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Regional Unemployment in the EU before and after the Global Crisis

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ABSTRACT

In this paper, we have empirically assessed the evolution of European regions in terms of both employment and unemployment during the recent financial crisis and Global Recession. Our specific research questions were as follows: (i) has there been a reversal in employment and unemployment dynamics at a regional level, during the crisis (2007–10) compared to the previous period (2004–07)? (ii) have the western regions in ‘old’ EU states behaved differently in response to the crisis compared with the eastern regions of the NMS? Finally, (iii) are the differences between the two groups of regions related to structural or institutional variables? After a review of the literature on the key determinants of regional unemployment, we have summarized our main findings concerning the Global Crisis’ impact on the labour market. Our econometric investigation aimed to answer the questions we have posed. Structural characteristics have been considered in terms of sector specialization of regional economies. In addition, we have considered certain institutional characteristics, by including indicators of the share of temporary workers and of long-term unemployed. Our analysis has then been targeted at the sub-samples of western- and eastern-European regions: we show that the critical factors for labour market performance during the crisis in these two groups differs greatly. From a methodological viewpoint, we have exploited a spatial filtering technique which allowed us to greatly reduce any unobserved variable bias – a significant problem in cross-sectional models – by accounting for latent unobserved spatial patterns.

Keywords: crisis, employment, unemployment, European Union, NUTS-2, spatial filtering, sector composition

JEL codes: C21, R12

1. Introduction

The 2007–08 financial crisis and the subsequent Great Recession have had profound effects on labour markets, with employment cuts (delayed, in certain European countries, by labour-hoarding practices and working hour adjustments) and consequent increases in unemployment, which are likely to become, at least partially persistent over time. Impact on the labour market due to the crisis has been heterogeneous both between and within countries. It has been deeper in areas specialized in construction (which, in the previous decade, was one of the most dynamic sectors, at least in certain countries) and also – during the general fall of production of 2009 – in many manufacturing areas.

Consequently, the first research question looked at is whether the previous dynamics of employment and unemployment at a regional level, so dominant in the ‘normal’ period of 2004–07, continued or reversed during the ‘crisis’ of 2004–07. In other words, it is interesting to see whether the most penalized regions were also the weakest ones – i.e. where unemployment was rising even before the crisis – or if there has been an ‘inversion’ causing a bigger impact on the previous best-performing regions. This question will be addressed in our econometric investigations (Section 4).

Secondly, it is worthwhile to look at possible differences in the behaviour of eastern European regions (i.e. the New Member States, NMS) compared to old member states regions (OMS) of the European Union (EU). Given the still profound differences in the economic structure and institutional setting of the two groups and the recent inclusion of the latter in the EU (between 2004 and 2007), we expected this differentiation to provide precious evidence on how structurally different economic areas have coped with the global economic crisis. For example, the local industry mix may have played a crucial role in shaping the labour market performance of regional economies before the crisis and in particular, in determining their response to the crisis period.

Thirdly, these two elements – economic structure and institutional setting – imply the need to look for control variables to include in regressions. Although this task is not easy at a regional level (we choose the Eurostat’s NUTS-2 level), we considered the industry mix for structural variables particularly referring to certain specific economic sectors. As for the institutional setting, we have included indicators of the spread of ‘temporary contracts’¹ and long-term unemployment.

Lastly, we have accounted for spatial autocorrelation in model residuals, which was statistically significant. We have therefore used a spatial filtering (SF) technique which, in addition to curing spatial auto-correlation, has an additional advantage. That is it allows us to greatly reduce unobserved variable bias, a significant problem in cross-sectional models, by including indicators of latent unobserved spatial patterns.

Our empirical analysis was carried out for both employment and unemployment in order to control for the behaviour of labour supply. This is potentially relevant in explaining unemployment changes over the business cycle (i.e., the ‘discouraged worker effect’ is particularly important in influencing the propensity of women and young people to work, especially after a profound macroeconomic shock).

The structure of the paper is as follow. Section 2 includes a review of the main literature on the theories and empirical evidence about unemployment dynamics at the regional level. The labour market impact of the recent global crisis is discussed in Section 3, including a

¹ We have used the Eurostat definition of ‘temporary worker’, without considering the different meanings that it has in different countries (indeed this depends on the specific institutions of labour markets, on the legal definition of work contracts, on the various ‘atypical contracts’ existing in many countries, etc.). It should be noted that the concrete meaning of ‘permanent contracts’ is also quite different, in various countries, according to the degree of employment protection legislation (especially the dismissal rules).

descriptive analysis of regional effects. Our econometric investigations are presented and commented in Section 4. Finally, Section 5 concludes.

2. Review of the Literature

The review of the literature is organized around our main research questions. However, let us first briefly explain the determinants of unemployment and their differences between countries and regions.

Unemployment has traditionally been studied at a national level. The main national determinants are found in active labour market policies, unemployment benefits, benefit duration, benefit replacement ratio, tax wedges, degree of coordination, degree of centralization, union density and union coverage (see e.g., Scarpetta, 1996, Nickell, 1997, Garcilazo and Spiezia, 2007, Bassanini and Duval, 2009, Feldmann, 2009, Howell and Rehm, 2009). Blanchard & Wolfers (2000) among others, focused on the interaction between institutional arrangements and economic shocks (especially to explain differences in cross-sectional unemployment rates). On the other hand, Belot and van Ours (2004) investigated the evolution of unemployment over time by interacting institutions and changes in institutions. More recently, Duval *et al.* (2011) addressed the complex topic of the effects of downturns on labour force participation, while Hölscher *et al.* (2011) analysed the dualism between regular and flexible jobs in eastern and western Europe.

It should be noted, however, that the regional level is particularly important not only from an empirical analyses perspective, but also from a policy standpoint. For example, both in terms of the EU's cohesion objectives and considering that, in the multilevel policy design of several European countries, key labour market policies have been decentralized at the sub-national level (e.g., Signorelli, 2008). The regional dimension of unemployment has been given more attention since Blanchard and Katz's work (1992). Regional unemployment differentials are wide and persistent,² and low unemployment regions tend to cluster close to each other. Moreover, such differentials show a clear and persistent core-periphery pattern (European Commission, 2002), since high and persistent unemployment is concentrated in peripheral regions.³

We will first look at work pertaining to the first research question, i.e., on the effects of the crisis on labour markets. The growing literature investigating the labour market impact of the last crisis has treated above all the global and national levels (e.g., Furceri and Mourougane, 2009, Stiglitz, 2009, Arpaia and Curci, 2010, Guichard and Rusticelli, 2010, Furceri and Zdzienicka, 2011). On the other hand regional (sub-national) analyses have been rare (e.g., Demidova and Signorelli, 2011), apart from specific studies by international organizations.⁴

Regarding the second theme, i.e., the differentiation between OMS and NMS, a comprehensive survey on regional labour market developments in transition countries can be found in Huber (2007). A more specific research, by Tyrowicz and Wójcik (2010), investigates convergence (using beta, sigma and stochastic convergence methods) in regional unemployment rates of three transition countries. The development of regional labour markets in NMS has also been analysed and compared to OMS (e.g. Perugini and Signorelli, 2010),

² Persistence and evolution of regional differences in labour market performance have been largely studied also in recent literature (for a review, see Perugini and Signorelli, 2010).

³ Wage rigidities, low labour mobility and specific labour market institutional factors make the effects of the (otherwise temporary) aggregate demand shocks more persistent (see Bentolila and Bertola, 1990).

