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Back to the Future:

The forward-looking consequences of COVID-19 across EU Regions

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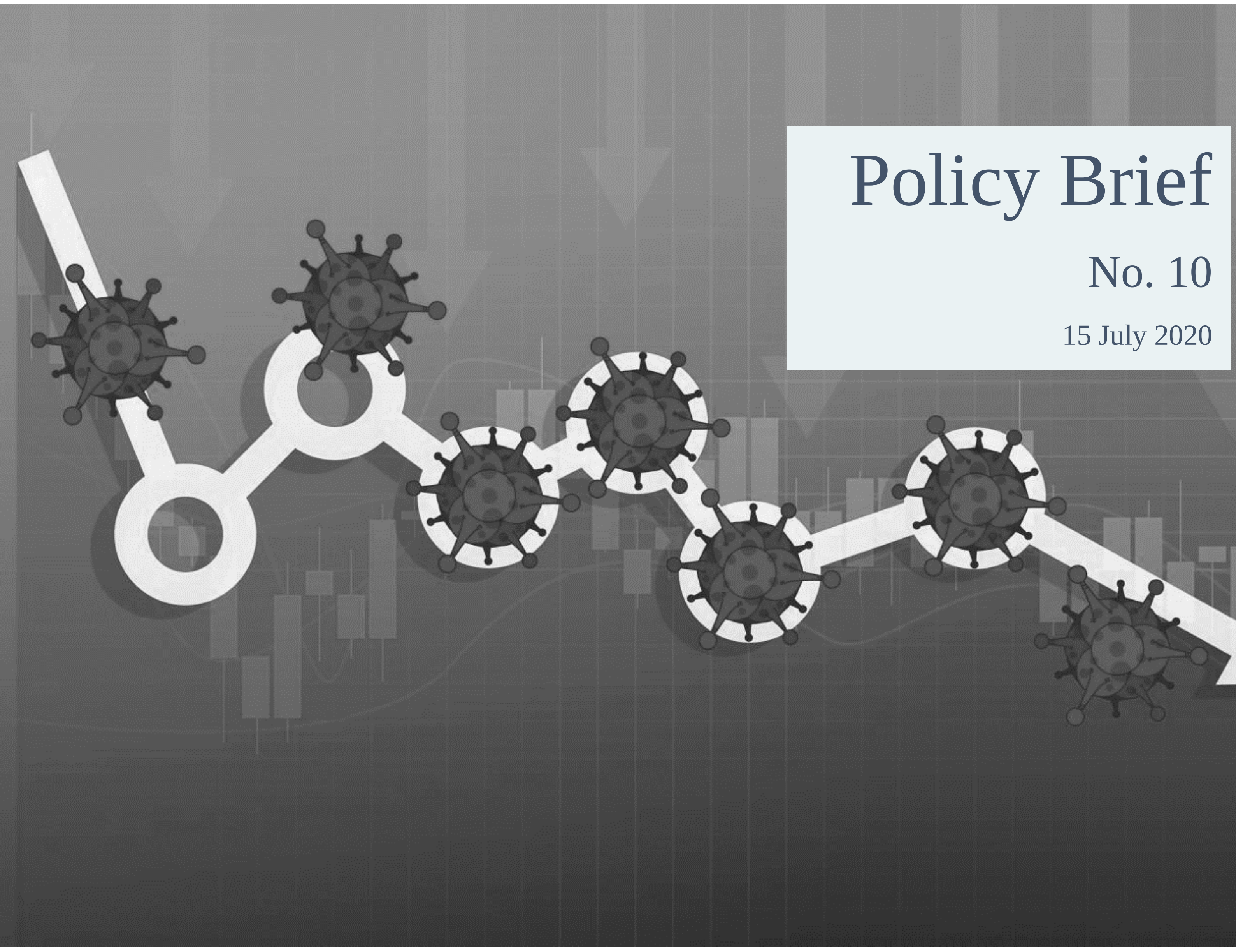

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ABSTRACT

In this post we assess to what extent the COVID-19 shock might affect EU countries and regions in the near future. In particular, we develop two specific indicators. First, an indicator of exposure to ‘external disruption risk’ (EDR): we use recently available data on GVCs flows to assess the potential disruptions for EU regions (countries) arising from obstacles to extra-EU trade in the post-COVID world. Second, an indicator of exposure to ‘internal disruption risk’ (IDR): we use information on the new safety regulation across industries to evaluate the exposure of production processes across EU regions (countries). We then exploit these two indicators in order to assess, for each EU region, the potential exposure of its underlying economic structures to COVID-related shocks. The ensuing ranking of regions provides an additional metric to evaluate the allocation of funds within the Recovery and Resilience facility under discussion within the European Institutions.

INTRODUCTION

The COVID-19 epidemic has had a very heterogeneous impact across EU Member States and regions. Death rates have varied considerably, from more than 800 per million inhabitant in Belgium, to some 5-600 in Sweden, Italy and Spain, around 450 in France, 350 in the Netherlands, around 100 in Germany, less than 50 in many Eastern European countries and Greece.[1] These numbers mask an even higher heterogeneity within countries: Lombardy accounts for some 70% of all the Italian deaths, with a rate of 1,600 death per million inhabitant, but mortality in South Italy equals the one of Greece. A similar difference can be seen for the Paris or Madrid metropolitan areas (1,160 and 1,300 deaths per million inhabitants, respectively) when compared to the majority of the regions in France or Spain.

Notwithstanding a different impact of the contagion, the outcome of COVID-19 has been insofar substantially homogeneous in terms of economic shock across countries. In its Spring Forecast the European Commission predicts an average fall in GDP growth rates of -7.4% for the European Union, with a relatively narrow standard deviation (1.3; coefficient of variation of 0.18). For comparison, the coefficient of variation of the COVID-related deaths across the same European countries is 1.27, i.e. seven times larger. A look at high frequency data across countries is also consistent with this reading: change in weekly electricity consumption (from 2019 to the same week of 2020) indicate that

[1] All data on COVID cases by country can be retrieved from https://www.worldometers.info/coronavirus/

countries that started first with a harsh lockdown (e.g. Italy) gradually lost up to 30% of electric power actual load. By mid-April, however, this figure was essentially similar for countries with less harsh lockdown/contagions (e.g. Germany). All countries then rebounded together as soon as the lockdown was released.[2]

The latter evidence certainly points at the deep inter-relations existing in economic terms across EU countries and regions, but it also poses a number of fundamental policy questions, given that the European Union is currently negotiating on the correct allocation of a package of some 750billion euros to help countries (and regions) recover from the COVID-19 shock. Should the EU favor in the allocation of funds the countries (regions) most affected by the COVID epidemic, or should we ignore these figures, as the economic impact seems to be more homogeneous in any case? Moreover, if we consider only economic consequences, should we look at the past performance of a country / region as a predictor of future performance (as the EC seems to suggest implicitly in its proposal on the allocation criteria), or should we have a forward-looking approach?[3]

In order to contribute to this debate, we have looked in detail at how countries and regions differ in the EU over their industrial and employment structures, trying to assess to what extent the COVID-19 shock might affect them in the near future. In particular, we have built and combined two specific indicators.

