Has mobility decreased? Reassessing regional labour market adjustments in Europe and the US

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1. INTRODUCTION

The economic turmoil that resulted from the financial and sovereign debt crises has increased heterogeneity in European labour markets. In 2012, the unemployment rate in Spain, for example, rose to 25%, but it dropped to nearly 5% in Germany. Crucially, heterogeneity is large not only between countries but also within. In France, Belgium and Spain the highest regional unemployment rates were twice as high as the lowest. In Italy, as an extreme example, the unemployment rate in Veneto was just a third of the unemployment rates in Campania or Sardinia. Moreover, this regional heterogeneity has increased since 2008 (see Marelli, Patuelli, and Signorelli, 2012).

This development raises the question of how regional labour markets adjust to diverse macroeconomic developments and whether the role of labour mobility has changed. Interstate migration in the US, for example, is at its lowest value since World War II

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(Frey, 2009). Migration between European countries, on the other hand, has increased (Beine et al., 2013).

Migration has entered the European public debate because it can cushion the negative impact of adverse labour demand shocks on unemployment. This is particularly important within a monetary union, in which relative wage adjustments may be slow due to the absence of the nominal exchange rate instrument. The European Union acknowledges the power of labour migration to reduce unemployment, increase growth and counteract heterogeneous macroeconomic developments. In April 2013 the Commission adopted a proposal for a directive on new measures to facilitate mobility. In June 2013 EU leaders at a European Council meeting agreed on measures to fight youth unemployment aiming also at increasing the mobility of young workers. While migration from the crisis countries (Spain, Portugal, Italy and Greece) has increased – net migration between Germany and the crisis countries, for example, has risen from minus 10.000 in 2009 to 70.000 in 2012 – adjustment through labour migration is overall still weak.

In this paper we apply the methodology of Blanchard and Katz (1992) to study the regional labour market adjustment mechanism in Europe and the United States, which also allows us to analyse labour migration. We basically update and refine the comparison of European and US regions in Decressin and Fatás (1995). There are a number of reasons why such an update is useful. First, we analyse a much longer sample (36 years rather than 13 years in Decressin and Fatás (1995)). This allows us to increase the robustness of the empirical findings and to investigate possible changes in the adjustment process over time. Second, in contrast to Decressin and Fatás (1995), we use similar data sources for the US and Europe, which is likely to increase the comparability of the results. Finally, and in line with Greenaway-McGrevy and Hood (2013), we apply a factor analysis to separate the regional labour market response to region-specific shocks and to heterogeneous reactions to aggregate shocks. Since migration and job churnings vary with the business cycle (Saks and Wozniak 2011) the two adjustments can be expected to differ. We impose a structure on the factor model and introduce global, continental and country/area factors. The introduction of country factors is crucial to filter out countries effects in Europe. Moreover, we also analyse the adjustment of countries to national shocks. The latter is more likely to be hampered by bigger cultural, language and institutional differences. Note that our paper neither explains permanent differences between regions or countries, for example different average unemployment rates, nor steady migration flows, for example from Southern to Northern Italy.

First, we find that by allowing for global, continental and country effects the regional labour market adjustment to region-specific shocks is very fast and job creation (destruction) is relatively more important than has previously been argued; in fact, less than half of the initial employment change becomes permanent due to migration in Europe and the US. Second, we find that the regional adjustment to heterogeneous reactions to common shocks is very different since much more persistent and driven by considerably higher migration. Third, we find that both processes are not fundamentally different on both continents, but in line with common wisdom mobility is somewhat higher in the US. Fourth, the role of migration has decreased over the past 35 years and equally so in Europe and the US. Finally, the labour market adjustment process across countries (to country-specific shocks) is more persistent and the role of migration less important than across regions (to region-specific shocks).

In the rest of the paper, we first briefly review the relevant literature in Section 2. Section 3 then presents the Blanchard-Katz methodology and our modifications and may be skipped by readers only interested in the results. The data are presented and discussed in Section 4 and Section 5 contains the main empirical analysis. Section 6 contains some robustness checks that are not relevant for our main message and, finally, Section 7 outlines some policy implications.

2. LITERATURE

The importance of labour migration in facilitating adjustment to asymmetric shocks in a monetary union has been recognised at least since the seminal research on optimal currency areas of Mundell (1961). The empirical analysis of migration has, however, been hampered by the lack of reliable data. Recently an increasing number of papers have started to analyse migration patterns directly. Molloy, Smith and Wozniak (2011) analyse changes in the US over the last 30 years and detect a widespread decline in movements across all distances and across all population sub-groups. Frey (2009) shows that in 2007 migration rates in the US reached their lowest value since World War II and that the decline was strongest for interstate migration. Reasons for the decline in mobility remain, however, unclear. Likely reasons include an increasing share of women in the labour force and increasing homeownership rates.[1]

Beine et al. (2013) with a new dataset containing 30 countries and covering the period 1980-2010 come to contrary conclusions regarding migration in Europe. They claim that both the Schengen agreements and the introduction of the Euro have increased migration between the member countries. Also Molloy, Smith and Wozniak (2011) suspect the decline in migration to be US specific. However, migration between countries covers only a small part of all movements. In Germany, for example, in 2012 around 600.000 people moved from Germany to another country, but more than one million moved within Germany from one state to another.

Due to a lack of reliable data to analyse labour mobility directly, a large part of the literature has pursued the indirect approach proposed by Blanchard and Katz (1992). In their seminal paper on regional evolutions they develop a small model of regional labour markets (in the following: BK model) and suggest estimating the joint behaviour of the employment growth, the employment rate and the participations rate to analyse regional labour market adjustments to regional labour demand shocks. The respective reduced-form vector autoregression model (VAR) that they derive from their theoretical model

[1] The recent decline in migration may be somewhat overestimated (Kaplan and Schulhofer-Wohl, 2012). Earlier papers detecting a decline include Greenwood (1997) and Long (1988). Glaesser and Tobio (2007) discuss the role played by very long-term adjustment processes over many centuries that may have been concluded. Also demographics and an aging of the population may matter. Dao, Furceri and Loungani (2014) point to a decreasing dispersion of regional labour markets.

offers an indirect approach to study migration because all employment changes unexplained by either the participation or the employment rate must originate from a change in working-age population, which is identified with migration. Applying the methodology to US states, Blanchard and Katz (1992) find that migration already plays a predominant role in the first year of the adjustment process after a shock to regional labour demand. Decressin and Fatás (1995) analyse large Western European regions and compare them to US states and find that in Europe the participation rate is the major force driving adjustment. Obstfeld and Peri (1998) analyse how regions in the US, Canada, the UK, Germany and Italy react to asymmetric labour demand shocks and show, first, that regional real exchange rates play a minor role in the regional adjustment process and, second, that the US adjustment process is the fastest due to the highest labour mobility. The methodology of Blanchard and Katz (1992) has been applied in many other studies and has become the standard model to analyse regional labour market adjustment mechanisms and to approach migration patterns indirectly. Greenaway-McGrevy and Hood (2013) apply the model to metropolitan statistical areas (MSAs) in the US and find that the adjustment to location-specific and heterogeneous reactions to aggregate shocks differ considerably. Our paper shares their main modification, namely the use of a factor structure to separate region-specific from common shocks. Dao, Furceri and Loungani (2014) reassess the adjustment of US states and find that the contribution of migration has decreased since 1980 and link it to declining trend in state dispersion of unemployment rates. In addition, they show that migration contributes more in aggregate downturns and sketch some differences between the US and Europe. We will comment on the latter point in detail later.[2]

3. METHODOLOGY

Starting from the observation that region-specific labour demand shocks have permanent effects on employment, but only temporary effects on the employment rate, the participation rate and wages, Blanchard and Katz (1992) develop their simple model of regional labour market dynamics that is based on two basic features. First, regions are assumed to produce distinct bundles of goods that are sold in an aggregate goods market and, second, labour and capital are assumed to be perfectly mobile in the long run. In this model, state-specific shocks to labour demand result in short-lived mean deviations of wages, but cause permanent changes of the employment level. Lost jobs after an adverse demand shock, for example, are not fully recovered because workers move out of the region until wages are back to equilibrium. Similarly, when region-specific labour demand increases, relative wages tend to increase. On the one hand, this leads some firms to reduce their employment and possibly to move at least part of their production outside of the region, which reduces labour demand. On the other hand, higher wages

[2] Numerous other papers relied on the BK model: Jimeno and Bentotila (1998) adapt the methodology to study Spanish regions; Fredriksson (1999) looks at Swedish regions; Fidrmuc (2004), Gács and Huber (2005), Bornhorst and Commander (2006) focus on regions in Central and Eastern Europe, and Tani (2003) suggests that migration in Europe is higher than expected.

attract inward migration that increases labour supply. The relative sensitivities of labour demand and labour supply determine how large the permanent effect of the labour demand shock on regional employment is. In the short run, changes in the unemployment and the participation rate take up part of the adjustment.

In order to implement this model empirically and in the absence of reliable regional wage data, Blanchard and Katz (1992) propose to estimate the joint behaviour of the employment growth, the employment rate and the participation rate. The short and long run adjustment of the regional labour market can then be analysed by tracing out the impact of a shock to the employment growth equation. The identifying assumption is that this shock captures unexpected changes in regional labour demand[3]. The following short-run restrictions follow naturally from the identification: current changes in employment affect both employment and participation rates but not *vice versa*. With these three variables, one can, as mentioned, distil the response of working-age population, since any change in the employment level that is not explained by changes in the employment rate or the participation rates must be explained by changes in working-age population. Following Blanchard and Katz (1992), we will assume that such changes are due to migration.

Our implementation of the VAR in these three variables proceeds in two steps. In the first step, we estimate aggregate fluctuations as common factors. In the second step, we add either these factors or their residuals, i.e. the idiosyncratic regional movements, as exogenous regressors in the VAR. When we condition on the common factors, the reaction of regions to aggregate shocks is filtered out, so that the impulse response shows the adjustment to region-specific shocks. When instead we condition on the residuals, the idiosyncratic movements are filtered out, so that the impulse response shows the adjustment to common shocks.

Blanchard and Katz (1992) cannot separate the two mechanisms. They compute regional relative (in contrast to region-specific) variables as simple differences between the regional variables and their aggregate counterpart. Basically this means that they condition each of the variables on one common factor and restrict the loading on that factor to be equal to one.[4] Only if all regions responded identically to aggregate fluctuations, they would estimate the adjustment to region-specific shocks. We regress the variables on their aggregate counterpart and can reject a unity coefficient in many regions both in Europe and the US, confirming that regions react heterogeneously to aggregate business cycles (see also Hamilton and Owyang 2012). In addition to region-specific shocks also different responses to common shocks disperse regions and thus necessitate adjustment. Because migration slows in recessions its contribution shortly

[3] This assumption is in line with nearly all papers using this methodology. Dao, Furceri and Loungani (2014), however, test the assumption and conclude that identification with an instrument reveals a lower contribution of migration. We are not fully convinced that the only effect of the IV identification is a clearer demand shock. It may also change the type of the adjustment and thus overestimate the difference. For a better comparison with all other papers and given that an IV as in their paper cannot be constructed for Europe, we stick to the original assumption. Also in Dao, Furceri and Loungani (2014) the results for Europe are based on that assumption.

[4] For large cross-sections the idiosyncratic components average out so that the aggregate converges to the common factor (Forni and Reichlin 1998 and Pesaran 2006). For a large sample this is hence identical to including a common time trend. The aggregate most often refers to national variables (as in Blanchard and Katz 1992 or in Obstfeld and Peri 1998) but continental variables can also be used (as in Decressin and Fatás 1995).

after a common shock can be expected to be lower than after a region-specific shock. But common shocks, in contrast to region-specific ones, increase the dispersion of regions so that migration in the long run can be expected to be higher. Blanchard and Katz (1992) are estimating a mixture of the two adjustments. Also Dao, Furceri and Loungani (2014) do not differentiate between the two mechanisms, but by analysing differences over time they realise that the adjustment differs depending on aggregate conditions. The reason for the differences they detect is precisely that the adjustments to regional-specific and common shocks (with heterogeneous effects for regions) are different.

