Chapter 6

Unemployment: Empirical analysis*

High levels of national unemployment pose an important policy concern for the European Union. Moreover, there is concern that unemployment rates vary substantially across regions within countries. According to the “Employment Guidelines” of the European Council (2005), member states should attempt to strengthen social and territorial cohesion and reduce regional disparities in terms of employment, unemployment and labour productivity.

A graphical illustration of both the large dispersion of regional unemployment rates around the national averages, and the dispersion of national unemployment rates around the European average in the data to be analysed in this chapter, can be found in appendix 6.A. We see that the disparities of the unemployment rate within countries are about as large as those between countries, indicating that both regional and national variables are consequential in explaining unemployment rates.\(^1\) The graphs also show that regional unemployment disparities are highly persistent over time.

Figure 6.1 depicts the geography of the unemployment rates of the regions included in the analysis. We see that regional unemployment rates are as high as 31.8% in Andalucia (Spain) and as low as 3.1% in Oberösterreich (Austria). We can also observe a clustering of regional unemployment rates, especially within countries. An analysis of regional unemployment rates has to account for this spatial dependence.

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*This chapter is based on joint work with J. Paul Elhorst.

\(^1\)The ratio of disparities within countries to disparities between countries is, on average, 1.02. These disparities are measured as “within group variation” and “between group” variation.
In our view, regional unemployment rates are determined by both regional and national factors. Regional unemployment rates are, on the one hand, strongly influenced by the structure of the regional labour market. On the other hand, regional labour markets operate in an environment that is heavily influenced by national labour market institutions. In the previous chapter we analysed the effect of moving costs and unemployment benefits on regional unemployment in a theoretical model with centralised wage bargaining. In this chapter we use a wider range of variables to empirically investigate regional unemployment in countries of the EU.

Most empirical studies examine the effect of regional variables on regional unemployment for a single country. The problem with this approach is that one cannot measure the effect of different national level variables. However, regional unemployment studies that do consider multiple countries nevertheless tend to omit national labour market institutions as explanatory variables. Finally, studies that investigate the effect of labour market institutions on unemployment for several countries usually focus on national unemployment rates.

By using the regional econometric model developed earlier in chapter 2, we are able to model the two components simultaneously and thus to determine the relative importance of regional and national characteristics.

Chapter 6 is structured as follows. In section 6.1 national and regional determinants of the (regional) unemployment rate are deliberated. In section 6.2 we delineate an econometric model in which the variable to be explained is the unemployment rate at the regional level, and in which both regional-level and national-level variables serve as explanatory variables. Because we are interested in the regional distribution of the unemployment rate within countries as well as among them, we employ a mixed model with random coefficients for the regional-level variables and fixed coefficients for the national-level variables. The common problems of space-time data, serial dependence, spatial dependence, and heteroskedasticity are accounted for. We discuss the data in section 6.3, present and discuss the results of our empirical analysis in section 6.4, and recapitulate our major findings in section 6.5.

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2For an overview, see Elhorst (2003a).
3See e.g., Baddeley, Martin, and Tyler (1998b) and Taylor and Bradley (1997b).
4Two fairly recent surveys of the literature on the effect of labour market institutions on aggregate performance are conducted by Blau and Kahn (1999) and Nickell and Layard (1999).
6.1 Determinants of unemployment

Regional unemployment rates are determined by labour demand variables, labour supply variables and wage-setting variables. Some of these variables may vary between countries, while others may also vary between regions within countries. In section 6.1.1 we examine the national variables and in section 6.1.2 the regional variables.

6.1.1 National variables

In the past two decades several studies investigating the effect of labour market institutions on national unemployment rates have appeared. The general idea behind most of these studies is that institutions influence *equilibrium unemployment*, i.e. the unemployment level that is consistent with stable inflation. This equilibrium level is also called the Non-Accelerating Inflation Rate of Unemployment (*NAIRU*). Actual unemployment is determined by this equilibrium level as well as deviations from this equilibrium level.\(^5\) Most of these studies assume imperfect labour and product markets. Some studies delineate an explicit theoretical model, assuming imperfect labour and product markets, while others implicitly assume imperfect labour and product markets.

Nice examples of the former are Belot and Van Ours (2001, 2004), whose theoretical models consist of a wage bargaining model where unions and employers or employer federations bargain over wages and employers determine the level of employment, known as a “Right to Manage” (RTM) model. Another explicit theoretical model is a two-period overlapping generations model in which wages are set by monopolistic trade unions (Daveri & Tabellini, 2000).

An example of implicitly assumed imperfections is Scarpetta (1996), who uses a simple model with a downward sloping labour demand curve and an upward sloping wage-setting schedule.\(^6\) The wage-setting schedule reflects the negative relation between unemployment and wages, and the positive impact of wage push factors, such as the relative wage bargaining power of unions on unemployment.

The empirical literature investigating the influence of institutions on unemployment in a cross-country perspective is expanding rapidly.

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\(^5\) An in-depth discussion on the NAIRU can be found in the special issue of *The Journal of Economic Perspectives*, volume 11, No.1 of 1997, pp. 1–108.

\(^6\) The curves are shown in a figure with employment measured as labour supply, minus unemployment on the x-axis and real wage on the y-axis.
These empirical studies can be grouped into three categories. First are studies examining the effect of institutions on unemployment independent of other institutions (Daveri, Tabellini, Bentolila, & Huizinga, 2000; Fitoussi, Jestaz, Phelps, & Zoega, 2000; Nickell, 1998, 1997; Scarpetta, 1996).⁷

Second are analyses that also allow the effect of an institution on unemployment to differ, depending on the value of other institutions. In these studies the interaction effect between institutions is captured by including the product of two institutions as an independent variable (Belot & Van Ours, 2001, 2004; Di Tella & MacCulloch, 2005; Elmeskov, Martin, & Scarpetta, 1998).

Third are investigations of the impact of interaction effects between shocks and institutions on unemployment (Blanchard & Wolfers, 2000; Nickell, Nunziata, & Ochel, 2005).⁸

Whereas the effect of some institutions is consistent across studies, the effect of other institutions on unemployment is more ambiguous. Below we discuss the theoretically expected effect of institutions on unemployment, the empirical results found in previous studies, as well as the way we include institutions as national level explanatory variables in our analysis.

**Wage bargaining level**

According to Calmfors and Drifflill (1988), the relation between the degree of centralisation of wage bargaining and wages is hump-shaped. Both low and high levels of centralisation lead to moderation of wage demands. In the former case wage moderation is caused by market forces. The reasoning is that if wage bargaining takes place at the firm level, the market power of unions is limited and wage demands moderate. In the latter case moderation is caused by the internalisation of externalities. If the union and the employer federation bargain at the national level, it is likely that they account for the effect of higher wages on the general price level as well as unemployment. By contrast, if wage bargaining takes place at the industry level, the union and the employer federation do not take into account that higher wages and lower employment in the own sector hinders workers from other sectors in

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⁷Though Fitoussi et al. (2000) examine the effect of labour market institutions on unemployment, the primary aim of their paper is to determine the effect of stock market valuation on unemployment.

⁸Nickell et al. (2005) include interactions between institutions as well.
obtaining a job.\textsuperscript{9} Assuming a downward sloping labour demand curve, the hump-shaped relation between centralisation and wages corresponds to a U-shaped relation between centralisation and employment, and a hump-shaped relation between centralisation and unemployment. In other words, both low and high levels of centralisation cause the unemployment rate to decrease.\textsuperscript{10}

The empirical evidence is a mixed. Both Elmeskov et al. (1998) and Scarpetta (1996) find evidence in favour of the hump-shaped hypothesis. Elmeskov et al. (1998) find a positive effect on unemployment for countries with an intermediate level of centralisation and a negative effect for countries with a high level of centralisation. In Scarpetta (1996) the centralisation variable has a positive and its square a negative impact on unemployment.

The regressions of Belot and Van Ours (2001, 2004) show a negative effect of centralisation on unemployment, but this effect becomes insignificant if country and time period fixed effects are included.

Partly because of a lack of variability over time and across countries (see OECD, 2004, Table 3.5), we do not use the centralisation variable as a separate variable in our analysis, but rather combine the centralisation variable with union density.

**Union density**

Since higher union density strengthens the bargaining position of the union, we might expect higher wage demands, lower employment, and higher unemployment if union density increases. To explain this, let us consider a ‘Right to Manage’ (RTM) model. In an RTM model all equilibria are on the labour demand curve, and the higher the wage bargaining power of the union the more the equilibrium point will move upwards along the labour demand curve (see e.g., Teulings & Hartog, 1998, Chapter 4). So if we proxy wage bargaining power in an RTM model by union density, higher union density leads to higher wages and lower employment.

