Duration of Regional Unemployment Spells in Slovenia

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The paper begins with an overview of the unemployment rate in Slovenia and focuses on duration of unemployment and regional characteristics of the unemployment rates. It is shown that the dispersion of regional unemployment rate is gradually decreasing and is also slightly below European average on NUTS 3 level. The analysis of the duration of regional unemployment spells is based on the data obtained from the Employment Office of the Republic of Slovenia, which consists of the unemployment spells between January 1st, 2002 and November 18th, 2005 with more than 450,000 entries. The Kaplan-Meier estimates of the survival function are presented and the effects of region on the duration of unemployment spells are discussed.

Key Words: unemployment, regions, survival analysis, Kaplan-Meier estimator, Slovenia
JEL *Classification:* P33, P34

Introduction

In the previous system the regions within transition countries had been more or less equally developed and had registered similar volume of economic activity. The structural change witnessed by these countries due to adopting the market economies in many cases caused substantial regional differences.

According to Huber (2007) the regional consequences of transition raise a number of issues: identifying the causes of regional differences, labour market mechanisms regarding wage flexibility and migration, new firm creation and economic policy response to regional disparities. Answering these questions could help in coping with characteristics of national labour markets, and thus, improve the efficiency of economic policy.

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Analyses of regional unemployment in transition countries include Römisch and Ward (2005) and Landesmann and Römisch (2006). Recent review papers on the topic of regional unemployment include Elhorst 2003, Huber 2007, Ferragina and Pastore 2008. Empirical estimates of regional unemployment and its persistence in transition economies are presented in Bornhorst and Commander (2006). Western European countries are empirically tested in Bayer and Jüssen (2006), while Taylor and Wren (1997) evaluate UK regional policy in the mid-1990s. Feragina and Pastore (2008) address two cases for explaining regional disparities in transition countries: (1) regions with high unemployment deal with low job creation rates due to similar labour market trends after the transition on the national level, (2) on the other hand the regional differences are an outcome of diverse speed of restructuring.

In the last couple of decades different survival analyses and duration techniques have gained popularity in the social sciences to model the length of unemployment spells and strike duration. Moffitt (1999) applied the usual econometric techniques in labour economics, including the proportional hazard methods and the duration models. Examples of duration model applications in labour markets can be found in Green and Riddell (1995), D'Agostino and Mealli (2000), and Arranz and Romero (2003). They explain the effects of different determinants of unemployment duration for Canada, nine EU15 members and Spain, respectively. Newell and Pastore (2006) apply duration models to estimate the effect of regional unemployment variation on aggregate economic restructuring in Poland. Factors of unemployment duration in Ukraine are discussed in Kupets (2006) by using the Cox proportional hazard model with two competing risks. The author concludes that age, marital status, income during unemployment and local demand constraints significantly affect the duration of unemployment.

Analytical papers investigating unemployment in Slovenia are rather rare. Slovenian unemployment is analysed by Vodopivec (1995a; 2004), Domadenik and Pastore (2006), Orazem, Vodopivec, and Wu (2005) and Kavkler and Boršič (2006; 2007). Vodopivec (1995a) uses a duration model in presenting effects of unemployment insurance on the unemployment duration. While Domadenik and Pastore (2006) test the impact of education and training systems on the participation of young people in the labour markets of Slovenia and Poland. Kavkler and Boršič (2006; 2007) estimate the effects of age, gender and education on duration of unemployment by duration data techniques.

All the above listed papers are devoted to the aggregate labour market in Slovenia. To the best of our knowledge, there is no analytical paper dealing with regional issues of unemployment in Slovenia. Thus, this paper attempts to estimate the effect of regional disparities on the duration of unemployment in Slovenia by duration data techniques, namely the Kaplan-Meier estimator. Although Slovenia is in general regarded as relatively equally developed throughout the geographical area, regional differences do exist. There are disparities of regional activity rates and regional GDP. The pace of restructuring after the transformation of the economic system was not equally distributed throughout the country. Consequently, regional unemployment rates differ significantly. That is why we expect the results of our empirical analysis to confirm the significant effect of regional differences on the duration of unemployment in Slovenia. Given that the analysis is based on a huge database consisting of more than 450,000 entries, this paper sheds light on additional information about regional differences and notably contributes to the existing studies about the Slovenian labour market. Namely, analysing regional labour market issues can give information about labour market flexibility, which is of prime importance for an effective functioning of monetary union. Additionally, such analysis also provides vital information for establishing an appropriate structural funds policy. Thus, the message of this paper can be important not only to national but also to EU authorities.

The paper is structured as follows. The introduction is followed by an overview of the characteristics of total unemployment rate in Slovenia presenting important stylized facts about the labour market against which regional differences evolved. Then, the regional unemployment rate is discussed and compared to European regional developments. Next, a description and preliminary analysis of the dataset is presented. It is followed by a brief presentation of duration models and survival analysis. Results of Kaplan-Meier estimates are discussed. The paper concludes with a short summary of the main findings.