Also in Decressin and Fatás (1995) a unity reaction of regions to aggregate shocks is rejected for most regions. They suggest using the estimated coefficients as weights when differencing, so that regions are allowed to react with a different sign and magnitude to aggregate movements. As Blanchard and Katz (1992), they thus condition on one common factor per variable, but in contrast to them they allow for different weights. Regional relative variables computed as such β-differences are uncorrelated with aggregate variables and, if there were only one common factor per variable, would enable a separation of regional and aggregate fluctuations. There may, however, be more than one common factor per variable. In the European data set it may, for example, be important to account for common country factors. Using the ABC criterion of Alessi, Barigozzi and Capasso (2010), we find indeed strong evidence for more than one common factor per series.

In this paper we will therefore use an approximate factor structure to model labour shocks and separate regional from aggregate fluctuations. More specifically, we use a multi-level linear factor model with global factors, continent-specific factors, and country- or area-specific factors. By areas we refer to the four US areas Northeast, Midwest, West, and South. We impose a structure on the factors in order to capture the variables' pervasive covariation for the different geographical entities. Most likely each factor is explaining a different proportion of the variance in each entity, i.e. entities respond with different strength to common factors. By allowing for different loadings we of course acknowledge such heterogeneous reactions to common factors.

Since principal-components methods cannot account for a hierarchical factor structure, we estimate the factors with the quasi-maximum likelihood approach of Doz, Giannone, and Reichlin (2012). They show that maximum likelihood is suitable to estimate the common factors in large cross-sections of time series. We implement the QML estimator using the Kalman smoother and the EM algorithm.[5]

[5] Forni, Hallin, Lippi, and Reichlin (2000) and Stock and Watson (2002) propose to estimate common factors using principal components. Principal components are indeed easy to compute and consistent for any path of the cross-section and sample length (Bai and Ng 2002; Forni, Giannone, Lippi, and Reichlin, 2009). Yet, with principal components it is not possible to restrict the factor structure as we intend. Other authors working with structural factors include: Forni and Reichlin (2001); Bernanke, Boivin, and Eliasz (2005); and Boivin and Giannoni (2006). Also Kose, Otrok, and Whiteman (2003) apply a likelihood based estimator. The QML approach of Doz, Giannone, and Reichlin (2012) assumes that all series are I(0). In our case, however, some series are I(1). Principal components deliver consistent estimates also in this case (Bai and Ng 2004). We re-estimate the three global factors using principal components and the structural factors of the remaining unexplained fluctuations – that all turn out to be I(0) – with the QML approach. The factors are very similar. Doing the factor analysis in two steps underestimates the errors, because the QML estimation uses estimated data. However, in the VAR we treat the factors in any case as observations (Bai 2003, Giannone and Lenza 2009).

Different factor structures are, of course, possible. In the baseline specification, we assume that regional labour market developments are affected by three global factors, a continental factors, and a country factor in Europe and an area factor in the US (in addition to the idiosyncratic fluctuations). In Section 6, we check that our findings are robust to a different specification of the factor structure.

More concretely, let $X_{it} = [\Delta \log E_{it}, \log(E_{it}/L_{it}), \log(L_{it}/P_{it})]'$ be the vector containing the regional variables, for $i = 1, \dots, 98$, and $t = 1, \dots, 36$, where E_{it} stands for number of persons employed; L_{it} for the labour force in persons and P_{it} for the working-age population in persons, all for region (i) at time (t). In addition to an idiosyncratic part, regional variables load on LR country/area factors (f_{lr}^{ca}, one per country/area), *C* continental factors (f_c^{cont}, one per continent), and three global factors ($f^{g,1}, f^{g,2}, f^{g,3}$). Hence for observable *i*:

(1) $$X_{i,t} = i_{i,t} + L_i^{g,1} f_t^{g,1} + L_i^{g,2} f_t^{g,2} + L_i^{g,3} f_t^{g,3} + L_i^{cont} f_{c,t}^{cont} + L_i^{ca} f_{ca,t}^{ca}$$

where *c* denotes the continent number and *ca* the country/area number and L_i^j is a 1×3 vector containing the factor loadings of each series of region *i* on factor *j*. The loadings represent the sensitivity of the regional series to the different common factors. In total we estimate 14 factors, namely three global, two continental (US and EU) and nine country/area (Germany, France, Italy, Spain, UK, Northeast, Midwest, South and West). Each region, however, loads on a maximum of five factors. Since we allow for more than one global factor regions may react with a lag to these factors so that reactions may not only vary across locations but also across time. Region-specific variables from this specification are simply the idiosyncratic component $i_{i,t}$.

In the second step, we then estimate a panel VAR, pooling over potentially different subsamples:

(2) $$\Delta \log E_{it} = \varphi_{i10} + \varphi_{11}(L)\Delta \log E_{it-1} + \varphi_{12}(L) \log \frac{E_{it-1}}{L_{it-1}} + \varphi_{13}(L) \log \frac{L_{it-1}}{P_{it-1}} + \varphi_{i14}\Gamma_{it} + \varepsilon_{i\rho t}$$

(3) $$\log \frac{E_{it}}{L_{it}} = \varphi_{i20} + \varphi_{21}(L)\Delta \log E_{it} + \varphi_{22}(L) \log \frac{E_{it-1}}{L_{it-1}} + \varphi_{23}(L) \log \frac{L_{it-1}}{P_{it-1}} + \varphi_{i24}\Gamma_{it} + \varepsilon_{i\sigma t}$$

(4) $$\log \frac{L_{it}}{P_{it}} = \varphi_{i30} + \varphi_{31}(L)\Delta \log E_{it} + \varphi_{32}(L) \log \frac{E_{it-1}}{L_{it-1}} + \varphi_{33}(L) \log \frac{L_{it-1}}{P_{it-1}} + \varphi_{i34}\Gamma_{it} + \varepsilon_{i\tau t},$$

where Γ_{it} are either the estimated common factors or the idiosyncratic movements. In the first case, when we project onto the space orthogonal to the factors, we filter out common movements and estimate the reaction to a region-specific shock. In the second case we filter out the region-specific fluctuations and thus estimate the reaction to a common shock.

Strong-form dependence of the variables in the panel allows consistent identification of the factors that can hence be used in linear regressions (Bai and Ng 2006, Bai 2009, Greenaway-McGrevy and Hood 2013). Moreover, the standard estimators are consistent under fairly general conditions and under certain restrictions on the expansion rate of the cross-section and the time period they are also asymptotically normal. Given our large cross-section and modest sample length including the factors does not cause a generated regressor problem (Pagan 1984, Bernanke and Boivin 2003, Bai and Ng 2006) so that we can indeed treat them as observations (Bai 2003, Giannone and Lenza 2009). In addition, due to the long sample the potential inconsistency arising from fixed effects with lagged depended variables is very small, so that we restrict our estimations to ordinary least-squares; all of the papers applying this framework only report these results.

The region-specific constants in each equation represent regional fixed effects. They allow for different regional long-term averages of the variables and relate to drift terms present in the BK model.

4. DATA AND COMMON DISTURBANCES

4.1. Regional Disaggregation and Data Sources

The regional disaggregation follows Blanchard and Katz (1992) for the US and is similar to Decressin and Fatás (1995) for Europe. For the US, the disaggregation is straightforward: we count each state plus the District of Columbia as a region so that there is a total of 51 US regions. In Europe entities of comparable size refer less strictly to administrative divisions. Yet, all regions in the sample can be understood as consisting of one or more NUTS2-regions. We include eight French, seven German, eleven Italian, seven Spanish, and eight British regions, as well as Belgium, Denmark, Greece, Ireland, the Netherlands and Portugal. For a list of all regions see Appendix A.

The primary European data sources are the national Labour Force Surveys, but we also use data from different international and national sources and apply some data modifications to fill in missing data points and replace data of obviously bad quality. The data from different sources is linked using adjusted growth rates of the working-age population, the unemployment and the participation rates. They are then used to extend the most recent data backwards. We compared different ways to link the data and found that differences are minor.

The European Labour Force Surveys are comparable to the US Current Population Survey (CPS), which constitutes the input for the US data used for the comparative analysis. CPS data is available annually and by different demographic characteristics (sex and age). In addition, we use Local Area Unemployment Statistics (LAUS) from the Bureau of Labor Statistics as an alternative data source for investigating the US adjustment mechanism with model-based data using many different inputs. Most importantly, the employment numbers are mainly based on establishment data and thus closer to the data Blanchard and Katz (1992) used in their analysis. In addition, this data does not include part-time jobs whereas our CPS data does. LAUS data is also available monthly. For more details regarding the regional disaggregation as well as data sources and modifications refer to the data appendix.

The average regional population in the US in 2011 was 4.7 million with a standard deviation of 5.3 million leading to a coefficient of variation of 1.1. With 29 million California was the biggest region in the US and with less than half a million Wyoming was the smallest. The average regional population in Europe is very similar and equal to 4.6 million but the standard deviation is with 2.5 million smaller, resulting in a smaller coefficient of variation, 0.5. Nordrhein-Westfalen in Germany is the largest region with a population of 12 million in 2011, whereas Abruzzi-Molise in Italy is the smallest with only 1 million working-age inhabitants. The total working-age population in 2011 was 240 million in the US and 220 Million in Europe.

The average unemployment rate in an US region in 2011 was 8.2% with a standard deviation of 1.9%. In Europe the average unemployment rate was slightly higher, namely 12%, and the regions were much more heterogeneous, indicated by a standard deviation of 7%. Over the whole sample the average unemployment rate in the US was 6% and 10% in Europe.

[Insert Figure 1 here]

Figure 1 plots the means and the standard errors of the employment growth, the employment rate and the participation rate of all 98 regions. Employment growth and the employment rate are cyclical and the latter returns to its mean roughly every ten years. The participation rate, however, shows a clear upward trend, which is likely due to an increase of female labour force participation.

[Insert Figure 2 here]

Figure 2 illustrates the persistency of the original and regional relative employment growth, employment rate and participation rate. Both in Europe and the US the original variables seem permanently effected by a shock, i.e. it seems they contain a unit root. Once the aggregate US series is subtracted from the employment and participation rate, they look stationary, though still persistent. In Europe, however, the persistence of the employment rate with simple differences is only marginally lower and the one of the participation rate is nearly unaffected, once the aggregate is subtracted.

4.2. Common Labour Market Disturbances

Next we estimate the multi-level factor model (1) to extract the common factors from the data.

[Insert Table 1 here]

The squared factor loading tells us how much of the variance of the loading variable is explained by the respective factor. Table 1 reports the variance explained by the different factors for the whole sample and two subsamples, namely the European and US regions. Note, first, that overall explained variance is between 63% and 85%. The global factors explain around half of the employment growth and employment rate fluctuations and already 70% of the variation in the participation rates. Regional European employment growth and employment rates load more heavily on the global factors than the US ones. The continental factors contribute between 5% and 10% both in Europe and the US and are more or less equally important for all variables. The country and area factors matter above all for employment growth and explain 12% of the fluctuations in Europe and 18% in the US. In Europe the proposed factor structure captures more variance than in the US.

