



Geography of COVID-19 outbreak and first policy answers in European regions and cities.

Sébastien Bourdin, Nicolas Rossignol, Mounir Amdaoud, Giuseppe Arcuri, Damiana Costanzo, Mihail Eva, Corneliu Iatu, Bogdan Constantin Ibanescu, Ludovic Jeanne, Nadine Levratto, et al.

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ESPON STUDY //

Geography of COVID-19 outbreak and first policy answers in European regions and cities

Policy Brief // December 2020

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1 Introduction

General context

Since the appearance of the virus in China at the end of last year, the European way of considering the coronavirus has changed radically. While the first cases of Covid-19 occurred in Europe at the end of January, the European Centre for Disease Prevention and Control, an EU agency, reported only 275 cases a month later. On the 1st of June, Europe totalled 170,000 deaths and on the 1st of November, it was 223,000 deaths that was registered, figures that give an idea of the pandemic scale on the continent.

In response to the pandemic, the leaders of the 27 Member States took more or less drastic measures. Italy, the first country to be massively affected by Covid-19, confined its population on the evening of the 9th of March. Most of the other 26 Member States gradually followed suit, adopting policies of social distancing, closure of non-essential businesses and border closures to limit the circulation of the virus. Spain has implemented the most radical containment on the continent, banning children from going out until the 26th of April. In Central and Eastern European countries, the virus propagated later and lockdown measures have been implemented in the very early stages of the virus propagation. For example, Romania instituted a national lockdown on the 24th of March, at a moment when there were only 726 confirmed cases across the country, and similar decision patterns can be found in most CEE countries. Conversely, Sweden has adopted the least restrictive policy in Europe. The government has advocated the strategy of herd immunity, according to which the circulation of the virus allows the immunisation of a majority of the population and would therefore make the disease harmless.

Since early May, many countries have entered a phase of deconfinement. This is particularly the case in Europe, where most of the measures taken in March to combat the spread of the coronavirus have been made more flexible. But the “second wave” that Europe is undergoing has, once again, led to containment measures in several countries.

Understanding the spread of the virus and its determinants

More than ever, the epidemic of coronavirus infection makes the social facts that geography questions visible through space and at all scales: worldwide, European, national, local and even the finest one. The epidemic acts here as a powerful indicator of the organization of geographical space. It highlights the multiple interactions between territories at different scales.

In Germany as in France, there are significant geographical contrasts in the density of confirmed cases and deaths. However, these inequalities correspond to very different patterns of spatial organization in the two countries. This example reinforces the usefulness and interest of conducting a comparative and multiscale study to understand the drivers of the spread of the disease and its impacts fully. By compiling the data produced by the national statistical institutes in Europe at a fine scale, we retraced the Covid19 geography from the beginning of the pandemic until the end of August.

By cross-referencing data on mortality with socio-economic, demographic, and institutional data, we were able to understand why some territories were more affected than others.

Overview of policy answers to the Covid-19 on the regional/local scale

The EU's response to COVID19 is based on four priorities: (i) limiting the spread of the virus; (ii) ensuring the supply of medical equipment; (iii) promoting research on treatments and vaccines; (iv) supporting jobs, businesses and the economy. At the same time, local authorities are/were in the front line of the pandemic. Consequently, various territorial responses have been implemented with the aim of limiting the spread of the Covid-19. These measures include health/social policy, economic policy and fiscal policy. From that point, we identified, on the local scale, the policies adopted and the tools implemented to mitigate the effects of the epidemic.

2 Understanding the spread of the virus and its determinants

2.1 Geography of the outbreak: a European perspective

2.1.1 From Wuhan to Europe: between topographical and topological diffusion

The unprecedented crisis we are currently experiencing with the coronavirus pandemic, like any global epidemic, is part of an evolving spatiotemporal process: the hierarchy of the territories affected by high mortality linked to Covid-19 evolves over time; this is what we call "the kinetics of the pandemic" in medical terms. After its outbreak in the megalopolis of Wuhan (whose yearly airport traffic represents 25 million people), the capital of the Hubei province in central China, the spread initially occurred neighbourhood by neighbourhood (topographical spread) in nearby countries having intense relations with China. On the 20th of January 2020, South Korea reported its first confirmed case: a Chinese woman. On the 21st of January 2020, Taiwan detected a first case with a Taiwanese businesswoman established in Wuhan who came back to the island. At the same time, Asia, such as Japan, Hong Kong and Singapore, were affected, as the city-state was the first air destination from Wuhan.

The virus could not remain Asian since Asia, and particularly China, has many relations with other continents. From this point of view, the epidemic clearly took advantage of the forces of globalisation to spread to the most economically integrated metropolitan areas. This is what we call a topological diffusion, *i.e.* reticular diffusion, in the networks of the most globalised cities. The virus has thus exploited the mobility networks, at the heart of our economic development and tourism, and has flourished in the densest and most productive and sociably intense spaces. The fact that Northern Italy was the first European region to be particularly affected (Map 1) was logical, given the importance of the Chinese diasporas and mobility between Milan and China. It should be remembered that the Milan-Malpensa airport, the second Italian airport after that of Fiumicino in Rome, has above all become the FedEx hub in Southern Europe and an important freight airport, well connected to China, the world's leading exporter. Milan is also directly connected to China through the rail freight, with the inauguration of the first direct link between Chengdu and Milan on the 12th of February 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.

2.1.2 Mapping the circulation/diffusion of the virus

In order to map the circulation/diffusion of the virus, we created a geodatabase on the regional scale (NUTS 2 or 3) with data on daily deaths. We collected data from the beginning of February to the end of August.

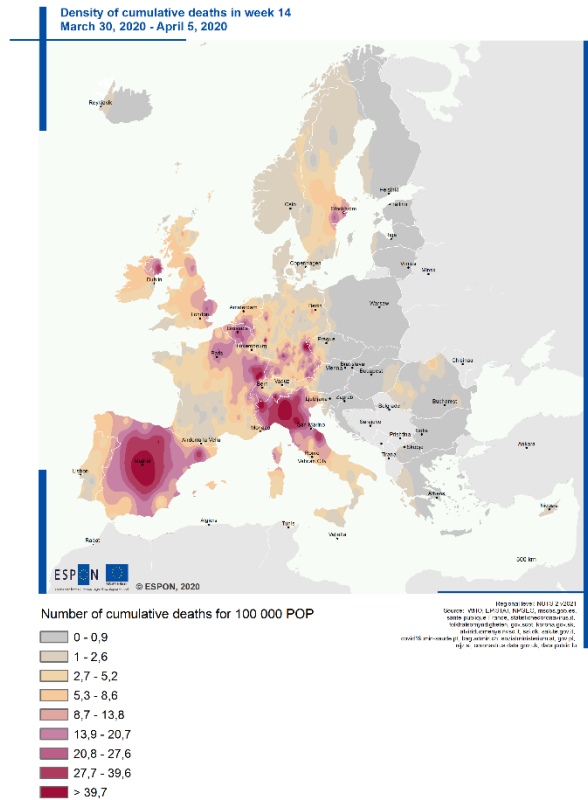
Maps 1, 2 and 3 show the cumulative death rate per 100,000 inhabitants across the European regions. As it can be observed, during the first months of the pandemic, the first cases were strictly limited to some regions in Italy (5.9 per 100,000 people in Lombardy), France (4.25 per 100,000 people in Haut-Rhin) and Spain (4.15 per 100,000 people in Madrid Community). Over the following weeks, the Covid-19 epidemic spread out throughout the continent, and, at the end of May, high levels of death ratio were also recorded in other European countries as the United Kingdom (Northern Ireland and North East England), Belgium (Brussels region) and Sweden (Stockholm). A similar picture is shown by Map 3 that presents the spatial diffusion of the Covid-19 epidemic at the end of the first wave (end of July 2020). All in all, remote rural regions were less affected. Except some Romanian and Polish regions, most of the regions located in the Baltic countries and in Eastern and South Eastern Europe were spared by this first wave, the necessary measures having been put in place before the virus entered these territories.

Nevertheless, it should be noted that the places where Covid-19 emerged in Europe are not solely based on metropolitan logics (Map 1). Indeed, in addition to these globalised circuits, the virus has found favourable development conditions in other places and this unexpected second phase arose as a game-changer and shaped the peculiar regional geography of this first wave. In addition to global networks, Covid-19 found favourable circulation conditions through super-spreading events which had an accelerating effect: a religious conference in Eastern France, a football game in northern Italy, carnival festivities in Western Ger-

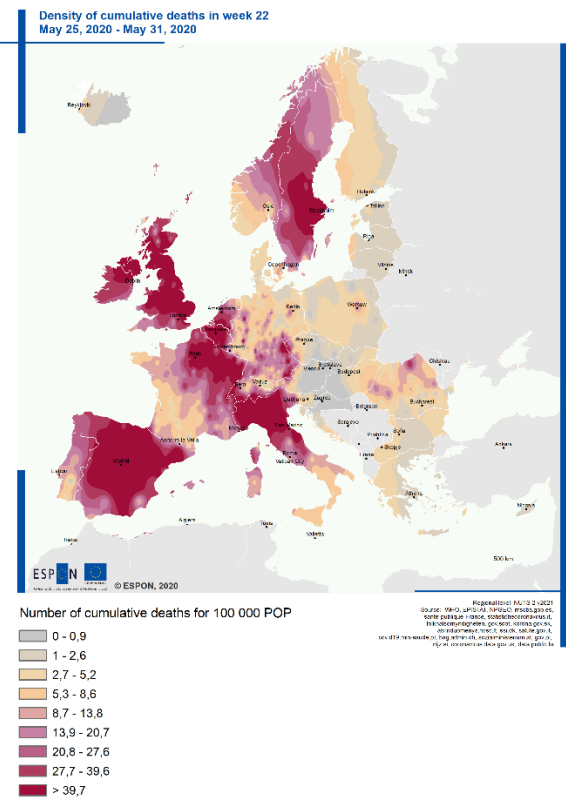
many, a night event in a ski resort in the Austrian Alps. Some entailed major regional outbreaks that explained most of the uneven distribution of fatalities between regions in some countries. For instance, a religious event gathered 2,500 people on a weekend in February 2020 was the cause of the first massive outbreak of Covid-19 in France. On the 1st of April 2020, one-third of the deaths due to Covid-19 in the country originated this region. 4 months later, they still represented 22% (Map 3).

All of these super-spreading events contributed to widespread relocation diffusion through interregional mobility. The pandemic indeed spread to many different regions, with an intensity depending on the flows of returnees from touristic and business trips abroad. Italy as a source of infections was important since the north of the country faced a drastic COVID-19 outbreak beginning in mid-February, and this country is both one of the most connected regional economy of Europe and a trendy touristic destination in winter. Jumping in space over large distances, Covid-19 diffusion via mobile network societies caused extreme scaling of the outbreak process in many European regions, strongly affecting the biggest metropolitan areas. From then on, several regions in Scandinavia, the Benelux countries and the UK started being strongly affected (Map 2). These examples of relocation diffusion demonstrate the importance of network logics in the regional development of the outbreak during this first phase.

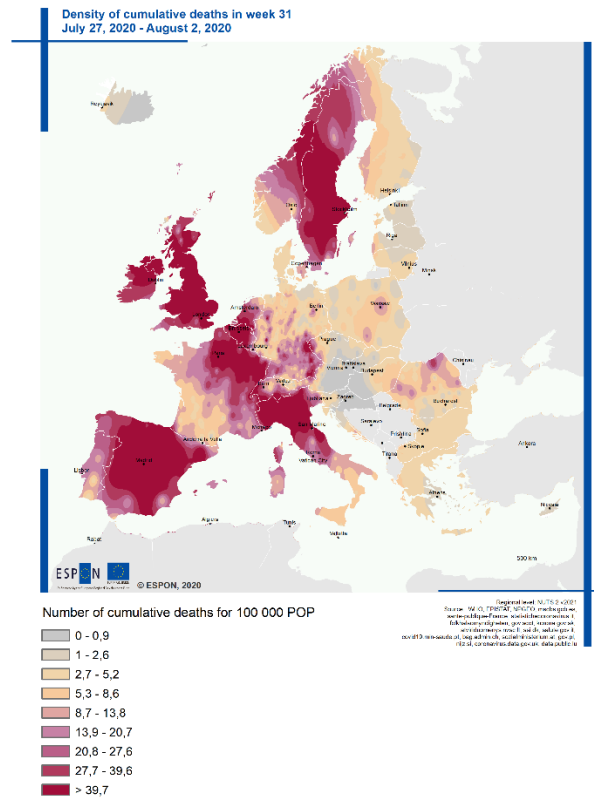
Map 1: Incidence of deaths (end of March)



Map 2: Incidence of deaths (end of May)



Map 3: Incidence of deaths (end of July)



2.2 Understanding the kinetics of Covid-19

2.2.1 A spatial analysis of the outbreak

After the first cases were reported in Europe, some studies pointed out that European regions were not equally hit but that strong differences existed between the peripheral ones where the infection rate remained limited and the core ones where the rates reached high levels (Amdaoud et al. 2020, Bourdin et al. 2020). The regional and local impact of the COVID-19 crisis is highly heterogeneous, with a strong territorial dimension that has significant consequences for crisis management and policy responses. Governments, on a subnational scale, are responsible for crucial issues of containment measures, health care, social services, economic development, and public investment, putting them in the front line of the crisis management (OECD, 2020).

The analysis conducted in this report is based, on the one hand, on an explanatory analysis of spatial autocorrelation which makes it possible to account for the level of dependence of the death rate linked to Covid-19 in different places. On the other hand, we use spatial regression models to capture the diffusion effect of the epidemic between neighbouring regions and the role exerted by territorial determinants in the spread of the epidemic.

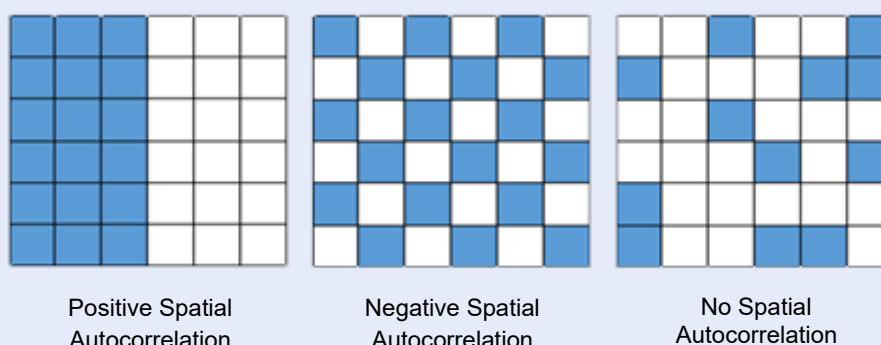
To test the existence of a spatial data clustering phenomenon, we apply the Exploratory Spatial Data Analysis (Box 1) which can provide useful summary information about the spatial arrangement of mortality rate related to the Covid-19 epidemic.