An Overview of Aggregate Unemployment Rate in Slovenia

The low rate of registered unemployment in Slovenia prior to transition (below 2%) is not difficult to explain, since the old economic system provided assurance in the labour market by striving to achieve full employment and equal wealth distribution. Consequently, severe regulation of labour market was necessary in order to provide jobs for practically

everyone. The unlimited assurance of employees was even a constitutionally guaranteed right in former Yugoslavia (Vodopivec 1995b). After the economic transformation the registered rate of unemployment rose to more than 14.4% in 1993. It remained above 13.9% until 1998, when it gradually started to fall and had reached 7.7% in 2007.[1]

Significant changes occurred in labour demand during the transition, which caused the high increase in the unemployment rate at the beginning of the nineties. Young people suddenly had no assurance of getting a job after completing education. Since the high level of employment in the former system was artificial, they were also unlikely to get a job easily. In order to produce more efficiently, most of the companies started with massive lay-offs. Many older workers became unemployed and were also very unlikely to get a new job. The relative advantage of high educated workers increased. Higher educated employees were changing jobs more easily; they were less likely to become unemployed and had better chances of re-employment, if needed.

According to Vodopivec (1995b), women represented a higher share in the two highest vocational classes (managers and leading clerks) in comparison to men in the mid-1980s. Consequently, women in Slovenia had no disadvantages in the labour market at the beginning of transition, which was not the case in other transition economies.

According to Kajzer (1998) the relatively high level of unemployment in the nineties is mostly a consequence of a combination of the following:

- increasing disequilibrium in the labour market was prolonging the long term unemployment;
- the effect of increasing investment activity on employment was neutralised by the structure of investment and increasing structural discrepancies;
- the effect of economic growth on employment was decreased by wage growth, hidden unemployment among the employed in the former system and employers' caution in employment.

The main characteristics are low level of employment and high level of unemployment among the low educated, extremely low employment rate of older people, relatively high rate of unemployment among young people and non-intensive human resource management in enterprises (Kajzer 2005).

Table 1 presents the duration of unemployment in Slovenia in the last seven years. It can be seen that the highest share of unemployment is

TABLE 1 Duration of unemployment in Slovenia in % of total number of unemployed

Duration	2000	2001	2002	2003	2004	2005	2006	2007
Up to 3 months	17.9	20.2	20.2	23.6	25.5	22.7	22.4	21.7
From 3 till 6 months	10.0	13.2	13.0	14.0	14.3	13.9	11.3	12.6
From 6 till 9 months	5.5	6.2	7.0	8.4	8.2	8.8	8.1	7.8
From 9 till 12 months	5.2	5.8	7.5	8.0	7.5	8.3	7.5	7.2
From 1 till 2 years	15.3	14.2	18.5	19.1	19.4	18.3	20.4	18.2
From 2 till 3 years	12.1	9.0	8.1	9.7	9.1	9.5	9.7	10.3
From 3 till 5 years	16.4	13.5	10.2	7.3	7.7	8.8	9.7	10.1
From 5 till 8 years	10.5	9.3	7.5	4.4	3.6	4.5	5.3	6.3
More than 8 years	7.2	8.6	7.9	5.4	4.7	5.2	5.5	5.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total in persons	104,583	104,316	99,607	95,993	90,728	92,575	78,303	68,411

NOTE Based on data available on the Employment Office of the Republic of Slovenia web site (http://www.ess.gov.si/).

represented by the spells of less than 3 months. This is mainly due to the fact that all unemployed receive a financial compensation as a certain share of their previous wage in the first three months of unemployment. The duration of up to 3 months is followed by the duration of 1 to 2 years, which represents the long-term unemployment. It has increased in the last seven years from 15.3% in 2000 to 20.4% in 2006. On the other hand, very long-term unemployment, measured as duration of unemployment above 2 years, amounted to 30.2% of total unemployed workers in 2006, which is 16 percentage points less than in 2000.

Relatively generous unemployment benefits throughout the observed period makes people less motivated for searching for a new job (Kajzer 2005). This can be also confirmed by observing the difference among ILO[2] unemployment rate and registered unemployment rate. In Slovenia, there is a large discrepancy among the two rates of unemployment. Table 2 shows significant differences among the rates, although it is gradual in the recent years. This is mainly due to above mentioned financial aid, relatively high level of informal work and a high share of long term unemployed who become passive and do not meet the second criterion of actively seeking for a job in the Labour Force Survey (Kajzer 2005). Consequently, registered rates imply that Slovenia has high unemployment, while ILO rates show that it has low unemployment. Taking into account international criteria, the ILO rates should be considered. We

TABLE 2 Comparison of the registered and ILO unemployment rates for Slovenia

Unemployment rate	2000	2001	2002	2003	2004	2005	2006	2007
Registered	12.2	11.6	11.6	11.3	10.6	10.2	9.4	7.7
ILO	6.7	6.2	6.3	6.7	6.3	6.5	6	4.9
Difference (% points)	5.5	5.4	5.3	4.6	4.3	3.7	3.4	2.8

NOTE Based on data available on the Employment Office of the Republic of Slovenia website (registered rates, see http://www.ess.gov.si/) and on the Eurostat website (ILO rates, see http://ec.europa.eu/eurostat).

present the comparison of Slovenia in the EU according to ILO rates in the rest of this section. While the analytical part of the paper below is based on registered unemployment data, since the database required for the duration analysis is not available in the Labour Force Survey but was provided by the Slovenian Employment office.

According to the Labour Force Survey the unemployment rate in Slovenia is below the European average. The light gray columns for individual countries in figure 1 present total ILO unemployment rates, while the gray columns denote the long term unemployment rate, measured as a share of long term unemployed[3] in the active population of individual countries. Both unemployment rates for Slovenia are below EU15 and EU25 in 2006. The total unemployment rate is 6.0%, which is 1.4 and 1.9 percentage points below the EU15 and EU25 averages, respectively.