[Insert Figure 3 here]

Figure 3 visualises exemplarily the consequences of the different ways of filtering out the response to common shocks. It shows the unemployment rates in Europe, Spain, and Centro (which is a region in Spain), as well as the Centro's regional relative unemployment rate computed using simple differences and Centro's region-specific unemployment rate using the factor augmented approach. Note that the increase of the unemployment rate in Centro in the early nineties was not specific to that region but shared among all Spanish regions and thus a Spanish phenomenon and the same is true for the decrease in the following years. Simple differences do not recognise and account for national developments, but our specification does. Also, after the outbreak of the financial crisis unemployment rates increased strongly in Spain and they also increased in Centro, though to a lesser extent. The region-specific unemployment rate in Centro increased if computed as simple differences (it increased stronger in Centro than in Europe) but decreased with our specification (while it increased stronger than in Europe, it increased much weaker than in the rest of Spain).

[Insert Figure 4 here]

As mentioned the BK model guiding the specification and interpretation of the analysis postulates a stationary region-specific employment growth, employment rate and participation rate. In Figure 4 we add to the autoregressive processes of the original labour market variables and the differences relative to the continental aggregate from Figure 2 the processes of the residuals from the factor model. As discussed before, both in Europe and the US all original time series seem to contain a unit root. Once we filter with our common factors, the persistence of all variables decreases strongly. With simple differences – and also β-differences, for which persistency is only marginally lower – the assumption of stationary employment and participation rates seems violated at least in Europe. We report the coefficients and discuss the estimation procedure in Appendix B.

[Insert Table 2 here]

A violation of the stationarity assumption without appropriately accounting for common factors in Europe is confirmed by the results from the panel unit root test[6]. For the US, a unit root can be rejected at the 1% level for all series and all filtering strategies. In Europe a unit root is rejected in employment growth across all normalisations. However, neither for the employment rate, nor the participation rate a unit root can be rejected with simple and β-differences as Table 2, which reports the respective p-values, unveils. For our region-specific variables, on the other hand, a unit root is rejected for all series at the 1% level.

5. THE DISTRIBUTION OF UNEMPLOYMENT RATES

Blanchard and Katz (1992) find a stable distribution of regional relative unemployment rates, which motivates their introduction of time-invariant regional amenities in the BK model that influence the regions popularity both for workers and firms given a certain level of wages and unemployment. These amenities explain permanent differences between regions and in the VAR analysis are translated into regional fixed effects. In the following we will partly reconsider their analysis and study the evolution of the distribution of regional unemployment rates over our longer sample: first, by looking at their standard deviations over time, second, by looking at the movements of their percentiles, and, third, by looking at non-parametric kernel density estimates in different years.

[Insert Figure 5 here]

Figure 5 shows the standard deviations for the regional unemployment rates in Europe and the US over time. A flat standard deviation would signal a stable distribution, but both in Europe and in the US it has changed over time. In Europe regions diverged until 1998 but after the introduction of the Euro they converged fast. Since the outbreak for the financial crisis, however, regions are again diverging strongly and today the standard deviation is back at the high levels of the late nineties. Note that the standard deviation in the US in all years is considerably lower than in Europe confirming that US regions are more homogenous than European ones. In the US regions diverge in recessions: the three steepest increases of the standard deviation – in the early eighties, the early nineties, and between 2008 and 2010 – all coincide with recessions[7]. Also in Europe the latest increase of the standard deviation correlates with a recession. In a recession the regional distribution of unemployment rates becomes wider because consequences vary across regions. The increase of the oil price in the early 80s, for example, has different

[6] A panel unit root test increases the power compared to individual tests. Nevertheless, we run individual augmented Dickey-Fuller tests and find that both in Europe and the US a unit root in employment growth is rejected in all regions across all specifications. For the employment and participation rate, however, a unit root with simple and β-differences is rejected in only very few regions. Note, however, that the power of the test is low. Still, with factor augmented variables we can reject a unit root in nearly all regions for all variables.

[7] The connection between increasing standard deviations and recessions is also discussed in Greenaway-McGrevy and Hood (2013) as well as in Dao, Furceri and Loungani (2014).

consequences for a region like Texas producing oil itself and one like Michigan being heavily industrialised. It is for that reason that regional labour markets respond both to region-specific shocks and different reactions to common shocks. In the US regional unemployment rates seem to have slightly converged until the financial crisis, which, as in Europe, dispersed regional rates.

[Insert Figure 6 here]

Figure 6 plots the 2^{nd}, 4^{th}, 6^{th}, and 8^{th} percentile of the regional relative unemployment rates computed as simple differences. They are smoothed and thus allow us to detect long-term trends. As already found above, European regions diverged until the introduction of the Euro, then converged and are diverging again since 2008. We are now able to attribute the increases of the standard deviation to the regions with the highest unemployment rates. Note that the difference between the 8th and 6th percentile increased until 1998 and is again increasing since 2008; the difference between the 6th and 4th percentile, however, is roughly constant. The unemployment rate necessary to belong to the 20% worst performing regions increased but the one necessary to belong to the 40% or 60% highest unemployment regions stayed more or less constant. In the US regions converged until the early nineties, then entered a very stable period until the financial crisis and then diverged again. In contrast to Europe the 2^{nd} and 8^{th} percentile are roughly axisymmetric.

[Insert Figure 7 here]

Figure 7 plots non-parametric kernel density estimates, which are basically histograms with infinitely small ranges. They show how likely a certain unemployment rate is found in any region. Would all regions have the same unemployment rate, all probability mass would be at the common rate. The less concentrated the mass is, the less homogenous are the regions. We already showed that European regions are more heterogeneous than US ones, which here this is reflected in a wider distribution. In addition, in Europe the distribution has a right-tale meaning that the majority has an unemployment rate below the average while some regions are cursed with particularly high rates. In line with Overman and Puga (2002) European regions have polarized between 1981 and 2001, i.e. an increasing number of regions had rates below the average while the situation in high unemployment regions further worsened. Between 2001 and 2011, however, this trend seems to have reversed. As expected from the axisymmetric 2^{nd} and 8^{th} percentile, the distribution of US regions is in general very symmetric, meaning that there are as many better-than-average than worse-than average regions. From 1981 to 2001 regions have become more concentrated and the average unemployment rate decreased. Due to the financial crisis, however, the distribution in 2011 looks again very similar to the one in 1981.

[Insert Figure 8 here]

Figure 8 shows the standard deviations and kernel estimates for the region-specific unemployment rate derived from our factor model. The standard deviations now have a constant mean to which they return fast. The important changes of the distribution described above are really due to aggregate events, like national recessions or common policy changes. The distribution of the European region-specific unemployment rates looks much more symmetric than the regional one. Large parts of the right-tale detected before are hence not connected to regions as such but can be explained by country effects.

6. REGIONAL AND NATIONAL ADJUSTMENT MECHANISMS

In the following we contrast the labour market adjustment of regions to region-specific shocks and common shocks in Europe and the US and analyse changes over time. In addition, we look at the adjustment of countries in Europe and discuss the role of country effects. We report impulse responses of the employment level, the employment rate and the participation rate to a positive one standard deviation shock to labour demand. Note that deviations of the employment rate are approximately equal to negative deviations of the unemployment rate. The responses show percentage deviations from region-specific means. We also decompose the change in employment in the first five years and in the long run (which we define to be 15 years) into contributions from the employment rate, the participation rate and migration, which is simply the unexplained part of the change in the employment level.

6.1. Regional Adjustment to Region-specific Shocks

[Insert Figure 9 here]

Figure 9 compares the impulse responses for Europe and the US to region-specific shocks where in line with the literature we allow for two lags. Note, first, that following a positive labour demand shock the employment level increases on impact, then falls back towards its initial level, but remains above it in the long run. The fact that some but not all of the shock remains means that both job destruction and labour migration play a role in the adjustment process. The fraction remaining in the long run gives the relative importance of job destruction and migration, i.e. which mechanism overall contributes how much. Since in the long run unemployment and participation rates revert to their pre-shock baseline, the permanent change in employment must stem from migration. Due to migration 36% of the initial increase of employment becomes permanent in Europe and 43% remain in the US. While mobility, as expected, is higher in the US, the difference is small.

The adjustment towards the new steady state is quite fast. Employment reaches its long run level after five years in Europe and after four years in the US. The temporary contribution of the participation rate to the adjustment process is a little more persistent in Europe, but also here the differences with the US are not very large. The employment rate in contrast reacts much stronger in Europe than in the US. It initially contributes twice as much to the employment change than in the US, and is also more persistent. After three years the employment rate still contributes 0.15 percentage points in Europe whereas it is not contributing anymore in the US. The bulk of the migration happens in the first year and increases only slightly in the years thereafter.

We note that while there are differences between the regional adjustment mechanisms in Europe and the US – in Europe it is more persistent and employment rates contribute more while migration contributes less – the differences are smaller than previous work suggests. We find a faster adjustment mechanism and a more important role for job creation (and consequently a less important role for migration).

[Insert Table 3 here]

Recently a decrease in mobility has been documented for the US, whereas in Europe integration across countries has increased. With our sample we can analyse whether migration as an adjustment factor has become more or less important. For that purpose we divide the dataset into two periods of equal length and re-estimate the VAR but here with one instead of two lags to accommodate the shorter sample length. Using one lag is unproblematic, since, first, the underlying model postulates that all processes are AR(1) and, second, the impulse responses in the previous section do pretty much look like AR(1) processes. Nevertheless, in Section 6 we analyse in detail the role of lag length. Table 3 shows the contributions of the employment rate, the participation rate and migration to the change in the employment level following a labour demand shock in both samples. A few results are worth noting. First, on both continents the role of migration as an adjustment mechanism has fallen in the second half of the sample. This is in line with other findings in the literature that regional labour mobility has decreased in the US. In the light of the results found by Beine et al. (2013) – namely that migration across countries has increased in Europe as a result of European integration – it may, however, be surprising that we find a similar fall in the role of migration in Europe. But of course these results are not directly comparable, as Beine et al. (2013), first, focus on migration across countries (not regions) and, second, look at overall (not only labour) movements. The decline in labour mobility in Europe and the US suggests that on both continents either the costs of migration have increased or the benefits decreased.

Second, in the later sample the participation rate is playing a stronger and more persistent role in both Europe and the US. One reason could be the higher number of part-time jobs; another could be the increased share of women in the labour force. We estimate the US regional adjustment mechanism also separately for men and women and find that women are less likely to migrate than men and that the response of the participation rate is more important for women than for men. Women are on average employed in lower skill positions than men which means that their severance costs are lower. In addition, more women than men hold part-time jobs possibly only available under good economic conditions. Houseman and Abraham (1993) also show that women are more likely than men to drop out of the labour force.

Finally, note that in Europe the adjustment through the unemployment rate has become more important in the most recent sample, whereas it has fallen in the US.

While our results for the US are in line with Dao, Furceri and Loungani (2014), we come to contrary conclusions for Europe. We are sceptical regarding their finding that the contribution of migration increased in Europe. First, their sample period is very short and only runs from 1998 to 2009 so that the results are highly uncertain probably eviscerating the small difference. And second, the pretended difference only refers to the very last years. Our analysis in contrast is based on the same sample period for both continents and covers 36 years.

6.2. Regional Adjustment to aggregate shocks

[Insert Figure 10 here]

As discussed, aggregate shocks disperse regional labour markets because they affect regions heterogeneously at different locations and at different points in time. Hence also common shocks drive apart regions and necessitate adjustment. A region that is less affected by a national economic downturn than other regions in that country will for example attract workers from harder hit regions, even though condition worsened. Greenaway-McGrevy and Hood (2013) show that the adjustment processes of MSAs are fundamentally different after location-specific and aggregate shocks. In the former case migration plays a smaller role and adjustment, in particular after some time, is driven by job-creation. Conversely, the adjustment to heterogeneous reactions to common shocks is driven mainly by migration precisely in the long run.