There is some empirical evidence to support this hypothesis, see Nickell (1997, 1998) and Scarpetta (1996), but not all studies find a significant effect of union density on unemployment (Blanchard & Wolfers, 2000; Elmeskov et al., 1998; and Nickell et al., 2005), or on the change

\textsuperscript{9}A more elaborate overview of negative wage externalities is given by Calmfors (1993).
\textsuperscript{10}Note that the effect of intermediate level wage bargaining on unemployment can be offset by the extent to which bargaining is coordinated.
of unemployment (Fitoussi et al., 2000). The reason is that the effect of union density on wage demands may also depend on the degree of centralisation. Belot and Van Ours (2001) expect union density to have a larger positive effect on unemployment in countries with decentralised and uncoordinated economies, because unions have a more favourable bargaining position under such circumstances. Belot and Van Ours (2001, 2004) find empirical evidence for this hypothesis, in that union density has a positive effect on unemployment in case of decentralised wage bargaining only.

Another hypothesis about the interaction between union density and centralisation is that in countries with plant level bargaining, unions may moderate wage demands compared to individual non-union workers to ensure local plant employment. Similarly, in countries with centralised wage bargaining, unions may consider the macroeconomic consequences of higher wages and therefore moderate their wage demands. Conversely, in countries with intermediate wage bargaining both effects do not occur and higher union density may lead to higher wage demands, lower employment and higher unemployment, unless wage bargaining is coordinated.

The OECD has constructed both a centralisation index and a coordination index (OECD, 2004, Table 3.5). However, centralisation and coordination appear to be highly correlated; in our sample the correlation coefficient between these two indices is 0.83.

The combined influence of centralisation and union density is covered in the analysis by interacting centralisation with union density. Three variables result: union density with centralised wage bargaining, union density with decentralised wage bargaining, and union density with intermediate level wage bargaining.

**Unemployment benefits**

Unemployment benefits influence unemployment in three ways. First, higher unemployment benefits may have a positive influence on wage demands because the fear of unemployment decreases. The higher wages in turn lead to lower employment and higher unemployment, as has been demonstrated in chapter 5 using an RTM wage bargaining model. Second, higher unemployment benefits make participation in the labour

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11Fitoussi et al. (2000) find an insignificant effect of union density on the change of average unemployment between the 1980s and the 1990s.

12An interesting exception is Germany, where wage bargaining usually takes place at the intermediate level, but wages are coordinated across sectors (Soskice, 1990).
market more attractive because of the entitlement effect, which may result in higher labour force participation. As we have seen in section 3.3, higher unemployment benefits increase the expected benefits of participation in the labour market relative to the expected benefits of being inactive. Third, in a standard search model higher unemployment benefits lead to lower search intensities of unemployed workers, thereby lowering the number of successful matches (see e.g., the survey article by Atkinson & Micklewright, 1991). As a result, average unemployment duration increases and so does the unemployment rate. In sum, all three effects may lead to higher unemployment.

Previous studies based on cross-country data usually find a positive effect of unemployment benefits on unemployment (Blanchard & Wolfers, 2000; Daveri et al., 2000; Elmeskov et al., 1998; Fitoussi et al., 2000; Nickell et al., 2005; Nickell, 1998, 1997; Scarpetta, 1996). However, Di Tella and MacCulloch (2005) do not find a significant effect of unemployment benefits on unemployment. This also holds for Fitoussi et al. (2000) and Daveri et al. (2000), who analyse the effect of unemployment benefits on unemployment change. Finally, Belot and Van Ours (2001, 2004) find a negative effect of unemployment benefits, provided that the interaction effect of unemployment benefits and taxes is also included. The latter effect is found to be positive.

A potential problem of including unemployment benefits when explaining unemployment in a cross-country study is reverse causality, since governments in countries with higher levels of unemployment might be induced to install more generous unemployment benefit systems. So higher unemployment might cause higher unemployment benefits instead of the other way around. There is, however, some micro-economic evidence showing that unemployment benefits positively affect the duration of individual unemployment in European countries, see e.g., Røed and Zhang (2003) for Norway and Narendranathan, Nickell, and Stern (1985) for the UK. The evidence for the Netherlands is mixed. Van den Berg (1990) finds virtually no effect of unemployment benefits on unemployment duration, whereas Abbring, Van den Berg, and Van Ours (2005) show that punitive benefit reductions substantially increase individual re-employment rates. Another form of reverse causality is that higher unemployment rates may induce governments to reduce unemployment benefits. This would result in a negative relation

\footnote{Fitoussi et al. (2000) find a negative though insignificant effect of the unemployment benefit replacement ratio on the change of average unemployment between the 1980s and the 1990s.}
between unemployment benefits and unemployment rates.

We include the influence of unemployment benefits by using the unemployment benefit replacement rate from the OECD as an explanatory variable. The unemployment benefit replacement rate is the ratio between the unemployment benefit and the median wage. For further details, see appendix 6.B.

Tax wedge
Although an increase in payroll taxes will have no long-run effects on unemployment in a perfectly competitive world, it might raise unemployment if unions have bargaining power and product markets are not perfectly competitive (Scarpetta, 1996). Furthermore, even if capital is perfectly mobile between countries while labour is not, the employer will bear the tax burden of a rise in payroll tax, provided that a worker is already receiving the minimum wage (Nickell, 1997). This in turn may lead to lower employment and higher unemployment.

On the other hand, the effect of an increase in the tax wedge on employment and unemployment also depends on the tax treatment of unemployment benefits (Daveri & Tabellini, 2000). The more an increase in the tax wedge is accompanied by an equal decrease in net unemployment benefits (i.e. the outside option of workers if unions and employer federations bargain over wages), the less wages and unemployment will increase. In other words, the effect of an increase in the tax wedge is partly cancelled out if it is accompanied by an increase in the tax on unemployment benefits. In theory the effect of an increase in the tax wedge on unemployment could be zero if the tax on unemployment benefits is equal to the tax on labour. In practise, however, this is not the case. Daveri and Tabellini (2000, Table 3) show that labour is more heavily taxed than unemployment benefits, and that in many countries unemployment subsidies are (partially) exempted from social security contributions. Consequently, we expect a positive effect of the tax wedge on wages and unemployment.

A positive relation between a tax wedge and unemployment rates is found by Daveri et al. (2000), Blanchard and Wolfers (2000), Nickell (1997), and Nickell (1998). The tax wedge also has a positive effect on unemployment in the study by Elmeskov et al. (1998), but this effect only persists for intermediate and low levels of centralisation and coordi-

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14In the study by Nickell (1998) the effect of the tax wedge on unemployment is positive in the short-term, while the effect of the tax wedge on unemployment is insignificant in the long-term.
nation if the tax wedge is interacted with a centralisation-coordination variable.

The tax wedge has an insignificant effect on unemployment in the analysis by Scarpetta (1996), while employment taxes have an insignificant effect on unemployment in a regression by Di Tella and MacCulloch (2005). The effect of the employment tax rate on unemployment is positive in Nickell et al. (2005), whereas the interaction between the employment tax rate and coordination has a negative effect on unemployment.

We use the tax wedge constructed by the OECD as an explanatory variable to measure social security contributions and personal income tax, less transfer payments of employees and employers as a percentage of gross labour costs for married couples. See appendix 6.B for further details.

Interaction between tax wedge and unemployment benefits
Belot and Van Ours (2004) show that the effects of the tax wedge and the unemployment benefits on unemployment are co-dependent. They develop an RTM wage bargaining model. Using this model they find a downward-sloping labour demand curve and an upward sloping bargaining curve, representing labour supply, in \((w, L)\)-space. Next, they show that the effect of a shift of the bargaining curve due to an increase in benefits depends on the tax level. Whether this interaction effect is positive or negative does not follow from this theoretical model; however, according to the empirical analysis of Belot and Van Ours (2001, 2004), the interaction between the tax wedge and unemployment benefits is positive.

Employment protection
Stronger employment protection reduces the inflow into unemployment, because firing an employee becomes more difficult while conversely, stronger employment protection makes an employer more cautious about hiring a new employee and reduces the outflow from unemployment. One would therefore expect lower short-term unemployment and higher long-term unemployment if employment protection increases. The overall effect on unemployment can go either way, albeit it could be quite small, because the short-run and long-run effects tend to cancel each other out.

\[\text{OECD (2004, Table 2.2).}\]
Beginning with the seminal paper of Lazear (1990), most theoretical studies predict a positive effect of employment protection on unemployment, with the exception of Alvarez and Veracierto (2001), who find that severance payments can have large positive effects on employment in a model with search costs and rigid wage contracts.