While the long term unemployment in Slovenia is 2.9%, which is 0.2 percentage point below EU15 average and 0.7 percentage point below the EU25 average. The highest total unemployment rates were recorded for Poland (13.8%), Slovakia (13.4%) and France (9.5%), while the lowest rate is 3.9% for Denmark and Netherlands. As far as the long term unemployment rate is concerned, the highest rate was noted for Slovakia (10.8%), Poland (7.8%) and Germany (4.6%). On the other hand, the lowest long term unemployment rates are recorded for Denmark (0.8%), Cyprus (0.9%) and Sweden (1.1%).

Regional Unemployment in Slovenia

According to the Statistical Office of the Republic of Slovenia there are twelve statistical regions in Slovenia: Pomurska, Podravska, Koroška, Savinjska, Zasavska, Spodnjeposavska, Jugovzhodna Slovenija, Osrednjeslovenska, Gorenjska, Notranjsko-kraška, Goriška and Obalno-kraška. Registered unemployment rates in these regions clearly indicate the East-West distribution. Eastern regions, such as Pomurska and Po-

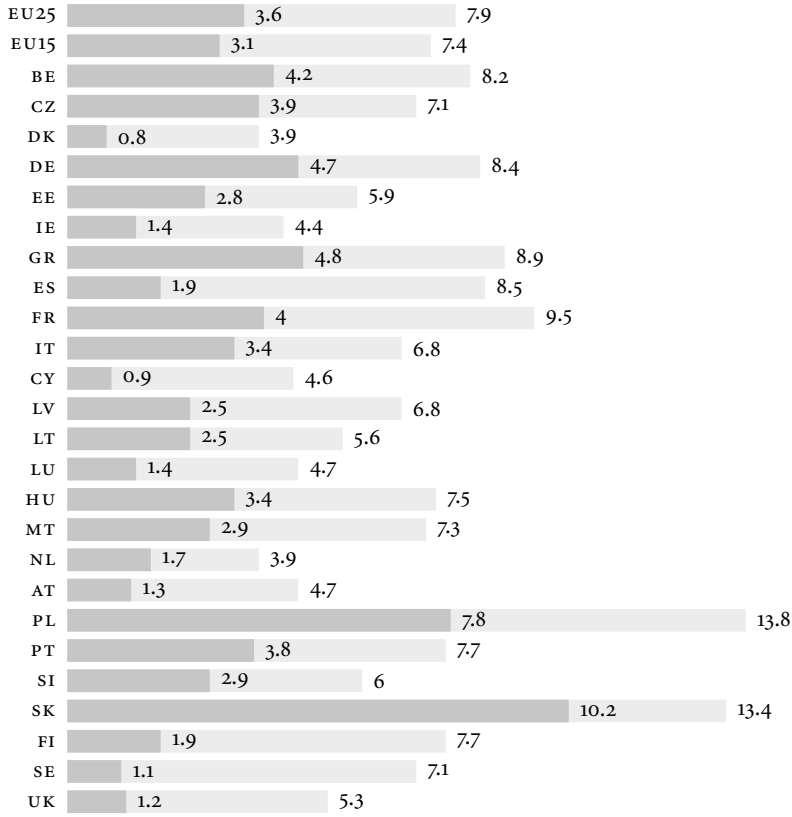

FIGURE 1 ILO unemployment rates in EU25, 2006, in % (light gray – harmonized unemployment rates, yearly averages; gray – long-term unemployment in % of active population)

dravska, have the highest unemployment rates while Western regions, such as Gorenjska, Goriška and Obalno-kraška, have the lowest unemployment rates. The order of regions is the same regardless of which unemployment rate is taken into account. The difference is only in the levels as noted above for the aggregate data (table 2).

The reasons for the East-West distribution of unemployment rates can be mainly attributed to different patterns of economic activity in the former system as well as different pace of restructuring after the economic transformation. Namely, in the former system eastern regions were characterized by a large share of manufacturing activities specifically specialized in labour intensive industries, such as textile industry, automobile industry, etc. When restructuring took place many manu-

facturing companies were abolished, leaving behind huge numbers of unemployed workers, who had difficulties in finding new jobs due to at least two reasons: (1) required qualification in other sectors and (2) the problem of overall lower labour demand. Despite the fact that many new small firms arose, their labour demand was/is much lower compared to the large socialist companies in the previous system. Moreover, investigating patterns of regional specialization and concentration of manufacturing, Traistaru, Nijkamp and Resmini (2002) found that in Slovenia regional specialization had not changed significantly in the period 1990–1999. Thus, the regional distribution of sectoral activity has not changed much in comparison to the former system. Consequently, the high level of unemployment persists in regions with a high share of manufacturing.

