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Regional Disparities in Europe

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Prepared by Ravi Balakrishnan, Christian Ebeke, Melih Firat, Davide Malacrino, and Louise Rabier

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ABSTRACT: While the level of disparities across regions in 10 advanced European economies studied in this paper mostly reflects productivity gaps, the increase since the Great Recession has resulted from diverging unemployment rates. Following the pandemic, this could be further exacerbated given teleworkability rates are lower in poorer regions than in high-income regions, making them ex-ante more vulnerable to the pandemic's likely material impact on the prevalence of remote work. Preliminary evidence from 2020 confirms that regional disparities between countries increased during 2020. A further concern is that the pandemic might accelerate the automation of jobs across Europe, something which often happens following recessions. While lagging regions have lower ex-ante vulnerabilities against the routinization, the transformation of jobs through sectors with higher routinization rates in these regions could increase their vulnerability to technological change over time. The green transition could also lead to challenges for regions that have benefitted from carbon-intensive growth strategies. Finally, the paper discusses the role for policies—including placed-based ones—in reducing disparities in the face of the aforementioned short, medium, and long-term risks.

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WORKING PAPERS

Regional Disparities in Europe

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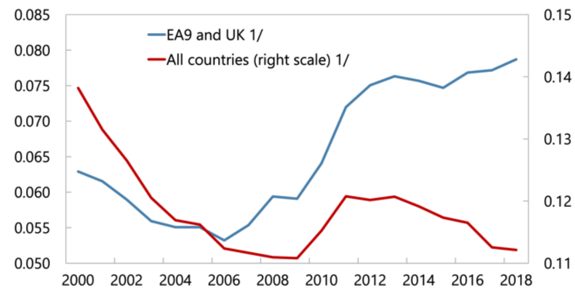
Contents

Introduction

Regional disparities among European advanced economies (aggregating both within and across) declined until the Great Recession and, depending on the coverage, have flatlined or increased thereafter.[1] Figure 1 shows that the trend for nine large EU advanced economies[2] and the United Kingdom is quite different than for all European economies, with the former displaying a marked increase in disparities.

Figure 1. Coefficient of Variation in GDP Per Capita

(Coefficient of variation)



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom. All countries: EA9, Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Luxembourg, Latvia, Malta, Poland, Romania, Slovakia, Sweden, and United Kingdom.

The COVID-19 pandemic has renewed interest in the connection between large economic downturns and disparities (IMF 2020). Considering the increase in regional disparities that followed the last large recession in Europe, this paper offers novel insights on the risks of further economic divergence across European regions resulting from the pandemic. It specifically zooms in on the structural characteristics of regions that were already stagnating prior to the crisis, and who are now likely to face relatively stronger pandemic-related headwinds.

The first part of the analysis documents the evolution of disparities in GDP per capita across European regions, decomposes disparities into within- and between-countries components, and separates the drivers of disparities into various economic components, such as employment, labor force participation, and productivity.

The second part of the paper focuses on the COVID-19 pandemic and considers its likely impact on disparities across European regions, in the short, medium, and long run. For example, it assesses the extent to which the decline in mobility, low levels of teleworkability,[3] and the exposure to routinization,[4] are likely to trigger asymmetric effects of the pandemic across regions and shape divergent regional economic recoveries.

Taking a long-run perspective, the paper also examines the impact of goals associated with the green transition planned by the European Union (EU). A close look at the data points suggests the need to carefully consider how to address the impact of the green transition on certain regions. In particular, those regions with a low GDP per capita level but high growth have traditionally been dependent on carbon-inefficient sectors both in terms of production and shares of employment. So, there will need to a strong policy focus on making sure such regions can transition smoothly to greener and more sustainable growth.

Finally, we discuss how "place-based" policies might help reduce disparities, including the potential adverse effects of the pandemic. Besides noting the benefits of spatially-targeted policies on lagging regions, we argue that post-pandemic policies should focus on increasing the teleworkability of regions and improving

[1] The analysis examines the sources of disparities in GDP per capita across regions at the NUTS-2 level. Specifically, we use the coefficient of variation (CV) to measure dispersion across regions each year. Each component is further broken down into the contribution of each country. Another decomposition allows separating the drivers of dispersion in GDP per capita into the dispersion of its components: regional labor productivity, the employment to labor force ratio (ELR), the labor force participation rate, and the working-age share.

[2] Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, Spain (and the United Kingdom). Figure A1 and A2 confirm that inequality went up during 2020, although data for the UK are not available in that year.

[3] Regional teleworkability rates are calculated following Dingel and Neiman (2020).

[4] Regional exposure to routinization/automation (indexes) are calculated following Autor and Dorn (2013).

vulnerabilities to automation. Furthermore, we take two German regions to provide a micro-level analysis on potential green/growth tradeoffs that we stress in the paper. Overall, a holistic approach will be needed to make sure that nobody (or no one region) gets left behind from climate change mitigation policies given the sectoral transformation they will induce.

The paper is organized as follows. Section 2 presents the dataset and the concepts used in the paper. Section 3 shows the evolution of regional disparities across regions for the period before the COVID-19 pandemic. Section 4 discusses the channels by which the pandemic can potentially impact regional disparities. Section 5 discusses if there is a green/growth tradeoff related to climate change mitigation policies, while Section 6 considers what mix of policies can help reduce disparities, including place-based policies. Section 7 concludes.

Data and Measurement of Disparities

The analysis uses data on GDP, employment (aggregate, at the sector level, and by firm size), and population at the NUTS-2 regional level provided by Eurostat, with a focus on nine EU countries (Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, Spain) and the U.K.

These data are combined with occupation-customer interaction indexes from Koren and Peto (2020), occupation-teleworkability rates from Dingel and Neiman (2020), and occupation-routinization indexes from Autor and Dorn (2013), to investigate the channels through which the COVID-19 pandemic is likely to impact European regional disparities. Moreover, the Google Community Mobility Report provides daily regional mobility data, and the European Pollutant Release and Transfer Register (E-PRTR) has information on regional GHG emission levels.

To assess the level and dynamics of disparities in GDP per capita across regions r, the chosen measure is the unweighted square of Coefficient of Variation (CV^2) as it can be decomposed into within- and between-country components. Moreover, CV^2 displays a variable's dispersion independent of its unit.[5] Hence, while the standard deviation cannot be used to compare the level of dispersion across two different variables, CV^2 can be used to this end as it is scale-free, a useful feature leveraged in the analysis to compare disparities across the components of GDP per capita. The square of the CV can be written as:

$$CV(y)^2 = \frac{1}{y^2}\left[\frac{1}{N}\sum_{c=1}^{C}\sum_{r=1}^{N_c}(y_{rc} - y)^2\right]$$

where y_{rc} and y denote regional (the *rc* index denotes region r in country c) and average GDP per capita, respectively, and N_c and N denote the number of regions in country c and the total number of regions across all countries considered. The measure lends itself to a useful decomposition into within- and between-country components as:

$$CV(y)^2 = \underbrace{\sum_{c=1}^{C}\left(\frac{y_c}{y}\right)^2\frac{N_c}{N}\underbrace{\left[\frac{1}{y_c^2}\frac{1}{N_c}\sum_{r=1}^{N_c}(y_{rc} - y_c)^2\right]}_{CV(y_c)^2}}_{CV_W} + \underbrace{\frac{1}{y^2}\sum_{c=1}^{C}\frac{N_c}{N}(y_c - y)^2}_{CV_B}$$

[5] As the CV is the ratio between the standard deviation and the mean of a variable and both statistics are measured in the same unit, their ratio is unit free. Squaring the CV does not change this feature of the measure.

where CV_W and CV_B denote the within- and between-country components of the CV^2 in GDP per capita.

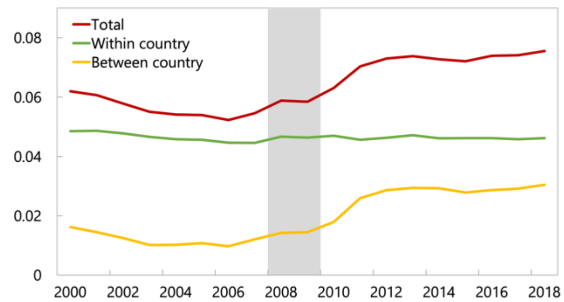
Anatomy of Regional Disparities

In this section, we analyze the trends in regional disparities in GDP per capita and its components. We provide a decomposition into within- and between-country components and assess the evolution of these components over time.[6]

The Evolution of Disparities Since the Early 2000s

Figure 2 shows that total disparities across regions declined slightly through 2006. However, post-2006 total disparities started moving up slowly, to erase the earlier gains on the eve of the Great Recession. The divergence accelerated after the Great Recession and was mostly driven by increased between-country gaps, although, within-country disparities appear to be consistently higher than between-country disparities looking across the whole period. During 2020, disparities increased by about 0.01 points in terms of the coefficient of variation, mostly driven by between-country gaps.[7]

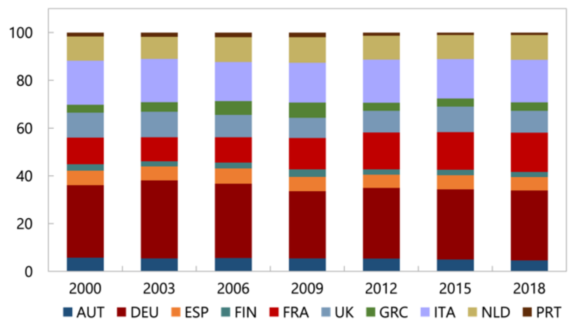
Figure 2. Coefficient of Variation in GDP Per Capita
(EA9 and UK; coefficient of variation) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

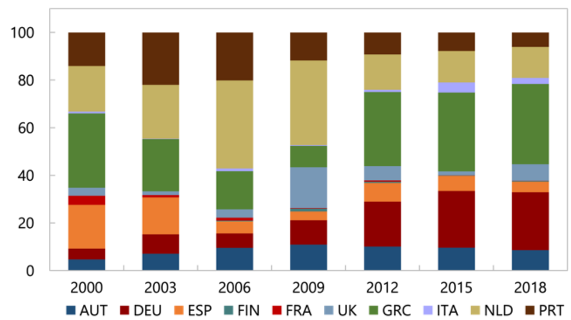
A decomposition of within- and between-country disparities sheds light on the contribution of each country to both components. The left panel in Figure 3 shows that Germany and Italy have the largest disparities across their regions, consistent with substantial East/West and North/South differences in each country. The right panel shows that the increase in between-country disparity after the Great Recession has been driven by relatively weaker GDP per capita growth in Greece and stronger growth in Germany.

Figure 3.1. GDP Per Capita Disparity (Country Contribution)
(Percent; within country) 1/



Sources: Eurostat; and IMF staff calculations.
1/ Legend uses (ISO) country codes.