The cross-country empirical literature delivers mixed results for the effect of employment protection on unemployment. Belot and Van Ours (2001, 2004) find a negative effect of employment protection on unemployment in the case of decentralised wage bargaining. Daveri et al. (2000) also find a negative effect of employment protection on unemployment, which becomes insignificant if a growth variable is included. By contrast, in studies by Blanchard and Wolfers (2000), Elmeskov et al. (1998) and Scarpetta (1996), employment protection has a positive effect on unemployment, while in Fitoussi et al. (2000), Nickell et al. (2005), and Nickell (1997), the effect of employment protection on unemployment is insignificant.\(^\text{16}\)

We use the employment protection index from Nickell in our analysis, supplemented by data from the OECD Labour Market Statistics Database.

**Changes in inflation**

If the actual price level exceeds the expected price level, real wages are lower than expected during the wage bargaining process and, as a result, employment increases and unemployment decreases (see e.g., Belot & Van Ours, 2001; Nickell, 1998). The opposite holds if the actual price level is lower than the expected price level. Belot and Van Ours (2004) use the change of inflation as the driving macroeconomic variable that causes actual unemployment to deviate from its equilibrium value. Similarly, Fitoussi et al. (2000) include the change of inflation to control for “effective demand” shocks.

Both lines of reasoning lead us to expect that the change of inflation has a negative influence on unemployment, and in fact, this expectation is supported by empirical evidence. Both Belot and Van Ours (2001, \(^\text{16}\)Nickell (1997, 1998) find a positive effect (at a 10% significance level) of employment protection on long-term unemployment and a negative effect of employment protection on short-term unemployment. The effect on total unemployment is insignificant in Nickell (1997). Nickell (1998) does not regress total unemployment on employment protection.
2004) and (Nickell, 1998) report negative coefficients for the change of inflation in explaining unemployment.

We incorporate price surprises (actual price level minus the expected price level) by using the change in inflation as a proxy.

**Minimum wage**
Another labour market institution related to wage bargaining is the minimum wage level. However, since many countries do not have statutory minimum wages, and because minimum wages do not tend to have much impact on employment except for young people (see e.g., Dolado et al., 1996), we do not include this variable in our analysis.

### 6.1.2 Regional variables

An extensive overview of regional variables used in empirical studies to explain regional unemployment differentials is provided by Elhorst (2003a). Elhorst reviews 41 empirical studies in order to provide a detailed overview of both theoretical and empirical explanations of regional unemployment differentials used in the applied literature. We have grouped the explanatory variables from Elhorst’s study into nine categories shown in the first column of table 6.1. The regional variables included in the econometric analysis of this chapter are listed in the second column of table 6.1. Regional variables reviewed in Elhorst (2003a) are given in column four. The third and fifth column of table 6.1 contain the most likely sign of the explanatory variables.

It can be observed from table 6.1 that we do not include regional variables from all categories. Variables from the categories “Wage-setting” and “Social security” are added as national rather than regional variables in our analysis because in contrast to the United States, wage-setting institutions and social security indicators do not vary between regions within countries in the European Union.¹⁷

Variables from the categories “Housing market” and “Amenities” are not used because regional data are unavailable for all regions and countries in our sample. What is more, amenities commonly do not appear

¹⁷Note that, although the degree of centralisation of wage bargaining does not vary within EU countries, union density probably does. Unfortunately, we do not have regional data on union density and therefore we include this variable as a national level variable.
to have a significant influence on regional unemployment in empirical studies (Elhorst, 2003a).\footnote{In theory amenities could have an upward effect on regional unemployment by acting as a compensating differential.}

In the remainder of this section we discuss why, through using table 6.1, we include some regional variables mentioned in Elhorst (2003a) and exclude others.

**Demographic composition**
The demographic composition of the population may have the following effects on regional unemployment rates. First, we expect a positive effect of the percentage of younger people in a region on unemployment, due to relatively high youth unemployment.\footnote{Note that the upward effect on unemployment will be tempered if relatively many young people are enrolled in full-time education.} Second, the effect of the percentage of older individuals in a region can go both ways. For instance, older workers may use the unemployment benefit system as an early retirement scheme, thus raising unemployment.\footnote{In The Netherlands, for example, workers aged 57.5 years and above who became unemployed were exempted from the obligation to search for a job in order to collect unemployment benefits. However, this exemption ended in 2004.} Conversely, older workers may use actual early retirement schemes and exit the labour force into retirement, which may lower unemployment.

According to Elhorst (2003a), regional unemployment tends to increase if the population is relatively young and decrease if the population is relatively old (i.e. aged 60 years and over or aged 65 years and over). On the other hand, if the population is moderately old (i.e. age group 55-59 and age group 40-64 in the studies cited in Elhorst, 2003a), the effect on unemployment is positive.

We include two variables to account for regional differences in the demographic composition of the population, the percentage of the working age population aged between 15 and 24, and the percentage of the working age population aged between 55 and 64.

Another variable representing the demographic composition of the population is birth rate. The birth rate not only captures whether or not a population is relatively young, but it also influences the labour force participation rate of women, which in turn influences unemployment (Elhorst, 2003a). However, as we already include labour participation as an explanatory variable, it suffices to include the two population age groups.
Table 6.1: Regional explanatory variables.

<table>
<thead>
<tr>
<th>Category</th>
<th>Included regional explanatory variables</th>
<th>most obvious sign</th>
<th>Explanatory variables reviewed in Elhorst (2003)</th>
<th>most obvious sign</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic composition</strong></td>
<td>Population [15-24]</td>
<td>+</td>
<td>Birth rate</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Population [55-64]</td>
<td>+</td>
<td>Relatively young population</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Relatively old population</td>
<td>-</td>
</tr>
<tr>
<td><strong>Educational attainment</strong></td>
<td>Education</td>
<td>-</td>
<td>Education</td>
<td>-</td>
</tr>
<tr>
<td><strong>Economic performance</strong></td>
<td>Lab. prod. growth</td>
<td>-</td>
<td>GRP/capita</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Employment growth</td>
<td>-</td>
<td>Employment growth</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Vacancy rate</td>
<td>-</td>
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<td></td>
<td></td>
<td></td>
<td>Market potential</td>
<td>-</td>
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<td></td>
<td></td>
<td></td>
<td>Industry mix</td>
<td>uncertain</td>
</tr>
<tr>
<td><strong>Labour supply</strong></td>
<td>Participation rate</td>
<td>-</td>
<td>Participation rate</td>
<td>-</td>
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<td></td>
<td></td>
<td></td>
<td>net (inward) migration rate</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>net (inward) commuting rate</td>
<td>-</td>
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<tr>
<td><strong>Lagged unemployment</strong></td>
<td>Unemp. rate ((t - 1))</td>
<td>+</td>
<td>Unemp. rate ((t - 1))</td>
<td>+</td>
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<td></td>
<td></td>
<td></td>
<td>Unemp. rate in contiguous regions</td>
<td>+</td>
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<td></td>
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<td>Unemp. rate in hinterland regions</td>
<td>+</td>
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<td></td>
<td></td>
<td></td>
<td>National unemp. rate</td>
<td>+</td>
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<tr>
<td><strong>Wage-setting</strong></td>
<td></td>
<td></td>
<td>Wages</td>
<td>+</td>
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<tr>
<td><strong>Social security</strong></td>
<td></td>
<td></td>
<td>Availability social security</td>
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<td></td>
<td></td>
<td></td>
<td>Generosity social security</td>
<td>+</td>
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<tr>
<td><strong>Housing market</strong></td>
<td></td>
<td></td>
<td>Public rental</td>
<td>+</td>
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<td></td>
<td></td>
<td></td>
<td>Owner occupied</td>
<td>+</td>
</tr>
<tr>
<td><strong>Amenities</strong></td>
<td></td>
<td></td>
<td>Amenities</td>
<td>+</td>
</tr>
</tbody>
</table>
**Educational attainment**
We expect that education has a negative effect on (an individual’s) unemployment for three reasons (see Elhorst, 2003a, p. 738). First, in an economy with continued technological progress, labour demand tends to focus on skills presumably exhibited mainly by better educated individuals. Second, the search behaviour of better educated individuals is expected to be more efficient. As a result, better educated individuals find a job more quickly than less educated individuals. Third, the higher a person’s educational attainment the lower the probability that an individual is laid off. This results in longer employment spells for better educated individuals. In addition, a fourth reason may even be more important: higher skilled workers crowd out workers with less education by accepting jobs that require lower educational attainments than they possess.