⁴ See, for example, European Commission (EC; 2009) and Eurostat (2011).

while the only contribution on the labour market effects of the global crisis on NMS has been recently provided by Blažek and Netrdová (2012).⁵

Some specific features of transition countries are important in explaining regional unemployment differentials. The first feature is human capital: according to Jurajda and Terrell (2009), human capital explains the bulk of regional variation in unemployment of four post-communist countries; the dispersion of human capital across regions is largely explained by its distribution at the end of communism. The second feature is migration which however, is low in both groups of countries⁶. Other studies found that a common feature between NMS and OMS is that most adjustment to asymmetric shocks is carried out by participation decisions, while migration plays only a small role (see Gács and Huber, 2005). Certain other features, concerning the wage bargaining system and other institutional elements, will be analysed shortly.

We would now like to look at work on the third issue, i.e., the structural and institutional determinants of unemployment.⁷ Among structural determinants, the sector specialization of regions has received special attention, although the question of whether the specialization of European regions is increasing or decreasing over time is still being debated.⁸ For example, while Izraeli and Murphy (2003) found that in the US an increase in industrial diversification (i.e., a fall in sector specialization) reduces regional unemployment rates, in Europe the institutional elements are more likely to modify such a relation. Indeed, the relationship between regional specialization and the regional unemployment rate is stronger in countries with intermediate collective bargaining institutions. Only in these countries where policies aim to foster regional diversification might they be useful – compared to countries with centralized collective bargaining institutions (see Longhi *et al.*, 2005).⁹

A different strand of research focuses on the effects of the industry mix on the business cycle rather than on long-run structural trends. For example, Belke and Hein (2006) examined correlation among EU regional employment cycles. Their empirical finding was that synchronicity between regions has declined unlike national business cycles, which have become more synchronized. The main reason is related to differences in regional industry structure. Indeed, employment growth is more synchronized when regions are similar in their sector structure. This outcome has been more thoroughly explained in Belke (2007), where it

⁵ The evolution of regional labour market performance in the ‘old’ EU countries and their determinants was previously investigated in Perugini and Signorelli (2007).

⁶ Indeed, the divergence of regional unemployment and wage rates is also influenced by the migration patterns of workers, by skills, and by the flow of foreign capital: more educated workers and FDI flow to regions with a higher concentration of educated workers (see again Jurajda and Terrell, 2009).

⁷ These are the two key determinants, since empirical investigation on regional unemployment differentials have employed a wide range of variables (for a survey, see Elhorst, 2003). Many explanatory variables are negatively correlated with regional unemployment, such as GDP per capita, industry concentration and participation rate; while other variables, such as the weight of young people in the population or the presence of amenities in the region, are positively correlated with it.

⁸ For example, Marelli (2007) found – by using different specialization indices – that for aggregate economies, structural convergence is a widespread phenomenon across European countries and regions, but within the industrial sector and market services, specialization trends are more mixed (with concentration prevailing in some industrial activities).

⁹ The growing integration of European regions, extended to many EU countries – the alleged existence of a core of regions located in northern Europe with uniform employment dynamics is not corroborated – has also been discovered in employment terms. Marelli (2006) analysed a large sample of (NUTS-2) EU regions. He also found that national borders are not particularly significant in singling out clusters of regions with similar patterns of employment growth (in particular, manufacturing employment seems to be more intensively correlated across regions than aggregate employment).

is related to the theories – and empirical evidence – concerning so-called ‘endogenous’ optimum currency areas.¹⁰

As for institutional determinants, these range from the degree of flexibility of labour markets – both numerically (including employment protection legislation, EPL) and in wages – to the diffusion of temporary or other ‘atypical’ jobs, from ‘passive’ policy instruments (unemployment benefits), to the tax wedge and finally including measures for labour mobility. For instance, Bornhorst and Commander (2006) investigated the persistence of regional unemployment rates in six major transition countries. Despite increasing wage flexibility, employment creation has suffered in regions of high unemployment and labour mobility remains limited. They also provided some policy suggestions (e.g. policies addressing housing market imperfections and information asymmetries). Some specific institutional variables were considered in explaining unemployment differentials in transition countries and regions (e.g., indices of ‘progress in transition’).¹¹

For both NMS and OMS, the effects of different wage bargaining systems have been investigated. Indeed, a high regional employment differentiation may be the consequence of a centralized wage bargaining system that causes a low regional wage differentiation.¹²

Last but not least, spatial links between regions have been shown to be important in affecting the performance of regional economic systems and labour markets. Many studies have discussed the importance of such links, both from a theoretical viewpoint (e.g., in a neo-classical, factor-mobility perspective, or within a new economic geography framework) and from an empirical point of view, employing varying econometric techniques, such as (spatial) dynamic panel or spatial VAR models.

More specific studies established that the regional distribution of unemployment rates is more dependent on spatial elements and geographic location (neighbourhood effects) than on national factors (state effects), including labour market institutions. The underlying theories refer frequently to the new economic geography (NEG) models. Garcilazo and Spiezia (2007), considered not only both types of effects but also some joint effects. As a result they came to the conclusion (through a methodology based on nonparametric stochastic kernels) that neighbourhood effects are really stronger (than state effects) in Europe – as originally discovered in the oft-cited work by Overman and Puga (2002). In North America on the other hand joint effects are also important. The policy implication is that in Europe labour market policies alone cannot reduce unemployment if they are not accompanied by measures to generate agglomeration economies.

¹⁰ The existence of endogenous mechanisms leading to ‘real’ convergence is one of the factors underlying the success or failure of the European Monetary Union (see also Marelli and Signorelli, 2010a). On the other hand, the possibility that regional economies exhibit business cycles different from the national ones was originally stressed by Fatàs (1997).

¹¹ In order to explain employment growth in a large sample of NUTS-3 regions in eight transition countries, Marelli and Signorelli (2010b) included an index of ‘progress in transition’, calculated from the European Bank for Reconstruction and Development (EBRD) statistics. Their key finding was a negative effect of the ‘transition index’ on employment growth in a first period (1990–2000), which became positive in the years after 2000 (indeed, the initial privatizations and market reforms were accompanied by rationalizations and restructuring processes causing negative effects on employment). Another important result of the paper is that regional divergence *within countries* co-exists with convergence *between countries*. However, this evidence, although stronger for transition countries (in which the clustering of employment and economic activities in the capital city regions is especially evident), has also been shown for western EU regions (as already found in Marelli, 2007).

¹² Vamvakidis (2009) provides empirical evidence for the EU regions for the period 1980–2000.

3. The latest Crisis' impact on Labour Market Impact: Key Descriptive Features

The latest crisis began as a financial crisis at the end of 2007. Its most severely felt impact on financial markets (with Lehman Brothers default) was in September 2008, when the real effects initially emerged with huge falls in production (until the first half of 2009) which in turn led to increased unemployment (particularly in 2009). After the US and 'old' EU countries, the second round of adverse effects of crisis appeared in transition and developing countries (although China and India were only slightly affected by the crisis).¹³ The real effects (on output, income, etc.) of financial crises are always *lagged* and the labour market effects are lagged even more.

Moreover, not only were such effects delayed, but they were also significantly heterogeneous, differing between countries and regions. Reactions depended upon various factors: for example, country reliance on international trade, dependence on natural resources, financial liberalization of banking system, fiscal resources available to governments, and so on.