Figure 3.2. GDP Per Capita Disparity (Country Contribution)
(Percent; between country) 1/



Sources: Eurostat; and IMF staff calculations.
1/ Legend uses (ISO) country codes.

[6] While our main analysis focuses on disparities in GDP per capita, appendix B reports other results on disparities in disposable income, emphasizing the role of tax and transfers.

[7] See appendix A. 2020 data excludes the UK following its exit from the EU.

In the next subsection, we propose a canonical decomposition of regional GDP per capita into its components to better isolate the main sources of regional disparities in GDP per capita.

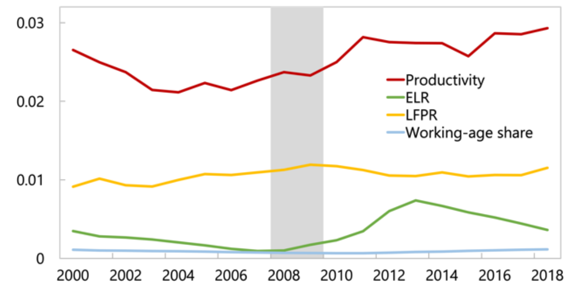
Components of the GDP per Capita

Leveraging the EUROSTAT data across NUTS-2 regions, GDP per capita can be decomposed into labor productivity, the employment to labor force ratio (ELR) (or one minus the unemployment rate), the labor force participation rate, and working-age population share as follows:

$$y = \frac{GDP}{Pop} = \frac{GDP}{Emp} \times \frac{Emp}{LF} \times \frac{LF}{WorkAgePop} \times \frac{WorkAgePop}{Pop}$$

Figure 4 shows that productivity is responsible for the largest fraction of disparities and drove up disparities in GDP per capita after the Great Recession together with the ELR. While productivity has preserved its prominent share, the dispersion in ELR has declined since 2013, pointing to a convergence in unemployment rates across countries in this period.

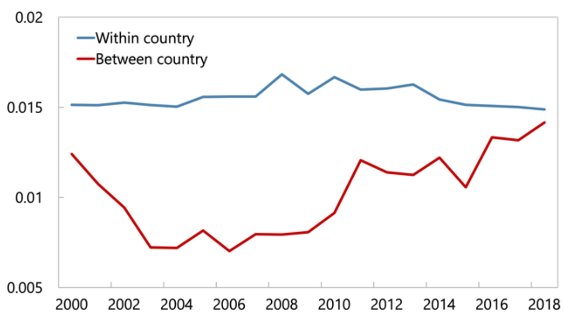
Figure 4. Coefficient of Variation for the Components of GDP Per Capita
(EA9 and UK; coefficient of variation) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

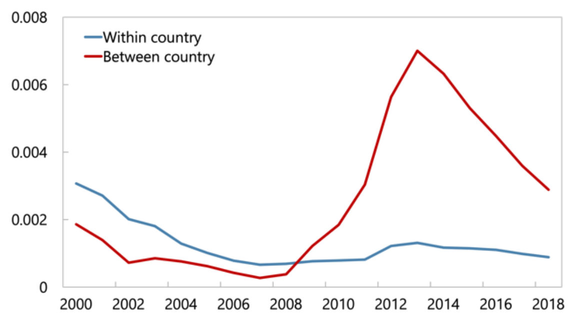
We also find that within-country disparities appear to be the most important component of the dispersion of each variable except for the ELR (Figure 5). The increasing ELR dispersion explains growing GDP per capita disparities after the Great Recession, driven by an increase in ELR divergence between countries: this is driven by decreasing unemployment rates in Germany against significant job losses in in all other countries (especially in Greece, Spain, and Portugal).

Figure 5.1. Country Decomposition of Productivity
(EA9 and UK; coefficient of variation) 1/



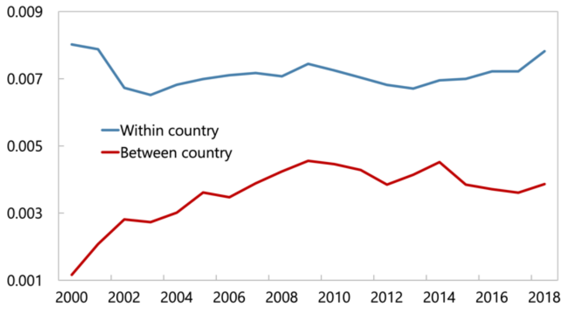
Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

Figure 5.2. Country Decomposition of ELR
(EA9 and UK; coefficient of variation) 1/



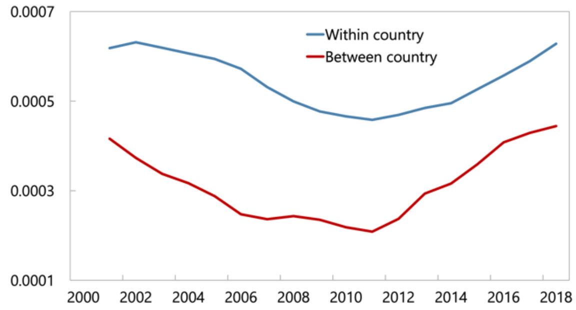
Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

Figure 5.3. Country Decomposition of LFPR
(EA9 and UK; coefficient of variation) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

Figure 5.4. Country Decomposition of Working-Age Share
(EA9 and UK; coefficient of variation) 1/



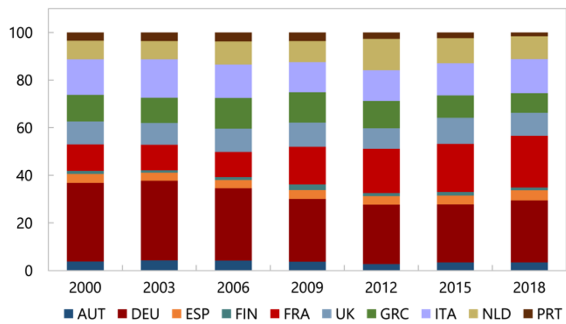
Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

Productivity

When focusing on regional productivity gaps (measured by GDP per employee), the left panel of Figure 6 shows considerable disparities within some high-productivity countries such as Germany, the Netherlands, and France.

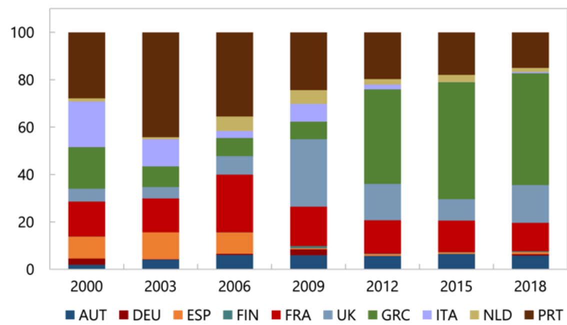
Meanwhile, the low-productivity levels recorded in Greece and Portugal contribute to more than half of the between-country disparities. Yet, Portugal's productivity has been slightly converging to the mean, while productivity in Greece has diverged sharply from the mean.

Figure 6.1. Productivity Disparity (Country Contribution)
(Percent; within country) 1/



Sources: Eurostat; and IMF staff calculations.
1/ Legend uses (ISO) country codes.

Figure 6.2. Productivity Disparity (Country Contribution)
(Percent; between country) 1/

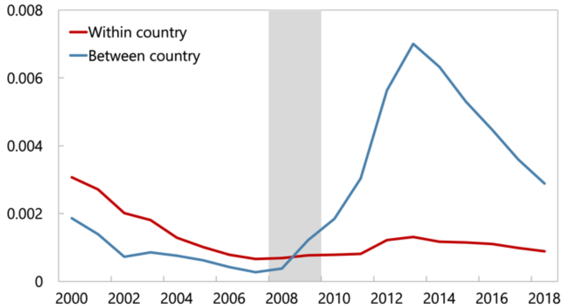


Sources: Eurostat; and IMF staff calculations.
1/ Legend uses (ISO) country codes.

Labor Markets

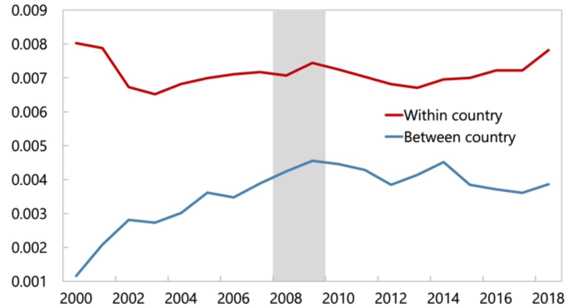
Figure 7 shows the sharp increase in between-country disparities in the ELR. However, the dispersion in labor force participation rates evolved entirely differently between 2000 and 2018. Dispersion increased steadily until 2009 in both between and within components, but a mild convergence has followed until recently.

Figure 7.1. Country Decomposition of ELR
(EA9 and UK; coefficient of variation) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

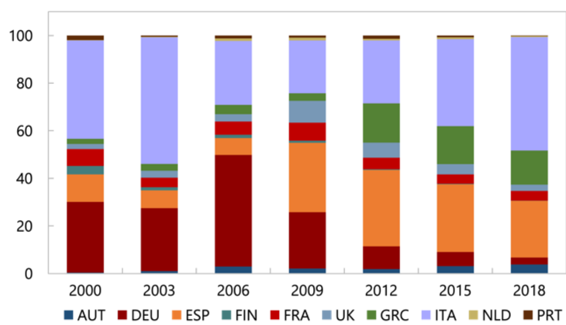
Figure 7.2. Country Decomposition of LFPR
(EA9 and UK; coefficient of variation) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

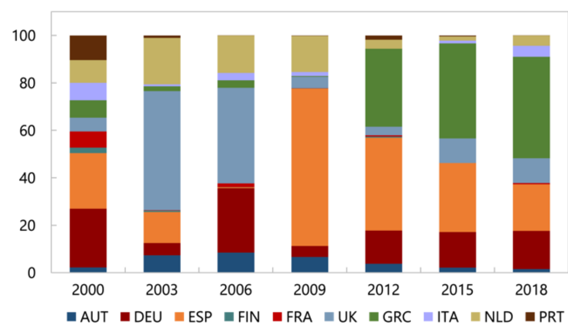
Contributions of each country to the within- and between-country disparities in the ELR are shown in the left and right chart, respectively, of Figure 8. Within-country disparities in the ELR were higher in Italy and Germany compared to other countries in 2000. However, Germany succeeded in lowering the dispersion across its regions over the next 15 years, whereas Italy's contribution to total within-country dispersion has only slightly changed during this period.

Figure 8.1. ELR Disparity (Country Contribution)
(Percent; within country) 1/



Sources: Eurostat; and IMF staff calculations.
1/ Legend uses International Organization for Standardization (ISO) country codes.

Figure 8.2. ELR Disparity (Country Contribution)
(Percent; between country) 1/



Sources: Eurostat; and IMF staff calculations.
1/ Legend uses International Organization for Standardization (ISO) country codes.