Maps 4, 5 and 6 display the LISA of the Covid-19's evolution between different dates and reveal distinctive geographic patterning of the epidemic's spreading. Between February and March (Map 1), we can easily identify where the "hot points" of the epidemic were: Italy, Spain, Belgium and the West part of Germany have high-high clustering, meaning that it was in these red areas that the progression of the epidemic was the highest. The high-high clustering recorded in France had as starting point in the eastern region but rapidly spread out from the East to the Ile de France region (the political and economic centre of the country) and formed a big cluster. On the contrary, Central and Eastern Europe seemed to be spared (low-low clustering).

Through a visual analysis of map 1 compared to maps 2 and 3, some distinctive geographical patterns appear. First of all, the lockdown seems to have had the expected effects since, for the April-May and June-July periods, the evolution of the number of new deaths/100,000 inhab. is low in a large part of the areas that were the most hit in February-March. It should be noted that over the April-May period, the United Kingdom and Ireland experienced an explosion in the number of deaths (high-high clustering). This can be explained by the late decision to implement a containment. Sweden, which did not implement any containment, recorded a significant increase in the number of deaths for the same period.

BOX 1**Exploratory Spatial Data Analysis (ESDA)**

Spatial autocorrelation is defined as the correlation of a variable with itself due to the spatial location of the observations. It is said to be positive when similar values of the variable to be studied are grouped together geographically: close geographical units are more alike than distant units following Tobler's first law of geography (Tobler, 1970). Conversely, it is negative when variables dissimilar to the variable to be studied are grouped together geographically: close geographic units are different from distant units. Finally, the spatial autocorrelation is equal to zero when the observations of the variable are randomly distributed in space (see figure below).

Forms of Spatial Autocorrelation

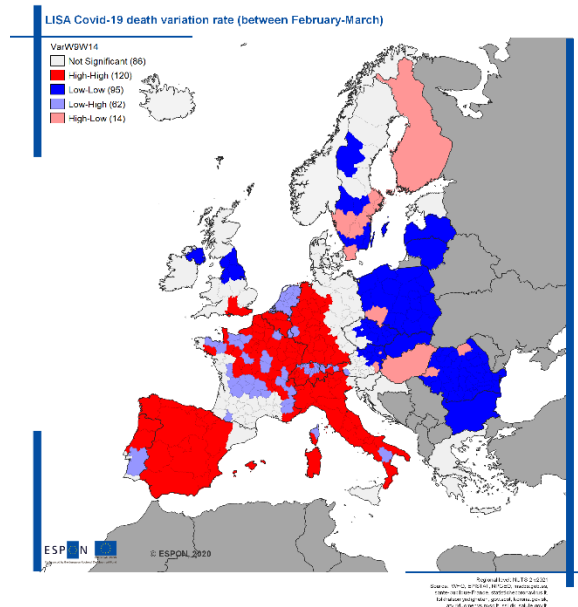
Particularly, the LISA (Local Indicators of Spatial Association; Anselin, 1995) maps provide the identification of clusters or collections of similar geographical units, based on the indicator used. They are used to identify hot spots or cold spots across space. Positive spatial autocorrelation is observed in areas considered as high-high (i.e. high death rates in a region surrounded by high values of the weighted average rate in the neighbouring regions), and low-low (low rate in a region surrounded by low values of the weighted average rate in the neighbouring regions). There are also two forms of negative spatial associations (i.e. association between dissimilar values); high-low (high rate in a region surrounded by low values of the weighted average rate in the neighbouring regions), and low-high (low rate in a region surrounded by high values of the weighted average rate in the neighbouring regions).

The LISA indicator is expressed as follows:

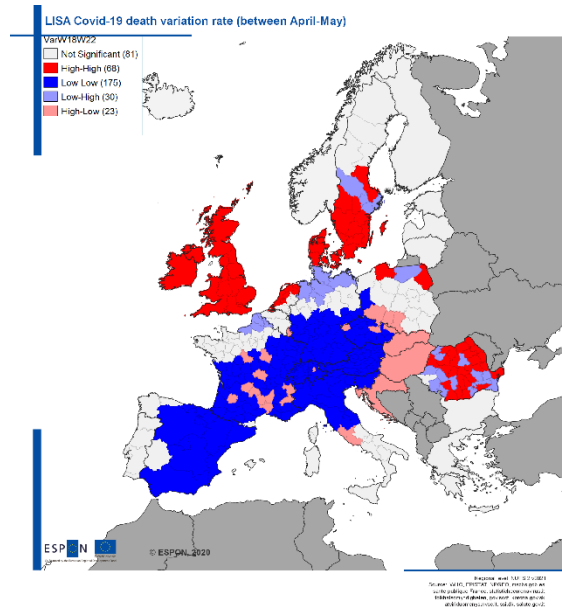
$$z_i = \sum_{j=1}^n w_{ij} z_j \quad j \neq i$$

where z_i is the difference of the variable y in region i from the global mean ($y_i - \bar{y}$), z_j is the difference of the variable y in region j from the global mean ($y_j - \bar{y}$), and w_{ij} is an element of the Spatial Weight matrix $N \times N$ which expresses for each observation (row) those locations (columns) that belong to its neighbourhood set as nonzero elements. In this study, the specification of these elements are nonzero relies on the inverse of distance weight function such as $w_{ij} = 1/d_{ij}^\alpha$ where the effect of observation j on i is a declining function of the distance between them.

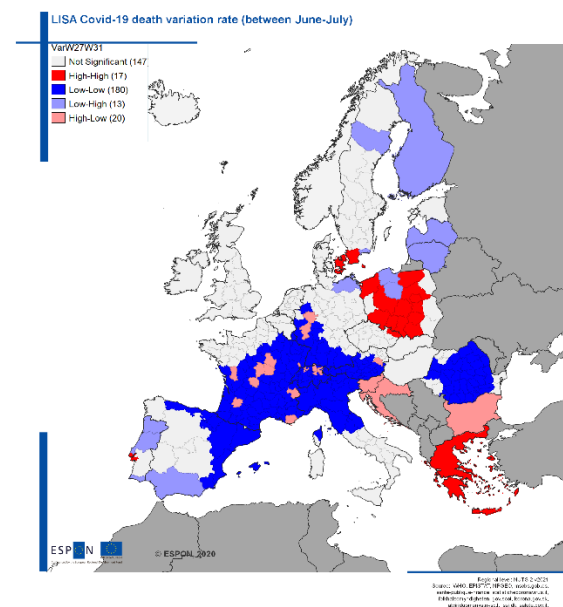
Map 4: Evolution of deaths (February-March)



Map 5: Evolution of deaths (April-May)



Map 6: Evolution of deaths (June-July)



2.2.2 The determinants of regional disparities in terms of mortality

In the following section, we apply spatial regression models to our data, to capture the diffusion effect of the epidemic between neighbouring regions and the role exerted by territorial determinants in the spread of Covid-19. Spatial and geostatistical techniques have been used widely in several contributions dedicated to viruses, such as Hepatitis C infection, MERS-CoV, H1N1 influenza, HIV, dengue, and recently Covid-19 (Bourdin et al., 2020; Amdaoud et al., 2020).

Clinical data and surveillance reported, at an early stage, two important aspects of the epidemic: (i) there is a higher risk for the elderly male population (over the age of 65) and for patients suffering from co-morbidities such as diabetes, hypertension, chronic respiratory diseases, cancer, and cardiovascular disorders to die from Covid-19 (Du et al., 2020), and (ii) a strong territorial dimension in SARS-CoV-2 pandemic spread (OECD, 2020). In this train of thought, a multitude of local features (social, demographic and economic ones) have been considered as potential determinants for the observed variation in the Covid-19 outcome.

BOX 2**Spatial econometrics models**

The econometric specification considered in this research takes the Ordinary Least Squares (OLS) linear regression model as its starting point:

$$Y = X\beta + \varepsilon \quad (1)$$

Y is the dependent variable (Covid-19 death rate). X stands for the explanatory variables used, β is the vector of parameters to assess, and ε is the error term. When a spatial autocorrelation is ignored in the model specification but is present in the data generating process, the OLS estimators are biased and non-convergent.

The spatial autoregressive model (**SAR**) consists in correcting this bias by integrating an "endogenous shifted variable" WY in the model (1) and taking into account the spatial autocorrelation related to the variable Y . The model is written as follows:

$$Y = \rho WY + X\beta + \varepsilon \quad (2)$$

WY is the shifted endogenous variable for the inverse distance matrix W , ρ is the autoregressive parameter indicating the intensity of the interaction between the observations of Y . In this model, the observation of Y is partly explained by the values of Y in the neighbouring regions.

A second way of incorporating spatial autocorrelation in econometric models is the Spatial Error Model (**SEM**) which consists in specifying a process of spatial dependency of errors in a regression model. The SEM model is defined as follows:

$$Y = X\beta + \varepsilon \text{ with } \varepsilon = \lambda W\varepsilon + u \quad (3)$$

The λ parameter reflects the intensity of the interdependence between the residuals of the regression and u is the error term. Omitting a spatial autocorrelation of errors produces unbiased but inefficient estimators, so that the OLS-based statistical inference will be biased.

These two models can be combined to produce a general model called Spatial Autoregressive Confused (**SAC**). It includes a lagged endogenous variable and a spatial autocorrelation of errors. The model is written as follows:

$$\begin{cases} Y = \rho WY + X\beta + \varepsilon \\ \varepsilon = \lambda W\varepsilon + u \end{cases} \quad (4)$$

There are different approaches that can be used to choose models. We have adopted the so-called bottom-up approach, which consists in starting with the non-spatial model. Tests of the Lagrange multiplier (Anselin et al., 1996) then make it possible to decide between the SAR, SEM, SAC or non-spatial models.

The importance of local parameters in explaining the health of populations and mortality rates is widely demonstrated in the literature (Cambois and Jusot, 2007). This dimension is also found in the declaration of the Millennium Development Goals signed in September 2000, which underlines the importance of the fight against poverty and the improvement of the care conditions on the reduction of mortality especially those of children. In addition, these factors have been associated with other epidemics in the past, and there is no reason why this should not be the case for this new disease. For instance, Linard et al. (2007) found that

environmental and socio-economic factors play a crucial role in determining the spatial variation of Puumala and Lyme borreliosis infection in Belgium. Stanturf et al. (2015) come to the same observation in their study on the Ebola epidemic in 2014 in three West African countries (Liberia, Sierra Leone, and Guinea). Results shows that taking these contextual elements into account is essential in the study of health-related questions and that their omission would lead to a partial understanding of the phenomena studied, as underlined by Geronimus et al. (1999) or, more recently and regarding Covid-19 in Italy, Bayer and Kuhn (2020). The latter thus assume that family structures and the presence of several generations within the same household differ according to the regions and would thus explain the geographic differences observed.

We venture the hypothesis that spatial dependence between the regions across different channels explains the variety in the spread of Covid-19. To analyse the unequal spatial diffusion of the epidemic across Europe, we use ~~for that~~ an original dataset covering 377 European regions in 28 countries. For each region, we calculate an indicator to describe the prevalence of the pandemic in the territory. It is defined as the ratio between the number of Covid-19-related deaths over the number of inhabitants. Data on Covid-19-related deaths were collected at three moments of the pandemic's first wave (end of March, end of May and end of July).

Table 1: Definition and source of the variables

Variable	Definition	Year	Source
Covid death rate	10.000*(cumulative deaths due to Covid-19/Population)	2020	WHO and National Health Ministers
Population density	Total population per km ² (log)	2019	Eurostat
Share of the population aged 65 and over	Number of people aged 65 and older over total population	2019	Eurostat
Life expectancy	Life expectancy at birth rate	2019	Eurostat
GDP per capita	Gross domestic product (GDP) per capita at current market prices	2016	Eurostat
Poverty rate	Percentage of people at risk of poverty	2019	Eurostat
Hospital beds	100 000*(number of hospital beds/Population)	2017	Eurostat & NHS
Governance	Index of Good Governance derived from the European Government Quality Index (University of Gothenburg)	2009	ESPON
Education	Part of population aged 25-64 with tertiary education level (levels 5-8). The variable equals one if the value is greater or equal to the mean	2019	Eurostat
Region typology	Urban/rural typology: Variable that classifies regions as predominantly urban, intermediate, or predominantly rural regions.	2020	OECD

We distinguish different groups of indicators that may explain the spatial heterogeneity in mortality due to the Covid-19 pandemic: demographic & concentration determinants (Population Density, Share of the population aged 65 and over, Life expectancy), income & wealth determinants (GDP per capita, Poverty Index), health care determinants (hospital beds), an index that proxies the governance quality in the regions and an indicator describing the region typology (Urban, Intermediate, Rural). Table 1 shows the definition and source of the variables.

This econometric analysis provides spatial dynamic information about the spread of Covid-19 in the European regions and identifies socioeconomic factors associated with mortality (Table 2).

Table 2: Empirical results for Covid-19 deaths rate determinants

	March 31st	May 31st	July 31st
Population density	N.S.	N.S.	N.S.
Share of the population aged 65 and over	N.S.	N.S.	N.S.
Life expectancy	Positive	Positive	Positive
GDP per capita	N.S.	N.S.	Negative
Poverty	N.S.	N.S.	N.S.
Hospital beds	N.S.	Negative	Negative
Governance index	Negative	Negative	Negative
Education	Negative	Negative	N.S.
Intermediate region	N.S.	Positive	Positive
Urban region	N.S.	Positive	Positive
Neighbourhood effects	+++	+++	+++

N.S. = Not Significant

Demography is a factor of spatial differentiation in health and, as such, is the subject of systematic analyses to explain the international (Hu and Goldman, 1990) and regional (Frohlich and Mustard, 1996) differences. Among the demographic variables (Population density, Share of the population and Life expectancy), only one is significant. We observe that a higher proportion of people with high expectancy life causes a higher prevalence of Covid-19. This result confirms the risk factor of age frequently mentioned in the literature (Wilson et al. 2020) and the critical role of demography, particularly, how the age structure of a population may help explain differences in fatality rates across regions and how transmission spreads. According to WHO Regional Office for Europe (2020), 95% of the people who died from Covid-19 in the European regions are over 60, and more than 50% of all the deaths were people aged 80 years or older.

Wealth and income dimensions play a major part in driving the pattern of Covid-19 cases and deaths around the world. An important literature points out the responsibility of poverty in the prevalence of epidemics. Low-income are linked to living and housing conditions. For example, accommodation that is too small or overpopulated has been related to a high risk of infection from several pathogens, such as tuberculosis or Epstein-Barr virus (Sannigrahi et al., 2020). GDP per capita is also another aspect used in modelling health outcomes, health system performance and mortality trends (Markowitz et al., 2019).