1. The exposure of EU regions to external COVID shocks

First, we have constructed an indicator of external dependency of EU regions. In particular, with restrictions on international trade harnessing businesses and industries, we have employed recently available data on Global Value Chains to look at how much the value added exported in each industry is exposed to global trade, in terms of both foreign source of inputs embedded into exports and domestic value added absorbed

[2] Elaborations of BoFA-ML Euro Area Economic Watch on ENTSO-E data.
[3] In the Annex to the Proposal establishing a Recovery and Resilience Facility, the most substantial part of the Next Generation EU package (aka Recovery Fund), the EC proposes an allocation key for each Member State that is computed as a function of: population; the inverse of GDP per capita; the average unemployment rate over the past 5 years compared to the EU average (2015-2019). It then employs certain caps to avoid excessive concentration of resources in a given Member State.

abroad. We have then combined these data in an 'external disruption risk' indicator (EDRI) at the regional level.

In doing so, we have assumed that obstacles to the free movement of goods, services, capital and people will be completely removed within the EU over the next weeks, and thus we have concentrated our analysis on extra-EU trade. In Annex we also report an index of overall GVC exposure of EU regions to allow for comparisons. Combining industries' GVC exposure with the industrial structure of each NUTS-2 region we have derived our EDRI, that is, the extent to which the economic structure of each region (or country) is going to be affected by the potential disruptions arising from obstacles to extra-EU trade.

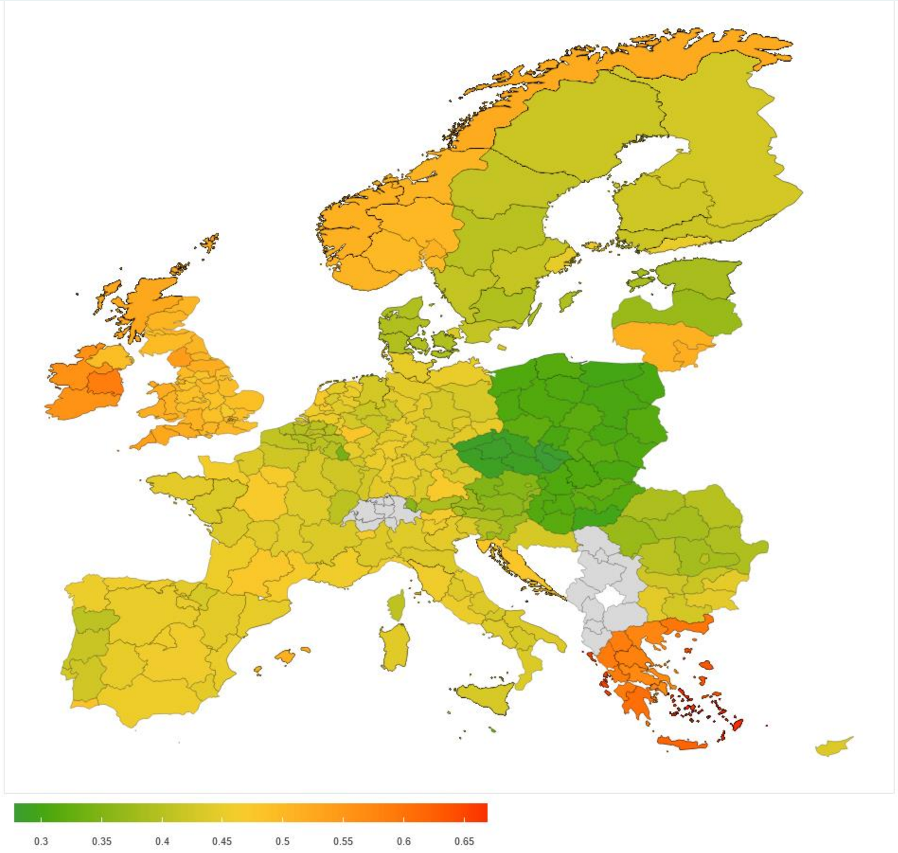
Specifically, we consider two measures. First, we look at the Domestic Value Added (DVA) content of total exports in each country-sector pair. We take the total figure and all the DVAs from bilateral flows and we account for the portion of DVA generated either within Europe or outside Europe.[4] Then, we look at the portion of Extra-EU Import Value Added (VA) in each country-sector pair. We retrieve the total import-related VA and then look at the VA originated in each bilateral relationship with partner countries. We then aggregate as above in two groups depending on the imports' origin. Thus, we know how much each country-sector pair is "dependent" on Extra-EU flows, both in its imports and exports (see Annex for details). We then take a simple average between the two shares and build a regional-level measure by using labor share for the same sector at the regional level as weights. The result is the above-mentioned EDR indicator.[5] Figure 1 shows the relevant figure at the NUTS-2 level.[6]

[4] We consider as Europe the EU27 together with Norway and United Kingdom (i.e. EU29).

[5] We have also run robustness checks by looking at the extra-EU portion of GVC-related trade, i.e. restricting the exported component of Domestic Value Added to the flows re-exported by partner countries, obtaining similar results.

[6] Please note that throughout the paper we use within-region weights, as we want to compare the exposure of regions to the shock, regardless of their weight at the EU level. The weights we have employed account for the within-region composition of employment, based on Eurostat SBS data. The Annex contains the technical description of the weights. Using these weights allow us to compare regions without considering their relative importance in the EU framework, thus "normalizing" only with respect to the internal industrial structure, i.e. capturing their 'pure' exposure to the shock. Using regional weights normalized for European or country-level measures, as it is more common in the trade literature, would give more weight to larger regions. Hence, regions like Lombardy, Catalonia, Madrid, Bavaria, would stand out in the chart, not necessarily because they have been more exposed to the shock, but because they carry a higher economic weight. Our exercise instead focuses on the different industrial structures within each region and points out the associated risks allowing for a comparison across regions.