Before discussing some national and regional (sub-national) evidence, we would briefly like to present key interpretations of the various national labour market effects of the latest crisis.¹⁴

The various national labour market adjustments have mainly been explained on the basis of institutional frameworks and labour hoarding phenomena. There are two main types of adjustments:

- 1) in the most 'flexible' countries, such as the United States, Ireland, the Baltic states and also Spain (in the latter case because of the huge number of temporary contracts), employment was cut rapidly and deeply, helping to maintain labour productivity (which in some countries had a counter-cyclical pattern), but at the cost of high increases in unemployment;
- 2) on the other hand, other countries (such as Germany, Japan, the Netherlands, Denmark and Italy), experienced less remarkable effects on labour market performance, thanks to more significant labour hoarding practices, working hour adjustments and specific policy measures¹⁵. Moreover, in certain countries (especially in Italy) the fall in labour demand was accompanied by a reduction in labour supply (the 'discouraged worker effect'), thus dampening down the impact on unemployment rates.

As for the intensity of the reaction, the IMF (2009) partly explained this heterogeneity by considering the multi-faceted dimensions of labour market flexibility, including: EPL, types of wage-bargaining arrangements, the level and duration of unemployment benefits and the diffusion of temporary contracts. The stronger employment response in low EPL economies, compared to medium/high EPL economies, is consistent with the literature, suggesting that employment protection reduces both inflows to and outflows from employment. For medium/high EPL countries, the reduction in employment after the crisis was similar to previous cycles despite substantially bigger GDP declines, confirming the higher degree of labour hoarding.

¹³ Throughout the world, the financial crisis initially harmed the US, the UK, Ireland, Spain and smaller countries (Iceland, Greece, the Baltic States). On the contrary, the largest output (real GDP) reductions in 2009 were recorded – among the biggest countries – in Japan, Germany, and Italy (GDP fall was around or above 5% in all three countries). This was a consequence of world trade contractions, affecting more deeply industrial and export-oriented countries.

¹⁴ As we highlighted in Section 2, interpretations of the regional labor market effect of the latest crisis are still few and far between. To our knowledge, this paper is one of the very first that has tried to address this topic.

¹⁵ For instance, subsidies for part-time work in Germany, or extending income support for workers formally maintaining job contracts at reduced working-time or at 'zero-hours' in Italy.

Regarding the timing of the labour market responses, it was estimated that in normal recessions it takes three quarters, after output has started to recover, for employment to start increasing and an additional two quarters for the unemployment rate to peak.¹⁶ In any case, the responsiveness of the unemployment rate to changes in output has increased in many countries, due to less strict employment protection and more temporary employment contracts (IMF, 2010, chapter 3). This responsiveness should help in raising employment rates (after the fall due to the recession) when the recovery will become stronger.

Furthermore, many studies agree that the impact on the labour market has increased gender inequality and poverty. For example, in developing economies, the initial decline in textile and agricultural exports caused an increase in unemployment among women, together with a rise in the female share in the informal sectors and vulnerable (low paid) jobs (Choudhry *et al.*, 2012a). On the contrary, in certain developed economies (especially those directly affected by the crisis or more export oriented), as shown by descriptive statistics, the crisis mainly affected sectors with high male employment, for instance construction and manufacturing, producing a different gender impact compared to past crises (European Commission, 2009).

For future developments a certain degree of persistence is likely, similarly to past crises, due to ‘hysteresis’ effects (an upward shift in ‘structural unemployment’).¹⁷ Persistence and hysteresis largely depend on the robustness of the recovery, also related to the adoption of macroeconomic policies. In the world as a whole, recovery has initially been satisfactory, thanks to emerging economies. In the EU, on the contrary, it has been feeble, also because of the new uncertainty caused by the ‘sovereign debt’ crisis.

We now will consider certain descriptive data concerning national and regional unemployment in the EU countries.¹⁸ In the EU-27, the unemployment rate was 9.7 per cent in 2010 (2.6 points more than the 7.1 per cent of 2008) and persisted at a very similar level in 2011 (a similar value is expected also in 2012 and 2013).¹⁹ With reference to individual countries, in Table A1 in the Appendix, past, present and expected national evidence on unemployment rates are shown for ‘old’ EU countries, new EU transition countries, the US and Japan.

Empirical analyses and interpretations addressing the regional (sub-national) impact of last crisis are still scarce, notwithstanding its importance due to the existence of huge regional differences in unemployment (and employment) rates in Europe (see Figure A3 in the Appendix): in 2010, unemployment rates ranged from 2.7 to 28.9 per cent (more than one fifth of the regions were above 12 per cent, while a further fifth were below 6 per cent) and the employment rates – calculated on population 20–64 – ranged from 43.7 to 83.6 per cent (only a quarter of the regions have already reached the Europe 2020 target of 75 per cent, while 30 per cent have a rate below 65 per cent).

Figure A1 in the Appendix depicts, for the 271 NUTS-2 EU regions: (i) employment change in 2008–09 vs. employment change in the period (average per annum values) 2000–08;

¹⁶ Moreover, these lags are longer if the recession comes together with a financial crisis. It should also be noted that unemployment can still rise (for a period) even after employment growth has become positive.

¹⁷ The EC (Autumn 2011) forecasts for the year 2012–13 largely confirm this expectation.

¹⁸ The employment rate – the key labour market performance indicator of the European Employment Strategy (EES) – declined in 2009 (at 64.6%) and 2010 (at 64.2%) in EU-27. Thus, interrupting its previous continuous rise - towards the ‘Lisbon objective’ (70%) - started with the launch of the EES in 1997 (employment rate EU-27 at 60.7%) and culminated in 2008 (65.9%).

¹⁹ Young people have been remarkably affected by the employment crisis (they are workers with weaker contracts and lower qualifications and experience), as investigated in Choudhry *et al.* (2012b): long term unemployment for young workers can be harmful and may result in ‘discouraged workers’ effects and social exclusion from labour market.

(ii) unemployment rate (UR) change in 2008–09 vs. UR change in 2000–08.²⁰ Although it is apparent that there are clusters of regions on a national base, some of these go beyond national borders.²¹

An emerging question is now whether the deteriorating performance of labour markets after the crisis was accompanied by an increase in disparities between regions. If we calculate the co-efficient of variation (CV) of regional unemployment rates (as shown in Table A2 in Appendix), the answer is negative.²² The data are depicted for all years in Figure A2, together with the UR (average for the EU-27): the top CV was achieved in 2001, after which there was a continuous decrease, before and after the recent crisis. However, the reduction in the CV was not uniform over individual countries, so the overall reduction in the CV of unemployment rates (shown in Figure A2) is expected to have been triggered mostly by the *between-countries* reduction in disparities.

4. Econometric Analysis

The preceding section has outlined recent evidence on the effects of the economic crisis on labour markets and descriptive statistics shown for the data currently available from Eurostat's Labour Force Survey (LFS), which have been used in this paper. This section aims to look further into the preliminary evidence given in Section 3 by means of econometric tools. In particular, we are interested in inspecting the impact of the economic crisis on regional labour markets on the basis of the pre-crisis conditions, and of previous trends. In other words, our focus is on identifying structural weak points in regional labour markets (or factors of competitive advantage) compared to a region's reaction to the crisis.

Furthermore, we have tested for differences between NMS and OMS, that is, whether these factors operated to the same extent for the two groups of regions. In our analysis, we have added two non-EU countries (Switzerland and Norway) to the OMS group, because of the traditional trade and institutional ties between them (e.g., Norway participates in the Schengen agreements and Switzerland has strong trade links with three major Eurozone countries). Thus, we have considered a total of 217 NUTS-2 European regions.

