Forty years of productivity and labour market resilience in European regions

Alexandra Tsvetkova

OECD

Forty years of productivity and labour market resilience in European regions

Alexandra Tsvetkova

To mark the 40th anniversary of the OECD Local Employment and Economic Development (LEED) Programme, this paper examines determinants and consequences of employment resilience, or lack of, in European NUTS3/TL3/TL3 regions over the last 40 years. Descriptive evidence shows that the least resilient regions (those with the largest percentage drop in employment during a recession) slip to persistently lower post-recession employment-to-population ratio trajectories. On the other hand, regions with higher productivity pre-recession lost proportionally fewer jobs during a recession and were more likely to recover to the pre-recession employment levels (except for the recession induced by the COVID-19 pandemic). Overall, the findings point to the ability of productivity to serve as a shield against negative employment impacts of economic crises.

ABOUT THE OECD

The OECD is a multi-disciplinary inter-governmental organisation of 38 member countries which engages in its work an increasing number of non-members from all regions of the world. The Organisation's core mission today is to help governments work together towards a stronger, cleaner, fairer global economy. Through its network of 250 specialised committees and working groups, the OECD provides a setting where governments compare policy experiences, seek answers to common problems, identify good practice, and co-ordinate domestic and international policies. More information available: www.oecd.org.

ABOUT OECD LOCAL ECONOMIC AND EMPLOYMENT DEVELOPMENT (LEED) PAPERS

The OECD Local Economic and Employment Development (LEED) Programme Papers present innovative ideas and practical examples on how to boost local development and job creation. A wide range of topics are addressed, such as employment and skills; entrepreneurship; the social economy and social innovation; culture; and local capacity building, among others. The series highlights in particular policies to support disadvantaged places and people, such as the low skilled, the unemployed, migrants, youth and seniors.

OECD Working Papers should not be reported as representing the official views of the OECD or of its member countries. The opinions expressed and arguments employed are those of the author(s).

Working Papers describe preliminary results or research in progress by the author(s) and are published to stimulate discussion on a broad range of issues on which the OECD works. Comments on Working Papers are welcome, and may be sent to the Centre for Entrepreneurship, SMEs, Regions and Cities, OECD, 2 rue André-Pascal, 75775 Paris Cedex 16, France.

This paper is authorised for publication by Lamia Kamal-Chaoui, Director, Centre for Entrepreneurship, SMEs, Regions and Cities, OECD.

This document, as well as any statistical data and map included herein, are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Acknowledgements

Table of contents

FIGURES

TABLES

BOXES

Executive summary

Regions differ in their ability to weather crises. Some places are hit harder than others. Some are able to recover faster. In the aftermath of the 1980-1982 recession, triggered by the 1979 energy crisis, governments in OECD countries were facing varying degrees of high unemployment and anaemic job growth, including particular regions within countries. In response, in 1982, the OECD Co-operative Action Programme on Local Employment and Economic Development (LEED) was created as a platform to exchange on innovative approaches to local development and job creation.

To mark LEED's 40th anniversary, this paper explores local employment performance during the different crises across Europe over the last four decades, drawing the following main conclusions:

1. **Less resilient regions during a recession (those losing proportionately more jobs) can be pushed to a permanently lower employment performance path.** The gap in the employment-to-population ratio between the most and the least resilient regions, which emerges during a recession, almost never closes afterwards. This is particularly striking as in the years preceding two out of three recessions for which recovery can be traced over sufficiently long periods (1992-93 and 2008-09), the least resilient regions had higher employment to population rates than the most resilient regions.

2. **Despite a long growth period after the 1992-93 and the "double dip" (2008-09 and 2012) recessions, many regions did not return to their pre-recession employment levels by the time the next recession hit.** While a sizeable share of regions enjoys equal or higher employment levels in the last year of a recession compared to pre-recession, employment levels remained suppressed in 18% of regions after the 1992-93 recession and in 26% of regions after the double-dip of the 2008-9 and 2012 recessions. In regions that did recover, it took four to five years on average.

3. **Higher productivity regions tend to have higher employment-to-population ratio pre-recession and to be more resilient during recessions. On average, they experience a smaller employment drop during a crisis and are more likely to fully recover after it.** Pre-recession productivity level is the most consistent predictor of resilience across crises. In three out of four recessions over the last 40 years (1992-93, 2008-09 and 2012), productivity was positively linked to both components of resilience: robustness (stronger employment performance during a crisis) and recovery (the speed of restoring pre-recession employment levels after a crisis). The COVID-19 pandemic was, however, the exception to this rule, reflecting in large part the unusual drivers of this recession, and in particular the impact of lockdowns.

Two policy conclusions follow from this paper. **First, regions need to focus policy attention on employment resilience**, as large job losses during a recession can be irreversible. **Second, steering economic development in higher-productivity activities can be a viable resilience-boosting strategy.** The analysis presented in this paper suggests that higher-productivity jobs can be more resilient during economic crises.

Further analysis is needed to identify and quantify the common drivers of productivity and employment resilience. Existing literature suggests that such drivers can be linked to flexibility in resource reallocation and to branching into new paths (for example, industrial and/or technological knowledge), as they are prominent components of both regional productivity performance and regional economic resilience.

1 Local employment performance during crises over the last 40 years

Regions differ in their ability to weather a crisis. Some places are hit harder than others. Some are able to recover faster.[1] In the aftermath of the 1980-1982 recession, triggered by the 1979 energy crisis, just before the LEED Committee was created, it was clear that the degree of hardship such as high unemployment rates and anaemic job creation differed significantly within countries.[2]

The analysis in this paper is conceptually closely related to regional economic and employment resilience in the face of exogenous shocks and other economic pressures. Box 1 provides a brief review on the concept of regional employment resilience and the related literature.

Box 1. Existing evidence on employment resilience of places

What is employment resilience?

The ability of the local or regional economy to withstand a negative shock, to recover and to adjust is called economic resilience. As the evidence on sizable variations in economic performance of places during recessions accumulated, so grew an interest to understand the sources of these variations and to find ways of helping places do better during crises. Research attention turned to the concept of resilience, which appeared an appropriate tool for studying how economies perform under, adjust to, and recover from stress.

Within the economic geography field, the concept of economic resilience can be distilled into three components, each capturing a specific dimension of how an economy (local, regional or national) reacts and readjusts in the face of a negative shock (Martin, 2012[5]):

- **Robustness**, the capacity of an economy to absorb a shock before the negative impacts are observed in economic indicators, alternatively, how little a shock affects an economy;
- **Recovery**, the ability of an economy to fully recover to the pre-shock performance (or how quickly the recovery happens);
- **Reorganisation**, an evolution of the structures and relationships within an economy in response to a shock supposedly rendering it more prepared to deal with future negative disturbances.

Employment (or labour market) resilience indicates how immune employment in a place or a region is to a negative shock, and how well it recovers from or adjusts to such a shock. That is, employment resilience is economic resilience measured by the performance of employment-related indicators (e.g. employment growth, unemployment rates, etc.). Ideally, the geographical unit of analysis when focusing on employment resilience should correspond to labour market areas, which tend to be smaller than the commonly used TL2 or TL3 regions.[a] In practice, many labour market resilience studies look at regions, not labour market areas, due to data availability constraints.

What does academic research on (employment) economic resilience say?

The body of research on economic resilience (and employment resilience in particular) is diverse in terms of empirical settings, which affect the results; this can make generalisations hard to make. Overall, the results tend to differ depending on the choice of the dependent and independent variables, the time period and geography used, the estimation approach selected and other study characteristics.

The indicators used to approximate each component of economic resilience (i.e. robustness, recovery and reorganisation) can be "straightforward" or more complex. Examples of the "straightforward" measures include growth rates in economic indicators, time it takes to reach a pre-crisis level of performance, or emergence of new industrial specialisations in a region. More complex approaches involve calculating various indices, which can be designed to capture simultaneously different facets of economic performance or to compare regions to a benchmark group (usually the whole economy).

Broadly, factors that determine regional economic resilience fall into three categories – compositional, collective and contextual (Martin and Sunley, 2015[1]). Compositional factors include industrial and sectoral structures. Collective factors are characteristics and relationships between local economic agents. Contextual factors refer to the position of regional and local actors as well as of a region itself within the global division of labour, international networks, national policies and multi-scale institutions. More specifically, empirical studies of regional economic resilience determinants mostly focus on four sets of characteristics that fall within the three categories above: i) industrial composition; ii) human capital; iii) innovation and technology and iv) networks.

Although the literature does not directly study the productivity-resilience nexus, it does suggest that productivity-related variables such as industrial diversity, human capital, innovation and more developed networks are linked to greater resilience. The results, however, are very diverse. One important distinction is whether resilience is measured by employment or output. To illustrate, regional human capital (the share of population with a tertiary degree) and industrial diversity are often linked to greater resilience in output (Fusillo, Consoli and Quatraro, 2022[2]; Crescenzi, Luca and Milio, 2016[3]) but not necessarily in employment (Kitsos and Bishop, 2018[4]; Rocchetta et al., 2022[5]). Yet, there is evidence of a positive link between human capital and employment resilience in United States metropolitan statistical areas (MSAs) after the 2008-09 recession (Doran and Fingleton, 2018[6]). Another important distinction is between resilience dimensions, e.g. robustness and recovery. Doran and Fingleton (2018[6]) show that industrial concentration and dissimilarity with the national industrial structure exacerbated job losses during the 2008-09 recession but facilitated subsequent recovery in US MSAs. Differences in measurement of explanatory variables also play a role. For instance, innovativeness measured by the European Innovation Index is linked to the ability of regional employment to withstand and recover from the 2008-09 recession (Bristow and Healy, 2018[7]) but patenting intensity (another measure of innovation) can be unrelated to resilience measured in terms of regional structural adjustments (Pontarollo and Serpieri, 2020[8]). Noteworthy, due to the varying origins and the nature of economic crises, some resilience determinants play a role across recessions while others are highly recession specific. Existing evidence on the labour market resilience dynamics is scarce for recessions before the 2008-09 one, and for any recession at the local (more fine-grained) geographical level.

Notes: [a] OECD classifies regions within its member countries on two territorial levels, which reflect the administrative organisation. Large (Territorial Level 2 or TL2) regions represent the first administrative tier of subnational government, such as States in the USA or Regions in Italy. Small (Territorial Level 3 or TL3) regions correspond to administrative regions in all countries except for Australia, Canada and the USA. Examples of TL3 regions are Provinces in Italy or Groups of Municipalities in Mexico. In several countries (Costa Rica, Israel and New Zealand) TL2 and TL3 regions coincide. In all countries except for the USA TL3 regions are contained in TL2 regions.
Source: Author's elaboration.

Employment performance has varied considerably across NUTS3/TL3 regions over the last four recessions

This analysis uses regional (NUTS3/TL3) employment data from 1992 to 2020 sourced from the Annual Regional Database of the European Commission (ARDECO). Box 2 provides further background on the data and the caveats, which should be kept in mind when interpreting the results.

Box 2. Data and caveats

Data in this paper is retrieved from the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO). The total employment (workplace based, employed persons, SNETD code) are not adjusted to full time equivalent numbers. As the source of data is from the European Commission, small regions are NUTS3 regions. For European Union countries these are equivalent to OECD TL3 regions.

At least two possible caveats should be kept in mind when looking at Figure 1- Figure 4 below. First, when comparing employment growth rates during a recession, which is uniformly defined for the European Union, the fixed dates of the pre-recession and the post-recession can be inaccurate for individual regions if a crisis hits them at a different timeline. This timing issue can potentially explain some of the outlier numbers, such as a 20% growth rate during a recession. Second, time-series data can be inconsistent, particularly in countries with many NUTS3 regions, like Germany.

Care is needed in interpretation and in particular when identifying "the winners" and "the losers". To illustrate, a region with a high employment rate may have the same drop (measured by percentage change) in employment during a recession as a region with very low employment rates or low productivity, but the inferences will, of course, differ. In economies with already very low employment, for example, the scope for further employment decrease during a recession may be more limited (especially if the public sector is a relatively large employer) and, in turn, inferences around the resilience of the region compared to regions with higher employment rates will necessarily differ.

The concern of relative vs absolute employment changes is particularly valid when analysing economic performance during a crisis of individual regions. Incorporating additional metrics in the analysis can offer a more comprehensive view on how a region navigates a crisis. One example is to compare the employment growth rates during the crisis to the pre-crisis employment growth. Table A A.3 and Table A A.4 in Annex A, show the three top performing and the three bottom performing NUTS3/TL3 regions in each country based on the difference in employment growth before and during a crisis. On average across regions, however, in three out of four recessions covered in this paper, there was a weak positive relationship between the pre-recession employment rates (employment-to-population ratio) and employment growth rates during a recession.

Source: Author's elaboration.

In all economic recessions over the last 40 years (Box 3 and Table 1**), subnational differences in labour market performance were sizable**.

> **During the 1992-93 recession (Figure 1)**, the difference in employment growth between the best performing and the worst performing small regions within a country[3] exceeded 10 percentage points in nine out of 14 countries with available data. In two countries (Belgium and Germany), the difference exceeded 25 percentage points. On average across countries, the difference stood at 13 percentage points.

- **During the 2008-09 recession (Figure 2)**, the difference in employment growth between the best and the worst performing regions within a country exceeded 10 percentage points in 12 out of 24 countries with more than six NUTS3/TL3 regions. The difference exceeded 25 percentage points only in Greece. On average across countries, the difference was 12 percentage points.

- **During the 2012 recession (Figure 3)**, the difference in employment growth between the best and worst performing regions within a country exceeded 10 percentage points in only four out of 24 countries with more than six NUTS3/TL3 regions. Only in Romania did the difference exceed 25 percentage points. On average across countries, the difference stood at slightly over 9 percentage points.

- **Finally, during the COVID-19 induced recession in 2020 (Figure 4)**, the difference in employment growth across regions within a country exceeded 10 percentage points in seven out of 24 countries with at least six NUTS3/TL3 regions. The difference exceeded 25 percentage points only in Croatia. The average difference across countries was slightly under 9 percentage points.

Box 3. Recessions: What and when

A recession is defined by the Euro Area Business Cycle Dating Committee (EABCDC) as "a significant decline in the level of economic activity, spread across the economy of the euro area, usually visible in two or more consecutive quarters of negative growth in GDP, employment and other measures of aggregate economic activity for the euro area as a whole." All analyses in this paper use the EABCDC-defined recession periods "converted" into annual data as shown in Table 1.

Table 1. Recession periods starting from 1980

Recession as identified by the EABCDC	Recession as used in the analysis
Q2 1980 – Q3 1982	None
Q2 1992 – Q3 1993	1992, 1993
Q2 2008 – Q2 2009	2008, 2009
Q4 2011 – Q1 2013	2012
Q1 2020 – Q2 2020	2020

Note: A year is marked as a recession year in the data if two or more its quarters were identified as recession by the EABCDC. The ARDECO database provides data starting in 1980, which makes it impossible to benchmark performance during the 1980-82 crisis against the pre-recession period.
Source: Methodology | EABCN; Author's elaborations.