Figure 1 - External Disruption Risk Indicator (EDRI), NUTS-2 level



The mean value of this indicator is 44% with a standard deviation of 0.07, meaning that more than 50% of the trade for EU regions happens within the European borders, and that there is substantial homogeneity across regions. Nevertheless, there are some specific regions that are much less reliant on extra-EU trade, such as Eastern EU territories, while others are significantly more exposed to these flows, such as Greece. This difference is mostly accounted for by the large portion of employment concentrated in Construction and Accommodation services, industries that are very exposed to extra-EU trade according to the data.

2. The exposure of EU regions to internal COVID vulnerabilities

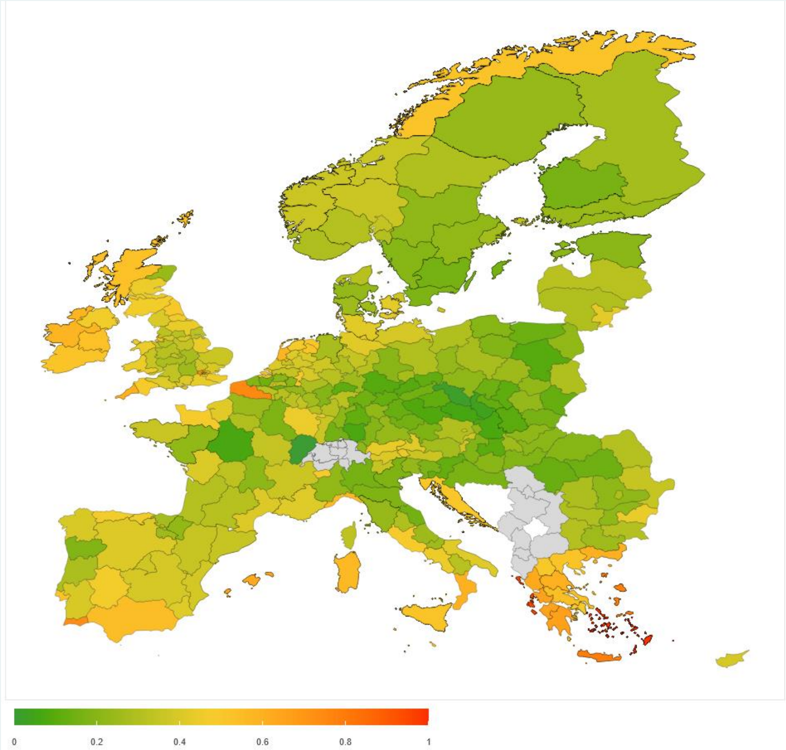
Our EDR indicator captures the external dependencies of EU countries and regions to COVID-induced GVC shocks, in terms of availability of inputs for production, or the possibility to sell output on global markets. However, regions are also internally exposed to vulnerabilities in the production process induced by COVID. These are mainly related to the disruptions arising in the production function as a result of the impending new safety standards (think for example at restaurants or transports). To gauge what is a very heterogeneous picture across industries, we have constructed an indicator of exposure to 'internal disruption risk' (IDR). This indicator capitalizes on work done in Italy by INAIL, the Italian agency for job safety, which has classified each narrow sector in terms of three characteristics:

- *Contact*: the probability of social contact while on the work premises (the index takes value from 0, low probability, e.g. agriculture to 4, high-probability, e.g. nurses);
- *Proximity*: the intrinsic characteristics of the workflow that do not allow for sufficient social-distancing (the index takes value from 0, working alone, to 4, work in strict contact with other people);
- *Aggregation:* the level of contact with other subjects other than the firm's workers (e.g. restaurants, education, also taking value from 1 to 4).

Combining these sectoral indices with the industrial structure of each NUTS-2 region, we derive our IDRI, that is, the extent to which the economic structure of each region (or country) is going to be affected by the potential disruptions arising from obstacles to the production process.

Figure 2 shows the distribution by regions of a 0-1 rescaled indicator (see Annex for details). It is interesting to note how the regions with the highest level of risk are mostly Southern European ones (take as an example the Balearic or Greek Islands). Manufacturing-intensive regions are instead less exposed to social-proximity risks, given the possibility of adopting social distancing measures. This indicator gives a different picture of the situation if compared with the GVC share of exports and with the reliance on extra-EU trade.

Figure 2 - Internal Disruption Risk Indicator (IDRI, re-scaled), NUTS-2 level



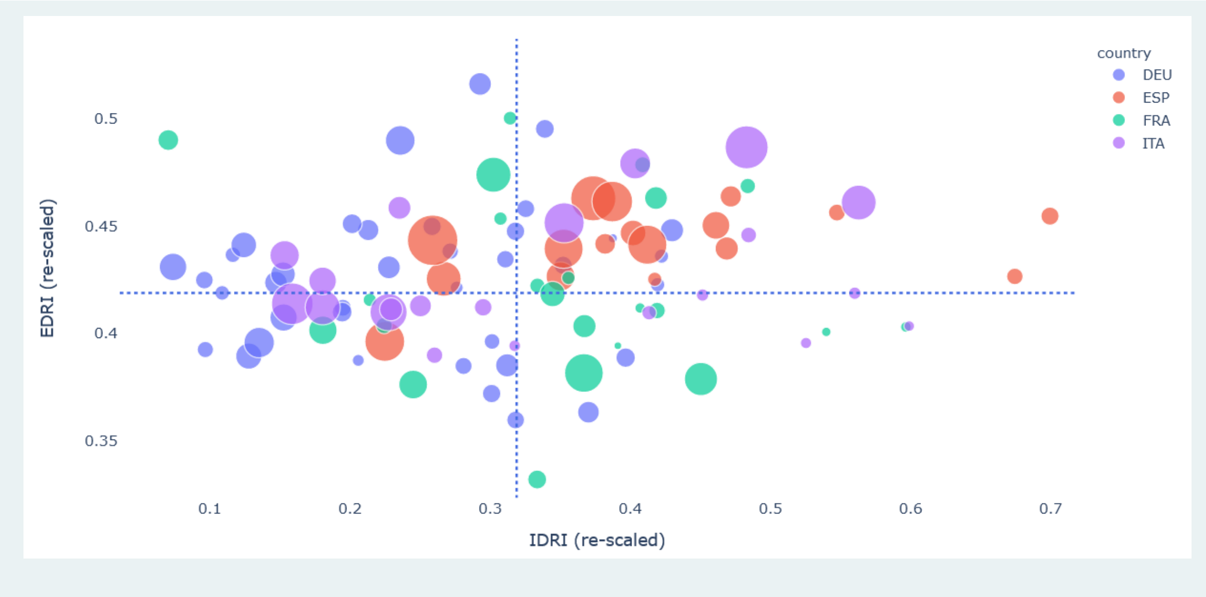
3. The external and internal exposure of regions to COVID

We now combine the EDRI and the IDRI in an aggregated chart. To show how these two indicators interact, we plot each region in a scatterplot in terms of its combined exposure, comparing it to the median values of the indexes for the EU.

