboration between regional and local authorities and societal groups and volunteer organisations in the delivery of support to vulnerable groups. Collaborations of this nature could become institutionalized through the development of more permanent platforms that promote a continuous dialogue between institutions and actors, which could help: 1) improve the coordination and delivery of policies; 2) target local policies on the most vulnerable groups; 3) increase cross-sectoral integration; 4) identify and maximise areas of regional growth potential; and 5) ensure that policies are evidence-based and reduce levels of misinformation among citizens. Permanent crisis management platforms of this nature will ensure that all actors can react swiftly and appropriately in case of future crises and policy shocks.

5.3 Territorial recommendations

The pandemic presented both challenges and opportunities for different types of regions across Europe. High density urban and metropolitan regions were particularly vulnerable to the spread of the virus and border closures created obstacles for cross-border regions; whereas increases in digital remote working could prove a catalyst for rural revitalisation processes. The following territorial specific recommendations are targeted at policymakers in urban, cross-border, and rural areas.

- ***In urban and metropolitan regions, ensure that planning policies and strategies are targeted at high density population areas and districts with the highest levels of vulnerable groups.*** During the pandemic, the highest spread of infection rates was predominantly in high density urban

and metropolitan regions. In the Amsterdam and Helsinki regions, policymakers made use of big data and digital monitoring tools to identify the most populated areas in the city. There is a need for policymakers to work more closely with statisticians and GIS experts to identify overpopulated districts most at risk during crisis periods. By identifying districts with the highest population density levels and at-risk groups, policymakers can also ensure that the green space planning and social policies outlined above are carefully targeted at the most overpopulated areas and the most vulnerable groups.

- ***In cross-border regions, enhance dialogue between key institutions and actors to maintain smooth cross-border cooperation and flows of people, goods, and services during crisis periods.*** National-level actors should consult more widely with existing cross-border committees and local public authorities to minimise the obstacles of potential border closures to citizens working and living in cross-border areas. Dialogue should focus on exploring the possibilities for greater cross-border cooperation in crisis management and the delivery of key public services. Such dialogue could be built around the establishment of cross-border crisis management units to develop plans to enhance cross-border regional resilience in the face of policy shock scenarios, such as future pandemics.

- ***In rural regions, maximize the potential for rural revitalization presented by digitalisation and green tourism.*** The pandemic has given significant momentum to digitalization and local green tourism processes. Rapid advances in digitalisation could prove a catalyst for rural revitalization processes as the potential of digital remote work opportunities can contribute towards counter urbanisation processes and limit outmigration of young people from rural areas. Policymakers can facilitate this process by implementing policies that focus on improving digital connections, improving mobility links between urban and rural areas, and making rural areas more attractive areas to live in terms of quality housing provision and greater access to services of general interest. Furthermore, the pandemic resulted in increases in local nature tourism as a result of travel restrictions, which created economic growth opportunities for rural areas. Policymakers can foster this emerging growth and development area by focusing investment and promoting local rural tourism businesses and natural assets.

5.4 Financial recommendations

The high levels of national government expenditure incurred during the pandemic, mainly in the form of loans and grants to prevent business closures and unemployment, has contributed to record highs in public funding debt across European states. Consequently, the financial impact of the crisis may lead towards further rounds of austerity and budget cuts at the sub-national level. The following recommendations are targeted at regional and local policymakers to help them find innovative ways to cut costs, diversify access to new funding sources, and engage citizens in financial planning activities.

- ***Reduce costs and make savings by enhancing inter-departmental and inter-institutional cooperation and coordination.*** Policymakers can share financial resources and avoid duplication of spending by taking a more holistic approach to policy development and implementation. This can be achieved by carefully mapping roles and responsibilities at an institutional level (i.e. between regional and local public authorities) and a departmental level (i.e. within public authorities) to identify areas of potential overlap, synergy and cooperation. Continuing the practice of conducting digital communication and online meetings between regional/local authorities, different departments, or with national authority representatives and agencies, may also help to reduce travel costs.

- ***Diversify access to new funding resources by exploring opportunities for raising private and community resources that help address the most pressing social problems in the region.*** In several case study regions including Azores and Malmo, the crisis forged stronger links between regional and municipal authorities and Chambers of Commerce. There is a potential to build on this social capital to help facilitate greater communication between local policymakers and key industries/businesses to explore the potential for generating private funding resources to address social challenges and support regional regeneration projects. Strengthening connections between regional and local policymakers and third sector organisations, and volunteer groups, will also be important for raising community funding to finance specific local initiatives through crowd sourcing and other public donation techniques as seen in the Veszprem case study.

