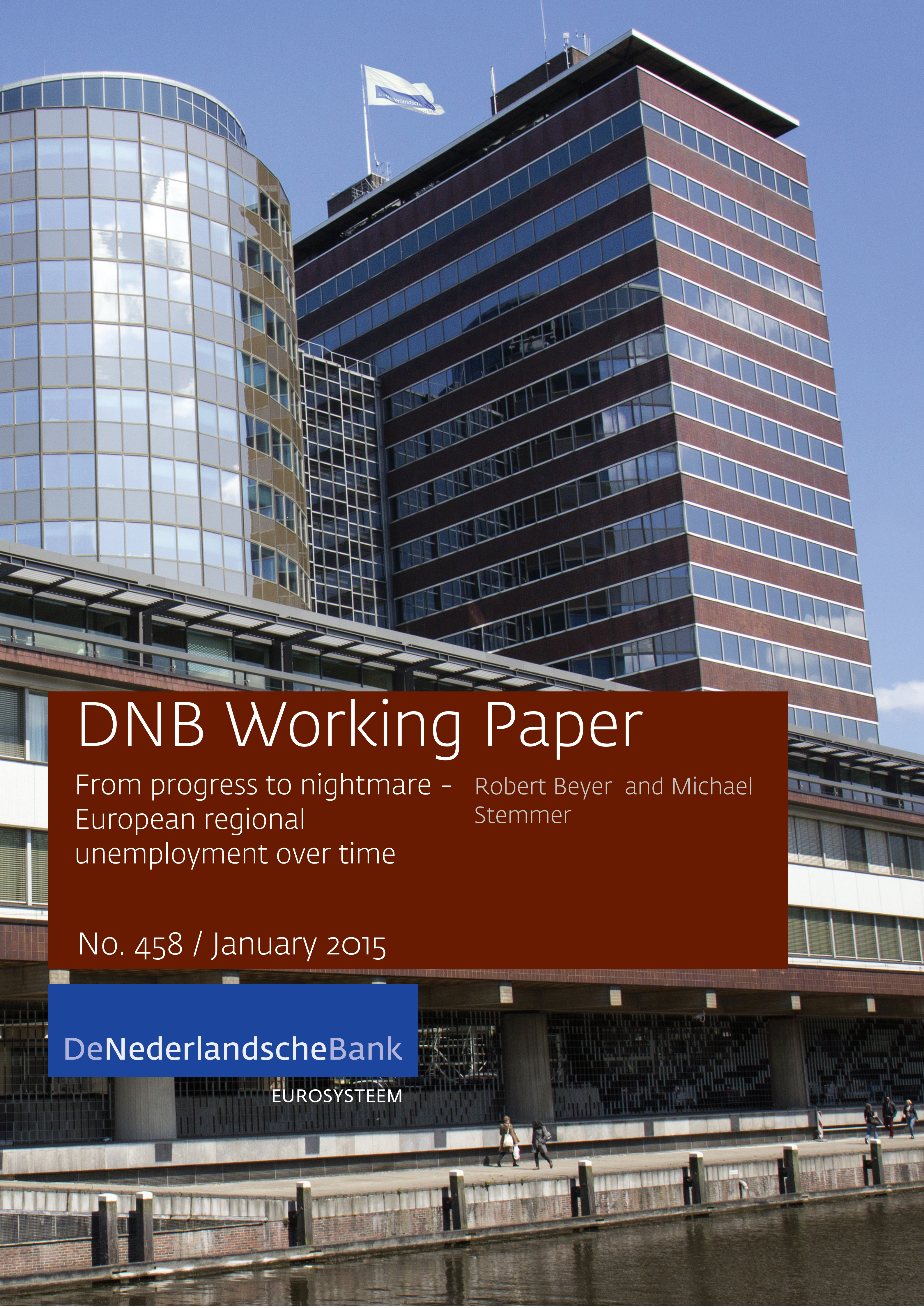

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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From progress to nightmare – European regional unemployment over time[1]

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Abstract

We analyze the distribution of regional unemployment in Europe over the last three decades using non-parametric kernel densities and stochastic kernels. In addition, we employ a multi-level factor model to separate European, country, and region-specific unemployment fluctuations. Three phases of distributional change of EU relative unemployment rates are detected: they polarized from 1986 to 1996, converged after the introduction of the Euro and have been polarizing again since the outbreak of the financial crisis, having reached the highest levels ever. We find that European fluctuations account for roughly two fifths of the total variance confirming the existence of a European unemployment cycle. Country fluctuations are equally important, which leaves one fifth to be explained by region-specific movements. German regions are found to respond negatively to the European factor and country movements cause diverse responses in particular in Italy and England. The convergence prior to 2007 can be attributed to country affects and the divergence thereafter both to country and region-specific factors. Finally, we also discuss within country heterogeneity.

Keywords: unemployment, European regions, distribution dynamics, multi-level factor model.
JEL classifications: R12, R23, C14.

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1. Motivation

With the economic turmoil that followed the financial crisis unemployment rates in Europe rose sharply and have remained extremely high since then. Unemployment undermines social cohesion and is a burden for public finance, both because of increased spending on unemployment benefits and decreased tax earnings. High levels of unemployment are therefore worrying policy makers and researchers alike.

The unemployment rate in the Euro Area, the weighted average of the unemployment rates in the member countries, increased from 7.5% in 2007 to 11.9% in 2013. It is a useful measure for a first impression, but hides substantial heterogeneity: in 2013 the unemployment rate was close to 5% in Germany but was above 25% in Spain. Even behind country rates lies a very heterogeneous picture. The unemployment rate in Bruxelles-Capitale, for example, is almost five times higher than the unemployment rate in Oost-Vlaanderen, even though both regions belong to Belgium. While unemployment rates have been persistently higher than the average in some countries and regions, the recent economic turmoil has aggravated heterogeneity in European labor markets. Not all countries and regions were affected similarly and consequently unemployment rates both between as well as within countries diverged.

We aim to contribute to the understanding of the recent developments by studying the distribution of European regional unemployment. While we are motivated by the recent increase in unemployment rate differences, we are not restricting our analysis to the post 2008 period. Instead, our analysis starts in 1986, so that we are able to put recent developments into a long-term perspective and, in addition, to include the developments after the introduction of the Euro.

Our analysis builds on the work of Overman and Puga (2002), who focus on the spatial distribution of 150 European regional unemployment rates and detect an increasing polarization between 1986 and 1996. This paper extents their analysis and aims at answering five questions. (1) How did the introduction of the monetary union and the financial and sovereign debt crises affect the distribution? (2) Are good and bad performing regions always the same, i.e. is their position in the distribution stable? (3) What proportion of unemployment rate fluctuations is due to European, national, and region-specific movements? (4) Do European unemployment cycles exist? (5) Movements at which level can explain the recent changes of the distribution?

2. Related Literature

Interest in regional unemployment dispersion is not new. Blanchard and Katz (1992) show that there are permanent differences between US states and find a very stable distribution of regional unemployment. Decressin and Fatás (1995) find a higher heterogeneity among European regions. In addition, regional year-on-year changes are both less correlated and exhibit more pronounced differences in amplitudes. Obstfeld and Peri (1998) look in more detail at regional unemployment trends in existing currency unions and find similar results. Over the period from 1968 to 1995 Italy stands out with sharply increasing differences between their regions from the early 1980s onwards. The UK in contrast registered decreasing differences later in that decade. Canadian and US rates, in contrast, remain rather stable and move around two standard deviations. From the mid-1970s onwards within-country rates in Continental Europe started to fan out and reached ever-higher dispersion towards 1995. Beyer and Smets (2014) report a fast convergence of European regional unemployment rates after the introduction of the Euro but increasing standard deviations since 2008. Today they are back at the high levels experienced in the late nineties. Estrada, Galí, and López-Salido (2013) show that prior to 2008 regions in other developed countries converged as well – though less than in Europe. We contribute to the existing literature by extending the analysis of regional unemployment distributions of Overman and Puga (2002) to the introduction of the Euro and the recent financial and sovereign debt crises. Moreover, we decompose regional unemployment and study the role of country and regional factors in these distributional dynamics; to our best knowledge we are the first to do so.

3. Data

3.1. Source and Coverage

We update the dataset from Overman and Puga (2002) using Eurostat's regional database on unemployment rates and end up with a year coverage ranging from 1986 to 2013.[2] Due to data availability we include only 131 of the 150 regions included in the original dataset.[3] In addition, we linearly interpolate the years 1997 and 1998 for which data is not available for any region.