To provide additional information in terms of the COVID-related shock, we also consider the relative number of contagions by region. Specifically, we have collected data on the number of contagions up to 29 May 2020 and have been able to retrieve information for 225 regions across 296 EU regions. We have created the relative measure of contagions by dividing the number of cases by the total population in each NUTS-2 region and then re-scaled this measure to the 0-1 interval using the EU-level distribution. Data about the total population come from Eurostat. For completeness, Figure A2 in the Annex shows the regional distribution of the *absolute* number of contagions.

Figure 3 plots a bubble chart for the four biggest EU countries: France, Germany, Italy and Spain.[7] The size of the bubble is the re-scaled relative number of contagions. The two axes represent the re-scaled extra-EU trade exposure and social proximity risk measures that we have described above.

Figure 3 - NUTS-2 Combined Risk



The dashed lines represent median levels of the two indicators at the regional European level. The graph shows how regions that were hit relatively more strongly by the COVID pandemic in terms of contagions (the larger bubbles) are not necessarily those more externally or internally exposed to the COVID economic consequences. Regions in the right bottom and top quadrants are southern EU ones, relying on tourism and proximity-based activities. Regions in the top right quadrant are also those whose trade is composed by a significant portion of extra-EU activities.

[7] An Interactive HTML version of the chart including all EU countries and regions is available at: https://github.com/andreacoali/COVID_back_to_future

To give a practical example of a region falling in the top right quadrant, our indicators show how Balearic Islands could be very much affected by the pandemic despite not having had a large number of contagions. In line with our predictions, recently Ibiza clubs started cancelling or significantly reducing the traditional concert and entertainment summer season, which attracts millions of tourists every year. [8] The tourism-related activities account for 75% of the income, so it is easy to understand how the pandemic could have a large impact on this type of economy.[9]

Other examples of regions in this quadrant are Provence-Alpes-Cote d'Azure in France, Madeira in Portugal or Berlin in Germany. Many touristic regions are also at the border between the top-right and bottom-right quadrants, such as Calabria and Sardinia in Italy, Brussels in Belgium, Cyprus or Martinique in France.

When looking at the left part of the figure, we find many of the regions that were severely hit by the COVID pandemic. Lombardy, Bavaria and Ile de France are just three examples. Lombardy for instance is at the border between the top and bottom left quadrants, since its industrial structure has a large manufacturing component and this region has a relatively higher share of trade with EU rather than non-EU partners compared with other regions.

Examples of regions falling in the bottom-left quadrant are the Silesian province in Poland, which is an industrial region where manufacturing accounts for the largest share of employment, or Oberosterreich, which is the leading industrial region of Austria.

Conclusion: regionalizing the Recovery and Resilience EU allocation

We have shown that adopting a 'forward-looking' approach to evaluating the potential economic impact of the current COVID pandemic based on indicators of the exposure to internal (EDRI) and external (IDRI) disruption risk can lead to very different outcomes

[8] Ibiza Coronavirus Updates, 19 June 2020. Available at: https://www.ibiza-spotlight.com/magazine/2020/06/ibiza-coronavirus-update-5-19-6-2020

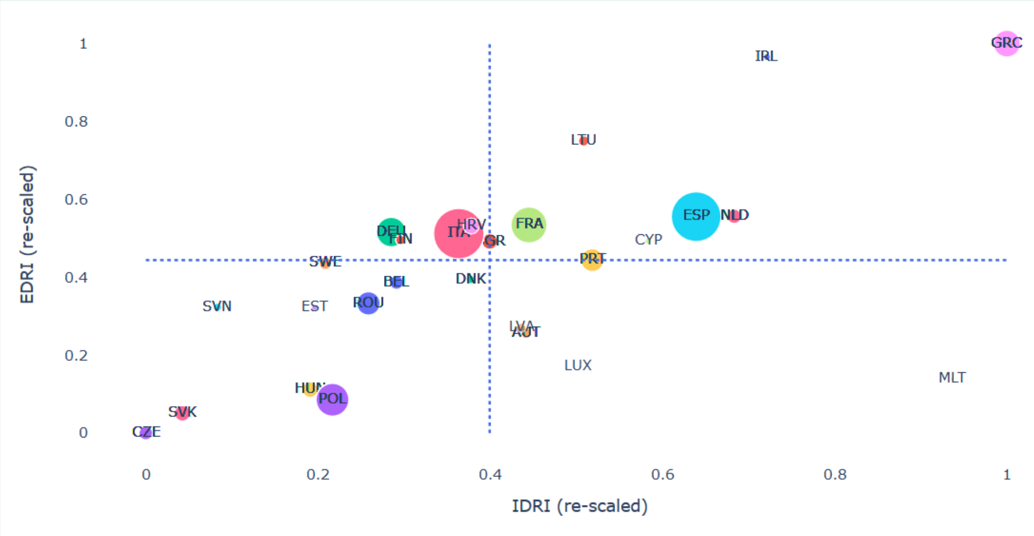
[9] Barnes,M. (6 May 2020). 'It's a tough island to live on': why coronavirus spells doom for Ibiza. *The Guardian Online*. Available at: *https*://www.theguardian.com/music/2020/may/06/its-a-tough-island-to-live-on-why-coronavirus-spells-doom-for-ibiza

compared with those implied by standard metrics, such as past economic performance or exposure to contagions.
This leads us to argue that, in order to tailor a more consistent and effective allocation of EU recovery money, policymakers should consider the intrinsic differences of EU regions in terms of industrial and employment structures, and how such differences are going to determine the future local impact of the COVID shock.