- ***Proactively engage citizens in regional and local financial planning through the implementation of inclusive and participatory financial planning tools.*** Regional and local policymakers

should explore the possibilities of using digital citizen engagement tools to directly involve key stakeholders and citizens in determining how and in which policy areas EU and national level regional funds and emergency crisis recovery funding is spent. For example, in the Iasi case study region, policymakers were exploring the potential of **participatory budgeting** as a method for engaging citizens directly in determining the overall direction of regional spending. These tools can play a particularly significant role in raising citizen awareness on the role of key EU funding resources in helping to regenerate their region and local areas (e.g. especially the European Structural Investment Funds, EU NextGeneration Funds and the EU Just Transition Funds).

- ***Use available public funding and procurement to help accelerate transition processes.*** Regional and local policymakers can give momentum to transition processes by ensuring that access to public funding is tied to meeting certain just, green, and smart transition requirements. This will help incentivize industries, businesses, and other organisations to focus on societal challenges and develop more sustainable and environmentally friendly internal processes, services and products.

5.5 Future research recommendations

This research has brought to light new potential future research topics. The following research recommendations are predominantly targeted at funding bodies, academics and statisticians working in the fields of regional resilience, development, and planning.

- ***New research is needed on how border closures and other disruptions of traffic across borders affect the labour market and economy, as well as individuals and families in cross-border regions.*** COVID-19 has exposed the fragility of transnational co-operation, particularly in cross-border areas where the negative impact of the pandemic on flows of people, services and goods has been most evident. The crisis has highlighted the need for further research assessing how existing cross-border governance structures, institutions and actors cooperate, and how collaboration and social capital can be maintained to ensure resilient cross-border areas during crisis periods.

- ***Increase cooperation between statistical institutes, public authorities, research institutes and funding bodies to help develop measurable indicators and reliable data collection methods.*** Closer dialogue and collaboration between these key actors will help improve the quality and availability of reliable statistical information and administrative data (at NUTS 3 and LAU levels) on key socio-economic measures (e.g. household income and cost of living), on the number of persons, goods and services crossing borders, the number of cross-border commuters and the number of unions/families where members live on different sides of the border.

- ***Conduct further research into novel and innovative interregional, intermunicipal and cross-border collaborative governance processes.*** The pandemic was the catalyst for enhancing collaboration and cooperation between institutions and actors at the sub-national level. More research is needed on any new models of public-private cooperation in the delivery of key public services that emerged during the crisis. Analysis should focus on examining the key contextual factors and stakeholders driving collaboration, and how these newly emerging governance models contribute towards empowering local actors and enhancing regional resilience.

6 Conclusion

The COVID-19 pandemic has caused considerable changes in all facets of our daily lives and has caused major shifts in economic and social capital worldwide. Europe was not exempt from such severe disruptions, and the vast majority of European regions and municipalities were severely hit by the pandemic, resulting in high death rates, great disturbances in the labour market, and the reduction of people's freedoms because of the frequently applied lockdown measures. Furthermore, the impacts of the health crisis were heterogeneously distributed across regions and had significant implications for crisis management and policy response.

Examining the spatial diffusion of COVID-19 mortality rates at the subregional level, during the first wave, the virus affected a limited number of EU countries (the highest mortality recorded in Italy and Spain), while hitting the major vibrant centres of Europe and their surrounding areas, such as Madrid (Spain), Paris (France), London (the UK) and Milan (Italy). During the first wave, the most affected regions (e.g. Italy, Lombardia; Spain, Madrid; the UK, London; France, Paris and Val-de-Marne; and Sweden, Stockholms län) are megacities – for instance global nodes (e.g. Paris and London), European engines (e.g. Madrid, Barcelona, Brussels and Milan) and strong MEGAs (e.g. Bilbao and Turin). After the first wave, the virus transitioned from Western to Eastern European countries (e.g. Poland, Mazowiecki, Czechia, Střední Čechy and Moravskoslezsko). However, computing the case fatality ratios showed major territorial disparities in terms of healthcare infrastructure robustness, where French and some Spanish regions have managed to contract the pandemic, Italian and Western regions kept experiencing an upward trend in case fatality ratios. This suggests that the healthcare systems were unable to yield resistance to the virus, or ultimately had reached their tipping points because they had lost their resilience in containing the pandemic during the subsequent waves. Such divergent patterns of territorial impacts are dependent on several local factors, which may explain why some regions were more heavily affected than others. Overall, we can conclude that all European regions and cities were unprepared for a pandemic driven by (i) miscalculating the risk of the initial outbreak in China, (ii) the lack of subnational crisis management plans, and (iii) the relatively fragile healthcare systems, especially in Southern and Eastern European regions.