Differences among regions can be presented by the coefficient of variation. This is one of the structural indicators by which the EU follows the implementation of the Lisbon strategy in employment, innovation and research, economic reforms, social cohesion and environment (Pečar 2005). According to Eurostat's methodology, the coefficient of variation of regional unemployment rates is based on the weighted variance of unemployment rates, which is defined as:

$$Var\left(\frac{x_i}{y_i}\right) = \sum_i \left(\left[\frac{x_i}{y_i} - \frac{\bar{x}}{\bar{y}}\right]^2 \frac{y_i}{\sum_i y_i}\right). \quad (1)$$

where x_i denotes unemployed persons in region i, y_i represents active population in region i, $\bar{x}$ and $\bar{y}$ stand for the averages of x_i and y_i, and $\bar{x}/\bar{y}$ is the unemployment rate at national level. The coefficient of variation of unemployment rates is the square root of the variance stated in Equation 1 divided by the unemployment rate at national level. It gives a measure of the regional spread of unemployment rates.

In the period 2000–2002 the coefficient of variation was increasing and it reached the highest point of 35.1% in 2002. Afterwards it was decreasing and it reached the lowest value of 30.8 in the first half of 2006. This development of coefficient of variation implies that the regional differences in the unemployment rate in Slovenia have been decreasing during the last four years (figure 2).

Also the regional level of unemployment and its regional dispersion can be compared at the European level. Eurostat (2006) divides statistical units according to the Nomenclature of Territorial Units for Statistics

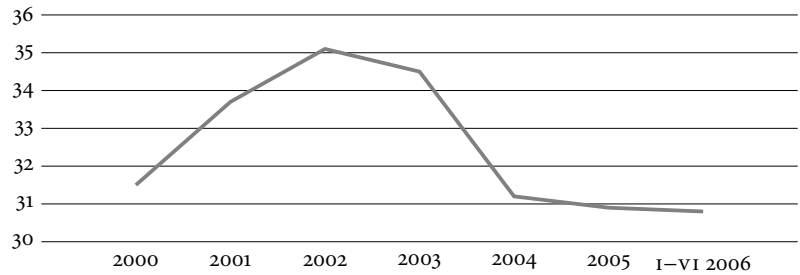

FIGURE 2 Coefficient of variation of regional unemployment in Slovenia, 2000–2006 (adapted from Pečar 2006)

(NUTS) adopted in July 2003 and revised in 2005. The NUTS regulation comprises three main levels of statistical regions according to population size NUTS 1 (3 million–7 million), NUTS 2 (800,000–3 million) and NUTS 3 (150,000–800,000). Below NUTS 3 level, there are so called Local Administrative Units (LAU), which represent districts and municipalities and are not subject to NUTS regulation. Thus, NUTS classification divides Europe into 89 regions on NUTS 1 level, 254 regions on NUTS 2 level and 1214 regions on NUTS 3 level (Eurostat 2007).

According to the size of Slovenia, the whole country belongs to NUTS 2 level, while each of the 12 statistical regions described above belongs to NUTS 3 level. Thus, Slovenia as a whole is one of the 254 regions and Slovene statistical regions are 12 among 1214 European regions.

At NUTS 2 level the lowest rates of unemployment in 2005 were recorded in Herefordshire, Worcestershire and Warwickshire in UK (2.6%), Provincia Autonoma Bolzano/Bozen in Italy (2.7%) and North Yorkshire in UK (2.9%). While the highest regional unemployment rates were attained in Výhodné Slovensko in Slovakia (23.1%), Dolnośląskie (22.8%) and Zahodnieopomorskie (22.7%) in Poland (Mladý 2006). As noted above, at the same level Slovenia has reached the unemployment rate of 6.5% (SORS 2006).

Table 3 presents regional unemployment rates at NUTS 3 level for 2005. The first part are the lowest rates, below 3%, in the second part are the 12 statistical regions in Slovenia and the third part of the table shows the highest unemployment rates in Europe, above 25%. It can be noted that the unemployment rates below 3% were recorded for 6 regions in UK, 4 regions in the Netherlands, 3 regions in Italy and 2 regions in Austria. On the other hand, the highest unemployment rates were registered for 8 German regions, 3 Polish regions and 1 Greek region. Slovenian regional

TABLE 3 European Regional Unemployment Rates, NUTS 3 level, 2005

Region (country)	Rate
EU25 *minimum*	
Overig Zeeland (NL)	2.4
Oxfordshire (UK)	2.4
Bolzano-Bozen (IT)	2.7
Bologna (IT)	2.7
North and North East Somerset, South Gloucestershire (UK)	2.7
Salzburg und Umgebung (AT)	2.8
Innsbruck (AT)	2.8
Warwickshire (UK)	2.8
Kop van Noord-Holland (NL)	2.9
Midden-Noord-Brabant (NL)	2.9
Devon CC (UK)	2.9
Oost-Zuid-Holland (NL), North Yorkshire (UK), Surrey (UK)	3.0
Slovenia	
Goriška	4.2
Gorenjska	4.7
Obalno-kraška	4.8
Osrednjeslovenska	4.9
Notranjsko-kraška	5.1
Jugovzhodna Slovenija	5.6
Koroška	6.8
Spodnjeposavska	7.4
Savinjska	8.1
Podravska	8.7
Zasavska	8.8
Pomurska	11.0

Continued on the next page

unemployment rates in 2005 range from 4.2% in Goriška to 11.0% in Pomurska region.