The recent study by Darvas (2020) estimates the cross-country allocation of the funds proposed by the EU institutions as a recovery tool, showing how the proposal implies both an insurance element (countries hit harder get more EU funds) and a redistribution element (countries with lower GNI per capita get more EU funds).[10] How such estimates would change if our 'forward-looking' indicators were taken into account? Figure 4 reproduces Figure 3 above at the country level, using weights covering the same sectors as in the regional exercise. This time however the size of the bubble is the potential share of allocated funds according to the EU Commission estimates.[11] If our 'forward looking' indicators are considered as additional criteria for redistribution, we should expect to see the relatively larger bubbles in the upper right quadrant. While this is partly true for Greece and Spain and, to a somewhat lesser extent for France and Italy (as they are close to the EU average in terms of potential shock), some countries seems to be at odds with this metric. In particular, some of the potentially mostly hit countries are not benefitting proportionally (e.g. Ireland), while others appear to be disproportionally funded (e.g. Romania, Poland or Hungary), due to the allocation rules based on past economic performance (in particular the 2015-19 unemployment rate).[12]

[10] Darvas, Z. (2020) 'The EU's recovery fund proposals: crisis relief with massive redistribution', *Bruegel Blog*, 17 June, available at https://www.bruegel.org/2020/06/the-eus-recovery-fund-proposals-crisis-relief-with-massive-redistribution/
[11] Annexes to the Recovery Fund Proposal (European Commission, 02/06/2020)
[12] Median levels (dashed lines) are computed on the EU29 distribution, being coherent with previous figures.

Figure 4 – IDRI/EDRI and EC share of allocation



In any case, whatever the chosen criteria of allocation, it is important to recall that, based on our previous evidence, the country-level view can be misleading, in light of the strong regional heterogeneity existing within countries. This is true especially in countries, such as Italy and France, where there are strong internal differences. An approach to the allocation of EU funds informed by our indicators would instead allow for an intervention that is not only consistent over time, by considering the future inherent trade and production risks embedded in the industrial structure, but also across space, by considering the differences in industrial structure across regions.

Our study is not free of limitations, the most important being the reliance on SBS employment data for constructing regional weights, an issue that has limited the sectors covered in our analysis.[13] Nonetheless, our analysis shows the need to think more broadly about the spillover effects of the pandemic, which are spreading also to regions only marginally hit by the virus. A forward-looking approach based on industrial and economic structure could ultimately help better understanding the relevant regional impacts of the pandemic above and beyond contagion rates and previous economic

[13] We discuss the sensitivity of this approach vs. other possible measures in Annex. We also provide a freely available link to our data so as to stimulate an open and transparent discussion on this vs. alternative allocation criteria.

performance. The recovery funds should not be seen exclusively as medals for the past battles of the COVID campaign, but rather also as precious ammunitions for the next battles to come.

ANNEX

A. Weighting Scheme

We compute the industrial structure of each NUTS-2 region by exploiting the regional-level Eurostat Structural Business Statistics database (database code: sbs_r_nuts06_r2). We thus consider only the NACE rev.2 sectors covered by SBS and use the relevant employment figures to re-create the industrial composition.

We create a within-region weight as:

$$shareL_{irj} = \frac{L_{irj}}{L_{ir}}$$

Where *i* indicates the country, *r* the NUTS-2 region and *j* the industrial sector as in SBS. *L* stands for the number of persons employed from Eurostat SBS. We use data from 2017, i.e. the last available year in the database.
Thus, we consider the share of people employed in sector *j* in region *r* of country *i* over the total number of people employed in the same region *r* in the covered SBS sectors.

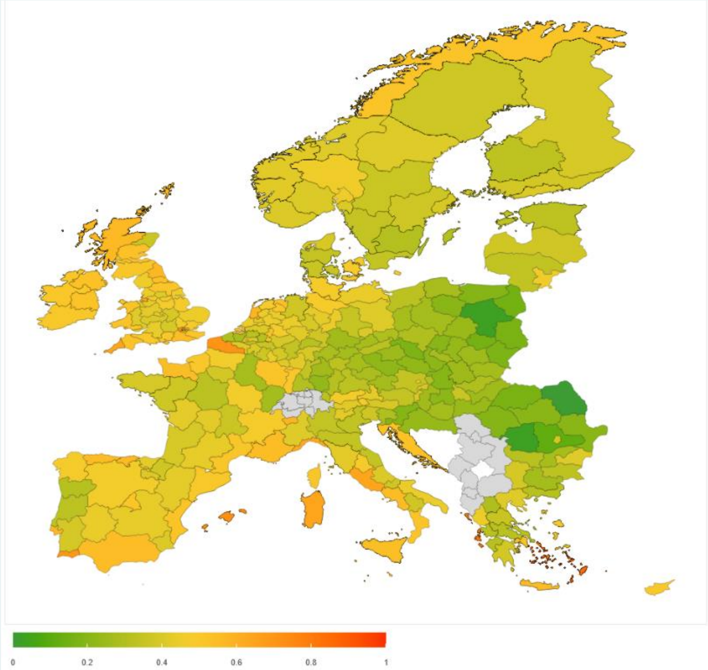
This weighting scheme allows us to understand which sectors are the most important (in employment terms) within a region. The rationale for using within-region weights is that we want to compare regions regardless of their weight at the EU level. These numbers thus accounts for the within-region composition of the employment in SBS sectors. Using EU or country-level weights, would have given higher weights to regions where labor is concentrated (e.g. Lombardy, Cataluna, Madrid, Bayern etc…) and would account for a different type of comparison.

We also tried to merge the SBS data with relevant information from Business Demography (BD) for retrieving data on sectors not covered by SBS. Results are qualitatively similar for countries where data is available. However, we decided to keep weights based on SBS since BD (database: bd_enace2_r3) does not cover all EU countries and information is less complete (for instance, data for many Netherlands regions is not available in recent years and German data is not available at all). Thus, to allow the most robust and cleaner cross-regional comparison, we decided to rely on the most complete weights as possible.