We set up two cross-sectional models, which employ the percentage change in employment (e_{07-10}) and unemployment (u_{07-10}) as dependent variables respectively, during the period 2007–10.²³ The models can be generically written, for region i , as:

$$e_{i,07-10} = \beta_0 + \beta_1 e_{i,04-07} + \beta_2 spec_i^{agr} + \beta_3 spec_i^{con} + \beta_4 spec_i^{fin} + \beta_5 spec_i^{hot} + \beta_6 spec_i^{man} + \beta_7 udur_i + \beta_8 etemp_i + u_i, \quad (1)$$

$$u_{i,07-10} = \beta_0 + \beta_1 u_{i,04-07} + \beta_2 spec_i^{agr} + \beta_3 spec_i^{con} + \beta_4 spec_i^{fin} + \beta_5 spec_i^{hot} + \beta_6 spec_i^{man} + \beta_7 udur_i + \beta_8 etemp_i + u_i, \quad (2)$$

²⁰ The grouping of regions refers either to large countries or to groups of small countries.

²¹ For both variables, the worst performance was found not only in Spanish regions, but also in the Irish and Baltic regions.

²² Indeed, for all EU regions, the CV has decreased not only in the years preceding the crisis (2004–08), but also in the crisis year (2009). The CV was calculated for all 271 EU regions and for the regions in each country. We excluded one-region countries (Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta), two-region countries (Ireland and Slovenia) and Denmark.

²³ We use data from the second quarter (30 June) for both dependent and independent variables. Although LFS data were available for the third quarter of 2010, which would have allowed us to observe some slightly later post-crisis developments, the high number of missing values made it inconvenient to use them, and indicated using second quarter data.

where: e_{04-07} (u_{04-07}) is the employment (unemployment) percentage change over the preceding three-year period (2004–07); $spec$ are variables defining a region’s specialization in a given (NACE) sector (i.e., five specific sectors: agriculture, construction, finance and insurance, hotels and restaurants, and manufacturing), calculated as the percentage of workers employed in the sector on overall (all-sectors) employment; $udur$ is the percentage of long-term (12 months or more) unemployed individuals over total unemployment; and $etemp$ is the percentage of temporary workers over total employment. All control variables were evaluated for the year 2007, that is, the initial year of the crisis, while for each year all data refer to the second quarter.

Figure 1 provides a graphical representation of our dependent variables, at the NUTS-2 level of geographical aggregation. Although there are some differences, the employment and unemployment maps draw a similar picture. Spain, Ireland, the Baltic States, Scotland and the North of Greece appear to be the biggest losers in terms of employment and were the regions where unemployment grew fastest²⁴ (in the latter case together with the North of Italy).

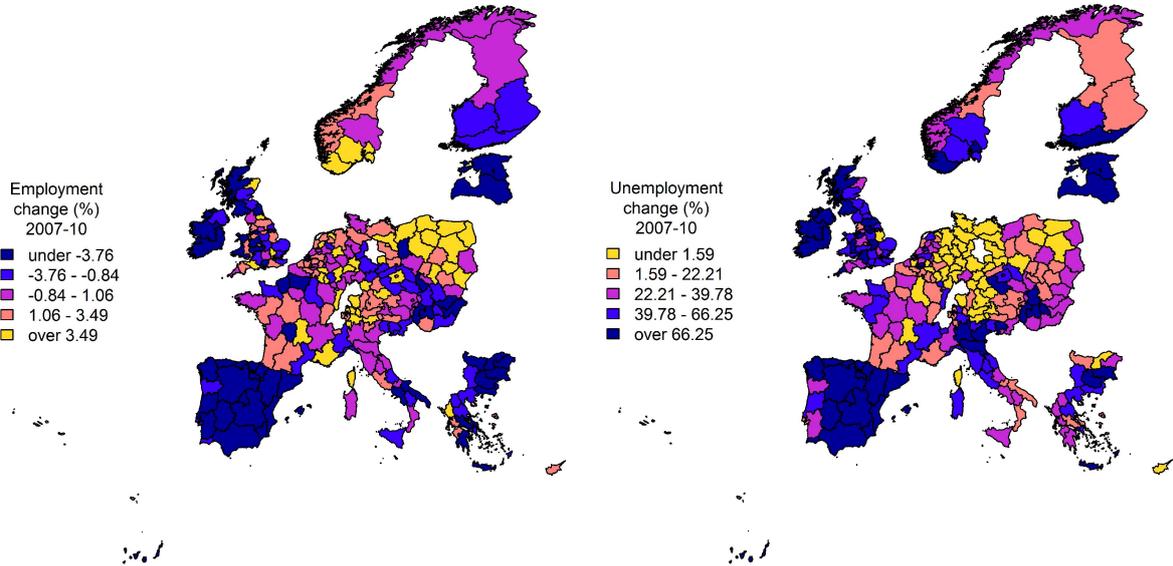


Figure 1 – Employment and unemployment change during 2007–10 at the NUTS-2 level

We included the lagged labour market performance (between 2004 and 2007) in the model in order to investigate trend inversion or continuation phenomena. In particular, we can speculate on the origins of a labour market improvement achieved previously on the grounds of the estimated regression parameter(s) for this variable. If such improvement was due to changes in the economic structure or rising local competitiveness (e.g., due to human capital-intensive industries), then this would have spread its positive effects over the crisis (or at least smoothed out its local impact), conditional on other labour market characteristics. If however labour market results were obtained by fragmenting jobs or by relying on volatile and low-human-capital sectors (such as constructions), we could have expected the crisis to cancel out these results as investments fall and to generate a trend inversion in the labour market.

Trend inversion or continuation should have been conditioned on the structural and institutional characteristics of the labour market at the beginning of the crisis. The $spec$ variables allowed us to control for regional specialization in key sectors (such as construction,

²⁴ Here we refer to the growth of unemployed people in relative terms (hence the increase appears huge even in regions where the initial number of unemployed was low), which can be seen as the percentage change in the representative individuals’ chance to be unemployed. As for spatial distributions of regional unemployment rates levels in 2010, see Figure A3 in the Appendix.

tourism or manufacturing), in order to provide an indicator of a region's exposure to demand volatility. We could expect regions highly specialized in these sectors – which suffered greatly from the crisis – to be more strongly hit by the crisis.

In addition, the *udur* variable aimed to capture the potentially different reaction of regions on the basis of structural characteristics of their unemployed population. We expected regions with high shares of long-term unemployed to be affected differently by a labour demand shock, i.e., that labour participation would have fallen more acutely in these regions because of discouraged workers, consequently moderating the effect of the crisis on unemployment.

Finally, the *etemp* variable provides information on a region's reliance on temporary workers, who, because of weaker contractual power and union support (e.g., the insider/outsider effect), would have been easier to lay off during the crisis. We could then expect regions with higher shares of temporary workers to have been more severely hit by the crisis in terms of employment and unemployment. On the other hand, a higher share of temporary workers may also have denoted a 'fragmentation' of work, which would have provided firms with the ability to redistribute (the decreased) labour demand over the same pool of employees. The expected sign for this variable therefore depends on which one of the these aspects was dominant and is therefore ambiguous.

We started by estimating our models, for employment and unemployment change, by OLS, as reported in Table 1.

