Unit labor cost growth differentials in the Euro area, Germany, and the US: lessons from PANIC and cluster analysis[§]

Ulrich Fritsche[*] Vladimir Kuzin[**]

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Abstract

Inflation differentials in the Euro area are mainly due to a sustained divergence of wage developments across the Euro area, and narrower differences in labour productivity growth (Alvarez et al., 2006). We investigate convergence of inflation using unit labour cost (ULC) growth and applying PANIC (Bai and Ng, 2002, Bai and Ng, 2004) and cluster procedures (Hobijn and Franses, 2000, Busetti et al., 2006) to Euro area countries as well as US States, US Census Regions and German *Länder*. Euro area differs in that dispersion in general (and its fraction due to idiosyncratic factors in specific) is larger and common factors are much less important in explaining the variance of ULC growth. We report evidence for convergence clusters in all countries.

Keywords: Unit labor costs, inflation, European Monetary Union, Germany, United States of America, convergence, convergence clubs, panel unit root tests, PANIC

JEL classification: E31, O47, C32, C33

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[*]University Hamburg, Faculty Economics and Social Sciences, Department Economics and Politics, Von-Melle-Park 9, D-20146 Hamburg, and DIW Berlin, Germany, `ulrich.fritsche@wiso.uni-hamburg.de`

[**]Goethe-University Frankfurt, Faculty of Economics and Business Administration, Statistics and Econometric Methods, Gräfstr. 78, D-60054 Frankfurt a. M., Germany, `kuzin@wiwi.uni-frankfurt.de`

1 Introduction

Inflation differentials in the Euro area are a matter of concern for central bankers (European Central Bank, 2005, Trichet, 2006, Gonzalez-Paramo, 2005, and Issing, 2005) as well as researchers (Alvarez et al., 2006, Angeloni et al., 2006, Cecchetti and Debelle, 2006). It is argued, that the observation of a continuing divergence in price dynamics might be due to structural rigidities or differences in labour or product market structures, which in turn reduce the speed of the adjustment process (Angeloni and Ehrmann, 2004, Benigno and Lopez-Salido, 2002, Campolmi and Faia, 2006) or due to an inappropriate wage-setting process (Fritsche et al., 2005). It has furthermore been argued that the cross-section dispersion in inflation and growth rates are connected (Lane, 2006). This in turn might lead to dangerous imbalances in EMU if amplified.

The research results of the "ECB Inflation Persistence Network" indicate that the most important source of inflation differentials across EMU can be found in internal factors, namely a sustained differential in wage growth and narrower differences in productivity growth. This, in turn became an official argument of ECB officials quite recently:

> "I]n most countries [of the Euro area], domestic factors dominate external factors in generating inflation differentials. In particular, we have witnessed a sustained divergence of wage developments across the euro area, and narrower differences in labour productivity growth. As a result, differentials in the growth of unit labour costs have been persistent." (Trichet, 2006)

This became a matter of even greater concern because some of the large countries in the Euro area - Germany and Spain - showed remarkable deviations from the average EMU inflation rate for a number of consecutive years after the introduction of the Euro.

To illustrate the relevance of the point, we calculated measures of unit labor cost variability. Denoting π_j the respective unit labor cost (ULC) growth in country/region j, π^* the currency area average and ϖ_j the real GDP weight of country/ region j, then the root of the weighted squared distance of j is given by:

$$s_j = \sqrt{\varpi_j \left(\pi_j - \pi^*\right)^2} \tag{1}$$

The respective cross-section distributions of s_j for each year are plotted using Box-Plots [1] for the Euro area (EU 12), Germany, the United States (States and Census regions). [2]

Insert figure 1 about here.

As can be seen in figure 1, the dispersion measured by GDP-weighted variability was high after the EMS crisis in the early 1990s and diminished in the process of accession to EMU. After 1999, however, dispersion increased again and is nowadays as high as it was in the early 1990s. This is mainly due to weighted deviations of unit labor cost growth rates from average in countries like Spain or Germany. This is visible, if we have a look at a developments of s_j over time in the different currency areas (figure 2).

Insert figure 2 about here.

The respective dispersion data for the panel Western German *Länder* show a remarkable increase in weighted dispersion measures since the re-unification boom which indicates a higher ULC variability among Western German *Länder*. For the United States – irrespective if we have a look at the states level or at a higher level of aggregation (e.g. Census regions) – the exercise reveals a very stable dispersion of unit labor cost growth over time.

Analyzing the topics of diverging unit labor costs dynamics in a common currency area needs theoretical underpinnings. It seems to be appropriate to refer to the concepts of β- and σ-convergence, when analyzing the topic. According to Barro and Sala-i-Martin (1991) β-convergence is present if different cross-sectional time series show a mean reverting behavior to a common level. In contrast, σ-convergence measures the reduction of the overall dispersion of the time series. As pointed out by Quah (1993), the absence of σ-convergence as we see from figure 1 can not be taken as indicating the absence of β-convergence. In the following, we will mainly base our arguments on β-convergence.

A further distinction, which has to be considered in the context of an empirical analysis regarding the convergence of unit labor cost growth in a

[1]The median is plotted by a line in the center of a box together with shaded areas denoting a significance area, a box denoting the borders to the first and third quartile, and a whisker denoting the inner fences (1.5 times the interquartile range). Data points with a circle denote near outliers, stars indicate a far outlier.

[2]See section 3 for details.

common currency area, refers to the distinction between *absolute* and *relative* convergence (Bernard and Durlauf, 1996). Absolute convergence implies, that the ULC growth rates converge towards the same rate, whereas relative convergence means that the relative distance between the growth rates is stationary. This distinction has important implications when applied to inflation rates: relative convergence within a currency union implies, that the competitive position of each country/ region deteriorates on average with a stable rate, whereas absolute convergence implies a stabilization of the competitive position at a given point.

New approaches - which have been used quite recently to analyze inflation differentials in the EMU (EU 12) area (Beck et al., 2006, Busetti et al., 2006) - do allow for interesting features of panel data sets: the existence of - possibly non-stationary - common (and idiosyncratic) factors driving the dynamics of the panel and the case for sub-groups of panel members showing β-convergence (either relative or absolute convergence).