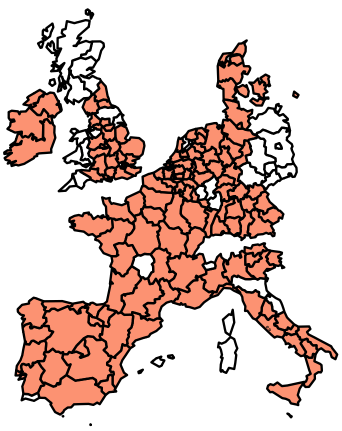

Figure 1. European regions

Source: Eurostat's NUTS 2 data.

Figure 1 shows that the regions are spread over eleven countries, namely Belgium, Germany, Spain, France, Italy, the Netherlands, Portugal, Ireland, Great Britain, Denmark, and Luxembourg. The regions are based on Eurostat's regional classification of territorial units, the NUTS2 level in 1996. Regions included are, for

[2] Unemployment is defined by Eurostat as a person aged between 15 and 75 and without work during the reference week, who is able to start work within the next two weeks and who has actively sought employment at some time during the last four weeks.

[3] A land reform in the UK in the mid-90s has in particular diminished our sample. However, other national administrative reclassifications or minor data availability issues affect nearly all our countries.

instance, the Oberpfalz in Germany, Friuli-Venezia Giulia in Italy or Kent in the UK. The average regional population in 2013 was 2.3 million. We list all regions included in the sample in Appendix A.

3.2. Descriptive Statistics

The average unemployment rate over all years and for all regions in our sample is 8.7%. It was lowest in 2007 with 6.5% and highest in 1994 with 10.9%. In 2013 a similar height was reached with a rate again above 10%. The minimum rate overall was experienced by Utrecht (NLD) with 1.2% in 2001 and the maximum with 36.6% by Andalucía (SPA) in 2013. Before the outbreak of the financial crisis in 2007 the highest unemployment was 17.1% in Bruxelles-Capitale (BEL).

Figure 2 presents the main characteristics of the European regional unemployment distribution. By looking at the outmost values on both the upper and the lower end of each year's distributions, minimum values can be observed to remain relatively stable over time and roughly fluctuate around 3%. Maximum values, on the other hand, exhibit high heterogeneity over time and pronounced movements. They provide a clear decreasing trend during the period from the mid-1990s until the eve of the financial crisis, falling from 34.7% to 17.1%. Even though the gradual decline already started in 1994, it was after the introduction of the Euro that in the early 2000s this trend intensified. Interestingly, the mean between 2001 and 2005 increased, even though maximum rates dropped strongly. The 95th percentile follows the same pattern as the maximum values and this pre-crisis development can also be detected through slightly falling interquartile ranges, including generally lower median values and means.

The fallout of the financial crisis, however, brought about a sudden and harsh reversal of previous gains in closing the gap between very high and very low regional unemployment rates. Maximum rates surged again from 2009 on to almost twice the size of 2008 and have since then experienced a continuous increase peaking at 36.6% in 2013. Again we find a similar trend for the 95th percentile and for the other distributional characteristics with mean and median unemployment rates creeping upwards and interquartile ranges widening.

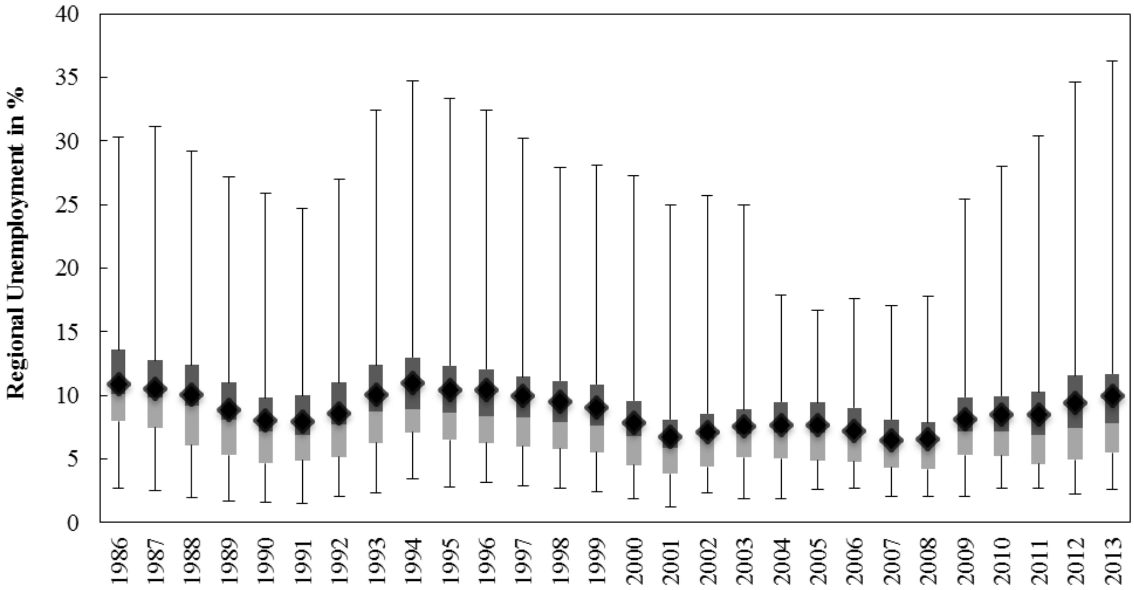

Figure 2. Distribution characteristics of European regional unemployment rates

Description: Exhibited distributional characteristics are the interquartile range within the boxes showing also the median as the parting line between lighter and darker grey shaded parts. The diamonds represent the mean in each year and the upper and lower whiskers respectively maximum and minimum values.

Source: Authors' calculations using Eurostat data.

4. Distributional Analysis

4.1. Normalization of Regional Relative Unemployment Rates

Regional variables are often measured relative to aggregate ones (Blanchard and Katz 1992; Obstfeld and Peri 1998; Overman and Puga 2002). We initially study the differences of regional and aggregate unemployment rates, as is typical in the literature:

$$u_{it}^{1} = U_{it} - U_{EU,t} \ , \tag{1}$$

where U_{it} is the regional unemployment rate of region i at year t, $U_{EU,t}$ is the European unemployment rate in year t, which is defined here as the average of all regions in the sample, and u_{it}^{1} is the *EU relative unemployment rate*. A narrower distribution of this measure signals increasing similarity of regional unemployment.

4.2. Standard Deviation

As a first measure of regional inequality in unemployment rates we plot the within standard deviations of EU relative regional unemployment rates over the whole sample period in Figure 3. The standard deviation measures the dispersion of the regional unemployment rates from the EU average. Overman and Puga (2002) study EU relative rates between 1986 and 1996. During this period the standard deviation increased slightly but with the introduction of the Euro regional differences to the EU average decreased considerably. The standard deviation dwindled from 5.8% in 1996 to 2.7% in 2007. The convergence reverses promptly after the outbreak of the financial crisis and the standard deviation increases strongly since then and at 6.8% it is today higher than in any year before.[4]

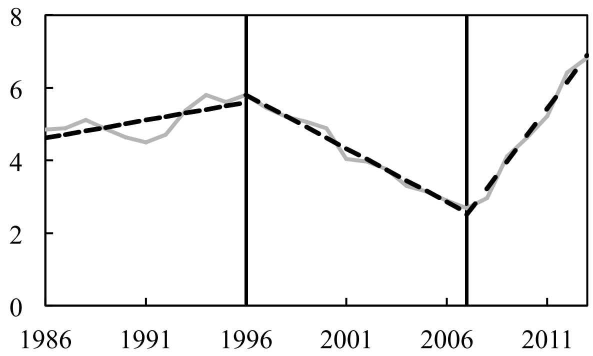

Figure 3. Standard deviation of EU relative rates with segmented linear trend (dashed line) in %

Source: Authors' calculations using Eurostat data.

We propose to focus on the distributional changes between these three periods: (1) 1986 to 1996, for a comparison with the results of Overman and Puga (2002), (2) 1996 to 2007, for capturing the initial Euro convergence, and (3) 2007 to 2013, for encapsulating the Great Recession divergence. With these names we refer to the concurrence of these events with clear trend changes in the dispersion of unemployment rates. We are not, however, claiming causality. While certain consequences from these events, like decreasing interest rates in Southern Europe after 1999 or the recessions in some countries during the financial and sovereign debt crises, most likely affected regional unemployment, we leave formal establishment of causality for future work. Instead, we proceed with a distributional analysis of unemployment.