Regarding our results, we do not find sound evidence on the effect of wealth and income determinants (GDP per capita and Poverty index) over the period considered in the analysis. Thus, our results do not bring additional evidence about the aggravating role of inequalities and social exclusion in the spreading and intensity of the epidemic. This can be partly explained by the level of aggregation of our study (NUTS2 or NUTS3 levels). If we had focused on the metropolis scale (comparison between urban districts), maybe we would have found some results confirming the importance of economic variables.

The quality of the health care system may also explain the differences between regions. For many countries in Europe, the local scale is the relevant level in public health organization. This reason clearly argues in favour of a geographic approach of the Covid-19. On this subject too, empirical studies report firstly that well-structured healthcare resources positively affect a government's capacity to deal with Public health emergencies as major epidemics (Gizelis et al., 2017). Secondly, the healthcare infrastructures also have a considerable impact on the government's ability to rapidly detect, diagnose, and report the new infections (Hogan, et al., 2018). Health care determinants reflect the Government's and regional health spending proxies by the number of hospital beds. The variable exerts a negative influence on Covid-19 prevalence (after the month of March) displaying greater susceptibility to the virus infection, confirming that regions in which the quality of health system is low are more likely to have a more significant mortality associated with Covid-

19. With a need for hospitalization in intensive care units for >15% of infected patients (Qiu et al. 2020), the number of available beds has been a critical issue in the management of the Covid-19 emergency and the death rate among areas (Vinci et al. 2020). Adjunctive pharmacologic therapies are, of course, a critical resource to face the pandemic but on the short term and as long as no vaccine is available, supportive care services determine the treatment of infected people. Over the studied period, the capacity of the medical system to treat patients with Covid-19 obviously depends on critical care beds. At the country level, resources shortening has been shown to be a critical issue when the number of COVID-19 severe cases are higher than the available resources (McCabe et al., 2020). It is also an issue on the regional scale as demonstrated by Guzzi et al. (2020) according to the availability of hospital structure resources which should be managed to limit the spreading of the disease.

Regarding different studies (Putnam, 1998; Alesina and Ferrara, 2000), education is one of the most important determinants of social capital. Education reflects an orientation towards the future by strengthening human capital and social capital for economic and social development. Schooling spreads knowledge – the basic component of human capital – and cultivates social norms, the core of social capital. Through civil education from schooling, students learn the basic standards and responsibilities in society and practice in a peer culture that shapes values such as reciprocity, respect and trust. It is for this reason that we introduce, in this study, the Education variable (Part of population aged 25-64 with tertiary education level) as a proxy of social capital. Our findings show that death rates due to Covid-19 are negatively correlated with social trust. It is reasonable to consider that social trust functions similarly to institutional trust in that a crisis intensifies the primary trust culture. People with low trust thus tend to identify negative aspects of ambiguous situations (to consider that others do not respect the rules and therefore try to bypass them, amplifying the severity of the epidemic). On the contrary, in places where a vast majority of citizens exhibits a high level of confidence in others, rules are expected to be more respected by others. They are indeed more respected by everyone, inducing a lower mortality rate. This sort of self-fulfilling process can explain the increasing coefficients over the period under study.

With this finding, we confirm that an essential aspect of epidemic spreading is citizen-to-citizen trust, an intangible asset capable of shaping the consequences of the Covid-19 phenomenon. Several sorts of trust are at stake in such a process. Top-down trust between citizens and authority figures are commonly evoked in the literature. This point has been enhanced by OECD which worries about the decline in confidence in governments and member states and underlines that during all stages of the COVID-19 pandemic trust in public institutions is vital for governments' ability to respond rapidly and to secure citizen support. But, beyond trust in institutions which are mostly national, horizontal, and local, trust also matters. Social relations, more influenced by local culture and habits, also shape the spreading of the disease, as mentioned by Edelman (2020). Indeed, people willing to engage in protective behaviours and respect lockdown rules depend on the belief that others act in the same way and, broadly speaking, on social capital, as shown by Chuang et al. (2015). In a paper examining whether each of the social capital dimensions contributes to the intention to adopt any of the health-protective behaviours during an influenza pandemic (wearing a mask or washing hands), those authors show that relational trust (relationships between the trusting person and another) is a more powerful predictor of compliance with recommended behaviours than calculative trust (the other's past behaviour), particularly in an unknown situation. The spreading of the virus could thus be less effective in places where interpersonal relations and social trust are high than in low social trust regions, as already mentioned by Habibov and al. (2017). Our results are consistent with research concluding that the pandemic tends to shape trust and solidarity between citizens and, by the way, the degree of compliance to the rules enacted by the government such as wearing a mask, maintaining social distance. This is especially true when it comes to wearing a mask, since it may cause various reactions, including mistrust, even if it is widely agreed that wearing masks is a sensible thing to do (Sunstein, 2020). Knowing that this protection against Covid-19 has been shown to be a critical factor in the control of the epidemic, one can understand that wearing it was more readily accepted in regions where people trust each other more, thus leading to a lower contagion rate and, consequently, to a lower mortality rate. Our finding confirms those of Putnam et al. (1993) who conclude that information and political decisions are not enough to ensure the success of sanitary policies. Instead, they recommend mobilizing 'social capital' in the community as an informal mean of action against the epidemic. This background help to adapt the measures to the context and to increase their effectiveness.

The global spread of Coronavirus (COVID-19) has been accompanied by a wave of disinformation that is undermining policy responses and amplifying distrust and concern among citizens. Around the world, governments are leveraging public communication to counteract disinformation and support policy. The efficacy

of these actions will depend on the way they will be integrated into open government principles, chiefly transparency, to create trust in public institutions. It is in this context that we consider the governance quality on the subnational scale as a fundamental indicator that could deeply influence the prevalence of the pandemic. Our findings confirm the hypothesis that a higher level of governance on the subnational scale reduced the death rate registered in the European regions significantly.

In the context of the Covid-19 pandemic, this type of intervention offers the dual advantage of supporting the effective implementation of emergency measures and satisfying the need for clear and definitive information. Public communication can also be deployed rapidly since, virtually, all governments have press offices and digital channels in place. These structures are especially important in contexts where pre-existing mechanisms or regulations against disinformation are inexistent or weak. In order to be effective and to foster public trust in governments, any activities conducted in this respect must be guided by the principles of transparency, integrity, accountability, and stakeholder participation set out in the OECD Recommendation of the Council on Open Government (OECD, 2017). These considerations are extremely relevant in the context of the lockdown imposed by several European countries. In response to the pandemic, several national governments, during the first wave, implemented a lockdown related to some specific territories or to the entire country. The lockdown corresponded to a set of measures that implies travel restrictions (national and international traffic) and social distancing requirements, such as closing schools, public spaces, shops, shopping malls and restaurants. Italy was the first to lockdown the entire country on the 11th of March, followed by Spain on the 14th of March, France on the 17th of March, the United-Kingdom on the 24th of March, and many other European countries. These measures are enforced to minimise the spread of the coronavirus disease transmission and reduce the peak healthcare demand, especially respiratory support with the objective to flatten the infection curve.

2.2.3 A spatial heterogeneity of the influence of the different factors

Despite the global results obtained with the previous models, it's reasonable to assume that some variable may have a positive effect in some regions, while negative effects are observable in others. The Geographically Weighted Regression (GWR) is a local estimation technique capable of coping with the spatial heterogeneity issue (Box 4). The GWR relaxes the supposed spatial stationarity in global regression (OLS, SAR, SEM, etc.) in the relationships between explanatory variables and dependent variable. Thus, it allows for the parameters to vary over space.

BOX 3

Geographically Weighted Regression (GWR)

GWR is based on locally linear regressions in order to obtain estimators at each point in space. The estimation procedure is based on a Gaussian principle in which the observations which are the closest to the regression point have greater weights than the other observations. The GWR model is formalised as follows:

$$y_i = \sum_j x_{ij} a_j(u_i, v_i) + \varepsilon_i$$

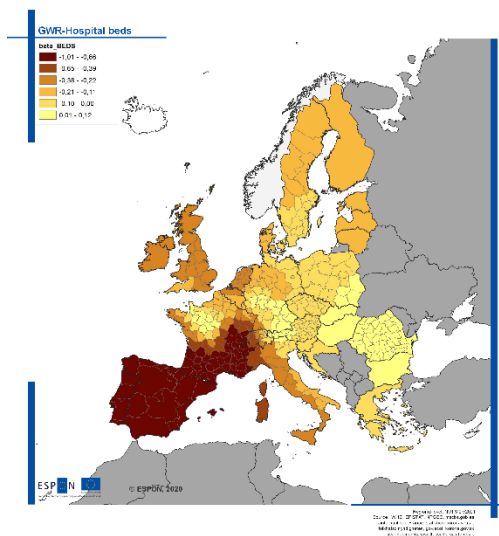
where (u_i, v_i) is the location in a geographic space of the i observation. When calibrating the GWR model, it is assumed that the observed data which are close to an "i" point have a greater influence in the estimation of the values of $a_j(u_i, v_i)$ than the data located far from i . The equation therefore measures the relations inherent to the model around each point i . In GWR, an observation is weighted with respect to its proximity to point i . The choice of weighting scheme is an important step in model specification since it implies that the observations which are closest to the location (u_i, v_i) have a greater influence over the estimated parameters of this location than the observations that are the furthest away. So, weight $W_i(u_i, v_i)$ can be considered as a continuous, ever-decreasing distance function $d_i(u_i, v_i)$. This is the Gaussian function which is used the most:

$$W_i = [1 - (d_{ij}/b)^2]^2$$

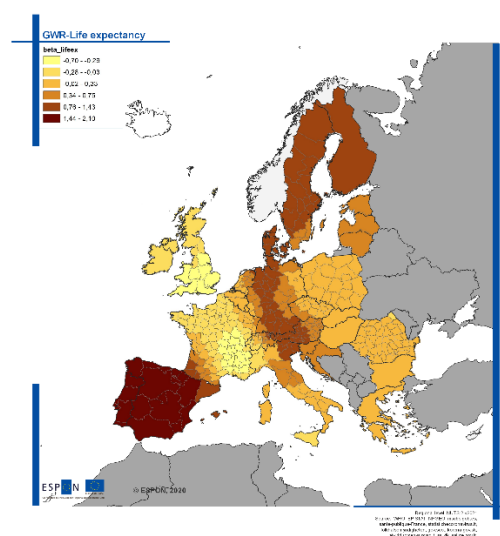
where $b > 0$ and is defined as being the bandwidth of the function or, in other words, the radius of the sphere of influence for point i .

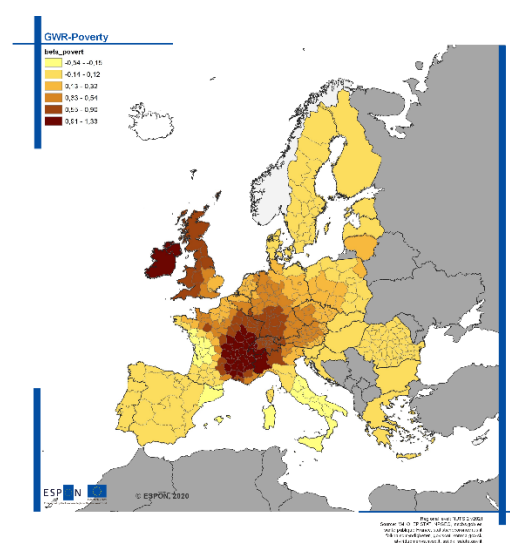
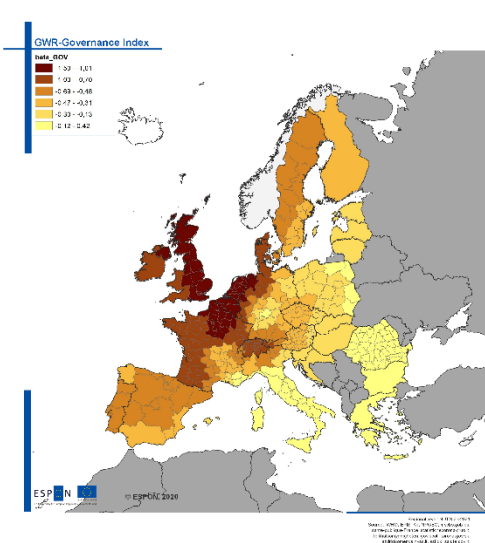
According to the results, four determinants (Life expectancy, Poverty, Hospital Beds, Governance) offer a heterogeneous effect on the Covid-19 Death Rate registered in the European regions. The results are summarised in the following figures. Generally speaking, we observe an East/West differentiation logic.

Map 7: GWR-Hospital beds



Map 8: GWR-Life expectancy



Map 9: GWR-Poverty**Map 10: GWR-Governance Index**

The visualisation of the GWR model's coefficients made possible by this method highlights the spatial variations of the parameters. GWR enables us to evaluate where and how the relation between selected explanatory variables and the dependent variable are the highest. From the figures below, we can observe that the geographic distribution of the estimated coefficients is not random.

The map showing the effects of the number of beds per 100,000 people suggests a negative association with mortality due to the Covid-19 pandemic. The magnitude of the coefficient varies considerably over space. It is strongly high in Portugal, Spain, the south and the east of France. This relationship is not surprising since the number of hospital beds is lower compared to the German regions, for example. This suggests the importance of accessibility to care beds in the fight against the pandemic. This finding is consistent with that of Bauer et al. (2020).

Life expectancy appears to have a positive influence over the severity of the coronavirus disease particularly in the Spanish and Portuguese regions (see Figure 8) and in a slightly lesser extent in Germany, Austria, the Netherlands and Sweden. It can be assumed that in the regions where life expectancy is higher, the elderly population is more present.

As illustrated in figure 9, poverty is a substantial factor in the description of the geographic distribution of the COVID-19 incidence rates in several regions of France, Italy, Germany, Ireland and the UK. Poor people – with a low level of education – are more likely to have a low level of health literacy and are therefore likely to increase the transmission of Covid-19. In effect, understanding the responsibility of complying with the recommended measures such as social distancing is crucial to prevent the spread of the virus across the regions. This aspect is documented in Singu et al. (2020)

The governance quality is an influential factor in the explanation of the disease's incidence rates across the regions in Europe (i.e., France, Germany, Belgium, Netherlands, the UK). Local government quality as a proxy of capacity to deal with Public health emergencies such as the Covid-19 outbreak contributes to reduce the potential mortality due to Coronavirus. Restrictive measures such as lockdown are a manifestation of the measures taken by regional governments to minimise the transmission spreading of the new coronavirus and to contain the peak healthcare demand.

2.2.4 Has the lockdown been effective?

We conducted an additional analysis with Ordinary Least Square Regression (OLS) to determine whether the lockdown measures effectively minimise the spread of the Covid-19 transmission or not. Based on the results obtained with the spatial model, we ventured the hypothesis that the effectiveness of the restriction measures depends on the governance quality on the local scale (government principles, chiefly transparency, to create trust in public institutions).