Here we estimate the regional adjustment mechanisms in Europe and the US after an aggregate shock. For that purpose, instead of including the estimated factors as exogenous regressors, we condition on the idiosyncratic movements. Doing so filters out the region-specific fluctuations.

Figure 6 compares the impulse responses for Europe and the US. As expected they attest a remarkably different adjustment process. Both in Europe and the US the employment level now is humped-shaped: after a positive shock to labour demand the employment level continues to increase during the first four years. In contrast to the adjustment to a regional shock, migration now continues to be a crucial adjustment mechanism in all years and in general contributes much more, so that in the long run the employment level increases nearly by the amount of the shock.

In the year of the shock there is nearly no difference between Europe and the US. In the years thereafter, however, the employment rate is, as for the adjustment to region-specific shocks, a much more important and persistent contributor in Europe. In the US, on the other hand, from year two onwards, migration absorbs more.

Aggregate shocks are mainly connected to recessions. An adverse aggregate shock to labour demand, for example a sudden increase of the oil price or a worsening of the economic conditions for example due to a financial crisis, decreases the net benefit of migration (Saks and Wozniak 2011). Even though they increase the dispersion of regional unemployment rates and drive apart regional wages, migration and job-churnings decrease during an economic bust, i.e. they are pro-cyclical (Fallick and Fleischman, 2004; Caballero and Hammour, 2005; Molloy, Smith and Wozniak, 2011; Davis et al. 2011). Due to the pro-cyclicality of migration and slower labour turnover in an economic downturn the adjustment to common shocks is much more persistent. In a region in particular hard hit by an adverse common shock, the employment and participation rate initially absorb most of the employment drop. In fact, migration in the first two years contributes less than after a region-specific shock. Thereafter, however, the greater regional dispersion translates into a higher contribution of migration than after a regional-specific shock (that leaves overall dispersion unaltered). In contrast to region-specific shocks, recessions lead to a strong and long lasting regional adjustment through migration which exacerbates after the recession is over.

Note that two caveats are in order here. First, the persistency of the participation rate in Europe is very high and clearly the stationarity assumption of the BK model seems violated. While this does not impair the short-run results we have highlighted above (Obstfeld and Peri 1998, Tani 2003), the European long run results are uncertain. Second, it is not obvious how to interpret the humped-shaped responses in light of the BK model. In the model it is possible that a negative labour demand shock that causes lower employment and wages results in a further decrease of the employment level if due to lower wages more workers leave the region than they create jobs. However, the original identification scheme is then not sufficient anymore, and moreover, even then the model cannot explain the humped-shaped response of employment, for which we would need to introduce time varying mobility parameters.

Nevertheless, the adjustment to aggregate shocks can of course be used to validate the finding that mobility decreased. Did mobility only decrease after region-specific shocks?

[Insert Table 4 here]

Table 4 documents the contributions of the employment rate, the participation rate and migration to the adjustment to an aggregate shock in the first and second half of our sample and thus mirrors Table 3 for the adjustment to common shocks. Given the high uncertainty about the long run results due to the high persistency of the participation rate we are not reporting long run contributions here. The decline detected for the adjustment to region-specific shocks is mirrored nearly one-to-one. Migration decreased considerably both in Europe and the US supporting our conclusion mobility has decreased on both continents.

6.3. The National Adjustment Mechanisms in Europe

[Insert Figure 11 Here]

Finally, we can investigate the role of migration in labour market adjustments across countries by aggregating over all regions belonging to the same country and then pooling over all 8 countries. Because of the small cross-section we again allow for only one lag. All global and continental factors from the factor analysis are used as exogenous regressors and as usually we allow for country fixed effects.

We test the empirical validity of the VAR specification by estimating the autoregressive responses of the new data series that all seem stationary. Also, we test for unit roots using the test developed by Levin, Lin and Chu (2002). A unit root is rejected in the US for all series at the 1% level. In Europe, it is rejected at the 1% level for employment growth and the employment rate and at the 5% level for the participation rate.

As expected, we find that migration is less important as a cross-country adjustment mechanism in Europe. The contribution of migration drops from 31% to 20% in the short run and from 36% to 29% in the long run. This is likely to be the case because the costs of migrating across countries are higher than those of migrating within countries due to the larger distance and greater language and other cultural barriers. The roles of unemployment and the participation rate, on the other hand, are more important. For example, the persistence of the response of the participation rate is much higher after a national shock. After a national shock it takes nearly ten years to return to its mean, whereas after a region-specific shock the adjustment is completed after five years.

[Insert Figure 12 Here]

Heterogeneous responses to national shocks and the differences of the national and regional adjustment mechanism underline the necessity to take into account country effects in Europe. Figure 8 plots the regional adjustment mechanism in Europe if we condition only on the three global factors and the global factors plus the continental factor. Also in this case the relative roles of unemployment and participation increase and both become more persistent, whereas the role of migration falls.

7. ROBUSTNESS

In this section we present some robustness checks with respect to changes in the specification of the factor analysis, changes in the lag length, changing the filtering strategy and using an alternative data source in the US.

7.1. Different Factor Models

[Insert Figure 13 Here]

Here we estimate a different multi-level factor model, namely one for each continent, where we allow for three continental factors and one factor for each country/area, so that each region loads on four factors. We then use these factors as alternative exogenous regressors in the VAR. We use the whole sample period and allow two lags. Figure 13 shows the impulse responses for Europe and the US both for the adjustment to region-specific shocks and to common shocks. Overall the impulse responses are similar to those in Figure 9 and 10. Most importantly, they carry exactly the same message. We also experimented with other factor analyses and found that results are not very sensitive to including different factors.

7.2. Different Lag Lengths

Instead of estimating the system with two lags we here estimate it first with one lag and then with four lags.

[Insert Figure 14 here]

Reducing the lag length to one has nearly no effect on the adjustment to region-specific shocks. Also the effect on the adjustment to common shocks is minor with the only difference of a slightly higher persistency irrelevant for the first years. Note that the standard errors are now slightly lower. Given that the underlying model assumes AR(1) processes we are glad to find this result. Estimating the VAR with one lag seems at least as plausible as with two.

[Insert Figure 15 here]

We also estimate the VAR with four lags and find important consequences. While neither adjustment to region-specific nor to common shocks is changing fundamentally in the first years, the long run differs. The permanent effect of a region-specific shock – and thus total contribution of migration – is lower when we use more lags. Our observation that job creation is the major driver of adjustment to region-specific shocks is thus even enhanced. With four lags only a third of the long run adjustment comes through migration but two thirds come from job destruction. The permanent effect of common shocks is much less affected. However, the introduction of more factors fastens the adjustment process after such shocks. As mentioned, the high persistency makes the long run adjustment to aggregate shocks highly uncertain.

7.3. Comparison with Blanchard and Katz (1992) and Decressin and Fatás (1995)

Our results differ from Blanchard and Katz (1992) and Decressin and Fatás (1995). Here we aim at understanding were these differences come from. First, we replicate their methodologies one-to-one and apply them to our sample. Next, we use an alternative data source for the US, which is more comparable to theirs.

[Insert Figure 16 here]

Figure 16 plots the impulse response functions for Europe and the US using the alternative filtering strategies. As discussed, our methodology allows us to distinguish adjustment to region-specific shocks and to heterogeneous reactions to aggregate shocks. Here the adjustment is a mixture of the two, which – as we have shown – differ considerably. In fact, the impulses look like a compromise of two mechanisms we were able to separate. Note that for the US we do not observe the strong humped-shape response that Blanchard and Katz (1992) find in the US.

[Insert Figure 17 here]

To analyse the role played by the data source, we estimate the adjustment process for the US with LAUS data and show the results in Figure 17. First we use simple differences. The Harris-Tzvalis test rejects a unit root at 1% for employment growth and the employment rate and at 5% for the participation rate. Interestingly, the impulse responses now look very similar to the responses in Blanchard and Katz (1992). The main difference to their responses is a stronger increase of the participation rate but we showed already that it increased in the second half of the sample period. These impulse responses are very similar to those in Dao, Furceri and Loungani (2014). The bigger similarity of the impulse responses with the adjustment to heterogeneous reactions to common shocks in our analysis could result from regional smoothening of the LAUS data.

If we estimate a new factor model with three US factors and one factor for each area – these factors are the equivalent to those used for Figure 9 – and use these as exogenous regressors, i.e. if we estimate the adjustment to region-specific shocks with LAUS data, the humped shape of the employment level is removed, as Figure 17 unveils. Nevertheless, the data source has an effect on the results. First, the size of the shock is much smaller with LAUS than with CPS data and, second, the participation rate reacts less initially but is more persistent, which translates into a higher contribution of migration both in the short- and long run. We can only speculate about the reasons, but the absence of part-time jobs in the sample can explain both the smaller size of the shock as well as the higher mobility. In addition, LAUS data is smoothed and revised, which may influence the results as well. In any case, the differences between the adjustment in Europe and the US increase if one uses LAUS data, but these differences can be attributed to the data itself.

With LAUS data we can estimate the VAR also with monthly data. We change the lag length to 24 to mirror the two year lag length of the annual VAR. The results turn out to be very similar so that annual data seems appropriate in this context.

7.4. Country Breakdown of Adjustment Mechanism to Region-specific Shocks

[Insert Table 5 here]

Instead of enforcing a uniform regional adjustment mechanism in Europe, we here allow for different mechanisms in each country. For that purpose we pool over all regions belonging to the same country (as long as there is more than one region in the country). Table 5 shows the respective contributions. While the adjustment in all countries is fundamentally the same, there are considerable differences. The lowest migration is found in the UK, where the employment rate is instead absorbing a lot. In Germany the migration is low at the beginning but then accelerates so that in the long run around one third of the shock remains. The permanent effect is similar to the one in Italy and Spain. In the Italy the employment rate is contributing little so that migration is important already from the first year onwards. In Spain, on the other hand, the participation rate is contributing very little, so that also there migration is important from the beginning. France clearly stands out. Neither the employment rate nor the participation rate is heavily contributing. Instead, migration is the main adjustment mechanism and the permanent effect due to migration is even higher than in the US. If we excluded the French regions from the European sample, migration would decrease somewhat, also increasing the difference between migration patterns in Europe and the US.

8. POLICY IMPLICATIONS

In this paper we revisit the role of labour mobility in regional labour market adjustments in Europe and the US. We study 47 European and 51 US regions over a period of 36 years. In line with Greenway-McGrevy and Hood (2013), we use a factor model to filter out the regional response to common factors. In particular, we allow for a heterogeneous response to global, continental and country-specific factors. Once we do this, we are able to distinguish between the regional adjustment to region-specific shocks and to heterogeneous reactions to common shocks. Moreover, we can compare the regional adjustment mechanism to the national one in Europe. A number of interesting results appear:

First, we find that both in Europe and the US the role of labour mobility in the adjustment to region-specific labour demand shocks is responsible for less than 50% of the long run adjustment. In addition, the adjustment in both areas is very fast and already completed after five years. On the other hand, adjustment to heterogeneous reactions to common shocks differs considerably. In line with a pro-cyclical migration in the first two years migration contributes less. Thereafter, on the other hand, migration contributes a lot more than after a region-specific shock, probably due to the increased regional dispersion. Overall the adjustment is more persistent and a higher proportion is absorbed by migration so that the permanent effect is around the size of the original shocks.

Second, the role of migration has decreased over the sample period in both cases, which is consistent with direct evidence that inter-state migration has fallen to a historic low in the US.

Third, there are differences in the regional adjustment mechanism in Europe and the US, where migration is more important, but they are less pronounced than previously thought. The adjustment process through changes in the unemployment rate is larger and more persistent in Europe, as one would expect due to the greater rigidity of labour markets.