The right chart shows that the ELR in Italy, Finland, France, and Portugal have been around the mean across 10 countries during this period. The significant drop in the ELR in Spain and Greece explains the substantial increase in the between-country component of the ELR CV^2 after the Great Recession.

Beta-convergence

After having relied so far on the coefficient of variation as our main method of assessing regional disparities, and qualitatively formed a view on the progress made on regional convergence, we now resort to a traditional method for quantifying the strength of regional convergence or divergence by using an econometric specification dubbed the Beta convergence framework. The basic equation takes the following form:

$$\Delta y_{r,t} = \alpha + \beta y_{r,t-1} + \varepsilon_{r,t}$$

where $y_{r,t-1}$ denotes the initial level of the variable of interest (e.g., real regional GDP per capita), and $\Delta y_{r,t}$ denotes the average annual change in this variable during a specific period. A negative estimate of the β

coefficient means that the regions with a lower initial level in y experienced a relatively faster growth rate, suggesting convergence.

In the following analysis, y will represent GDP per capita and its components separately. We estimate the equation for the period before the Great Recession (2000–08) and afterwards (2008–18), and test whether the crisis has led to a change in the convergence trend across NUTS-2 regions in the 10 countries (Table 1, Panel A).

Then, we enrich the specification by adding country-fixed effects to control for country-specific shocks during each period (Table 1, Panel B) and to infer within-country regional convergence directly from the estimated Beta coefficients.

Table 1. Beta-Convergence: With and Without Country Fixed Effects

Panel A	Without country-fixed effects									
	Pre-GR	Post-GR	Pre-GR	Post-GR	Pre-GR	Post-GR	Pre-GR	Post-GR	Pre-GR	Post-GR
	$\Delta y_{r,t}$	$\Delta y_{r,t}$	$\Delta prod_{r,t}$	$\Delta prod_{r,t}$	$\Delta ELR_{r,t}$	$\Delta ELR_{r,t}$	$\Delta LFPR_{r,t}$	$\Delta LFPR_{r,t}$	$\Delta was_{r,t}$	$\Delta was_{r,t}$
α	0.056***	-0.026*	0.198***	0.004	-0.005***	0.0007	0.006***	0.003***	-0.019***	-0.007**
	(0.010)	(0.014)	(0.047)	(0.074)	(0.0005)	(0.001)	(0.001)	(0.0007)	(0.002)	(0.003)
β	-0.008^{**}	0.011^{***}	-0.016^{***}	0.0004	-0.082^{***}	0.024	0.002	-0.005^{**}	-0.044^{***}	-0.009
	(0.003)	(0.004)	(0.004)	(0.007)	(0.007)	(0.017)	(0.005)	(0.002)	(0.006)	(0.006)
No of Obs	168	168	168	168	168	168	168	168	168	168
R^2	0.027	0.053	0.072	0.0001	0.693	0.024	0.001	0.069	0.261	0.008
Panel B	With country-fixed effects									
	Pre-GR	Post-GR	Pre-GR	Post-GR	Pre-GR	Post-GR	Pre-GR	Post-GR	Pre-GR	Post-GR
	$\Delta y_{r,t}$	$\Delta y_{r,t}$	$\Delta prod_{r,t}$	$\Delta prod_{r,t}$	$\Delta ELR_{r,t}$	$\Delta ELR_{r,t}$	$\Delta LFPR_{r,t}$	$\Delta LFPR_{r,t}$	$\Delta was_{r,t}$	$\Delta was_{r,t}$
α	0.063***	0.032***	0.101*	0.181***	-0.003***	-0.001	0.006***	0.003**	-0.013***	-0.008**
	(0.008)	(0.008)	(0.053)	(0.049)	(0.0006)	(0.005)	(0.002)	(0.001)	(0.003)	(0.003)
β	-0.008^{***}	-0.003	-0.006	-0.014^{***}	-0.086^{***}	-0.009	-0.011^{**}	-0.001	-0.033^{***}	-0.018^{**}
	(0.003)	(0.002)	(0.005)	(0.004)	(0.007)	(0.011)	(0.004)	(0.004)	(0.007)	(0.007)
No of Obs	168	168	168	168	168	168	168	168	168	168
R^2	0.706	0.805	0.587	0.756	0.778	0.821	0.396	0.237	0.656	0.529
* p < 0.10, ** p < 0.05, *** p < 0.01										

Panel A shows the estimation results without controlling for country-fixed effects to test for convergence across regions. The results suggest that before the Great Recession, β-convergence in GDP per capita was statistically significant, with contributions from convergence in productivity, the ELR, and the working-age population share. However, after the Great Recession, the results point to a sharp divergence in GDP per capita across regions in the 10 countries.

The within-country convergence estimates (i.e., when the econometric model includes country-fixed effects in Panel B) also suggest convergence in per capita GDP before the Great Recession, led by a somewhat stronger within-country convergence in the ELR. However, within-country convergence in GDP per capita becomes insignificant following the crisis. Comparing the estimates from panel A and B, we find between-country rather than within-country divergence in the 10 countries, confirming the previous results.[8]

[8] These findings are also robust to examining 2010 rather than 2008 as a reference point (i.e., around the European Sovereign Debt Crisis rather than the Great Recession; see Appendix Table A1).

Potential Impact of the COVID-19 Pandemic on Existing Disparities

This section discusses the potential effects of the COVID-19 pandemic on regional disparities in Europe. It follows an emerging literature that has examined the consequences of pandemics and associated policy responses on inequality. Furceri et al. (2020) use evidence from the past pandemics and argue that the COVID-19 pandemic might result in higher income inequality within countries in the absence of protective policies. Palomino et al. (2020) measure the impact of social distancing enforced policies on poverty and wage inequality for Europe, and find that poverty will increase, and wage losses will be experienced.

Here we focus on the possible channels through which the COVID-19 pandemic could affect regional inequality/disparities in Europe in the short, medium, and long run. We start by using Google Community Mobility Report as a proxy for shock intensity across European regions. Changes in mobility reflect both the restrictions imposed by the lockdowns and the autonomous decisions of citizens to move around less following the pandemic waves. The extent to which such changes effectively translated into economic disruptions was heavily dependent on the ability of workers to keep performing their jobs from home. Where remote work was possible thanks to the type of economic activities prevalent in a certain region, the economic consequences of large changes in mobility were arguably lower. Hence, in the reminder of the section we examine to what extent a (low) teleworkability rate acts as shock transmitter. In addition, we look at the role of a (high) customer interaction index across regions, and the intensity of job routinization.

To better highlight the differences across regions, we make use of a taxonomy that classifies regions into four distinct categories, all based on initial GDP levels and GDP growth rates between 2002 and 2016:

1. Low-income/low-growth (*Lagging*) regions are defined as those whose GDP per capita in 2003 was lower than the regional median and whose growth was lower than the country's average from 2002–16.
2. Low-income/high growth (*Catching up*) regions have GDP per capita below the regional median, but their growth rate was faster than the country's average from 2002–16.
3. High-income/low growth (*Striving*) regions are those whose GDP per capita in 2003 was higher than the regional median and whose growth was lower than the country's average from 2002–16.
4. High-income/high growth (*Thriving*) regions have GDP per capita above the regional median, and their growth rate was higher than the country's average from 2002–16.[9]

A Snapshot from High-frequency Data: Mobility Index

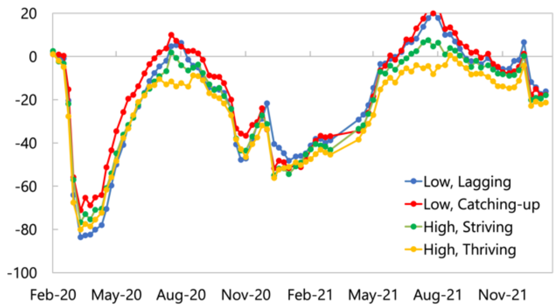
The Google Community Mobility Index is available daily for NUTS-2 regions since February 2020, and each daily index is compared to the mobility index during the January 3 and February 6 period. We use mobility to "Workplace" and "Retail Stores." The decline in mobility captures a mix of shock intensity and policy response (lockdowns) as both induce lower mobility.

Figures 9.1 and 9.2 show the weekly mobility index starting from February 15 for each regional group. We find that Low, Lagging regions experienced a larger decline in mobility during the first pandemic wave, around Retail stores and Workplaces, potentially suggesting that they suffered a larger economic contraction than

[9] The list of regions in each category is shown in Appendix A Table A2.

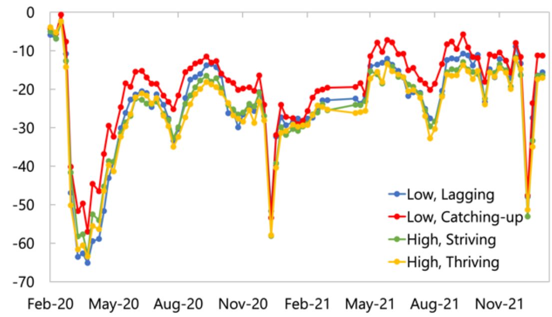
other regions. However, the mobility difference between Low, Lagging regions and High-income regions largely disappeared by June 2020.

Figure 9.1. Mobility Change in Retail
(Index) 1/



Sources: Google Community Mobility Reports; and IMF staff calculations.
1/Retail: Mobility trends for places like restaurants, cafes, shopping centers, theme parks, museums, libraries, and movie theaters.

Figure 9.2. Mobility Change in Workplaces
(Index) 1/



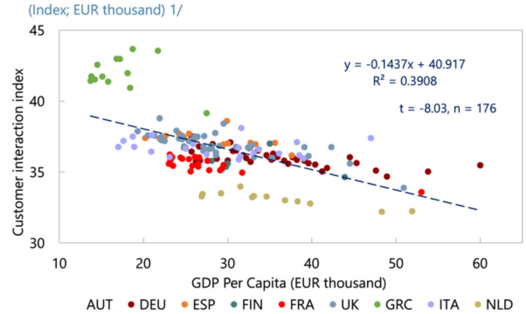
Sources: Google Community Mobility Reports; and IMF staff calculations.
1/ Workplaces: Mobility trends for places of work.

Customer Interaction Intensity

Next, we use the occupation-customer interaction index from Koren and Peto (2020) to further examine the differences across regions regarding dependency on occupations characterized with high customer intensity. The more a region has specialized in activities involving higher customer interaction intensity (e.g., counselors, social workers, and salespersons), the larger the expected activity loss due to lockdowns. Hence, if the employment share of these occupations is high in total employment in a region, then the region has a high customer interaction index.

In general, one can see a negative association between the level of economic development and the prevalence of occupations characterized by a higher customer interaction intensity (Figure 10). As Low-income regions in our sample tend to have a higher share of jobs with high customer-interaction, one would therefore expect that any decline in mobility would result in a larger negative impact on these regions. In the next section, we show the evidence from teleworkability rates across regions that supports this result.