Albeit the negative impacts driven by the pandemic across the European space (such as increasing unemployment, youth unemployment, and at-risk-of-poverty rates), the pandemic has accelerated the deployment of smart measures (e-governance, increasing local authorities' responsiveness, etc.). Several policies also contributed to weaving strong social bonds between communities and local stakeholders and pushed forward EU environmental agenda and green policy measures (promoting cycling and walking, reducing wastes, and encouraging materials reuse). As an illustration, Ireland has implemented a new policy framework called the *'10 Minutes Town Policy'*. All essential services are easily accessible alongside to promoting active travel to contain the infection rates and improve the wellbeing of citizens. This policy was originally shaped by the Southern Regional Assembly (Ireland) and because of the effectiveness of the measure it was incorporated into the *'National Sustainable Mobility Plan'*. On other scales, as in Paris, the concept of the *'15-minutes city'* has been implemented. Recently, this concept has also been extended to the *'30-minutes territory'*[21]. More specifically, the 30-minute territory should allow people to live, work, recreate, access medical care and public services, and enjoy a quality environment. Policies should therefore rethink their offer accordingly to improve the attractiveness of territories and make them more liveable.

Although local measures have been taken in all three areas (smart, inclusive and green), we show that particular attention has been paid to inclusiveness. European cities and regions have focused on cushioning the social effects of the pandemic and helping disadvantaged households. Attention to the social issue is crucial in the design of public policies and the crisis in Ukraine reminds us of this. In a war context, the social consequences can be very strong, especially for low-income households. For several months now, the Ukrainian crisis has caused a general increase in the cost of living. This increase is felt most acutely by the socially vulnerable. While the end of the pandemic seems to be in sight, it is highly likely that the indicators we have mobilised in our study (unemployment, youth unemployment, ARoP) will deteriorate further in cities and regions that have already experienced high negative social consequences during the pandemic. Therefore, policies at the local level must continue the social support and assistance provided during the pandemic.

We have also shown that multidimensional and multi-scale cooperation (local, regional and national) has been implemented in many European cities and regions. From this point of view, interregional collaboration has been crucial in the fight against the pandemic. For these reasons, in anticipation of future crises, improving the resilience of communities to unforeseen shocks requires strengthening planning that is no longer

[21] See https://territoriall.espon.eu/articles/223132?article=12-4

"self-centred" but rather cooperative with neighbouring territories. This would improve the coherence of local policies and, thus, their effectiveness.

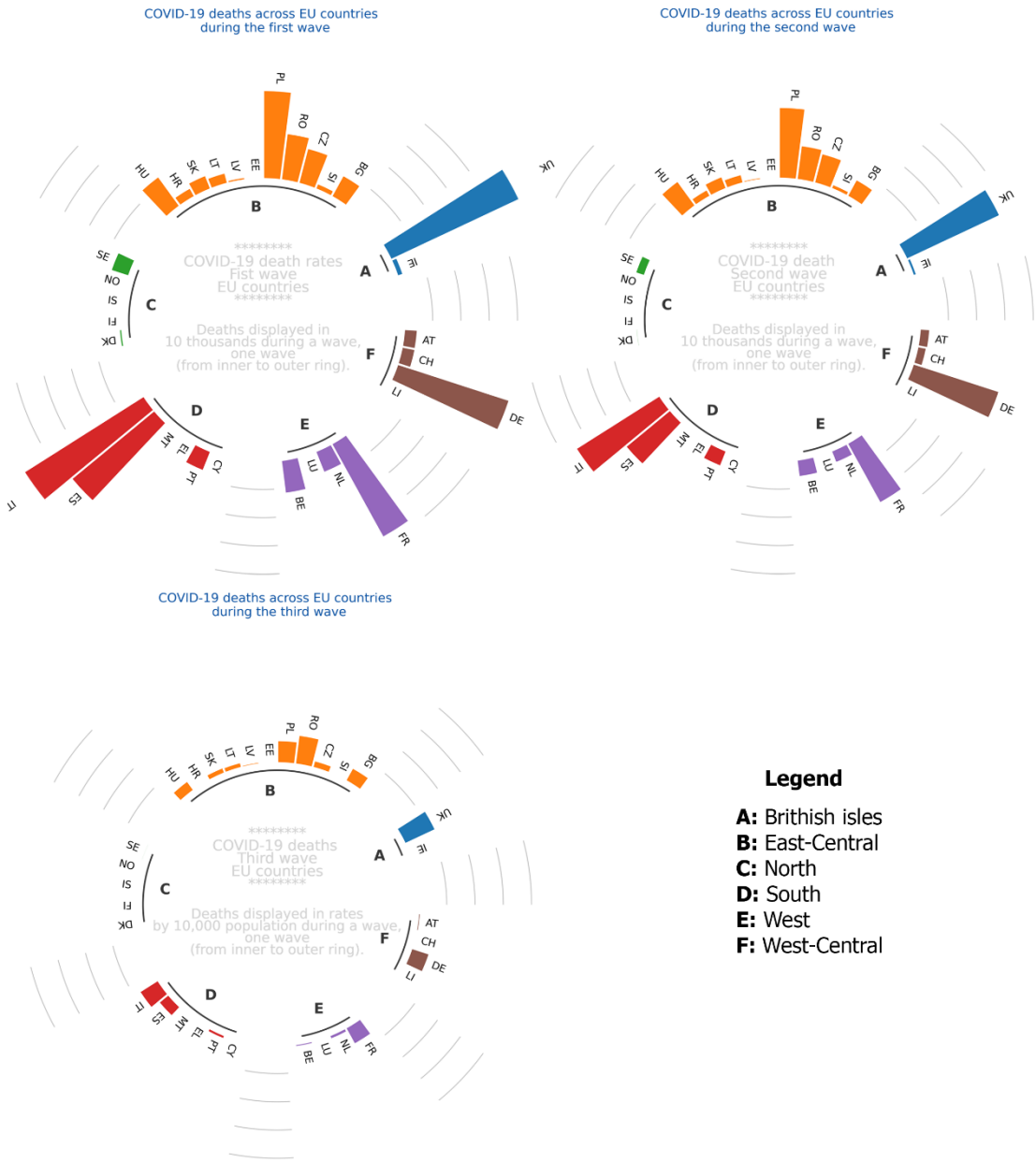
Lastly, we want to underline how much the lack of anticipation, strategic foresight (two key exercises in strategic intelligence approaches), and strategic culture (thinking in the long term, considering the fields of possibility, calculating risks, seeking for opportunities) is in itself a vulnerability of territorial entities. A crisis such as the COVID-19 pandemic underlines the founding paradox of any strategic intelligence approach: one cannot be ready if one waits for a crisis to be proven or for a hazard to be realised before preparing for it; one can only prepare for a crisis by accepting that it is possible without being certain that it will happen. These paradoxes are very difficult to grasp by territorial entities and their governing bodies, but also difficult to accept by their populations. This, unfortunately, increases their vulnerability to catastrophic risks tenfold, as previously stated (Jeanne, 2009). Therefore, cities and regions must have dedicated territorial intelligence units that can anticipate crises. It requires training people in strategic intelligence techniques. Again, the war in Ukraine reinforces the usefulness and relevance of such skills in local, regional and national authorities.