Table 1 – OLS estimates, for employment change and unemployment change

	Employment change			Unemployment change		
	Estimate	Std. error	p-value	Estimate	Std. error	p-value
$e_{i,04-07}$	-0.205	0.072	0.005	–	–	–
$u_{i,04-07}$	–	–	–	-0.501	0.169	0.003
$spec_i^{agr}$	0.084	0.063	0.187	0.156	0.559	0.781
$spec_i^{con}$	-0.516	0.162	0.002	10.429	2.315	0.000
$spec_i^{fin}$	1.044	0.233	0.000	-1.584	2.632	0.548
$spec_i^{hot}$	-0.300	0.230	0.194	1.645	2.128	0.440
$spec_i^{man}$	-0.039	0.050	0.441	-0.127	0.544	0.815
$udur_i$	0.065	0.022	0.003	-1.319	0.293	0.000
$etemp_i$	0.122	0.060	0.044	-0.768	0.819	0.349
Intercept	-0.431	2.386	0.857	7.121	25.247	0.778
Moran's I	0.269	–	0.000	0.324	–	0.000
Adj. R-squared	0.319	–	–	0.391	–	–
Residual dof	208	–	–	208	–	–

Note: Robust standard errors.

Table 1 shows consistent results for the effect of the lagged labour market performance, with a significant negative sign, implying – on average – a trend reversal, though the size of the effect was not strong (e.g., an increase of 1 per cent in employment over 2004–07 corresponded to a decrease in 2007–10 of 0.21 per cent). The trend reversal was confirmed also by the regression on unemployment.

Consistent signs between the two equations were found for *udur* as well, confirming the hypothesis that regions with higher shares of long-term unemployed (most likely already suffering from high unemployment and inefficient matching in labour markets) suffered apparently less from the crisis (indeed, the unemployment attenuation may have been caused

by the discouraged worker effect, while in stronger regions the new unemployed was likely to be actively involved in seeking a new job, thus increasing the official unemployment rate).

Specialization in the construction sector seemed to have had the strongest ‘negative’ effects on labour market performance (this is true for both employment and unemployment). On the contrary, specialization in the finance sector seemed to be positively related to employment change, possibly identifying more urbanized and advanced regions, specialized in the tertiary sector and therefore relying less on aggregate demand (it is also well known that the cyclical sensitivity of services is lower compared to other sectors). A further positive relation with employment change was found for the share of temporary workers over employed individuals, suggesting that the hypothesis of greater flexibility may be dominant over the one of easier lay-offs. However, this result should be treated with caution (also because statistical significance is achieved only in the employment equation).

Finally, we carried out diagnostic tests (Moran’s I ; Moran, 1948) for the presence of residual spatial auto-correlation (i.e., correlation between the regression residuals that is due to geographical proximity), which rejected in both cases the hypothesis of spatial randomness of residuals and suggested the presence of either unobserved and spatially correlated relevant explanatory variables or significant spatial spillovers/interaction.

We speculate that such spatial auto-correlation derived from unobserved variables may be due to the strong heterogeneity between European regions in socio-economic terms, for example because of historical/institutional reasons. In particular, eastern-European regions, which joined the EU only recently (between 2004 and 2007), may be seen as a potential driver of heterogeneity as their economies are still integrating into the common market and their transition from agricultural and industrial specialization to the service economy is still ongoing.

We tested the hypothesis that the drivers of labour market outcomes during the crisis – i.e. the way the economic crisis influences the economy and in particular labour – were different for OMS and NMS. Formally, the testable hypothesis is that the vectors of regression coefficients for the former and latter groups are not significantly different, that is, $H_0: \beta_{OMS} = \beta_{NMS} = \beta$. An unpooled model corresponding to Equations (1–2) was easily obtained by interacting an indicator variable with all regressors. Chow (F-)tests (Chow, 1960) can then be carried out between the pooled and unpooled models to test the poolability hypothesis H_0 . Table 2 provides our estimates for the unpooled models, as well as the related F-test results (at the bottom).

Table 2 clearly shows that the findings presented in Table 1 do not entirely hold for the unpooled model. An important outcome is that trend reversal is confirmed in both sub-samples (OMS and NMS) and in both equations. However, with regards to employment growth, pooled results (previously illustrated) suggested that regions with higher long-term unemployment and higher shares of temporary workers performed better during the economic crisis. These results were confirmed in the unpooled estimations only at times. For OMS, the importance of long-term unemployment was confirmed in the unpooled model. On the other hand, the positive effect of the share of workers with temporary contracts was only found for the NMS sub-sample. The co-efficients for the lagged employment growth rate were very similar and not significantly different, confirming the pooled model result.

For the growth rate of unemployed individuals, the findings of the pooled model were confirmed for OMS, that is regions with higher shares of long-term unemployed experienced smaller unemployment increases (because of the ‘discouraged worker’ effects), while those specialized in the construction sector were hit most severely, everything else remained constant (again similarly to the pooled results).

Table 2 – OLS unpooled estimates, for employment change and unemployment change

	Employment change		Unemployment change	
	OMS	NMS	OMS	NMS
$e_{i,04-07}$	-0.220**	-0.250**	–	–
$u_{i,04-07}$	–	–	-0.301**	-0.534*
$spec_i^{agr}$	-0.057	0.227	0.436	-1.459
$spec_i^{con}$	-0.292*	0.024	7.607***	7.911
$spec_i^{fin}$	0.563*	3.555***	2.209	-16.727
$spec_i^{hot}$	-0.204	0.139	2.730	-12.684
$spec_i^{man}$	0.002	-0.036	-0.411	-2.604
$udur_i$	0.069***	0.149	-1.547	-1.188
$etemp_i$	-0.071	0.389***	1.110	-4.262***
Intercept	0.982	-20.149*	1.553	228.738***
Moran's I	0.204***		0.252***	
Adj. R-squared	0.416		0.635	
Residual dof	199		199	
F-test vs pooled model	4.76***		3.97***	

(Table 1)

Notes: *, **, *** denote statistical significance at 10, 5, 1 per cent level, respectively. Robust standard errors.

Finally, the adjusted R^2 of both models was significantly improved from the previous estimates, both F-tests against the pooled models were very significant, as well as Moran tests for residual spatial auto-correlation. An econometric adjustment was then necessary in order to cope with spatial auto-correlation, which violated the assumption of observation independence.

A number of econometric approaches are available to model spatial auto-correlation in cross-sectional models. LeSage and Pace (2009) support the use of general model specifications such as the spatial Durbin model, where spatial lags at both the dependent and independent variables level are allowed for, encompassing all simpler typical spatial regression models such as the spatial lag or the spatial error model. On the other hand, Anselin (1988, 1990) developed a series of (Lagrange multiplier) specification search tests, which start from the OLS residuals augmenting the model in a forward-search fashion. Other contributions, for example Florax *et al.* (2003), suggested additional strategies.

An alternative approach, based on a non-parametric filtering of spatial autocorrelation, was proposed by Griffith (2000, 2003) and widely used in cross-sectional and – more recently – panel frameworks. SF does not require *a priori* knowledge of the type of spatial data-generating process, and allows the researcher to estimate a model in whatever functional form – unlike the other methods which, with the exception of some Bayesian ones – are all based on linear models. Furthermore, SF allows us to incorporate all spatially structured omitted variables in the resulting spatial filter.

The method is essentially based on eigenvector decomposition of a spatial weight matrix, defining neighbouring relations between regions and is mathematically related to the formula of Moran's I . Using a stepwise regression approach, a set of candidate eigenvectors, representing orthogonal and uncorrelated spatial autocorrelation patterns, is evaluated and a subset, called a 'spatial filter', is selected as additional co-variates. This spatial filter maximizes model fit or minimizes residual spatial autocorrelation, depending on the objective

function selected. The final model estimated is therefore (using the pooled unemployment model as an illustration):

$$u_{i,07-10} = \beta_0 + \beta_1 u_{i,04-07} + \beta_2 spec_i^{agr} + \beta_3 spec_i^{con} + \beta_4 spec_i^{fin} + \beta_5 spec_i^{hot} + \beta_6 spec_i^{man} + \beta_7 udur_i + \beta_8 etemp_i + \sum_j \gamma_j e_j + u_i, \quad (3)$$

where e_j is the j th selected eigenvector included in the spatial filter.