Fourth, we show that in Europe labour mobility is an even less important adjustment mechanism in response to country-specific labour demand shocks. In this case, both the unemployment rate and the participation rate play a larger and more persistent role, underlining remaining cultural, language and institutional barriers to labour mobility across European countries.

Finally, on a technical note, we also show that, first, the adjustment mechanism in Blanchard and Katz (1992) and Decressin and Fatás (1995) is a mixture of the regional adjustment to region-specific and to common shocks and, second, that part of the difference between Europe and the US in previous studies may be the result of the use of different data sources for the two continents.

The pro-cyclicality of migration prolongs the regional adjustment to heterogeneous reactions to common shocks and increases the social cost of such shocks both in Europe and the US. While Ferreira, Gyourko, and Tracy (2010) show that in the recent crisis the contraction of the housing market in the US has decreased migration, more generally, churnings in the labour market seem responsible for the pro-cyclicality of migration. Migration is only pro-cyclical for those in the labour force and is equally strong for renters and homeowners (Saks and Wozniak 2011). A reduction of the pro-cyclicality of migration would result in less severe recessions and a more rapid recovery due to a more efficient re-allocation of workers.

Both for the adjustment to region-specific shocks and to common shocks labour migration is somewhat lower in Europe than it is in the US, so that there seems some room for improving the adjustment in Europe by fostering mobility. A high general mobility requires for example flexible housing markets and compatible school systems. In Europe remaining barriers connected with country borders complicate migration. Indeed, migration is particularly low between countries increasing the persistency of the adjustment to country-specific shocks and thus their social costs. While certain barriers like language can of course not be cleared away fully, cross-country migration in Europe can certainly be simplified, for example by improving language education in schools, harmonizing pension systems, or by changing the attitude towards migrants. The recent initiatives of the European Commission and Council may hence help to foster adjustment to country-specific shocks.

However, the differences of the adjustment in particular to regional but also to country shocks in Europe and the US are smaller than has previously been argued, so that we may need to rethink our interpretation of European mobility patterns as a major issue for the monetary union. Since it is unrealistic to hope for higher migration between European countries than US states, higher migration ought not to be expected to change the European adjustment to labour demand shocks fundamentally in the future.

In addition, general mobility has decreased both in Europe and the US. Our work suggests that whatever the reasons for decline of mobility are, they seem to be at force on both continents. We suspect that the increasing share of women in the labour force plays a crucial role. A family disposing two incomes is less likely to migrate than a family disposing only one. First, unemployment in the former case decreases resources by less and, second, migrating is more difficult if two jobs need to found in another area. While the labour force may have become less mobile due to the higher share of women, the consequences of unemployment are of course less sever since it means that in case of unemployment only one of two incomes falls out. The reasons for the general decline of mobility so far remain blurred and future research on this is, of course, crucial. Only with a better understanding of the reasons we may be able to address the general decline in mobility.

From a normative perspective it is not clear whether adjustment through workers or jobs is preferable. While a lower mobility of workers *centeris paribus* increases the persistency of the adjustment to diverse shocks and thus is undesirable in the short run, it also reduces the permanent effect of shocks and thus has positive long run consequences for entities affected by adverse shocks. In addition, large-scale migration in Europe could also be socially disruptive (Emerson et al., 1992; Obstfeld and Peri, 1998). A fastening of the adjustment through job creation is in any case desirable. It may be achieved by more flexible wages – also increasing workers' mobility – and, equally important, a higher wage elasticity of jobs. In addition, our analysis underlines the need for regional policies and a banking union in Europe. Regional policies may be used to encourage job-creation in depressed regions, for example by offering tax deductions to firms moving in. Such policies are particularly promising right after region-specific shocks and after a recession is over. In addition, the implementation of a banking union in Europe will foster adjustment through job creation. Morgan et al. (2004) show that increased interstate banking in the US stabilised fluctuations within states and reduced divergence between them. Better financing options due to bank integration may simplify job creation and accelerate regional adjustment reducing the cost of adverse shocks and need to migrate.

I. Figures

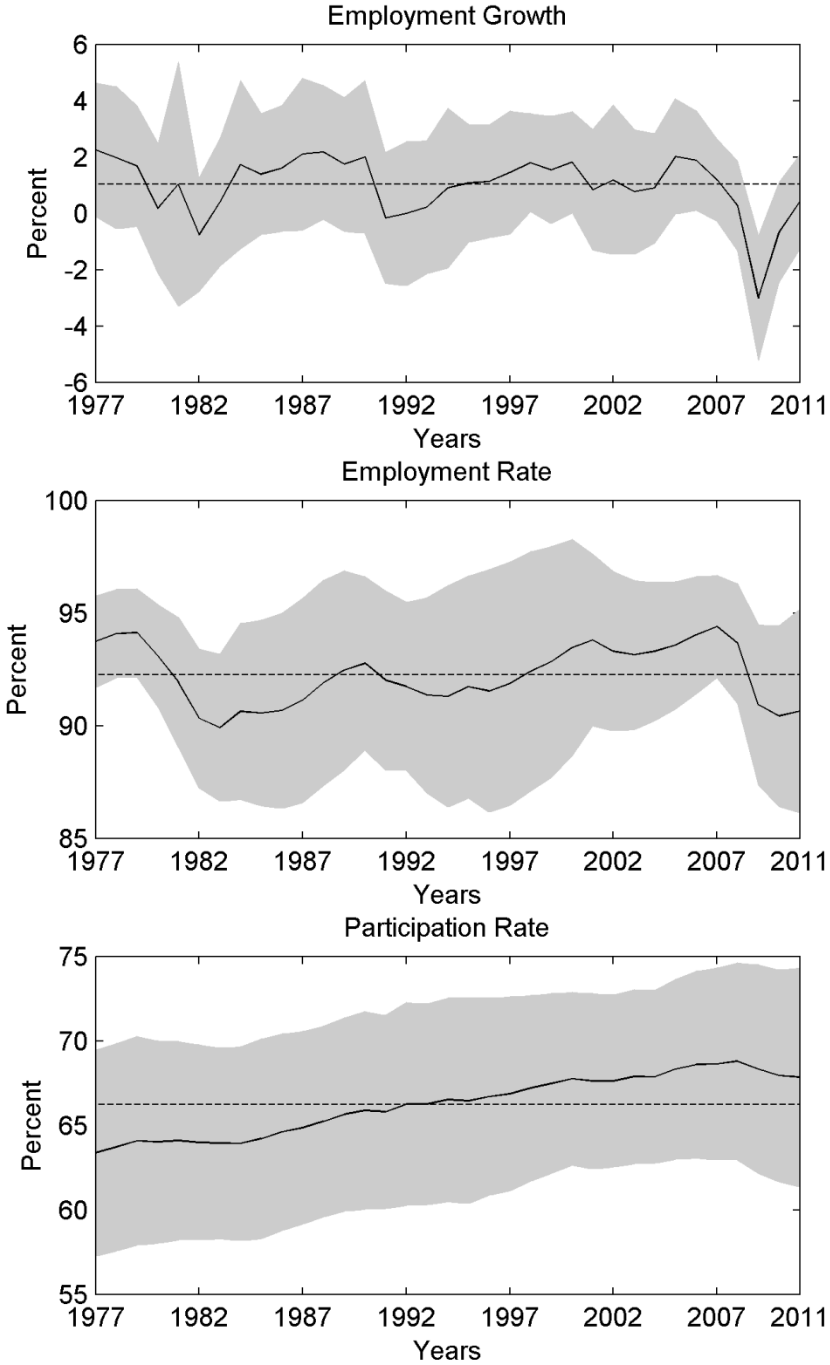

Figure 1. Employment growth, employment rates and participation rates

Technical Note: The solid lines show the yearly average over all 98 regions, the dashed lines the average over all regions and years and the grey areas the standard deviation.

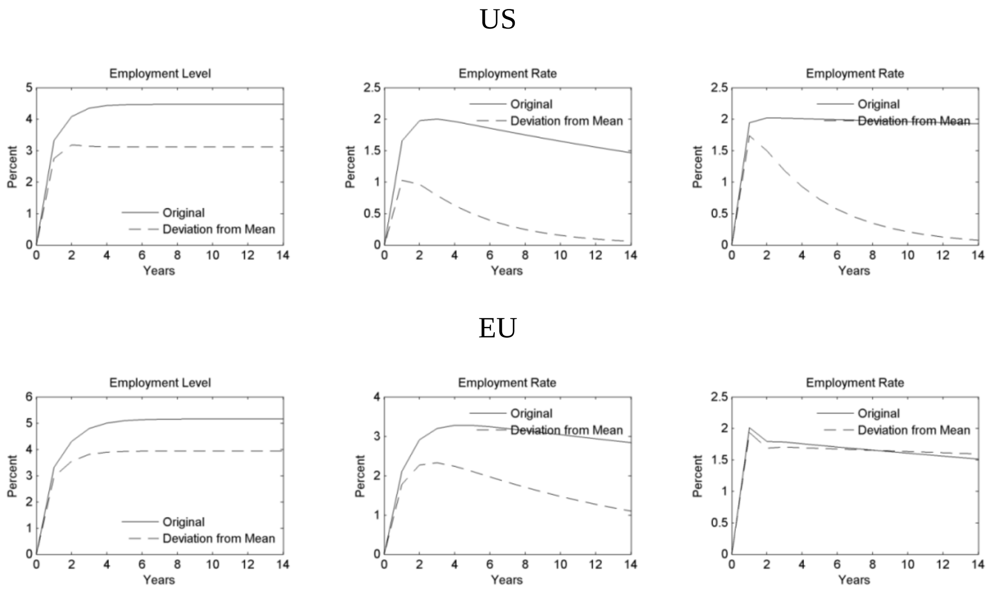

Figure 2. Persistency of original and regional relative variables

Technical Note: We plot impulses to a one standard deviation shock to AR(2) processes pooled over all regions on the same continent and estimated with ordinary-least squares.

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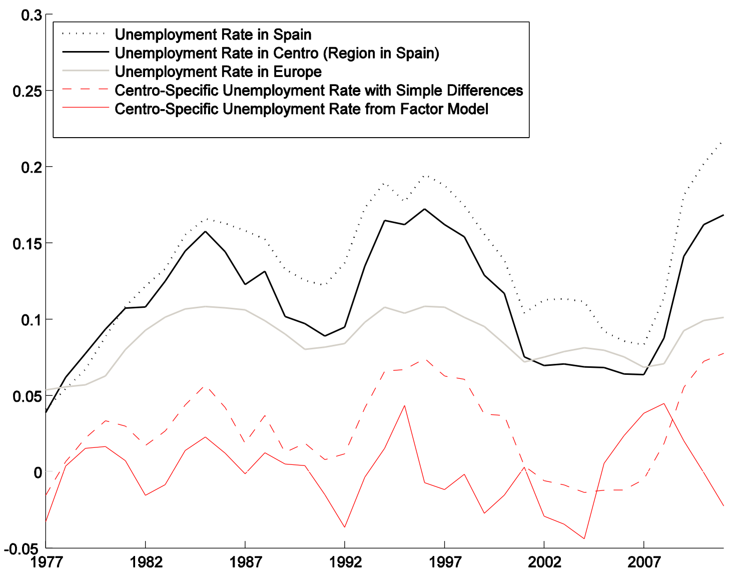


Figure 3. Centro's regional relative and region-specific unemployment rate

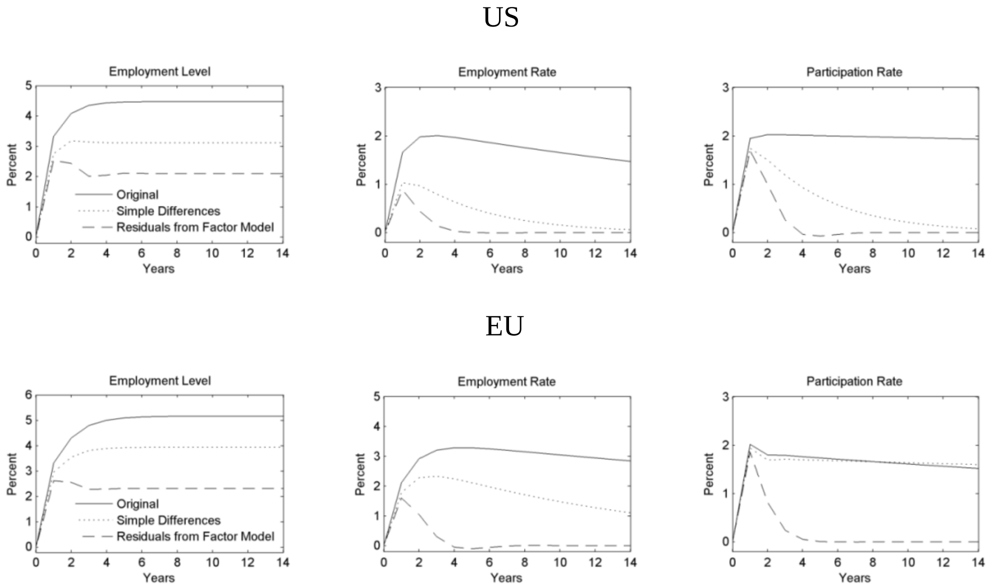


Figure 4. Persistency of original, regional relative and region-specific variables

Technical Note: We plot impulses to a one standard deviation shock to AR(2) processes pooled over all regions on the same continent and estimated with ordinary-least squares.