Figure 1. Minimum and maximum NUTS3/TL3 employment growth during the 1992-93 recession

Note: Employment growth refers to the percent change between the last pre-recession and a recession year with the lowest employment level; countries are ordered by maximum employment growth (from highest to lowest); countries with at least six NUTS3/TL3 regions are shown; Guadeloupe, Martinique, Guyane, La Réunion and Mayotte (France) and Jan Mayen and Svalbard (Norway) are excluded; data for the 1992-93 recession are not available for Bulgaria, Czech Republic, Croatia, Hungary, Lithuania, Latvia. Poland, Romania, Slovenia and Slovakia.
Source: Author's calculations based on the total employment (workplace based, employed persons, not FTE-adjusted, SNETD code) of the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Figure 2. Minimum and maximum NUTS3/TL3 employment growth during the 2008-09 recession
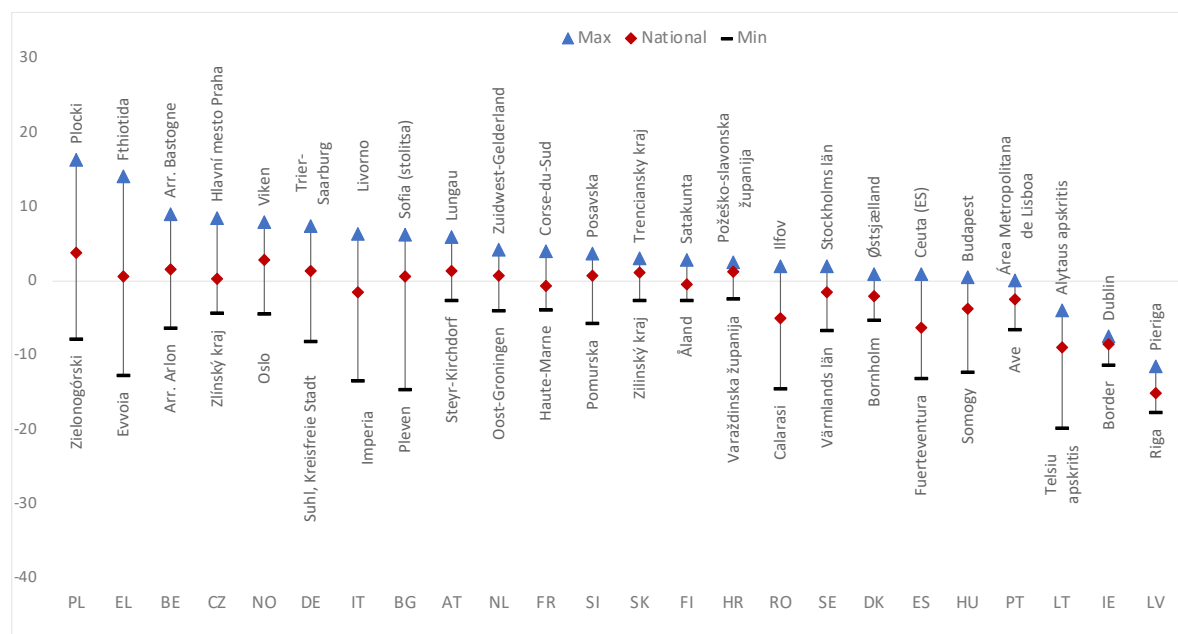
Note: Employment growth refers to the percent change between the last pre-recession and a recession year with the lowest employment level); countries are ordered by maximum employment growth (from highest to lowest); countries with at least six NUTS3/TL3 regions are shown; Guadeloupe, Martinique, Guyane, La Réunion and Mayotte (France) and Jan Mayen and Svalbard (Norway) are excluded.
Source: Author's calculations based on the total employment (workplace based, employed persons, not FTE-adjusted, SNETD code) of the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Figure 3. Minimum and maximum NUTS3/TL3 employment growth during the 2012 recession
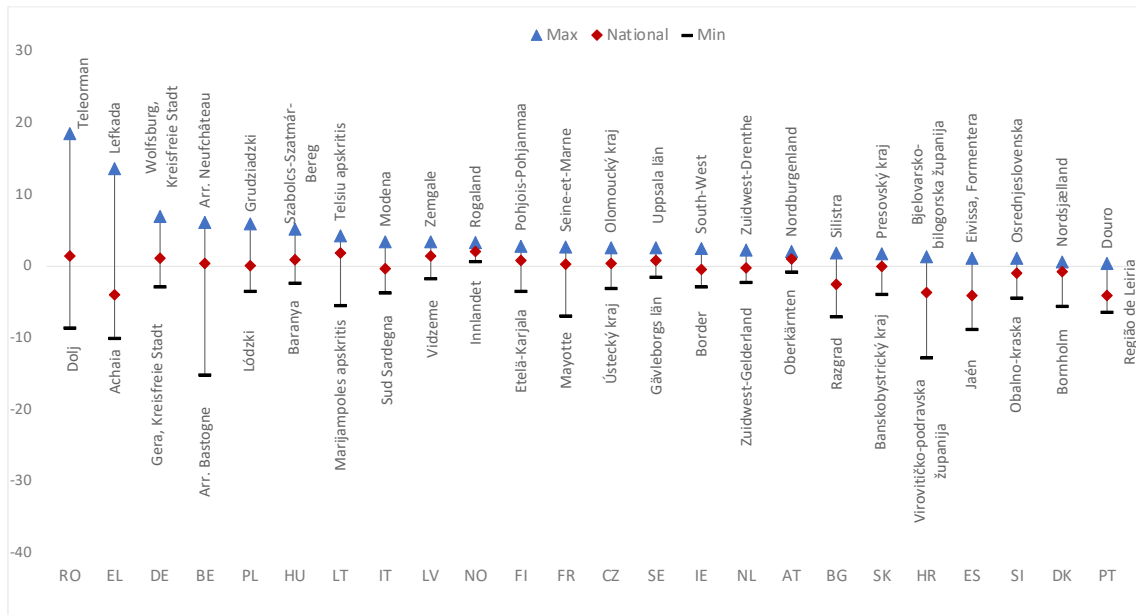
Note: Employment growth refers to the percent change between the last pre-recession and the recession year; countries are ordered by maximum employment growth (from highest to lowest); countries with at least six NUTS3/TL3 regions are shown; Guadeloupe, Martinique, Guyane, La Réunion and Mayotte (France) and Jan Mayen and Svalbard (Norway) are excluded.
Source: Author's calculations based on the total employment (workplace based, employed persons, not FTE-adjusted, SNETD code) of the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Figure 4. Minimum and maximum NUTS3/TL3 employment growth during the 2020 recession
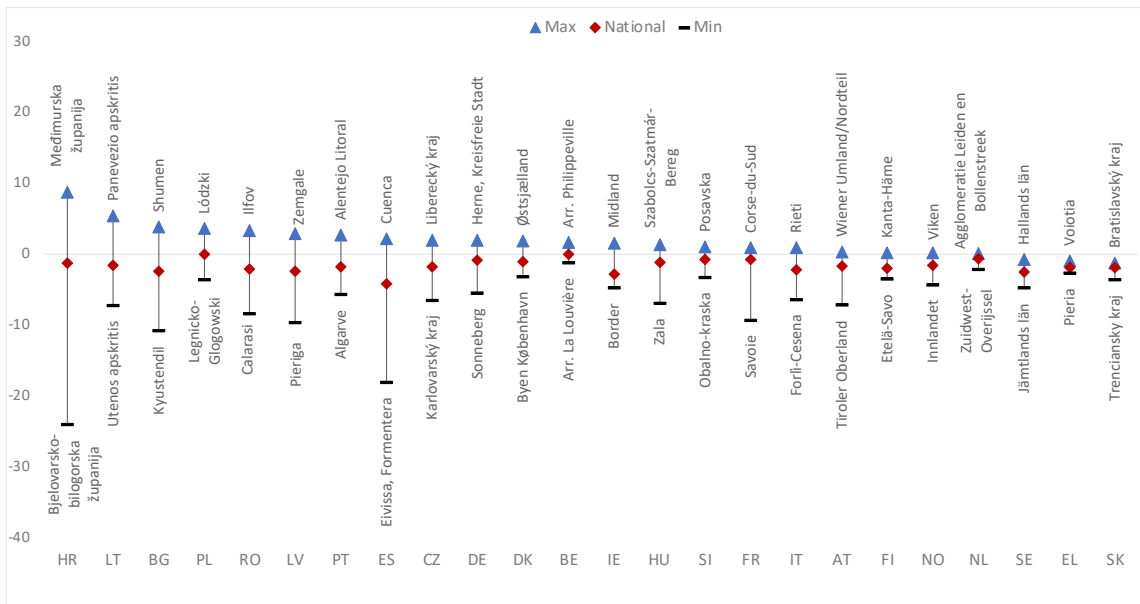
Note: Employment growth refers to the percent change between the last pre-recession and the recession year; countries are ordered by maximum employment growth (from highest to lowest); countries with at least six NUTS3/TL3 regions are shown; Guadeloupe, Martinique, Guyane, La Réunion and Mayotte (France) and Jan Mayen and Svalbard (Norway) are excluded.
Source: Author's calculations based on the total employment (workplace based, employed persons, not FTE-adjusted, SNETD code) of the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Of note is the observation that local employment performance differs considerably from recession to recession. Table A A.1 and Table A A.2 in Annex A show that the same regions can appear among the best performers in one recession and among the worst performers in another.[4]

The maps below (**Figure 5**) **visually illustrate the variation in employment performance for the last four recessions**.[5] The effects of recessions (and the ability of places to withstand them) differ significantly within countries and from recession to recession. This points to the varying nature of each shock – their severity, and sectors exposed (Box 4) – and, in turn, perhaps not surprisingly, the fact that certain characteristics of the regional economy can prove to be resilience-enhancing in one recession but not necessarily in another.

Figure 5. Maps of employment growth changes (%) for the last four recessions
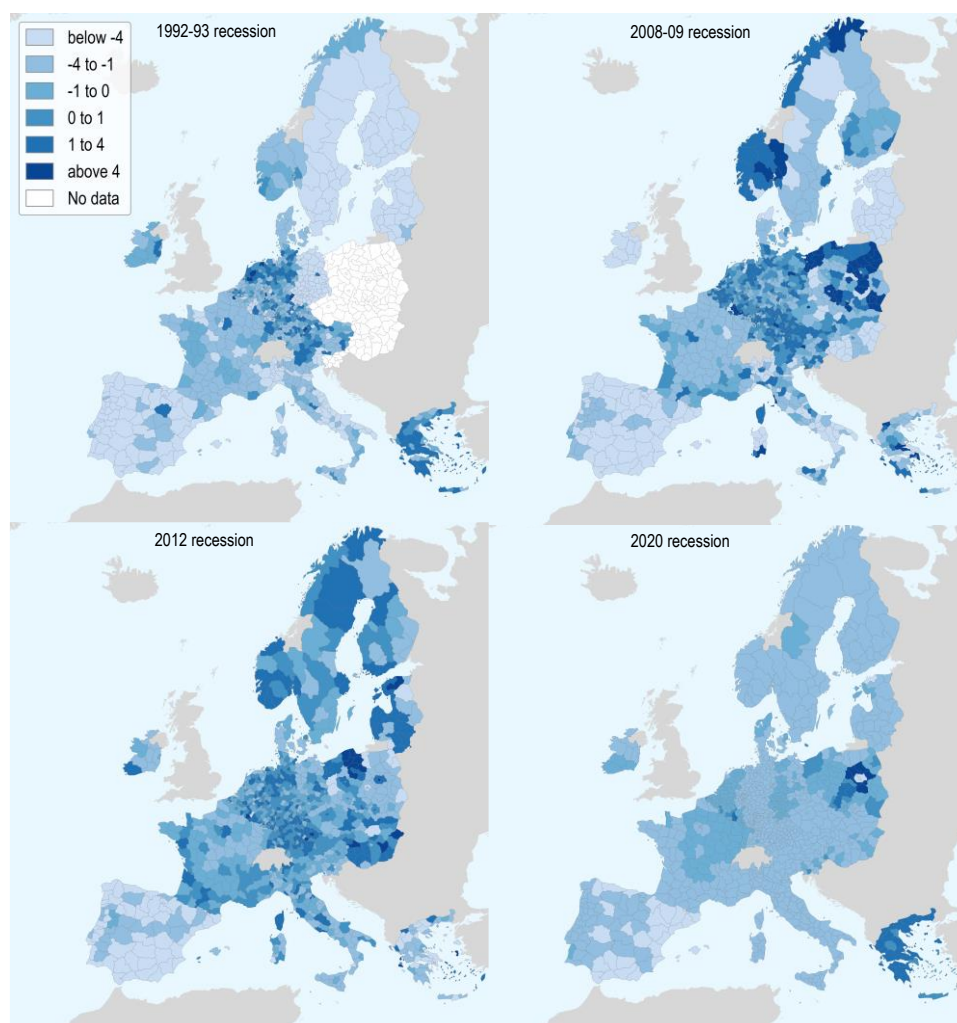
Note: Data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia. The percent growth is calculated using the last pre-recession year and the recession year (or the year of the lowest employment for the two-year recessions).
Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Box 4. The differing roots of the four recessions

The four recessions covered in this paper were very different in their root causes. While the combinations of causes and their particular role in starting a recession are often debated and are likely to differ from one country to another, the following factors are generally believed to be behind each of the four recessions.

**The 1992-93 recession** in Europe stemmed from a combination of factors, including the fallout from the reunification of Germany, which led to high interest rates and fiscal tightening in Europe's largest economy. Concurrently, the European Exchange Rate Mechanism (ERM), designed to reduce exchange rate variability ahead of the proposed monetary union, came under severe speculative pressure. Several countries struggled to maintain their currency pegs, causing the UK and Italy to exit ERM. Additionally, external factors, such as the aftermath of the 1990-91 global recession, high oil prices after the Gulf War and the uncertainties following the end of the Cold War, contributed to reduced confidence and investment. Combined, these elements contributed to a period of economic contraction across Europe in 1992-93.

The 2008-09 recession was the result of the global financial crisis, which started in the US with the bursting of the housing bubble and the subsequent subprime mortgage crisis. Many European banks invested heavily in securities linked to the US real estate. Vulnerabilities in the European banking system, coupled with high leverage, exacerbated the crisis when interbank lending froze due to eroding trust. The crisis deepened with concerns over solvency of several European nations and a significant downturn in global trade.

The 2012 recession stemmed primarily from the Eurozone debt crisis, where several European countries faced a threat of sovereign default due to high government debt levels and weak economic growth. The debt crisis originated in the global financial crisis of 2008-09 and corresponding economic downturn. In response, many governments increased public spending to stimulate their economies, leading to rising national debt. As concerns over sovereign debt grew, particularly in Greece, Portugal, Spain, Ireland and Italy, investor confidence decreased leading to higher borrowing costs for these countries and beyond.

The 2020 recession was a direct result of the global outbreak of the COVID-19 pandemic. As the virus started to spread across European countries, governments implemented strict lockdowns and social distancing measures to contain its transmission. These measures, while necessary for public health, resulted in an abrupt halt of economic activities in many sectors, most notably in travel, hospitality, retail and entertainment. Disruptions in global supply chains further strained manufacturing and trade. Consumer and business confidence plummeted leading to reduced spending and investment. While governments introduced fiscal measures to cushion the economic impact, the combination of supply and demand shocks led Europe into a deep recession in 2020.

As a consequence of the different factors behind each of the four recessions, the specific effects on local economies differed from one recession to another in large part reflecting pre-recession conditions of each place, such as existing industrial structure and other attributes. The differences in the nature of the recessions partially explain why the same places could be the least affected in one recession but the most affected in another (Figure 1 - Figure 4). Likewise, the explanatory power of specific local attributes changes from one recession to another. Something that helped withstand and recover from one recession might not play any role in another recession or can even exacerbate negative impacts (Figure 12 - Figure 13).

Source: Authors elaborations based on OECD (2021[9]); Kose et al. (2020[10]) (2020); Scheinert (2016[11]).

On average employment performance follows the urban-rural continuum. In all four recessions, rurality and remoteness were associated with larger average job losses (Figure 6).

Subnational differences in economic performance in many OECD economies have been expanding in recent decades, particularly at the NUTS3/TL3 level as a result of unequal globalisation effects, differing endowments in human capital, innovativeness, business dynamism and other factors (OECD, 2023[12]). On top of these factors, in many cases, crises are likely to have contributed to and perpetuated deepening disparities as employment losses can accumulate over time (see the next two subsections on the differences in recovery times and hysteresis in employment after crises).

Figure 6. Average, minimum and maximum employment growth by regional typology during the last four recessions
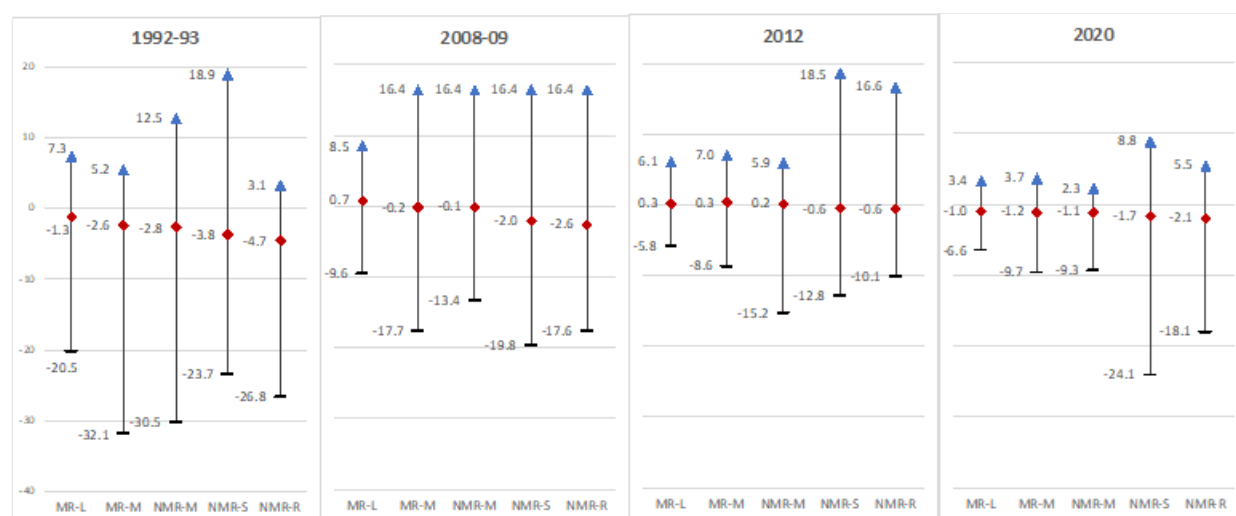
Note: Data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia. The percent growth is calculated using the last pre-recession year and the recession year (or the year of the lowest employment for the two-year recessions). MR-L = metropolitan region, large (region with a Functional Urban Area or FUA >1.5M inhabitants); MR-M = metropolitan region, mid-sized (region with a FUA between 250K and 1.5M inhabitants); NMR-M = nonmetropolitan region near a FUA >250K inhabitants; NMR-S = nonmetropolitan region near a FUA between 50K and 250K inhabitants; MNR-R = nonmetropolitan region remote from a FUA.
Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset using the OECD typology of regions by their access to cities.

There is considerable variation across NUTS3/TL3 regions in labour market recovery times after recessions

Labour markets differ considerably in their recovery trajectories post-recession. A sizeable share of regions enjoy equal or higher employment levels in the last year of a recession compared to pre-recession, at least during some recessions (Figure 7 and Figure 8). On the other extreme, labour markets in many regions do not manage to recover before the next crisis hits, and some do not recover to the pre-crisis employment levels at all. For example, despite a prolonged growth period, employment levels remained suppressed in 18% of regions after the 1992-93 recession and in 26% of regions after the double-dip of the 2008-9 and 2012 recessions.[6] Figure 8 shows geographical distributions of the labour market recovery times after the 1992-93 and the "double dip" recessions.