Figure 10. Customer Interaction Intensity
(Index; EUR thousand) 1/



Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Koren and Peto (2020).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Short-term Risks: Teleworkability

Teleworkability rates for NUTS-2 regions are calculated combining the occupation-level teleworkability rates from Dingel and Neiman (2020) and combined with information on employment by occupation at the country level and employment by sector at the regional level.

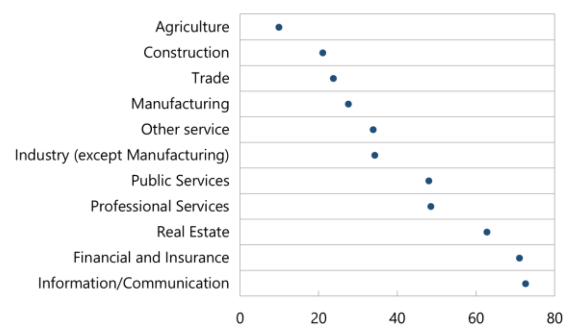
The process is not straightforward since EUROSTAT provides disaggregated employment data by sector and region at the 1- or 2-digit NACE-REV 2 codes, but it does not provide occupation-level employment levels at the NUTS-2 regional level. Therefore, data from the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) is used to calculate the share of each 2-digit ISCO occupation in the 10 sectors for each nine countries separately.[10] Then, using the occupation-sector share matrix, the sector-region teleworkability rates are computed by taking a weighted average of occupation-teleworkability rates from Dingel and Neiman (2020).

The last step is to aggregate sector-region teleworkability rates to the regional teleworkability rate by using sectoral employment data. The imputation relies on two strong assumptions. First, it relies on the assumption that teleworkability by occupation is the same across countries: in particular, Dingel and Neiman (2020) compute such an index for the U.S., and the same classification is adopted for the same occupation in other countries. Second, the occupation-sector matrix is computed at the country level and assumed to be the same across regions within country. Such an assumption is required as the PIAAC survey does not contain regional codes.

Below are the four steps to calculate region-teleworkability rates for each NUTS-2 regions:

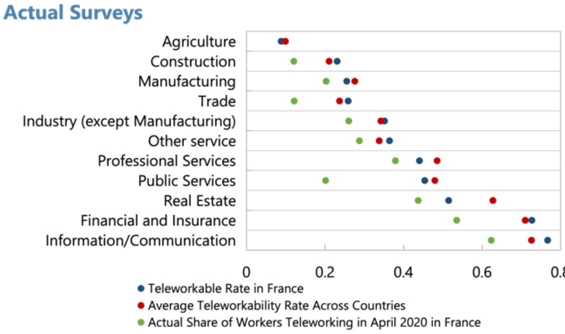
1. The occupation-teleworkability rates, $teleworkable_l$, from Dingel and Neiman (2020) at each 2-digit ISCO 2008 occupations l.
2. The share of each 2-digit ISCO occupation in each 1-digit sector for each country from the OECD PIAAC data: $w_{l,k,c} = \frac{Emp_{l,k,c}}{\sum_l Emp_{l,k,c}}$ where $Emp_{l,k,c}$ is the employment level in occupation l, sector k, and country c.
3. Using these weights, sector-country teleworkability rates are obtained as weighted averages of occupation teleworkability rates: $telework_{k,c} = \sum_l w_{l,k,c} \times telework_l$ where $teleworkable_{k,c}$ denotes the teleworkability rate in sector k, and country c.
4. Finally, sector-region employment shares from EUROSTAT, $w_{k,r}$, and sector-country teleworkability rates, $telework_{k,c}$, are combined to get the regional teleworkability index as: $teleworkable_r = \sum_k w_{k,r} \times telework_{k,c(r)}$ where $w_{k,r} = \frac{Emp_{k,r}}{\sum_k Emp_{k,r}}$ denotes the employment share of sector k in total employment in region *r's* country $c(r)$.

Figure 11. Teleworkability Rate Distribution Across Sectors
(Percent)



Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Dingel and Neiman (2020).

Figure 12. Comparison of Our Teleworkability Index with Actual Surveys



Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; French Labor Ministry (DARES): "Labor force activity and employment conditions survey - Covid Summary of results, June 2020"; and IMF staff calculations using Dingel and Neiman (2020).

Figure 11 shows the distribution of teleworkability rates across sectors ($telework_k$). As expected, teleworkability rates appear low in agriculture, construction, retail trade and wholesale, and transportation and other services, whereas information and communication and financial and insurance activities exhibit the highest teleworkability rates.

We then compare our sector-country teleworkability rates with the actual teleworking surveys conducted during the pandemic (Figure 12). The comparison of blue and green

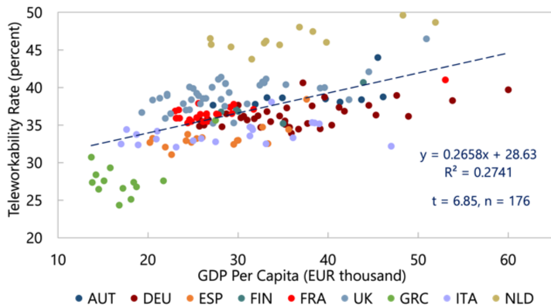
[10] Since Portugal has not participated at PIAAC, we could not calculate sectoral teleworkability rates, customer intensity and routinization indexes for this country. Therefore, all the analysis for the second part of the paper excludes Portuguese regions.

dots shows that our measure slightly overpredicts the sectoral teleworkability rates but provides a successful approximation overall.

Plotting regional teleworkability rates against GDP per capita (Figure 13) unsurprisingly shows that richer European regions seem to have a higher share of jobs that can be performed from home. The positive correlation suggests that COVID-19 might exacerbate regional disparities in the short run since poorer regions have had more jobs affected social distancing measures to flatten the infection curve. Section 6 will discuss the roles of place-based policies in addressing the potential risks on Lagging regions due to lacking the infrastructure to sustain economic activity.

Figure 13. Teleworkability Rate vs. GDP Per Capita

(Percent; EUR thousand) 1/

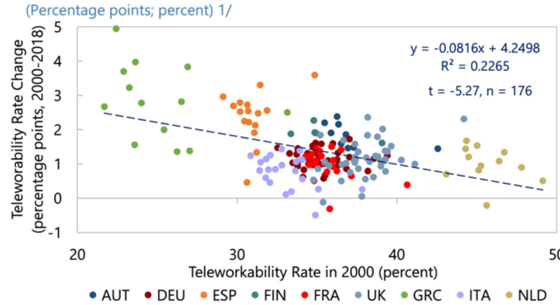


Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Dingel and Neiman (2020).

1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Figure 14. Change in Teleworkability Rate Between 2000 and 2018

(Percentage points; percent) 1/



Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Dingel and Neiman (2020).

1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Moreover, Figure 14 shows that regions with relatively lower teleworkability rates in 2000 have since increased the number of jobs that can be done from home. More specifically, the teleworkability rate in the region at the 10th percentile of the initial teleworkability rate distribution increased by 1.6 percent, whereas the change at the 90th percentile of the initial teleworkability rate distribution has only been 0.8 percent. As regional teleworkability rates were only 30.5 percent and 41 percent at the 10th and 90th percentile in 2018, the convergence process has a long way to go.

Longer-term Risks: Automation

There are also longer-term risks for local labor markets and regional disparities. One such risk is the vulnerability of regions to automation.[11] Since there is significant heterogeneity in the number of jobs at risk due to automation across regions, an adverse shock to local labor markets from higher robotization incentives might exacerbate existing disparities.

To calculate an index of jobs at risk from automation at NUTS-2 level, our data are combined with the occupation level routine task-intensity (RTI) index defined by Autor and Dorn (2013) as:

$$RTI_{l,t} = \ln\left(T^R_{l,t}\right) - \ln\left(T^M_{l,t}\right) - \ln\left(T^A_{l,t}\right)$$

[11] See Chapter 3 of IMF (April 2021) for further discussion on how COVID-19 might exacerbate pre-existing trends given the vulnerability of labor markets to automation.

where $T^R_{l,t}$, $T^M_{l,t}$ and $T^A_{l,t}$ denote the routine, manual, and abstract task inputs in each occupation l, respectively. The process is similar to the one adopted to compute the teleworkability rates.

Here are the steps to calculate the routinization rate for each NUTS-2 regions:

1. The occupation-routinization index from Autor and Dorn (2013) gives a measure of routinization for each 3-digit occupations in the OCC1990 code.
2. Then, two crosswalks from BLS allow mapping such an index from the original OCC1990 classification to the needed SOC2010 classification:

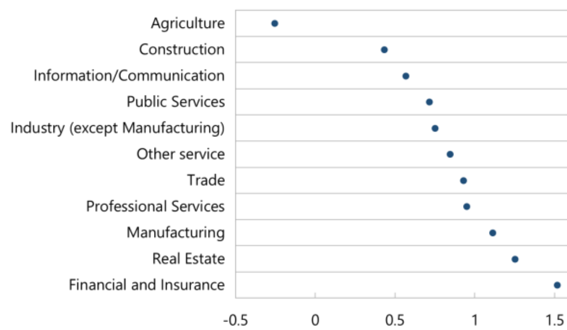
$$OCC1990 \longrightarrow OCC2000 \longrightarrow SOC2010$$

3. Once the occupation-routinization index is recovered for each SOC2010 occupation, steps 1–4 from the teleworkability section are followed to calculate sector-country routinization indexes, $RTI_{k,c}$, and regional indexes, RTI_r.

Figure 15 shows the sectoral routinization indexes. The agriculture sector has the lowest routinization index, as expected, while manufacturing sector jobs are at high risk of automation. The sectoral routinization indexes are similar to the ones from Das and Hilgenstock (2018).

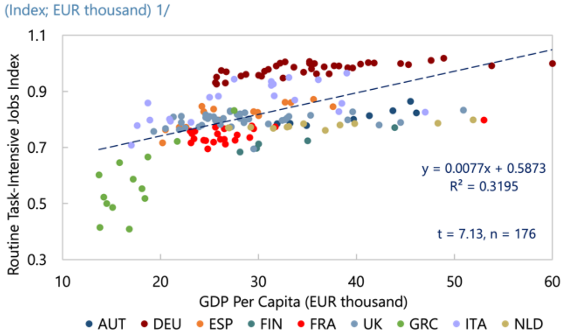
A plot of regional routinization index, RTI_r against the region's GDP per capita (Figure 16) shows that richer regions have more jobs at risk from automation. Therefore, longer-term risks from adverse technological shocks through automation are lower for poorer regions than for richer regions.