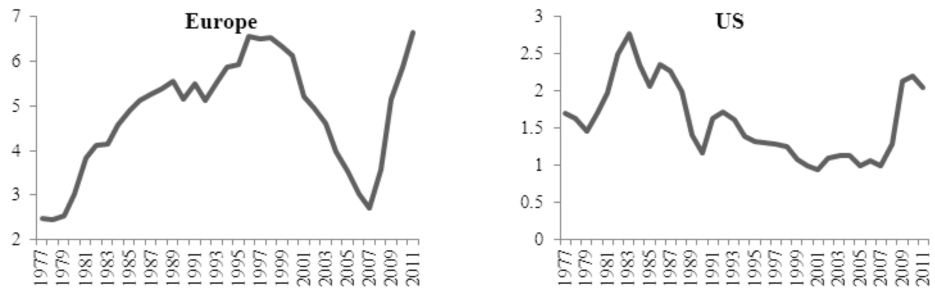


Figure 5. Standard deviation of regional unemployment rates

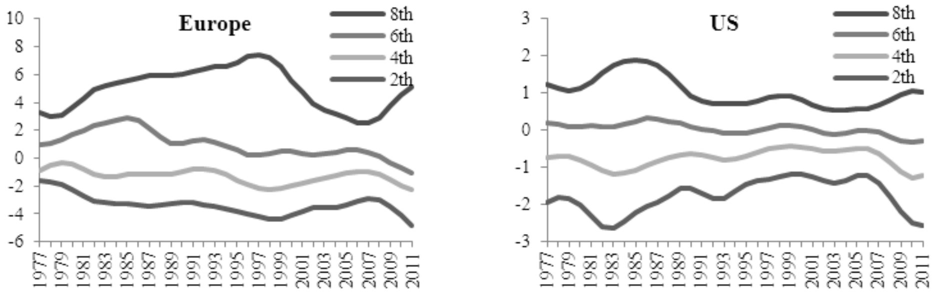


Figure 6. Moving percentiles of unemployment rates

Technical Note: The percentiles are smoothed using locally weighted scatterplot smoothing with a band width of 0.2.

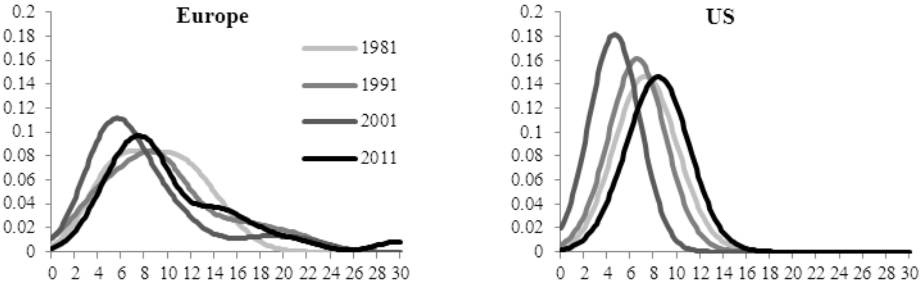


Figure 7. Kernel densities of unemployment rates

Technical Note: We plot densities calculated non-parametrically using Gaussian kernels with a bandwidth of 2.

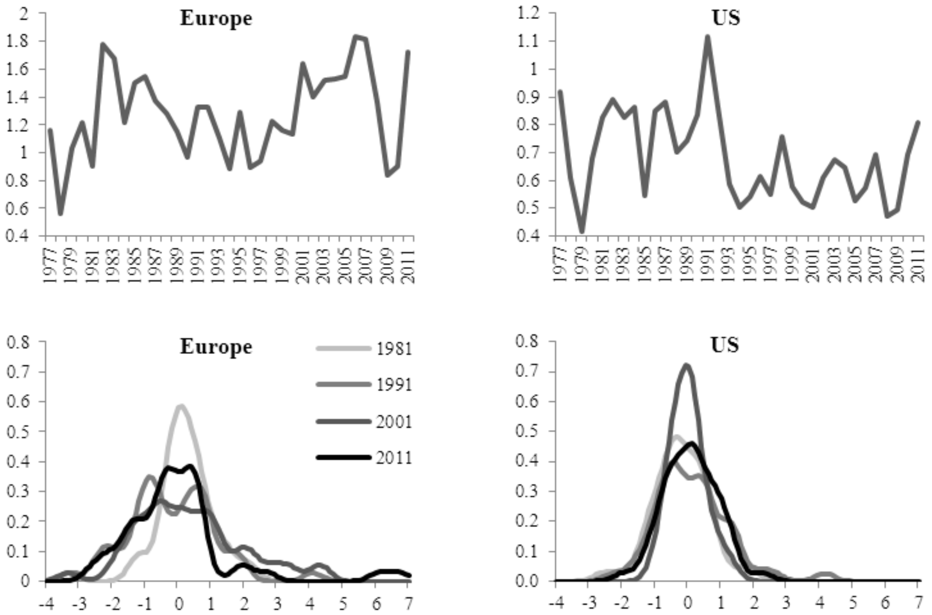
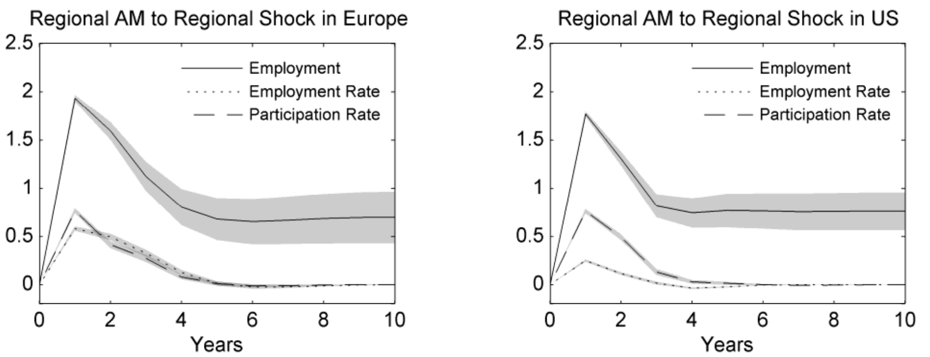


Figure 8. Region-specific unemployment rates: standard deviations and densities

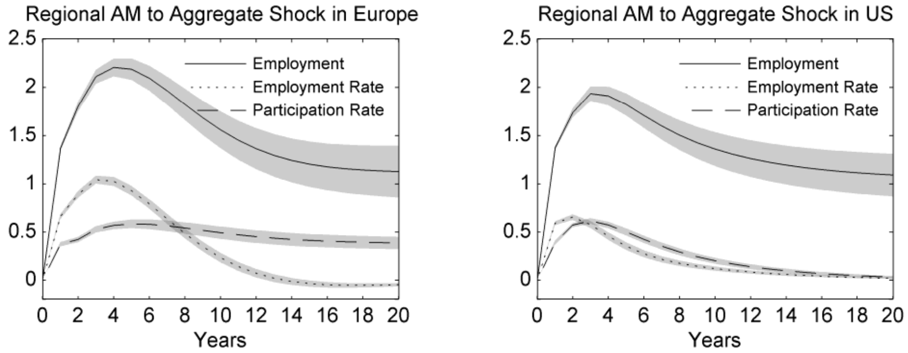
Technical Note: In the above graphs plot the standard deviation. The lower ones plot densities calculated non-parametrically using Gaussian kernels with a bandwidth of 0.3.



	Europe						US					
Years	**1**	**2**	**3**	**4**	**5**	**15**	**1**	**2**	**3**	**4**	**5**	**15**
Employment	1.00	0.82	0.58	0.41	0.35	0.36	1.00	0.74	0.46	0.42	0.43	0.43
Employment rate	0.30	0.26	0.17	0.06	0.01	0.00	0.14	0.06	0.01	-0.02	-0.01	0.00
Participation rate	0.40	0.21	0.14	0.04	0.01	0.00	0.43	0.28	0.07	0.02	0.01	0.00
Migration	0.31	0.36	0.27	0.31	0.34	0.36	0.43	0.40	0.38	0.42	0.44	0.43

Figure 9. Adjustment to regional-specific shocks

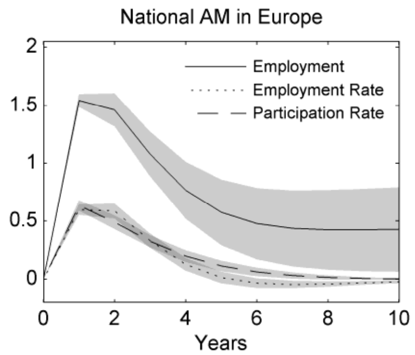
Note: We plot the impulse responses to a one standard deviation shock to labour demand. The y-axis shows the effect of the shock in per cent and the x-axis shows years. We condition on all fourteen factors, allow for two lags and estimate with least-squares. The grey area shows confidence bands of 95% bootstrapped with 250 replications. The table translates the employment response into contributions of the employment rate, the participation rate and migration, which is the unexplained part of the employment change.



	Europe						US					
Years	**1**	**2**	**3**	**4**	**5**	**15**	**1**	**2**	**3**	**4**	**5**	**15**
Employment	1.00	1.32	1.55	1.62	1.61	0.88	1.00	1.27	1.42	1.40	1.33	0.85
Employment rate	0.48	0.66	0.77	0.75	0.68	-0.03	0.43	0.48	0.42	0.33	0.26	0.04
Participation rate	0.27	0.31	0.39	0.42	0.43	0.30	0.28	0.42	0.45	0.42	0.37	0.06
Migration	0.25	0.36	0.40	0.45	0.50	0.61	0.29	0.38	0.55	0.65	0.71	0.76

Figure 10. Regional adjustment to aggregate shock

Note: As Figure 9 but instead of conditioning on the factors we here include the idiosyncratic movements as exogenous regressors.