BOX 4**Ordinary Least Square (OLS) Model**

The OLS model we consider is detailed in the following equation:

$$Covid\ Death\ rate_i = \alpha_0 + \alpha_1 Lockdown_i + \alpha_2 Gov_i + \alpha_3 Lockdown_i * Gov_i + \alpha_i Control\ Variables + u_i$$

The dependent variable indicates the Cumulative Covid19 death rate in region i during week t over-population, multiplied by 10000, with $i=1, \dots, 380$ regions and three dates for our analysis.

Lockdown is a dummy variable equal to 1 for European regions where a full lockdown has been voted by the government, 0 otherwise.

Gov_i is the measure of institutional quality on a regional scale.

We add the interaction term *Lockdown_i*Gov_i* to the model since we assume that the effect of the lockdown on the mortality rate due to Covid19 is different concerning the regional government quality.

The regression controls for all the other variables considered in the spatial regression (Table 3).

The results of this regression are shown in table 3. The empirical evidence shows that the lockdown measures adopted by several European countries have been significant since they reduced cumulated deaths. Indeed, both the coefficient and the significance level of the variable “Lockdown” increase over time since the adoption of the measures, exhibiting its real effectiveness in the medium-long term.

It is interesting to note that the interaction term enters with a negative sign and a high significance level in all the regressions, with a relatively high coefficient. The econometric findings would indicate that the effect of the lockdown measures on deaths is different depending on different values of “government quality”. More specifically, for regions with very weak government quality.

Table 3: The effect of the Lockdown and government quality on the mortality rate due to Covid19

	March 31st	May 31st	July 31st
Lockdown	Negative	Negative	Negative
Governance	Negative	Negative	Negative
Lockdown Governance	Negative	Negative	Negative

2.2.5 Advantages and limitations of spatial techniques

The relations between values observed in neighbouring territories have long been a focus for geographers. Waldo Tobler summed up the problematic in a statement often referred to as the first law of geography: “Everything interacts with everything, but two nearby objects are more likely to do so than two distant objects”. The availability of localised data, combined with the spatial statistics procedures now pre-programmed into multiple statistical software tools, raises the question of the way this proximity can be modelled into economic studies. The use of spatial econometrics tools has become particularly popular in studies in recent years (Arbia and Paelinck, 2003; Le Gallo *et al.*, 2003).

The motivation for using spatial econometrics tools is obvious: taking regional units as “isolated islands” (e.g. by using non-spatial estimation techniques) may lead to the wrong results, and in the presence of

spatial effects in regression analysis, the OLS estimations may be biased or inaccurate¹. Spatial autocorrelations of residuals with spatial data, i.e. dependency between nearby observations, are quite common. This dependency in the observations may either impair the OLS method (the estimators will be unbiased but less precise, and the tests will no longer have the usual statistical properties), or produce biased estimators. If the model omits an explanatory variable spatially correlated to the variable of interest, then omitted variable bias is said to occur. In addition, comparing multiple spatial econometric models leads to question the uncertainty of the data-generating process, which is never known, and verify the robustness of the results.

As spatial autocorrelation is measured based on a comparison of the value of an individual variable with that of its neighbours, the definition of the neighbourhood will have a significant impact on the measurement of spatial autocorrelation. Codifying the neighbourhood structure, the larger the planned neighbourhood is, the greater the number of neighbours is considered, and the greater the probability that their average will be closer to the population's average is, which may lead to a relatively low value for spatial autocorrelation.

A change in scale can also have implications when measuring spatial autocorrelation. The term MAUP (Modifiable Areal Unit Problem) introduced by Openshaw et al. (1979) is used to describe the influence of spatial breakdown over the results of statistical processing or modelling. Arbia *et al.* (1996) speak of a “second law of geography”.

More precisely, the irregular forms and limits of the administrative levels that do not necessarily reflect the reality of the spatial distributions studied are an obstacle to the comparability of the irregularly distributing spatial units². According to Openshaw (1984), MAUP is a combination of two distinct but similar problems:

- The scale problem stems from a change in the information generated when a set of spatial units is aggregated to form smaller and larger units for the needs of an analysis or due to data availability issues;
- The aggregation problem or zoning stems from a change in the diversity of information generated by the various aggregation schemes which are possible on the same scale. This effect is a characteristic of administrative partitioning and increases the scale effect.

The choice of the aggregation level is thus of paramount importance in any spatial econometric analysis. Some geographers recommend adopting a multi-scale approach to study the diversity of spatial aspects within a single phenomenon. However, in general, there is no solution to the MAUP problem. This aspect, in some way, can limit the analysis.

¹ For example, in the case of the European regions, we can expect that the infection rate of a region will be influenced by those of the neighbouring regions. Similarly, a COVID-19 outbreak in a given region may be correlated with outbreaks in neighbouring regions if unobserved variables display spatial dependence.

² For instance, it is perfectly possible, when analysing the economic convergence process of a set of regions, to observe convergence on the European NUTS-2 scale, and, conversely, divergence on another scale (e. g. the NUTS-3 scale).

3 Overview of policy answers to Covid-19 on the regional/local scale

3.1 Typology of the measures

3.1.1 General context

In the first months of 2020, COVID-19 has affected the lives of millions of people around the world. The pandemic has led national and local governments to operate in a context of uncertainty, and have to deal with difficult trade-offs given the health, economic and social challenges.

Beyond the health emergency and the human tragedy it represents, the disease triggered a social, human and economic crisis. The severe lockdown and social distancing policies put a stop on global economic growth. This led to a declining economic activity, a contraction of consumption and massive job losses.

In the second quarter of the year 2020, still marked by COVID-19 containment measures in most Member States, seasonally adjusted GDP decreased by 12.1% in the eurozone and by 11.9% in the EU, compared with the previous quarter, according to a preliminary flash estimate published by Eurostat, the statistical office of the European Union. Among the Member States, whose data are available for the second quarter of the year 2020, Spain (-18.5%) recorded the highest decline compared to the previous quarter, followed by Portugal (-14.1%) and France (-13.8%). Lithuania (-5.1%) recorded the lowest drop (Eurostat, 2020).

Regions and cities had to face food insecurity among vulnerable populations, overall declining consumption, increasing numbers of small and medium companies at risk of bankruptcy, high unemployment rates, and declining public revenues. Consequently, regional and local authorities found themselves in the front line of the fight against the pandemic. They had to take measures to cope with the pandemic and the subsequent crisis without having a pre-defined plan to tackle such situations. Furthermore, each city and region found itself in a particular and unique situation that required tailored responses to face the variegated consequences of the pandemic. Hence, a myriad of first policy responses have been taken by cities and regions throughout Europe during the first wave of the pandemic, and the most inspiring measures have already caught the eye of the media, policymakers and researchers.

However, previous studies dealing with public policy against COVID-19 mostly focused on analysing and comparing policy measures on a national scale (e.g. OECD, 2020³; European Centre for Disease Prevention and Control, 2020⁴; Eurofund, 2020⁵ etc.), whilst those taken on the regional and the local scale were rather overlooked. A few exceptions include reports from OECD and UN, which have greatly advanced the knowledge on first policy answers on the regional and the local scale. These reports paid a special attention to measures taken by urban areas, considering that cities were and still are in the front lines of the Covid-19 crisis (OECD on City Policy responses⁶; UNESCO on learning from cities' responses to Covid-19⁷; UN

³ OECD, "The Territorial Impact of COVID-19: Managing the Crisis across Levels of Government" (OECD, June 16, 2020), <https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/>.

⁴ European Centre for Disease Prevention and Control, "Data on Country Response Measures to COVID-19," March 11, 2020, <https://www.ecdc.europa.eu/en/publications-data/download-data-response-measures-covid-19>.

⁵ Eurofund, "COVID-19: Policy Responses across Europe" (Luxembourg: Publications Office of the European Union, June 24, 2020), <https://www.eurofound.europa.eu/publications/report/2020/covid-19-policy-responses-across-europe>.

⁶ OECD, "Cities Policy Responses" (OECD, 2020), <https://www.oecd.org/coronavirus/policy-responses/cities-policy-responses-fd1053ff/>.

⁷ UNESCO, "Urban Solutions: Learning from Cities' Responses to COVID-19," 2020, <https://en.unesco.org/urban-solutions-Learning-from-cities-responses-to-COVID19>.

on a Policy Brief on COVID-19 in an Urban World⁸), whilst regional policies have mostly been ignored. Overall, great emphasis has been put by various organisations on the collection of city responses to the ongoing crisis. However, systematic comparative approaches that facilitate cross-regional and cross-city policy learning have not been conducted yet. Consequently, there is still a need for having an overview on the nature of local and regional policy answers across the EU, as well as a need for a proper understanding of territorial commonalities and differences in tackling the consequences of the pandemic.

Consequently, the aim of this second part of this ESPON project is to provide quality evidence of policies implemented by EU's cities and NUTS3 regions during the first wave of the pandemic. This research work aims at assessing whether EU regions have taken steps to reinvent themselves and accelerate the transition to a green, sustainable, digital and inclusive Europe or not. To what extent did European regions and cities take policy measures that could be considered as resilient? Being resilient in such circumstances is particularly important as the current crisis brought back to the surface, not only significant challenges but also new opportunities. Furthermore, this research work addresses two distinct objectives: a) delivering an overview of first policy responses on the regional and the local scale across the EU by developing a new typology of policy measures based on the latter's nature (resiliency) and temporality; b) unveiling the differences and commonalities (from one type of territory to another) in tackling the consequences of the pandemic. It is possible by exploring three dimensions regarding the causes of variation in incidences and the nature of the measures taken i) the regional GDP level, ii) the Covid-19 mortality rates, and iii) the type of territory (capital city, regional city, predominantly urban region, intermediate region, predominantly rural region).

This systematic approach is further justified by the fact that there are lessons to be learned from comparing the approaches taken by various types of regions and cities across the European Union. Furthermore, it is worth mentioning that, overall, the focus of this research work was not set on the basis of restriction measures, but rather on actions designed to ease the impact of restrictions. Hence, the results could be translated into a potential guideline for future regional and urban policy strategies during the second wave of the pandemic, as well as during the recovery phase of the crisis. Methodological aspects of this second part of the study are reported in the Appendix section.

A total of 477 local and regional policy measures have been collected and analysed following the 35 case studies. Results show that, overall, during the first wave of the pandemic, the policy measures taken by local and regional authorities are overwhelmingly defensive, with mitigating and compensating measures accounting for 73.6% of all the measures taken (Table 4).

Table 4: Frequency of the measures according to their nature

Type of measure		Number of measures	Share (%)
Defensive	Mitigate	351	73.58
	Compensate	50	10.48
Offensive	Circumvent	65	13.63
	Exploit	11	2.31
Total		477	100.00

Source: first 35 factsheets

However, significant differences can be noticed between public action areas (Figure 1). Highest shares of adaptive and transformative strategies concern the 'daily way of life and work' area, including culture, leisure, education, mobility and public administration. Measures taken in this area display the highest share of circumventing initiatives, suggesting that regions and cities have mostly aimed at continuing daily activities *via* alternative ways that circumvent the negative effects of the pandemic and lockdowns. A large majority of

⁸ UN, "Policy Brief: COVID-19 in an Urban World," 2020, <https://unsdg.un.org/resources/policy-brief-covid-19-urban-world>.

these measures involve turning to online and digital solutions. A still significant, but lower share of offensive and proactive measures was found in the 'support to economic actors and recovery' area, in which the highest share of exploiting measures is to be found (5%).

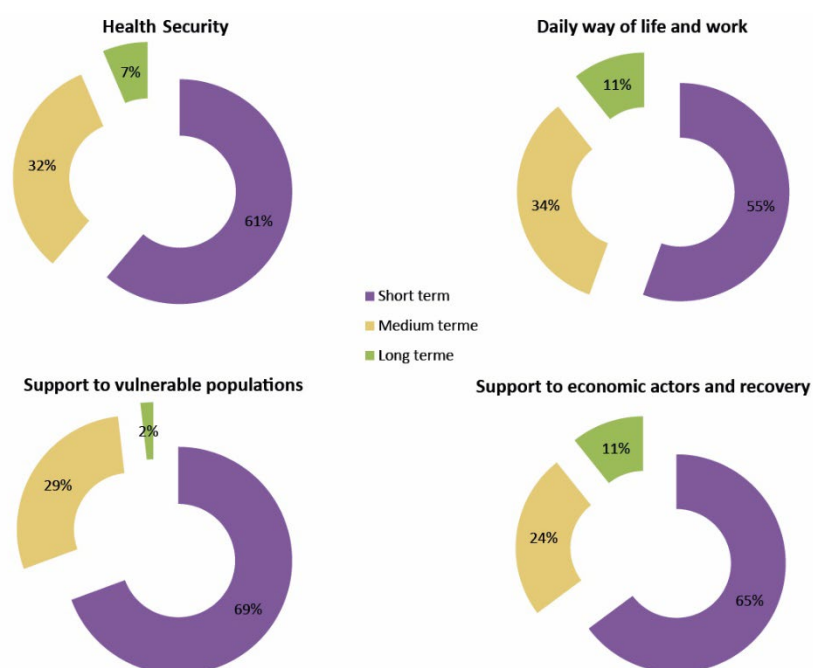
On the contrary, the offensive measures display the lowest shares in the 'support to vulnerable populations' area, suggesting that, despite significant mobilisation to help the poor, the homeless, vulnerable women, migrants and minorities, few of these policy measures are fundamentally transformative and, hence, few of them are expected to last.

The temporal perspective of local and regional policy measures further suggests that 'economy' and 'daily life and work' are the areas that are most likely to undergo significant changes in the long run (Figure 2). They display the highest shares of policy measures that are aimed to be held in places in the post-pandemic era (though only 11%). On the contrary, measures to support the vulnerable populations are overwhelmingly short and medium term-oriented.

Figure 1: Frequency of local and regional policy measures classified according to their nature and sector (N=477)



Figure 2: Measures classified according to their nature and their temporal perspective



3.1.2 Public Health Security – overview of the local and regional policy measures

Overall, the measures aiming at increasing the health security during the COVID-19 pandemic underscore the general answer, which consisted in easing the first effects of the shock. Two major outcomes emerge at first glance: a) the vast majority of the measures in this category, regardless of the territorial classification used for this study, aims at mitigating the impact of the pandemic, with very few actions addressing more ambitious strategies (compensating or circumventing); b) most of these measures are short-term orientated, designed to cover the period of the pandemic exclusively, with limited repercussions afterwards.