While we have referred to Griffith (2000) and Patuelli *et al.* (2012) for further details on the application of the method, in Table 3 there are results obtained by incorporating a spatial filter in the otherwise spaceless models given above. Given the poolability test results presented in Table 2, we limited ourselves to expanding the unpooled models only. The spatial filter approach, which works at the level of the intercept, is not affected by this choice.

Table 3 – SF unpooled estimates, for employment change and unemployment change

	Employment change		Unemployment change	
	OMS	NMS	OMS	NMS
$e_{i,04-07}$	-0.184**	-0.295**	–	–
$u_{i,04-07}$	–	–	-0.407**	-1.000**
$spec_i^{agr}$	-0.104	-0.221	0.374	-3.071*
$spec_i^{con}$	-0.118	-0.194	4.109**	7.859
$spec_i^{fin}$	0.393	0.722	3.179	-34.850*
$spec_i^{hot}$	-0.314	-0.104	3.411	-12.520
$spec_i^{man}$	-0.089	-0.283	0.574	-1.367
$udur_i$	0.071***	0.099	-0.276	-0.606
$etemp_i$	-0.000	0.267	-0.214	-3.786**
Intercept	2.044	-1.051	-34.487	226.881
# of eigen.	20		28	
Moran's I	-0.108		-0.217	
Adj. R-squared	0.665		0.794	
Residual dof	169		161	

Notes: *, **, *** denote statistical significance at 10, 5, 1 per cent level, respectively. Robust standard errors. Ten non-contiguous regions (islands) are omitted from the SF estimates since the spatial weight matrix needs to be non-singular in order to extract real eigenvectors.

The results shown in Table 3 confirm the inverse relationship between the pre- and mid-post-crisis labour market performance with highly significant parameters. Co-efficient values are more heterogeneous than in previous estimates, although a hypothesis of equal coefficients for the OMS and NMS sub-samples cannot be rejected. In the employment model, similar to the pooled OLS estimates, specialization in the construction sector plays a 'negative' role for the OMS, since it reduces employment growth (this effect is even more significant in the unemployment equation). For NMS, the finding of the unpooled OLS model is confirmed, with a positive effect given by the share of temporary workers, which we can guess allows for the needed degree of flexibility in coping with decreased labour demand.

Our unemployment results are consistent with the ones for the OLS model and those for employment. In the OMS, specialization in construction led to greater unemployment increase, suggesting that lay-offs were unevenly distributed across sectors and that the typical lack of investment experienced during economic crises hit the construction sector hardest. On the

other hand, in NMS, temporary workers acted as a cushion against high unemployment as well.

From a statistical perspective, we noted that the adjusted R^2 for both models grew considerably (from 0.416 to 0.665, and from 0.635 to 0.794) after the inclusion of the spatial filters and that spatial auto-correlation in the residuals was now absent. The spatial filters obtained for the two models are shown in Figure 2. In a spatial filter, recognizable spatial patterns can be used to identify the distribution of unobserved variables that influenced (un)employment change over the period 2007–10.

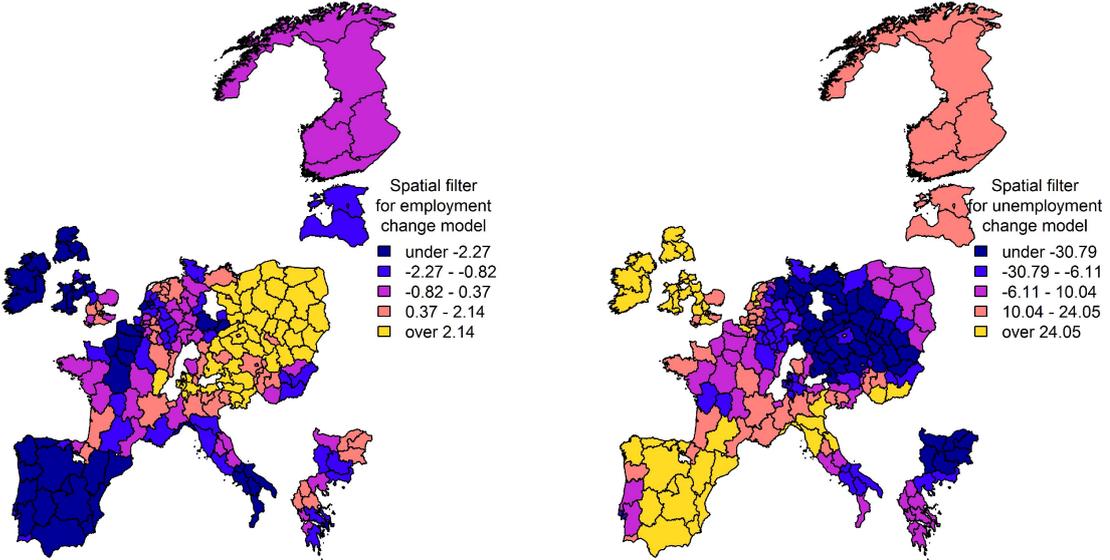


Figure 2 – Spatial filter calculated for the employment and unemployment model estimates

In the left-hand map, pertaining to the employment change model, a contrast can be identified between: (i) problematic areas such as Ireland, Scotland, Spain, the south of Italy and the Baltic States – as already seen in Figure 1 – and (ii) the best performing regions, including most of Poland, parts of Germany and the Alpine arc. The right-hand map, concerning unemployment, shows a similar pattern in inverted colours, as the greatest contrast can be seen between: (i) the areas of Germany, Poland and northern Greece, and (ii) those of Spain, Ireland and the UK. More generally, the estimated spatial filter maps out to what extent our models – which singled out the key factors explaining labour market performance between 2007 and 2010 – may have left out relevant factors. These may be important in fully explaining the superior performance of northern-European regions and, on the other hand, the negative one of areas such as Spain or Ireland.

5. Conclusions

The real effects of the 2007–08 financial crisis have been particularly severe in Europe and significant ‘between countries’ differences emerged also in labour market responses. The impact was exacerbated by the feeble recovery – which differentiated EU countries from other world regions – and further aggravated by the current (2010–11) sovereign debt crises. In addition, while in many countries (both in Europe and North America) the response was characterized by high flexibility, in some EU countries the labour markets were remarkably resilient during the ‘Great Recession’, with employment declining less than output, especially due to reduced working hours per employee. While growing literature investigating these phenomena at a national level already exists, focusing especially on different institutional

settings, our contribution is one of the very few – which is trying to detect certain determinants of the differentiated impact of the crisis on labour market performance at a regional level.

Descriptive statistics for the 271 NUTS-2 regions of the EU-27 highlighted that recent regional changes in (un)employment tend to (partially) cluster on a national base, but many exceptions have clearly emerged. In addition, the disparity for all EU-27 regions has decreased both before the crisis and during the crisis period. The reason for this is that during the crisis all regions suffered, in particular the previous best-performing regions. Moreover, increased unemployment was greater in the latter also because of the limited impact of the ‘discouraged worker effect’ (which reduces labour supply at critical periods).