Adopting this approach however limits our analysis in the following way. SBS sectors do not cover sectors such as Agriculture (NACE code A), Public Administration (O), Education (P), Human Health and Social Work Activities (Q), Arts and Recreation (R) and a bunch of other aggregated sectors. This has surely an effect on the estimates we produce since we are not considering the full spectrum of employment. Moreover, we might over/under weight our results depending on the full composition of labor in each region. At the same time, however, data for these sectors are often offered at a too aggregated level (e.g. BD data offers data aggregated for sectors R plus S, and P plus Q omitting public administration) compared to the higher detail of other sectors. and thus even using these broader data might result in distortions. Public administrative jobs are also difficult to classify and might group employees operating in very different segments of the economy at the same time.

In any case we have run a robustness exercise where we exploit employment data from the Regional Eurostat data on Employment (database: lfst_r_lfe2en2) to recover some of the sectors not covered by SBS. This database contains data on employees' numbers for aggregated NACE sectors (for instance, it provides aggregated employment figures for the sectors R-U). The larger aggregation of sectors in the weighting measure implies that assumptions have to be made when aggregating risk measures that are instead captured at a higher level of detail. Figure A1 shows the re-scaled IDR indicator using original weights complemented with this new data for the SBS missing sectors.
The regional ranking is very much like the one we obtained by using the SBS weights and it is clear how most affected regions are still those that we identified in the main section of this research.

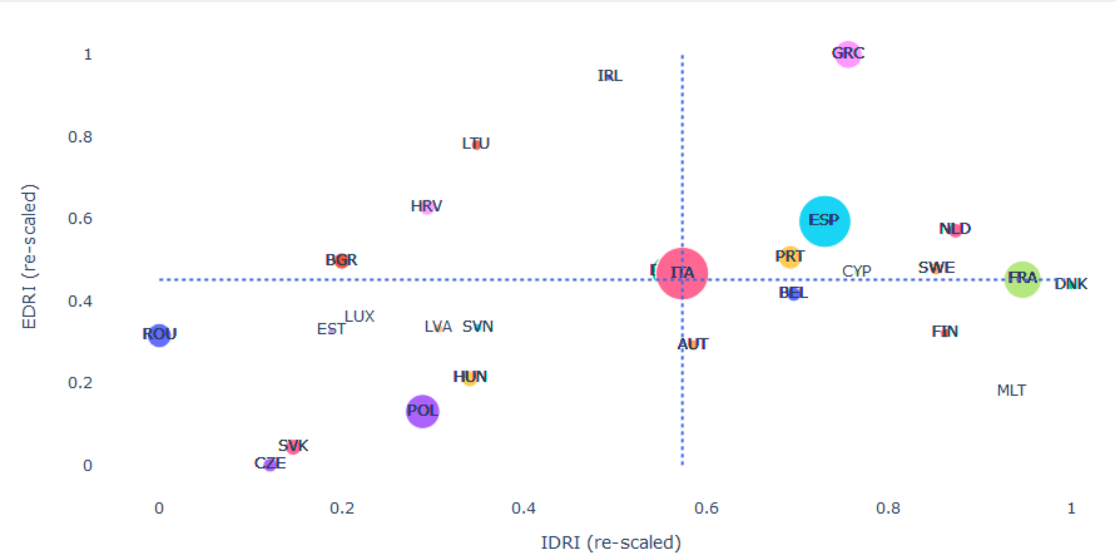
Figure A1 - Robustness Check for IDRI



We have thus chosen to use SBS data only, as the latter require less assumptions to be made when sectoral aggregation has to be done, and does not merge data coming from different sources and of different types (e.g. persons employed and employees). Results seem to be robust in any case.

We also tried to use a different weighting scheme at the country level. We rely on Value Added data from the WIOD database, thus exploiting information for all the available sectors, and weight each sector by its contribution to the overall country Value Added. Figure A2 shows a replication of Figure 4 using such weighting scheme (bubble size is still the allocation share based on EC estimates).

Figure A2 – Country Combined Risk (VA weights)



The picture is somehow different form the one in Figure 4, albeit not strikingly. The higher weight of the risk measure for northern EU countries is due to their higher sectoral share of health and social care sectors, that are classified as high risk in our dataset. Nevertheless, this exercise shows how it is crucial to choose the most appropriate weighting scheme if these indicators are used in any allocation exercise. Moreover, we stress how we are "losing" information coming from the regional heterogeneity, which is something that should be taken into account in such a context.

To ease replications and to let researchers propose and try other weighting schemes, we provide all the country-level data we have used in the *github* repository linked in the last section. Researchers are thus able to nail down the regional dimension using the weights they consider to be better suited for this exercise, also exploiting different aggregation levels or more detailed data if available.

B. Trade Exposure

As for data on Gross Exports, GVC-related trade and Imports at the country-sector level, we rely on the WIOD database (Timmer et al., 2015[14]). The WIOD database contains data back to 2014 for 56 sectors.

Out of all these sectors, we consider only those covered by the Eurostat SBS categorization[15].

GVC-related trade measure

We first compute the ratio between GVC-related export value and the total Gross Export value at the country *i* and sector *j* pair:

$$\frac{GVC_{ij}}{GEXP_{ij}}$$

We use the already computed data on GVC-related values in the WIOD tables, exploiting the *icio* STATA addon. The relevant syntax is:

```
icio, exporter(country, all)

icio, exporter(country, all) importer (partner)
```

We store all the information in specific excel files, and then re-import the relevant GVC data.

We then nail down the regional level by creating a within-region weighted average using the regional-employment weights described above. The regional GVC-related trade measure is thus:

$$GVC\_share_{ir} = \sum_j \frac{L_{irj}}{L_{ir}} * (\frac{GVC_{ij}}{GEXP_{ij}})$$

This implies that we have quite some homogeneity by country, since the assumption we make is that, for any given sector, the computed share in a given country will be the same