Therefore, these actions were taken for the most part during the initial weeks, in March, April or May, and covered specific strategies for reducing the spread of the virus and the protection of the inhabitants (cleaning and disinfection of public spaces and public transport vehicles, facemasks becoming mandatory in public space). Health systems were of great importance during the first weeks of the pandemic; they benefited from several dedicated measures like the purchase of supplementary medical equipment (Calabria, Kaliski, Braila), or various reorganisations of health care services (Bordeaux, Cluj, Skane). Most of the compensating measures focus on the reduction of the devastating impact of the pandemic on healthcare systems. Therefore, the most common actions undertaken by policy-makers call for recruitment of additional medical staff (Skane, Havelland, Dalarnas), new or temporary hospitals (Bordeaux, Cluj, Mantova, Cuenca). These measures cover the whole European Union, regardless of geographical position, type of region or initial impact of COVID-19, being instead an instantaneous, responsive, strategy that particular territorial units felt compelled to adopt, most likely based on an evaluation or prognosis of the virus spreading.

Figure 3: Examples of measures taken by European cities and NUTS-3 regions during the first wave of the pandemic in the Health security area

Mitigating	Compensating	Circumventing	Exploiting
Cleaning/Disinfection of public spaces	Tensile structures / new temporary hospitals/ new clinics / facility extension for COVID-patients	Development by Region Skåne (SE) of a self-assessment online test to be used by the population to test for cold symptoms.	Financing the University of La Mancha (30,000 EUR) to study the properties of local purple garlic as an anti-inflammatory that could help in the treatment of Covid-19 (Cuenca, ES).
Mandatory use of masks			
Increasing testing capacity	(Support for) recruitment of medical staff/ volunteers in the medical sector	Remote follow up of patients – using new digital services (the patients themselves send their values via a web application that is followed up by healthcare professionals) (Skåne, SE).	
(Facilitating the) purchase of protective equipment			
(Stimulating) local production of protective equipment			
Creation of a crisis management unit		Introducing medical teleconsultation and/or e-prescription (Warsaw, PL; Bordeaux, FR)	

Source: first 35 factsheets

It is worth noticing that several regions adopted slightly innovating measures, which denote a more proactive approach, e.g. teleconsultations and online follow-up of patients (Bordeaux, Skane), self-testing for non-essential consultations (Skane). These measures are rather circumventing, trying to continue the provision of medical services while ensuring a proper responsive strategy to the COVID-19 pandemic.

The existence of a sole measure classified as ‘exploiting’ is particularly interesting. Given the nature of health security measures, this type of action denotes not only an innovating approach and a proactive strategy but also an enterprising and capitalising method of local potential. The measure was undertaken by Cuenca authorities who awarded a 30,000 EUR grant to the University of La Mancha in order to study the properties of local purple garlic as an anti-inflammatory that could help in the treatment of COVID-19. While the measure does not compete with the massive investments in medical treatments and the vaccine industry, which were deployed last year, it shows an ingenious strategy to take advantage of local resources. The investment is far from being indispensable to Cuenca authorities and could prove to be extremely profitable if successful. In the worst-case scenario, this measure would represent an investment in local HEI. Its replicability, its high profitability in case of success, and its proactive strategy make this action very susceptible for replication.

3.1.3 Daily way of life and work – overview of the local and regional policy measures

The local and regional policy measures taken during the first wave of the pandemic suggest that the “daily way of life and work” area will undergo significant transformative changes in the future. Some of these changes are most probably going to last and significantly impact culture, leisure, education, public administrations and mobility during the post-pandemic period (Table 5). First policy answers also suggest that some cities and regions have taken the opportunity to enhance and stimulate positive transformations, by adopting offensive and bold strategies aimed at sustainable and smart societal transformation, whilst others did not.

The compensating and circumventing measures in the area of culture and leisure were very diverse. Some cities and NUTS3 regions have circumvented the closure of cultural events by enhancing online cultural services, such as online virtual tours of zoos (Warsaw-PL), museums (Leipzig-DE, Cuenca-ES), online streamed cultural programs (Bologna-IT, Cuenca-ES) and performances of plays and classical concerts (Warsaw-PL). Other local authorities physically brought small cultural events in the neighbourhood to allow

the vulnerable populations to enjoy culture from home (Goteborg-SE), or help all the residents overcome isolation difficulties where lockdowns have been implemented (Bologna-IT).

Direct financial support (including grants) for cultural associations, institutions and individual artists, along with financial compensation for the organisers of cultural events have also been widely reported: some public authorities delivered direct financial support to relief financial difficulties (Ghent-BE), whilst others launched calls with new regulations enhancing innovative forms (including digital) which enable everyone to enjoy culture (Goteborg-SE, Warsaw-PL).

Table 5: Examples of policy measures taken in the “daily way of life and work” area, classified according to their assumed temporality

Short term	Medium term	Long term
<ul style="list-style-type: none"> • Adaptation of urban public transport frequency and other services. • Contribution to companies that incentivise employees to go to work by bike. • Transforming neighbourhoods into culture venues that host small theatre performances, mobile storytellers, monologues, thus bringing culture to the vulnerable populations' home. 	<ul style="list-style-type: none"> • Offering online educational resources to families with children, to keep them entertained, educated and physically exercised without leaving the house. • Using car lanes to create temporary bike lanes & more space for walking in the most frequented streets. • Municipal grants temporarily changing their regulations to encourage (cultural) projects opened up to digital and other new forms of expression. 	<ul style="list-style-type: none"> • Long-term plan to digitalise the institutions (e.g. smart working, videoconferencing, new functionalities of the IT system for human resources management, adopting management software based on Open Source Database architecture, etc.). • New definitive bike lanes and increased walkability. • Creation of opportunities for experiencing online culture (museum organising digital resources, libraries borrowing digital books). • Investments in IT functionality for schools (fibre optic data connection, Wi-Fi connection inside schools, internal data security for schools).

Source: authors based on Factsheets

Table 6: Examples of measures in the “daily way of life and work” area classified according to their nature

Mitigating	Compensating	Circumventing	Exploiting
Financial support to cultural workers and cultural organisations during the pandemic;	Transforming neighbourhoods into culture venues that host small theatre performances, mobile storytellers, monologues, etc. (Bologna, IT);	Creation of opportunities for experiencing online culture (museums organising digital resources, libraries borrowing digital books) (Göteborg, Leipzig, Cuenca etc.);	Investing in a greater number of projects related to the film industry (Göteborg);
Exemption from rent for artists;	Aid package for actors in the social, cultural and economic life intended to cushion the consequences of the corona crisis and to gradually reactivate city life;	Online guided tours for natural attractions, parks, gardens, green routes, zoos (Lisbon, Warsaw);	Municipal grants temporarily changing their regulations to encourage (cultural) projects opened up to digital and other new forms of expression (Göteborg);
Exceptional advance payments for cultural agents;	Call for constituent municipalities aimed at promoting art, exhibitions, and museums;	Performances of all cultural groups to be recorded and uploaded online (Cuenca, ES);	Support for cultural digital actions (Rhône);
Almost free advertising on LCD screens in trams for foundations, associations and those organising/conducting educational or cultural activities (Warsaw, PL).	Initiation of consultations for building a provincial agreement for culture during the pandemic time;	Online cultural programme proposed by theatres, museums, and other cultural centres (Warsaw);	Fast track funding for art projects reaching out citizens digitally (Amsterdam);
Financial support for local arts and the culture sector.	Light construction interventions in schools (rearranging the interior spaces) and buying new furniture to meet anti-COVID measures.	Traditional programmes aiming at the promotion of local artists online (Cuenca, ES);	Extra, shortened procedure for applying for a play street.
Financial support for cultural events that were cancelled.	Investment in new anti-Covid-19 furniture and digital technological equipment for schools;	Investments in IT functionality for schools (Amsterdam, Mantova);	
	Providing all schools with support through the Ghent Education Centre;	Offering online educational resources to families with small children to help and keep them entertained, educated and physically exercised without leaving the house (Bologna, IT);	
	Renting additional facilities for schools to meet distancing requirements.	Make digital educational platforms more accessible;	
		Training courses for teachers related to the use of digital tools and remote teaching methods (Warsaw);	

Source: authors based on Factsheets

Interestingly, in terms of urban mobility, the pandemic brought to the surface old differences between traditional transport planning and sustainable urban mobility planning. Some cities and NUTS3 regions (e.g. Warsaw-PL, Iasi-RO) only *focused on traffic issues* by taking regular disinfection of public transport vehicles, limiting the maximum number of passengers in public transport vehicles, closing the buses' front door to passengers until further notice to protect the drivers, etc. These measures have made public transport less attractive and could have negative consequences on the modal share of public transport in the long run. Others instead (e.g. Skåne-SE) chose a different approach and *focused more on people* by accompanying traffic reduction measures with customer-oriented measures in organising public transport: adaptation of pricing schemes to the pandemic, and rapid delivery of innovative services such as online applications that show in real time the number of free seats on buses and trains.

Furthermore, some cities took the opportunity to accelerate the transition towards active and clean mobility (Bologna-IT, Zaragoza-ES, Gent-BE), while others did not (Iasi-RO). Those who did focused on one or more

of the following measures: (1) providing new definitive or temporary infrastructure for bicycles and increasing walkability (Ghent-BE, Zaragoza-ES); (2) conducting marketing campaign to encourage biking (Bologna-IT), (3) offering financial incentives to companies which encourage their employees to go to work by bicycle (Bologna-IT).

Overall, measures targeting the “daily way of life and work” area display the highest share of medium and long-term impact measures (45%) as well as the highest share of offensive measures (38%), among the four sectors of public action (Figure 1 and Figure 2). This suggests that most of the long-lasting changes are to be expected in the “daily life and work” area.

3.1.4 Support to vulnerable populations

Just like health security measures, the actions undertaken in this category are overwhelmingly considered as being mitigating (91%) and having a short-term perspective (69%). The most common measures involve actions to support the homeless, seniors, unemployed people, vulnerable families and disabled people. While the actions fall under the same category, each vulnerable group has specific preventive or institutive procedures.

The measures in favour of the homeless deal almost exclusively with food as a support and, very commonly, shelter (Bologna, Zaragoza, Iasi, Leipzig), they focus on a short-term or mid-term perspective, the main strategy being to mitigate the initial impact of the virus and its immediate spread. The measures dedicated to the older and disabled people are quite the same, encompassing actions such as home delivery services (Zaragoza, Bologna, Guadalajara, Bordeaux, Gorj), the creation of dedicated helplines (Bologna, Bordeaux, Göteborg, Poznań, Zaragoza), or dedicated public transport vehicles (Iasi). The unemployed were granted financial aids (Cuenca, Calvados, Hannover) or online training courses (Skane).

Table 7: Examples of measures to support vulnerable populations classified according to their temporal perspective

Short term	Medium term	Long term
Accommodation and hot meals for the homeless	Corona helpline for people feeling lonely or under psychological stress due to the exceptional situation	Computers for vulnerable families with young children
Vouchers for those who are in serious economic difficulty to buy food, personal and home hygiene products.	Phone line offering digital support for people aged 65 and over	Providing tablets to disabled people
Protective masks for people in need	Building a bridge between people who want to offer their help and people in need.	Launch of online solidarity platforms.
Activation of the “heatwave” plan to ensure the follow-up of isolated people.		

Source: authors based on Factsheets

Table 8: Examples of measures to support vulnerable populations classified according to their nature

Mitigating	Compensating	Circumventing
Launch of a solidarity network of volunteers collecting donations and goods for the most vulnerable citizens.	Initiative called "Culture to the neighbourhood" aimed at reducing loneliness among the elderly by allowing them to "enjoy live music from their window or balcony" (in 50 residential areas) (Goteborg, SE).	Launch of online solidarity platforms (Calvados, Amsterdam).
Financial aid for vulnerable people		Launch of a social TV programme to "promote solidarity fundraising in favour of the most fragile people in Bologna and of three city public hospitals" (Bologna).
Protective equipment for vulnerable people.	Supplementary employees for services aimed at vulnerable populations.	Creation of a Labor Pact steering group to support people who have lost their job and need help to find a new job as quickly as possible (Gent).
		Organising "Meeting points on Fb" in different areas of Goteborg (aimed at seniors) (Göteborg).
		Collecting and sharing free online training opportunities for the unemployed (Skane).

Source: authors based on Factsheets

While almost all actions are generally defensive, there are several measures and types of measures which stand up for their mid-term or long-term approach. These measures represent positive examples of proactive strategy regarding the support to vulnerable populations in case of pandemic:

- Digital-based measures; the digitalisation of several services, functions and utilities proved to be highly efficient for the vulnerable populations, regardless of the type of measure. Most examples cover tablets, computers or various hardware improvement for digital access (Rhone, Calvados, Bordeaux), online training courses (Emsland), online platform for solidarity solutions (Nièvre, Calvados). Their impact is immediate; their replicability is relatively smooth, and represent long-lasting tools, which make them imperious during a pandemic-like shock. Furthermore, the measures, while designed for fighting the virus, they also contribute to the reduction of digitalisation drawbacks noticeable among vulnerable populations throughout the European Union.
- Socialising measures; one of the most encountered psychological distress among the citizens during the lockdown was social alienation. It had severe repercussions upon the vulnerable populations, who were forced to overcome a supplementary hurdle. Therefore, a series of measures designed for fighting social alienation among the vulnerable populations stand up for their extreme appropriateness. They both originate from Goteborg and represent solutions which are easy to replicate: communication support to vulnerable people and online meeting points.

3.1.5 Support to economic actors and recovery

The area measures in support of the economic actors and recovery have been dominated by measures aimed at helping small and medium companies to overcome the crisis.

Measures taken by the local and regional authorities have been defensive in most cases (85%). Mitigating measures are commonly dominated by fiscal measures aimed at relieving small and medium companies of financial stress. Most of them aim at postponing, reducing or cancelling various local taxes and municipal rents and have been taken by all the cities included in this study. On the other hand, the public authorities which contemplated a compensating strategy wanted to regain the pre-crisis balance by taking measures such as planning massive investments in public works to relaunch the economy, support to financial institutions to raise the number of loans granted to companies, or give bars and restaurants the right to extend their outdoor areas without any charge.

Around 11% of the measures can be considered as long-term measures aiming at being effective right away and beyond the pandemic period (Figure 2). Also, around 15% of these measures could be considered as circumventing or exploiting, suggesting that some of the local authorities saw new opportunities and took steps to adapt actively and even to exploit them sometimes (Figure 1). Some local authorities have mobilised local staff and provided companies and entrepreneurs with consultancy so that they could find the right support and explore every existing opportunity (e.g. Göteborg-SE), whilst others offered them financial support for the purchase of external consultancy so they can adjust operations and ensure long-term survival on global markets, through digitalization, export subsidies for new markets, and implement a green transition (e.g. Skåne-SE). Interestingly, some of the exploiting measures originate from rural, peripheral regions that launched tourism marketing campaigns to attract tourists from neighbouring metropolises. Following such a campaign, the Cuenca Province from Spain managed to increase the number of tourism arrivals by 23% in July 2020 compared to the same period the previous year.