Our econometric investigation evaluates the impact of the crisis on regional labour markets in terms of both employment and unemployment, on the basis of pre-crisis conditions, specialization and trends. An initial important result is that in general, a 2007–10 trend ‘reversal’ was common to many European regions, thus confirming that the crisis hit the regions which had been more successful in the recent past more heavily (i.e., those with better labour market dynamics during the years 2004–07).

Moreover, we checked the existence of heterogeneity between the two wide groups of regions in Europe, the NMS and OMS. We therefore performed poolability (parameter stability) tests which showed that in western- and eastern-European regions, the critical factors which drove labour market outcomes were very different. This is particularly relevant given that the latter group coincides with NMS regions, which underwent a long and complex process of transition over the previous two decades. Consequently, our final empirical models were carried out by specifying separate effects for the two groups of regions. For both groups, we selected certain control variables – to represent either structural or institutional conditions. These turned out to be significant: for example, the share of workers in specific economic sectors, the weight of temporary employment and the share of long-term unemployment.

Finally, applying appropriate diagnostic tests to our basic OLS model, we found either unobserved and spatially correlated relevant explanatory variables or significant spatial spillovers. Even when taking spatial auto-correlation into account, a ‘trend reversal’, i.e., an inverse relation between the pre- and post-crisis labour market dynamics, clearly emerged, with highly significant coefficients.

For the more specific econometric results, regional specialization in the construction sector and selected characteristics of the labour market (such as long-term unemployment or reliance on temporary workers) seemed to have conditioned regional reactions to the crisis, although to different extents and for particular sub-samples. In particular, we found that western-European (OMS) regions were sensitive to sector specialization, in that the construction sector was a negative factor, both in terms of employment and unemployment.

On the other hand, regions which already showed structural problems, identified by the share of long-term unemployed, were less sensitive to the effects of the crisis (because of the ‘discouraged worker effect’). NMS regions however, were not sensitive to these factors but benefited from the flexibility of workers on temporary contracts.

As previously highlighted, this paper is one of the first dealing with the regional labour market impact of the European crisis. However, the main limitation of our results is the fact that the ‘long crisis’ is still ongoing. Further empirical studies (over a longer period) are necessary to explain the complex dynamics of the regional labour market performance ‘in crisis time’ more in-depth.

From an initial policy perspective, our empirical results can contribute to better implementation of multi-level governance in Europe. In particular, the existence of a clear spatial correlation emerging from regression results confirmed the key importance of both European and national policies. However, neither can ignore *regional* labour market features,

dynamics and drivers, which are particularly important for sub-national (regional) policies, as well as the existence of different determinants of labour market performance in east and west EU regions.

From a further policy perspective, one could speculate that two different approaches should be followed. Regions that before the crisis were in relatively 'good condition' – e.g. regions with low long-run unemployment rates – could benefit from a firmer recovery, and therefore sound European and national macro-economic policies (which in Europe now include credible policies to solve the sovereign debt crisis), accompanied by appropriate active and passive, labour policies. Regions that had already suffered – from structural problems (not only long-term unemployment, but also specialization in cycle-sensitive sectors such as construction) require more specific measures, including proper fiscal and industrial policies, to solve them. Finally, in a long-term perspective, as both types of regions have experienced low rates of economic growth, policies to enhance economic growth – in the spirit of the 'Europe 2020' strategy – should be strongly implemented.

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Appendix

Table A1 – Unemployment rates in European and selected extra-European countries

	1991– 2000	2001– 2010	2004	2005	2006	2007	2008	2009	2010	2011*	2012*
Austria	3.9	4.4	4.9	5.2	4.8	4.4	3.8	4.8	4.4	4.2	4.5
Belgium	8.5	7.8	8.4	8.5	8.3	7.5	7.0	7.9	8.3	7.6	7.7
Bulgaria	–	11.2	12.1	10.1	9.0	6.9	5.6	6.8	10.2	12.2	11.3
Cyprus	–	4.6	4.7	5.3	4.6	4.0	3.6	5.3	6.2	7.2	7.5
Czech Rep.	–	7.0	8.3	7.9	7.2	5.3	4.4	6.7	7.3	6.8	7.0
Denmark	6.6	4.9	5.5	4.8	3.9	3.8	3.3	6.0	7.4	7.4	7.3
Estonia	–	9.7	9.7	7.9	5.9	4.7	5.5	13.8	16.9	12.5	11.2
Euro area (17)	–	8.7	9.0	9.1	8.5	7.6	7.6	9.6	10.1	10.0	10.1
EU (27)	9.2**	8.6	9.1	9.0	8.2	7.2	7.1	9.0	9.7	9.7	9.8
Finland	12.5	8.2	8.8	8.4	7.7	6.9	6.4	6.2	8.4	7.8	7.7
France	10.6	8.9	9.3	9.3	9.2	8.4	7.8	9.5	9.8	9.8	10.0
Germany	7.8	8.8	9.8	11.2	10.3	8.7	7.5	7.8	7.1	6.1	5.8
Greece	9.5	9.8	10.5	9.9	8.9	8.3	7.7	9.5	12.6	16.6	18.4
Hungary	–	7.5	6.1	7.2	7.5	7.4	7.8	10.0	11.2	11.2	11.0
Ireland	11.1	6.3	4.5	4.4	4.5	4.6	6.3	11.9	13.7	14.4	14.3
Italy	10.4	7.8	8.0	7.7	6.8	6.1	6.7	7.8	8.4	8.1	8.2
Japan	3.3	4.7	4.7	4.4	4.1	3.9	4.0	5.1	5.1	4.9	4.8
Latvia	12.7	11.1	10.4	8.9	6.8	6.0	7.5	17.1	18.7	15.0	13.5
Lithuania	7.5	10.9	11.4	8.3	5.6	4.3	5.8	13.7	17.8	15.1	13.3
Luxembourg	2.5	4.1	5.0	4.6	4.6	4.2	4.9	5.1	4.6	4.5	4.8
Malta	5.7	7.1	7.4	7.2	7.1	6.4	5.9	7.0	6.9	6.7	6.8
Netherlands	5.1	4.0	5.1	5.3	4.4	3.6	3.1	3.7	4.5	4.5	4.7
Poland	–	14.3	19.0	17.8	13.9	9.6	7.1	8.2	9.6	9.3	9.2
Portugal	5.5	7.4	6.7	7.7	7.8	8.1	7.7	9.6	12.0	12.6	13.6
Romania	–	7.1	8.1	7.2	7.3	6.4	5.8	6.9	7.3	8.2	7.8
Slovakia	–	15.1	18.2	16.3	13.4	11.1	9.5	12.0	14.4	13.2	13.2
Slovenia	–	6.1	6.3	6.5	6.0	4.9	4.4	5.9	7.3	8.2	8.4
Spain	15.7	11.9	10.6	9.2	8.5	8.3	11.3	18.0	20.9	20.9	20.9
Sweden	7.6	7.0	7.4	7.7	7.1	6.1	6.2	8.3	8.4	7.4	7.4
UK	7.9	5.6	4.7	4.8	5.4	5.3	5.6	7.6	7.8	7.9	8.6
US	5.6	6.1	5.5	5.1	4.6	4.6	5.8	9.3	9.6	9.0	9.0

Source: European Commission. * Autumn Forecasts ** EU-15.