Figure 15. Vulnerability to Automation Across Sectors
(Routinization index)



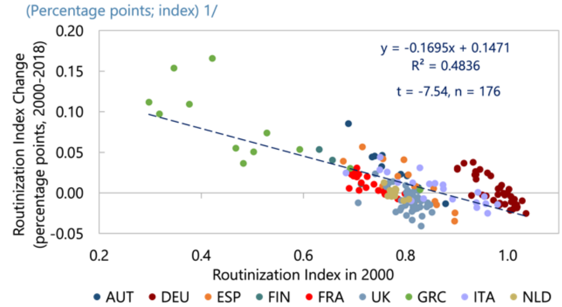
Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Autor and Dorn (2013).

Figure 16. Automation Vulnerability vs. GDP Per Capita
(Index; EUR thousand) 1/



Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Autor and Dorn (2013).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Figure 17. Change in Routinization Index Across Regions Between 2000 and 2018
(Percentage points; index) 1/

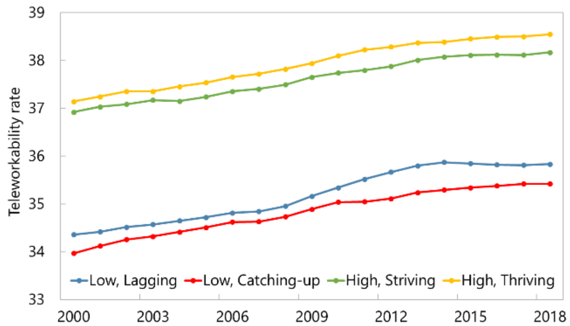


Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Autor and Dorn (2013).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

However, there is a negative correlation between the initial routinization index in 2000 and the change in this index over the 18 years (Figure 17). The routinization index has decreased (increased) in the regions with a high (low) initial routine job intensity. Since our sector-routinization index is constant over time, this result is explained by the sectoral shift in regions. The highest increase in the routinization index is observed in Greek regions where the share of agriculture (least routinization index) in employment decreased, and the share of manufacturing (high routinization index) increased during this period. On the other hand, the routinization index change was negative for most U.K. regions and half of the French, German, and Italian regions, implying that workers have switched to sectors with lower routinization index between 2000 and 2018.

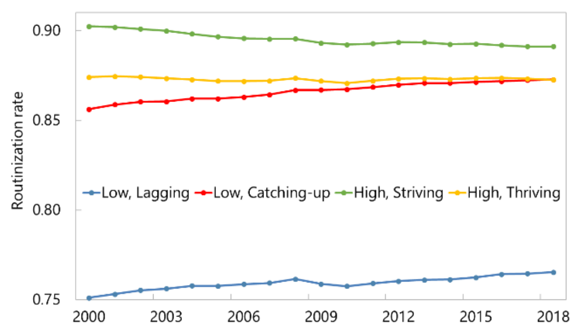
We also represent the results for the four groups in Figure 18. The left chart shows that the speed of convergence in the teleworkability rate is low. The right chart shows that *ex-ante* vulnerabilities from automation are lower in lagging regions. However, the increasing trend in the routinization rate in these regions will likely shape future vulnerabilities.

Figure 18.1 Teleworkability Rate Across 4 Groups
(Percent)



Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Dingel and Neiman (2020).

Figure 18.2 Routinization Index Across 4 Groups
(Percent)



Sources: Eurostat; OECD – PIAAC Survey of Adult Skills; and IMF staff calculations using Autor and Dorn (2013).

Disparities and the Green Transition

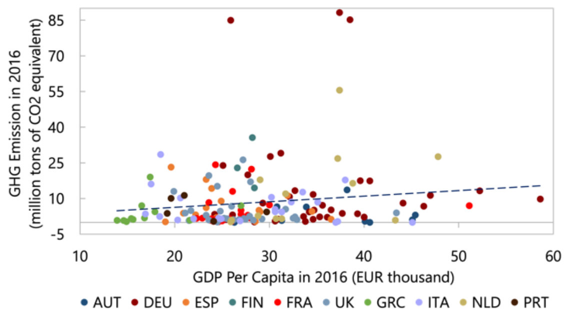
The last part of the analysis focuses on climate risks across regions. We rely on data on GHG emissions levels and intensity to analyze the efforts needed at the regional level to start green transitions. This perspective is especially important given the groundbreaking NextGenerationEU package that was introduced during the pandemic. In particular, NextGenerationEU has significant requirements for investment in green technologies.

The GHG emissions level is calculated annually for each region using European Pollutant Release and Transfer Register (E-PRTR) data. The data covers large industrial facilities and is available annually after 2007. GHG emission intensity represents GHG emissions per unit of value added in the least carbon-efficient sectors: Energy and Manufacturing Industry.[12]

The analysis finds consistently weak and mixed associations between economic indicators and GHG emissions levels. For instance, in Figure 19 the left chart shows a slightly positive correlation between GDP per capita and GHG emission levels across regions, while the right chart displays a negative relationship between income level and GHG emission intensity. A possible rationalization of this result is that richer regions have high activity in the manufacturing industry, hence GHG emissions are higher. Yet, the high value added in this sector leads to a relatively lower GHG emissions intensity.

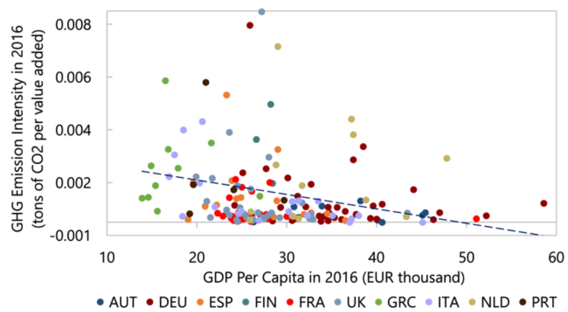
[12] This dataset, although suffering from some shortcomings compared to other national level datasets (such as incompleteness or varying thresholds; and the absence of treatments for statistical use), it is the only dataset covering emissions at regional level. Moreover, its coverage is significant: In 2016, emissions reported in the E-PRTR by the 10 countries covered in our study represented about 98 percent of GHG emissions of the direct energy production and manufacturing industries emissions and the minimum country coverage was 72 percent.

Figure 19.1 GHG Emission by Regions in 2016
(EA9 and UK; million tons of CO2 equivalent; EUR thousand) 1/



Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

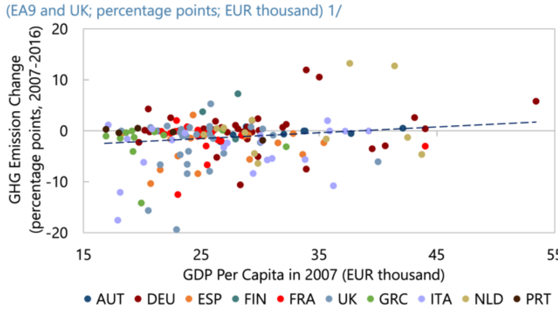
Figure 19.2 GHG Emission Intensity by Regions in 2016
(EA9 and UK; tons of CO2 per euro; EUR thousand) 1/



Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

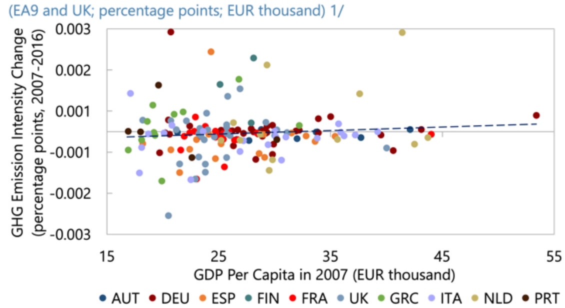
The two panels in Figure 20 plot GHG growth in emissions and intensity between 2007 and 2016 against GDP per capita. The positive but insignificant relationship in both charts does not suggest a strong association between GHG emissions reductions and economic development.

Figure 20.1 GHG Emission Change Between 2000 and 2016 vs. Initial GDP Per Capita
(EA9 and UK; percentage points; EUR thousand) 1/



Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

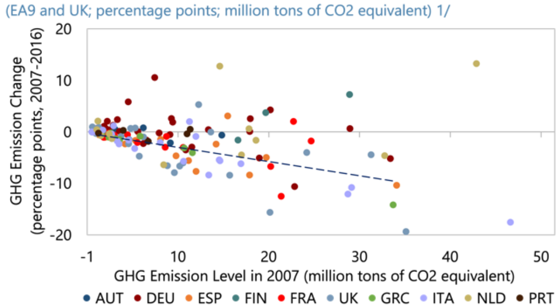
Figure 20.2 GHG Emission Intensity Change Between 2000 and 2016 vs. Initial GDP Per Capita
(EA9 and UK; percentage points; EUR thousand) 1/



Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

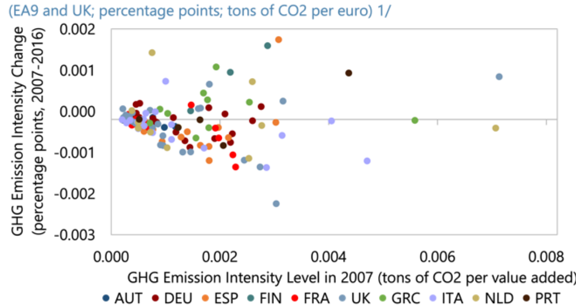
Figure 21 shows instead a much simpler empirical regularity: between 2007 and 2016 emissions (and intensity) fell more in regions that had higher levels in 2007. This result might be due to the increases in carbon taxes or higher subsidies to reduce emissions in regions with higher GHG emission levels, or simply to a base effect.

Figure 21.1 GHG Emission Change Between 2000 and 2016 vs. Initial Emission Levels
(EA9 and UK; percentage points; million tons of CO2 equivalent) 1/



Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Figure 21.2 GHG Emission Intensity Change Between 2000 and 2016 vs. Initial Emission Levels
(EA9 and UK; percentage points; tons of CO2 per euro) 1/

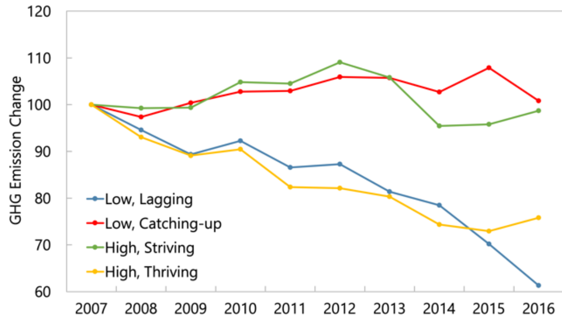


Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).
1/ Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Yet, Figure 22 shows that, Low, Catching-up regions have high GHG emissions growth and high dependence on carbon inefficient sectors (agriculture and industry). Hence, policies that focus on the green transition might slow down the growth of those regions, mostly due to the sectoral composition of their economy, unless their design incorporates compensating mechanisms that help accelerate the necessary reallocation of resources in those regions.