4.3. Updating Overman and Puga (2002)

Following Overman and Puga (2002) we tackle the spatial analysis of European regional unemployment with two non-parametric methods: (1) a standard density distribution analysis for the aforementioned selected year pairs and (2) estimations of so-

[4] Note that the average regional unemployment rate follows a similar trend, i.e. it remained mostly stable until 1996, decreased until 2007 and is increasing again since then. When we normalize the EU relative standard deviation by the mean, we still find the same pattern as just discussed. We show the coefficient of variation in Figure A1 in the Appendix.

called stochastic kernels, initially proposed in the economic growth literature by Quah (1993, 1996, and 1997). Our analysis thus inspects the evolution of the cross-sectional distribution of European regional unemployment rates by exposing both changes in external shape and intra-distributional dynamics.

While density functions are widely known, stochastic kernels are less used. They can be interpreted as the graphical equivalent of a transition matrix with infinitely small ranges. To avoid potential shortcomings of discretizing a continuous transition process, the stochastic kernel estimates through kernel densities a transition matrix containing a continuum of rows and columns.[5] Eventually, these continuous transition probabilities, i.e. the stochastic kernels, are derived from estimations of conditional probability density functions that are obtained by dividing the joint probability density functions by marginal probability density functions.

We do not want to solely rely on a graphical interpretation of our kernel densities and stochastic kernels and therefore, where appropriate, report Gini coefficients and the polarization measure proposed by Esteban, Gradin, and Ray (2007).[6] The Gini ratio measures the degree of statistical dispersion of the overall distribution. The latter measure allows quantifying the degree of regional polarization into two groups – high and low relative unemployment. The degree of internal group cohesion or with which both groups stand in antagonism to each other determines the measure.[7]

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[5] For a more detailed description of kernel density estimation as well as mathematical preconditions see Quah (1996, 1997) and Magrini (2007).

[6] Both measures have been computed with the DASP Package for distribution analysis (Araar and Duclos 2007).

[7] This is an extended version of the original measure by Esteban and Ray (1994) and can be applied to continuous distributions allowing for an endogenous determination of groups. In our case of two groups, either high or low unemployment, we calculate the *bipolarization* of a cumulative distribution of unemployment rates. The endogenous determination of each group is achieved by finding a cut-off point through maximizing the vertical difference between the Lorenz curve and the 45° line, what in our bipolar case becomes the mean deviation. Following Esteban, Gradin, and Ray (2007), we set the constant of group identification and the weight of measurement error equal to one. Polarization is then measured as twice the mean deviation minus the Gini ratio of the density.

4.3.1. Kernel Densities

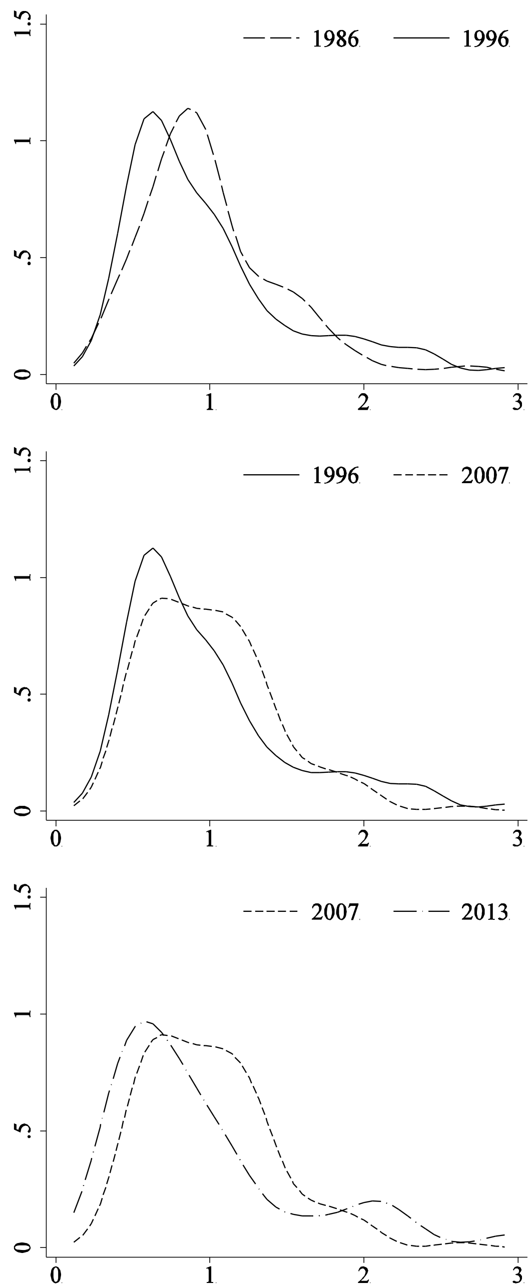

Figure 4. Kernel densities of EU relative rates

Description: Kernel densities can be considered as a continuous form of histograms. They depict the shape of the overall distribution of regional EU relative unemployment and allow discerning changes from one period to another. All densities are calculated non-parametrically by using a Gaussian kernel and a fixed bandwidth.

Source: Authors' calculations using Eurostat data

Figure 4 plots kernel densities for the year pairs 1986 and 1996, 1996 and 2007, as well as 2007 and 2013. These years mark the start and end points of the three periods identified before. For an easier comparison with Overman and Puga (2002) we now define the EU relative rate as a fraction instead of a difference. Regions at 1.5 then have an unemployment rate that is 50% above the EU average. If all mass had been concentrated at one, all regions would have had the same rate. Clearly, a wider distribution shows a larger heterogeneity of unemployment rates.

The upper graph of the triplet is the same as Figure 2 in Overman and Puga (2002) and shows the polarization of EU relative unemployment rates between 1986 and 1996. More mass moved to the extremes, so that in 1996 there were more very low but also more very high rates. This is also reflected in a 39% increase in the above mentioned polarization measure, with polarization rising from 0.094 to 0.131. Between 1996 and 2007, however, this trend has clearly reversed. Regions from both extremes have converged and while the distribution is still right-skewed (very few regions have very high rates), the right tale has shortened signaling a convergence also of the weakest regions. A reduction in polarization by about 25%, from 0.131 to 0.099, illustrates this convergence trend as well. As expected from looking at the evolution of the standard deviation, the distribution widened again strongly from 2007 to 2013. Regions have polarized so that today much more regions have unemployment rates more than twice as large as the EU average but also more regions have had a rate less than half the EU average. Twelve Spanish and three Italian regions had an unemployment rate more than twice as large as the EU average in 2013. This bipolarization of regions with very high and very low unemployment rates again becomes strongly evident through a roughly 60% increase in polarization when comparing 2013 with the pre-crisis level.[8]

4.3.2. Spatial Dissemination

Figure 5 relates the previously revealed changes in the aggregate distribution to a more detailed picture of the spatial dissemination. The heat maps show a regional breakdown of EU relative unemployment rates. In 1986, at an average unemployment rate of 10.9%, primarily the South of Spain and Ireland belonged to the upper extreme of relative unemployment rates. As darker colors indicate, by 1996 more regions in the South of Europe displayed rates of twice and above the EU average, which almost remained stable at 10.4%. Also in France relative unemployment rates increased, whereas some Northern regions, in particular in Ireland and the United Kingdom, now either find themselves on a par with or below the average. In line with the convergence process indicated by the densities, regional heterogeneity decreased in the following years and was much lower in 2007. This is true not only in relative terms, as the average unemployment rate decreased to 6.5%. By 2013, however, this development has been reversed completely. Not only are many regions back at the high unemployment rates relative to the EU average experienced in the 1980s, but for some the situation has never been worse. Almost all Spanish and Southern Italian regions have relative rates at least twice as high as the EU average. Note that the average in 2013 was back at the pre-convergence levels of slightly above 10%.

Just by looking at the maps one notices certain country effects. For example, the increase of EU relative rates from 2007 to 2013 was shared by all Spanish regions, which makes the increase a Spanish phenomenon. In other words, these regions did not all perform worse because of regional features but because of their country affiliation. In this particular case the financial and sovereign debt crises have adverse effects on all Spanish regions. Equally important, though, country effects can clearly not explain all changes. Note for example the increase of relative rates from 1986 to 1996 in Southern Italy. At the same time other Italian regions improved their relative position. We think that the question of country and regional fluctuations deserves further attention and hence return to it in Section 5. Before that we address the question of the inner distributional mobility of regions.