To get a better understanding of the sources of underlying divergence, we add therefore to the existing literature on inflation divergence in the following way: First, we employ the PANIC approach as developed in Bai and Ng (2002) and Bai and Ng (2004). The question of interest refers to the distinction common and idiosyncratic factors driving the penels of ULC growth dynamics. As a second approach, we analyze the case for convergence clusters (clubs), using the procedure of Hobijn and Franses (2000). Furthermore, we compare the divergence in unit labor cost dynamics in the EMU countries with the evidence for the States and census regions of the United States of America as well as the German *Länder*.

In short, our analysis points to the existence of one non-stationary and one stationary common factor for all countries/ regions except Europe. This is in line with the hypothesis of β-convergence around common factors (which could e.g. be associated by country-wide factors like supply or demand shocks like oil price hikes or monetary policy actions). For the Euro area, however, it is quite difficult to identify common factors – idiosyncratic factors dominate in explaining the bulk of variance – and clustering seems to be present. The idiosyncratic components in all currency areas are found to be stationary – however their persistence properties are quite different. Wheras in the case of Germany and the US, idiosyncratic components show a white noise behaviour, in the case of EU 12 we find strong serial correlation. The case for convergence clusters is confirmed for all currency areas when using the procedure as in Hobijn and Franses (2000) for all currency areas.

The paper is organized as follows. Having introduced the topic in section 1, in section 2 the applied methods are explained the results presented. Section 3 summarizes the findings.

2 Empirical analysis

2.1 A PANIC attack on ULC growth rates

Bai and Ng (2004) suggest a very useful approach to test for panel unit roots in the presence of stationary or nonstationary common components, known as PANIC – Panel Analysis of Analysis of Nonstationarity in the Idiosyncratic and Common components. PANIC approach allows both idiosyncratic and common components to be integrated of order one, which makes it very flexible in testing panel unit roots. Since we investigate growth rates of unit labor costs, we assume a model with an intercept but without linear trend and following the notation of Bai and Ng (2004) our model is:

$$X_{it} = c_i + \lambda_i' F_t + e_{it} \tag{2}$$

where X_{it} are $i = 1, \ldots, N$ observed growth rates, F_t is an unobserved vector of common factors and e_{it} are unit specific idiosyncratic components. Both F_t and e_{it} are allowed to be I(1) and for this reason the model has to be estimated in differences, where $x_{it} = \Delta X_{it}$, $f_t = \Delta F_t$ and $z_{it} = \Delta e_{it}$, so we estimate the model:

$$x_{it} = \lambda_i' f_t + z_{it} \tag{3}$$

employing the method of principal components. However, we standardize the first differences before estimating in order to avoid possible distortions by volatile series in calculating principal components, see Bai and Ng (2001). Estimated common factors and idiosyncratic components are then obtained via cumulating for $t = 2, \ldots, T$ and $i = 1, \ldots, N$

$$\hat{e}_{it} = \sum_{s=2}^{t} \hat{z}_{is} \tag{4}$$

$$\widehat{F}_{it} = \sum_{s=2}^{t} \hat{f}_s \tag{5}$$

where $\hat{z}_{it} = x_{it} - \hat{\lambda}_i' \hat{f}_i$ are estimated residuals. Bai and Ng (2004) show that estimated factors and idiosyncratic components are consistent, in particular $T^{-1/2}\hat{e}_{it} = T^{-1/2}e_{it} + o_p(1)$ and $T^{-1/2}\widehat{F}_t = T^{-1/2}HF_t + o_p(1)$, where H is a full rank matrix. This rate of convergence is fast enough to leave the asymptotic distribution of the ADF-test unchan ged, if applied to estimated series $\widehat{F}_t$ and $\hat{e}_{it}$. So we can apply the univariate ADF-test as well as pooled unit root tests to estimated factors and idiosyncratic components respectively. In case of estimated factors we allow for a constant in a test regression and test without any deterministic terms in the panel case of idiosyncratic components.

Another important issue is determining the number of factors in PANIC framework. Bai and Ng (2002) suggest some information criteria, in particular IC_{p1}, IC_{p2} and IC_{p3}, to determine the number of factors. However, in our case there is no closed minima of the criteria or they choose too many factors compared to our sample size. For this reason we employ another criteria suggested by Bai and Ng (2002), BIC_3, that lead to more plausible results. But also the use of BIC_3 becomes problematic because its value is dependent on some maximal number of factors, as one can see below:

$$BIC_3(k) = V(k, \widehat{F}^k) + k\hat{\sigma}^2 \left(\frac{(N+T-k)\ln(NT)}{NT} \right) \tag{6}$$

where $V(k, \widehat{F}^k) = N^{-1}\sum_{i=1}^{N} \hat{\sigma}_i^2$ is the mean of all estimated variances of idiosyncratic components and $\hat{\sigma}^2$ can be approximated by $V(kmax, \widehat{F}^{kmax})$. Determination of k in dependence on $kmax$ turns out to be a quite complicated issue and considering some values of $kmax$, we decide to use $k = 2$ for our four panels - Germany, European Union, US States and US Census Regions.

Estimation results for all four panels can be seen in figures 3, 4, 5 and 6. In case of Germany we obtain one factor that has clearly non-stationary patterns and on the other hand estimated idiosyncratic components look stationary, see figure 3. Unlike the first picture, there are no clear differences in patterns of European factors and idiosyncratic components, see figure 4. Finally, figures 5 and 6 reveals different patterns between US factors and idiosyncratic components, where the two estimated factors appear to be non-stationary.

Insert figure 3, 4, 5, and 6 about here.

The visual impression is confirmed by unit root tests. In tables 5 and 6 we see the results of ADF tests on estimated common factors. The tests were performed with EViews 5 by employing the Schwarz (SIC) and modified Schwarz information criteria (MSIC) to determine the lag length. The null of unit root is not rejected for Germany in case of the first factor and is rejected in case of the second one. The test results for the EU 12 reveal rejection of the null for the first factor and mixed evidence for the second factor. Finally, in the US case the first factor turns out to be non-stationary and the null is rejected in the case of the second factor. However, the small sample size in the US case makes the reliability of non-panel unit root tests highly questionable.