7 Appendix

Table 6 Availability of pandemic data by country (territorial level) Sources: Ministries of health and national statistical institutes for death and cases; Eurostat for excess mortality

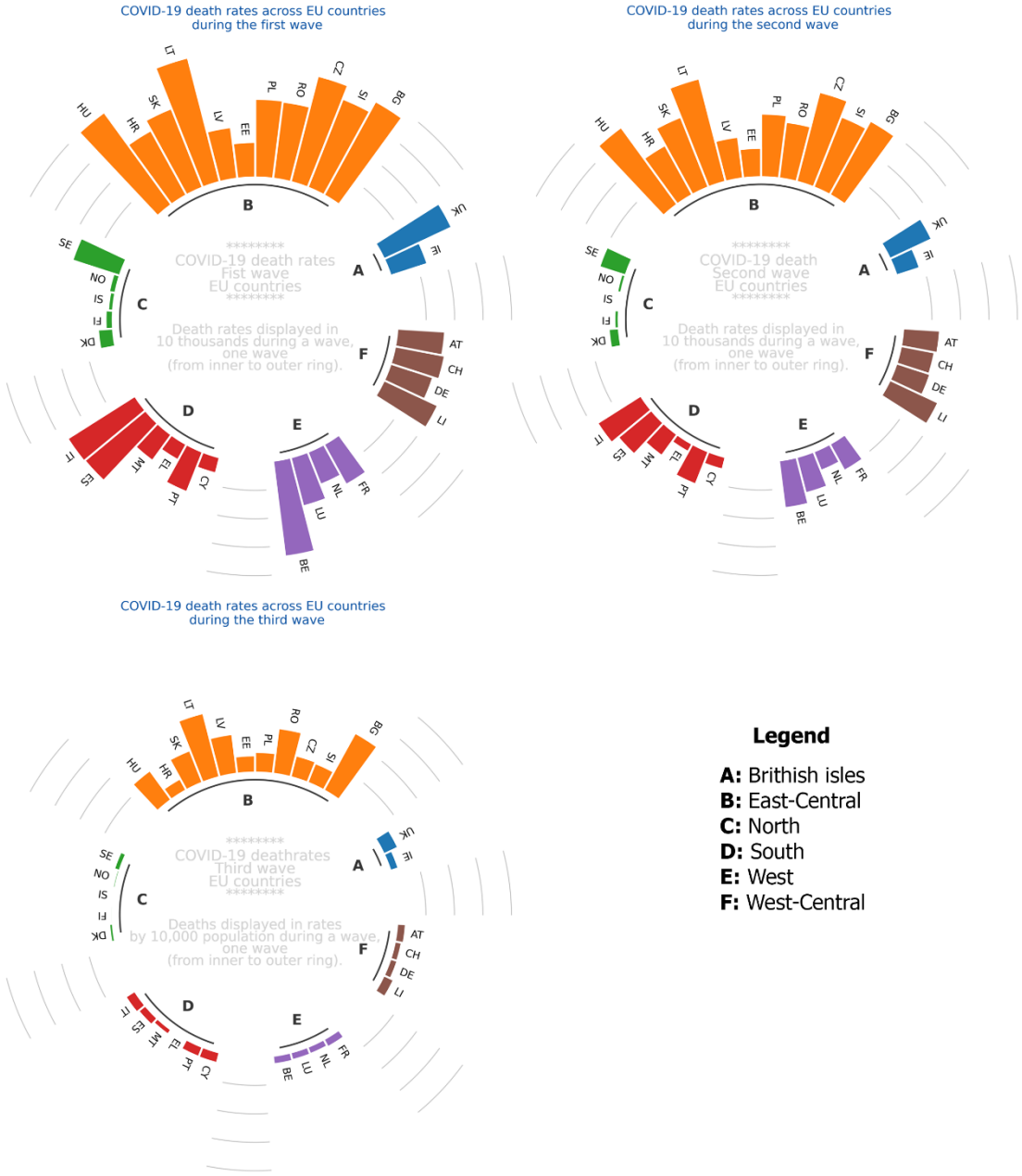
Country	Reported cases	Excess mortality	Reported deaths	Unemployment rates (%)	Youth unemployment rates (%)	At-risk-of-poverty rates (%)
Austria	***NUTS 3***	NUTS3	NUTS 3	NUTS3	NUTS2	NUTS0
Belgium	NUTS 1	NUTS3	NUTS 3	LAU	LAU	NUTS2
Bulgaria	NUTS 0	NUTS3	NUTS 3	NUTS3	NUTS1	NUTS3
Croatia	NUTS 3	NUTS1	NUTS 1	NUTS3	NUTS3	NUTS0
Cyprus	NUTS 3	NUTS3	NUTS 3	LAU	NUTS2	NUTS2
Czech Rep.	***NUTS 3***	NUTS3	NUTS 3	NUTS3	NUTS3	NUTS3
Denmark	NUTS 2	NUTS3	NUTS 3	LAU	LAU	LAU
Estonia	NUTS 2	NUTS1	NUTS 2	NUTS3-LAU	NUTS2	NUTS3
Finland	NUTS 0	NUTS3	NUTS 3	NUTS3	LAU	NUTS3
France	NUTS 3	NUTS3	NUTS 3	NUTS3	NUTS3	NUTS0
Germany	NUTS 3	NUTS1	NUTS 1	NUTS3	NUTS3	NUTS0
Greece	NUTS 3	NUTS3	NUTS 3	NUTS2	NUTS2	NUTS2
Hungary	Budapest - Countryside	NUTS3	NUTS 3	NUTS3	NUTS3	NUTS2