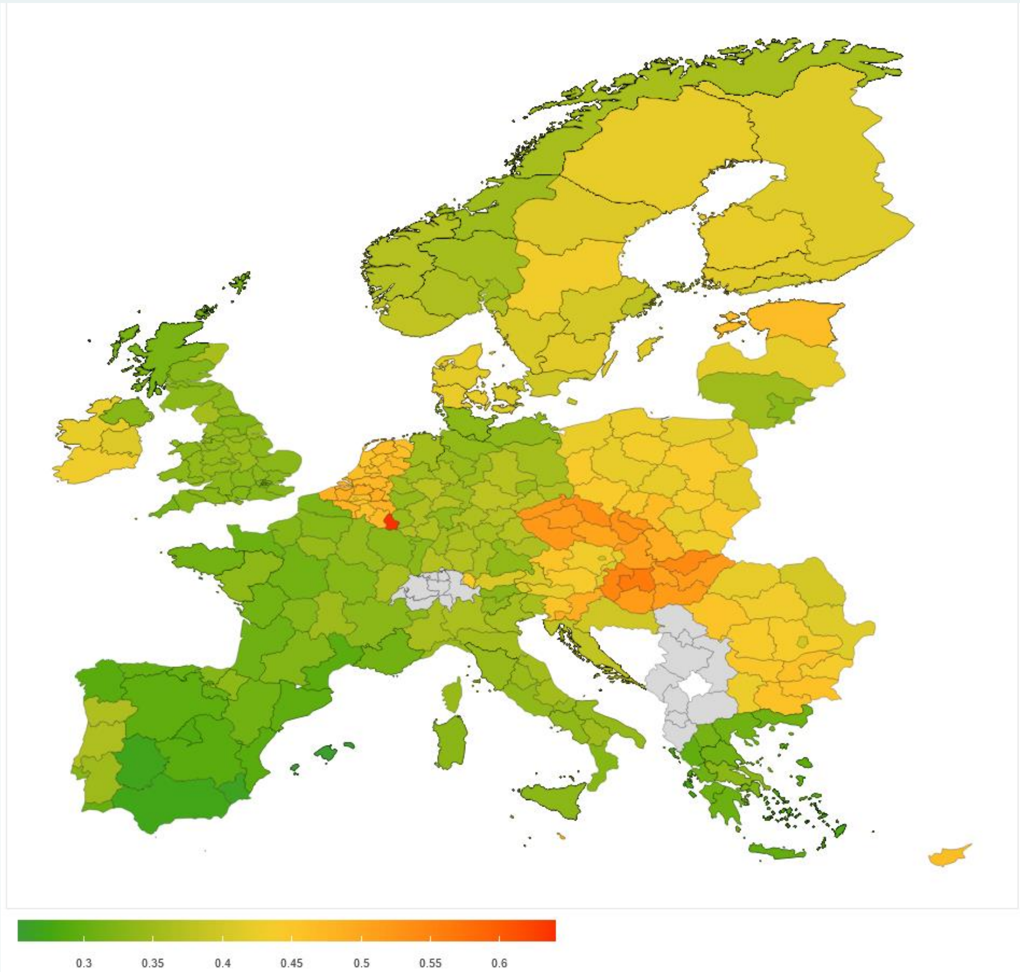
[14] Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015), "An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production", *Review of International Economics.*, 23: 575–605

[15] Particularly, in our analyses we exclude from the regional-level computations the following NACE codes that are not covered in SBS: A, K, O, P, Q, R, S, T. Please see the discussion in the Annex section devoted to the weighting scheme we adopted.

in each of its regions (e.g. if for the automotive sector in Italy the share of GVC-related trade is 40%, the assumption is that such share for the automotive sector will be the same in both Lombardy and Sicily).

Figure A3 plots the NUTS2-level map of GVC-related share of exports. It shows how the most exposed regions are those in Eastern Europe countries, probably for their strong connection with Western Europe, and those in countries active in more financially related sectors (Netherlands, Luxembourg and Ireland). The most GVC-exposed region, which is also a country, is Luxembourg, followed by Hungarian and Czech territories. The least exposed seem to be Spanish and Greek regions.

Figure A3 - Share of GVC-related trade at NUTS-2 level (weighted by labor share)



We now describe the procedures followed to build the "External Risk Disruption Indicator" (EDRI).

Building the EDR indicator (EDRI)

The first component of the EDRI is the Domestic Value Added (DVA) content of total exports in each country-sector pair. To build it, we follow the prescriptions of Belotti, Borin and Mancini (2020)[16] and Borin and Mancini (2019), by taking both the total DVA figure and all the DVAs from bilateral flows. We then aggregate the bilateral data in two groups: belonging to EU29 (EU27 + GBR + NOR) and extra-EU29 countries (including the fictional *Rest of the World* country in WIOD).
Thus, we can account for the portion of DVA generated either within Europe or outside Europe. The country-sector level measure is thus:

$$\frac{DVA_{ij}^{extraEU}}{DVA_{ij}}$$

Since we are interested in the exposure to extra-EU flows.

The relevant STATA code used to retrieve DVA information is the same as above, but we import DVA-related data rather than GVC-related data.

The second component we consider is then the portion of Extra-EU Import Value Added (VA) in each country-sector pair. We retrieve the total import-related VA from WIOD and then look at the VA originated in each of the WIOD countries, again following Belotti, Borin and Mancini (2020). We then aggregate as above in two groups: EU29 and extra-EU29. The country-sector level measure is thus:

$$\frac{VA\_IMP_{ij}^{extraEU}}{VA\_IMP_{ij}}$$

Thus, we know how much each country-sector pair is "dependent" on Extra-EU29 flows, both in its imports and exports.

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[16] Belotti, F., Borin, A. and Mancini, M. (2020). icio: Economic Analysis with Inter-Country Input-Output Tables in Stata. *World Bank: World Development Report 2020 Policy Research Paper*.
Borin, A., and Mancini, M. (2019). Measuring What Matters in Global Value Chains and Value-Added Trade. *Policy Research Working Paper; No. 8804. World Bank.*

The relevant STATA code is:

```
icio, importer(country, sector) origin(all) output(va)
```

To build the final "External Disruption Risk Indicator "(EDRI), we take a simple average between the two shares explained above and build a regional-level measure by using labor share for the same sector at the regional level as weights.

Summing the numbers over sectors and by region results in a within-region weighted average by sector of the extra-EU29 trade exposure at the regional level.

$$regio\_exposure_{ir} = \sum_j \frac{L_{irj}}{L_{ir}} * averageExp_{ij}$$

Where

$$averageExp_{ij} = mean(\frac{DVA_{ij}^{extraEU}}{DVA_{ij}}; \frac{VA_{IMP}{}_{ij}^{extraEU}}{VA_{IMP}{}_{ij}})$$

The EDRI has an average value of 0.44, with a standard deviation of 0.071.

C. Building the IDR Indicator (IDRI)

To compute the "Internal Disruption Risk Indicator" (IDRI), we rely on the sector-specific risk measure coming from the Italian Institute of Labour (INAIL).