Years	**1**	**2**	**3**	**4**	**5**	**15**
Employment	1.00	0.95	0.70	0.50	0.37	0.29
Employment rate	0.39	0.38	0.21	0.08	0.01	0.00
Participation rate	0.41	0.32	0.21	0.13	0.07	0.00
Migration	0.20	0.25	0.27	0.28	0.29	0.29

Figure 11. National Adjustment to country-specific shock

Note: As Figure 9 but here we aggregate over all European regions that belong to a country and estimate the VAR with country data. We include the three global and the European factors and allow for one lag.

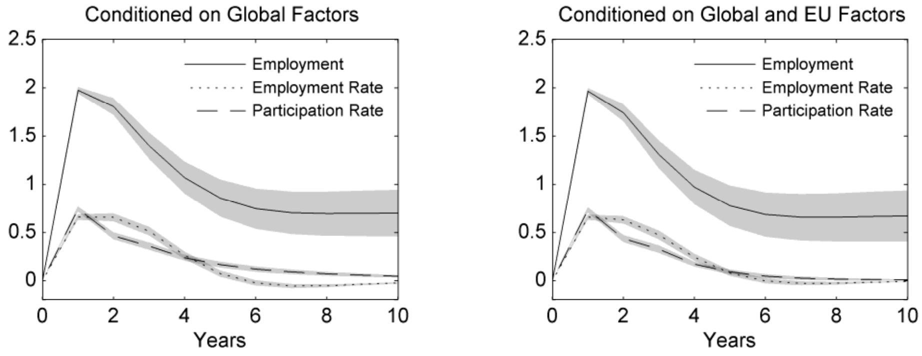


Figure 12. Regional adjustment mechanism in Europe with limited number of factors

Note: As Figure 9 but here we first include only the global factors (left) and then the global and continental factors (right).

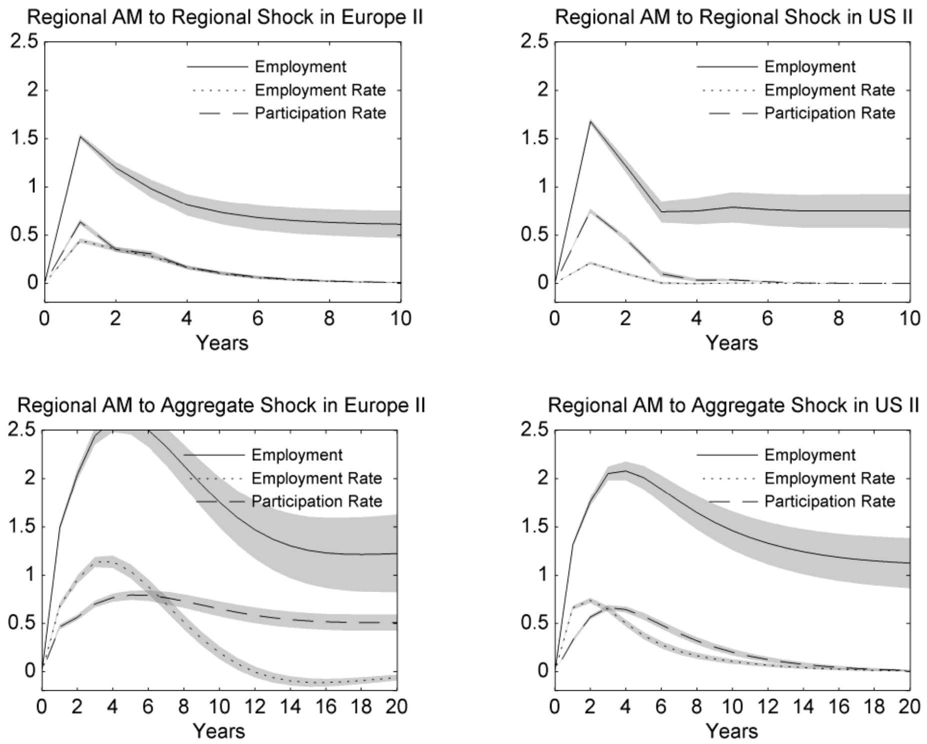


Figure 13. Regional adjustment with alternative factor analysis

Note: As Figure 9 (first row) and Figure 10 (second row), but the factors stem from an alternative factor analysis.

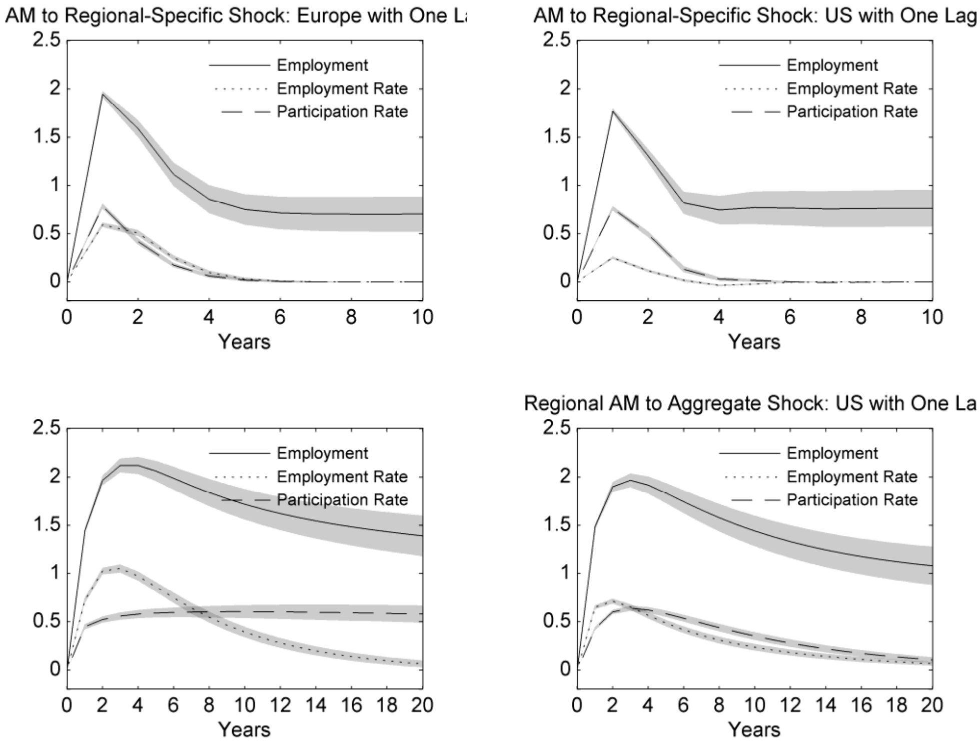


Figure 14. Regional adjustment with one lag

Note: As Figure 9 (first row) and Figure 10 (second row), but with one instead of two lags.

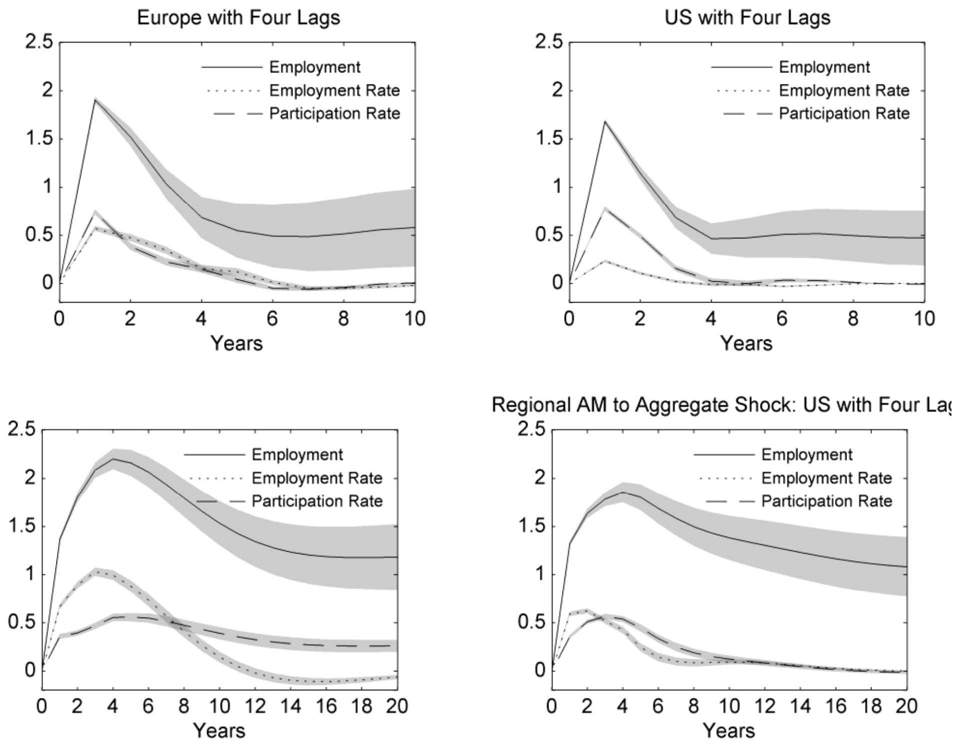


Figure 15. Regional adjustment with four lags

Note: Note: As Figure 9 (first row) and Figure 10 (second row), but with four instead of two lags.

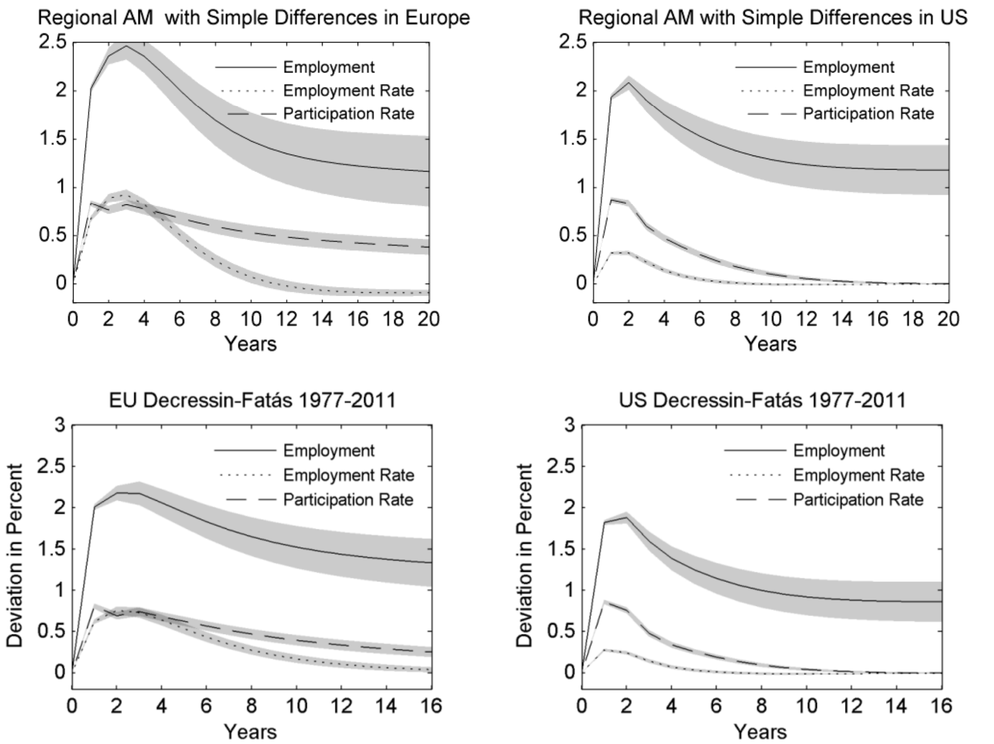


Figure 16. Regional adjustment with simple and β-differences

Note: As Figure 9 but here we estimate the VAR in simple differences as in Blanchard and Katz (1992) and with β-differences as in Decressin and Fatás (1995).