Elhorst (2003a) refers to two additional reasons why, on a regional scale, regions with a better educated workforce tend to have lower unemployment. First, regions with a low level of human capital may suffer from an outflow of workers with the highest skill levels who seek opportunities in other regions. As a consequence, the human capital level of a region deteriorates thus increasingly leaving the region in a low-skill poverty trap. A second, related reason is that individuals with low skill levels from regions with relatively high unemployment are at a disadvantage if they search for a job in a region with higher human capital levels. The implication is that the probability that low skilled individuals will migrate from regions with high unemployment is small.

The aforementioned considerations are supported by the empirical evidence surveyed by Elhorst (2003a) in which the effect of education on unemployment is either negative or insignificant.

We chose to include the percentage of individuals having medium or higher education to account for differences in the educational attainment of the labour force.

**Economic performance**
There are several ways to measure a region’s economic performance such as employment growth, gross regional product (GRP) per capita, market potential, industry mix, the vacancy rate, and labour productivity growth (table 6.1).
High employment growth rates, high gross regional product per capita, a favourable industry mix, high vacancy rates, large labour productivity growth rates, and a large market potential are all considered indicators of good economic performance of a region. The latter indicator is defined as the size of the population in that region plus the weighted sum of the population in the surrounding regions. The weights are inversely related to the distance to these regions.

One scarcely used variable is the growth of GRP per worker, even though this variable could be considered a more adequate measure of labour productivity growth than GRP per capita.

There are two theoretical reasons for including labour productivity growth as an explanatory variable. First, regions with higher labour productivity growth will have a relatively large share of innovative industries with high growth rates and a higher level of competitiveness resulting in lower unemployment. Second, according to standard search theory (Pissarides, 1990, Chapter 2), an increase in labour productivity growth leads to a higher discounted value of profits from creating new jobs. Accordingly, the number of vacancies and employed workers increases and unemployment decreases; the so-called “capitalisation effect.”

There is a counteracting effect, however, as shown by Aghion and Howitt (1994). They include labour reallocation spurred by technological progress in a search model. The arrival of new technologies causes labour reallocation from production units with low labour productivity to production units with high labour productivity. Faster growth reduces the duration of a job match by increasing the job separation rate.\textsuperscript{21} Faster growth also reduces the life-time of a production unit, thus discouraging firms from the creation of job vacancies. Both effects of faster growth raise equilibrium unemployment. These positive effects of growth on unemployment are called the “creative destruction” effect. Whether productivity growth results in higher or lower unemployment depends, according to Aghion and Howitt (1994), on the size of both the “capitalisation effect” and the “creative destruction” effect.

We do not include vacancy rates, as these are not available for all regions and countries within our dataset. The market potential is kept out of our analysis because the number of regions and countries included in our analysis changes over time.

\textsuperscript{21}The job separation rate is the fraction of jobs destroyed between time \( t - 1 \) and time \( t \).
Nor do we include industry mix variables, such as the shares of different industries in employment. The reason is that the share of services, for instance, may increase for two reasons. The share may increase because employment in the service sector has increased; or the share may increase due to a decline in employment in the manufacturing sector. Both phenomena lead to a higher share of services in total employment, but the expected effect on regional unemployment is quite different. For this and other reasons the effect of employment shares on unemployment is mixed and differs across countries and over time (Elhorst, 2003a, Table 3).

In summarising, we have included two variables that influence the demand for labour in a region in order to capture the economic performance of a region: labour productivity growth, being the growth of GRP per worker, and employment growth, being the average employment growth over the past two years. We expect that both labour productivity growth and employment growth lower the unemployment rate.

Labour supply
The effect of labour supply on regional unemployment can be measured by several variables, such as the labour force participation rate, the net inward migration rate, and the net inward commuting rate (Elhorst, 2003a).

The effect of labour participation on the unemployment rate can be argued to be either positive or negative. Due to the accounting identity it should be positive, whereas due to the fact that “people cause jobs” (Layard, 1997), it might be negative. The accounting identity defines unemployment as the working age population multiplied by the labour force participation rate, plus net inward commuting, minus the level of employment. This equation expresses the fact that higher labour supply, ceteris paribus, leads to higher unemployment. However, Layard (1997) argues that this ceteris paribus condition does not apply and that the number of jobs rises proportionately to the labour force. In addition, increased labour participation encourages local job growth.

In general, regional participation is found to have a negative effect on unemployment in the empirical literature (Elhorst, 2003a). The empirical evidence for the effect of net inward migration rate on unemployment is mixed, whereas the (little) empirical evidence on the inward commut-
ing rate suggests a positive relation with the regional unemployment rate.

Data on migration and commuting are not available for our dataset, but to cover the effect of labour supply on unemployment we do include the labour force participation rate. Since this variable also depends on unemployment, it is not strictly exogenous and will therefore be estimated using instrumental variables.

Lagged unemployment
We can take advantage of our multilevel setup by including national level variables to account for differences between countries, which makes the inclusion of national unemployment rates obsolete (see Elhorst, 2003a).

We do, however, include the lagged unemployment rate to deal with serial dependence. In order to correct for spatial dependence among the regions at each point in time, we allow for spatial autocorrelation in the error terms. Further details are discussed in the next section.

6.2 Econometric model
In the previous section we have identified different explanatory variables of the regional unemployment rate. Part of these variables only varies between countries, while another part may also vary between regions within countries. The former may be denoted as national-level variables and the latter as regional-level variables. The integration of both types of variables enables the evaluation of labour market institutional variables on the one hand, and regional economic explanatory variables on the other. For this purpose, we adopt the econometric model developed in section 2.7 to model the hierarchical structure of regions (level 1 units) within countries (level 2 units). In this model the parameters with respect to the regional-level variables may vary from one country to another, while the parameters with respect to the national level variables are the same for all countries:

\[
U_{rc} = \beta_c'X_{rc} + \alpha'Z_{ct} + \varepsilon_{rc}, \quad (6.1a)
\]
\[
\beta_c = \beta + \nu_c, \quad (6.1b)
\]
\[
E(\varepsilon_{rc}) = 0, \quad \text{var}(\varepsilon_{rc}) = \sigma_c^2[(I_{Re} - \delta_cW_c)'(I_{Re} - \delta_cW_c)]^{-1} = \sigma_c^2\Omega_c, \quad (6.1c)
\]
\[
E(\nu_c) = 0, \quad \text{var}(\nu_c) = V, \quad (6.1d)
\]
where $c = (1, \ldots, N)$ refers to a level 2 unit, $r$ refers to a country ($= 1, \ldots, R_c$ with $R_c$ the number of regions in country $c$), and $t (= 1, \ldots, T)$ refers to a given time period.

$U_{rct}$ is the unemployment rate in region $r$ of country $c$ at time $t$ and is defined as the number of unemployed persons divided by the active population aged between 15-64 (i.e. the sum of the number of employed and unemployed). $X_{rct}$ is a vector of explanatory variables measured in region $r$ of country $c$ at time $t$; and $Z_{ct}$ is a vector of explanatory variables in region $r$ but only observed at the national level of country $c$ at time $t$, since these variables do not differ between regions within a country. $\varepsilon_{rct}$ is a heteroskedastic disturbance term with variance $\sigma^2_c[(I_{R_c} - \delta_cW_c)'(I_{R_c} - \delta_cW_c)]^{-1}$, where $\sigma^2_c$ is different for different countries and $W_c (c = 1, \ldots, N)$ is an $R_c \times R_c$ non-negative matrix with zeros on the diagonal describing the spatial arrangement of the regions in country $c$. $\delta_c$ is called the spatial autocorrelation coefficient and is assumed to be fixed, but is different for different countries. To allow for heteroskedasticity, $\sigma^2_c$ is allowed to differ across countries.

According to Elhorst (2003a), regional studies are frequently found to include lagged unemployment. The results from these studies show that regional unemployment rates are highly correlated in time. We include lagged unemployment as an explanatory variable to correct for serial autocorrelation. The higher the coefficient of lagged unemployment the higher the persistence of unemployment.

To account for spatial dependence we include spatial autocorrelation in the error terms ($\delta_cW_c$). Another option used to reckon with spatial dependence is to include unemployment lagged in space as an explanatory variable. However, since not one theoretical model of unemployment poses a relationship between the unemployment rate in one region and the unemployment rate in surrounding regions, we do not

\footnote{Recall that endogenous explanatory variables will also be classified among $Z_{ct}$, even when they are observable at the regional level.}

\footnote{National level studies of unemployment include lagged unemployment as well. An example is Nickell et al. (2005), who include a lagged dependent variable for two reasons: (i) to deal with the persistence of unemployment, and (ii) to guarantee that estimated coefficients are not distorted by omitted trended variables or common shocks.}
choose this option.\textsuperscript{24} $\beta_c$ represents a vector of random response parameters and $\alpha$ a vector of fixed response parameters in the regression equation. The $\beta_c$ of a particular country is the outcome of a random process with common-mean-coefficient $\beta$ vector and covariance matrix $V$. When the vectors $\beta$ and $\beta_c (c = 1, \ldots, N)$ are of size $K$, $V$ is of size $K \times K$. Variables with \textit{random} coefficients are education, the percentage of the working population aged between 15-24 and 55-64, labour productivity growth, and employment growth.