Ireland	NUTS 1	NUTS1	Missing data	NUTS3	NUTS0	NUTS2
Italy	NUTS 2	NUTS3	NUTS 3	NUTS3	NUTS2	NUTS2
Latvia	NUTS 2	NUTS3	NUTS 3	NUTS3	NUTS2	NUTS3
Lithuania	***NUTS 3***	NUTS3	NUTS 3	NUTS3	NUTS3	NUTS2
Luxembourg	NUTS 3	NUTS3	NUTS 3	LAU2	NUTS3	NUTS3
Malta	NUTS 2	NUTS1	NUTS 2	NUTS2	NUTS2	NUTS2
Netherlands	***NUTS 3***	NUTS3	NUTS 3	LAU	NUTS2	NUTS2
Poland	***NUTS 3***	NUTS2	NUTS 3	LAU1	LAU	NUTS2
Portugal	NUTS 2	NUTS3	NUTS 3	NUT2	NUTS3	NUTS2
Romania	NUTS 3	NUTS3	NUTS 3	NUTS3	NUTS2	NUTS2
Slovakia	NUTS 0	NUTS3	NUTS 3	NUTS3	NUTS3	NUTS3
Slovenia	NUTS 3	NUTS1	NUTS 1	NUTS3	NUTS2	NUTS2
Spain	NUTS 3	NUTS3	NUTS 3	NUTS3	NUTS2	NUTS2
Sweden	NUTS 3	NUTS3	NUTS 3	LAU	NUTS2	LAU
United Kingdom	***NUTS 1***	NUTS3	NUTS 3 (until the end of 2020)	NUTS2	NUTS1	NUTS0
Iceland	NUTS 2	NUTS3	NUTS 3	NUTS2	NUTS2	NUTS0
Liechtenstein	NUTS 3	NUTS3	NUTS 3	NUTS3	-	-
Norway	***NUTS 2***	NUTS3	NUTS 3	NUTS3	NUTS2	NUTS2
Switzerland	NUTS 3	NUTS3	NUTS 3	NUTS3	NUTS3	NUTS2