Furthermore, we perform panel unit root tests for estimated panels of idiosyncratic components. Two type of tests are calculated: under assumption of a common unit root process suggested by Levin et al. (2002) as well as by Breitung (2000), and under assumption of individual unit root processes proposed by Maddala and Wu (1999) employing a Fisher-type procedure of combining p-values, see tables 7 and 8 respectively. In all cases we employ SIC as well as MSIC to select the lag length and Andrews bandwidth selection with quadratic spectral kernel to estimate the long run variances. In almost all cases we reject the null of panel unit root. The only exceptions are the Breitung (2000) test with lag length selected accordingly to MSIC on US Census idiosyncratic components and also Phillips-Perron test in the same case. So on the basis of the test results we consider all panels of idiosyncratic components as stationary processes.

Combining our PANIC test evidence with a visual inspection of estimated factors and idiosyncratic components we conclude that there are a lot of similarities between panels of German *Länder*, US States and US Census Regions. Firstly, in both cases we get at least one non-stationary common factor and stationary idiosyncratic components. Secondly, if we consider the loadings of this first factor ($\lambda_{1i},\ i = 1, \dots, N$, see (2)), we observe that they reveal not a lot of variation and always posses the same sign. On the other hand, in the European case many individual idiosyncratic components seem not to be very different from the common factor itself in terms of variance and also their individual course. It can be also seen if we consider fractions of the total variation in the data explained by individual factors, see table 2. The fraction of the first factor in the European case is quite small, compared to the results for Germany and the US, and it is almost equal to the fraction of the second factor. Moreover, the individual loadings of the first common factor are very different in the case of EU 12. They clearly appear to form clusters. In particular, there are some countries with relatively large positive loadings and on the other hand units with negative loadings. Last but not least, we can see differences in the persistence of idiosyncratic components.

Figure 7 shows cross sectional means of estimated ACFs of the idiosyncratic components. There is much more persistence in the parts of ULC dynamics unexplained by common factors than in the US or Germany.

Insert figure 7 about here.

2.2 Convergence clubs in ULC growth?

The new growth theory allows for the possibility, that countries may not converge to the same level of per capita GDP, productivity or prices but instead sub-groups may form convergence clubs. Hobijn and Franses (2000) propose an algorithm for the identification of convergence clubs based on multivariate stationarity tests. The procedure has recently been applied to regional EMU inflation rates (Busetti et al., 2006). Applying the algorithm using a version of stationarity test which does not allow for an intercept is equivalent to identifying clusters around the same mean (Busetti et al., 2006, p. 15). The procedures has the nice feature that it is independent of the ordering of the series. It is however, not invariant to the number of series in that sense that including additional series may change the composition of clusters.

The clustering algorithm (Hobijn and Franses, 2000, Busetti et al., 2006) is applied to a panel of all possible bivariate differentials in ULC growth rates and can be described as follows:[3]

1. Denote k_i as a set of indices of variables in cluster i, $i \leq n^*$, where $n \leq n^*$ denotes the number of clusters. Define p^* as a significance level for the inclusion of a series in the cluster. Proceed with the following steps.
2. Initialize $k_i = \{i\}$, $i = 1, \ldots, n = n^*$ so that each country/ variable is a cluster.
3. For all $i, j \leq n^*$, such that $i < j$ perform a test whether $k_i \cup k_j$ form a cluster according to the criterion of a multivariate stationarity test on the contrast (here: by means of a multivariate version of the Kwiatkowski et al. (1992) test) and let $p^{i,j}$ the resulting p-value of the test. Decide: If $p^{i,j} > p^*$ for all i, j then go to the end of the procedure.

[3]The programs for this exercise are available on Bart Hobijn's homepage. We thank Bart Hobijn for helpful comments.

4. Replace cluster k_i by $k_i \cup k_j$ and drop k_j, where i, j correspond to the most likely cluster (maximum p-value of the previous step); replace the number of clusters by $n^* - 1$ and go one step back.

5. The resulting n^* clusters are labeled "convergence clubs" (convergence to a common mean))

6. The procedure proceeds in testing for relative convergence (convergence to a stationary distance) by applying the same procedure with different p-values.

Due to comptutational errors – probably due to the fact, that the cross-sectional dimension is much larger in this case than the time dimension – we were not able to conduct the test for the US states, however, we applied the procedure succesfully for the US census regions. For all tests, we applied a p-value of 0.01 and a bandwidth of 4 for the Bartlett window used to perform the Kwiatkowski et al. (1992) test. The results are however robust with regard to the choice of p-value.[4]

The tables 3 and 4 summarize the result.

Insert table 3 and table 4 about here.

There is evidence for 2, respective 3 clusters in the United States, 3 clusters in Germany and 2 cluster in EU 12. There is furthermore no difference between the results for absolute and relative clustering with the exception of the US census regions.[5] We can learn two things from the exercise: First, even in established currency regions we can find evidence for convergence clustering and the existence of stable clusters does not *per se* hinder the functioning of a currency area. The differences between ULC growth rates are, however, much smaller for the United States and Germany than within the EU 12 (table 1).

Insert table 1 about here.

The differences among the clusters in EU 12 on the one hand and the clusters in Germany and the United States are clearly more pronounced – as shown in the respective figures 8 to 10.

[4] We did not experiment with the bandwidth, since the value was proposed in the paper of Hobijn and Franses (2000).

[5] This can be interpreted as evidence for absolute convergence clusters, because each of them is a relative convergence cluster with a stationary distance of zero as well.

Insert figures 8, 9, and 10 about here.

Second, the clusters in EMU confirms the finding that historically there was a “hard currency” block – lead by Germany – where countries like Austria or Netherlands were anchored too and a “soft currency” block (mainly all other countries). Quite astonishing is the finding that Spain is counted as a member of the “hard currency” club. However, looking at the data reveals that Spain for long periods “overshot” the criterion for being a member in the “good boys club” in terms of more inflationary policy, a strategy which was however from time to time interrupted by sharp (nominal) devaluations. Seen over a long period, this is in line with the hypothesis of absolute convergence. It might create a problem however if the mechanisms of (nominal) devaluation are not available anymore and the real exchange rate has to adjust by differences in inflation rates only.