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[8] The same trends are also visible when looking at the Gini index numbers. Inequality rose by about 20% during the period 1986 to 1996, decreased by about the same amount in the next decade and strongly increased again by 47% from 2007 to 2013.

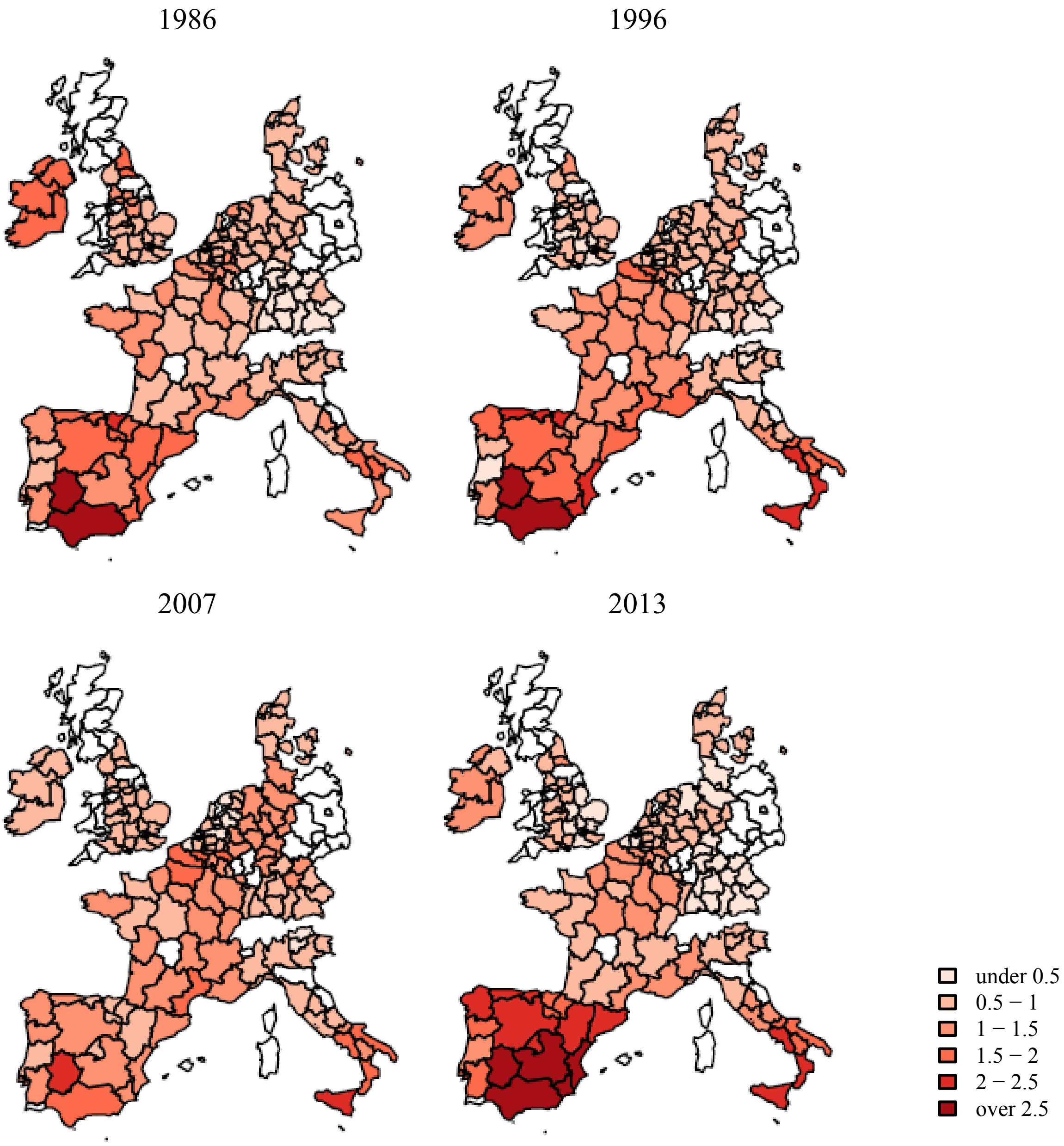

Figure 5. European relative unemployment rates 1986, 1996, 2007, and 2013

Description: The heat maps above present regional unemployment rates relative to the European average in the respective year. Darker colors indicate regions with higher EU relative rates; regions left white denote missing data. The average EU unemployment rate in 1986 was 10.89%, 10.42% in 1996, 6.49% in 2007, and 10.01% in 2013.

Source: Authors’ calculations using Eurostat data.

4.3.3. Stochastic Kernels

We analyze the inner distributional mobility of regions to determine whether always the same regions are at the extremes. Stochastic kernels allow for such an examination of intra-distributional dynamics across time.[9]

Year pairs and normalizations under scrutiny remain the same as before. The left-hand side in Figure 6 shows the respective three-dimensional surface graphs of the stochastic kernels whereas the right-hand side displays their contour plots. These can be read like geographical contour maps with inner lines representing higher levels of the graphs and thus more mass. A plot with mass only along the diagonal line from the lower left corner to the upper right points at a complete persistence of the distributional dynamics, i.e. regions with, for instance, an EU relative rate of two at the beginning of the time period will have the same above EU average rate at the end of the period. For graphs primarily concentrated along the inverted diagonal line the picture gets reversed and high intra-distributional mobility occurs from one period to the other. Regions with previously high relative unemployment rates now migrate to lower rate areas and vice versa. The other extreme case of unemployment rates amassing around the vertical axis implies that regional rates at period commencement contain no information about their whereabouts some years later.

The graph in the upper-left panel of Figure 6 resembles to a high degree Figure 3 in Overman and Puga (2002) for 1986 and 1996. It shows the development towards a polarization due to the two peaks on the lower left and upper right confirming opposing developments among regions during this decade. Regions moved to extremes while the middle area of moderate relative unemployment figures thinned out. The picture changes during the subsequent period with the introduction of the Euro. While relative positions are not reversed, mobility among regions within the distribution increases strongly. Regions with a high relative rate in 1996 were very likely to have a lower rate in 2007, i.e. during the convergence process particularly hitherto high relative unemployment regions migrated to lower rates. Note the multiplicity of local maxima discernible in both the surface shape of the kernel and the contour plot, which can be related to specific countries. During the decade from 1996 to 2007, Spanish regions experienced the largest progress overall and moved from unemployment rates of twice and beyond the European average down to rates of around equal or even below the mean. The best performing regions Cantabria, Pais Vasco, and Murcia, saw their rates drop by more than once the European average. The peak in the upper right corner belongs to Italy's Southern regions including Sicilia, which moved somewhat downwards from roughly 2.5 times to around two times the European average. Campania and Calabria, with a respective decrease in their unemployment rates by 0.72 and 0.67 times the European average, also belonged to the group of regions with the highest mobility. The strong regional clustering by country suggests that country factors might be crucial to explain the observed changes of the external shape as well.

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[9] We thank Stefano Magrini for providing a helpful *Matlab* code.