Figure 22.1 GHG Emissions Across Region Types

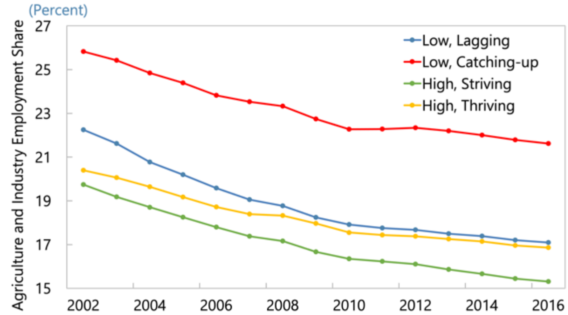
(Change from 2007 level)



Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).

Figure 22.2 Employment Shares by Broad Sectors Across Different Region Types

(Percent)



Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).

Policy Discussions

In light of the documented significant differences in teleworkability and routinization rates across regional groups, the role that regional characteristics might play after the pandemic in terms of the widening of regional disparities—support by early evidence from 2020 data—we now discuss the policy side. We focus on two aspects: (i) the role for place-based policies in alleviating existing disparities and providing a shock absorber for regions with higher vulnerabilities against the pandemic-related shocks; and (ii) which policies can help smooth the potentially uneven effects of the green transitions across regions.

Is There a Role for Place-based Policies?

Place-based policies can take various forms: business tax incentives, cash grants to business and households, and public services such as customized job training, business development centers, and infrastructure investment. However, their effectiveness in tackling regional disparities varies substantially. Place-based polices are context and region dependent. Such policies are more effective when lagging regions are more densely populated, labor is less mobile and administrative capacity or political accountability is stronger (Gbohoui et al., 2019), in regions with higher human capital and high-quality local government (Ehrlich and Overman, 2020), and regions with high involuntary unemployment rate and large agglomeration potential (Bartik 2020).

In the European context, Becker, Egger and Ehrlich (2010) analyzes the role of EU cohesion policies using regional data and find that on average transfers appear to foster growth in recipient low-income regions and reduce disparities, but their effectiveness might be reducing over time as large and persistent regional disparities are partly due to a declining trend in labor mobility (Gbohoui et al., 2019).

A more recent study by Ehrlich and Overman (2020) finds that European Union funds are concentrated in transport infrastructure investment and in local public goods and services such as firm subsidies and human capital investment (e.g., employment training). They state that 60 percent of total budget goes to less developed areas for transportation, research and development and business support. This allocation of resources is quite consistent with some of the lessons summarized by Bartik (2020), who points out that good placed-based policies ought to be targeted to distressed regions and focus on enhancing business inputs (e.g., via job-training).

However, given the findings that poorer regions have lower teleworkability rates, future EU policies could usefully evolve to tackle the issue of uneven connectivity, as digitalization will play an ever-increasing important role both in terms of growth and economic resilience. Some policies that could be considered include tax incentives for businesses to invest to ease teleworking, and incentives to improve high-speed internet access (see also Gbohoui et al. 2019, who highlight the importance of spatially targeted policies that focus on digital infrastructure by boosting digital labor skills and broadening access to broadband).

Future research could analyze whether it would be more beneficial to target some industries in the presence of disruptive events like future pandemics.

Smoothing the Effects of the Green Transition Across Different Regions

As mentioned in Section V, catching-up regions have relatively high GHG emissions growth and high dependence on carbon inefficient sectors (agriculture and industry), and thus will likely be faced with larger sectoral shifts to smoothly manage the ongoing green transition. In this subsection, we focus on some important considerations to help facilitate such a transition and avoid exacerbating regional disparities.

While going through major structural transformations, economies tend to leave some groups of the society behind. As stressed in IMF (2020), although policies such as carbon pricing can weaken growth and displace workers and, they also generate “green growth” following both public and private “green investment” in new technologies. Therefore, the net effect is dependent on the extent of substitution between high-emission (job losses) and low-emission (job gains) activities. Simulations from IMF (2020) find a positive impact of jointly implemented carbon pricing and fiscal stimulus plans on global employment. However, low-income households are more likely to experience losses in labor income since they tend to be employed in low-skill occupations in carbon-intensive sectors.

There is a growing literature analyzing the role of climate mitigation policies on labor markets. Dechezlepretre and Sato (2017) review the empirical literature on the effects of environmental regulations on firms’ competitiveness and find the cost of these policies to be very small and mainly concentrated on a small group of very energy-intensive industrial sectors. Also, using data from 31 European countries, Metcalf and Stock (2020) estimate the dynamic effects of a carbon tax on the growth rate of GDP and employment. Their results point to a lack of evidence of adverse macroeconomic effects emanating from a carbon tax.

Although the empirical literature cannot find strong evidence from climate policies as job or growth killers at the aggregate level, studies show their impact at the micro-level. For example, Marin and Vona (2019) provide empirical findings on climate policies' distributional (skill-biased) impact on labor markets. In particular, they find that climate change policies favored technicians and worked against manual workers in 14 European countries between 1995 and 2011.

To provide some granularity on how policies can support a smooth decarbonization of economies, Appendix C provides a case study looking at the decline in the coal industry in two German regions crossing the East/West divide: the Ruhr Valley and Saarland. The key lesson from the case study is that there is no one “silver bullet.”

It is important to combine not only policies to address unemployment and attract new companies and investments, but also have measures to improve infrastructure, education, research facilities and soft location factors. Moreover, quick short-term gains in employment may not lead to greater longer-term diversification.

Conclusions

In this paper, we document increasing regional disparities in Europe up to 2018 and illustrate channels via which the COVID-19 pandemic can impact disparities by using regional data.

First, we show that convergence had stopped *between* countries pre-pandemic, but was still progressing *within* countries. Moreover, in 2020, between-country gaps were responsible for a significant increase in regional disparities (although data for 2020 do not include information on the United Kingdom). Overall, a major part of the level of disparities across regions can be attributed to disparities in regional productivity, although the rise since the Great Recession mostly resulted from diverging unemployment rates.

Second, we illustrate various ways the pandemic may impact disparities. While mobility has declined everywhere, a unit decline in mobility results in larger negative impact in lagging regions. The teleworkability rate is also lower in lagging regions, implying greater short-term vulnerabilities, although a lower routinization index suggests potentially smaller medium-term vulnerabilities in these regions. Turning to the green transition, we show that low, catching-up regions have relatively high GHG emissions growth and high dependence on carbon inefficient sectors (agriculture and industry). Hence, policies that are designed to favor the green transition should incorporate provisions to smooth the potential uneven effects across regions with different sectoral compositions.

Finally, we review the academic literature on policies that may help address disparities, including any role for place-based policies and other policies that may help facilitate smoother green transitions. While more research is needed to precisely inform policy, from the existing literature and the evidence collected in the paper, EU policies of the future could usefully evolve to tackle the issue of uneven connectivity in an economy where digitalization will play an ever-increasing important role, both in terms of growth and economic resilience (for instance, incentives or tax deductions for investments by firms to improve teleworkability of workers and incentives to improve high-speed internet access).

Regarding climate policies, a key—albeit admittedly generic—lesson is that there is no one “silver bullet.” Still, it is important to combine policies to address unemployment and attract new companies and investments, with measures to improve infrastructure, education, research facilities and soft location factors. Moreover, quick short-term gains in employment may not necessarily lead to durable longer-term diversification. Given the vital importance of a smooth green transition in the years to come, more research on this is warranted.

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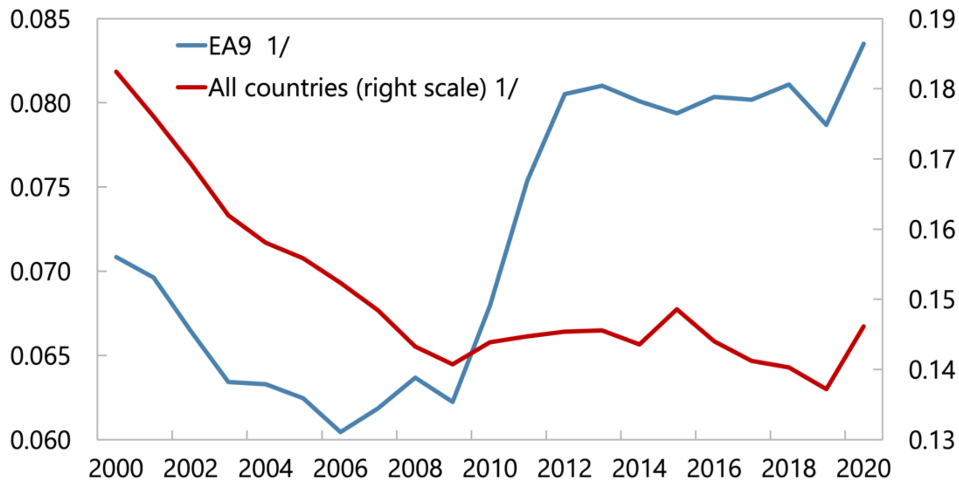
Appendix A. Figures and Tables

Figure A1. Coefficient of Variation in GDP Per Capita

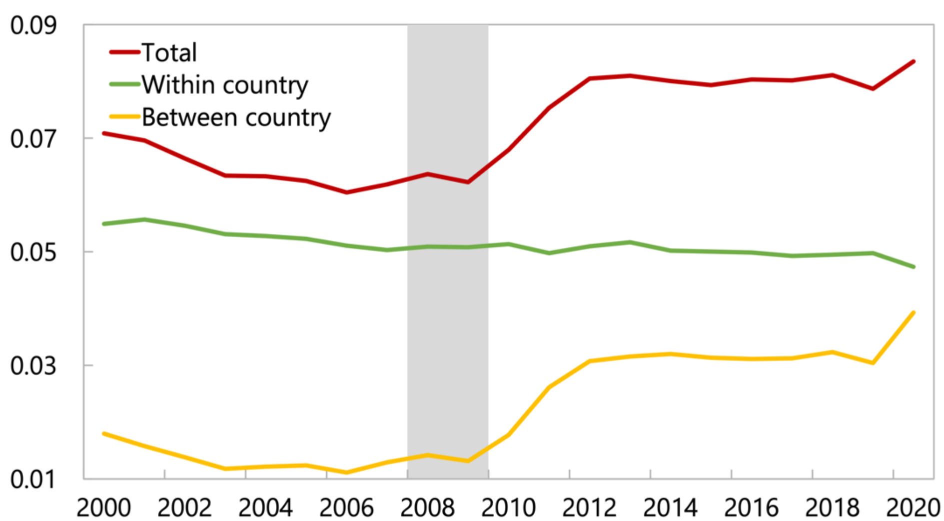
(Coefficient of variation)



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. All countries: EA9, Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Luxembourg, Latvia, Malta, Poland, Romania, Slovakia, and Sweden.

Figure A2. Coefficient of Variation in GDP Per Capita

(EA9; coefficient of variation) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain.