3 Summary

Our analysis of ULC growth dynamics in selected countries/ regions points to the existence of one non-stationary common factor for the United States (States and Census regions) and Germany. The idiosyncratic components in all currency areas are found to be stationary. This is in line with the hypothesis of β-convergence around common factors (which could e.g. be associated by country-wide factors like supply or demand shocks like oil price hikes or monetary policy actions). For the Euro area, however, it is quite difficult to identify common factors – idiosyncratic factors dominate in explaining the bulk of variance – and clustering seems to be present. It cannot be rejected that idiosyncratic factors in the Euro area are stationary, however the persistence is much stronger than in other currency areas – which points to long-lasting adjustment processes. There is little sign of change in that respect in the second half of the sample. The case for convergence clusters is confirmed when using the procedure as in Hobijn and Franses (2000) for all currency areas. The differences between individual ULC growth rates are, however, much smaller for the United States and Germany than within the EU 12 (table 1).

Due to a lack of evidence after the introduction of the Euro and given the existence of long-lasting adjustment processes, we can only informally test for structural change. However, preliminary stability investigations as well as a visual inspection of the factor decomposition analysis results gives rise to serious concern for the Euro area. The behaviour of idiosyncratic components does not seem to have changed and shows strong persistence. The same is true when looking at the cluster procedure results – there is still evidence for inflation clubs in the EMU (12). This finding is in line with the findings of Busetti et al. (2006).

This has clear implications for the conduct of economic policy within the Euro area. The lasting evidence for persistent inflation differentials calls for re-organization of macroeconomic policy at a European level – e.g. newly designed fiscal transfer mechanisms or wage policy coordination (Fritsche et al., 2005)– or for increased labor mobility and productivity adjustment (Belke and Gros, 2006, Blanchard, 2006). Both solution have their own advantages and drawbacks – which goes beyond the scope of this paper.

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Appendix

Data

The data refer to nominal unit labor costs, defined as the ratio of a nominal compensation of employees numbers to the respective real gross domestic - or gross state - product numbers.[6] All data are annual data – however the available time span differs a lot. The longest available data set covers the EMU countries. The data (1960 to 2007 as we included the commissions forecast as two extra data points) are directly available from the AMECO data base of the EU commission. [7]

For Germany, the numbers were calculated using the data from the website of the Länder's network for economic statistics ("Arbeitskreis VGR der Länder").[8] Unit labour costs have been computed by dividing the (nominal) compensation for employees by the real gross regional product for each of the 11 Länder. The SNA classification was changed quite recently in Germany and the backward calculated numbers cover the time span from 1970 to 2004 only. As the data for the old federal republic is only available until 1990, and from 1991 only data for all of Germany is provided, the pan-German unit labour cost index is calculated from the old Länder data until 1990 and from pan-German data from 1991 onwards.

For the United States, the necessary data on gross state products and total compensation of employees has been taken from the Bureau of Economic Analysis' database on regional and state GSP. [9] The change from the SIC industrial classification to the NAICS classification in 1997 has created however a slight problem: As data on employees' compensations has not been published for the first years after the statistical change and have only been resumed in 2001, the time series can only be constructed from 1977 to 1997.

[6]We thank Sebastian Dullien for making his data available.

[7]Please follow the link.

[8]Please follow the link.

[9]Please follow the link.