At NUTS 3 level Eurostat has information about 21 countries. Their dispersion of regional unemployment rates, measured by the coefficient of variation, is shown in figure 3. In 2005 the estimated coefficient of variation for Slovenia was 30.9%, which is 0.9 percentage point below the

TABLE 3 *Continued from the previous page*

Region (country)	Rate
EU25 *maximum*	
Nordvorpommern (DE)	25.0
Ostvorpommern (DE)	25.7
Uckermark (DE)	25.9
Görlitz, Kreisfreie Stadt (DE)	26.0
Sangerhausen (DE)	26.0
Mansfelder Land (DE)	26.1
Jeleniogórsko-walbrzyski (PL)	26.5
Slupski (PL)	27.2
Elcki (PL)	27.3
Demmin (DE)	27.9
Kastoria (GR)	28.5
Uecker-Randow (DE)	29.8

average of 31.8%. Below the average are also differences among regions in Sweden (15.6%), Ireland (16.6%) and Denmark (20.3%), while the most evident are the differences among regional unemployment rates in Italy (62.5%), Czech Republic (46.6%) and Germany (45.3%).

In general, the European regional dispersion of unemployment rate has decreased at NUTS 3 level in the last three years. Considerable falls in the regional difference were recorded for Italy (19.4 percentage points), Hungary and Germany (both 6.8 percentage points). On the other hand, there were also some gaps expanded, as for Slovakia, Estonia and Lithuania with an increase in coefficient of variation by 6.8, 6.1 and 3.7 percentage points, respectively.

Regional Comparison of the Length of Unemployment Spells in Slovenia

The data for our empirical investigation were obtained from the Employment Office of the Republic of Slovenia. The database consists of the unemployment spells completed between January 1st, 2002 and November 18th, 2005 and all of the ongoing spells on November 18th, 2005. For each of the unemployment spells, the start and end date and the factors sex, age, level of education and statistical region were made available to us. Since the Employment Office of the Republic of Slovenia is not al-

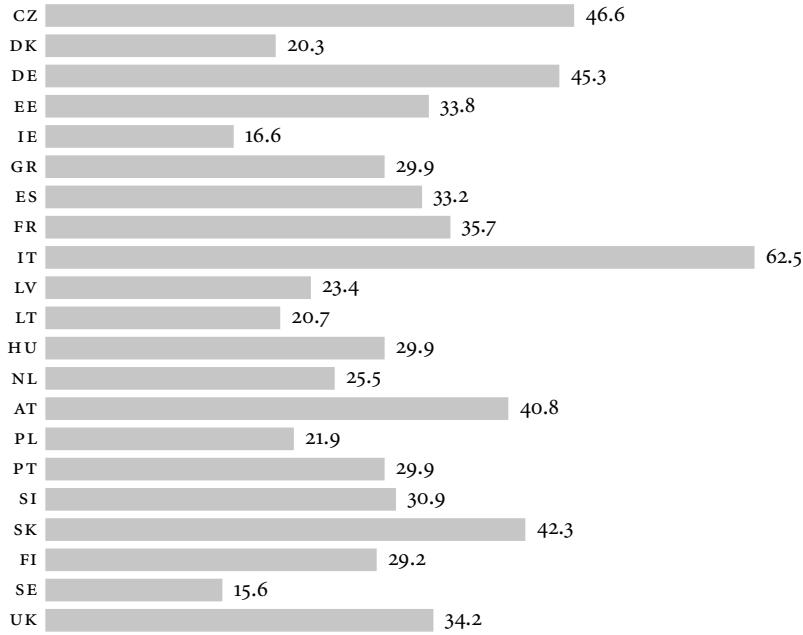

FIGURE 3 Dispersion of regional unemployment rates in EU (NUTS level 3) in 2005, in %

lowed to disclose personal data about the unemployed, only a personal identifying number was added to enable identification of repeated spells. 455,581 unemployment spells are included in our database with the maximal length of 13,547 days.

In a preliminary analysis, the descriptive statistics for the 348,281 spells completed on November 18th, 2005 were calculated. The mean, standard deviation and the 95% confidence intervals of the mean for the 12 Slovenian regions can be found in table 4. Already from the 95% confidence intervals for the mean one may observe significant differences among different regions.

One of the visual aids to present such results are the boxplots (figure 4). The boxplot (also called the box-and-whiskers plot) summarizes a single numeric variable within categories of another variable. Each box shows the median, the quartiles and the whiskers that extend to the last point within 1.5 times the interquartile range. The outliers are usually also given in the boxplots, but we left them out due to the fact that our distribution has a very long right tail.

The difference between Podravska, Zasavska and Savinjska region on the one hand and Gorenjska, Goriška and Obalno-kraška region on the

TABLE 4 Descriptive statistics for the duration of unemployment spells, in days

Region	(1)	(2)	(3)	(4)
Total	348,281	479.69	791.11	(477.07, 482.32)
Pomurska	31,122	472.54	815.10	(463.49, 481.60)
Podravska	76,393	565.38	906.26	(558.95, 571.81)
Koroška	13,633	467.75	756.92	(455.05, 480.47)
Savinjska	50,941	509.86	809.46	(502.83, 516.89)
Zasavska	9,873	505.27	791.79	(489.65, 520.89)
Spodnjeposavska	14,542	486.75	813.92	(473.52, 499.98)
Jugovzhodna Slovenija	19,503	510.35	893.39	(497.81, 522.88)
Osrednjeslovenska	60,716	426.60	660.58	(421.34, 431.85)
Gorenjska	33,227	375.98	636.94	(369.13, 382.83)
Notranjsko-kraška	7,947	452.62	714.22	(436.92, 468.33)
Goriška	12,938	395.48	668.45	(383.96, 407.00)
Obalno-kraška	16,736	430.46	779.92	(418.64, 442.28)

Column headings are as follows: (1) *N*, (2) mean, (3) standard deviation, (4) 95% confidence interval for the mean.