Variables with \textit{fixed} coefficients are the labour force participation rate, unemployment benefits, tax wedge, union density per centralisation class, the change in inflation, employment protection, lagged unemployment, and the interaction between unemployment benefits and the tax wedge.

The participation rate and the lagged unemployment rate are treated as endogenous explanatory variables and are estimated with instrumental variables. We use all strictly exogenous variables lagged one or two periods in time to instrument these endogenous explanatory variables. Strictly exogenous variables measured as growth rates are included as instruments with a one-year lag only.\textsuperscript{25}

Time-specific effects are also added to the model in order to prevent that trends along the observations over time, either linear or cyclical, might bias the actual cross-section relation between regions within countries and between countries under our scrutiny. Finally, since regions vary in size, the observations are weighted by the size of the working age population in each region.

\section*{6.3 Data}

Our primary data source for the empirical analysis is Eurostat’s regional database, supplemented with OECD data on national institutions. We

\textsuperscript{24}An example variable for which including a spatially-lagged dependent variable as an explanatory variable is more appropriate, is innovation. Including innovation of neighbouring regions as explanatory variable makes sense because innovation in one region directly influences innovation in neighbouring regions through spill-over effects.

\textsuperscript{25}If the endogenous variables at time $t$ are correlated with the random error term, so will the endogenous variables at time $t - 1$, as a result of which these variables are not suitable as instruments.
use the regional division of Eurostat on the NUTS 2 level, with the exception of the UK, since Eurostat only provides NUTS 1 data for the UK. The dataset covers the period 1983-1997. The total number of observations is 1549 divided over 143 regions across 10 countries.\textsuperscript{26} The data set is not complete, mainly because some countries became member states of the EU after 1983, and in some regions Eurostat began data registration after 1983. Data registration in the former East Germany started in 1991. Due to large differences in the data and their different histories, East and West Germany are treated as two different level 2 units. The OECD does not collect data on all institutional variables for Greece and Luxembourg, so these countries have been excluded from our analysis. The regional division is shown in figure 6.1, while a more elaborate description of the data can be found in appendix 6.B.

The results of our analysis must be interpreted with care for three reasons: (i) Institutional variables change slowly over time. (ii) The educational variable is available from 1992 onwards only. (iii) Reverse causality may occur, as we have illustrated in the discussion of unemployment benefits.

The spatial weight matrices used in the estimations are symmetric inverse travel time matrices for passenger traffic. Travel time over land depends on road type, urban and mountainous speed constraints and national car speed limits. Overseas travel time depends on embarkation waiting time and the travel time by ferry.\textsuperscript{27} As most clustering of regional unemployment rates occurs within countries, as can be seen in figure 6.1, cross border weights have been set to zero.

\section*{6.4 Results}

The main estimation results are recorded in table 6.2, while the fixed country-specific coefficients on which the overall estimates of the random coefficients are based are presented in table 6.3. The coefficients of the variables measured in percentages (POP 15-24, POP 55-64, education, labour productivity growth, employment growth, labour participation

\textsuperscript{26}Taking into account the effect of using one and two period lagged variables as instrumental variables.

\textsuperscript{27}Source: Institut für Raumplanung, see Schürmann and Talaat (2000).
rate, tax wedge, unemployment benefits, union density) present the shift in the unemployment rate when these variables rise by one percentage point. Note that the unemployment rate and almost all explanatory variables are measured on the interval 0-100%, with the exception of the variable employment protection, which ranges between 0-2.

The coefficient estimates in the first column of table 6.2 reflect short-term effects. Long-term effects can be obtained from the short-term estimated coefficients by multiplying the latter by \(1/(1 - \hat{\tau})\), where \(\hat{\tau}\) is the coefficient estimate of lagged unemployment. The coefficient of the lagged dependent variable equals 0.68 and is highly significant, indicating that unemployment is highly persistent. The last column reports the standard deviation of the variables with random coefficients based on the \(V\) estimate.\(^{28}\) In addition to the results recorded in table 6.2, we found evidence of spatial autocorrelation and of variety in the autocorrelation coefficients \(\delta_c\) across countries. The average spatial autocorrelation coefficient equals 0.58. The R-squared is quite high (0.93) for a regression model based on 1549 observations.

Table 6.2 also reports the results of four diagnostics to test whether the model is correctly specified.

In addition to our decision to regress the unemployment rate on its serial lagged value to deal with serial dependence among the observations over time, we also tested for any additional serial dependence in the error terms, using Breusch and Godfrey’s Lagrange Multiplier test. This test augments the matrix of explanatory variables by an additional column containing the serial lagged residuals. If no fit is found, the hypothesis of any additional serial dependence is rejected. Given that the test statistic is chi-squared distributed with one degree of freedom, this appears to be the case.

For testing the heteroskedasticity assumption of the model, we depart from the hypothesis \(H_0: \sigma^2_1 \equiv \cdots \equiv \sigma^2_N = \sigma^2\). The corresponding Lagrange Multiplier test is chi-squared distributed with \(N - 1\) degrees of freedom.\(^{29}\) The hypothesis must be strongly rejected, indicating that our choice to generalize the standard two-level model with a ho-

\(^{28}\)This is the square root of the diagonal elements of the matrix \(V\).

\(^{29}\)The restriction is that the variance of all countries are equal to each other and not to a specific value. Since we treated East and West Germany as two different level 2 units, \(N - 1\) is equal to 12.
moskedastic error term to a model with a heteroskedastic error term was correct.

The third diagnostic is meant to test the joint hypothesis that the instruments are valid and that the model is correctly specified. To evaluate this, the instruments that do not lie in $X$ and $Z$ should have no ability to explain any variation in the unemployment rate. This test is taken from Davidson and MacKinnon (1993, pp. 232-37) and has a chi-squared distribution. The degrees of freedom are equal to the number of instruments that do not lie in $X$ and $Z$, which in our case is 24.\textsuperscript{30} We find that the joint hypothesis cannot be rejected.

Finally, we tested whether it is necessary to account for time-specific effects by departing from the hypothesis that they can be replaced by one intercept for the whole observation period. As expected, this hypothesis must be rejected.

Given that the fit of the equation is satisfactory, that the equation is correctly specified, and that 13 out of 15 coefficients are statistically significant, one of the most striking results is the considerable heterogeneity of the coefficients across countries. As can be seen from table 6.2, the standard deviation of the variables with random coefficients tends to exceed the coefficient estimate of these variables. Our results indicate that, the hypothesis that regional unemployment rates in different countries of the EU are determined by a common structure, must be strongly rejected. The implication is that a common regional policy to lower unemployment in the EU is impracticable. Policy measures that have large effects in one country may have small or even adverse effects in another country.

Similarly, following earlier work by Belot and Van Ours (2001, 2004), the significant interaction effects show that national institutions which help to reduce unemployment successfully in one country may not work in another country, because the impact of an institution depends on other institutions.

\textsuperscript{30}We use exogenous variables in $X$ and $Z$ measured at both time $t - 1$ and $t - 2$ as instrumental variables. We also ran a regression with exogenous variables in $X$ and $Z$ measured only at time $t - 1$ as instrumental variables. Using less instrumental variables did not alter the estimation results very much. However, we chose to use both instruments from $t - 1$ and $t - 2$, because otherwise the test of serial autocorrelation would only not be rejected at a 1% significance.
Table 6.2: Dependent variable: Unemployment rate.