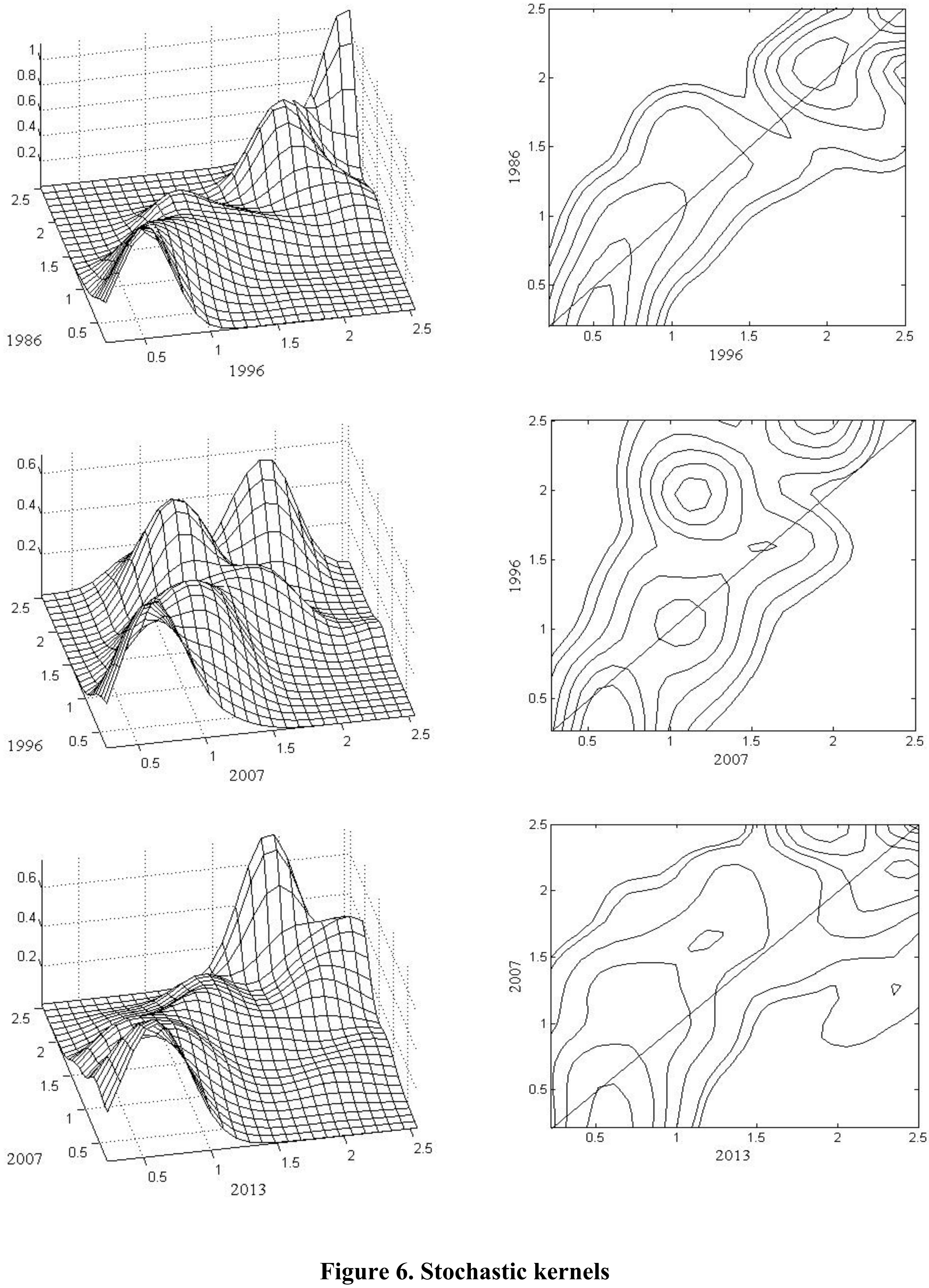

Figure 6. Stochastic kernels

Source: Authors’ calculations using Eurostat data.

For the period of 2007 to 2013, the graphs in the lower panels are in line with the previously shown kernel densities and point at a thorough reversal of the convergence process after the financial and the sovereign debt crises. Regions with a very low unemployment rate decreased their rates further, regions with middle and high rates remained where they were or experienced increasing rates. This also refers to the aforementioned Spanish and Italian regions that converged before but today have again rates twice as high as the European average. With the exception of Andalusia, Extremadura, and Pais Vasco, Spanish regions faced an increase of above one time the European average; Southern Italian regions already had elevated levels before and experienced therefore comparatively smaller increases in unemployment rates.

Both analytical parts above show that distributions in 2013 look very similar to the ones in 1986; the convergence between 1996 and 2007 has therefore been undone by the current crisis. In spite of all efforts, European cohesion policies did not result in a regional convergence in the long run.

5. Decomposing Unemployment Fluctuations

After having analyzed the changes of regional relative unemployment rates, we are now interested in the origin of these changes. For that reason we first need to separate unemployment fluctuations in different level contributions. How important are European fluctuations, i.e. how correlated are unemployment changes in Europe? How much do country movements contribute and how *regional* is regional unemployment, i.e. how much of the observed fluctuation is idiosyncratic? Is there a European unemployment cycle?

5.1. The Multi-Level Factor Model

So far we have filtered out regional relative unemployment rates using the European unemployment rate for computing simple differences. Other strategies are possible. Decressin and Fatás (1995), for example, stress that European regions are very differently correlated with the aggregate and, in order to compute region-specific variables, propose to first regress the regions on the European aggregate and then use the coefficients as weights when differencing. They hence condition the regional variables on one common factor as well, but they allow for heterogeneous reactions to aggregate fluctuations. Beyer and Smets (2014) find that European labor market variables have more than one common factor, above all due to the presence of country effects, and propose to compute region-specific variables as residuals from a multi-level factor model accounting for country factors. The factor model is used to classify co-movements of variables as either continental or country fluctuations and minimizes the region-specific fluctuations.

We follow the latter strategy and separate the regional unemployment into European, country and regional contributions. For understanding the changes detected above, it might be important to allow for country factors. For a policy maker this question is important, because it determines the appropriate level of action. For example, national factors influencing unemployment rates, e.g. labor market institutions, financial conditions, or the educational system, lie beyond the reach of regional policy. If regions diverge because of these factors, the effectiveness of regional policies will be limited and rather national reforms are necessary. On the other hand, if countries converge because some high unemployment rate countries experience decreasing rates, but some regions in these countries are not benefitting from the trend, then regional reforms are necessary.

We hence estimate a multi-level factor model to decompose the regional unemployment rates. We include one European factor on which all regions are allowed to load and eight country factors (Belgium, Germany, Spain, France, Italy, the Netherlands, Portugal, and Great Britain) on which all regions belonging to a particular country load.

We estimate the following model:

$$U_{i,c,t} = u_{it}^{2} + L_i^{\mathrm{EU}} f_t^{\mathrm{EU}} + L_i^{\mathrm{c}} f_t^{\mathrm{c}}, \tag{2}$$

where L_i^{EU} is the regional specific loading on the EU factor f_t^{EU}, and L_i^c are the regional specific loadings on the country factors f_t^c. Since we allow for a structure of the factors, the model cannot be estimated with principal components. Instead, we estimate it using the quasi-maximum likelihood approach of Doz, Giannone, and Reichlin (2012).[10] The factors are shown in Figure A2 in the Appendix.

5.2. Explained variance and loadings

Table 1. Explained variance in %

Europe	Countries	Regions
41	38	22

Source: Authors' calculations using Eurostat data.

Table 1 contains the variance decomposition, where we have aggregated the variance explained by the different factors. European fluctuations alone explain already 41% of the regional fluctuations, suggesting clearly the existence of a European unemployment cycle. The country factors are nearly as important and explain another 38% so that only 22% idiosyncratic variance remains. Figure A3 in the Appendix shows a

[10] The QML estimator is implemented using the Kalman smoother and the EM algorithm. For initialization we use principle components. We confirmed stationarity of unemployment rates using the panel unit root test suggested by Levin, Lin and Chu (2002), which rejects a unit root at the 1% level.

regional breakdown of the variance decomposition. Note that the explained variance by a factor is given the squared loading on that factor. Instead of discussing the breakdown of the variance decomposition, we will focus directly on the loadings. The differences between the loadings inform us about the homogeneity of regional unemployment reactions to European and country movements. By looking directly on the loadings we are able to differentiate between the sign of the correlation.

Table 2. Minimum, maximum, and mean regional factor loadings

Factor	EU	BEL	DEU	ESP	FRA	ITA	NLD	PRT	GBR
Mean	0.44	0.65	0.83	0.36	0.51	0.38	0.56	0.88	0.36
Max	0.92	0.83	0.93	0.70	0.86	0.91	0.65	0.96	0.91
Min	-0.63	0.43	0.69	-0.23	0.21	-0.22	0.28	0.67	-0.13

Source: Authors' calculations using Eurostat data.

Table 2 shows the mean as well as the minimum and maximum regional loadings on the European factor and on each country factor. Note that regions load in fact with different signs on the same factor. An increase of the price of oil, for example, benefits a region producing oil but is harmful for a region producing steel. Such contrary developments are even reflected in the overall business cycles, as regions turn out to load both positively and negatively on the European factor. The same is true within Italy and Spain, two countries clearly characterized by enormous structural differences between their regions. In most countries, however, regions react with different intensity but not different signs to the national factor. The most homogenous reactions are found in Germany, the Netherlands, and Portugal.