16 |

Figure 7. Labour market recovery times after the 1992-93 and the "double-dip" (2008-9 and 2012) recessions

% of all regions

Note: Recovery time in years until the post-recession employment level reaches that of the last pre-recession year; the "double-dip" recession refers to the 2008-2012 period, which encompasses the 2008-09 and the 2012 recessions; data for TL3 regions in Austria, Belgium, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, Slovakia; data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia.
Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Figure 8. Maps of labour market recovery times after the 1992-93 and the "double-dip" recessions

Note: Recovery time in years until the post-recession employment level reaches that of the last pre-recession year; the "double-dip" recession refers to the 2008-2012 period, which encompasses the 2008-09 and the 2012 recessions; data for TL3 regions in Austria, Belgium, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, Slovakia; data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia.
Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

The hardest-hit regions can slip into a permanently lower path of employment performance

The hardest-hit regions may potentially slip into a permanently lower path of employment performance.[7] Average employment-to-population ratios of the top and the bottom regions in each country (measured by employment growth rates *during* a recession) tend to diverge during a crisis and the gap can persist indefinitely even if there were no systematic differences in employment-to-population ratio pre-crisis. This pattern is consistently observed in all recessions during the past 40 years for which recovery data are available.

In particular, during the 1992-93 recession, the average employment-to-population ratio of the three regions with the lowest employment growth rate in each country sharply dropped and never recovered. Not surprisingly, gaps in employment-to-population ratios with their best-performing counterparts (three regions in each country with the highest employment growth during the crisis) expanded. Importantly, before they were hit hard during the recession (losing the most jobs in their respective countries as a percentage of pre-recession employment), regions with the lowest employment growth had consistently higher employment-to-population ratios on average (Figure 9).

Figure 9. Long-term labour market performance of regions with the highest and lowest employment growth in the 1992-93 recession

Average employment-to-population ratio
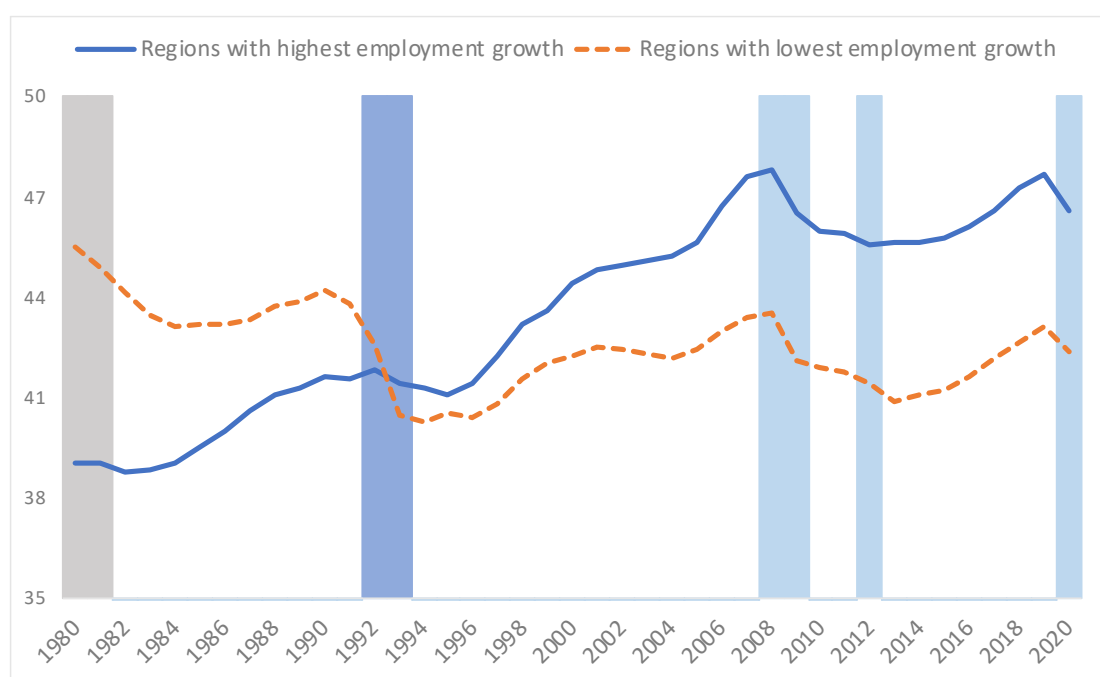
Note: Averages of the three regions with the highest employment growth and the three regions with the lowest employment growth during the 1992-93 recession in Austria, Belgium, Germany, Denmark, Greece, Spain, Finland, France, Ireland, Italy, Lithuania, the Netherlands, Norway, Portugal, and Sweden.
Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Likewise, the regions with the lowest employment growth during the 2008-09 recession slipped to a lower employment-to-population ratio trajectory during the crisis (Figure 10). The difference between this group of regions and regions with highest employment growth during the recession persisted in all post-recession years of data availability. Similar to the patterns observed in Figure 9, before sliding to a lower trajectory of the employment-to-population ratio during and after the crisis, the regions with the biggest employment losses during the crisis consistently outperformed other regions, which fared best (in terms of employment growth) during the crisis.

Figure 10. Long-term labour market performance of regions with the highest and lowest employment growth in the 2008-09 recession

Average employment-to-population ratio
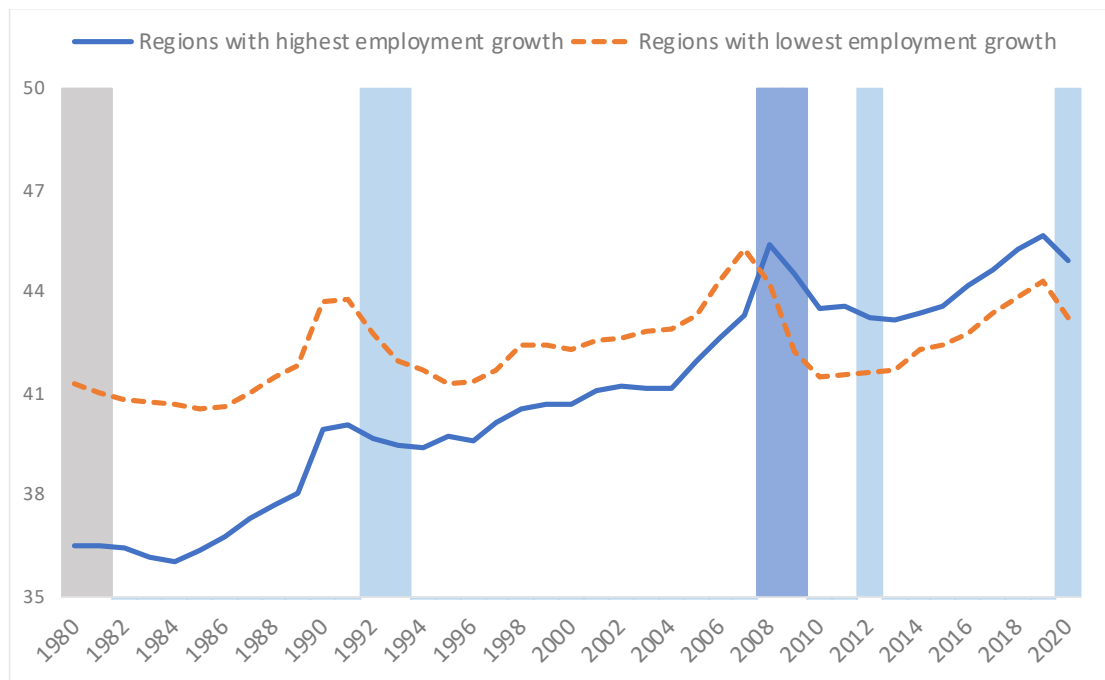
Note: averages of the three regions with the highest employment growth and the three regions with the lowest employment growth during the 2008-09 recession in Austria, Belgium, Bulgaria, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Croatia, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovenia and Slovakia.
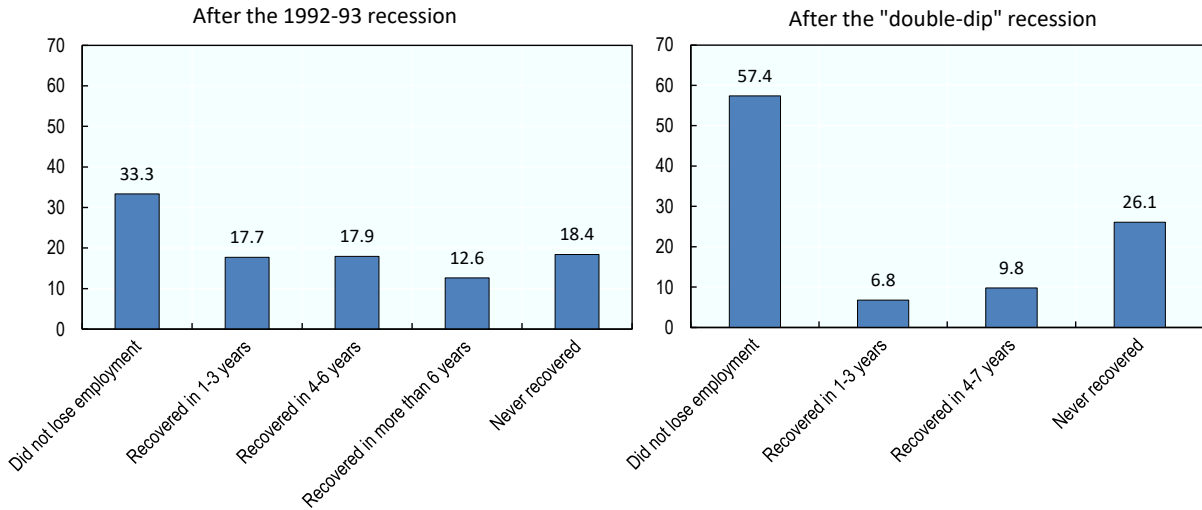Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Finally, the differences in the employment-to-population ratio between regions with the highest and the lowest employment growth during the 2012 recession doubled compared to the pre-recession period and remained of sizable magnitude until the COVID-19 pandemic (Figure 11). In contrast to Figure 9 and Figure 10, before the 2012 crisis, the employment-to-population ratio of the regions with the lowest 2011-2012 employment growth was below that of the regions with the highest 2011-2012 employment growth. The expansion of the gap during the recession resulted from both a decrease in the employment-to-population ratio in the regions with lowest employment growth during the crisis and an increase in the employment-to-population ratio in the regions with the strongest employment growth during the crisis. The weakest performing regions enjoyed a faster recovery in their employment-to-population ratio post-recession compared to the strongest performing regions.

Figure 11. Long-term labour market performance of regions with the highest and lowest employment growth in the 2012 recession

Average employment-to-population ratio
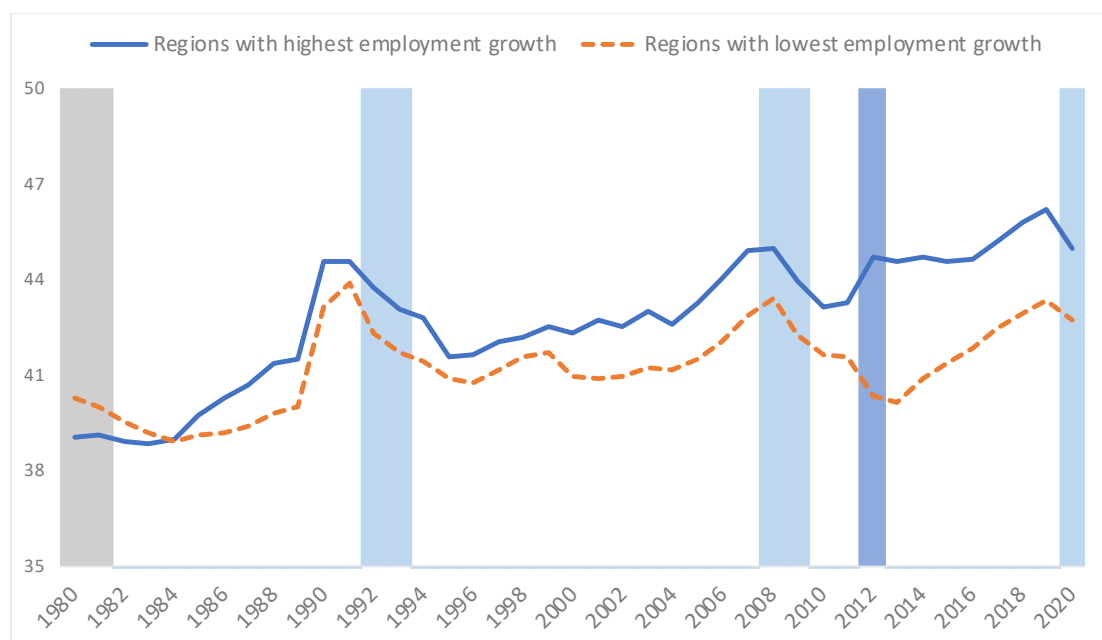
Note: averages of the three regions with the highest employment growth and the three regions with the lowest employment growth during the 2012 recession in Austria, Belgium, Bulgaria, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Croatia, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovenia and Slovakia.
Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

The inability of hard-hit regions to return to their pre-crisis levels of economic performance (which can be measured by various indicators, including employment-to-population ratio, unemployment and others) is called hysteresis, and can have several underlying mechanisms (Fingleton, Garretsen and Martin, 2012[13]). One mechanism is an erosion of human capital of the unemployed, which makes it harder for them to return to work. The longer the downturn and the longer people stay out of work (which is more likely in more affected regions), the more profound the skills loss is. Another possible mechanism involves higher wages (for example, negotiated by workers still in the labour force or set through other mechanisms), which leads to higher equilibrium unemployment. In addition to erosion of skills or a changed wage structure, a crisis can also lead to suppressed investments and lower growth for years to come (Krugman, 2011[14]).

Hysteresis has been documented for several recent recessions. Jaeger and Parkinson (1994[15]) empirically confirm the presence of hysteresis in unemployment rates in several countries, including West Germany and the United Kingdom (UK) between 1961 and 1991. Jacobson, Vredin and Warne (1997[16]) show that the wage mechanism is behind hysteresis in unemployment in Scandinavian countries. Sensier, Bristow and Healy (2016[17]) report that close to 20% of European regions did not return to peak levels of employment after the crisis of the early 1990s despite a prolonged growth period afterwards. Fingleton, Garretsen and Martin (2012[13]) show that employment shocks in UK regions over several recent recessions had permanent effects on employment.

2 Taking a long-term view: Productivity is the most consistent determinant of resilience

This section describes an econometric study that uses regression analysis to identify regional characteristics associated with greater employment resilience in the last four recessions. The selection of the regional characteristics is guided by the existing academic literature on regional economic resilience and data availability. Some explanatory variables used in the literature, which focuses on more recent recessions, could not be included as data for the earlier recessions are not available.[8]

Estimation approach, variables and data

The analysis focuses on two components of resilience – robustness and recovery. Each component is approximated by two alternative measures as described in Box 5. The measures are used as the dependent variables in empirical estimation. The next subsection reports results for one measure of each component for brevity. Full results are provided in 0.

Labour productivity in the last year before a recession is the main explanatory variable. It is calculated as total gross value added in a NUTS3/TL3 region divided by total employment.[9] A set of additional variables is included in the estimation to control for the influence of other factors. Table 3 provides a list of all independent variables, offers a brief rationale for inclusion, and indicates the data source.

Two main approaches - cross section and panel data - are used to estimate the link between pre-recession labour productivity in a region and its employment performance (resilience) during and after a recession. The first approach recognises that each recession is different – in the origins of a crisis, its severity across countries and regions, and other dimensions. In this vein, the link is estimated separately by recession. This highlights how the effects of the explanatory variables change from recession to recession. The second approach recognises that regions differ in many characteristics and these differences can be very difficult to account for in a regression. To factor out potential effects of time-invariant regional traits (for example, culture, social capital and others), a fixed effects panel approach is used.

Box 5. Resilience measures

The analysis in this paper focuses on two resilience dimensions, robustness (how little regional employment contracted during a recession) and recovery (whether and how quickly regional employment returned to the pre-recession level). Two alternative operationalisations (measurements) are used for each of the two resilience dimensions, as described below.

Robustness

The first measure of robustness used is a "Robustness index", which is calculated as described in Equation 2. The index benchmarks the employment level in a region during a recession (or the lowest point in a two-year recession) to its own pre-recession performance and to the national benchmark (Equation 1). The index is widely used in the regional economic resilience research (Martin et al., 2016[18]; Tsvetkova, Grabner and Vermeulen, 2020[19]).

$$\text{NB}_{c,t} = \left(Emp_{c,t} - Emp_{c,t-1}\right)/Emp_{c,t-1}$$

Equation 1

$$Robustness1_{r,c,t} = (\frac{Emp_{r,c,t} - Emp_{r,c,t-1}}{Emp_{r,c,t-1}} - NB_{c,t})/|NB_{c,t}|$$

Equation 2

where $NB_{c,t}$ stands for the national benchmark for country c in time period t, i.e. national employment growth rate between the last pre-recession year $t-1$ and the recession (its lowest point if the recession period spans two years) t while r stands for region.