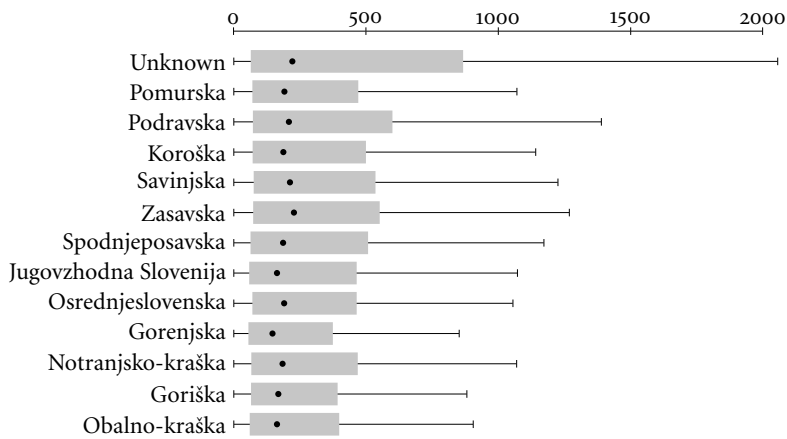

FIGURE 4 Boxplots depicting the duration of unemployment spells (in days) for different regions

other hand is obvious. The regions of Gorenjska and Goriška are the most advantageous in the labour market with mean length of unemployment spells of 376 and 395 days, respectively. The unemployed from Podravska region are in the worst position, as they have to wait for 565 days on average to find a new job. The mean length of unemployment spells for the unemployed from Savinjska, Zasavska and Jugovzhodna

Slovenija is slightly above 500 days, whereas the mean lengths of other regions are between 400 and 500 days. The region is thus a crucial factor when searching for a job. Note that the boxplot in figure 4 displays the median of the length of the unemployment spells, whereas in table 4 the mean length of the unemployment spells is given.

To test the null hypotheses that the mean duration of unemployment spells is the same for every region, we performed the nonparametric Kruskal-Wallis test. ANOVA is inappropriate in our case, because the distribution is asymmetrical. The null is strongly rejected, since the p-value is lower than 10^{-6}.

The above described database allows us to take a look into different characteristics of duration of unemployment by regions:

1. According to gender, in Osrednjeslovenska and Notranjsko-kraška region men and women have similar durations of unemployment. The biggest difference among them is in Zasavska region, where women need on average 43 days more than men to find a new job. Women are in a worse position also in Pomurska, Podravska and Koroška region. On the other hand, it takes longer for men to get re-employed in Goriška and Spodnjeposavska region.
2. Regarding age, in all regions the unemployed aged between 40 and 60 years are in the worst position. It is interesting to note that young unemployed (18 years or less) have a relatively long duration of unemployment in Jugovzhodna Slovenija, Spodnjeposavska, Zasavska, Podravska and Pomurska region.
3. As for level of education, the length of regional unemployment in general decreases with higher levels of education with a few exceptions. In many regions the longest unemployment was experienced by those who finished 3-year lower vocational education (Obalno-kraška, Goriška, Osrednjeslovenska, ...). Also post-secondary vocational education does not prove the above statement, as this level of education required longer unemployment than lower levels of education in many regions. The next exception is master's degree in Obalno-kraška, Gorenjska, Spodnjeposavska, Koroška and Podravska, and doctorate in Jugovzhodna Slovenija and Zasavska.

Survival Analysis and Duration Models

Survival analysis and duration models originate in biostatistics, where the survival time is the time until death or until relapse of an illness.

During the recent years these techniques have also gained popularity in the social sciences to model the length of unemployment spells and the strike duration. One of the unavoidable problems encountered when analyzing the duration data is the so-called *censoring*. Since the event under observation (i. e. death or the end of the unemployment spell) has often not occurred till the end of the study, it is only possible to estimate the lower bound of the survival time. This kind of censoring is called the *right censoring*.

A comprehensive overview of the methods and models used in survival analysis is given by Therneau and Grambsch (2000) and by Klein and Moeschberger (1998).

BASIC NOTIONS

Let the random variable T denote the *survival time*. The distribution function of T is defined by the equation $F(t) = P(T < t)$ and measures the probability of survival up to time t. Since T is a continuous random variable, its density function can be computed as the first derivative of the distribution function $f(t) = F'(t)$. The *survival function* $S(t)$ denotes the probability to survive until time t or longer and is given by

$$S(t) = P(T \geq t) = 1 - F(t). \tag{2}$$

The limit

$$\lambda(t) = \lim_{\delta \to 0} \frac{P(t \leq T < t + \delta \,|T \geq t)}{\delta} \tag{3}$$

represents the risk or proneness to death at time t. The function $\lambda(t)$ is usually called the *hazard function* or the *failure rate* and measures the instantaneous death rate given survival until time t.