To deepen these insights, Figure 7 below depicts the regional breakdown of the region-specific loadings on the European and the country factors. We plot the positive loadings and in the first and the negative in the second row. The left panel refers to the loadings on the European factor, the right panel to the loadings on the country factor. The table allows us to identify the regional sensitivity to European and country unemployment cycles.

While regions from all countries load differently on the European factor, German regions clearly stand out. They load negatively on that factor meaning that they are not only detached from the European unemployment cycle, but that their unemployment rates change in the opposite direction. Interestingly, Bruxelles-Capitale (BEL) and Luxembourg also load negatively on the European factor. Portuguese regions deserve attention because they load very heterogeneously on the European factor. While three out of the four regions load positively on it, Norte loads negatively. In England, France and Italy regional loadings vary considerably as well, though to a lesser extent.

Turning now to the loadings on the respective country factors, Italy is clearly standing out. The Italian factor is driven by the South that loads heavily and positively on it. Northern Italy, on the other hand, loads negatively on that factor. This effect is strongest in the two autonomous regions Alto-Adige and Trentino. Surprisingly, strong heterogeneity is also found in England. While Greater London and its surrounding regions load strongly on the English factor, many other regions are only marginally moving with it. And four regions, including Greater Manchester, even load negatively on the English factor. While Spanish regions react much more homogenously to their country factor, Pais Vasco also loads negatively on the factor. It is striking that regions enjoying autonomy are less (or even negatively) correlated with the unemployment cycle of the country. Major capital regions, on the other hand, such as Île-de-France (FRA), Greater London (GBR), Bruxelles-Capitale (BEL), and Lisboa e Vale do Tejo (PRT) load heavily on the country factor, often in contrast to neighboring regions. German regions load homogenously on their country factor. This result relates nicely to Montoya and De Haan (2008), who look at regional business cycles and find a strong border effect in Germany as well.

Belke and Heine (2006) and Barrios and De Lucio (2003) analyze the strength of business cycles over time and find that national business cycles have become more synchronized. We split our sample and run the factor model separately for the three periods identified before. While the variance share explained by regional fluctuations remains constant over time, the share explained by the country factors decreases, whereas the variance explained by the European factor increases. European integration has thus not only synchronized business cycles, but also national unemployment cycles.

To conclude, a European unemployment cycle is discernible and the vast majority of regions load positively and strongly on that factor. However, German regions are moving in the opposite direction. Moreover, we find that regional loadings on the country factor vary in particular in Italy and England.

We can interpret the residual of the factor model u_{it}^2 as another measure of regional unemployment performance. We refer to it as *region-specific unemployment rate*.

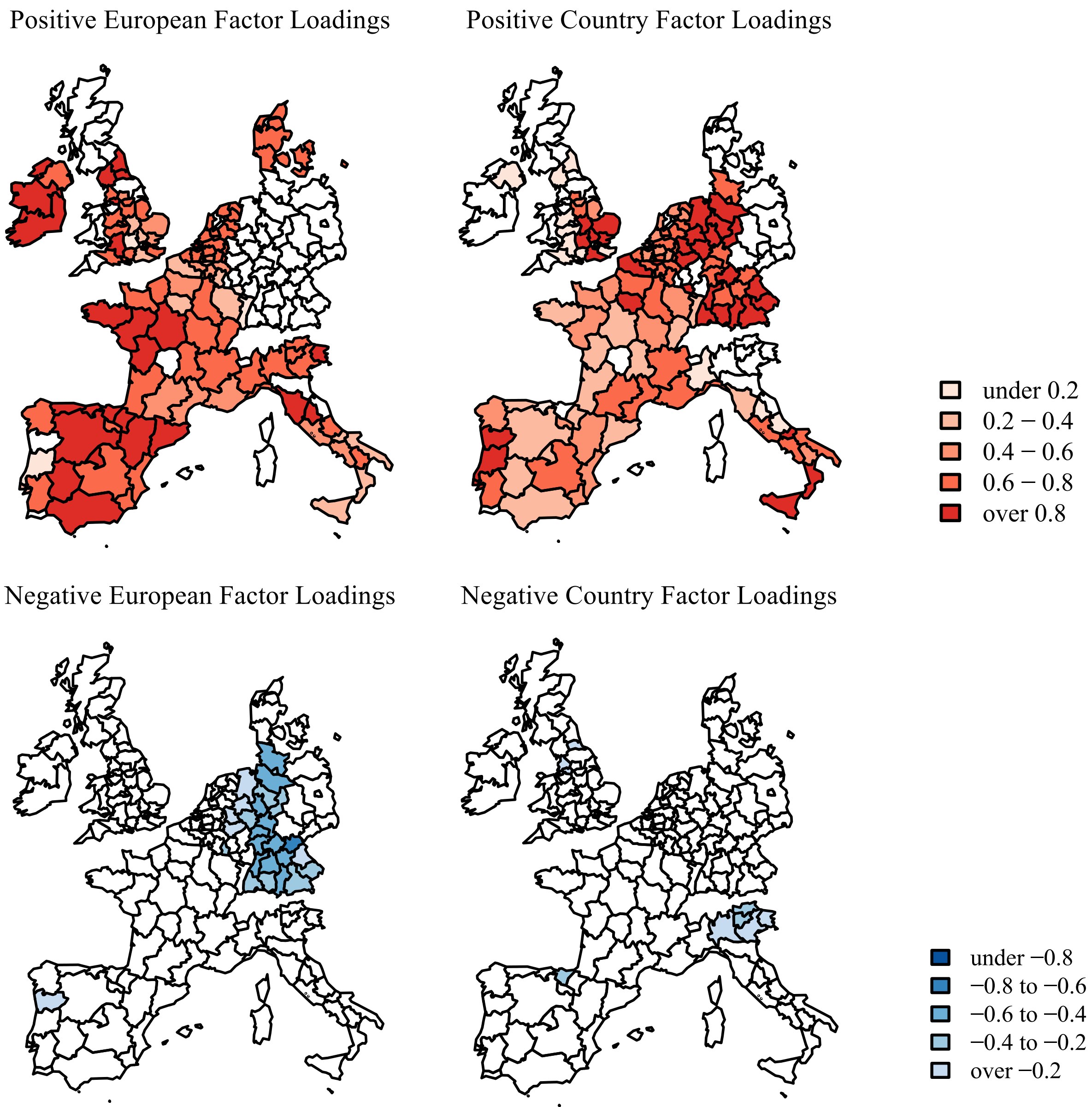

Figure 7. European and country factor loadings

Description: The heat maps above present constant but region-specific loadings on the European and the country factors. Darker colors depict regions with stronger loadings on the respective factors.

Source: Authors' calculations using Eurostat data.

5.3. Which level is responsible for distributional changes?

Since we have separated the contributions in the previous section we can now analyze the distributions of the different contributions over time. We sum the European and country contributions and contrast its distribution with the distribution of the region-specific unemployment rates. We estimate again kernel densities as before and in Figure 8 report the distributions in 1996, 2007, and 2013. The left panel shows the unemployment rate predictions of the factor model, i.e. the European and country contribution to regional unemployment; the right panel shows the region-specific unemployment, i.e. the residual of the factor model. A region with a region-specific unemployment rate of -2 in a specific year has an unemployment rate that is 2 percentage points lower than one would expect for this region. Adding the region-specific unemployment rate to the European and country contribution gives the actual regional unemployment rate.

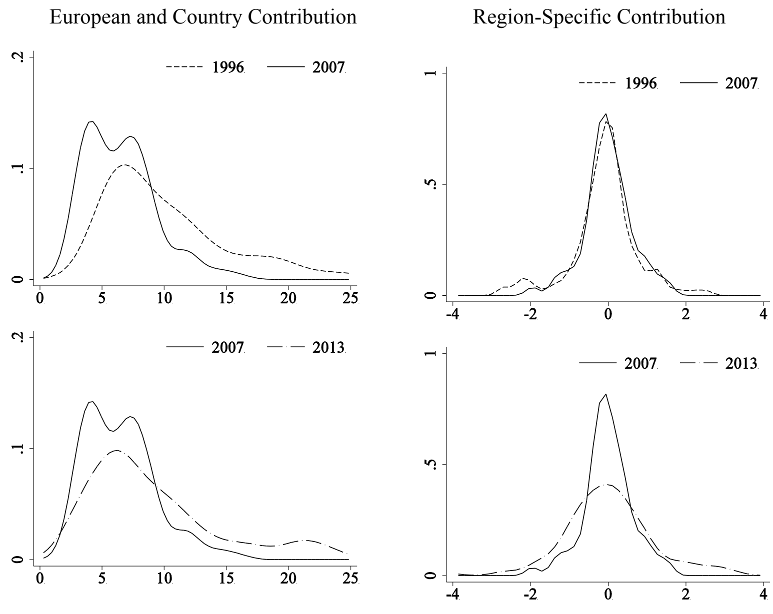

Figure 8. Kernel densities for region-specific and country-specific unemployment rates

Source: Authors' calculations using Eurostat data.