<table>
<thead>
<tr>
<th></th>
<th>Short term</th>
<th>T value</th>
<th>Long term</th>
<th>T value</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-4.57</td>
<td>-2.47</td>
<td>-14.16</td>
<td>-2.59</td>
<td>71.71</td>
</tr>
<tr>
<td>Population [15-24]</td>
<td>0.05</td>
<td>3.79</td>
<td>0.14</td>
<td>3.75</td>
<td>1.05</td>
</tr>
<tr>
<td>Population [55-64]</td>
<td>0.02</td>
<td>1.47</td>
<td>0.06</td>
<td>1.49</td>
<td>3.59</td>
</tr>
<tr>
<td>Education</td>
<td>-0.02</td>
<td>-11.48</td>
<td>-0.07</td>
<td>-7.06</td>
<td>0.32</td>
</tr>
<tr>
<td>Labour prod. growth</td>
<td>-0.05</td>
<td>-8.97</td>
<td>-0.15</td>
<td>-7.58</td>
<td>0.32</td>
</tr>
<tr>
<td>Employment growth</td>
<td>-0.05</td>
<td>-9.95</td>
<td>-0.16</td>
<td>-9.57</td>
<td>1.62</td>
</tr>
<tr>
<td>Lagged unempl. rate</td>
<td>0.68</td>
<td>33.30</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Participation rate</td>
<td>-0.03</td>
<td>-2.59</td>
<td>-0.10</td>
<td>-2.35</td>
<td>-</td>
</tr>
<tr>
<td>Tax wedge</td>
<td>0.44</td>
<td>14.90</td>
<td>1.35</td>
<td>9.57</td>
<td>-</td>
</tr>
<tr>
<td>Unempl. benefits</td>
<td>0.26</td>
<td>10.60</td>
<td>0.80</td>
<td>8.56</td>
<td>-</td>
</tr>
<tr>
<td>UnionD</td>
<td>centr.barg.≤ 2</td>
<td>-0.01</td>
<td>-2.80</td>
<td>-0.03</td>
<td>-2.87</td>
</tr>
<tr>
<td>UnionD</td>
<td>2 &lt;centr.barg.&lt; 4</td>
<td>0.00</td>
<td>0.48</td>
<td>0.00</td>
<td>0.47</td>
</tr>
<tr>
<td>UnionD</td>
<td>centr.barg.≥ 4</td>
<td>-0.01</td>
<td>-3.93</td>
<td>-0.03</td>
<td>-3.88</td>
</tr>
<tr>
<td>∆ Inflation</td>
<td>-2.09</td>
<td>-14.56</td>
<td>-6.48</td>
<td>-8.07</td>
<td>-</td>
</tr>
<tr>
<td>Unempl.ben.*Tax wedge</td>
<td>-0.01</td>
<td>-11.29</td>
<td>-0.03</td>
<td>-8.89</td>
<td>-</td>
</tr>
</tbody>
</table>

R^2 = 0.93
\( \tilde{\delta}_j \) = 0.58

χ^2(1) = 3.67 Not rejected

χ^2(12) = 2561.8 Rejected

χ^2(24) = 5.00 Not rejected

χ^2(12) = 750.53 Rejected

Table 6.3: Fixed country-specific coefficients.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>23.86</td>
<td>0.69</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.84</td>
<td>-0.95</td>
<td>0.11</td>
<td>0.44</td>
<td>-0.34</td>
<td>-0.24</td>
<td>0.19</td>
<td>0.16</td>
</tr>
<tr>
<td>Belgium</td>
<td>7.65</td>
<td>0.31</td>
<td>0.89</td>
<td>1.88</td>
<td>-0.20</td>
<td>-0.41</td>
<td>-0.06</td>
<td>-1.03</td>
<td>-0.50</td>
<td>-1.93</td>
<td>-1.39</td>
<td>-3.24</td>
</tr>
<tr>
<td>Denmark</td>
<td>228.16</td>
<td>3.60</td>
<td>-1.91</td>
<td>-2.58</td>
<td>-11.57</td>
<td>-2.89</td>
<td>0.05</td>
<td>0.18</td>
<td>-0.02</td>
<td>-0.04</td>
<td>3.44</td>
<td>1.98</td>
</tr>
<tr>
<td>ex-GDR</td>
<td>108.72</td>
<td>0.96</td>
<td>-0.46</td>
<td>-0.17</td>
<td>-0.41</td>
<td>-0.17</td>
<td>-0.61</td>
<td>-0.50</td>
<td>-0.07</td>
<td>-0.12</td>
<td>-0.29</td>
<td>-0.22</td>
</tr>
<tr>
<td>Germany (excluding ex-GDR )</td>
<td>-12.98</td>
<td>-0.76</td>
<td>-0.01</td>
<td>-0.10</td>
<td>0.53</td>
<td>8.20</td>
<td>0.31</td>
<td>11.50</td>
<td>0.03</td>
<td>0.53</td>
<td>0.14</td>
<td>4.55</td>
</tr>
<tr>
<td>France</td>
<td>26.26</td>
<td>1.48</td>
<td>0.26</td>
<td>3.62</td>
<td>0.14</td>
<td>2.14</td>
<td>-0.12</td>
<td>-7.70</td>
<td>-0.08</td>
<td>-1.19</td>
<td>-0.14</td>
<td>-2.09</td>
</tr>
<tr>
<td>Ireland</td>
<td>-29.58</td>
<td>-0.52</td>
<td>1.14</td>
<td>2.08</td>
<td>3.01</td>
<td>0.80</td>
<td>-0.10</td>
<td>-0.17</td>
<td>-0.68</td>
<td>-1.72</td>
<td>-0.77</td>
<td>-1.14</td>
</tr>
<tr>
<td>Italy</td>
<td>-15.50</td>
<td>-0.65</td>
<td>2.05</td>
<td>5.28</td>
<td>0.49</td>
<td>1.13</td>
<td>0.13</td>
<td>1.39</td>
<td>-0.36</td>
<td>-1.02</td>
<td>-1.01</td>
<td>-2.63</td>
</tr>
<tr>
<td>Netherlands</td>
<td>25.40</td>
<td>1.33</td>
<td>0.14</td>
<td>1.28</td>
<td>-0.05</td>
<td>-0.32</td>
<td>-0.10</td>
<td>-1.04</td>
<td>-0.16</td>
<td>-3.37</td>
<td>-0.25</td>
<td>-3.58</td>
</tr>
<tr>
<td>Portugal</td>
<td>-8.72</td>
<td>-0.46</td>
<td>0.12</td>
<td>0.68</td>
<td>0.87</td>
<td>4.89</td>
<td>0.16</td>
<td>2.65</td>
<td>0.08</td>
<td>0.58</td>
<td>-0.04</td>
<td>-0.25</td>
</tr>
<tr>
<td>Spain</td>
<td>13.67</td>
<td>0.30</td>
<td>1.26</td>
<td>1.24</td>
<td>0.50</td>
<td>0.46</td>
<td>-0.31</td>
<td>-1.79</td>
<td>-0.90</td>
<td>-0.92</td>
<td>-1.29</td>
<td>-1.43</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>-6.11</td>
<td>-0.50</td>
<td>1.50</td>
<td>12.35</td>
<td>0.61</td>
<td>3.87</td>
<td>-0.05</td>
<td>-2.11</td>
<td>-0.98</td>
<td>-11.23</td>
<td>-1.14</td>
<td>-11.10</td>
</tr>
</tbody>
</table>

Note: Significant (at the 0.5 level) country-specific coefficients are in bold.
We first present a detailed discussion of the results for the regional variables reported in tables 6.2 and 6.3. Table 6.3 reports the fixed country-specific coefficient on which the random coefficients of the regional variables in table 6.2 are based. The population aged between 15 and 24 has a positive and significant effect on unemployment, which corresponds to the theoretical notion that the youth unemployment rate generally exceeds the overall unemployment rate.\(^{31}\) Moreover, the positive sign corresponds with the empirical evidence cited in Elhorst (2003a). A one percentage point increase in the percentage of the working age population aged between 15 and 24 will cause the unemployment rate to rise by 0.14 percent point. The fixed country-specific coefficients on which this overall measure is based are also positively related to the absolute and relative levels of youth unemployment at the country level. For example, Italy appears to have the largest positive and significant fixed country-specific coefficient, while Italy’s youth unemployment rate of over 30 percent is the second largest in the sample. In addition, the ratio of youth unemployment to total unemployment in Italy is nearly three—and is the largest in the sample.\(^{32}\) An exception is the negative and significant coefficient of the population aged between 15 and 24 of Denmark, where youth unemployment is the second lowest in the sample. This negative and significant effect may stem from the unique institutional set-up of Denmark. Denmark has a long tradition of apprenticeships and has taken several measures to prevent dropouts from formal education (Barrell & Genre, 1999). An example of such a measure is the benefit entitlement criterion of a young person without an employment history, who must have at least 18 months post-school education or training to obtain benefits (Barrell & Genre, 1999).

The population aged between 55 and 64 does not have a significant effect on unemployment. Note that the fixed country-specific coefficients on which the overall measure is based, if significant, are mainly positive. An exception is Denmark where the effect on unemployment is markedly negative. This could be caused by relatively high employment

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\(^{31}\)Youth unemployment is defined as the unemployment rate of individuals aged under 25. Source: Labour Force Survey, Eurostat.

\(^{32}\)We calculated the youth unemployment rates per country for each year in our sample and used the mean of these values per country to obtain the youth unemployment rates mentioned in the main text.
rates of older workers in Denmark.\textsuperscript{33} This in turn could be caused by the possibility offered to older workers to work part-time while already receiving partial retirement benefits.\textsuperscript{34} Overall, most notable is the large variation in the fixed country-specific coefficients across countries.