By integrating the hazard function over the interval $[0, t]$ one obtains the so-called *cumulative hazard function*

$$\Lambda(t) = \int_o^t \lambda(u)du. \tag{4}$$

In addition to defining basic notions, we shall also derive the relations between them that will be needed in the following subsections. Obviously,

$$\lambda(t) = \lim_{\delta \to 0} \frac{P(t \leq T < t + \delta \,|T \geq t)}{\delta} =$$

$$= \lim_{\delta \to 0} \frac{P(t \leq T < t + \delta)/P(T \geq t)}{\delta} =$$
$$= \frac{1}{S(t)} \lim_{\delta \to 0} \frac{F(t+\delta) - F(t)}{\delta} = \frac{F'(t)}{S(t)}. \quad (5)$$

It follows from the definition of the survival function $S(t)$ given by equation (4) that $F'(t) = -S'(t)$, therefore

$$\lambda(t) = \frac{-S'(t)}{S(t)} = -\frac{d\log S(t)}{dt}. \quad (6)$$

Rewriting the last equation in the form $\lambda(u)du = -d\log S(u)$ and integrating from 0 to t yields

$$-\log S(t) = \int_0^t \lambda(u)du = \Lambda(t), \quad (7)$$

therefore

$$S(t) = e^{-\Lambda(t)}. \quad (8)$$

We have observed the fact that $\log S(0) = \log 1 = 0$ since $P(T \geq 0) = 1$.

NONPARAMETRIC METHODS

The parametric models are often used because of their simplicity. It has to be emphasized that they impose a complex structure on the data, which can lead to distortions in the estimated hazard rates. Better models may be obtained by using nonparametric methods that impose very few restrictions.

Kaplan-Meier estimator

The derivation of the Kaplan-Meier estimator of the survival curve can be found in Greene (2003) and in Zeileis (2002). This estimator of the survival function is also called the *product limit estimator* for reasons that will be clear later on.

Given n individuals with p distinct survival times $t_1 < t_2 < \ldots < t_p$ and d_i deaths at t_i, assume at first that no censoring occurs. For the time t from the interval $[t_s, t_{s+1})$ the survival function can be estimated in the following way:

$$\hat{S}(t) = 1 - \hat{F}(t) = \frac{n - \sum_{j=1}^{s} d_j}{n}, \quad t_s \leq t < t_{s+1}. \quad (9)$$

If the numerator and the denominator of the previous expression are

successively multiplied by factors of the form $n - d_1 - d_2 - \cdots - d_i$, $i = 1, 2, \ldots, s-1$, one obtains

$$\hat{S}(t) = \frac{n-d_1}{n} \cdot \frac{n-d_1-d_2}{n-d_1} \cdot \ldots \cdot \frac{n-d_1-d_2-\cdots-d_s}{n-d_1-\cdots-d_{s-1}}. \qquad (10)$$

Let $r_i = n, i = 2, \ldots, p$, denote the number of individuals whose observed survival time is at least t_{i-1} and let r_i. In other words, the *number at risk* r_i takes into account all individuals alive during the time interval $[t_{i-1}, t_i)$. Under the assumption of no censoring, the equation $r_{i+1} = r_i - d_i$ holds, whereas $r_{i+1} = r_i - d_i - c_i$ if censorings occur, with c_i equal to the number of censored observations in the interval $[t_{i-1}, t_i)$. The final version of the Kaplan-Meier estimator can thus be written as

$$\hat{S}(t) = \left(1 - \frac{d_1}{r_1}\right) \cdot \ldots \cdot \left(1 - \frac{d_s}{r_s}\right) = \prod_{j=1}^{s} \left(1 - \frac{d_j}{r_j}\right), \quad t_s \le t < t_{s+1}. \qquad (11)$$

RESULTS

Recall that the survival function $S(t)$ denotes the probability of survival time greater than or equal to t. In our case, the probability for the unemployment spell to last until time t or longer is measured. Figure 5 depicts only the two extreme levels of the factor region with the highest and lowest probability of survival, namely the survival curves for Podravska and Gorenjska region, respectively, to make the figure easier to read. The survival function estimates for other regions lie between the two extremes. The differences between the survival function estimates are clearly visible. The estimate of the unemployed from Podravska decreases to 0 at a much slower rate, indicating that the unemployed from Gorenjska region have a far better position in the labour market.

To test the null hypothesis that the survival functions are the same for two or more levels of a given factor, the so-called log rank test with the χ^2-distribution under the null can be used. When performed for our data, the highly significant p-value (lower than 10^{-16}) confirms the results derived graphically from the Kaplan-Meier estimates of the survival functions.

Since the differences between the highest and the lowest unemployment region might be specific to the regions considered, we also performed the Kaplan-Meier analysis for the 4 lowest and the 4 highest unemployment regions pooled together (figure 6). The log rank test is again highly significant with a p-value of less than 10^{-6}.