Publicly available data[17] include a combined index that considers the two measures of contact and proximity, plus the plain aggregation one. In line with the prescriptions of the technical document, we use the aggregation measure to *weight* the first risk measure. Each social aggregation risk class correspond to a weight ranging from 1 to 1.5.

The final risk measure thus considers these two components and is computed at the NACE 2-digit level as:

$$risk_{weighted} = risk_{class} * weight_{aggregation}$$

[17] INAIL Dossier Covid 19 (Italian language. Available at: https://www.inail.it/cs/internet/comunicazione/covid-19-prodotti-informativi.html)

Since some sectors in WIOD are the result of an aggregation of multiple 2-digit sectors, we took the average *risk_weighted* measure for aggregated WIOD sectors.

To compute the NUTS-2 level risk, these measures have been weighted using the same labor weights as in the previous section, allowing for a regional comparison. As before, we computed a weighted average by sectors (j) of the risk at the regional level r:

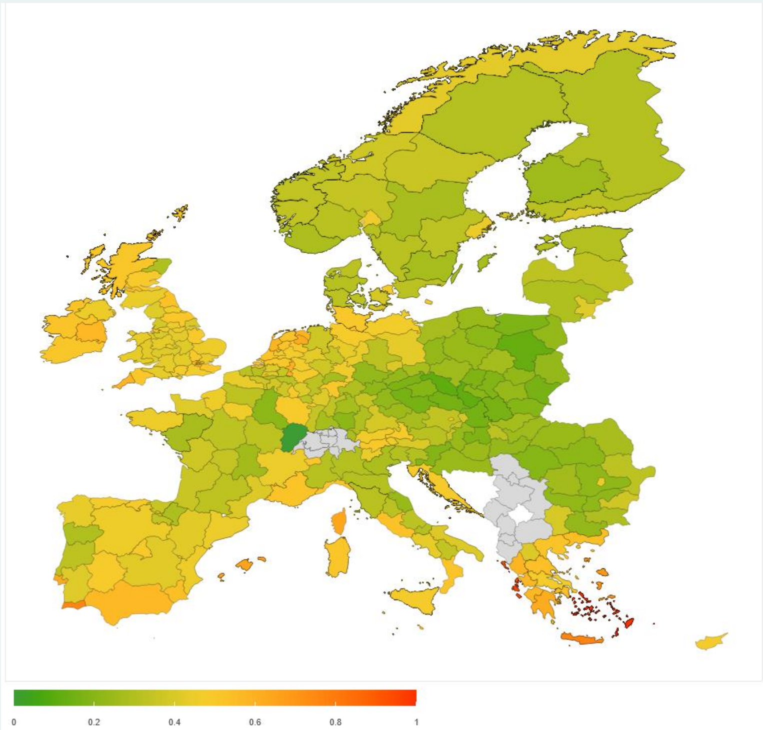
$$risk_{ir} = \sum_{j} \frac{L_{irj}}{L_{ir}} * riskweighted_j$$

The EU-level re-scaled IDRI has an average of 0.34, with a standard deviation of 0.16.

We run a comparative check using the aggregation measure only as a proxy for social risk, obtaining similar results (the two indicators are correlated at 0.9). We also run a second robustness check where we take the maximum value within aggregated WIOD sectors rather than averages: results are qualitatively similar, and the two measures are highly correlated (r = 0.96).

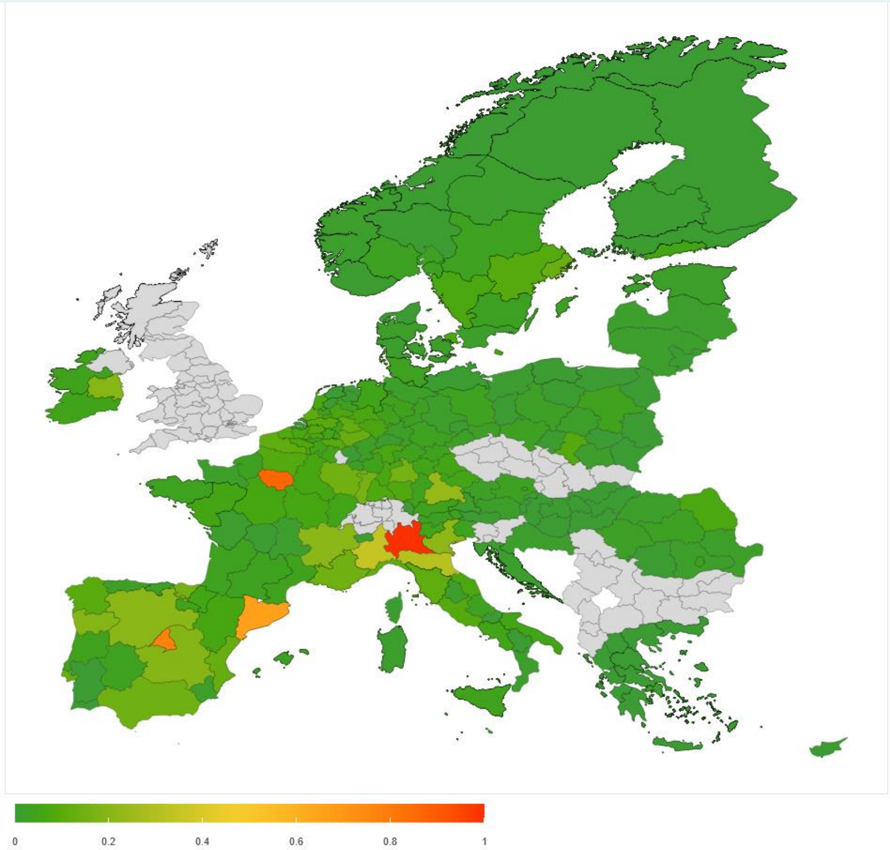
For ease of comparison, we add the EU-regions map showing the distribution of the aggregation component using SBS weights (Figure A4).

Figure A4 - Aggregation Risk (re-scaled), NUTS-2 level



Finally, Figure A5 below instead shows the regional map with absolute levels of COVID contagions.

Figure A5 - Absolute Number of COVID cases (re-scaled, up to 29/05/2020)



D. Data Availability

We make the data used for the calculations available on *github*.

You can retrieve the dataset used for the computations and the interactive version of Figure 3 at : https://github.com/andreacoali/COVID_back_to_future