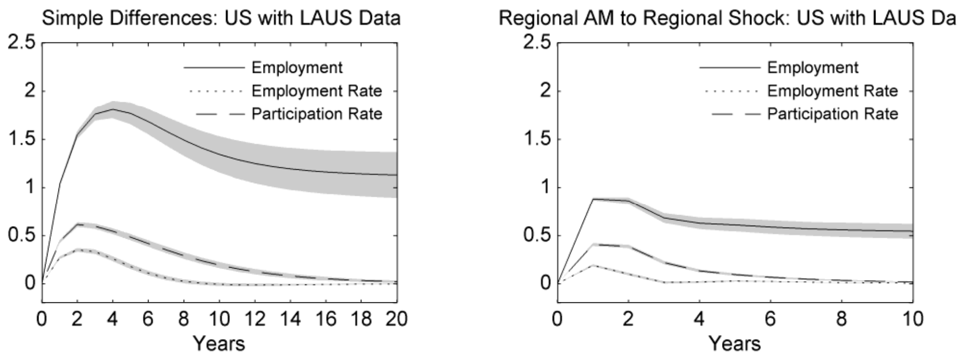


Figure 17. Regional adjustment in US with LAUS data

Note: As top right panel of Figure 16 (left) and right panel of Figure 9 (right) but with LAUS instead of CPS data.

II. Tables

Table 1. Explained variance by factors

Continent	Variables	W1	W2	W3	US	EU	A	C	World	Total
Europe	Employment growth	27	11	33	8		12		71	90
	Employment rate	43	13	10	5		5		67	77
	Participation rate	29	39	8	6		9		76	91
US	Employment growth	4	18	8		8		18	30	56
	Employment rate	16	8	7		10		10	31	51
	Participation rate	41	18	14		4		2	72	79
All	Employment growth	15	15	20	4	4	6	9	50	73
	Employment rate	29	10	9	2	5	3	5	48	63
	Participation rate	35	28	11	3	2	4	1	74	85

Note: The squared loading of a variable on a factor measures the explained variance by that factor. We have summarized the explained variance for each variable in Europe, the US and overall. We have aggregated the area and country factors.
Source: Authors' calculations.

Table 2. P-values of Harris-Tzavalis panel unit root test in Europe

	Employment growth	Employment rate	Participation rate
Simple differences	0	0.53	1.00
B-differences	0	0.64	0.99
Factor augmented	0	0	0

Note: We report the p-values of the panel unit root test outlined in Harris and Tzavalis (1999) for European regions.
Source: Authors' calculations.

Table 3. Adjustment to region-specific shocks over time

		Europe						US					
	Years	**1**	**2**	**3**	**4**	**5**	**15**	**1**	**2**	**3**	**4**	**5**	**15**
1976 - 1993	Employment	1.00	0.59	0.45	0.47	0.48	0.48	1.00	0.57	0.56	0.57	0.57	0.57
	Employment rate	0.23	0.11	-0.03	-0.02	0.00	0.00	0.14	0.03	0.00	0.00	0.00	0.00
	Participation rate	0.36	0.04	0.00	0.00	0.00	0.00	0.35	0.08	-0.02	0.00	0.00	0.00
	Migration	0.41	0.44	0.48	0.49	0.49	0.48	0.51	0.45	0.58	0.58	0.57	0.57
1994 - 2011	Employment	1.00	0.70	0.57	0.49	0.44	0.39	1.00	0.67	0.49	0.48	0.49	0.49
	Employment rate	0.28	0.19	0.17	0.11	0.07	0.00	0.07	0.03	-0.01	-0.01	0.00	0.00
	Participation rate	0.44	0.21	0.07	0.01	0.00	0.00	0.46	0.20	0.03	-0.01	-0.01	0.00
	Migration	0.28	0.30	0.34	0.36	0.37	0.39	0.47	0.44	0.48	0.49	0.49	0.49

Note: As the table in Figure 9, but here we estimate the VAR separately for the first and second half of the sample.
Source: Authors' calculations.

Table 4. Adjustment to aggregate shocks over time

		Europe					US				
	Years	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
1976 - 1993	Employment	1.00	1.14	1.20	1.12	1.01	1.00	1.13	1.11	1.06	0.99
	Employment rate	0.41	0.52	0.55	0.47	0.38	0.48	0.38	0.26	0.19	0.13
	Participation rate	0.18	0.14	0.22	0.21	0.18	0.19	0.27	0.30	0.29	0.27
	Migration	0.41	0.47	0.42	0.44	0.46	0.33	0.48	0.55	0.58	0.59
1994 - 2011	Employment	1.00	1.31	1.51	1.53	1.46	1.00	1.30	1.49	1.66	1.83
	Employment rate	0.65	0.81	0.93	0.86	0.73	0.54	0.63	0.63	0.62	0.61
	Participation rate	0.26	0.28	0.29	0.30	0.29	0.30	0.46	0.55	0.60	0.63
	Migration	0.09	0.21	0.29	0.38	0.44	0.15	0.20	0.32	0.45	0.59

Note: As the table in Figure 10, but here we estimate the VAR separately for the first and second half of the sample.
Source: Authors' calculations.

Table 5. Adjustment to regional-specific shocks across countries

	Years	1	2	3	4	5	15
Italy	Employment	1.00	0.77	0.70	0.62	0.55	0.42
	Employment rate	0.17	0.14	0.16	0.14	0.11	0.00
	Participation rate	0.52	0.36	0.22	0.13	0.07	0.00
	Migration	0.31	0.27	0.32	0.35	0.37	0.42
Germany	Employment	1.00	0.93	0.85	0.78	0.71	0.41
	Employment rate	0.30	0.41	0.36	0.31	0.27	0.06
	Participation rate	0.53	0.33	0.27	0.23	0.20	0.04
	Migration	0.17	0.20	0.22	0.23	0.25	0.31
UK	Employment	1.00	0.36	0.14	0.13	0.16	0.17
	Employment rate	0.45	0.22	-0.02	-0.04	-0.01	0.00
	Participation rate	0.47	-0.05	-0.02	0.00	0.00	0.00
	Migration	0.08	0.20	0.18	0.17	0.17	0.17
France	Employment	1.00	0.91	0.84	0.81	0.80	0.79
	Employment rate	0.10	0.08	0.02	0.01	0.00	0.00
	Participation rate	0.14	0.06	0.03	0.01	0.01	0.00
	Migration	0.75	0.78	0.78	0.79	0.79	0.79
Spain	Employment	1.00	1.01	0.70	0.41	0.26	0.29
	Employment rate	0.39	0.37	0.22	0.07	-0.01	0.00
	Participation rate	0.29	0.21	0.07	-0.01	-0.03	0.00
	Migration	0.32	0.44	0.41	0.35	0.30	0.29

Note: As table in Figure 9 but here we only pool over regions belonging to the same country and estimate separate VARs for each country.
Source: Authors' calculations.

Appendix

A Regions

Germany	France	Italy	Spain	United Kingdom	Countries
S.Holst. & Hamb.	Ile de France	Nord-Ovest	Noroeste	York and Humb.	Belgium
Nieders. & Bremen	Bassin Parisien	Lombardia	Noreste	East Midlands	Denmark
Nord.-Westfalen	Nord-Pas-de-Cal.	Nord-Est	Madrid	East of England	Greece
Hessen	Est	Emilia-Romagna	Centro	South-West	Ireland
R.-Pfalz & Saarl.	Ouest	Centro	Este	West Midlands	Netherlands
Baden-Württemb.	Sud-Ouest	Lazio	Sur	Wales	Portugal
Bayern	Centre-Est	Campania	Canarias	Scotland	
	Mediterrane	Abruzzi-Molise		Northern Ireland	
		Sud			
		Sicilia			
		Sardegna			

US Midwest	US South	US West
Wisconsin	Delaware	Idaho
Michigan	Maryland	Montana
Illinois	DC	Wyoming
Indiana	Virginia	Nevada
Ohio	West Virginia	Utah
Missouri	North Carolina	Colorado
North Dakota	South Carolina	Arizona
South Dakota	Georgia	New Mexico
Nebraska	Florida	Alaska
Kansas	Kentucky	Washington
Minnesota	Tennessee	Oregon
Iowa	Mississippi	California
	Alabama	Hawaii
	Oklahoma	
	Texas	
	Arkansas	
	Louisiana	

B Coefficients of AR(2) Processes

		Employment Growth			Employment Rate			Participation Rate		
		Simple Δ	β-Δ	Factor Model	Simple Δ	β-Δ	Factor Model	Simple Δ	β-Δ	Factor Model
Blundell-Bover										
EU	L	0.200***	0.117**	-0.0236	1.279***	1.202***	0.653***	0.871***	0.828***	0.440***
		(0.0621)	(0.0536)	(0.0586)	(0.0314)	(0.0287)	(0.0368)	(0.0752)	(0.0885)	(0.0736)
	L2	0.0493	0.0176	-0.106***	-0.324***	-0.304***	-0.237***	0.122	0.154*	-0.0640
		(0.0406)	(0.0398)	(0.0372)	(0.0330)	(0.0329)	(0.0212)	(0.0765)	(0.0842)	(0.0469)
	RMSE	0.0296	0.0285	0.0262	0.0178	0.0167	0.0160	0.0194	0.0189	0.0185
US	L	0.156***	0.144***	-0.0395	0.937***	0.852***	0.497***	0.862***	0.960***	0.586***
		(0.0239)	(0.0269)	(0.0253)	(0.0347)	(0.0373)	(0.0390)	(0.0249)	(0.0229)	(0.0449)
	L2	-0.0393	-0.0730***	-0.168***	-0.114***	-0.0290	-0.0896***	-0.0615**	0.0137	-0.189***
		(0.0256)	(0.0278)	(0.0254)	(0.0304)	(0.0357)	(0.0266)	(0.0259)	(0.0221)	(0.0359)
	RMSE	0.0275	0.0266	0.0253	0.0103	0.00959	0.00884	0.0174	0.0184	0.0169
Least-Squares										
EU	L	0.192***	0.106***	-0.0185	1.232***	1.202***	0.650***	0.831***	0.813***	0.435***
		(0.0339)	(0.0327)	(0.0352)	(0.0341)	(0.0323)	(0.0346)	(0.0414)	(0.0411)	(0.0426)
	L2	0.0414	0.00566	-0.102***	-0.350***	-0.320***	-0.240***	0.143***	0.158***	-0.0688*
		(0.0318)	(0.0314)	(0.0313)	(0.0361)	(0.0345)	(0.0307)	(0.0413)	(0.0402)	(0.0384)
	RMSE	0.0214	0.0205	0.0190	0.0124	0.0120	0.0114	0.0137	0.0136	0.0135
US	L	0.133***	0.126***	-0.0443	0.903***	0.819***	0.488***	0.840***	0.835***	0.582***
		(0.0283)	(0.0280)	(0.0279)	(0.0304)	(0.0302)	(0.0299)	(0.0279)	(0.0281)	(0.0274)
	L2	-0.0647**	-0.0951***	-0.174***	-0.143***	-0.0646**	-0.0979***	-0.0766***	-0.115***	-0.192***
		(0.0254)	(0.0262)	(0.0296)	(0.0288)	(0.0292)	(0.0292)	(0.0274)	(0.0284)	(0.0290)
	RMSE	0.0197	0.0190	0.0182	0.00738	0.00691	0.00643	0.0126	0.0127	0.0124

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Since least-squares estimators are downward biased if fixed-effects are included in the regression (Nickel 1981), we estimate the AR(2) processes both with Blundell and Bond (1998) GMM methods and with least squares. The Arellanno and Bond (1991) estimator addresses the same issue, however, with large autoregressive parameters it performs poorly. Blundell and Bond (1998) – based on Arellano and Bover (1995) – use additional moment restrictions. While the least-squares estimates are, as expected, slightly downward biased, they are fundamentally the same. From now on we will hence restrict our estimations to least-squares.
Source: Authors' calculations.

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