Note that the European and country contributions in 1996 were much wider than in 2007. In particular, there were fewer regions for which a rate above 10% was predicted in 2007 than in 1996. The distribution of the region-specific contributions, on the other hand, is nearly identical in 1996 and 2007. The unemployment specific to a region, i.e. the unemployment that the factor model is unable to explain, varies between minus three and plus three percent in both years and is symmetric around 0. The convergence between EU relative unemployment rates detected before can hence be attributed to a smaller heterogeneity of European and country contributions. The contribution of region-specific factors remained the same. This finding does not surprise us. After the introduction of the Euro interest rates in the Euro Area converged and in particular weaker countries experienced booms and a decline of their unemployment rate, possibly explaining the lower European and country contribution. It seems national convergence has been a powerful tool to reduce regional heterogeneity measured relative to the EU average.

From 2007 to 2013 the distribution of the European and country contribution has widened again and looks very similar to the one in 1996, with numerous regions for which the factor model predicts rates above 20%. In addition, also the distribution of the region-specific unemployment has widened. Hence the divergence since 2007 has been driven by an increasing heterogeneity of both European and country contributions as well as of region-specific rates.

6. Cross-Country Differences

Having completed our spatial analysis of European regional unemployment rates, an open issue relates to the differences of unemployment rates in the different countries. Are their regions equally dispersed? In order to shed some light on the differences within countries we use *country relative unemployment rates* in 2013 to first calculate Gini coefficients and then employ the aforementioned polarization measure. Figure 9 reports the results.

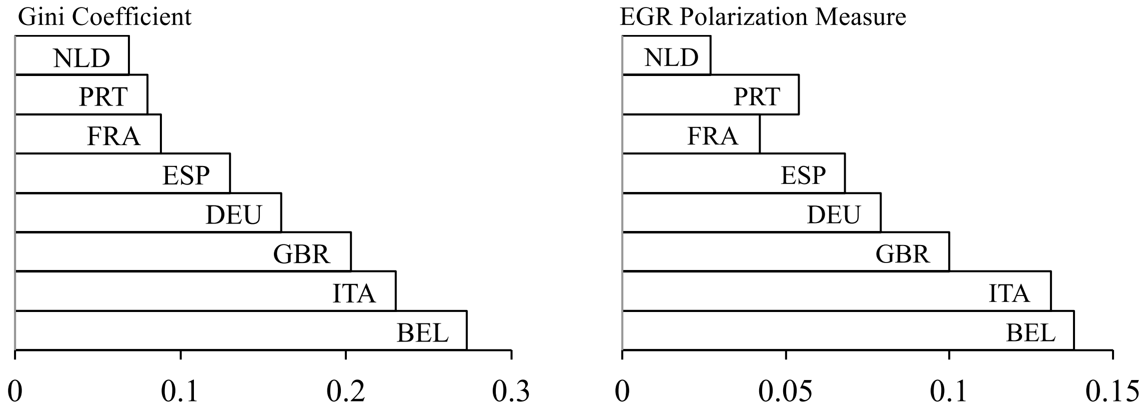

Figure 9. Gini coefficients and polarization measures: Countries in 2013

Description: The Gini measure is equivalent to the space between the 45-degree line and the Lorenz curve plotting the share of unemployment among a country's regions with a higher ratio indicating higher inequality and vice versa. The polarization measure is high when the density takes the shape of two groups of regions with small differences in unemployment rates within each group and large differences across groups. Polarization increases as regions within each group become more homogenous in terms of their unemployment rates and/or as the two groups move further apart from each other.

Source: Authors' calculations using Eurostat data.

The most homogenous regions are currently found in the Netherlands, Portugal and France, the most heterogeneous regions in Italy and Belgium. Spanish, German[11], and British regions are in-between. Bruxelles-Capitale (BEL) had an unemployment rate of nearly 20% percent, in Oost-Vlaanderen (BEL) it was below 4%. The huge diversity of economic performance in South and North Italy is common knowledge. The unemployment rate in Calabria was above 20% but was close to 5% in Trentino-Alto Adige. In Italy the highest regional unemployment rate is thus four times larger than the lowest. In the Netherlands the highest and lowest unemployment rates are quite close with a rate of 7.8% in Friesland and a rate of 4.7% in Zeeland. The ranking of the countries for the polarization is nearly identical. The only exception is Portugal that has a smaller Gini coefficient than France but a higher polarization measure. Note that Italian regions are not just very heterogeneous, but also strongly polarized.

[11] Note that our German sample only includes West German regions. The coefficient would probably be much higher if East German regions were included as well.

7. Conclusion

In our analysis we divided our sample into three periods clearly marking trend changes in regional unemployment dispersion. While not establishing causality, we pointed to the concurrence of the trend changes with the introduction of the Euro and the financial crisis. Building on this partitioning, we were able to show the following:

(1) With the introduction of the Euro regional unemployment relative to the EU average converged strongly. The Gini coefficient decreased from 1996 to 2007 by 20% from 0.28 to 0.23. In particular Spanish regions were able to move within the distribution.

(2) With the outbreak of the financial crisis these developments reversed. Heterogeneity is strongly increasing since then and today has reached the highest level ever. Between 2007 and 2013 the Gini coefficient of EU relative rates has increased by nearly 50% and the polarization measure by over 60%. In addition, the same regions that converged before moved back to their previous positions resulting in a strong persistency of EU relative rates over the whole sample.

(3) European fluctuations explain two fifths of the variance in regional unemployment rates, meaning that European unemployment cycles exist. Country factors are nearly as important so that only one fifth of unemployment movements are region-specific.

(4) European regions react very heterogeneously to European and country fluctuations. German regions, Bruxelles-Capitale (BEL), and Luxembourg respond in the opposite direction to European movements. The response to country movements vary in particular in Italy and England.

(5) We attribute the convergence between 1996 and 2007 purely to country factors but the divergence between 2007 and 2013 to both country and region-specific factors.

(6) There are considerable differences within countries. The highest labor market heterogeneity is found in Belgium and Italy; the lowest in the Netherlands, Portugal and France.

A convergence of regional unemployment rates in Europe was clearly a crucial goal of European regional policies, as well as the agenda of converging life conditions in general. It seems that with the introduction of the Euro countries and regions initially converged. However, the financial and sovereign debt crises annihilated all progress made in the years before. Taking a medium to long-term perspective, we do not find any evidence for a convergence of regional unemployment rates, raising the question about the effectiveness of European regional policies. Heterogeneity has never been larger than today resulting both from diverging country rates and diverging region-specific rates. Given the positive nature of our analysis, we cannot derive clear policy recommendations. A policy response, however, seems necessary at all levels.

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Appendix

A Sample

Belgium
Région de Bruxelles-Capitale/Brussels Hfdst. Gew.
Antwerpen
Limburg (BEL)
Oost-Vlaanderen
Vlaams Brabant
West-Vlaanderen
Brabant Wallon
Hainaut
Liège
Luxembourg (BEL)
Namur

Denmark
Denmark

France
Île de France
Champagne-Ardenne
Picardie
Haute-Normandie
Centre
Basse-Normandie
Bourgogne
Nord-Pas-de-Calais
Lorraine
Alsace
Franche-Comté
Pays de la Loire
Bretagne
Poitou-Charentes
Aquitaine
Midi-Pyrénées
Rhône-Alpes
Auvergne
Languedoc-Roussillon
Provence-Alpes-Côte d'Azur

Germany
Stuttgart
Karlsruhe
Freiburg
Tübingen
Oberbayern
Niederbayern
Oberpfalz
Oberfranken
Mittelfranken
Unterfranken
Schwaben
Bremen
Hamburg
Darmstadt
Giessen
Kassel
Braunschweig
Hannover
Lüneburg
Weser-Ems
Düsseldorf
Köln
Münster
Detmold
Rheinhessen-Pfalz
Saarland
Schleswig-Holstein