Table A2. Beta-Convergence: Pre- and Post-2010										
Panel A	Without country-fixed effects									
	Pre-EA	Post- EA	Pre- EA	Post- EA	Pre- EA	Post- EA	Pre- EA	Post- EA	Pre- EA	Post- EA
	$\Delta y_{r,t}$	$\Delta y_{r,t}$	$\Delta prod_{r,t}$	$\Delta prod_{r,t}$	$\Delta ELR_{r,t}$	$\Delta ELR_{r,t}$	$\Delta LFPR_{r,t}$	$\Delta LFPR_{r,t}$	$\Delta was_{r,t}$	$\Delta was_{r,t}$
α	0.022*** (0.008)	-0.029*** (0.012)	0.151*** (0.051)	-0.077 (0.064)	-0.006*** (0.0007)	0.002* (0.001)	0.005*** (0.001)	0.003*** (0.0007)	-0.019*** (0.002)	0.001 (0.003)
β	-0.001 (0.003)	0.015^{***} (0.004)	-0.012^{**} (0.005)	0.008 (0.006)	-0.054^{***} (0.011)	-0.004 (0.009)	0.0009 (0.005)	-0.008^{***} (0.003)	-0.042^{***} (0.006)	0.013* (0.007)
No of Obs	168	168	168	168	168	168	168	168	168	168
R^2	0.0008	0.122	0.054	0.025	0.251	0.001	0.0002	0.037	0.312	0.019
Panel B	With country-fixed effects									
	Pre- EA	Post- EA	Pre- EA	Post- EA	Pre- EA	Post- EA	Pre- EA	Post- EA	Pre- EA	Post- EA
	$\Delta y_{r,t}$	$\Delta y_{r,t}$	$\Delta prod_{r,t}$	$\Delta prod_{r,t}$	$\Delta ELR_{r,t}$	$\Delta ELR_{r,t}$	$\Delta LFPR_{r,t}$	$\Delta LFPR_{r,t}$	$\Delta was_{r,t}$	$\Delta was_{r,t}$
α	0.050*** (0.007)	0.034*** (0.008)	0.094** (0.045)	0.169*** (0.042)	-0.003*** (0.0006)	-0.0001 (0.0006)	0.004* (0.002)	0.005*** (0.001)	-0.016*** (0.003)	-0.0001 (0.003)
β	-0.007^{**} (0.002)	-0.002 (0.003)	-0.007 (0.004)	-0.013^{***} (0.003)	-0.071^{***} (0.007)	-0.002 (0.004)	-0.010^{**} (0.005)	-0.003 (0.003)	-0.039^{***} (0.007)	0.003 (0.007)
No of Obs	168	168	168	168	168	168	168	168	168	168
R^2	0.687	0.733	0.662	0.727	0.805	0.728	0.333	0.386	0.532	0.559
* p < 0.10, ** p < 0.05, *** p < 0.01										

Table A2: List of NUTS-2 Regions in Each Income/Growth Group

Low-income/Low-growth Regions		Low-income/High-growth Regions	
Country	Region	Country	Region
France	Länsi-Suomi	Austria	Burgenland
France	Champagne-Ardenne	Austria	Niederösterreich
France	Picardie	Finland	Pohjois- ja Itä-Suomi
France	Haute-Normandie	France	Nord - Pas-de-Calais
France	Centre	France	Midi-Pyrénées
France	Basse-Normandie	France	Auvergne
France	Bourgogne	France	Corse
France	Lorraine	Germany	Oberfranken
France	Franche-Comté	Germany	Brandenburg
France	Pays de la Loire	Germany	Mecklenburg-Vorpommern
France	Bretagne	Germany	Lüneburg
France	Poitou-Charentes	Germany	Weser-Ems
France	Aquitaine	Germany	Münster
France	Limousin	Germany	Arnsberg
France	Languedoc-Roussillon	Germany	Koblenz
Greece	Kriti	Germany	Trier
Greece	Anatoliki Makedonia, Thraki	Germany	Dresden
Greece	Kentriki Makedonia	Germany	Sachsen-Anhalt
Greece	Dytiki Makedonia	Germany	Thüringen
Greece	Ipeiros	Greece	Voreio Aigaio
Greece	Thessalia	Greece	Peloponnisos
Greece	Ionia Nisia	Italy	Puglia
Greece	Dytiki Ellada	Italy	Basilicata
Greece	Sterea Ellada	Italy	Sardegna
Italy	Abruzzo	Netherlands	Zeeland
Italy	Molise	Portugal	Norte
Italy	Campania	Portugal	Algarve
Italy	Calabria	Portugal	Centro
Italy	Sicilia	Portugal	Alentejo
Netherlands	Friesland	Spain	Galicia
Netherlands	Drenthe	Spain	Principado de Asturias
Spain	Cantabria	Spain	Castilla y León
Spain	Castilla-la Mancha	Spain	Extremadura
Spain	Comunidad Valenciana	United Kingdom	Cumbria
Spain	Andalucía		
Spain	Región de Murcia		
United Kingdom	Tees Valley and Durham		
United Kingdom	Northumberland and Tyne and Wear		
United Kingdom	Lancashire		
United Kingdom	East Yorkshire and Northern Lincolnshire		
United Kingdom	South Yorkshire		
United Kingdom	Derbyshire and Nottinghamshire		
United Kingdom	Lincolnshire		
United Kingdom	Shropshire and Staffordshire		
United Kingdom	West Midlands		
United Kingdom	Kent		
United Kingdom	Dorset and Somerset		
United Kingdom	Devon		
United Kingdom	West Wales and The Valleys		
United Kingdom	Northern Ireland (UK)		

Table A2: List of NUTS-2 Regions in Each Income/Growth Group *(continued)*

High-income/Low-growth Regions		High-income/High-growth Regions	
Country	Region	Country	Region
Austria	Wien	Austria	Kärnten
Finland	Helsinki-Uusimaa	Austria	Steiermark
Finland	Etelä-Suomi	Austria	Oberösterreich
France	Alsace	Austria	Salzburg
France	Rhône-Alpes	Austria	Tirol
France	Provence-Alpes-Côte d'Azur	Austria	Vorarlberg
Germany	Stuttgart	France	Île de France
Germany	Karlsruhe	Germany	Tübingen
Germany	Freiburg	Germany	Niederbayern
Germany	Oberbayern	Germany	Oberpfalz
Germany	Bremen	Germany	Mittelfranken
Germany	Hamburg	Germany	Unterfranken
Germany	Darmstadt	Germany	Schwaben
Germany	Gießen	Germany	Berlin
Germany	Hannover	Germany	Kassel
Germany	Düsseldorf	Germany	Braunschweig
Germany	Köln	Germany	Detmold
Germany	Saarland	Germany	Rheinhessen-Pfalz
Germany	Schleswig-Holstein	Greece	Attiki
Greece	Notio Aigaio	Italy	Liguria
Italy	Piemonte	Italy	Provincia Autonoma di Bolzano/Bozen
Italy	Valle d'Aosta/Vallée d'Aoste	Italy	Veneto
Italy	Lombardia	Italy	Emilia-Romagna
Italy	Provincia Autonoma di Trento	Italy	Toscana
Italy	Friuli-Venezia Giulia	Netherlands	Overijssel
Italy	Umbria	Netherlands	Gelderland
Italy	Marche	Netherlands	Flevoland
Italy	Lazio	Netherlands	Noord-Holland
Netherlands	Groningen	Netherlands	Noord-Brabant
Netherlands	Utrecht	Netherlands	Limburg (NL)
Netherlands	Zuid-Holland	Spain	País Vasco
Portugal	Área Metropolitana de Lisboa	Spain	Aragón
Spain	Comunidad Foral de Navarra	Spain	Comunidad de Madrid
Spain	La Rioja	United Kingdom	Herefordshire, Worcestershire and Warwickshire
Spain	Cataluña	United Kingdom	Highlands and Islands
Spain	Illes Balears		
United Kingdom	Greater Manchester		
United Kingdom	North Yorkshire		
United Kingdom	West Yorkshire		
United Kingdom	Leicestershire, Rutland and Northamptonshire		
United Kingdom	East Anglia		
United Kingdom	Bedfordshire and Hertfordshire		
United Kingdom	Essex		
United Kingdom	Berkshire, Buckinghamshire and Oxfordshire		
United Kingdom	Surrey, East and West Sussex		
United Kingdom	Hampshire and Isle of Wight		
United Kingdom	Gloucestershire, Wiltshire and Bristol/Bath area		
United Kingdom	East Wales		

Appendix B. Disparities in Net Disposable Income

The data also allows us to investigate the pattern of regional disparities in household net disposal income. At the national level, the difference between gross domestic product and net households' income stems from the consumption of fixed capital and the share of domestic income going to households.

Total economy		Gross value added
	-	*Consumption of fixed capital*
	=	Net value added
	-	*Net external balance*
National economy		Net value added
Households	=	Net primary income
	-	*Net taxes and social contributions*
	=	Net disposable income

Additionally, at the regional level, the location of value added might be biased if it is recorded where holdings are registered, for example if companies record capital consumption where they register their headquarters. Another source of difference is caused by commuting: households do not necessarily live where they work, and where the value is generated. Similarly, owners of capital do not necessarily live where the value is generated.

$$\frac{Total\ economy\ GDP}{Population} = \frac{Total\ economy\ GDP}{Household\ net\ market\ income} * \frac{Household\ net\ market\ income}{Household\ net\ disposable\ income} * \frac{Household\ net\ disposable\ income}{Population}$$

$$\frac{GDP}{population} = \left(\sim \frac{1}{Share\ of\ capital\ consumption\ in\ net\ market\ income * Share\ of\ Total\ economy\ income\ going\ to\ households}\right) * \frac{1}{net\ transfers + 1} * net\ disposable\ income\ per\ capita$$

With $net\ transfers\ as\ a\ share\ of\ market\ income = \frac{DI-MI}{MI}$ (noting DI = Household net disposable income; MI = Household net market income)

The data point to three findings (Figure B.6). First, disparities in household market income net of depreciation appear lower than in GDP. This partly reflects the concentration of capital in certain places where headquarters are located. France is an outlier in terms of size of the gap between disparities in GDP and in market income, likely due to the centralized organization of its companies. Moreover, the gap has widened in France.

Second, disparities in household disposable income are lower than in market income, reflecting net transfers that take place both through horizontal national policies and targeted spending and tax cuts allocated to certain regions. In most countries, transfers are progressive, in other words they are larger in poorer regions. At the EA9+U.K. level, disparities in household disposable income account for about half of GDP disparities (Theil decomposition). In Italy and Spain, disparities in disposable income account for the largest share of GDP disparities.