Figure 14 COVID-19-related deaths by country



Data source: National COVID-19-related databases (2021)

Figure 15 COVID-19-related death rates by country



Data source: National COVID-19-related databases (2021)

Table 7 Descriptive statistics

Variable	Nb regions	Mean	Std. Dev.	Min	Max
COVID death rate first wave	352	2.36	2.93	0.00	16.71
COVID death rate second wave	352	8.27	5.74	0.03	38.56
COVID death rate third wave	352	4.28	3.62	0.00	17.86
Excess mortality Z-score (first wave)	352	0.28	0.99	-0.98	12.78
Excess mortality Z-score (second wave)	352	0.40	0.99	-4.84	6.15
Excess mortality Z-score (third wave)	352	0.38	0.99	-0.71	10.29
Population density	352	4.79	1.26	0.96	9.95
Share of the population aged 65 and over	352	20.79	3.39	10.72	30.32
GDP per capita (log)	352	10.01	0.76	4.92	12.05
Poverty	352	20.98	7.76	8.50	53.60
Hospital beds	352	523.32	193.88	101.97	1,286.28
Medical doctors	352	270.31	153.65	43.37	826.80
Governance	352	0.64	0.48	0	1
Education	352	0.32	0.10	0.12	0.60
Hit (first wave)	352	0.31	0.46	0	1
Predominantly rural region	352	0.38	0.49	0	1
Intermediate region	352	0.42	0.49	0	1
Predominantly urban region	352	0.20	0.40	0	1

Table 8 Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Population density	1.000										
(2) Share of the population aged 65 and over	-0.507***	1.000									
(3) GDP per capita	0.309***	0.023	1.000								
(4) Poverty rate	-0.045	-0.132**	-0.491***	1.000							
(5) Hospital beds	-0.019	0.082	-0.266***	-0.037	1.000						
(6) Medical doctors	0.218***	-0.150***	0.142***	0.056	-0.154***	1.000					
(7) Governance index	0.091*	0.172***	0.692***	-0.446***	-0.197***	-0.174***	1.000				
(8) Education	0.304***	-0.115**	0.661***	-0.490***	-0.261***	-0.062	0.624***	1.000			
(9) Hardest hit region (first wave)	0.122**	-0.052	0.383***	-0.146***	-0.409***	0.014	0.328***	0.346***	1.000		
(10) Intermediate region	-0.021	-0.091*	0.114**	-0.070	-0.210***	0.117**	0.012	-0.028	0.075	1.000	
(11) Predominantly urban region	0.591***	-0.285***	0.261***	-0.037	-0.065	0.159***	0.161***	0.338***	0.190***	-0.429***	1.000

References

Amdaoud, M., Arcuri, G., Levratto, N., 2021. Are regions equal in adversity? A spatial analysis of spread and dynamics of COVID-19 in Europe. Eur. J. Health Econ. 22, 629–642.

Antonietti, R., Falbo, P., Fontini, F., 2021. The Wealth of Nations and the First Wave of COVID-19 Diffusion. Ital. Econ. J. https://doi.org/10.1007/s40797-021-00174-z

Barrero, J.M., Bloom, N., Davis, S.J., 2021. Why working from home will stick. National Bureau of Economic Research.

Bavel, J.J.V., Baicker, K., Boggio, P.S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M.J., Crum, A.J., Douglas, K.M., Druckman, J.N., Drury, J., Dube, O., Ellemers, N., Finkel, E.J., Fowler, J.H., Gelfand, M., Han, S., Haslam, S.A., Jetten, J., Kitayama, S., Mobbs, D., Napper, L.E., Packer, D.J., Pennycook, G., Peters, E., Petty, R.E., Rand, D.G., Reicher, S.D., Schnall, S., Shariff, A., Skitka, L.J., Smith, S.S., Sunstein, C.R., Tabri, N., Tucker, J.A., Linden, S. van der, Lange, P. van, Weeden, K.A., Wohl, M.J.A., Zaki, J., Zion, S.R., Willer, R., 2020. Using social and behavioural science to support COVID-19 pandemic response. Nat. Hum. Behav. 4, 460–471. https://doi.org/10.1038/s41562-020-0884-z