Great Britain
Cleveland, Durham
Cumbria
Northumberland, Tyne and Wear
South Yorkshire
West Yorkshire
Derbyshire, Nottinghamshire
Leicestershire, Northamptonshire
Lincolnshire
East Anglia
Bedfordshire, Hertfordshire
Berkshire, Buckinghamshire, Oxfordshire
Surrey, East-West Sussex
Essex
Greater London
Hampshire, Isle of Wight
Kent
Avon, Gloucestershire, Wiltshire
Dorset, Somerset
Hereford-Worcestershire, Warwickshire
Shropshire, Staffordshire
West Midlands (county)
Greater Manchester
Lancashire
Northern Ireland

Ireland
Ireland

Italy
Piemonte
Liguria
Lombardia
Trentino-Alto Adige
Veneto
Friuli-Venezia Giulia
Toscana
Umbria
Lazio
Abruzzo
Molise
Campania
Puglia
Basilicata
Calabria
Sicilia

Luxembourg
Luxembourg

Netherlands
Groningen
Friesland
Drenthe
Overijssel
Gelderland
Utrecht
Noord-Holland
Zuid-Holland
Zeeland
Noord-Brabant
Limburg (NLD)

Portugal
Norte
Centro (PRT)
Lisboa e Vale do Tejo
Alentejo

Spain
Galicia
Asturias
Cantabria
Pais Vasco
Navarra
Rioja
Aragón
Madrid
Castilla y León
Castilla-La Mancha
Extremadura
Cataluna
Comunidad Valenciana
Andalucía
Región de Murcia

B Coefficient of Variation

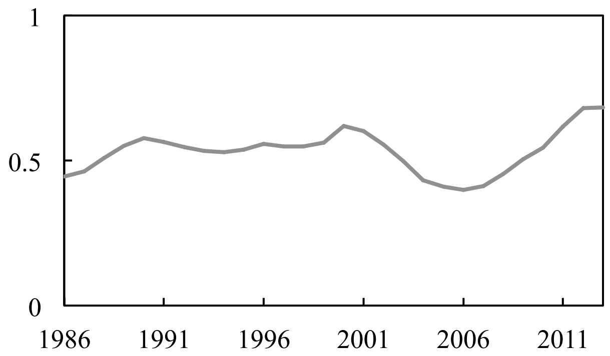

Figure A1. Coefficient of variation of EU relative rates

Source: Authors' calculations using Eurostat data.

C Factors

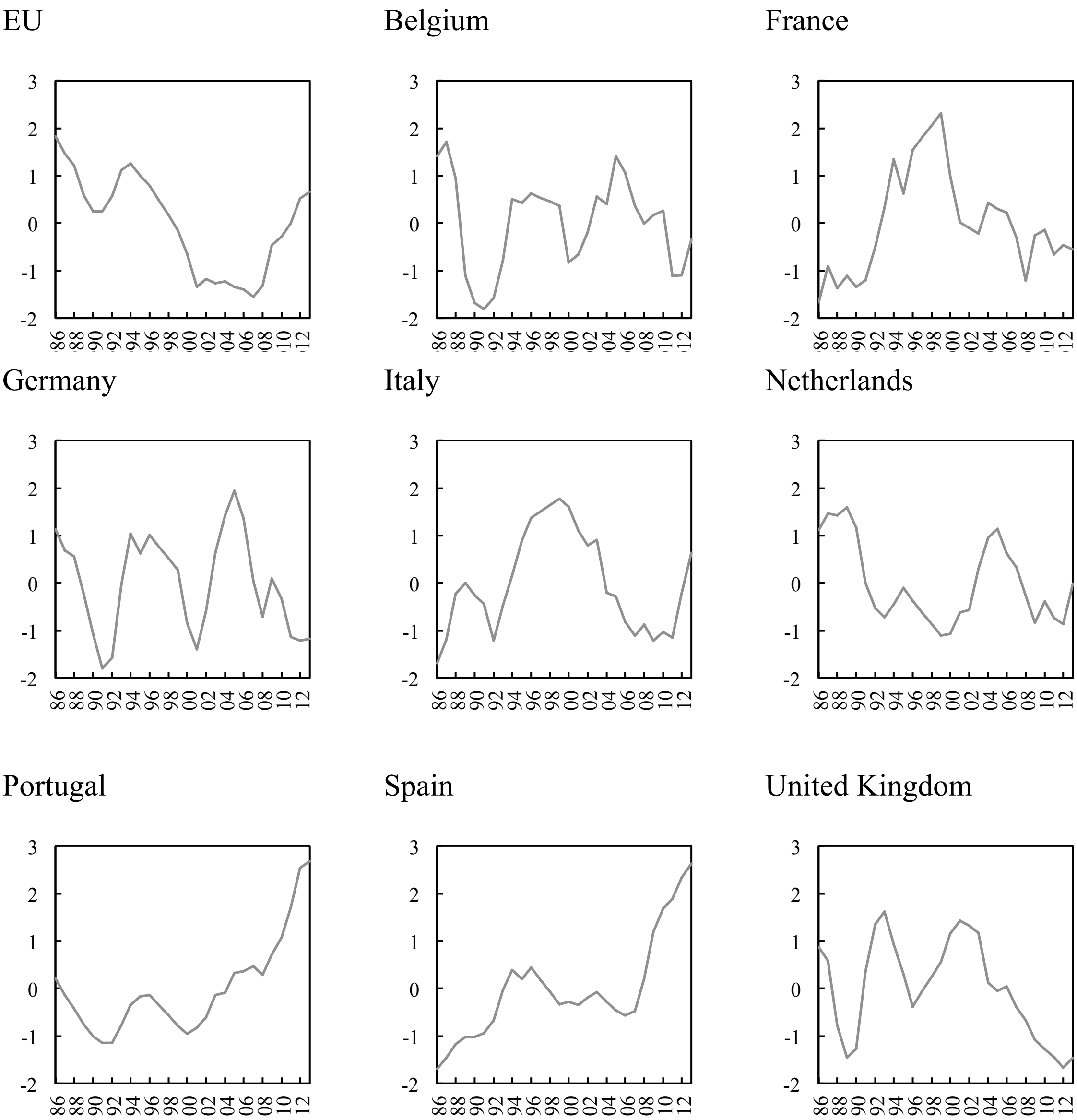

Figure A2. Estimated Factors

Source: Authors' calculations using Eurostat data.

D Explained Variance by Region

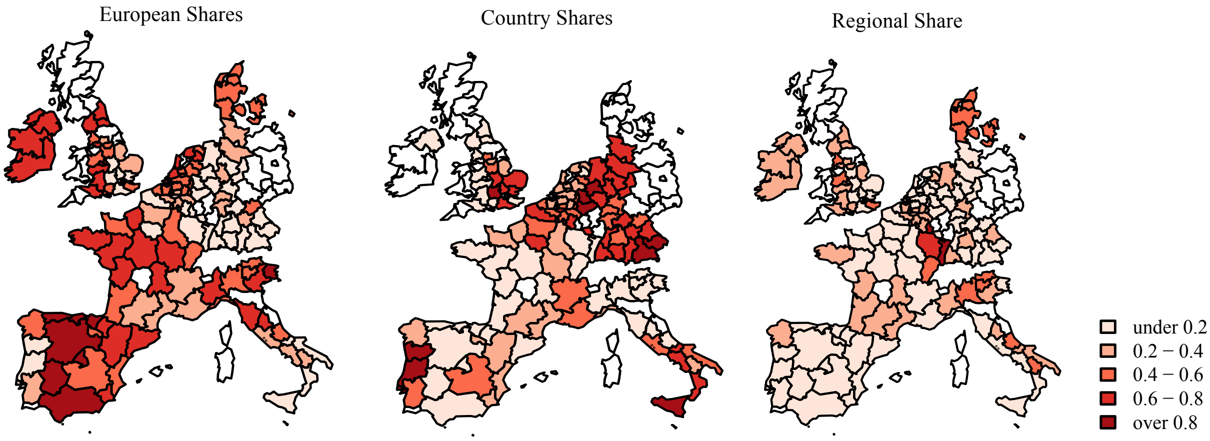

Figure A3. European, country and regional variance shares

Description: The heat maps above present the disaggregated variance decomposition of the European and country factors as well as regional shares. Variance shares are located within the [0, 1] interval. Darker colors depict stronger explanatory power of the respective factors for the regional fluctuations.

Source: Authors' calculations using Eurostat data.

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