The second measure of robustness is a difference between the employment growth rate during a recession and the annualised employment growth rate over a pre-recession period (denoted in tables of results as **Difference in annualised growth**, Equation 4). Equation 3 shows the formula for annualised growth.

$$\text{AG}_{r,t} = [(\text{Emp}_{r,t-1}/\text{Emp}_{r,t-1-n})^{1/n}] - 1$$

Equation 3

where $AG_{r,t}$ stands for annualised (compound) growth rate in region r during the pre-recession period $t-1$; t is the first year of each of the recessions; n is the number of the pre-recession years (see Table 2); Emp stands for the employment level.

$$Robustness2_{r,t} = EmpGr_{r,t} - AG_{r,\tau}$$

Equation 4

where $EmpGr_{r,t}$ is the employment growth rate between the last pre-recession year (i.e. 1991 for the 1992-93 recession; 2007 for the 2008-09 recession and so forth) and the year of a recession (or the year of the lowest employment level for the two-year recessions) in region r and $AG_{r,t}$ is as defined above.

Table 2. Pre-recession and post-recession periods

Recession as identified by the EABCDC	Recession as used in the analysis	Pre-recession years	Post-recession years
Q2 1992 – Q3 1993	1992, 1993	1983-91	1994-2007
Q2 2008 – Q2 2009	2008, 2009	1994-2007	2010-11
Q4 2011 – Q1 2013	2012	2010-11	2013-19
Q1 2020 – Q2 2020	2020	2013-19	

Recovery

The recovery component of resilience is also approximated by two measures. The first one is a dichotomous variable (denoted in tables of results as **Recovery**), which takes on a value of one if the employment level of the last pre-recession year is reached during any year before the next recession starts (Table 2 lists post-recession periods for each recession).

The second measure (denoted in tables of results as **Speed of recovery**) counts the number of years it takes for a region to reach the employment level of the last pre-recession year before the next recession starts. If a region never recovers before the next recession, this information is also accounted for by the estimation framework (survival analysis).

Note: A recession is defined by the Euro Area Business Cycle Dating Committee (EABCDC) as "a significant decline in the level of economic activity, spread across the economy of the euro area, usually visible in two or more consecutive quarters of negative growth in GDP, employment and other measures of aggregate economic activity for the euro area as a whole." A year is marked as a recession year in the data if two or more of its quarters were identified as a recession by the EABCDC.
Source: Methodology | EABCN; Author's elaborations.

Table 3. Independent variables

Variable	Why included	Source
Labour productivity in the last pre-recession year	To answer the main research question: Do more productive regions pre-recession enjoy better employment performance during and after the recession (are more resilient)?	ARDECO
Employment to population ratio in the last pre-recession year	To control for a possibility that the apparent resilience (especially robustness) might be a result of already low employment levels in some regions	ARDECO
Annualised growth during the pre-recession years (see Table)	To account for the possibility that growing regions can be more likely to resume growth; their resilience (especially recovery) might be the result of the historic factors, not contemporaneous ones included in the model	ARDECO
Sectoral concentration (Herfendahl-Hirshman Index)	To control for the impact of industrial concentration	ARDECO
Employment shares in the following sectors (included separately) in the last pre-recession year: A, B-E, F, G-J, K-N	To control for the differences in how economic recessions affect different sectors and the varying ability of sectors to recover from various shocks	ARDECO
Population density	To account for the effects of agglomerations	ARDECO
Dichotomous variables to control for the following fixed attributes (only in cross-section models): urban region, rural region, coastal region	To account for possible differences stemming from structural and other characteristics unique to each of the regional types	Eurostat
Fixed effects: countries (only in cross-section models); recessions (only in panel data)	To control for unobserved characteristics that are the same for each country (for cross-section models) or for each recession (in panel data models)	

Note: Regional typologies come from Tercet – Territorial typologies - NUTS - Nomenclature of territorial units for statistics - Eurostat (europa.eu)
Source: Author's elaboration.

Four estimation techniques appropriate for the data structures are applied. The cross-section models that focus on robustness are estimated using Ordinary Least Squares (OLS). The model focusing on recovery (dichotomous dependent variable) uses a logit regression. The model focusing on the speed of recovery relies on survival analysis. Finally, the panel data is estimated using fixed effects linear regression for robustness and fixed effects logit for recovery. In all specifications, errors are clustered at the country level.[10]

The data were collected from several official sources, including the OECD Regional Database, Eurostat and the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO)[11]. ARDECO is maintained and updated by the Joint Research Centre (JRC) and contains time-series indicators for demography, labour market, capital formation and GDP starting in 1980 at different levels of geographical disaggregation (data for Eastern European and some other countries start at a later date).

Estimation results

Over the last forty years, labour productivity was the most consistent predictor of labour market resilience in Europe in terms of both robustness and recovery. On average, NUTS3/TL3 regions enjoyed a 0.05 percentage point smaller drop in employment (compared to the pre-recession annualised employment growth) for each additional EUR 1 000 in labour productivity in all recessions except for the exceptional COVID-19 pandemic (Figure 12). The odds ratio of recovery was 1.1 (1992-93 and 2008-09 recessions) or 1.2 (2012 recession) times higher per each additional EUR 1 000 in pre-crisis labour productivity (Figure 13).

Figure 12. Estimation results for robustness by recession

Regression coefficients with 95% confidence intervals.
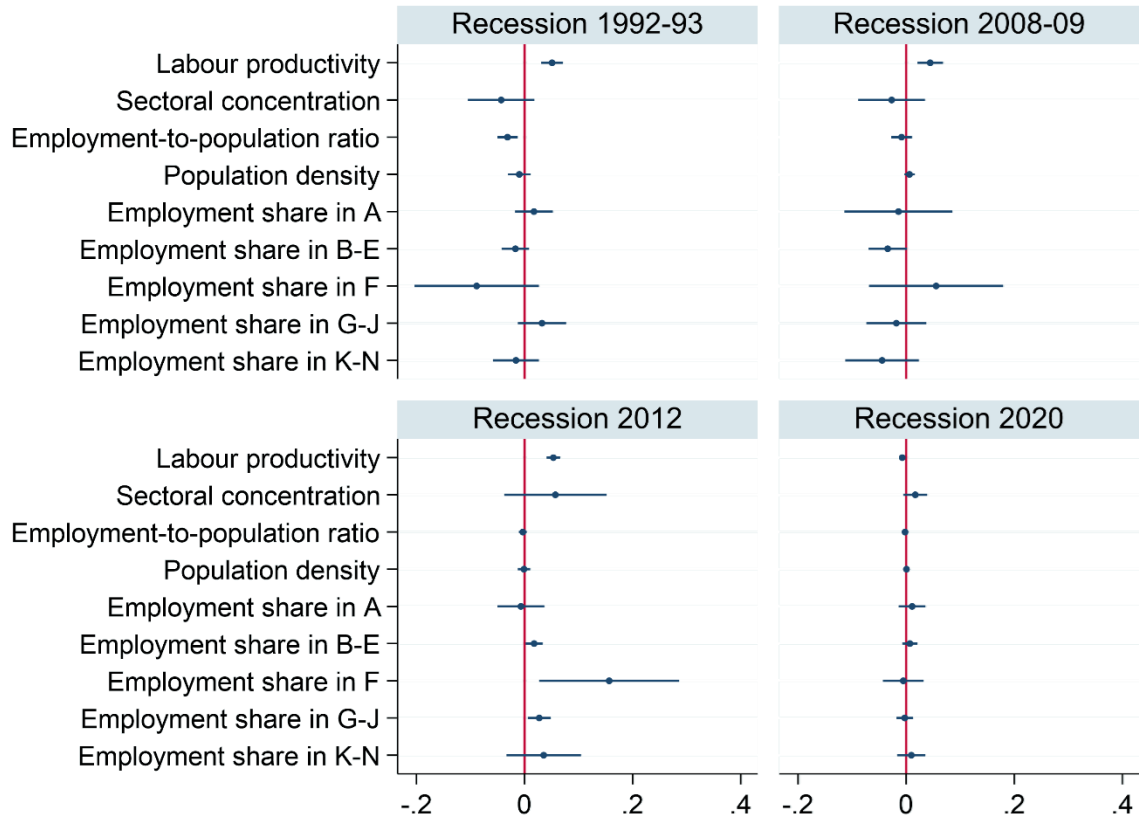
Note: Ordinary least squares (OLS) estimation for robustness (differences in annualised growth), standard errors clustered by country; a constant and controls (annualised pre-recession employment growth and dummies for a country, coastal regions, rural regions and urban regions) included in estimation are not shown; sectors: A – agriculture, B-E – industry, F – construction, G-J – retail and wholesale trade, transportation, accommodation and food, information and communication, K-N – finance, professional and scientific services, administrative support; data for TL3 regions in Austria, Belgium, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, Slovakia; data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia.
Source: Author's estimation.

Figure 13. Estimation results for recovery by recession

Regression coefficients with 95% confidence intervals.
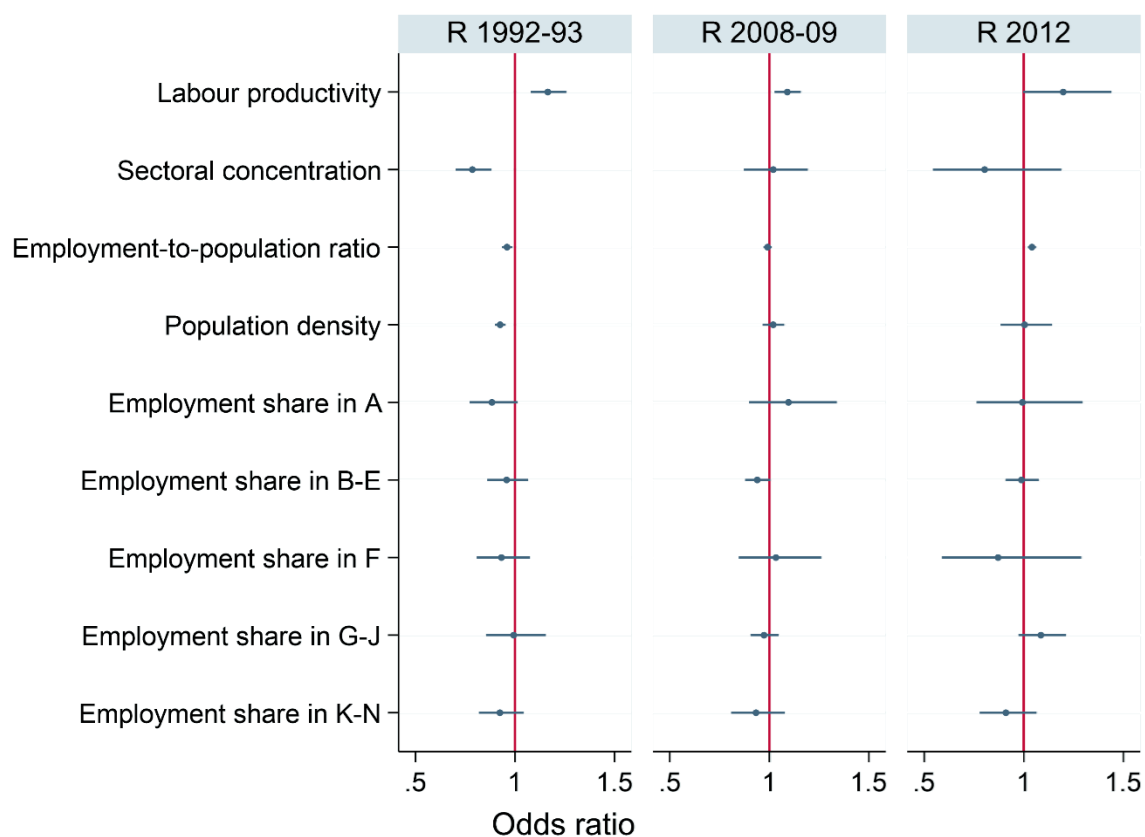
Note: Logit regression (dependent variable is a yes/no for employment recovery to the pre-recession levels during the post-recession period), standard errors clustered by country; a constant and controls (annualised pre-recession employment growth and dummies for a country, coastal regions, rural regions and urban regions) included in the models are not shown; A – agriculture, B-E – industry, F – construction, G-J – retail and wholesale trade, transportation, accommodation and food, information and communication, K-N – finance, professional and scientific services, administrative support; data for TL3 regions in Austria, Belgium, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, Slovakia; data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia.
Source: Author's estimation.

The effects of other statistically significant variables change from one recession to another (reflecting clear differences in the nature of the recessions). For example, employment in regions with a higher concentration of industry contracted less (compared to the pre-recession performance) after the 2012 recession but more after the 1992-93 recession. A larger contraction during the 1992-93 downturn was mostly due to global competition and structural shifts. The rise of emerging markets, especially in Asia, brought intense competition to European industries, challenging their dominance and forcing many to downsize or restructure. The transition of former Soviet republics and satellite states from centrally planned economies to market-oriented ones introduced new low-cost competitors to the industrial landscape. Simultaneously, Europe was undergoing a broader transformation from an industrial-based economy to a more services-oriented one. This shift was accelerated by the recession further pushing industries into contraction and leading to greater job losses in regions that were yet to adapt to these changing economic dynamics.

In contrast, the 2012 recession was predominantly a financial and sovereign crisis, affecting the banking, finance and services sectors more acutely. Industrial regions, particularly those engaged in export-oriented manufacturing, benefited from a diversified customer base including markets outside of the crisis-hit Eurozone. Additionally, many industrial regions had learned from past recessions – on top of already having mostly lean manufacturing, they invested in innovation, technology and upskilling bolstering resilience.

Likewise, employment levels in regions with a greater employment-to-population ratio were more likely to recover after the 2012 recession but less likely to recover after the 1992-93 recession. Again, the dissimilar nature of the recessions can explain the differences. Regions with high employment-to-population ratio prior to the 1992-93 recession often had a high share of their population employed by industries that were especially vulnerable to the structural shifts and competitive pressures of the early 1990s. The sudden market changes intensified by the fall of the Soviet Union and the rise of global competition considerably affected these densely employed regions. The reliance on sectors that were undergoing transformation meant that these areas struggled to adapt quickly. Their previously advantageous high employment concentration became a vulnerability, as sectors stagnated or contracted, leading to longer periods of joblessness and stunted recovery.

The negative effects of the 2012 recession (a financial and a sovereign debt crisis) did not directly affect the sectors with largest shares of regional employment. A higher employment-to-population ratio implied a broader tax base, providing governments with more fiscal flexibility to stimulate the economy and to invest in recovery measures. After the structural transformation towards a services-based economy, higher employment levels often correlate with better skills development and education, making these regions more adaptable to economic shifts. The diversified skill sets, and proactive workforce likely facilitated a quicker rebound from the economic setback.

Unlike other determinants whose impacts differ across recessions, higher productivity consistently serves as a shield, which can protect regions against economic shocks, while low productivity makes regions less resilient and more vulnerable to crises. This can be seen from examining predictive margins, which show how employment resilience during a crisis is linked to the pre-crisis labour productivity **(**Figure 14). The left panel shows predictive margins (averages of predictions) for robustness[12] at different levels of labour productivity. During all recessions except for the COVID-19 pandemic, the measures of robustness were negative in regions with productivity below a certain value[13] but were positive in regions with productivity above this value. [14]

Likewise, higher pre-recession labour productivity was positively associated with the likelihood of recovery after a crisis after three recessions. As seen in the right panel of Figure 14, there is a strong positive link between the recovery likelihood (vertical axis) and pre-recession labour productivity (horizontal axis), but with declining marginal benefits for each unit increase in labour productivity above EUR 75 000.

Figure 14. Marginal effects of labour productivity
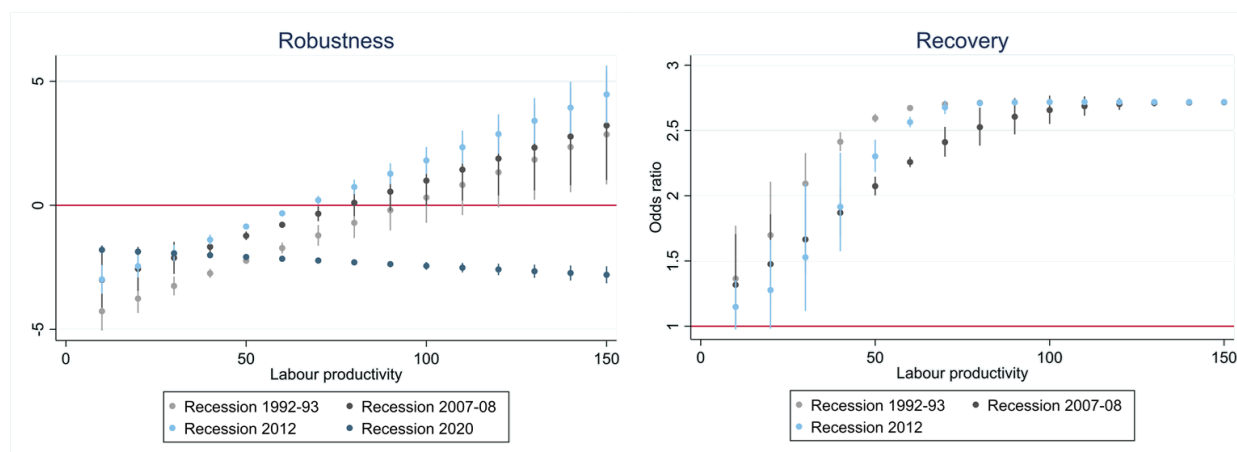
Note: Ordinary least squares (OLS) estimation for robustness (dependent variable is the differences in annualised growth rates); logit regression for recovery (dependent variable is a yes/no for employment recovery to the pre-recession levels during the post-recession period); standard errors clustered at the country level; the estimated models include all controls listed in Figure 13 plus annualised pre-recession employment growth and dummies for a country, coastal regions, rural regions and urban regions; data for TL3 regions in Austria, Belgium, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, Slovakia; data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia.
Source: Author's estimation.