Bogoch, I.I., Watts, A., Thomas-Bachli, A., Huber, C., Kraemer, M.U.G., Khan, K., 2020. Pneumonia of unknown aetiology in Wuhan, China: potential for international spread via commercial air travel. J. Travel Med. 27, taaa008. https://doi.org/10.1093/jtm/taaa008

Bourdin, S., Ben Miled, S., Salhi, J., 2022. The Drivers of Policies to Limit the Spread of COVID-19 in Europe. J. Risk Financ. Manag. 15, 67. https://doi.org/10.3390/jrfm15020067

Bourdin, S., Jeanne, L., Nadou, F., Noiret, G., 2021. Does lockdown work? A spatial analysis of the spread and concentration of COVID-19 in Italy. Reg. Stud. 55, 1182–1193. https://doi.org/10.1080/00343404.2021.1887471

Brockmann, D., 2021. Dirk Brockmann - Research on Complex Systems [WWW Document]. Dirk Brockmann - Res. Complex Syst. URL https://rocs.hu-berlin.de/ (accessed 2.6.22).

Childs, L.M., Abuelezam, N.N., Dye, C., Gupta, S., Murray, M.B., Williams, B.G., Buckee, C.O., 2015. Modelling challenges in context: Lessons from malaria, HIV, and tuberculosis. Epidemics, Challenges in Modelling Infectious Disease Dynamics 10, 102–107. https://doi.org/10.1016/j.epidem.2015.02.002

Cone, L., Brøgger, K., Berghmans, M., Decuypere, M., Förschler, A., Grimaldi, E., Hartong, S., Hillman, T., Ideland, M., Landri, P., van de Oudeweetering, K., Player-Koro, C., Bergviken Rensfeldt, A., Rönnberg, L., Taglietti, D., Vanermen, L., 2021. Pandemic Acceleration: COVID-19 and the emergency digitalisation of European education. Eur. Educ. Res. J. 14749041211041792. https://doi.org/10.1177/14749041211041793

Darvas, Z., 2020. COVID-19 has widened the income gap in Europe. Bruegel-Blogs.

ECDPC, 2022. SARS-CoV-2 variants of concern as of 27 January 2022 [WWW Document]. Eur. Cent. Dis. Prev. Control. URL https://www.ecdc.europa.eu/en/COVID-19/variants-concern (accessed 2.3.22).

ESPON, 2020. Geography of COVID-19 outbreak and first policy answers in European regions and cities [WWW Document]. ESPON. URL https://www.espon.eu/geocov (accessed 2.6.22).

Eurofound, 2021a. What just happened? COVID-19 lockdowns and change in the labour market [WWW Document]. Eurofound. URL https://www.eurofound.europa.eu/publications/report/2021/what-just-happened-COVID-19-lockdowns-and-change-in-the-labour-market (accessed 2.9.22).

Eurofound, 2021b. Living, working and COVID-19 (Update April 2021): Mental health and [WWW Document]. Eurofound. URL https://www.eurofound.europa.eu/publications/report/2021/living-working-and-COVID-19-update-april-2021-mental-health-and-trust-decline-across-eu-as-pandemic (accessed 2.9.22).

Eurofound, 2021c. Impact of COVID-19 on young people in the EU [WWW Document]. Eurofound. URL https://www.eurofound.europa.eu/publications/report/2021/impact-of-COVID-19-on-young-people-in-the-eu (accessed 2.9.22).

Fana, M., Torrejón Pérez, S., Fernández-Macías, E., 2020. Employment impact of COVID-19 crisis: from short term effects to long term prospects. J. Ind. Bus. Econ. 47, 391–410. https://doi.org/10.1007/s40812-020-00168-5

Frohlich, N., Mustard, C., 1996. A regional comparison of socioeconomic and health indices in a Canadian province. Soc. Sci. Med. 42, 1273–1281. https://doi.org/10.1016/0277-9536(95)00220-0

Gatto, M., Bertuzzo, E., Mari, L., Miccoli, S., Carraro, L., Casagrandi, R., Rinaldo, A., 2020. Spread and dynamics of the COVID-19 epidemic in Italy: effects of emergency containment measures. Proc. Natl. Acad. Sci. 117, 10484–10491. https://doi.org/10.1073/pnas.2004978117

Grek, S., Landri, P., 2021. Editorial: education in Europe and the COVID-19 pandemic. Eur. Educ. Res. J. 20, 393–402. https://doi.org/10.1177/14749041211024781

Grzegorczyk, M., 2020. The scarring effect of COVID-19: youth unemployment in Europe. GSTDTAP.

Haggett, P., 2001. Geography: a global synthesis. Pearson Education.