Table 9: Examples of measures to support economic actors and recovery classified according to their nature

Mitigating	Compensating	Circumventing	Exploit
Compensation for the loss of income of self-employed people or freelancers	Logistical support for opening new distribution points	Providing training courses to enhance the companies' digitalization	Financial support to companies for the purchase of external consultancy so that they can reinvent their products / ensure long-term survival / find new markets
Financial aid for constituent municipalities	Planned investments in public works to re-launch economy	Organising virtual B2B (business-to-business) or B2C (business-to-consumer) events for local businesses	Promoting specific economic sectors to exploit the new opportunities created by the pandemic (e.g. proximity tourism in rural areas)
Fiscal reliefs (on rents, taxes, fees)	Support to financial institutions to rise the number of loans granted to companies	Grants/Subsidies to help businesses install hardware and software required for teleworking	Call for a study to find out which areas of economy will be most dynamic during the next two decades so that the city/region can best position itself in the global market.
Absence of legal actions against companies to regain various rights	Extension of the outdoor areas in bars and restaurant (for tables and chairs) without any charge.	Launch of an online, tax free platform (B2C) for restaurants, to connect them with clients	Creation of a regional vehicle to boost investment in sustainable economic development (of Invest-MRA, Amsterdam).
Providing consultancy to companies regarding urgent issues		Support for the conversion of local accommodation units into long-term rentals	Programme dedicated to the recovery phase: smart mobility, circular economy and digital city (Amsterdam).
Reducing the average period of payment to suppliers so that companies can have more liquidity.		Using the Living Lab concept to co-create solutions for the gastronomy sector.	

Source: authors based on Factsheets

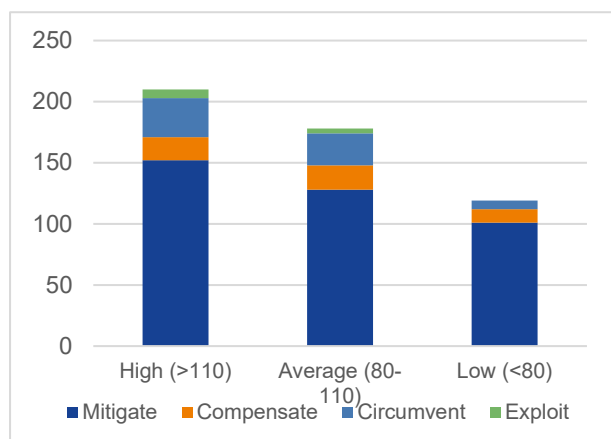
3.2 Understanding commonalities and differences in tackling consequence of the pandemic

The 477 measures taken by the 35 territorial entities included in this study have finally been analysed to determine whether their incidence and nature are significantly associated or not with the 1) GDP per capita, 2) Covid-19 mortality levels and 3) type of territory.

3.2.1 Incidence of first policy responses for each regional GDPPC

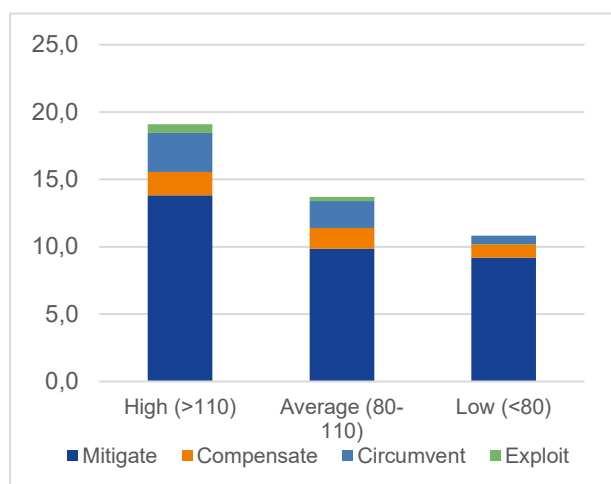
Results issued from our exploratory analysis show that both the incidence and the nature of the measures taken by the local/regional authorities are significantly associated with the GDP per capita of the corresponding NUTS3 region. NUTS3 regions and cities from NUTS3 regions with a GDP per capita higher than 110% of the EU 27 average took, on average, two times more measures than their counterparts whose GDP per capita is lower than 80% of the EU average (Figure 4 and Figure 5). Further research is needed to determine whether the pattern is due to the fact that the rich have been hit by the pandemic harder, and hence more measures were needed to help them cope with the shock, or whether the pattern is rather explained by their greater financial capacities and creativity.

Figure 4: Total number of policy measures for each territory



Total number of policy measures taken by cities/NUTS3 regions classified according to the level of GDPPC (EU27=100) of the corresponding NUTS3 region. Data computed for a number of 35 regions/cities (11 with high GDPPC, 13 with average GDPPC, 11 with low GDPPC)

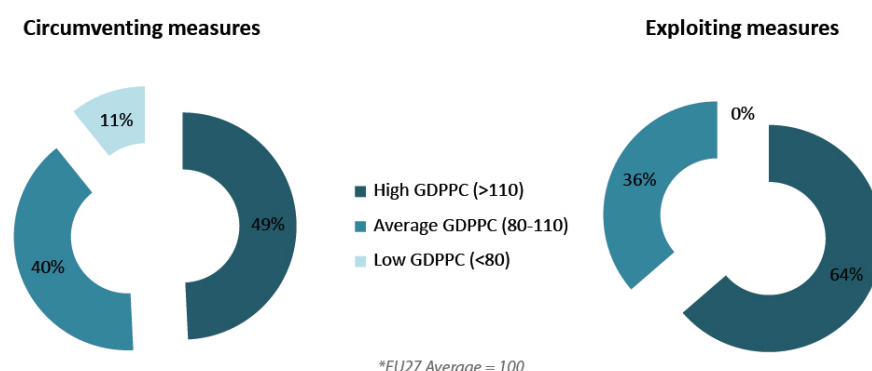
Figure 5: Frequency of policy measures depending to the GDPPC level



Frequency of policy measures depending on the GDPPC level (EU27=100) of corresponding NUTS3 regions (average no of policy measures per region/city). See also the Appendix section.

Rich regions and cities (GDPPC > 110% of the EU27 average) account for almost half of the circumventing measures (49%) and almost 2/3 of the exploiting measures (63%) (Figure 6). However, they only represent 1/3 of the 35 territorial entities included in this study. Interestingly, we do not identify any exploiting measure in region/cities where incomes are low (GDPPC less than 80% of the EU average). This suggests that, although rich regions might have been most severely impacted by the crisis, they are also those which are the most capable of adapting and of reinventing themselves for the post-pandemic world. Hence, in the absence of efficient place-based policies, the current crisis is most probably going to increase territorial inequalities.

Figure 6: Most resilient measures



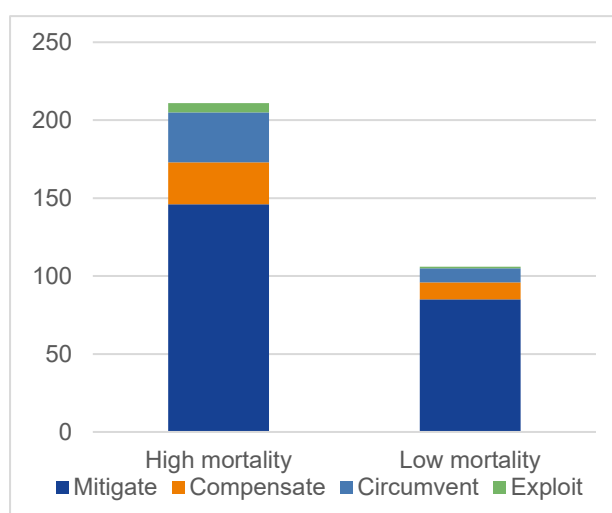
Most resilient measures (circumventing and exploiting) occur in regions with higher levels of GDP per capita

* Source: fact sheets and EUROSTAT (nama_10r_3gdp). * Data computed for 11 high GDPPC regions, 13 Average GDPPC regions and 11 low GDPPC regions.

3.3 Incidence of first policy responses depending on the COVID-19 mortality levels

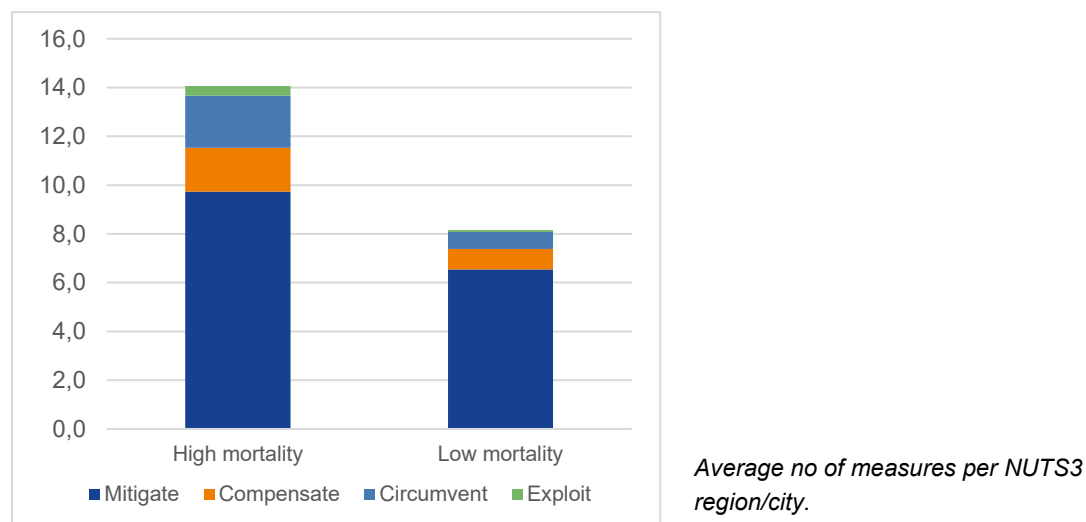
Regions that experienced high mortality levels during the first wave (> 12 deaths/100,000 inhabitants) were significantly (almost two times) more active in taking on local policy answers. Furthermore, they add up 77% of the most resilient measures (circumventing and exploiting ones). The explanation for the low incidence of offensive/pro-active measures in regions where mortality is low, compared to those where it is high, is subject to further research. However, one may hypothesise that the areas where the mortality rate is high mostly correspond to those having a higher GDPPC, or that profound shocks enhance creativity and the emergence of more adaptive and transformative initiatives.

Figure 7: Number and nature of local and regional policy measures according to the mortality level



Computed for 15 NUTS3 regions and cities where mortality is high, and 13 NUTS3 where mortality is low.

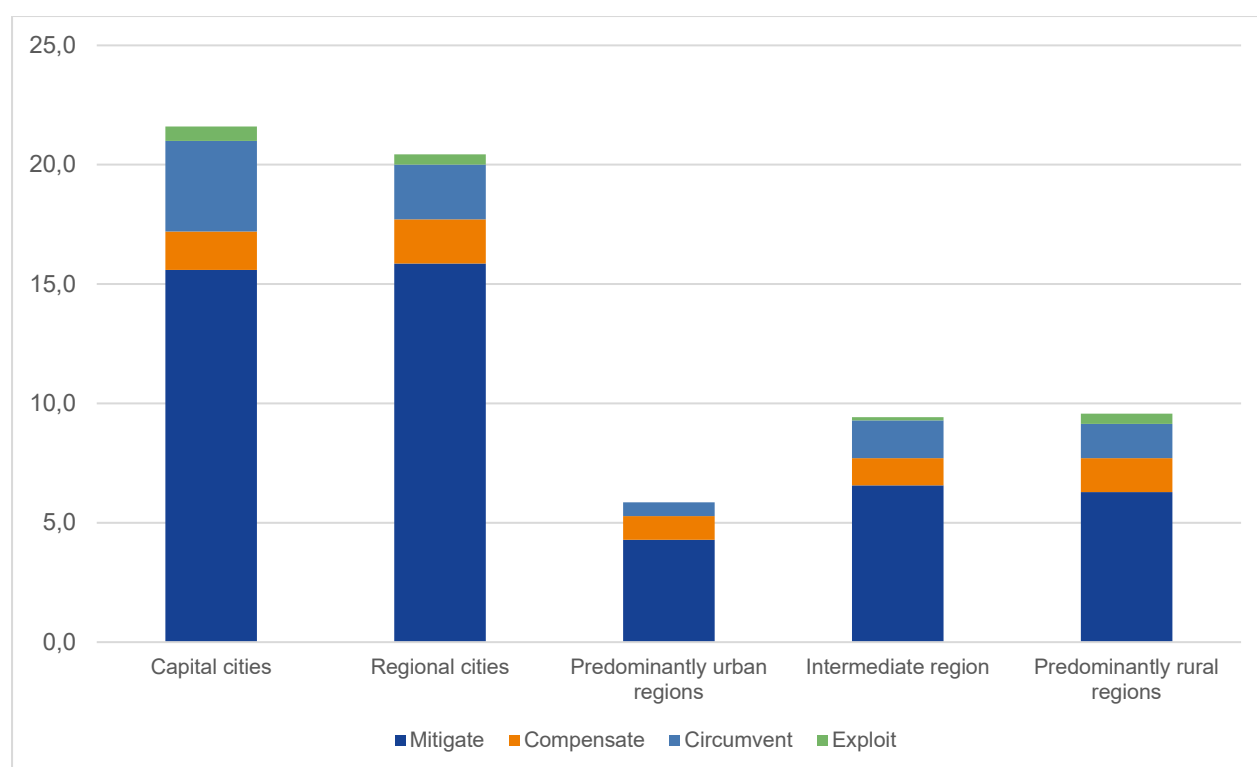
Figure 7: Frequency and nature of local and regional policy measures according to the mortality level



3.4 Incidence of first policy responses for each type of territory

Finally, the incidence and nature of the policy measures have been analysed in respect of each type of territory. As expected, the highest incidence is encountered in capital and regional cities. This confirms the commonly stated affirmation that cities have been in the front line of the pandemic, at least during the first wave. Interestingly, the share of innovative and policy measures is not necessarily lower in intermediate and predominantly rural regions, as one may expect. In fact, some of the predominantly rural regions proved to be resilient by implementing circumventing and exploiting measures, such as Cuenca (ES).

Figure 8: Average number of measures for each type of territory



Data computed for 5 capital cities, 7 regional cities, 7 predominantly urban regions, 7 intermediate regions, and 7 predominantly rural regions.

The low incidence of measures in predominantly urban regions is subject to further research, as it might be due to either the small sample used or the fact that they host important metropolises that took the initiative of implementing the largest number of measures.