3 Discussion and conclusions

Employment resilience matters beyond the obvious reasons of sustaining employment during an economic downturn. Employment contractions can leave long-lasting scars on labour markets, potentially depriving places and their residents of economic opportunities. On average, the employment-to-population ratio of places with large job losses during a recession slips to a considerably lower point, creating or widening a gap with regions, which enjoyed the smallest employment loss during a crisis. This gap persists for all years of data availability, spanning decades in some cases.

Employment loss during recessions can contribute to the widening disparities in economic performance within countries. The most recent OECD Regional Outlook (2023[12]) documents continued expansion in economic performance disparities at the NUTS3/TL3 level. In Europe, analysis presented in this paper shows that during the last four recessions, rurality and remoteness were associated with larger employment losses potentially contributing to widening disparities.

As the frequency of negative economic shocks intensifies, policy needs to strengthen regional resilience (including robustness and recovery components). This resilience will help regions not to slip into lower employment performance paths and lagging behind. Policies to reinforce resilience should be based on an understanding of the factors that are helping to preserve and restore employment levels during and after recessions. This task is complicated by the different sets of factors linked to employment resilience from one recession to another, which is not surprising given the vastly different root causes of the last four recessions.

Regional factors often play a more important role in resilience compared to the national ones. Academic research finds that regional characteristics are more important predictors of the ability of places to withstand and recover from crises. At least after the 2008 global financial crisis, national conditions tended to play a relatively limited role (Crescenzi, Luca and Milio, 2016[3]). For example, regional labour market concentration, educational attainment and GDP per capita were linked to the likelihood of European NUTS2 regions withstanding the 2008-09 recession, while the national levels of these variables were statistically insignificant (Giannakis and Bruggeman, 2017[20]).

Local labour productivity is the only characteristic consistently linked to greater employment resilience in three out of four recent recessions. The analysis presented in this paper shows that in three out of four recessions over the last 40 years, more productive regions pre-recession enjoyed a smaller drop in employment and were more likely to recover. Further analysis illustrates how higher labour productivity in a sense serves as a possible shield against negative impacts of economic crises on employment. For example, regions with productivity levels above EUR 75 000- EUR 90 000 (depending on a recession) tended to have on average higher employment growth rates during a recession then before a recession, controlling for other factors. Likewise, higher labour productivity is positively linked to the likelihood of employment recovery after a recession, but the additional benefits become considerably smaller or disappear after the labour productivity level exceeds EUR 75 000.

Both productivity and resilience can be linked to industrial, technological and institutional renewal of places, although more research is needed to better understand the exact underlying mechanisms and how they can be leveraged for enhanced employment resilience. Higher regional productivity signals greater resources and capabilities, including an ability of a region to renew its technological, industrial and

institutional structures. On the resilience side, faster resource reallocation within regional economies and creation of novel combinations of capabilities can soften the shocks and open new growth paths, particularly in weaker regions. A number of studies point to the link between faster adjustments in a local economy and stronger economic outcomes. For example, Partridge and Tsvetkova (2020[21]) show that greater "rewiring" ability (approximated by changes in regional industrial and occupational mix together with a measure of greater inter-sectoral job flows) was linked to higher employment growth after the 2008-09 recession in the United States. The positive association was particularly pronounced in rural counties and counties that underperformed after the 2008-09 recession compared to the pre-recession period. Likewise, Hane-Weijman et al. (2018[22]) show that presence of related industries in a region speeds up re-employment of workers laid off during a major downsizing of manufacturing industry in Sweden. The positive link between related industrial structure and re-employment is particularly evident in the economically weaker regions.

Although not based on the analysis in this paper, one can expect places, which are "in the habit" of renewal and readjustment to be likely to be better prepared to quickly react to a crisis. Academic literature suggests that regions able to branch into new technologies and to rejuvenate their knowledge base tend to be more resilient (Martin and Sunley, 2006[23]; Rocchetta et al., 2022[5]). A history of regional economic adaptability contributes to the resilience of regions, whilst resilience to past shocks helps future resilience through an evolutionary process (Tsiapa, Kallioras and Tzeremes, 2018[24]). Relatedly, "resilience thinking" offers an analytical tool that is better suited for understanding and coping with an increasingly uncertain, volatile and risk-prone world (Zolli and Healy, 2012[25]; Martin and Gardiner, 2019[26]). Although discussed in the context of natural disasters, a focus on resilience through resilience planning, projects and practices can bring a range of added economic and social returns in terms of employment opportunities, social cohesion and other benefits during both good times and bad times (Rodin, 2014[27]; Vermeulen, 2022[28]).

Policies that support "flow and adjustment" in the regional economy can boost both productivity and employment resilience in regions. Despite the popular narrative that resilience comes at the expense of efficiency (or productivity), the reality is more nuanced. Both resilience and productivity can be enhanced simultaneously. Examples include future-proofing of jobs through skills development, diversification into more innovative and technology-based economic activities and ensuring that resources within the economy can be reallocated to a better use quickly.

In some cases, economic support measures can dampen dynamism in the economy and its future growth prospects. Depending on their scope or longevity, various policy interventions such as employment or income guarantees for workers, credit extensions and transfers to firms can slow or even reverse (e.g. when policies help unviable firms) resource reallocation to the more productive uses. Policy makers can evaluate the pros and cons of interventions in each specific case and prioritise policy designs, which provide necessary support while minimising the incentives for adverse selection and the likelihood of unintended negative consequences. Vermeulen (2022[28]) offers a synopsis of policies that can increase resilience and how they affect both resilience and productivity.

In a crisis situation, however, empirical evidence suggests that the gains from preserving the employer-employee relationships or helping firms to stay in business can outweigh the loss of economic efficiency. During a recession, the economic support to workers and firms functions as a public insurance scheme, which pools risks. This helps beneficiaries to stay employed or to continue business operations. After a crisis, recovery is facilitated by a preserved employer-employee relationships and by the fact that financial capital was not destroyed. In European countries, the use of retention schemes during the 2008-09 recession was linked to a number of positive outcomes ranging from faster employment growth and lower unemployment to higher firm survival rates (Kopp and Siegenthaler, 2021[29]; Cahuc, Kramarz and Nevoux, 2018[30]). During the COVID-19 pandemic, the emergency support was effective in preventing widespread bankruptcies, thus avoiding a negative spiral through credit markets (OECD, 2021[31]). Job

retention schemes can be well-targeted with only minor losses in allocative efficiency as was the case shortly after the 2008-09 crisis (Hijzen and Martin, 2012[32]).

When it comes to regional labour markets, upskilling and lifelong learning enhance both resilience and productivity (as well as regional growth and prosperity). Skills corresponding to the needs of the local economy can facilitate reabsorption of workers in the case of adverse shocks to local enterprises or industries. The ability of workers to be occupationally and regionally mobile is an important precondition for such reabsorption. More generally, the above average skill levels are associated with more flexibility and employment opportunities for workers and greater innovativeness, absorptive capacity and growth prospects for firms that employ them, as well as for local economies as a whole.

Regional policies should be coordinated with the national ones to maximise their benefits. Indeed, longer-term regional economic development is path-dependent, and this path is significantly shaped by national economic trends (Webber, Healy and Bristow, 2018[33]). In this sense, national policies can have pronounced effects on employment resilience. For example, nationally organised intra-national transfers (e.g. unemployment transfers) can increase robustness through interregional risk sharing, particularly during shocks that affect regions within countries unevenly. Active labour market policies can increase adaptability to local economic shocks boosting resilience (both robustness and recovery). During the COVID-19 pandemic, short-term work schemes mandated by national governments helped maintain employer-employee relations and skills setting foundations for subsequent recovery (Vermeulen, 2022[28]).

Notes

[1] Productivity performance likewise differs across regions. In this section we focus on employment performance and move on to the link between productivity and employment in section 2.

[2] For example, in five out of 10 countries with available data, the 1980 unemployment rate in the bottom quarter of regions was more than twice the rate of the top quarter of regions. In four additional countries, this ratio exceeded 1.6. By 1987, the ratio was 2 or higher in seven countries, reaching 3.4 in one of them (OECD, 1989[34]). The vast disparities in labour market performance across regions of the OECD countries called for a more detailed examination and policy solutions to address the subnational differences. In response, the OECD Co-operative Action Programme on Local Employment and Economic Development (LEED) was created in 1982 as a platform to exchange on innovative approaches to local development and job creation.

[3] For countries with at least six NUTS3/TL3 regions.

[4] Overall, employment performance of a region in one recession is a weak predictor of the same region's performance in another recession. The correlation coefficient for employment growth in any pair of recessions (e.g. a correlation of employment growth in the 1992-93 recession and the 2008-09 recession; a correlation of employment growth in the 1992-93 recession and 2012 recession, etc.) ranges from 0.06 to 0.33.

[5] The cross-regional variations are even more pronounced when more growth rate intervals are used to classify regions (Annex B).

[6] The rest of the regions take different amounts of time to reach the level of the pre-recession employment – their median recovery time was five years after the 1992-93 recession and four years after the "double-dip" recession.

[7] This argument applies to any loss of employment, not necessarily a general recession. Country- and region-specific shocks can have the same effect. An exercise of tracking the employment-to-population ratio for the best and the worst performing regions in two placebo recessions shows comparable patterns (not shown for brevity), although the difference in the trajectories of the two groups of regions tends to be slightly larger after the actual crises. Likewise, an alternative measure of labour performance (a robustness index as described in Box) produces comparable charts.

[8] Two additional explanatory variables, an entropy measure for industrial diversity and a measure of educational attainment (the latter is available only for the last three recessions and at the NUTS2 level), were included in additional estimations but did not change the results (not shown for brevity).

[9] An estimation that uses labour productivity two years before the onset of a crisis gives very similar results.

[10] Results stay qualitatively the same if bootstrapped, jackknife or robust errors are used.

[11] ARDECO database | Knowledge for policy (europa.eu)

[12] Measured by the difference between employment growth rates during and before a recession.

[13] Between approximately EUR70000 and EUR95000 depending on the recession.

[14] Positive robustness measures imply that during a recession, employment growth rate in a region was higher than this region's annualised pre-recession employment growth rate; negative robustness measures imply that during a recession, employment growth rate in a region was lower than this region's annualised pre-recession employment growth rate.

References

Bristow, G. and A. Healy (2018), *Innovation and regional economic resilience: an exploratory analysis*, Springer Verlag, https://doi.org/10.1007/s00168-017-0841-6. [7]

Cahuc, P., F. Kramarz and S. Nevoux (2018), "When Short-Time Work Works", *Banque de France Working Papers*, No. 692, Banque de France, https://doi.org/10.2139/SSRN.3247486. [30]

Crescenzi, R., D. Luca and S. Milio (2016), "The geography of the economic crisis in Europe: national macroeconomic conditions, regional structural factors and short-term economic performance", *Cambridge Journal of Regions, Economy and Society*, Vol. 9/1, pp. 13-32, https://doi.org/10.1093/CJRES/RSV031. [3]

Doran, J. and B. Fingleton (2018), "US metropolitan area resilience: insights from dynamic spatial panel estimation", *Environment and Planning A: Economy and Space*, Vol. 50/1, pp. 111-132, https://doi.org/10.1177/0308518X17736067. [6]

Fingleton, B., H. Garretsen and R. Martin (2012), "Recessionary shocks and regional employment: Evidence on the resilience of U.K. regions", *Journal of Regional Science*, Vol. 52/1, pp. 109-133, https://doi.org/10.1111/j.1467-9787.2011.00755.x. [13]

Fusillo, F., D. Consoli and F. Quatraro (2022), "Resilience, Skill Endowment, and Diversity: Evidence from US Metropolitan Areas", *Economic Geography*, Vol. 98/2, pp. 170-196, https://doi.org/10.1080/00130095.2021.2008797/SUPPL_FILE/RECG_A_2008797_SM4761.DOCX. [2]

Giannakis, E. and A. Bruggeman (2017), "Determinants of regional resilience to economic crisis: a European perspective", *European Planning Studies*, Vol. 25/8, pp. 1394-1415, https://doi.org/10.1080/09654313.2017.1319464. [20]

Hane-Weijman, E., R. Eriksson and M. Henning (2018), "Returning to work: regional determinants of re-employment after major redundancies", *Regional Studies*, Vol. 52/6, pp. 768-780, https://doi.org/10.1080/00343404.2017.1395006/SUPPL_FILE/CRES_A_1395006_SM6218.PDF. [22]

Hijzen, A. and S. Martin (2012), *The role of short-time working schemes during the global financial crisis and early recovery: a cross-country analysis.*, http://www.oecd.org/els/workingpapers. (accessed on 18 December 2020). [32]

Jacobson, T., A. Vredin and A. Warne (1997), "Common trends and hysteresis in Scandinavian unemployment", *European Economic Review*, Vol. 41/9, pp. 1781-1816, https://doi.org/10.1016/S0014-2921(96)00027-X. [16]

Jaeger, A. and M. Parkinson (1994), "Some evidence on hysteresis in unemployment rates", *European Economic Review*, Vol. 38/2, pp. 329-342, https://doi.org/10.1016/0014-2921(94)90061-2. [15]

Kitsos, A. and P. Bishop (2018), "Economic resilience in Great Britain: the crisis impact and its determining factors for local authority districts", *Annals of Regional Science*, Vol. 60/2, pp. 329-347, https://doi.org/10.1007/S00168-016-0797-Y/TABLES/6. [4]

Kopp, D. and M. Siegenthaler (2021), "Short-Time Work and Unemployment in and after the Great Recession", *Journal of the European Economic Association*, Vol. 19/4, pp. 2283-2321, https://doi.org/10.1093/JEEA/JVAB003. [29]

Kose, M., N. Sugawara and M. Terrones (2020), "Global Recessions", *Policy Research Working Papers*, No. 9172, World Bank, https://doi.org/10.1596/1813-9450-9172. [10]

Krugman, P. (2011), "Hysteresis Begins", *The New York Times*, https://krugman.blogs.nytimes.com/2011/09/18/hysteresis-begins/ (accessed on 12 April 2022). [14]

Martin, R. and B. Gardiner (2019), "The resilience of cities to economic shocks: A tale of four recessions (and the challenge of Brexit)", *Papers in Regional Science*, Vol. 98/4, pp. 1801-1832, https://doi.org/10.1111/PIRS.12430. [26]

Martin, R. and P. Sunley (2015), "On the notion of regional economic resilience: conceptualization and explanation", *Journal of Economic Geography*, Vol. 15/1, pp. 1-42, https://doi.org/10.1093/jeg/lbu015. [1]

Martin, R. and P. Sunley (2006), "Path dependence and regional economic evolution", *Journal of Economic Geography*, Vol. 6/4, pp. 395-437, https://doi.org/10.1093/JEG/LBL012. [23]

Martin, R. et al. (2016), "How Regions React to Recessions: Resilience and the Role of Economic Structure", *Regional Studies*, Vol. 50/4, pp. 561-585, https://doi.org/10.1080/00343404.2015.1136410. [18]

OECD (2023), *OECD Regional Outlook 2023: The Longstanding Geography of Inequalities*, OECD Publishing, Paris, https://doi.org/10.1787/92cd40a0-en. [12]

OECD (2021), *OECD Regional Outlook 2021: Addressing COVID-19 and Moving to Net Zero Greenhouse Gas Emissions*, OECD Publishing, Paris, https://doi.org/10.1787/17017efe-en. [9]

OECD (2021), *Supporting jobs and companies: A bridge to the recovery phase*, OECD. [31]

OECD (1989), *OECD employment outlook*, OECD Publishing, Paris. [34]

Partridge, M. and A. Tsvetkova (2020), "Local ability to rewire and socioeconomic performance: Evidence from US counties before and after the Great Recession", *OECD Local Economic and Employment Development (LEED) Papers*, No. 2020/04, OECD Publishing, Paris, https://doi.org/10.1787/31b980f6-en. [21]

Pontarollo, N. and C. Serpieri (2020), "Towards regional renewal: a multilevel perspective for the EU", *Regional Studies*, Vol. 54/6, pp. 754-764, https://doi.org/10.1080/00343404.2019.1640357/SUPPL_FILE/CRES_A_1640357_SM5441.PDF. [8]

Rocchetta, S. et al. (2022), "Technological knowledge spaces and the resilience of European regions", *Journal of Economic Geography*, Vol. 22/1, pp. 27-51, https://doi.org/10.1093/JEG/LBAB001. [5]

Rodin, J. (2014), *The resilience dividend : managing disruption, avoiding disaster, and growing stronger in an unpredictable world*, Profile Books Ltd. [27]

Scheinert, C. (2016), *Vicious circles. The interplay between Europe's financial and sovereign debt crises*, European Parliamentary Research Service. [11]

Sensier, M., G. Bristow and A. Healy (2016), "Measuring Regional Economic Resilience across Europe: Operationalizing a complex concept", *Spatial Economic Analysis*, Vol. 11/2, pp. 128-151, https://doi.org/10.1080/17421772.2016.1129435. [17]

Tsiapa, M., D. Kallioras and N. Tzeremes (2018), "The role of path-dependence in the resilience of EU regions", *European Planning Studies*, Vol. 26/6, pp. 1099-1120, https://doi.org/10.1080/09654313.2018.1458284. [24]