Figures and Tables

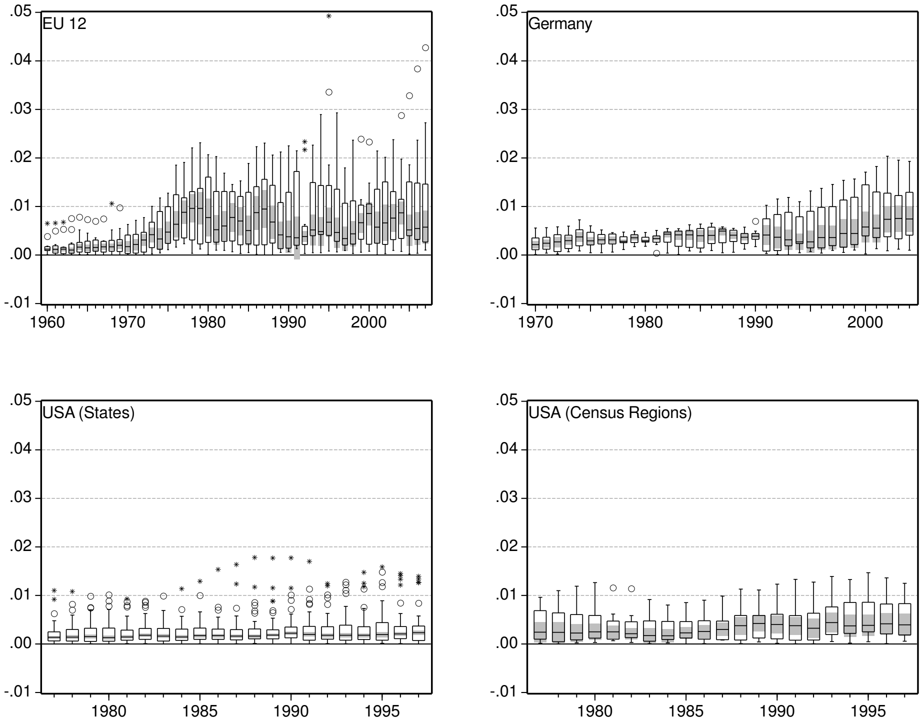

Figure 1: Weighted ULC growth variability: Box-Plots

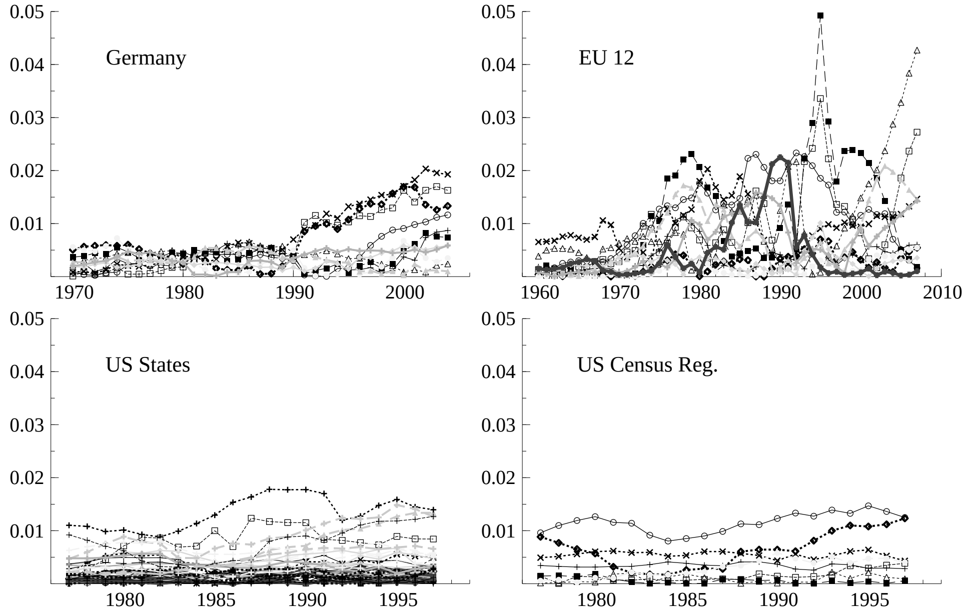

Figure 2: Weighted ULC growth variability: inividual s_j

EU 12 before 1998	0.070
EU 12 after 1998	0.023
Germany	0.014
United States	0.010

Table 1: Average S.E. in panels of inflation differentials

	Factor 1	Factor 2
Germany	0.654	0.098
EU 12	0.227	0.211
US States	0.410	0.108
US Census Reg.	0.739	0.123

Table 2: Fractions of the total variation in the differenced data explained by individual common factors.

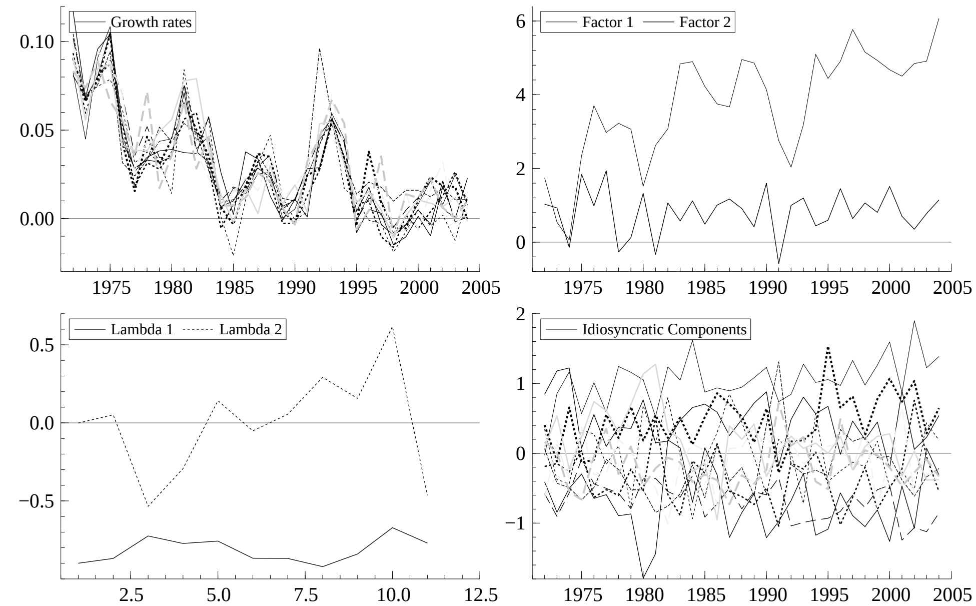

Figure 3: Observed ULC growth rates, estimated factors, loadings and idiosyncratic components for German *Länder*.

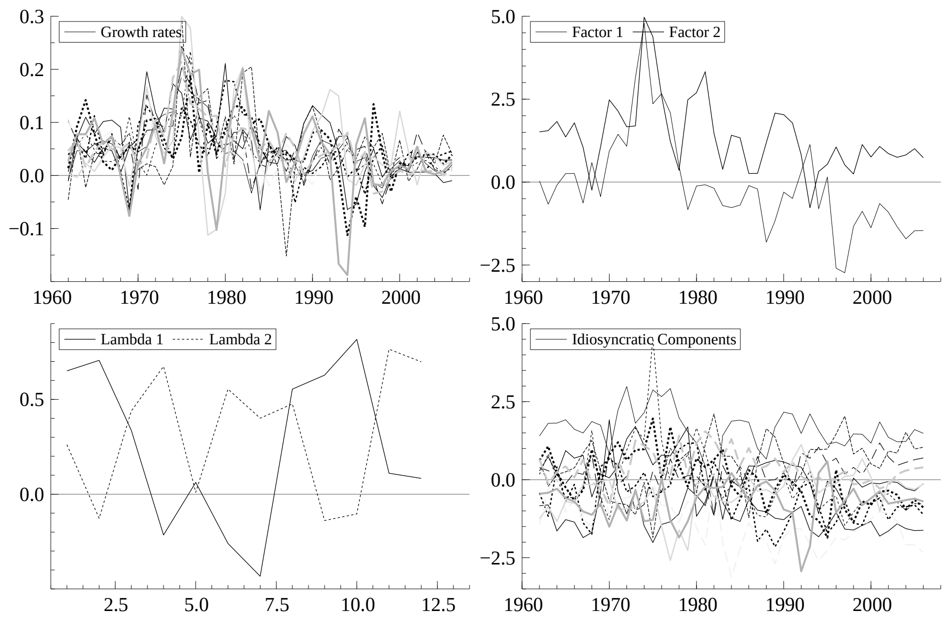

Figure 4: Observed ULC growth rates, estimated factors, loadings and idiosyncratic components for the European Union.