Table A2 – Coefficient of Variation (CV)

	1999–2003	2004–08	2009
Austria	36.0	38.5	29.7
Belgium	47.6	50.9	48.8
Bulgaria	23.0	28.1	28.0
Czech Rep.	42.4	47.5	37.0
EU27	63.0	54.2	48.9
Finland	52.9	42.0	27.2
France	46.6	57.8	50.3
Germany	52.1	43.0	37.6
Greece	21.0	21.8	17.7
Hungary	33.6	33.0	28.3
Italy	75.3	57.4	44.6
Netherlands	24.9	19.9	21.2
Poland	19.0	15.1	18.8
Portugal	36.8	29.3	20.7
Romania	14.7	23.9	29.1
Slovakia	39.0	50.6	45.4
Spain	38.8	40.4	29.1
Sweden	23.8	13.1	9.7
UK	30.9	27.4	24.9

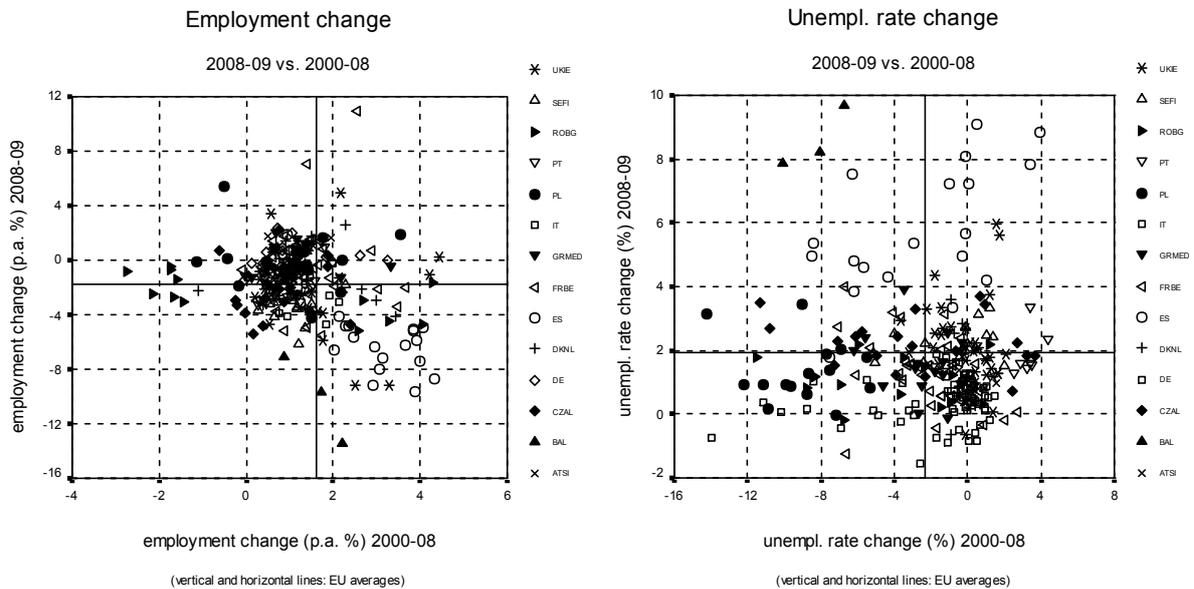


Figure A1 – Employment and unemployment change in 2000–08 and 2008–09 at the NUTS-2 level

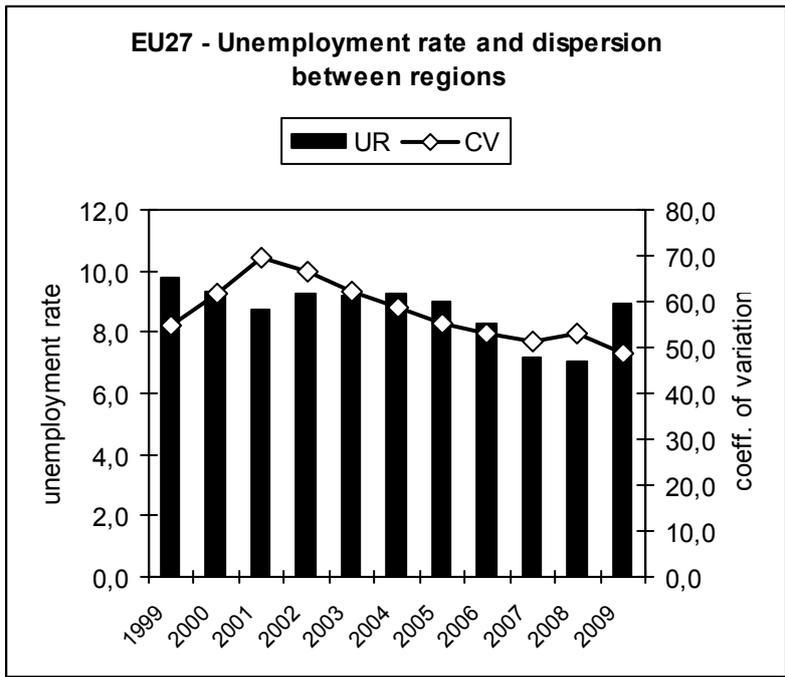


Figure A2 – UR level and CV (EU-27)

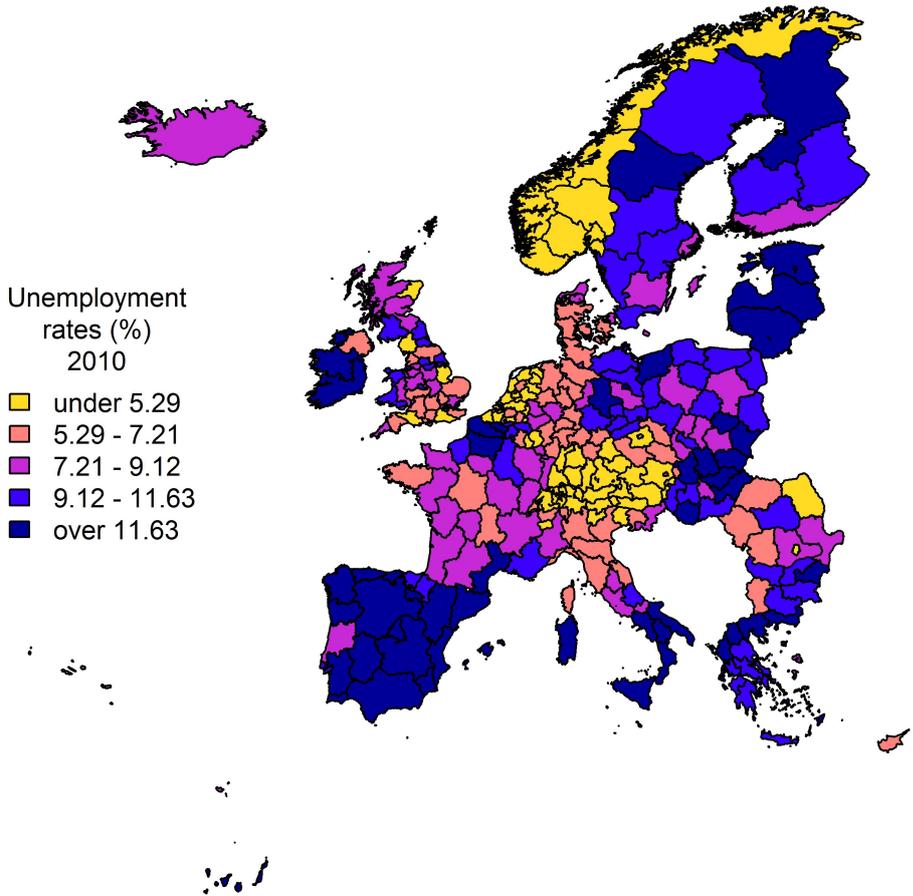


Figure A3 – Unemployment rate, by NUTS-2 regions, for the year 2010