Tsvetkova, A., S. Grabner and W. Vermeulen (2020), "Labour demand weakening during the COVID-19 pandemic in US cities: Stylised facts and factors related to regional resilience", *OECD Local Economic and Employment Development (LEED) Papers*, No. 2020/06, OECD Publishing, Paris, https://doi.org/10.1787/700d91ba-en. [19]

Vermeulen, W. (2022), "Policies for resilient local economies", *OECD Local Economic and Employment Development (LEED) Papers*, No. 2022/09, OECD Publishing, Paris, https://doi.org/10.1787/872d431b-en. [28]

Webber, D., A. Healy and G. Bristow (2018), "Regional Growth Paths and Resilience: A European Analysis", *Economic Geography*, discussion is ok, focus on role of sectors is useful, but empirics are very opaque and probably wrong., pp. 355-375, https://doi.org/10.1080/00130095.2017.1419057. [33]

Zolli, A. and A. Healy (2012), *Resilience: Why Things Bounce Back*, Simon and Schuster, Hachette UK, https://books.google.com/books/about/Resilience.html?id=Af17NTCJqIUC (accessed on 19 September 2022). [25]

Annex A. Top three and bottom three regions by employment performance in the last four recessions

Table A A.1. Top three regions by employment growth during the last four recessions

Country	Recession 1992-93		Recession 2008-09		Recession 2012		Recession 2020	
	Region	Value	Region	Value	Region	Value	Region	Value
Austria	Mühlviertel	1.7	Tiroler Oberland	3.1	Tiroler Unterland	1.8	Nordburgenland	-0.1
	Klagenfurt-Villach	2.9	Innviertel	3.1	Wien	2.0	West- und Südsteiermark	0.1
	Pinzgau-Pongau	3.4	Lungau	6.0	Nordburgenland	2.1	Wiener Umland/Nordteil	0.3
Belgium	Arr. Eeklo	2.7	Arr. La Louvière	3.7	Arr. Marche-en-Famenne	3.3	Arr. Huy	1.1
	Arr. Dendermonde	3.3	Arr. Nivelles	4.0	Arr. Waremme	3.3	Arr. Waremme	1.5
	Arr. Tournai-Mouscron	3.4	Arr. Bastogne	9.0	Arr. Neufchâteau	6.1	Arr. Philippeville	1.7
Bulgaria			Plovdiv	3.7	Shumen	1.0	Montana	0.8
			Kardzhali	4.4	Kardzhali	1.8	Smolyan	1.6
			Sofia (stolitsa)	6.3	Silistra	1.9	Shumen	3.9
Czech Republic			Jihomoravský kraj	0.5	Jihomoravský kraj	1.8	Plzeňský kraj	-1.0
			Ústecký kraj	1.1	Hlavní mesto Praha	2.0	Pardubický kraj	0.4
			Hlavní mesto Praha	8.5	Olomoucký kraj	2.6	Liberecký kraj	2.0
Germany	Bonn, Kreisfreie Stadt	5.2	Havelland	5.8	Dingolfing-Landau	4.9	Pfaffenhofen an der Ilm	0.9
	Eisenach, Kreisfreie Stadt	12.5	Donau-Ries	6.7	Erding	6.1	Fürth, Landkreis	1.1
	Wartburgkreis	18.9	Trier-Saarburg	7.4	Wolfsburg, Kreisfreie Stadt	7.0	Herne, Kreisfreie Stadt	2.0
Denmark	Østsjælland	-1.9	Fyn	0.4	Østsjælland	-0.2	Østsjælland	0.2
	Østjylland	-1.7	Nordsjælland	0.5	Byen København	0.2	Københavns omegn	0.6
	Byen København	-1.0	Østsjælland	1.0	Nordsjælland	0.6	Østsjælland	1.9
Greece	Ikaria, Samos	3.9	Florina	9.7	Chios	7.9	Ioannina	-1.3
	Anatoliki Attiki	4.4	Zakynthos	13.1	Ithaki, Kefallinia	11.3	Larisa	-1.3
	Zakynthos	6.8	Fthiotida	14.1	Lefkada	13.6	Voiotia	-0.9
Spain	Ceuta (ES)	1.3	Melilla (ES)	-0.7	Melilla (ES)	-1.5	Ávila	0.0
	Melilla (ES)	1.3	El Hierro	0.0	Ceuta (ES)	-1.4	Teruel	0.2
	Soria	1.8	Ceuta (ES)	1.0	Eivissa, Formentera	1.1	Cuenca	2.2
Finland	Keski-Pohjanmaa	-10.6	Keski-Pohjanmaa	1.4	Varsinais-Suomi	2.0	Pohjanmaa	-1.2
	Pohjanmaa	-9.6	Etelä-Karjala	2.6	Helsinki-Uusimaa	2.3	Pohjois-Pohjanmaa	0.1
	Åland	-0.9	Satakunta	2.9	Pohjois-Pohjanmaa	2.8	Kanta-Häme	0.2
France	Territoire de	1.1	Loir-et-Cher	2.4	Haute-Garonne	1.9	Var	0.5

Country							
	Belfort						
	Bas-Rhin	1.5	Haute-Corse	3.8	Val-de-Marne	1.9	Haute-Corse	1.0
	Seine-et-Marne	3.8	Corse-du-Sud	4.0	Seine-et-Marne	2.7	Corse-du-Sud	1.0
Croatia			Brodsko-posavska županija	1.9	Sibensko-kninska zupanija	-0.2	Zadarska zupanija	1.5
			Sibensko-kninska zupanija	2.1	Varaždinska županija	0.0	Osječko-baranjska županija	4.3
			Požeško-slavonska županija	2.6	Bjelovarsko-bilogorska županija	1.3	Međimurska županija	8.8
Hungary			Csongrád	-2.9	Jász-Nagykun-Szolnok	4.5	Budapest	0.5
			Pest	-2.1	Gyor-Moson-Sopron	4.6	Pest	0.5
			Budapest	0.6	Szabolcs-Szatmár-Bereg	5.2	Szabolcs-Szatmár-Bereg	1.4
Ireland	Mid-West	0.3	South-West (IE)	-7.7	West	-0.7	South-East (IE)	-2.6
	Dublin	0.4	West	-7.4	Dublin	0.2	South-West (IE)	-1.8
	Mid-East	2.0	Dublin	-7.4	South-West (IE)	2.5	Midland	1.6
Italy	Bolzano-Bozen	1.6	Milano	4.2	La Spezia	2.7	Benevento	0.6
	Trento	1.6	Cagliari	4.9	Rieti	3.2	Trieste	0.9
	Terni	1.9	Livorno	6.4	Modena	3.4	Rieti	1.0
Lithuania			Vilniaus apskritis	-5.9	Klaipedos apskritis	3.3	Klaipedos apskritis	-2.0
			Siauliu apskritis	-4.7	Utenos apskritis	3.4	Vilniaus apskritis	0.2
			Alytaus apskritis	-3.9	Telsiu apskritis	4.3	Panevezio apskritis	5.5
Latvia			Zemgale	-14.1	Kurzeme	2.2	Latgale	-0.8
			Vidzeme	-13.3	Pieriga	3.1	Kurzeme	-0.4
			Pieriga	-11.4	Zemgale	3.4	Zemgale	3.0
Netherlands	Utrecht	4.6	Overig Zeeland	2.1	Noord-Limburg	1.6	Kop van Noord-Holland	0.1
	Overig Groningen	4.9	IJmond	2.7	Flevoland	2.2	Alkmaar en omgeving	0.1
	Flevoland	7.3	Zuidwest-Gelderland	4.3	Zuidwest-Drenthe	2.3	Agglomeratie Leiden en Bollenstreek	0.1
Norway	Vestland	-0.1	Innlandet	4.6	Trøndelag	2.3	Agder	-0.7
	Viken	0.1	Troms og Finnmark	6.0	Vestland	2.6	Trøndelag	-0.4
	Rogaland	0.8	Viken	8.0	Rogaland	3.3	Viken	0.2
Poland			Siedlecki	16.4	Inowroclawski	4.2	Miasto Kraków	3.3
			Zyrardowski	16.4	Swiecki	4.2	Sandomiersko-jedrzejowski	3.3
			Plocki	16.4	Grudziadzki	5.9	Lódzki	3.7
Portugal	Região Autónoma dos Açores (PT)	-2.1	Alto Minho	-1.1	Alto Tâmega	-0.6	Região Autónoma dos Açores (PT)	0.0
	Área Metropolitana de Lisboa	-1.1	Região Autónoma dos Açores (PT)	-1.0	Beiras e Serra da Estrela	-0.1	Alto Alentejo	0.4
	Região Autónoma da Madeira (PT)	2.3	Área Metropolitana de Lisboa	0.1	Douro	0.4	Alentejo Litoral	2.7
Romania			Caras-Severin	-1.5	Ialomita	13.6	Mures	0.6
			Bucuresti	0.2	Bistrita-Nasaud	16.6	Bacau	1.5
			Ilfov	2.0	Teleorman	18.5	Ilfov	3.4
Sweden	Jönköpings län	-5.5	Jönköpings län	-1.8	Stockholms län	1.7	Örebro län	-1.4
	Stockholms län	-5.1	Hallands län	-0.8	Norrbottens län	2.6	Östergötlands län	-0.9
	Gotlands län	-3.9	Stockholms län	2.0	Uppsala län	2.6	Hallands län	-0.7
Slovenia			Osrednjeslovenska	2.8	Podravska	-1.0	Primorsko-notranjska	0.2

Country	Region	Value	Region	Value	Region	Value
	Obalno-kraska	3.1	Koroska	-0.1	Osrednjeslovenska	0.6
	Posavska	3.7	Osrednjeslovenska	1.1	Posavska	1.1
Slovakia	Banskobystrický kraj	0.9	Bratislavský kraj	1.5	Presovský kraj	-1.6
	Bratislavský kraj	2.8	Zilinský kraj	1.8	Banskobystrický kraj	-1.5
	Trenciansky kraj	3.1	Presovský kraj	1.8	Bratislavský kraj	-1.2

Note: Employment growth refers to percent change between the last pre-recession and the recession year (in two-year recessions, the lowest employment level is used); countries with at least six NUTS3/TL3 regions; Guadeloupe, Martinique, Guyane, La Réunion and Mayotte (France) and Jan Mayen and Svalbard (Norway) are excluded; data for the 1992-93 recession are not available for Bulgaria, Czech Republic, Croatia, Hungary, Lithuania, Latvia. Poland, Romania, Slovenia and Slovakia.

Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Table A A.2. Bottom three regions by employment growth during the last four recessions

Country	Recession 1992-93		Recession 2008-09		Recession 2012		Recession 2020	
	Region	Value	Region	Value	Region	Value	Region	Value
Austria	Oberkärnten	-8.2	Steyr-Kirchdorf	-2.6	Oberkärnten	-0.8	Tiroler Oberland	-7.2
	Steyr-Kirchdorf	-5.3	Östliche Obersteiermark	-1.4	Mittelburgenland	-0.7	Lungau	-5.1
	Westliche Obersteiermark	-3.3	Westliche Obersteiermark	-0.9	Westliche Obersteiermark	-0.7	Pinzgau-Pongau	-4.5
Belgium	Arr. Verviers - communes francophones	-25.0	Arr. Arlon	-6.3	Arr. Bastogne	-15.2	Arr. La Louvière	-1.2
	Bezirk Verviers - Deutschsprachige Gemeinschaft	-24.5	Arr. Neufchâteau	-4.8	Arr. Kortrijk	-1.1	Arr. Verviers - communes francophones	-0.8
	Arr. de Bruxelles-Capitale / Arr. van Brussel-Hoofdstad	-8.1	Arr. Marche-en-Famenne	-3.8	Arr. Ieper	-0.5	Arr. Veurne	-0.8
Bulgaria			Pleven	-14.6	Razgrad	-7.1	Kyustendil	-10.8
			Lovech	-13.5	Pazardzhik	-5.6	Vratsa	-9.0
			Gabrovo	-9.1	Targovishte	-4.2	Sofia	-6.6
Czech Republic			Zlínský kraj	-4.3	Ústecký kraj	-3.1	Karlovarský kraj	-6.5
			Kraj Vysocina	-4.2	Liberecký kraj	-3.1	Královéhradecký kraj	-3.0
			Pardubický kraj	-4.1	Karlovarský kraj	-2.1	Olomoucký kraj	-2.6
Germany	Sömmerda	-32.1	Suhl, Kreisfreie Stadt	-8.2	Gera, Kreisfreie Stadt	-2.9	Sonneberg	-5.5
	Greiz	-30.5	Gera, Kreisfreie Stadt	-4.1	Frankfurt (Oder), Kreisfreie Stadt	-2.9	Rosenheim, Kreisfreie Stadt	-4.7
	Görlitz	-27.3	Rosenheim, Kreisfreie Stadt	-3.7	Cottbus, Kreisfreie Stadt	-2.8	Kyffhäuserkreis	-4.7
Denmark	Bornholm	-4.0	Bornholm	-5.3	Bornholm	-5.6	Byen København	-3.2
	Vest- og Sydsjælland	-3.4	Nordjylland	-4.1	Vestjylland	-1.8	Fyn	-1.7
	Fyn	-3.2	Østjylland	-3.5	Vest- og Sydsjælland	-1.8	Sydjylland	-1.3
Greece	Drama	-2.2	Evvoia	-12.7	Achaia	-10.1	Pieria	-2.7
	Lasithi	-1.8	Evros	-11.2	Evvoia	-7.8	Thesprotia	-2.7
	Pieria	-1.0	Lesvos, Limnos	-10.9	Kastoria	-7.4	Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	-2.7
Spain	Ourense	-9.8	Fuerteventura	-13.1	Jaén	-8.8	Eivissa, Formentera	-18.1

Country	Region	Value	Region	Value	Region	Value	Region	Value
	Burgos	-9.4	Segovia	-11.8	La Palma	-8.0	Fuerteventura	-14.4
	Sevilla	-8.8	Lanzarote	-11.6	Toledo	-6.2	Lanzarote	-13.2
Finland	Lappi	-14.4	Åland	-2.6	Etelä-Karjala	-3.5	Etelä-Savo	-3.5
	Kainuu	-14.3	Kainuu	-2.6	Lappi	-2.5	Päijät-Häme	-3.3
	Satakunta	-14.1	Pohjois-Pohjanmaa	-1.6	Kymenlaakso	-2.5	Pohjois-Karjala	-3.3
France	Orne	-5.5	Haute-Marne	-3.9	Haute-Marne	-2.8	Savoie	-9.3
	Creuse	-5.0	Meuse	-3.3	Territoire de Belfort	-2.8	Hautes-Alpes	-5.3
	Corse-du-Sud	-4.5	Jura	-3.3	Ardennes	-2.5	Haute-Savoie	-3.5
Croatia			Varaždinska županija	-2.4	Virovitičko-podravska županija	-12.8	Bjelovarsko-bilogorska županija	-24.1
			Međimurska županija	-1.9	Koprivničko-križevačka županija	-11.1	Primorsko-goranska zupanija	-3.8
			Istarska zupanija	-0.7	Međimurska županija	-8.9	Grad Zagreb	-2.1
Hungary			Somogy	-12.3	Baranya	-2.4	Zala	-6.9
			Vas	-11.0	Budapest	-1.8	Vas	-6.2
			Békés	-10.5	Borsod-Abaúj-Zemplén	0.5	Veszprém	-5.9
Ireland	West	-0.6	Border	-11.3	Border	-2.9	Border	-4.8
	Border	-0.3	Mid-West	-10.2	South-East (IE)	-2.7	West	-3.5
	Midland	-0.2	Mid-East	-9.5	Mid-West	-1.9	Mid-West	-3.2
Italy	Pordenone	-8.3	Imperia	-13.4	Sud Sardegna	-3.7	Forlì-Cesena	-6.4
	Gorizia	-8.1	Oristano	-11.3	Vibo Valentia	-3.6	Venezia	-5.9
	Oristano	-8.1	L'Aquila	-9.9	Vercelli	-3.4	Rimini	-4.8
Lithuania			Telsiu apskritis	-19.8	Marijampoles apskritis	-5.5	Utenos apskritis	-7.3
			Taurages apskritis	-15.2	Taurages apskritis	-1.8	Telsiu apskritis	-6.9
			Marijampoles apskritis	-13.2	Siauliu apskritis	-0.9	Alytaus apskritis	-6.7
Latvia			Riga	-17.7	Vidzeme	-1.8	Pieriga	-9.7
			Kurzeme	-15.6	Latgale	-1.0	Riga	-2.3
			Latgale	-14.5	Riga	1.5	Vidzeme	-0.9
Netherlands	Zuid-Limburg	-2.9	Oost-Groningen	-4.0	Zuidwest-Gelderland	-2.3	Zuidwest-Overijssel	-2.2
	Noord-Limburg	-2.9	Het Gooi en Vechtstreek	-3.7	Midden-Noord-Brabant	-1.8	Noord-Limburg	-2.2
	Midden-Limburg	-2.7	Zuidoost-Drenthe	-3.5	Midden-Limburg	-1.7	Midden-Noord-Brabant	-1.7
Norway	Innlandet	-0.9	Oslo	-4.4	Innlandet	0.6	Innlandet	-4.3
	Nordland	-0.8	Agder	0.9	Troms og Finnmark	0.8	Rogaland	-2.6
	Vestfold og Telemark	-0.5	Vestfold og Telemark	2.7	Vestfold og Telemark	1.1	Nordland	-2.4
Poland			Zielonogórski	-7.8	Lódzki	-3.5	Legnicko-Glogowski	-3.6
			Sandomiersko-jedrzejowski	-7.5	Piotrkowski	-3.4	Jeleniogórski	-2.5
			Gorzowski	-7.4	Sieradzki	-3.4	Walbrzyski	-2.2
Portugal	Beiras e Serra da Estrela	-8.9	Ave	-6.6	Região de Leiria	-6.4	Algarve	-5.7
	Beira Baixa	-7.1	Alto Alentejo	-5.2	Médio Tejo	-5.9	Região Autónoma da Madeira (PT)	-2.4
	Médio Tejo	-7.1	Tâmega e Sousa	-5.0	Região Autónoma dos Açores (PT)	-5.7	Ave	-2.4