4 Conclusion

Between February and July 2020, the uneven circulation of the virus across the European regions raised immediate geographic questions regarding the socio-economic, environmental, financial and demographic dimensions of the pandemic. Why were some areas hit harder than others? How could regional variations be explained? Is it possible to identify links between the spread of the disease and territorial characteristics likely to influence it? Another questioning whose aim is to understand what local policy solutions had been implemented by cities and regions to counteract the socio-economic effects of the containment. The ambition of the ESPON study about the “Geography of COVID-19 outbreak and first policy answers in European regions and cities” was to provide this first regional reading of the pandemic on the European scale.

As for any disease, mortality due to Covid-19 originates from individual characteristics. However, the local economic and social context also matters, as it is recalled by the abundant literature (McCoy, 2020) which, considering the regional characteristics as determinants of the regional mortality, may help understand the regional discrepancies observed from the beginning of the epidemic better. This paper sheds light on the spatial heterogeneity between the European region and its persistence during the expansion, peak, and beginning of decrease of the epidemic. It points out that, whereas some regions were severely hit by Covid-19 forming clusters where the mortality rates were significantly higher than on average, other regions have been spared, forming a belt of places where the mortality rate was low, mainly located near the eastern and southern borders of Europe.

Our first conclusion is thus that Covid-19 is a global pandemic taking the form of intense local epidemics. In addition to this peculiar spatial distribution of the mortality rates, our results lead us to conclude that if some peculiar events (football matches, church gathering, arrival of infected people coming from already affected non-European countries, etc.) the epidemic spread can be explained by a mix of factors describing the socio-economic context. In addition to the classical demographic indicators, we found that the degree of urbanisation, on the one hand, and both governance quality and public health policies, on the other hand, were tangible elements enabling us to explain the local differences observed. In addition to these aspects, the introduction of an intangible asset as education (in some extent proxy of social trust) made it possible for us to enrich the analysis by considering culture and interpersonal relationship. They are showed to influence the mortality rate of Covid-19 and that their role increased over the period. According to our findings, compliance to sanitary rules imposed to control the epidemic and to flatten the peak of infections to limit congestion in hospitals depends on trust. This cultural aspect should thus be considered when deciding on the implementation of sanitary rules because, beyond their expected theoretical effects, their real effect depends on their actual use resulting from social trust.

Our research underlines the importance of regional differences in the mortality rates and their origin along with the epidemic. This contribution can be of interest to policymakers and health agencies. The regional dimension of public health policies, even in centralized countries such as France, requires efforts to disentangle spatial aspects of epidemics to design policies adapted to the context in which they occur. Strengthening this local dimension is all the more essential for two main reasons. First, Covid-19, unlike other epidemics such as the flu, does not spread uniformly across regions but tends to remain clustered. Secondly, the high contagion rate of this disease requires a rapid detection of zero patients to adopt almost immediately the necessary sanitary rules that help to prevent the spreading of the cases. Moreover, the proximity between policymakers and citizens allows the former know the culture, social norms, and trust better. Consequently, measures adopted to reduce the severity of epidemics could be more effective when defined as closely as possible to the field.

The geography of COVID-19 has also highlighted inequalities in access to care services. Therefore, a polycentric organisation of access to health services seems to be essential. Public authorities must deploy several digital solutions and support platforms for professionals, users, private and public research, and innovation stakeholders.

The second part of the study, which focuses on the analysis of local political responses, shows several structuring trends in the way local public authorities have reacted to the CoViD-19 crisis: (i) there is a dominance of emergency measures, designed for the short term, corresponding to the first identified effects of the pandemic ; this mainly refers to measures to support the local economic fabric, from which immediate effects are expected; (ii) only a few measures can be described as "long-term" ones, (iii) some measures

are part of the medium term but risk not being sustainable, whereas the pandemic has sometimes led to innovation and the effects of the latter could remain beneficial beyond the closing horizon of the pandemic.

It is a challenge of anticipation that local authorities will have to face, especially the anticipation of other crises. Therefore, we think that Territorial Economic Intelligence can help us to negotiate the management and the crisis aftermath. If we need immediate reactions (attenuate, compensate), the strategic dimension, which is a matter of anticipation, requires hindsight and reflection.

Most periods of crisis accentuate emerging or underlying trends. Digital change was already accelerating in recent years, and the pandemic has precipitated this trend with an increase in teleworking, deployment of distance learning, digitalisation of services. By putting an abrupt end to physical exchanges, the Covid-19 pandemic, led to unprecedented digital use peaks. Covid-19 has greatly accelerated the pace: transformations that were planned for several years ahead were achieved in a few weeks, both in terms of uses and transformation. At all levels, we can see that the mastery of technology and the ability to use it gives a real advantage in this crisis.

We have entered the fourth industrial revolution, characterised by digital acceleration. The coronavirus crisis will mark the delay accumulated by certain companies and organisations in digitalisation. For companies, it will require substantial actions to avoid a drastic loss of customers or even the cessation of their respective activities. The crisis will also have revealed regional inequalities in terms of digital access. Taking these issues into account is fundamental to avoid places being left behind.

As a result, several recommendations can be made: (i) accelerate the digital coverage of the European territory, (ii) strengthen the digital inclusion programme, so that no European is left on the edge of the digital path, (iii) provide financial incentives for businesses - from local shops to industrial SMEs - to embark on the digital transition, (iv) continue efforts to promote the emergence of European digital “champion businesses”, by supporting entrepreneurs and investors.

Furthermore, economic recovery from the coronavirus crisis cannot result in a return to previous practices. It must be an opportunity to make real progress towards sustainable development. A structural transformation of the transport sector will be necessary if green and environmentally sustainable economies are to become a reality. According to the authors of a new study published entitled *Jobs in green and healthy transport: Making the green shift*⁹, this could lead to the creation of millions of new jobs. Therefore, local authorities should use this opportunity to speed up public transport as an alternative to car use. Giving more space to soft mobility should, therefore be a priority.

⁹ https://www.ilo.org/global/publications/books/WCMS_745151/lang--fr/index.htm

Appendix

1. Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Covid death rate week 9	377	0,00	0,00	0	0,01
Covid death rate week14	377	0,34	0,79	0	9,26
Covid death rate week18	377	1,46	2,13	0	13,19
Covid death rate week22	377	2,09	2,82	0	19,20
Covid death rate week27	377	2,32	3,07	0	20,52
Covid death rate week31	377	2,37	3,13	0	22,41
Covid death rate week36	377	2,41	3,16	0	22,86
Population density	377	4,82	1,22	0,96	9,95
Share of the population aged 65 and over	377	20,78	3,32	10,72	30,32
Life expectancy	377	81,22	2,76	74,10	85,50
GDP per capita	377	10,14	0,67	8,29	12,05
Poverty	377	20,34	7,69	8,5	53,60
Hospital beds	377	552,82	202,38	138,12	1286,28
Governance	377	1,17	0,21	0,5	1,50
Education	377	0,48	0,50	0	1,00
Intermediate region	377	0,42	0,49	0	1,00
Rural region	377	0,37	0,48	0	1,00
Urban region	377	0,21	0,41	0	1,00

2. Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Population density	1.000									
(2) % of pop aged 65 and over	-0.475***	1.000								
(3) Life expectancy	0.120**	0.238***	1.000							
(4) GDP per capita	0.325***	0.027	0.796***	1.000						
(5) Poverty rate	-0.028	-0.105**	-0.496***	-0.547***	1.000					
(6) Hospital beds	-0.005	0.080	-0.321***	-0.208***	-0.098*	1.000				
(7) Governance index	0.012	0.205***	0.651***	0.735***	-0.591***	-0.155***	1.000			
(8) Education	0.173***	-0.081	0.433***	0.455***	-0.278***	-0.320***	0.367***	1.000		
(9) Intermediate region	-0.011	-0.041	0.054	0.079	-0.047	-0.179***	0.004	0.024	1.000	
(10) Urban region	0.584***	-0.289***	0.126**	0.296***	-0.007	-0.053	0.103**	0.207***	-0.435***	1.000

3. Methodological aspects of part 3 “Overview of the policy answers to Covid-19 on the regional/local scale”

3.1. Types of territories and geographical analysis level

The present study complements previous policy notes and reports provided by the UN, OECD or UNESCO dealing with the COVID-19 impacts and responses; however, in order to boost the potential utility of findings,

we deepened our territorial focus in order to get more accurate results. Previous infra-national policy documents mostly focused on urban policy measures^{10,11,12}. Indeed, due to their connectivity, high concentration, and high density of inhabitants, cities represent, beyond the shadow of a doubt, the most affected type of territory. Therefore, case studies dedicated to urban areas, metropolises and mostly urban NUTS 3 units are included in this study. Nonetheless, we considered that an excessive spotlight on urban areas failed to fully understand the territorial realities, by omitting rural and semi-rural areas. As a result, the current study incorporated case studies dedicated to rural and intermediate NUTS-3 units, which, although less populated, less financially potent and mostly peripheral, had to face specific challenges during the first pandemic wave. Hence, our analysis aimed, to a greater extent, at the NUTS-3 administrative units, a decisional level which provides a complementary vision of the territorial impacts induced by the current pandemic. This approach allows a more thorough observation and interpretation of the policy responses, given the asymmetrical nature of the way the shock rippled throughout the European Union.

3.2. Overview of the methodological approach

The approach relies on qualitative research design. Its main pillars and steps are defined as follows:

1. Selection of 35 case studies across the European Union (21 NUTS-3 regions and 14 cities);
2. Collection of data on the policy measures taken by the 35 territorial entities (and creation of 35 subsequent factsheets);
3. Development of a theoretical typology of policy responses based on their nature (intend outcome), area of public action, and temporal perspective;
4. Categorisation of measures according to the typology created;
5. Analysis of first policy responses on the regional and local scale based on their nature, temporal perspective, and area of public policy action;
6. Computing descriptive statistics to see whether there are significant differences in incidence and nature of policy responses between i) territories with different economic performance before the crisis (GDPPC), ii) territories with high/low mortality levels due to the pandemic, and iii) different types of territory (predominantly rural regions, intermediate regions, predominantly urban regions, regional cities and capital cities).

3.3. Case study selection

A number of 35 territorial entities have been selected such as:

- An almost equal number of regions and cities with low/high covid-19 mortality levels;
- The same number of territorial entities for each type of territory: 7 predominantly rural regions, 7 intermediate regions, 7 predominantly urban regions (according to the OECD rural/urban typology), 7 regional cities and 7 capital cities;
- An equal number of regional cities and NUTS-3 regions from each selected country. Capital cities do not follow this rule as they have been added later to the study.

¹⁰ OECD, "Cities Policy Responses" (OECD, 2020), <https://www.oecd.org/coronavirus/policy-responses/cities-policy-responses-fd1053ff/>.

¹¹ UNESCO, "Urban Solutions: Learning from Cities' Responses to COVID-19," 2020, <https://en.unesco.org/urban-solutions-learning-from-cities-responses-to-covid19>.

¹² UN, "Policy Brief: COVID-19 in an Urban World," 2020, <https://unsdg.un.org/resources/policy-brief-covid-19-urban-world>.

Map 11: Geographical location of selected case studies

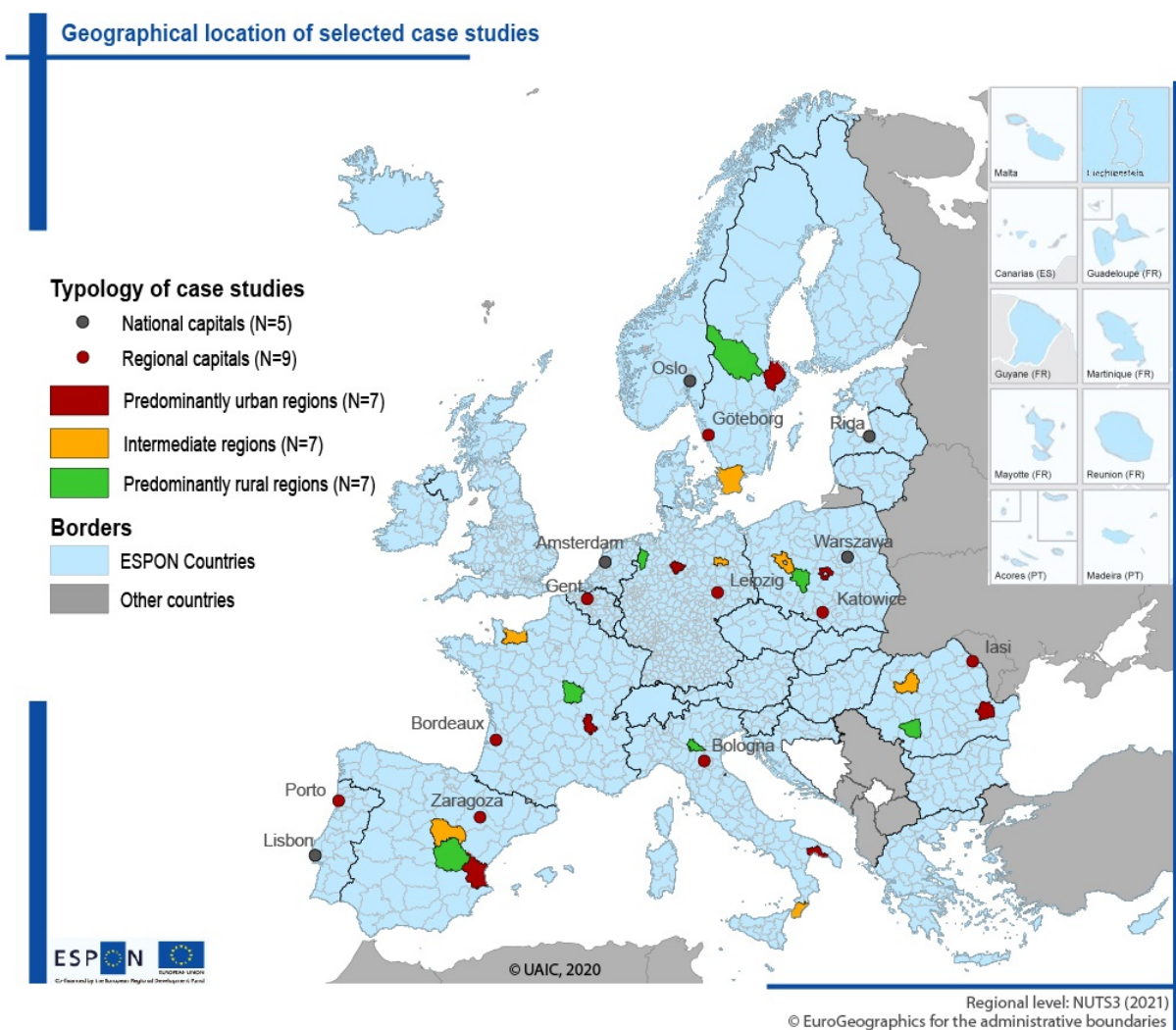


Table 10: List of case studies

Urban-rural typology	NUTS3 Region or City	Low level of COVID-19 mortality ¹	GDPPC ²
Predominantly urban region	Brăila (RO)	Low	Low
	Rhône (FR)	High	High
	Valencia (ES)	High	Average
	Lodzki (PL)	Low	Low
	Taranto (IT)	High	Low
	Uppsala län (SE)	High	High
	Hannover (DE)	Low	High
Intermediate region	Cluj (RO)	Low	Average
	Calvados (FR)	Low	Average
	Guadalajara (ES)	High	Low
	Poznański (PL)	Low	Average
	Reggio di Calabria (IT)	High	Low
	Skane (SE)	High	Average
	Havelland (DE)	Low	Low
Predominantly rural region	Gorj (RO)	Low	Low
	Nièvre (FR)	High	Low
	Cuenca (ES)	High	Average
	Kaliski (PL)	Low	Low
	Mantova (IT)	High	Average
	Dalarna (SE)	High	Average
	Emsland (DE)	Low	High
Regional cities	Iasi (RO)	Low	Low
	Bordeaux (FR)	High	Average
	Zaragoza (ES)	High	Average
	Katowice (PL)	Low	Average
	Bologna (IT)	High	High
	Göteborg (SE)	High	High
	Leipzig (DE)	Low	High
Capital cities	Amsterdam (NL)		High
	Warsaw (PL)		High
	Oslo (NO)		High
	Lisbon (PT)		Average
	Riga (LV)		Average
	Ghent (to be replaced with Vienna)		High
	Porto (to be replaced with Athens)		Low

Source: authors based on Factsheets

Notes: (1) threshold: 12 death/100.000 inhabitants; (2) Low = less than 80% of the EU27 average, Average = between 80 and 110 of the EU27 average, high = more than 110 of the EU27 average. GDP expressed in purchasing power standard (PPS) per inhabitant. Data source: EUROSTAT (*nama_10r_3gdp*)

3.4. Data collection

Data on first local and regional policy measures has been retrieved from publicly-available websites and platforms, such as those maintained by pan-European organisations and institutions which collected local and regional policy measures from their networks. Evidence and qualitative data on policy measures have also been collected from the local media and, above all, from official websites of corresponding local authorities.