Hradsky, O., Komarek, A., 2021. Demographic and public health characteristics explain large part of variability in COVID-19 mortality across countries. Eur. J. Public Health 31, 12–16. https://doi.org/10.1093/eurpub/ckaa226

Hu, Y., Goldman, N., 1990. Mortality differentials by marital status: an international comparison. Demography 27, 233–250. https://doi.org/10.2307/2061451

Igari, A., 2021. Regional differences of the spread of the coronavirus in Central Europe 20.

Jackson, J.K., 2021. Global economic effects of COVID-19. Congressional Research Service.

Jeanne L (2009) La fiabilité du raisonnement humain. Essai sur la contribution de l'épistémologie au management des risques catastrophiques. Management et avenir 27: 49–65.

Jeanne, L., Bourdin, S., Nadou, F., Nouret, G., 2022. Economic globalisation and the COVID-19 pandemic: Global spread and inequalities.

Kincses, Á., Tóth, G., 2020. How coronavirus spread in Europe over time: national probabilities based on migration networks. Reg. Stat. J. Hung. Cent. Stat. Off. 10, 228–231.

Lund, S., Madgavkar, A., Manyika, J., Smit, S., 2020. What's next for remote work: an analysis of 2,000 tasks, 800 jobs, and nine countries. McKinsey Glob. Inst. 1–13.

Markowitz, S., Nesson, E., Robinson, J.J., 2019. The effects of employment on influenza rates. Econ. Hum. Biol., New Findings in Economics and Human Biology: A special Issue in Honor of Founding Editor John Komlos 34, 286–295. https://doi.org/10.1016/j.ehb.2019.04.004

Medeiros, E., Guillermo Ramírez, M., Ocskay, G., Peyrony, J., 2021. Covidfencing effects on cross-border deterritorialism: the case of Europe. Eur. Plan. Stud. 29, 962–982. https://doi.org/10.1080/09654313.2020.1818185

Melki, J., Tamim, H., Hadid, D., Makki, M., Amine, J.E., Hitti, E., 2021. Mitigating infodemics: The relationship between news exposure and trust and belief in COVID-19 fake news and social media spreading. PLOS ONE 16, e0252830. https://doi.org/10.1371/journal.pone.0252830

Morrill, R., Gaile, G.L., Thrall, G.I., 2020. Spatial diffusion.

Müllner, D., 2011. Modern hierarchical, agglomerative clustering algorithms (No. arXiv:1109.2378). arXiv. https://doi.org/10.48550/arXiv.1109.2378

OECD, 2020a. The territorial impact of COVID-19: Managing the crisis across levels of government [WWW Document]. OECD. URL https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-COVID-19-managing-the-crisis-across-levels-of-government-d3e314e1/ (accessed 4.7.22).

OECD, 2020b. OECD Economic Outlook, Interim Report September 2020.

Stadtmüller, M., Laubner, A., Rost, F., Winkler, S., Patrasová, E., Šimůnková, L., Reinhardt, S., Beil, J., Dalpke, A.H., Yi, B., 2021. Emergence and spread of a sub-lineage of SARS-CoV-2 Alpha variant B.1.1.7 in Europe, and with further evolution of spike mutation accumulations shared with the Beta and Gamma variants. https://doi.org/10.1101/2021.11.01.21265749

Stiglitz, J., 2020. Point of view: Conquering the great divide. Finance Dev. 0057. https://doi.org/10.5089/9781513544595.022.A005

Tkalec, I., 2020. Dynamics in public health infrastructure : hospital beds and COVID-19. Policy puzzle no. 2. European University Institute. https://doi.org/10.2870/419511

UN, 2020. COVID-19 global humanitarian response plan | HumanitarianResponse [WWW Document]. URL https://www.humanitarianresponse.info/ru/programme-cycle/space/document/COVID-19-global-humanitarian-response-plan (accessed 5.2.22).

Veldkamp, L., Fogli, A., 2018. Germs, social networks and growth.

WHO, 2022a. Coronavirus disease (COVID-19) [WWW Document]. URL https://www.who.int/westernpacific/health-topics/coronavirus (accessed 2.2.22).

WHO, 2022b. Tracking SARS-CoV-2 variants [WWW Document]. URL https://www.who.int/health-topics/typhoid/tracking-SARS-CoV-2-variants (accessed 3.7.22).

Yeung, H.W., 2021. The trouble with global production networks. Environ. Plan. Econ. Space 53, 428–438.

Zhang, C.H., Schwartz, G.G., 2020. Spatial disparities in coronavirus incidence and mortality in the United States: An ecological analysis as of May 2020. J. Rural Health 36, 433–445. https://doi.org/10.1111/jrh.12476

Zhu, J., Yan, W., zhu, L., Liu, J., 2021. COVID-19 pandemic in BRICS countries and its association with socio-economic and demographic characteristics, health vulnerability, resources, and policy response. Infect. Dis. Poverty 10, 97. https://doi.org/10.1186/s40249-021-00881-w

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