			Calarasi	-14.5	Dolj	-8.6	Calarasi	-8.4
Romania			Teleorman	-13.1	Neamt	-6.1	Teleorman	-6.3
			Cluj	-10.0	Galati	-3.9	Arges	-5.1
Sweden	Västmanlands län	-14.3	Värmlands län	-6.7	Gävleborgs län	-1.6	Jämtlands län	-4.8
	Uppsala län	-13.8	Blekinge län	-5.6	Värmlands län	-0.9	Blekinge län	-4.2
	Södermanlands län	-12.5	Jämtlands län	-5.1	Jönköpings län	-0.6	Västernorrlands län	-3.4
Slovenia			Pomurska	-5.7	Obalno-kraska	-4.5	Obalno-kraska	-3.3
			Zasavska	-3.0	Zasavska	-3.5	Gorenjska	-2.6
			Koroska	-2.9	Primorsko-notranjska	-2.7	Jugovzhodna Slovenija	-2.4
Slovakia			Zilinský kraj	-2.6	Banskobystrický kraj	-4.0	Trenciansky kraj	-3.6
			Trnavský kraj	-1.1	Trenciansky kraj	-2.4	Nitriansky kraj	-2.0
			Presovský kraj	-0.6	Trnavský kraj	-0.3	Trnavský kraj	-1.9

Note: Employment growth refers to percent change between the last pre-recession and the recession year (in two-year recessions, the lowest employment level is used); countries with at least six NUTS3/TL3 regions; Guadeloupe, Martinique, Guyane, La Réunion and Mayotte (France) and Jan Mayen and Svalbard (Norway) are excluded; data for the 1992-93 recession are not available for Bulgaria, Czech Republic, Croatia, Hungary, Lithuania, Latvia. Poland, Romania, Slovenia and Slovakia.
Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Table A A.3. Top three regions by change in employment growth during the last four recessions

Country	Recession 1992-93		Recession 2008-09		Recession 2012		Recession 2020	
	Region	Value	Region	Value	Region	Value	Region	Value
Austria	Oststeiermark	2.2	Pinzgau-Pongau	2.2	Innsbruck	0.2	Mühlviertel	-1.3
	Klagenfurt-Villach	2.4	Innviertel	2.2	Tiroler Oberland	0.4	Wiener Umland/Nordteil	-1.1
	Pinzgau-Pongau	2.7	Lungau	6.2	Wien	0.4	West- und Südsteiermark	-0.8
Belgium	Arr. Dendermonde	1.8	Arr. Ath	2.3	Arr. Arlon	1.5	Arr. Dendermonde	0.0
	Arr. Eeklo	1.8	Arr. La Louvière	2.9	Arr. Oostende	2.4	Arr. Waremme	0.1
	Arr. Tournai-Mouscron	2.8	Arr. Bastogne	8.5	Arr. Neufchâteau	3.4	Arr. Philippeville	1.2
Bulgaria			Sofia (stolitsa)	2.8	Pazardzhik	5.0	Smolyan	1.6
			Yambol	2.8	Silistra	6.4	Montana	1.7
			Kardzhali	3.8	Vratsa	9.2	Shumen	2.7
Czech Republic			Jihomoravský kraj	0.6	Jihomoravský kraj	2.2	Plzeňský kraj	-1.6
			Ústecký kraj	1.9	Olomoucký kraj	2.2	Pardubický kraj	-0.5
			Hlavní mesto Praha	7.9	Hlavní mesto Praha	3.5	Liberecký kraj	1.0
Germany	Mainz-Bingen	2.3	Bremerhaven, Kreisfreie Stadt	4.4	Landshut, Landkreis	3.6	Prignitz	0.9
	Dillingen an der Donau	2.3	Donau-Ries	5.7	Garmisch-Partenkirchen	4.1	Heilbronn, Stadtkreis	1.1
	Bonn, Kreisfreie Stadt	3.5	Trier-Saarburg	6.0	Main-Taunus-Kreis	5.1	Herne, Kreisfreie Stadt	1.6
Denmark	Østsjælland	-2.9	Nordsjælland	-0.2	Østjylland	0.0	Københavns omegn	-1.2
	Byen København	-2.8	Fyn	-0.1	Fyn	0.4	Bornholm	0.0
	Østjylland	-2.4	Østsjælland	-0.1	Nordsjælland	1.6	Østsjælland	0.2
Greece	Dytiki Attiki	1.3	Zakynthos	7.2	Chios	10.2	Evrytania	-1.9
	Peiraias, Nisoi	1.3	Florina	8.6	Ithaki, Kefallinia	15.8	Zakynthos	-1.7
	Chania	1.4	Fthiotida	13.8	Lefkada	23.0	Lasithi	-0.9
Spain	Tenerife	-1.2	Salamanca	-4.3	Cáceres	1.0	Lleida	-0.9

Country	Region		Region		Region		Region	
	Lleida	-0.1	Melilla (ES)	-3.3	La Gomera	2.3	Teruel	-0.1
	Soria	1.6	Ceuta (ES)	-1.9	El Hierro	6.9	Cuenca	1.7
Finland	Keski-Pohjanmaa	-9.3	Keski-Pohjanmaa	0.1	Kanta-Häme	1.0	Satakunta	-1.1
	Pohjanmaa	-8.3	Etelä-Karjala	2.0	Helsinki-Uusimaa	1.5	Pohjois-Pohjanmaa	-0.9
	Åland	-2.4	Satakunta	2.1	Pohjois-Pohjanmaa	2.1	Kanta-Häme	0.4
France	Haute-Saône	1.0	Corse-du-Sud	1.6	Ariège	1.6	Orne	0.3
	Charente	1.1	Loir-et-Cher	1.6	Seine-et-Marne	2.2	Creuse	0.3
	Territoire de Belfort	1.2	Haute-Corse	1.8	Martinique	2.9	Val-d'Oise	0.4
Croatia			Brodsko-posavska županija	1.8	Sibensko-kninska zupanija	3.8	Zadarska zupanija	0.0
			Virovitičko-podravska županija	2.0	Istarska zupanija	4.0	Osječko-baranjska županija	3.0
			Požeško-slavonska županija	2.9	Bjelovarsko-bilogorska županija	11.6	Međimurska županija	8.9
Hungary			Nógrád	-2.4	Nógrád	5.9	Békés	-2.5
			Csongrád	-1.5	Szabolcs-Szatmár-Bereg	6.8	Pest	-2.5
			Budapest	-0.2	Jász-Nagykun-Szolnok	7.6	Szabolcs-Szatmár-Bereg	-1.3
Ireland	Border	0.5	West	-11.7	West	4.6	South-West (IE)	-5.1
	Midland	0.8	Midland	-11.5	Midland	4.6	South-East (IE)	-4.9
	Mid-East	4.2	South-West (IE)	-11.4	Mid-West	4.6	Midland	0.4
Italy	Bolzano-Bozen	0.9	Milano	2.8	Rieti	5.0	Benevento	1.0
	Trento	0.9	Cagliari	3.6	Grosseto	7.0	Caltanissetta	1.4
	Terni	1.4	Livorno	6.0	Lodi	8.3	Rieti	2.0
Lithuania			Vilniaus apskritis	-7.0	Alytaus apskritis	4.1	Siauliu apskritis	-1.7
			Siauliu apskritis	-3.5	Telsiu apskritis	8.3	Klaipedos apskritis	-0.9
			Alytaus apskritis	-2.2	Utenos apskritis	11.4	Panevezio apskritis	7.0
Latvia			Zemgale	-12.8	Pieriga	0.2	Latgale	1.0
			Pieriga	-12.3	Latgale	1.4	Kurzeme	1.7
			Vidzeme	-11.9	Kurzeme	6.8	Zemgale	6.9
Netherlands	Kop van Noord-Holland	2.1	Zuidwest-Gelderland	1.4	Zuidwest-Friesland	1.5	Noord-Drenthe	-0.8
	Het Gooi en Vechtstreek	2.4	Overig Zeeland	1.5	Flevoland	2.4	Zuidoost-Zuid-Holland	-0.7
	Agglomeratie Haarlem	2.6	Midden-Limburg	1.8	Noord-Drenthe	2.8	Oost-Groningen	0.4
Norway	Viken	-0.6	Innlandet	4.1	Vestland	1.3	Trøndelag	-2.0
	Innlandet	-0.6	Troms og Finnmark	5.2	Agder	1.5	Agder	-1.8
	Oslo	-0.6	Viken	6.3	Møre og Romsdal	2.3	Viken	-1.2
Poland			Ciechanowski	17.7	Szczecinski	4.2	Przemyski	2.1
			Siedlecki	17.7	Grudziadzki	4.7	Lódzki	2.8
			Plocki	18.3	Inowroclawski	5.8	Sandomiersko-jedrzejowski	3.2
Portugal	Alto Alentejo	-1.9	Alto Minho	-2.0	Alto Tâmega	1.2	Alto Alentejo	-0.2
	Alentejo Central	-1.9	Douro	-1.7	Beiras e Serra da Estrela	1.6	Terras de Trás-os-Montes	0.3
	Região Autónoma da Madeira (PT)	2.4	Área Metropolitana de Lisboa	-0.7	Douro	2.6	Douro	0.6
Romania			Neamt	0.9	Calarasi	25.1	Bacau	0.8
			Tulcea	1.9	Ialomita	28.4	Hunedoara	2.4
			Ilfov	2.4	Teleorman	28.8	Caras-Severin	2.9

Country	Region	Value	Region	Value	Region	Value	Region	Value
Sweden	Jönköpings län	-6.4	Västernorrlands län	-2.3	Norrbottens län	0.8	Norrbottens län	-2.5
	Stockholms län	-5.8	Kalmar län	-1.9	Kalmar län	1.0	Gävleborgs län	-2.2
	Gotlands län	-4.8	Stockholms län	1.0	Blekinge län	1.4	Hallands län	-2.0
Slovenia			Savinjska	1.8	Primorsko-notranjska	2.2	Posavska	-0.8
			Obalno-kraska	2.1	Posavska	2.6	Pomurska	-0.6
			Posavska	4.7	Osrednjeslovenska	2.8	Zasavska	-0.3
Slovakia			Bratislavský kraj	1.2	Bratislavský kraj	0.8	Trnavský kraj	-3.5
			Kosický kraj	1.4	Zilinský kraj	1.1	Bratislavský kraj	-3.1
			Banskobystrický kraj	2.0	Presovský kraj	1.8	Banskobystrický kraj	-3.0

Note: Change in employment growth refers to the difference between recession employment growth and pre-recession employment growth (calculated as the employment growth rate between the last pre-recession and the recession year - in two-year recessions, the lowest employment level is used) minus annualised employment growth rate in a corresponding pre-recession period as defined in Table 1; countries with at least six NUTS3/TL3 regions; Guadeloupe, Martinique, Guyane, La Réunion and Mayotte (France) and Jan Mayen and Svalbard (Norway) are excluded; East German regions are not included in calculations for the 1992-93 recession due to insufficient pre-recession data; data for the 1992-93 recession are not available for Bulgaria, Czech Republic, Croatia, Hungary, Lithuania, Latvia. Poland, Romania, Slovenia and Slovakia.

Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Table A A.4. Bottom three regions by change in employment growth during the last four recessions

Country	Recession 1992-93		Recession 2008-09		Recession 2012		Recession 2020	
	Region	Value	Region	Value	Region	Value	Region	Value
Austria	Oberkärnten	-9.4	Steyr-Kirchdorf	-3.8	Mittelburgenland	-3.8	Tiroler Oberland	-9.0
	Steyr-Kirchdorf	-7.4	Östliche Obersteiermark	-2.1	Südburgenland	-2.4	Lungau	-5.6
	Wiener Umland/Südteil	-4.0	Unterkärnten	-1.7	West- und Südsteiermark	-1.9	Pinzgau-Pongau	-5.5
Belgium	Arr. Verviers - communes francophones	-23.5	Arr. Arlon	-7.1	Arr. Bastogne	-16.4	Arr. Mechelen	-2.0
	Bezirk Verviers - Deutschsprachige Gemeinschaft	-22.9	Arr. Neufchâteau	-6.5	Arr. Hasselt	-2.3	Arr. Mons	-1.9
	Arr. Virton	-9.3	Arr. Marche-en-Famenne	-5.4	Arr. Kortrijk	-2.3	Arr. Nivelles	-1.9
Bulgaria			Pleven	-15.1	Kardzhali	-19.0	Kyustendil	-10.2
			Lovech	-11.9	Montana	-8.8	Vratsa	-7.9
			Silistra	-10.7	Vidin	-7.2	Sofia	-7.1
Czech Republic			Kraj Vysocina	-4.6	Liberecký kraj	-3.1	Karlovarský kraj	-7.1
			Zlínský kraj	-4.4	Ústecký kraj	-2.6	Olomoucký kraj	-4.6
			Pardubický kraj	-4.1	Karlovarský kraj	-1.4	Královéhradecký kraj	-4.5
Germany	Schweinfurt, Kreisfreie Stadt	-10.6	Suhl, Kreisfreie Stadt	-7.3	Erlangen, Kreisfreie Stadt	-6.3	Rosenheim, Kreisfreie Stadt	-6.2
	Friesland (DE)	-8.2	Ulm, Stadtkreis	-4.7	Freising	-4.0	Hof, Landkreis	-5.2
	Emden, Kreisfreie Stadt	-7.5	Rosenheim, Kreisfreie Stadt	-4.4	Unna	-3.7	Sonneberg	-5.1
Denmark	Bornholm	-3.6	Bornholm	-5.2	Bornholm	-5.6	Byen København	-5.3
	Fyn	-3.5	Østjylland	-4.8	Københavns omegn	-1.9	Fyn	-3.2
	Vest- og Sydsjælland	-3.5	Nordjylland	-4.7	Vestjylland	-1.8	Sydjylland	-2.4
Greece	Drama	-0.7	Evvoia	-13.7	Ikaria, Samos	-6.0	Andros, Thira, Kea, Milos, Mykonos,	-5.4

Country	Name	Value	Name	Value	Name	Value	Name	Value
							Naxos, Paros, Syros, Tinos	
	Achaia	0.0	Lesvos, Limnos	-12.9	Achaia	-5.8	Kerkyra	-5.2
	Lasithi	0.0	Evros	-11.3	Kastoria	-5.7	Kalymnos, Karpathos, Kos, Rodos	-4.6
Spain	Sevilla	-12.1	Fuerteventura	-22.5	Jaén	-6.0	Eivissa, Formentera	-22.3
	Burgos	-11.3	Lanzarote	-19.9	La Palma	-4.1	Fuerteventura	-17.5
	Huelva	-10.5	Alicante / Alacant	-15.4	Cádiz	-3.6	Lanzarote	-16.1
Finland	Lappi	-13.7	Åland	-4.2	Etelä-Karjala	-7.9	Helsinki-Uusimaa	-3.9
	Kainuu	-13.3	Pohjois-Pohjanmaa	-3.9	Pirkanmaa	-5.9	Pohjois-Karjala	-3.5
	Satakunta	-13.2	Helsinki-Uusimaa	-3.1	Lappi	-4.3	Pirkanmaa	-3.4
France	Essonne	-6.6	Ain	-4.5	Haute-Marne	-2.7	Savoie	-10.8
	Hauts-de-Seine	-6.0	Haute-Savoie	-4.0	Val-d'Oise	-2.4	Hautes-Alpes	-6.0
	Val-d'Oise	-5.9	Haute-Marne	-4.0	Territoire de Belfort	-2.2	Haute-Savoie	-4.7
Croatia			Varaždinska županija	-2.8	Koprivničko-križevačka županija	-9.2	Bjelovarsko-bilogorska županija	-25.7
			Međimurska županija	-2.5	Virovitičko-podravska županija	-8.4	Primorsko-goranska zupanija	-7.3
			Istarska zupanija	-1.6	Međimurska županija	-6.4	Grad Zagreb	-5.1
Hungary			Somogy	-12.1	Budapest	-2.0	Zala	-9.1
			Vas	-10.5	Heves	-0.5	Veszprém	-8.6
			Komárom-Esztergom	-10.0	Borsod-Abaúj-Zemplén	0.1	Vas	-7.5
Ireland	Dublin	-1.4	Border	-14.5	Dublin	-2.4	Border	-7.8
	South-East (IE)	-0.2	Mid-East	-14.4	Border	0.9	West	-6.9
	South-West (IE)	0.0	Mid-West	-13.5	South-East (IE)	2.6	Mid-East	-6.7
Italy	Pordenone	-9.2	Imperia	-15.1	Imperia	-10.0	Forlì-Cesena	-8.2
	Pescara	-9.2	Oristano	-11.9	Brindisi	-7.2	Venezia	-6.7
	Gorizia	-9.1	L'Aquila	-10.9	Chieti	-7.1	Prato	-5.7
Lithuania			Telsiu apskritis	-20.4	Taurages apskritis	-8.0	Telsiu apskritis	-8.0
			Taurages apskritis	-13.2	Marijampoles apskritis	-2.0	Alytaus apskritis	-6.8
			Marijampoles apskritis	-12.5	Vilniaus apskritis	-1.1	Vilniaus apskritis	-4.6
Latvia			Riga	-18.4	Riga	-2.8	Riga	-7.4
			Kurzeme	-15.9	Vidzeme	-1.7	Pieriga	-4.9
			Latgale	-15.2	Zemgale	-0.9	Vidzeme	0.6
Netherlands	Noord-Limburg	-5.2	Het Gooi en Vechtstreek	-5.7	Oost-Groningen	-6.3	Zuidwest-Overijssel	-4.5
	Overig Zeeland	-4.3	Oost-Groningen	-4.9	Zuidwest-Gelderland	-4.3	Groot-Amsterdam	-4.2
	Midden-Limburg	-4.2	Zuidoost-Drenthe	-4.5	Achterhoek	-3.5	Delft en Westland	-4.0
Norway	Troms og Finnmark	-0.7	Oslo	-6.2	Troms og Finnmark	-0.9	Innlandet	-5.3
	Møre og Romsdal	-0.7	Agder	-0.8	Vestfold og Telemark	-0.6	Troms og Finnmark	-3.8
	Rogaland	-0.7	Rogaland	1.4	Nordland	0.0	Nordland	-3.5
Poland			Sandomiersko-jedrzejowski	-9.2	Warszawski wschodni	-8.0	Legnicko-Glogowski	-3.9
			Zielonogórski	-8.1	Warszawski zachodni	-5.4	Trojmiejski	-3.8