The \textit{educational attainment} of the population has a negative and significant effect on unemployment. This negative effect corresponds to the theoretical arguments discussed in section 6.1.2 and the empirical evidence discussed in Elhorst (2003a). A one percentage point increase of the population with medium or higher education causes a 0.07 percent point decrease in the unemployment rate in the long-term. It is noteworthy that the fixed country-specific coefficients on which this overall measure is based are also mainly negative. Exceptions are the fixed country-specific coefficients of education for former West Germany and Portugal, which are positive and significant. The large variation in the fixed country-specific coefficients across countries points to different economic structures per country. The positive effect of education on Portuguese unemployment, for example, is in line with country level unemployment rates per educational attainment class.\textsuperscript{35} The unemployment rate of individuals with medium education in Portugal is higher than that of lower educated individuals (the ratio of medium to lower level unemployment rates is 1.1, whereas across all countries this ratio is 0.7). This is due to the relatively low unemployment level of lower educated individuals in Portugal (5.4 percent to 12.4 percent for the EU cross-country average). Meanwhile, higher educated Portuguese have the lowest unemployment rate (3.2 percent). Given the large variation in the fixed country-specific coefficients, a policy aimed at raising the educational level of the population is only recommended if lower educated jobs are expected to become scarce.

\textsuperscript{33}In our sample country level employment rates for the age group [55-64] year are the highest in Denmark for the whole period (Source: Labour Force Survey, Eurostat).

\textsuperscript{34}Denmark is one of few countries to offer this possibility, see Duval (2003).

\textsuperscript{35}Averages for all countries are based on data over the period 1992-1997, although data on some years are missing for some countries. The comparison for lower and medium education levels for Portugal is based on data over the period 1993-1997, whereas the comparison of medium and higher levels for Portugal is based on data over the period 1995-1996, due to data unavailability. Weighted averages are obtained through weighting by the number of people aged between 25-59. Source: Labour Force Survey, Eurostat.
Regarding the *regional structure*, both employment growth and labour productivity growth have a negative and significant influence on the unemployment rate.

A one percentage point increase in *employment growth* decreases unemployment by 0.16 percentage point in the long-term. The negative sign of the coefficient for employment growth is in line with the theoretical considerations discussed above. The fixed country-specific coefficients, on which the overall measure of employment growth is based, are also mainly negative. Although the partial correlation coefficient between employment growth and unemployment is negative for Denmark, its fixed country-specific coefficient is positive. One reason might be that we do not have regional data for Denmark. Due to its interesting institutional set-up, we have nonetheless decided to include Denmark in our analysis.

A one percentage point increase in *labour productivity growth* decreases the unemployment rate by 0.15 percentage point in the long-term. Recall that the effect of labour productivity growth on unemployment could go both ways. The negative coefficient of labour productivity growth implies that the “capitalisation effect” outweighs the “creative destruction effect.” The fixed country-specific coefficients, on which the overall measure of labour productivity growth is based, are also mainly negative. The negative effect of labour productivity growth is most pronounced for the UK. This may indicate that in the UK the “capitalisation effect” is relatively high. In other words, discounted profits increase relatively strongly in response to productivity growth in the UK. This may be explained by a relatively low responsiveness of wages to productivity growth because wage bargaining is most decentralised in the UK.

*Labour participation* has a negative effect on unemployment, as is found in most empirical regional studies (Elhorst, 2003a). A one percent increase in labour participation decreases unemployment by 0.10 percentage point.

We now turn to a more detailed discussion of the results for the national variables in the analysis. The direct effects of the *unemployment benefit replacement rate* and the *tax rate* are positive, but the interaction effect of the unemployment benefit replacement rate and the tax wedge is negative, that is the unemployment benefit replacement rate
and the tax wedge reduce each other’s influence on unemployment.

More specifically, the total effect of the unemployment benefit replacement rate on unemployment is equal to $0.80 - 0.03 \times (\text{tax wedge})$. In other words, the unemployment benefit replacement rate has the expected positive effect on unemployment for low values of the tax wedge. This is the case for the United Kingdom, Portugal and Ireland. The negative effect of the unemployment benefit replacement rate on unemployment in other countries in our sample is at odds with the theory and most of the empirical evidence discussed in section 6.1.1. The fact that the unemployment benefit replacement rate is negative for higher values of the tax wedge may be caused by the following mechanisms. Countries with high unemployment benefits may be induced to set strict eligibility criteria for unemployment benefits thereby reducing the number of unemployed. Moreover, countries with high unemployment rates could be forced to lower unemployment benefits to be able to finance the total expenses on unemployment benefits, especially if these countries already have high taxes.

The total effect of the tax wedge on unemployment is equal to $1.35 - 0.03 \times (\text{unemployment benefit replacement rate})$. Hence, the total effect of the tax wedge is negative for high values of the unemployment benefit replacement rate. This only occurs, however, in the case of Denmark and the Netherlands (from 1987 to 1991). The positive relation between the tax wedge and unemployment in most countries is in line with the theory and empirical evidence discussed in section 6.1.1.

Our results are comparable to previous empirical studies on unemployment that include both the tax wedge, the unemployment benefit replacement rate, and their interaction as explanatory variables. The estimation results by Belot and Van Ours (2001, 2004) also show a significant interaction effect between the tax wedge and the unemployment benefit replacement rate. In addition, the total effect of the benefit replacement rate on unemployment switched between positive and negative values depending on the value of the tax wedge in their study as well. The direct effect of the benefit replacement rate on unemployment was negative and the interaction effect with the tax wedge was positive in Belot and Van Ours (2001, 2004).\footnote{The direct effect of the tax wedge on unemployment was insignificant in Belot and Van Ours (2001, 2004).}

In other words, the total effect of the benefit replacement rate on unemployment in Belot and Van Ours
(2001, 2004) could be both positive and negative due to different signs of the direct effect of the unemployment benefit replacement rate, and the interaction effect with the tax wedge. In our analysis we also find both positive and negative values of total effect of the benefit replacement rate due to different signs of the direct effect of the benefit replacement rate, and the interaction effect with the tax wedge. However, in our case the direct effect of the benefit replacement rate on unemployment is positive, while the interaction effect is negative.

Union density has a negative effect on unemployment in the case of decentralised and centralised wage bargaining, but an insignificant effect in the case of intermediate wage bargaining. An increase of one percentage point in union density decreases unemployment by 0.03 percent point if wage bargaining takes place at the decentralised or centralised level. These findings support the second hypothesis postulated in section 6.1.1, that higher union density in the case of plant level and country level bargaining, leads to lower wage demands.

Note that the negative effect of union density on unemployment in the case of highly centralised wage bargaining could in part be caused by the higher degree of coordination that is generally associated with centralised wage bargaining.\textsuperscript{37}

Our result contrasts with those of Belot and Van Ours (2001, 2004) who found a positive and significant effect of union density in the case of decentralised wage bargaining.

Employment protection has a negative effect on unemployment. As this variable ranges between 0.3 and 2 in our sample, the negative effect of employment protection on unemployment, using the short-term coefficient, ranges between -0.6 and -4.2 percentage point. The negative coefficient indicates that the negative effect of higher employment protection on unemployment outweighs the positive effect in our sample. The reduction of the inflow into unemployment outweighs the reduction in the flow out of unemployment. This finding supports some of the empirical evidence discussed in section 6.1.1. Furthermore, this result does not reinforce fears of reverse causality, because that would lead to a positive correlation between employment protection and unemployment rates.

\textsuperscript{37}Recall that the correlation coefficient between centralisation and coordination in our sample is equal to 0.83.
The change of inflation has the expected negative effect on unemployment. The long-term coefficient amounts to -0.72. Note that Belot and Van Ours (2001, 2004) find a value of approximately -0.5, which is in between the value of our short-term coefficient and the value of our long-term coefficient. Nickell et al. (2005) found a coefficient of -0.21, which is smaller but closer to our short-term coefficient.

Finally, we establish the relative contribution of regional versus national variables to the explanation of the unemployment rate in order to determine whether or not it is important to include both sets of variables. We apply the average absolute contribution method of Broersma and Oosterhaven (2008, Table 6) to obtain the shares in table 6.4 through the following four steps.