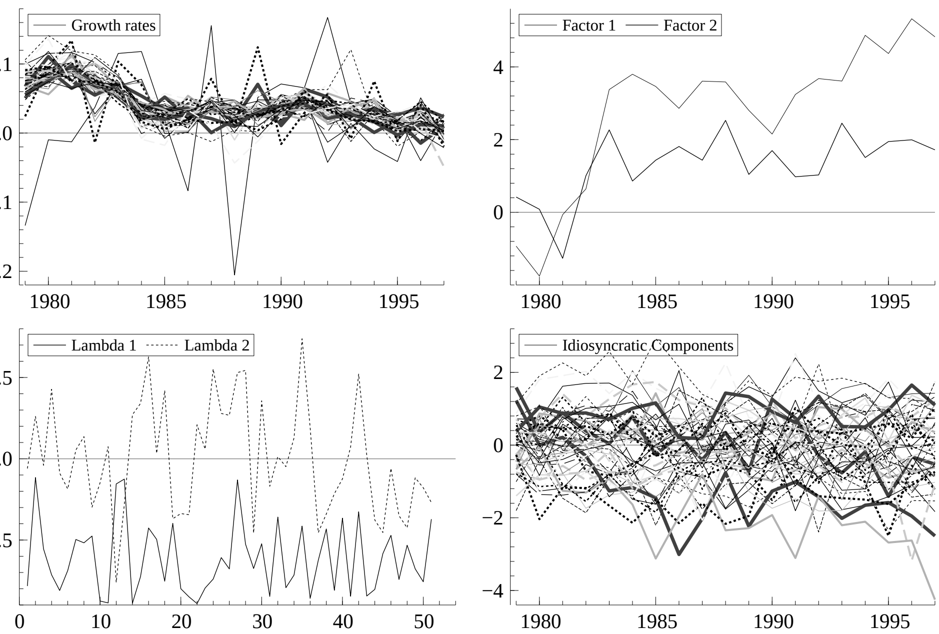

Figure 5: Observed ULC growth rates, estimated factors, loadings and idiosyncratic components for US States.

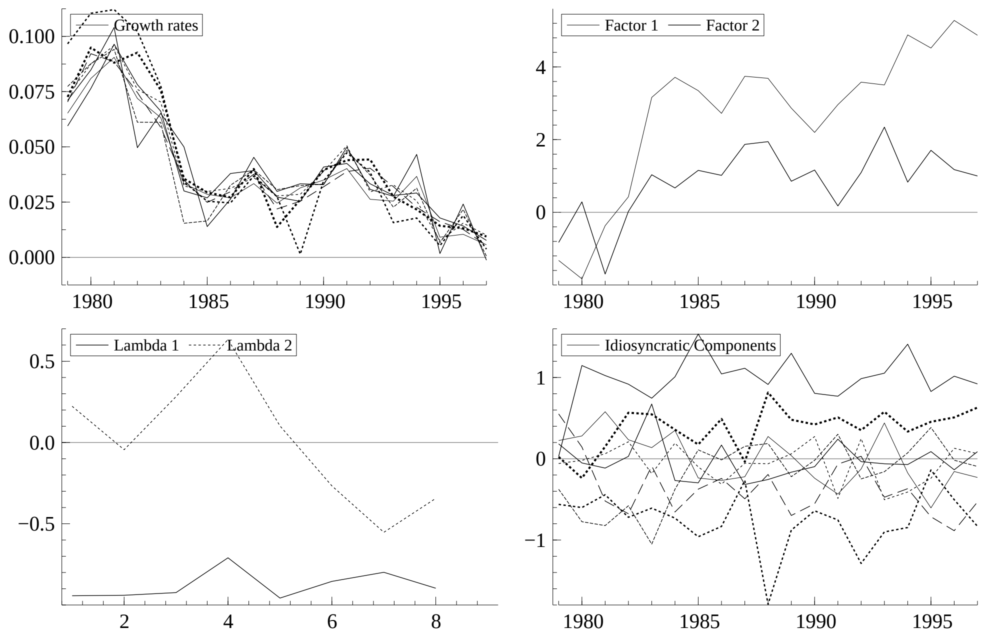

Figure 6: Observed ULC growth rates, estimated factors, loadings and idiosyncratic components for US census regions.

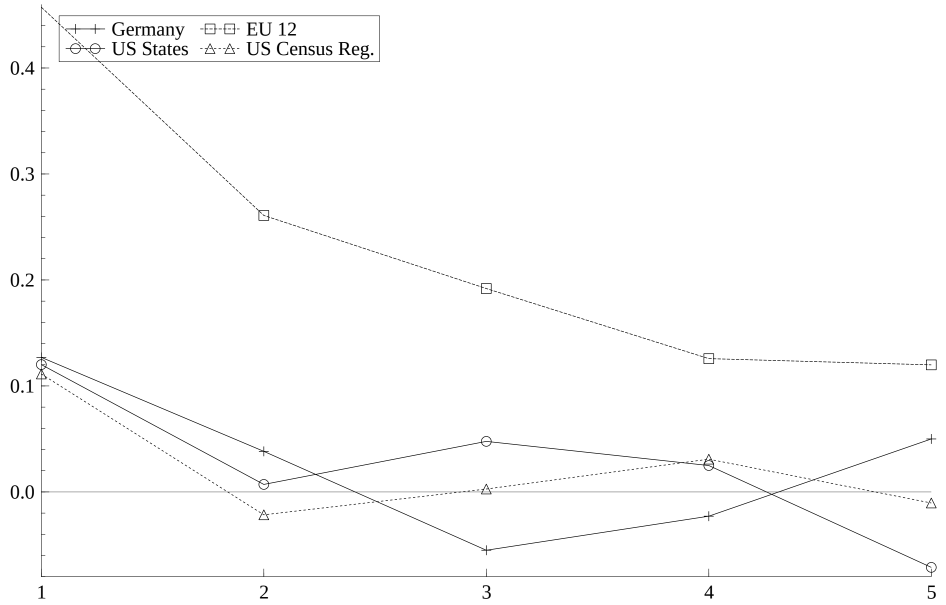

Figure 7: Cross sectional means of estimated autocorrelation functions of idiosyncratic components up to the fifth lag.