Country	Region	Value	Region	Value	Region	Value	Region	Value
			Gorzowski	-7.6	Sieradzki	-5.3	Miasto Wroclaw	-3.2
Portugal	Alto Minho	-7.8	Ave	-7.3	Alentejo Litoral	-5.7	Algarve	-9.3
	Algarve	-7.7	Alentejo Central	-6.6	Região de Leiria	-4.4	Área Metropolitana de Lisboa	-4.7
	Beiras e Serra da Estrela	-7.6	Tâmega e Sousa	-6.4	Região de Coimbra	-3.8	Área Metropolitana do Porto	-4.4
Romania			Calarasi	-12.2	Mehedinti	-9.7	Calarasi	-6.9
			Teleorman	-11.4	Dolj	-8.5	Arges	-6.1
			Arges	-8.8	Neamt	-7.0	Dâmbovita	-6.0
Sweden	Uppsala län	-15.3	Värmlands län	-6.9	Jämtlands län	-3.6	Jämtlands län	-6.0
	Västmanlands län	-14.4	Blekinge län	-6.0	Gotlands län	-3.6	Stockholms län	-5.0
	Södermanlands län	-12.9	Jämtlands län	-5.3	Värmlands län	-3.5	Kronobergs län	-4.9
Slovenia			Pomurska	-4.7	Obalno-kraska	-1.9	Obalno-kraska	-6.0
			Koroska	-2.7	Pomurska	-1.5	Jugovzhodna Slovenija	-5.1
			Jugovzhodna Slovenija	-1.4	Gorenjska	-1.2	Gorenjska	-5.0
Slovakia			Zilinský kraj	-3.2	Banskobystrický kraj	-8.0	Trenciansky kraj	-5.2
			Trnavský kraj	-1.1	Nitriansky kraj	-4.9	Nitriansky kraj	-4.1
			Presovský kraj	-0.7	Trenciansky kraj	-4.4	Zilinský kraj	-4.0

Note: Change in employment growth refers to the difference between recession employment growth and pre-recession employment growth (calculated as the employment growth rate between the last pre-recession and the recessions year - in two-year recessions, the lowest employment level is used) minus annualised employment growth rate in a corresponding pre-recession period as defined in Table 1; countries with at least six NUTS3/TL3 regions; Guadeloupe, Martinique, Guyane, La Réunion and Mayotte (France) and Jan Mayen and Svalbard (Norway) are excluded; East German regions are not included in calculations for the 1992-93 recession due to insufficient pre-recession data; data for the 1992-93 recession are not available for Bulgaria, Czech Republic, Croatia, Hungary, Lithuania, Latvia. Poland, Romania, Slovenia and Slovakia.

Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Annex B. Additional maps of employment growth during recessions

Figure A B.1. Map of employment growth rates (%) during the last four recessions, eight intervals
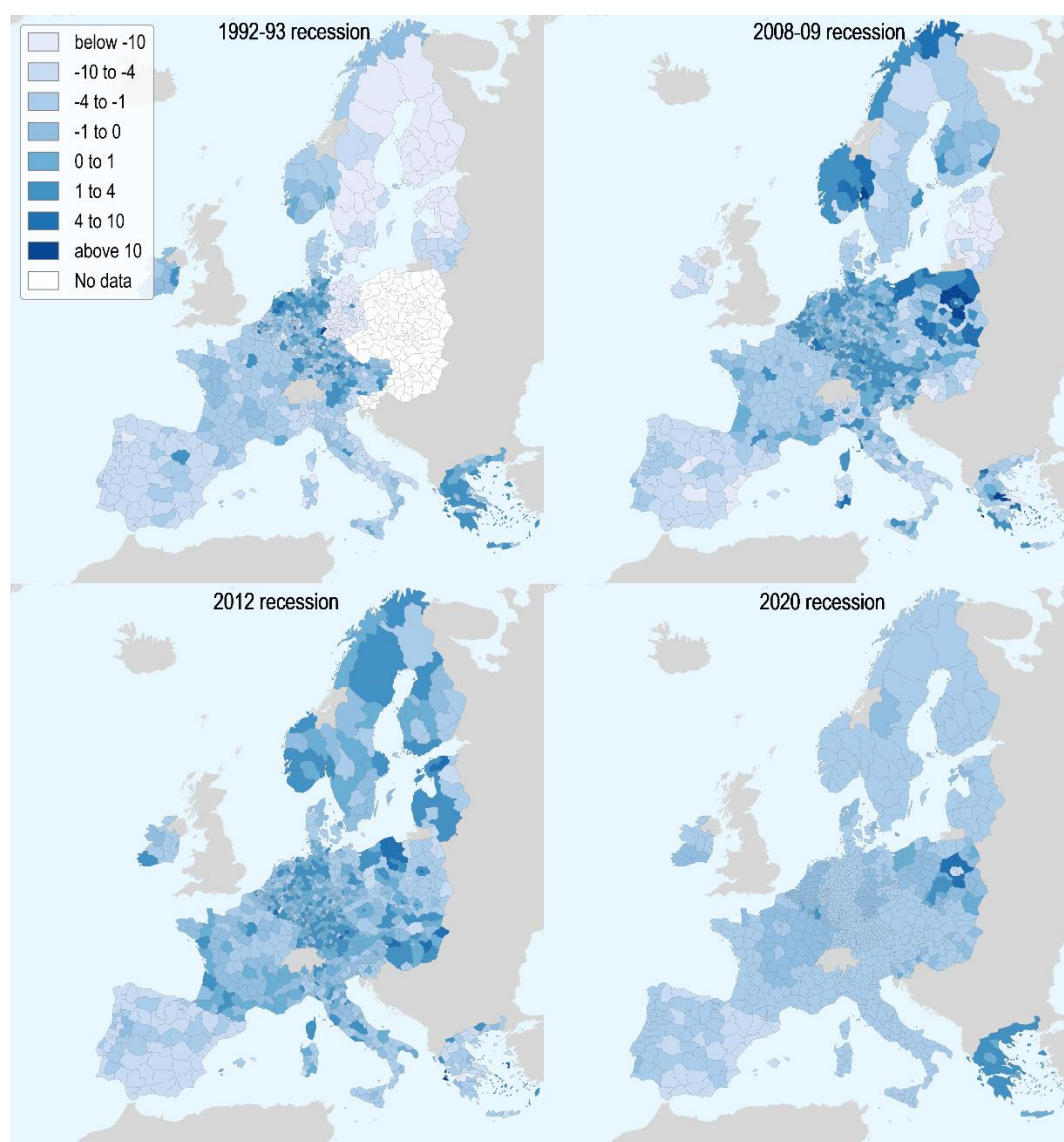
Note: Data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia. The percent growth is calculated between the last pre-recession year and the recession year (or the year of the lowest employment for the two-year recessions).
Source: Author's calculations based on the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO) dataset.

Annex C. Full estimation results

Table A C.1. Estimation results for robustness by recession

Explanatory variable	DV: Difference in employment growth				DV: Robustness index			
	R1	R2	R3	R4	R1	R2	R3	R4
Labour productivity	.051***	.044***	.053***	-0.01***	.041***	.074***	.075**	-.035
	(5.55)	(3.95)	(8.93)	(-4.07)	(3.41)	(3.19)	(2.63)	(-1.16)
Sectoral concentration	-.043	-.027	.057	.017	-.014	-.13	.024	.06
	(-1.53)	(-0.92)	(1.26)	(1.61)	(-0.63)	(-1.17)	(0.29)	(0.78)
Pre-recession emp growth	-.71***	-.89***	-.83***	-1.1***	.2	.19	.34	-.55
	(-3.93)	(-9.39)	(-10.73)	(-24.12)	(1.69)	(0.95)	(1.01)	(-1.55)
Employment-to-population ratio	-.032***	-8.4e-03	-3.2e-03	-2.0e-03*	-.025*	7.9e-03	.024	.011
	(-3.64)	(-0.93)	(-0.92)	(-2.04)	(-2.04)	(0.47)	(1.01)	(0.39)
Population density	-9.6e-03	6.1e-03	-1.1e-03	6.6e-04	-.013	.012	9.2e-04	.033
	(-1.00)	(1.34)	(-0.19)	(0.42)	(-1.58)	(1.63)	(0.03)	(0.88)
Employment share in A	.017	-.014	-6.8e-03	.011	4.4e-03	-.015	-.17*	-.14
	(1.08)	(-0.30)	(-0.33)	(0.93)	(0.41)	(-0.25)	(-2.06)	(-0.83)
Employment share in B-E	-.017	-.034*	.018**	6.9e-03	-.025*	-.065	-.014	-.045
	(-1.45)	(-2.03)	(2.36)	(1.03)	(-2.01)	(-1.24)	(-0.46)	(-0.56)
Employment share in F	-.089	.056	.16**	-5.3e-03	-.048	.2	.6	-.14
	(-1.68)	(0.94)	(2.53)	(-0.29)	(-1.52)	(1.38)	(1.41)	(-0.84)
Employment share in G-J	.032	-.018	.027**	-2.6e-03	5.7e-03	-8.6e-03	.05	.026
	(1.57)	(-0.69)	(2.67)	(-0.37)	(0.51)	(-0.43)	(0.98)	(1.14)
Employment share in K-N	-.016	-.045	.035	9.6e-03	.016	-.023	.11	-.28
	(-0.82)	(-1.38)	(1.08)	(0.77)	(0.58)	(-0.62)	(0.91)	(-0.77)
Urban regions	-.12	-.11	-.033	.015	-.12	-.012	.52	-.15
	(-0.49)	(-0.56)	(-0.23)	(0.41)	(-0.88)	(-0.03)	(0.91)	(-1.08)
Rural regions	-.073	-.15*	.22	.021	-.13	-.51	.43	.72
	(-0.38)	(-1.99)	(1.23)	(0.56)	(-0.72)	(-1.53)	(0.66)	(1.20)
Coastal regions	-.019	-.034	.11	.01	-.088	-.17	.41	-1
	(-0.05)	(-0.20)	(0.43)	(0.13)	(-0.44)	(-0.48)	(0.28)	(-1.33)
_cons	-.33	-7.4e-03	-7.2***	-1.4*	-.34	-2.2	-14	5.9
	(-0.32)	(-0.00)	(-3.95)	(-1.84)	(-0.53)	(-0.84)	(-1.57)	(0.62)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	686	822	848	827	686	822	848	827
R-sq	0.504	0.714	0.559	0.943	0.141	0.176	0.058	0.153

Note: DV stands for the dependent variable; Ordinary least squares (OLS) estimation; standard errors clustered at the country level; t statistics in parentheses; sectors: A – agriculture, B-E – industry, F – construction, G-J – retail and wholesale trade, transportation, accommodation and food, information and communication, K-N – finance, professional and scientific services, administrative support; data for TL3 regions in Austria, Belgium, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, Slovakia; data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia.
Source: Author's estimation.

Table A C.2. Estimation results for recovery by recession

Explanatory variable	DV: Recovery (yes/no)			DV: Recovery probability (continuous, right-truncated)		
	R1	R2	R3	R1	R2	R3
Labour productivity	.15***	.086***	.18*	-.013	.01**	.011*
	(3.91)	(2.80)	(1.94)	(-0.91)	(2.14)	(1.76)
Sectoral concentration	-.24***	.019	-.22	-.032	-.011	.017
	(-4.17)	(0.24)	(-1.09)	(-0.46)	(-0.28)	(0.39)
Pre-recession emp growth	.76***	.33**	.04	.45***	.18***	.062
	(3.02)	(2.44)	(0.25)	(2.64)	(6.48)	(0.61)
Employment-to-population ratio	-.041***	-9.1e-03	.04***	-2.4e-03	5.7e-03**	.01
	(-2.97)	(-0.86)	(4.04)	(-0.31)	(2.05)	(1.29)
Population density	-.077***	.019	4.4e-03	-.019	4.1e-04	5.3e-03*
	(-5.26)	(0.70)	(0.07)	(-1.63)	(0.08)	(1.74)
Employment share in A	-.12*	.092	-6.3e-03	.057***	.023	.058*
	(-1.78)	(0.90)	(-0.05)	(3.30)	(1.12)	(1.80)
Employment share in B-E	-.043	-.063*	-.012	.048	-.011	.042**
	(-0.78)	(-1.83)	(-0.27)	(1.45)	(-1.41)	(2.07)
Employment share in F	-.071	.033	-.14	.1**	.02	.036
	(-0.97)	(0.32)	(-0.69)	(2.22)	(0.75)	(0.63)
Employment share in G-J	-6.5e-03	-.027	.082	.085**	-5.6e-03	.064***
	(-0.08)	(-0.74)	(1.48)	(2.19)	(-0.77)	(4.92)
Employment share in K-N	-.079	-.069	-.094	.04	-.011	.048
	(-1.27)	(-0.95)	(-1.18)	(0.66)	(-1.29)	(1.27)
Urban regions	-.21	.13	.61	.33***	.13	.31***
	(-0.46)	(0.36)	(0.92)	(3.91)	(1.53)	(3.30)
Rural regions	-.011	-.38	-.35	-.27**	.016	.033
	(-0.02)	(-1.44)	(-0.70)	(-1.99)	(0.11)	(0.33)
Coastal regions	-1.6*	-.2	-.063	-.028	1.5e-04	.23
	(-1.79)	(-0.40)	(-0.10)	(-0.09)	(0.00)	(1.40)
_cons	7.5*	-1.7	-4.6			
	(1.84)	(-0.28)	(-0.34)			
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	623	754	667	4153	1195	2403

Note: DV stands for the dependent variable; logit estimation for recovery (yes/no); survival analysis (Cox model) for the speed of recovery; standard errors clustered at the country level; t statistics in parentheses; sectors: A – agriculture, B-E – industry, F – construction, G-J – retail and wholesale trade, transportation, accommodation and food, information and communication, K-N – finance, professional and scientific services, administrative support; data for TL3 regions in Austria, Belgium, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, Slovakia; data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia.
Source: Author's estimation.

Table A C.3. Panel data estimation results for robustness and recovery

Explanatory variable	DV: Difference in employment growth	DV: Robustness index	DV: Recovery (yes/no)
Labour productivity	.037**	.046*	.19***
	(2.57)	(1.76)	(2.68)
Sectoral concentration	-.045	-.049	-.028
	(-0.92)	(-0.46)	(-0.15)
Pre-recession emp growth	-.65***	-.11	-.11
	(-7.61)	(-0.56)	(-0.57)
Employment-to-population ratio	-.25***	-.39*	-.55***
	(-4.11)	(-1.90)	(-3.21)
Population density	-.24***	-.31	-2.4
	(-5.84)	(-1.49)	(-1.07)
Employment share in A	.064	-.19	4.0e-03
	(1.51)	(-1.43)	(0.03)
Employment share in B-E	.039	.068	-.097
	(0.88)	(0.52)	(-1.00)
Employment share in F	-.12*	.37	-.18
	(-1.73)	(1.28)	(-0.94)
Employment share in G-J	8.9e-04	-.14	-.18
	(0.04)	(-1.38)	(-1.58)
Employment share in K-N	.043	.041	-.2
	(1.42)	(0.31)	(-1.35)
_cons	9.1***	18**	.018***
	(4.11)	(2.14)	(3.91)
Recession FE	Yes	Yes	Yes
N	4034	4034	859
R-sq within	0.505	0.042	
R-sq between	0.010	0.000	
R-sq overall	0.042	0.001	
Wald chi2			65.88

Note: DV stands for the dependent variable; fixed effects liner panel data model for robustness, fixed effects panel data logit for recovery (yes/no); bootstrapped standard errors; sectors: t statistics in parentheses; A – agriculture, B-E – industry, F – construction, G-J – retail and wholesale trade, transportation, accommodation and food, information and communication, K-N – finance, professional and scientific services, administrative support; data for TL3 regions in Austria, Belgium, the Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, Slovakia; data for the 1992-93 recession are not available for the Czech Republic, Hungary, Poland, Slovenia and Slovakia.

Source: Author's estimation.