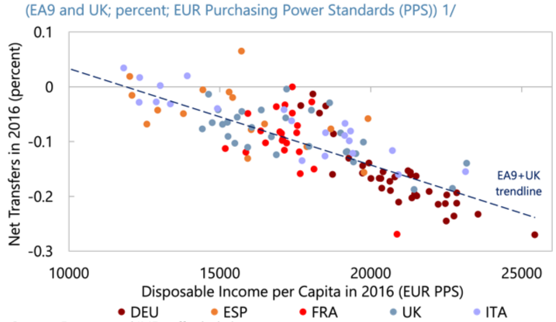
Third, total regional disparities in disposable income increased markedly during the Great Recession as a result of between-countries disparities, while within-countries disparities in disposable income declined. Disparities in redistribution also increased over the period, more so between than within countries.

Net direct transfers increased more in poorer regions, reflecting more cross-country dynamics rather than within-country policies. Over 2002–16, aggregate net transfers (defined as disposable income over market income) increased in Spain, Italy, and the U.K., were fairly stable in France, and decreased in Germany. Within countries, trends vary: net transfers increased more (resp. decreased less) in Spanish and German richer regions. In Italy and the U.K., transfers increased more in poorer regions. In France, changes in transfers were not strongly correlated with initial income. Within countries, transfers decreased more in regions that experienced the lower income growth; except in Germany (see below).

In Germany, the first two decades of this century were marked by a decline in transfers from taxes and social security contributions relative to the high level after the country's reunification and amid convergence in income levels. In the 1990's, redistribution towards East Germany was achieved through various instruments, including additional tax revenues, fiscal equalization, a special Solidarity Pact for the East, transfers to households via the federal social security system and supplementary allocations (see for example Frick and Goebel (2005); Schnabel and Sepp (2020) for a review). The decline in direct transfers to households observed over 2002–16 reflects a reduced reliance of poorer regions on direct social transfers given their income was catching up with the average.

Figure B.1 Net Transfers vs Disposable Income

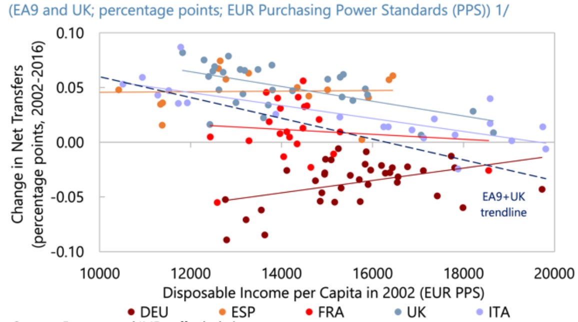
(EA9 and UK; percent; EUR Purchasing Power Standards (PPS)) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom. Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Figure B.2 Change in Net Transfers vs Disposable Income

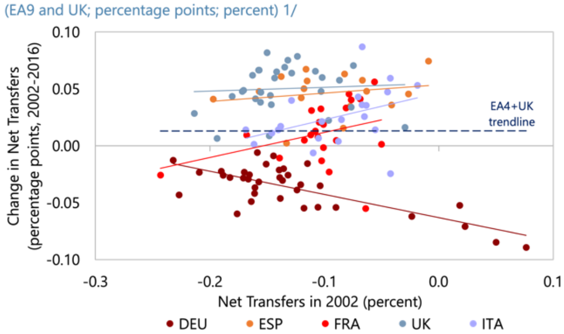
(EA9 and UK; percentage points; EUR Purchasing Power Standards (PPS)) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom. Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Figure B.3 Change and Level of Net Transfers

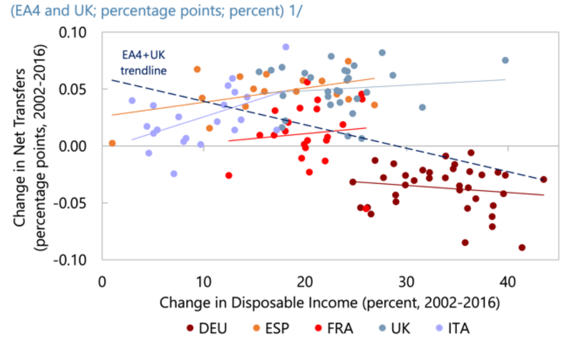
(EA9 and UK; percentage points; percent) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA4=Euro Area 4 countries. EA4: France, Germany, Italy, and Spain. UK: United Kingdom. Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Figure B.4 Change in Net Transfers and in Disposable Income

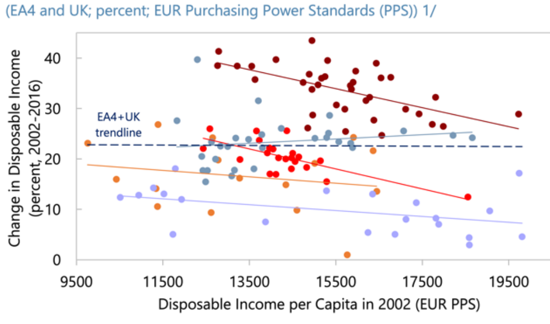
(EA4 and UK; percentage points; percent) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA4=Euro Area 4 countries. EA4: France, Germany, Italy, and Spain. UK: United Kingdom. Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Figure B.5 Change and Level of Disposable Income

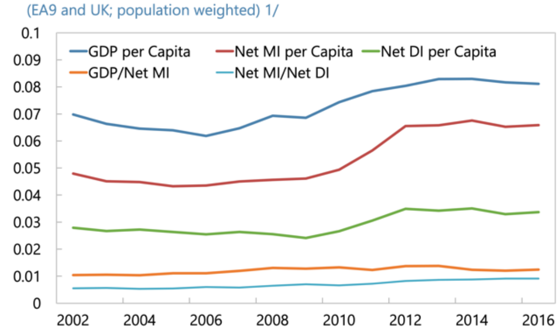
(EA4 and UK; percent; EUR Purchasing Power Standards (PPS)) 1/



Sources: Eurostat; and IMF staff calculations.
1/ EA4=Euro Area 4 countries. EA4: France, Germany, Italy, and Spain. UK: United Kingdom. Each data point refers to a NUTS 2 region. Legend uses (ISO) country codes.

Figure B.6 Disparities in Income Per Capita

(EA9 and UK; population weighted) 1/

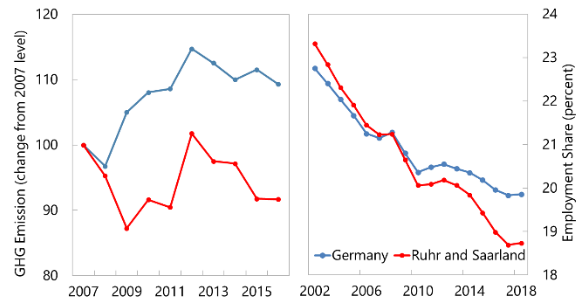


Sources: Eurostat; and IMF staff calculations.
1/ EA9=Euro Area 9 countries. EA9: Austria, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. UK: United Kingdom.

Appendix C. The Green/Growth Tradeoff: A Case Study of Two German Regions.

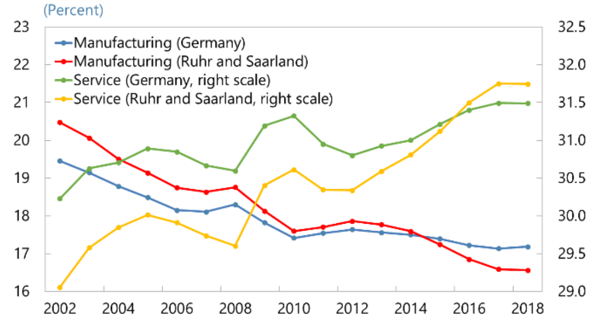
This appendix takes a deeper dive into some of the lessons learnt from the decline in the coal industry in two German regions crossing the East/West divide: the Ruhr Valley and Saarland. They were the two largest hard coal mining areas in Germany and experienced a 50-year decline in their coal industries until hard coal production in Germany stopped in 2018 with the end of subsidies (Oei et al. (2020)).

Figure C.1 Germany vs. Ruhr and Saarland: GHG Emission and Agriculture/Industry Employment Share



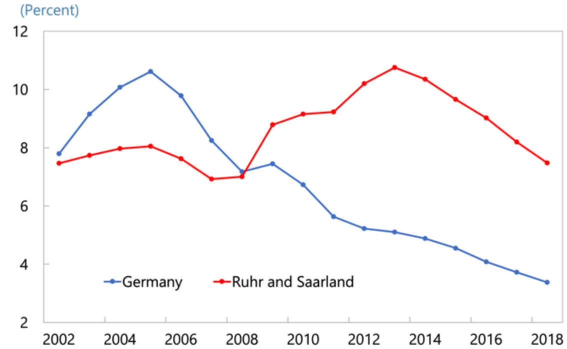
Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).

Figure C.2 Germany vs Ruhr and Saarland: Manufacturing and Service Employment Share
(Percent)



Sources: Eurostat; and European Environment Agency: "European Pollutant Release and Transfer Register" (E-PRTR v18).

Figure C.3 Unemployment Rate
(Percent)



Sources: Eurostat.

Given data limitations, the data analysis focuses on the post-2000 period only. Figure C.1 (left chart) shows that the decline in GHG emissions has been much higher in the Ruhr Valley and Saarland compared to Germany in aggregate since 2007, pointing to the success of the phase-out process and climate change mitigation policies. Relatedly, Figure C.1 (right chart) shows how the employment share of carbon inefficient sectors declined relatively more in these regions.

Digging deeper into employment composition trends, Figure C.2 shows that the decline in the share of manufacturing employment was higher in the Ruhr Valley and Saarland, and commensurately, the share of service sector employment increased more rapidly than in the rest of Germany.

Figure C.3 compares unemployment rates in the Ruhr Valley and Saarland with average rates in Germany. Up to the GFC, the trends were very similar. Since then, unemployment rates in the Ruhr Valley and Saarland have declined at a slower pace than on average for Germany, but there has still been a material reduction.

How did the Ruhr Valley and Saarland seemingly continue decarbonizing and diversify away from manufacturing without a major hit to unemployment? Oei et al. (2020) notes that both local and national policies helped these two regions diversify their economies. There were structural programs to improve connectivity of these mining regions with neighboring cities, hence increasing citizens' mobility and increasing the attractiveness of the regions for new enterprises.

But there were also important differences in the approaches of the two regions. For example, in Saarland, local government focused on incentivizing other companies (around 170 companies including the Ford Motor Company) to invest and support the transformation of the region. The fact that most new companies were in the automotive industry helped initially as they were looking for similar worker skills. Furthermore, the resistance from mining companies was less of an issue than elsewhere as they were publicly owned. In the Ruhr valley, the situation was more complicated given joint resistance of mining companies, politicians, and unions. Privately owned mining companies rejected selling their land to new companies. Overall, however, although the Ruhr valley transformed more slowly, it managed to create a more diversified industrial structure than Saarland. The latter has been mainly dependent on the automotive industry and is thus likely less resilient to shocks.

PUBLICATIONS

Regional Disparities in Europe

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