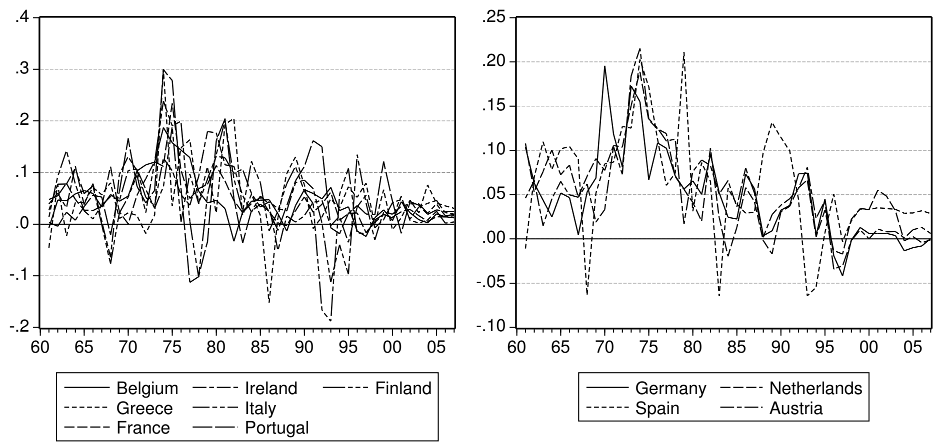

Figure 8: Absolute convergence clusters: EU 12

Region	No. of clusters	Cluster 1	Cluster 2	Cluster 3
Euro area	2	Belgium	Germany	
		Greece	Spain	
		France	Luxembourg	
		Ireland	Netherlands	
		Italy	Austria	
		Portugal		
		Finland		
Germany	3	Baden-Wuerttembg.	Berlin	Hamburg
		Bavaria	North Rh.-Westphalia	Hesse
		Bremen	Rh.-Palatinate	
		Lower Saxony		
		Saarland		
		Schleswig-Holstein		
US (regions)	3	Plains	South East	Great Lakes
		Middle East	South West	New England
		Far West	Rocky Mountains	

Table 3: Result of Hobijn and Franses (2000) cluster procedure: test for absolute convergence

Region	No. of clusters	Cluster 1	Cluster 2	Cluster 3
Euro area	2	Belgium	Germany	
		Greece	Spain	
		France	Luxembourg	
		Ireland	Netherlands	
		Italy	Austria	
		Portugal		
		Finland		
Germany	3	Baden-Wuerttembg.	Berlin	Hamburg
		Bavaria	North Rh.-Westphalia	Hesse
		Bremen	Rh.-Palatinate	
		Lower Saxony		
		Saarland		
		Schleswig-Holstein		
US (regions)	2	Plains	South East	
		Middle East	South West	
		Far West	Rocky Mountains	
		Great Lakes		
		New England		

Table 4: Result of Hobijn and Franses (2000) cluster procedure: test for relative convergence