First, we calculate the average absolute deviation from the mean for each explanatory variable. Second, we multiply these average absolute deviations by the value of the estimated coefficients. Third, we determine the absolute contribution of each variable (except for the tax wedge, the unemployment benefit replacement rate, and the interaction between these two variables) by taking the absolute value of the products of the second step. The contribution of the tax wedge, the unemployment benefit replacement rate, and their interaction is calculated by first adding up the three products from the second step and then taking the absolute value of this sum. Otherwise we would overestimate the effect of these three variables taken together, because the effect of the tax wedge and the unemployment benefit replacement rate on the unemployment rate is positive, whereas the effect of their interaction is negative and these variables—as well as their coefficient—are correlated with each other. Fourth, we determine the share of each variable by dividing the individual contribution by the sum of the contributions.

Table 6.4 shows that the ratio of the regional versus the national contribution using this method is 36:64.

Note that there are two problems associated with this method. First, this method does not account for differences in the significance level of the estimated coefficients. Second, although we corrected for the correlation between the tax wedge, the unemployment benefit replacement rate, and their interaction, other variables and their coefficient estimates are also correlated, but this method does not correct for these correlations.
Bearing these remarks in mind, the results in table 6.4 indicate that it is important to include both regional and national variables to analyse unemployment. Previous studies on unemployment excluded either national or regional variables and have therefore omitted an important part of the explanatory variables.

### 6.5 Conclusions

The model used in this chapter is a mixed model of random coefficients for regional-level variables and fixed coefficients for national-level variables. Including both regional and national variables at the same time is important, since both groups of variables have appeared to be important in their contribution to the explanation of variation in the unemployment rate.

A second striking result is the considerable heterogeneity of the coefficient estimates across countries, indicating that regional unemployment rates in the EU are not determined by a common structure. This
implies that the same policy causes different outcomes in different countries.

By looking at the fixed country-specific coefficients underlying the common mean coefficients, further interesting results surface. A noteworthy example is Denmark, where the effect of the demographic structure on unemployment appears to differ markedly from other countries. This is likely due to Denmark’s unique institutional set-up. Denmark has a long tradition of apprenticeships and several safeguards to avoid dropouts from formal education. Denmark also offers older workers the possibility to work part-time while already receiving partial retirement benefits. Both features of Denmark’s institutional set-up lead to negative rather than positive effects of the population aged between 15-24 and 55-64 on unemployment.

Another interesting finding is the impact of labour productivity on unemployment, which is highest in the UK, probably because wage bargaining is the most decentralised there.

Just as the effect of regional variables on regional unemployment varies across countries, so does the effect of national variables among countries. Due to interaction effects between institutions, the effect of one institution depends on the value of others, which differs between countries. For example, whereas the effect of union density on unemployment is found to be negative for countries with decentralised and centralised wage bargaining, no significant influence of union density on unemployment is found if wage bargaining takes place at the intermediate level. This outcome is probably influenced by the higher level of coordination in countries with centralised wage bargaining.

In addition, whereas both the direct effect of the tax wedge and the unemployment benefit replacement rate on unemployment is positive, the total effect of these two institutions is dampened due to a negative interaction effect.
6.A Unemployment per country
6.A Unemployment per country

Austria

Belgium

France
Unemployment: Empirical analysis

Germany (excluding former GDR regions)

Germany (former GDR regions)

Italy
Both regional and national data are used. The primary regional level data were selected from the Eurostat file called ‘Regions.’ Eurostat uses a classification in NUTS 1, NUTS 2, and NUTS 3 level regions, where NUTS is an abbreviation of “Nomenclature of Territorial Units for Statistics.” The higher the NUTS level the smaller the regions. Most regional data are available for NUTS 2 level regions, with the exception of the UK, for which NUTS1 level data are used, since Eurostat only provides NUTS 1 data for the UK up to 1995.

The NUTS classification by Eurostat changes over time. The NUTS 2 classification of 1999 is used for all countries except for the UK. For the UK the NUTS 1 classification of 1995 is used. Due to extensive changes in the territorial breakdown of the UK, the old NUTS 1 classification cannot be linked to the 1999 classification, and no historical series are available for the UK in the NUTS 1 classification of 1999 (Eurostat, 2002).

The regional division we have used consists of a maximum of 143 regions. The dataset covers the period 1983-1997, but is incomplete because in some countries or regions Eurostat started data registration after 1983, in part because some countries became member states of the EU after that time (in Spain and Portugal registration began in 1986 and in 1988 for the Algarve; in France registration started in 1988 for Provence and Corse; and in the Netherlands registration started in 1988 for Overijssel, Gelderland and Flevoland, while for all other regions data for 1984 and 1986 are missing). Finally, one region has been left aside (Ceuta y Melilla) and some regions are joined with others (Bremen with Lüneburg and Hamburg with Schleswig-Holstein). As a result, the number of observations is different for each year. The total number of observations is 1549, taking into account the effect of the lagged unemployment rate.

Spatial weight matrix

The spatial weight matrices used in the estimations are symmetric inverse travel time matrices for passenger traffic. Travel time over land depends on road type, urban and mountainous speed constraints, and national car speed limits. Overseas travel time depends on embarkation waiting time and the travel time by ferry. Source: Institut für Raumplanung, see Schürmann and Talaat (2000). The travel time between region A and region B in one direction sometimes differs from the travel time in the opposite direction. The spatial weight matrix is made symmetric by taking average travel times. The effect of taking average travel time is limited. The difference in travel time between both directions is less than 10 percent in 96 percent of the cases. Alternatively, the difference between the travel time in one direction and the average travel time is less than 10 percent in 99 percent of the cases.

Regional variables


Participation rate (%): Ratio of the economically active population aged between 15-64 years, and the total population aged between 15-64 years. The economically active population is the sum of employed and unemployed people. Available for the period: 1983-1997. Regional Division: NUTS2. Source: Regions database 1999, Tables LF2ACT and
6.B Data appendix


\textit{Unemployment rate (\%)}: Ratio of people being unemployed (harmonised unemployment) and the active labour population. It relates to persons aged at least 15 at a certain point in time. A person is considered unemployed if he/she is without work, currently available for work and seeking work, that is, if he/she has taken specific steps in a specified recent period to seek paid employment or self-employment. The active labour population is equal to the sum of the number of employed and unemployed people. Available for the period: 1983-1997. Regional Division: NUTS2. Source: Regions database 1999, Tables
Unemployment: Empirical analysis


National variables


\(\Delta\) Inflation: Annual change in inflation, where inflation is defined as the percentage change in consumer prices. Available for the period 1983-1997. Source: OECD, Main economic indicators.

Employment protection: Index of employment protection which increases with the strictness of employment protection and ranges between \{0-2\}. Available for the period 1983-1995. Source: Labour Market Institutions Database (LMIDB) by S.Nickell. Also available for the year 1998. Source: OECD Labour Market Statistics Database. The 1998 data from the OECD are made comparable to Nickell’s data by using 1990 data from both the LMIDB database and the OECD Labour Market Statistics Database. The intermediate years (1996 and 1997) are computed by linear interpolation.


Unemployment Benefits (%): Ratio between the unemployment benefit and the median wage. This ratio represents the average of the gross unemployment benefit replacement rates for a worker with a full record
of employment at two earnings levels (APW\textsuperscript{38} and two-thirds of APW), three family situations (single, married with dependent spouse, married with spouse in work), and three unemployment spell durations (first year; second and third year; fourth and fifth year). APW (the wage of an average production worker). Available for the period 1983-1997 (only odd years are available, even years are calculated by linear interpolation). Source: OECD.

*Union density (%)*: The number of union members as a percentage of the number of employees. Source: OECD Labour Market Statistic Database.

*UnionD|centr.barg. ≤ 2 (%)*: The number of union members as a percentage of the number of employees, in countries with a centralisation index of 2 or less. Available for the period 1983-1997. Source: OECD Labour Market Statistics Database.

*UnionD|2 < centr.barg. < 4 (%)*: The number of union members as a percentage of the number of employees, in countries with a centralisation index of between 2 and 4. Available for the period 1983-1997. Source: OECD Labour Market Statistics Database.

*UnionD|centr.barg. ≥ 4 (%)*: The number of union members as a percentage of the number of employees, in countries with a centralisation index of at least 4. Available for the period 1983-1997. Source: OECD Labour Market Statistics Database.

The correlation coefficients between the variables are shown in B.1. Note that although the correlation between the benefit replacement rate and the interaction of the benefit replacement rate and the tax wedge is very high (0.96), this does not pose a problem for our analysis. The reason is that high levels of collinearity between a product term and its component parts is generally not problematic (Jaccard & Turrisi, 2003). According to Jaccard and Turrisi (2003, p. 28), such a collinearity might only pose a problem if the level is so high that it disrupts the computer algorithm of a statistical package.

\textsuperscript{38}APW is an acronym for the wage of an average production worker.
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Table B.1: Correlation coefficients between the variables.

Note: Correlation coefficients larger than 0.5 are in bold.