Table 11: Main sources used for collecting data on first local and regional policy measures

Region/City	Main sources used
<i>NUTS3 regions</i>	
Brăila (RO)	Local media (online news articles)
Rhône (FR)	https://eurocities.eu/ ; https://www.rhone.fr/
Valencia (ES)	https://www.dival.es/
Lodzki (PL)	Local media (online news articles)
Taranto (IT)	https://www.provincia.taranto.it/
Uppsala län (SE)	https://www.lansstyrelsen.se/uppsala/
Hannover (DE)	https://www.hannover.de/
Cluj (RO)	Local media (online news articles), and https://www.cjcluj.ro/
Calvados (FR)	www.calvados.fr
Guadalajara (ES)	http://www.dguadalajara.es/) and local online media.
Poznański (PL)	Local media (online news articles)
Reggio di Calabria (IT)	https://www.cittametropolitana.rc.it
Skåne (SE)	https://www.skane.se/ ; https://www.skanetrafiken.se/ , and two of the Regions' official Facebook pages
Havelland (DE)	https://www.havelland.de/
Gorj (RO)	https://gj.prefectura.mai.gov.ro/ ; https://www.cjgorj.ro/ ;
Nièvre (FR)	https://nievre.fr/
Cuenca (ES)	https://www.dipucuenca.es/
Kaliski (PL)	Official website of Kaliski Powiat Council: www.powiat.kalisz.pl
Mantova (IT)	https://www.provincia.mantova.it/
Dalarna (SE)	https://www.lansstyrelsen.se/dalarna.html
Emsland (DE)	https://www.emsland.de/
<i>Cities</i>	
Iași (RO)	Local media (online news articles)
Bordeaux (FR)	http://www.bordeaux.fr and https://rue89bordeaux.com/ and https://www.bordeaux-metropole.fr
Zaragoza (ES)	https://www.zaragoza.es/sede/portal/coronavirus
Katowice (PL)	https://koronawirus.katowice.eu/ ; https://eurocities.eu/ ;
Bologna (IT)	http://www.comune.bologna.it and https://covidnews.eurocities.eu/
Göteborg (SE)	https://goteborg.se/
Leipzig (DE)	https://www.leipzig.de/
Amsterdam (NL)	Eurocities ; https://www.amsterdam.nl/ ; www.metropoolregioamsterdam.nl ;
Warsaw (PL)	https://warszawa19115.pl/ ; https://covidnews.eurocities.eu/ ; www.themayor.eu ; http://ngo.um.warszawa.pl/

Region/City	Main sources used
Oslo (NO)	https://www.oslo.kommune.no/
Lisbon (PT)	https://eurocities.eu/ ; https://lisboagreencapital2020.com/en/
Riga (LV)	https://www.riga.lv/

Source: authors

3.5. Data analysis and typology of local and regional policy responses

Data collection has resulted in a database of 477 local and regional policy measures. These measures have been categorised afterwards, according to three criteria, as described.

Table 12: A proposed typology of policy measures and corresponding conceptual categories¹³

	Area of public action	Temporal perspective ¹	Nature of intention ²
Conceptual categories	<ul style="list-style-type: none"> Public health security Daily way of life and work Support to vulnerable populations Support to economic actors and recovery 	<ul style="list-style-type: none"> Short term Medium term Long term 	<ul style="list-style-type: none"> Mitigate Compensate Circumvent Exploit

Source: Authors

Notes: “Short term” refers to measures having effects during the first 6 months, “Medium term” refers to measures having effects during the pandemic, “Long term” refers to measures having effects during the post-pandemic time).

Local and regional policy measures have been previously classified in the “public action and temporal perspective” category (e.g. OECD, 2020)¹⁴. On the other hand, categorising measures according to their intentional nature and resiliency constitutes a new approach. This implies the classification of the measures into four categories, as follows. ‘Mitigating’ measures show the capacity of local authorities to resist the crisis, and to take measures that limit the negative effects, whilst ‘Compensating’, ‘Circumventing’ and ‘Exploiting’ measures show the local authorities’ intention to recover, either towards the pre-crisis balance (Compensating and Circumventing) or a newly created one (Exploit).

- ‘Mitigating’ measures range from typical social distancing measures (similar to the initial Czech quarantine) to more sophisticated and smart approaches (that rival the ‘smart quarantine’ from South Korea and Singapore)¹⁵.
- ‘Compensating’ measures aim at regaining the pre-crisis balance, but also going back to business and the usual way of doing things.

¹³ Other frameworks conceived for the analysis of policy responses to COVID-19 include the four-stage RISE model developed by Craig et al. (2020) and the five-stage ‘5R’ model developed by the McKinsey Global Institute (2020). These two frameworks are conceived as a set of 4/5 conceptual categories of actions that follow one another in time. The RISE framework has been conceived for the particular case of local governments’ fiscal responses to the crisis, and stresses the importance of distinguishing Resilience (understood as resistance, i.e. the financial capacity of local governments to maintain current operations, thus including no particular actions from their part), Intention (“immediate actions taken to minimise financial impacts”), Sustain (“short term actions in the next budget cycles towards stabilisation”) and Endurance (“adapt to the ‘new’ normal, reform and rethink, and strategic planning”). Quite similarly, the 5R framework conceptualises the reaction of the private and public stakeholders as raging from Resolving to Resilience, Returning, Re-imagining, and finally Reforming.

¹⁴ OECD, “Cities Policy Responses.”

¹⁵ For a ‘blanked quarantine’ and ‘smart quarantine’ overview, see Kouřil & Ferenčuhová (2020) - <https://www.tandfonline.com/doi/full/10.1080/15387216.2020.1783338>

- 'Circumventing' measures show a higher resilience from the local authorities as they are aimed at regaining the pre-crisis balance in an adaptive way, following the logic of doing the same things differently.
- 'Exploiting' measures suggest the intention to follow an original recovery path, by creating a new balance and by following a transformative process, usually by taking advantage of the effects of the crisis and by doing new things compared to the pre-crisis period.

The aim of this new framework is twofold: 1) employ it as a conceptual instrument to produce knowledge and 2) assist the local public stakeholders and practitioners in the understanding of the range of existing options as well as their pros and cons.

Figure 9: Proposed grid for analysing policy responses on the local scale

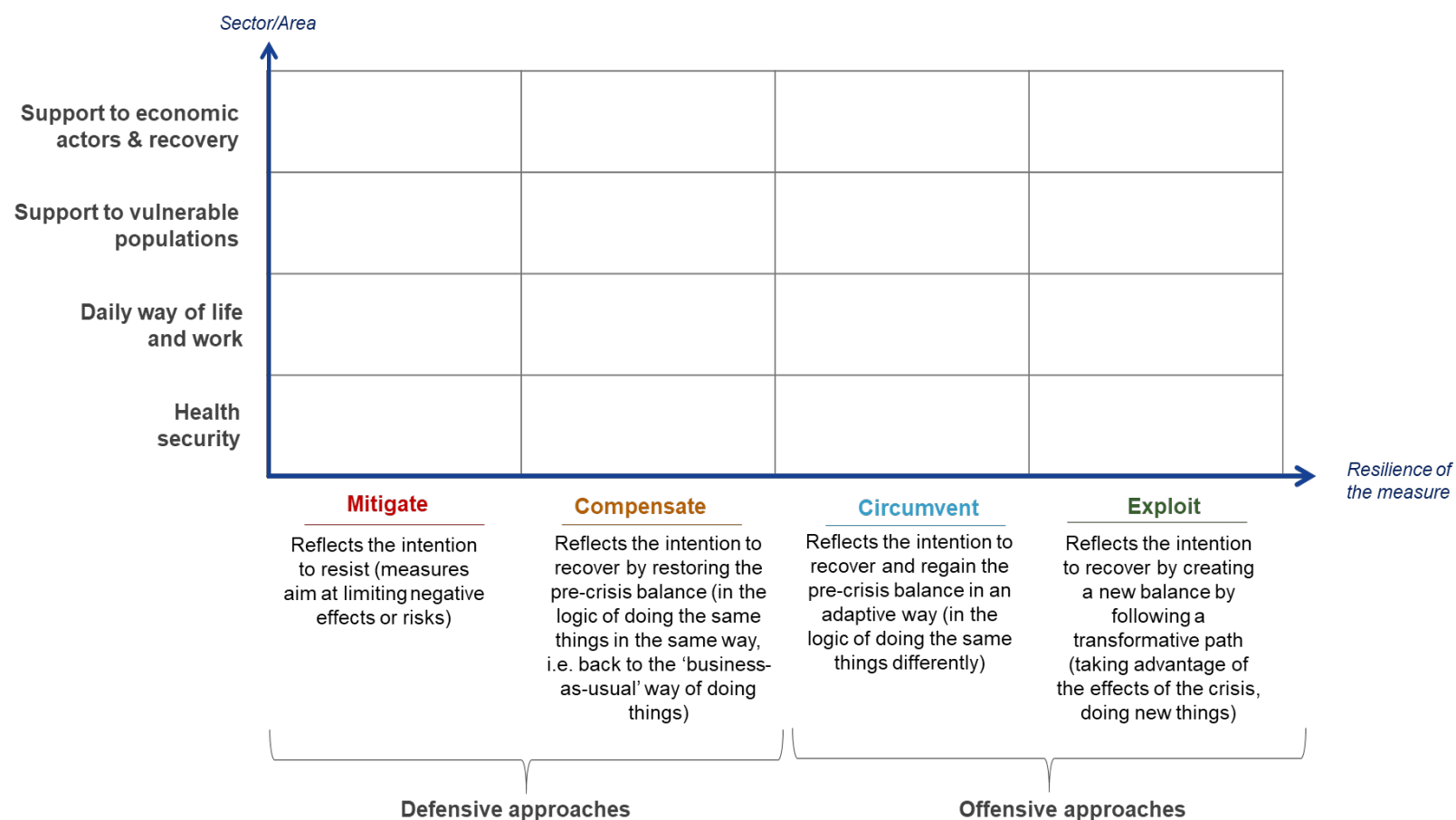


Table 13: Proposed criteria for classifying measures

Question	Criteria	Mitigate	Compensate	Circumvent	Exploit
Q1: In response to what? (response to negative effects vs. to opportunities created by the pandemic)	The measure is a response to negative effects or associated risks				
	The measure is a response to opportunities created by the pandemic				
Q2. To what purpose? (Aiming or not at restoring pre-crisis balance)	The measure is a response to urgent needs (it does not aim at restoring the balance)				
	The measure aims at restoring pre-crisis balance (the “business as usual” way)				
	The measure aims at restoring pre-crisis balance (doing things with the same purpose but in a different way*)				
	The measure aims at creating a new balance (the purpose and function of the system are changed)				
Q3. What and how? (same things vs. new things; same way vs. new ways of doing things)*	The measure supposes doing the same things in the same way				
	The measure supposes doing the same things in a different way				
	The measure supposes doing new things				

Source: authors

Table 14: No of policy measures according to their nature and level of wealth of corresponding NUTS-3 regions

Level of GDPPC	Mitigate	Compensate	Circumvent	Exploit	Total
High GDPPC (>110)	152	19	32	7	210
Average GDPPC (80-110)	128	20	26	4	178
Low GDPPC (<80)	101	11	7		119
Total	381	50	65	11	507

Note: Data computed for a number of 35 regions/cities (11 with high GDPPC, 13 with average GDPPC, 11 with low GDPPC).

Data sources: first 35 facheets for policy measures (see Annex 1); EUROSTAT (nama_10r_3gdp) for GDPPC (Purchasing power standard per inhabitant in percentage of the EU average).

Table 15: Frequency of policy measures according to their nature and GDPC level (EU27=100) of corresponding NUTS-3 regions (average no of policy measures per region/city).

Level of GDPPC	Mitigate	Compensate	Circumvent	Exploit
High GDPPC (>110)	13.8	1.7	2.9	0.6
Average GDPPC (80-110)	9.8	1.5	2.0	0.3
Low GDPPC (<80)	9.2	1.0	0.6	0.0

Note: Data computed for 35 regions/cities (11 with high GDPPC, 13 with average GDPPC, 11 with low GDPPC).

Data sources: first 35 facheets for policy measures (see Annex 1); EUROSTAT (nama_10r_3gdp) for GDPPC (Purchasing power standard per inhabitant in percentage of the EU average).

Table 16: Share of the number of circumventing and exploding measures depending on the GDPPC level of the corresponding NUTS-3 region

Level of GDPPC (EU27=100)		Mitigate	Compensate	Circumvent	Exploit
High (>110)		40	38	49	64
Average (80-110)		34	40	40	36
Low (<80)		27	22	11	0
		100	100	100	100

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