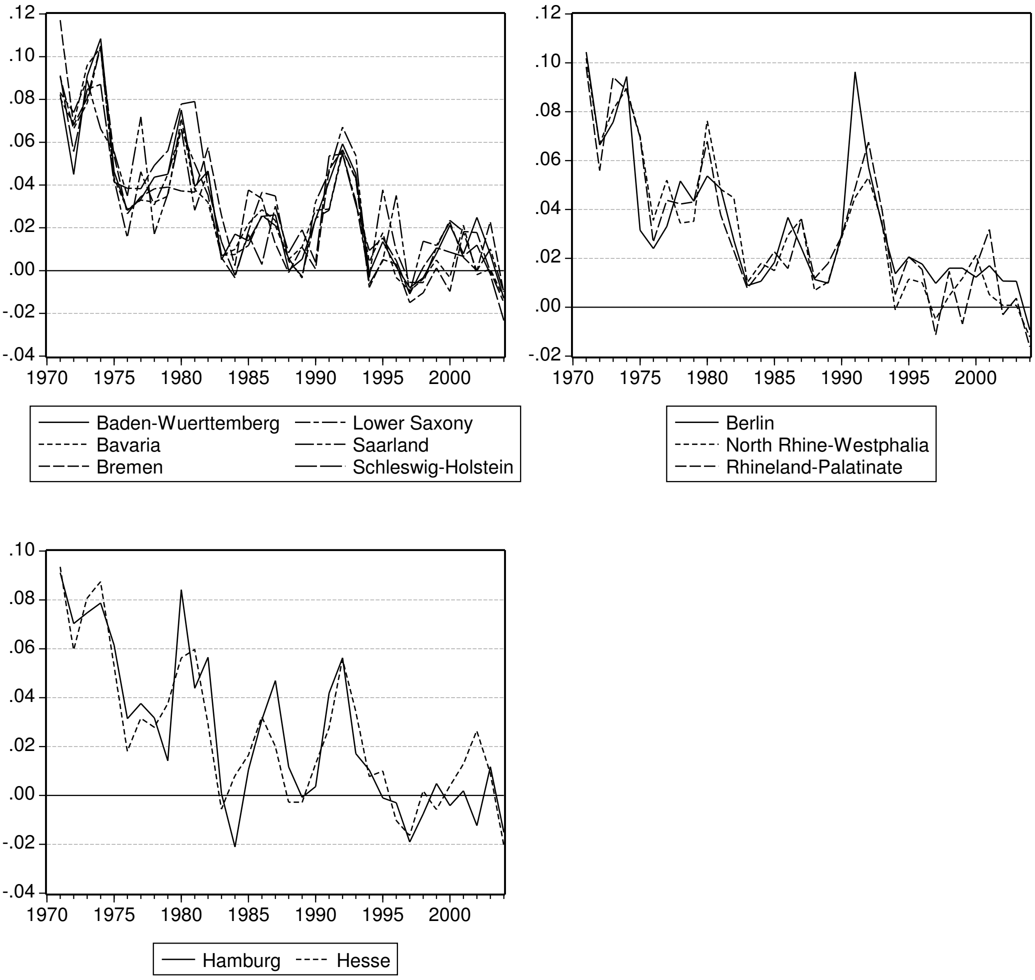

Figure 9: Absolute convergence clusters: Germany

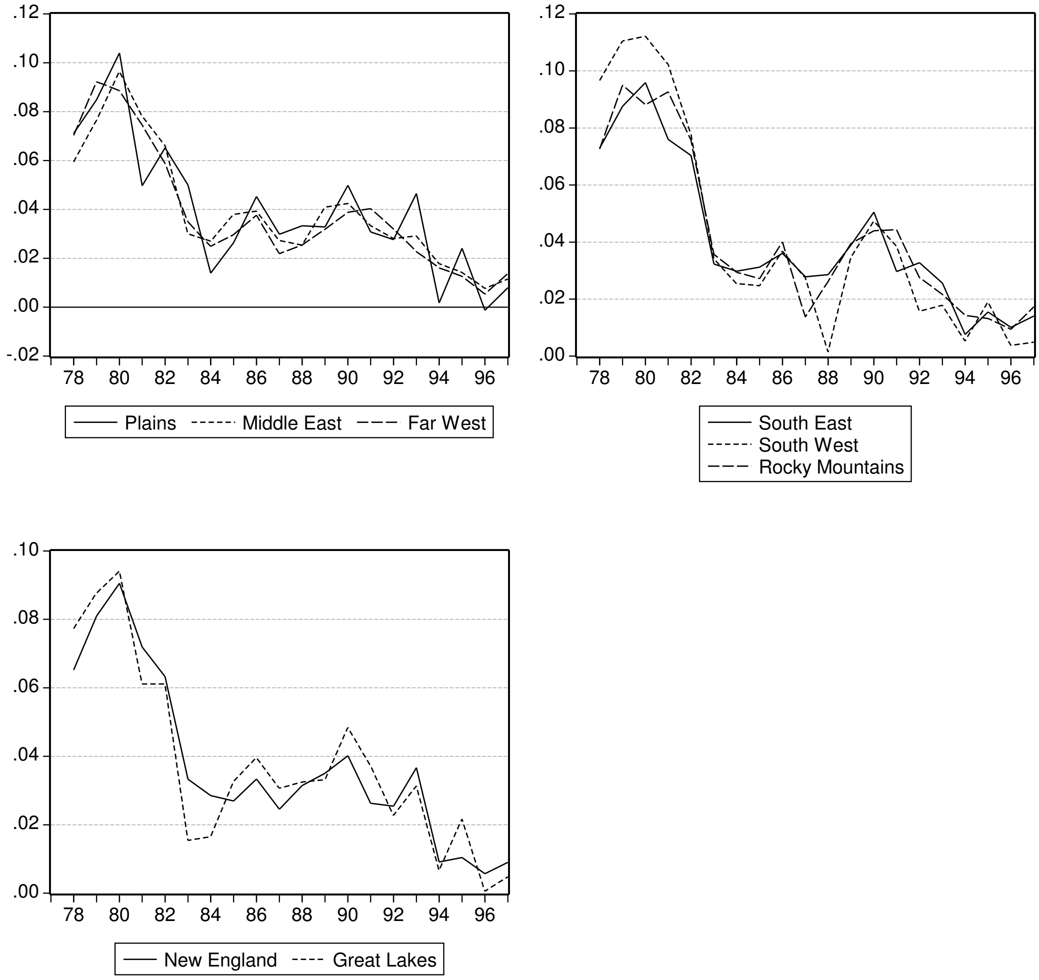

Figure 10: Absolute convergence clusters: United States (Census regions)

	SIC			MSIC		
	ADF	p	p_{max}	ADF	p	p_{max}
Germany	-1.88 (0.34)	0	8	-1.88 (0.34)	0	8
EU 12	-2.35 (0.16)	0	9	-2.35 (0.16)	0	9
US States	-1.80 (0.37)	0	3	-1.80 (0.37)	0	3
US Census Reg.	-1.86 (0.34)	0	3	-1.86 (0.34)	0	3

Table 5: ADF test result for the first estimated common factor, performed in EViews 5.0 with MacKinnon (1996) critical values. SIC and Modified SIC are used to determine lag length of test regressions, p and p_{max} denote the chosen and maximal lag lengths, p-values are in brackets.

	SIC			MSIC		
	ADF	p	p_{max}	ADF	p	p_{max}
Germany	-8.39 (0.00)	0	8	-3.05 (0.04)	3	8
EU 12	-3.34 (0.02)	0	9	-1.62 (0.46)	4	9
US States	-2.91 (0.06)	0	3	-2.91 (0.06)	0	3
US Census Reg.	-3.08 (0.05)	0	3	-3.28 (0.03)	2	3

Table 6: ADF test result for the second estimated common factor, see Table 5 for further comments.

	SIC		MSIC	
	LLC	Breitung	LLC	Breitung
Germany	-4.45 (0.00)	-4.43 (0.00)	-2.99 (0.00)	-1.85 (0.03)
EU 12	-3.40 (0.00)	-4.70 (0.00)	-3.94 (0.00)	-3.91 (0.00)
US States	-7.74 (0.00)	-6.83 (0.00)	-5.10 (0.00)	-4.89 (0.03)
US Census Reg.	-3.41 (0.00)	-1.84 (0.03)	-2.20 (0.01)	-0.89 (0.19)

Table 7: Results of panel unit root tests assuming a common unit root process, no deterministic is included, LLC denotes Levin, Lin and Chu test, Breitung denotes Breitung t-statistic, maximal lag length is set automatically by EViews 5.0, all tests assume asymptotic normality, p-values are in brackets.

	SIC	MSIC	
	ADF	ADF	PP
Germany	-4.45 (0.00)	-2.99 (0.00)	-1.85 (0.03)
EU 12	-3.40 (0.00)	-3.94 (0.00)	-3.91 (0.00)
US States	-7.74 (0.00)	-5.10 (0.00)	-4.89 (0.03)
US Census Reg.	-3.41 (0.00)	-2.20 (0.01)	-0.89 (0.19)

Table 8: Results of panel unit root tests assuming individual unit root processes, no deterministic is included, ADF and PP denote Fisher tests using individual ADF and PP tests, maximal lag length is set automatically by EViews 5.0, Andrews bandwidth selection using Quadratic Spectral kernel is employed, probabilities are computed using an asymptotic Chi-square distribution, p-values are in brackets.

Identifier	EMU	Germany	US Census Regions
1	Belgium	Baden-Wuerttembg.	New England
2	Germany	Bavaria	Middle East
3	Greece	Berlin	Great Lakes
4	Spain	Bremen	Plains
5	France	Hamburg	South East
6	Ireland	Hesse	South West
7	Italy	Lower Saxony	Rocky Montains
8	Luxembourg	North Rh.-Westphalia	Far West
9	Netherlands	Rh.-Palatinate	
10	Austria	Saarland	
11	Portugal	Schleswig-Holstein	
12	Finland		

Table 9: Country/ Region identifiers used in figures