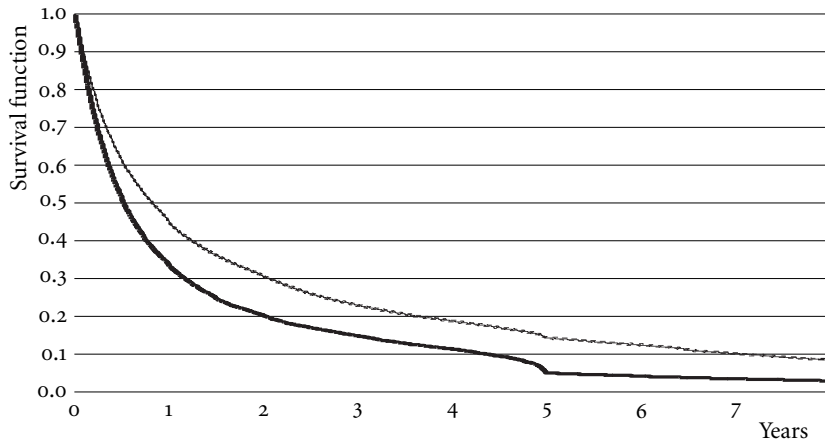

FIGURE 5 Survival function estimates for the unemployed from Podravska region and the unemployed from Gorenjska region (in bold)

Although having the advantage of being non-parametric and therefore of not imposing restrictions on the shape of the survival function, the Kaplan-Meier estimator has a major shortcoming. Namely, it does not allow testing for the presence of an omitted heterogeneity bias. This can be done in the penalized Cox proportional hazards models setting, or equivalently, with the help of the frailty models. These models embrace the idea that different individuals have different frailties, and that those who are most frail will die earlier than the others. The notion of frailty is modelled as a random effects term in survival models. A comprehensive discussion about frailty models can be found in Therneau and Grambsch (2000).

We fitted a gamma frailty model (since hazard cannot be negative) with the help of the survival package of the open source code statistical software R (see http://www.R-project.org). The random effects variable is highly significant (p-value is equal to 0.00046), thus the null hypothesis of no omitted heterogeneity bias has to be rejected. Omitted heterogeneity suggests the existence of some unobserved reason why regional unemployment differences might persist.

We can look for reasons of persistent regional disparities in regional labour market adjustment mechanisms: migration, wage flexibility, investments and changes in labour force participation. According to Gacs and Huber (2005) the unemployment rate accommodates to a minor part of regional asymmetric shocks in first round candidate countries (including Slovenia), on the other hand employment losses turned out

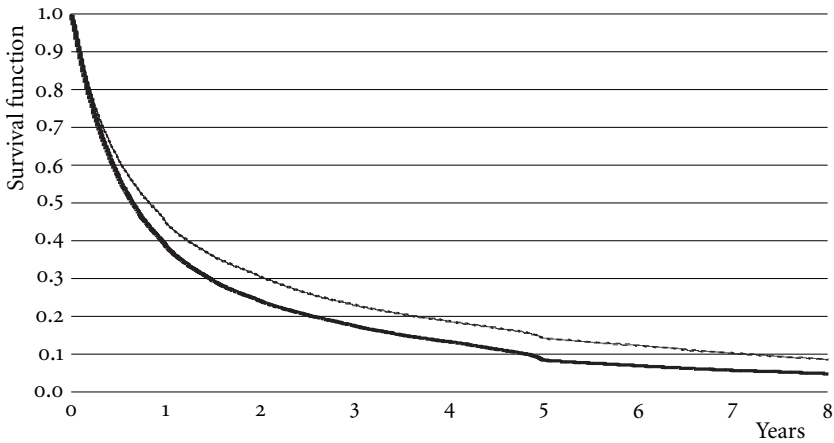

FIGURE 6 Survival function estimates for the unemployed from the four highest unemployment regions and the unemployed from the four lowest unemployment regions (in bold)

to be highly persistent, while participation rates importantly contribute to the adjustment.

Internal migration in Slovenia is low, has fallen during the transition, and it is not effective in reducing regional disparities (Huber 2007; Fidrmuc 2004). Such characteristics of migration despite substantial regional differences are in contrast to economic theory, according to which the migration should increase rather than fall. One of the major impediments for migration could be real estate market: house ownership and high land prices contribute to lower migration, while increased construction accelerates migration to a region (Huber 2007).

As far as wage flexibility is concerned, there is no straightforward outcome of existing studies for transition countries as well as for Slovenia. In general, Slovenia is known to have a high degree of labour market rigidity (Ferragina and Pastore 2008). Büttner (2007) does find a correctly signed (negative) and significant effect of regional unemployment rate on wage level in Slovenia after controlling for industry composition of employment. Although his findings show that the negative impacts of unemployment rates on wage level are similar to those of old EU members, this does not automatically imply a high level of wage flexibility, since EU countries are known for a relatively high level of wage rigidities to regional unemployment rates.

For transition countries Bornhorst and Commander (2006) show that a substantial fall in labour demand results in very slow employment re-

covery. Capital mobility has a limited role in diminishing regional disparities. Since Slovenia is a small country, close to EU markets, there is a dispersed structure of FDI across regions (Huber 2007) indicating there is no capital mobility effect in decreasing regional differences. In other transition countries stylized facts show that border regions and regions with the capital city are in better position in comparison to other much poorer regions. Due to the smallness of the country these effects are insignificant for Slovenia.

Conclusions

The highest unemployment rates are registered in Pomurska and Podravska. While the unemployment rate used to be the highest in Podravska, it is persistently decreasing in the last couple of years. Above average unemployment rates were also recorded in Zasavska, Spodnjeposavska and Savinjska regions. Notranjsko-kraška, Jugovzhodna Slovenija, Gorenjska, Obalno-kraška, Osrednjeslovenska and Goriška are the regions with the unemployment rate persistently below Slovenian average. The lowest unemployment rate was recorded in Goriška: 6.5% in 2005. Slovenian regional unemployment rates belong to the NUTS 3 level of European statistical regions and are below the EU average. Also the differences among regions are below European average and are gradually diminishing.

Survival analysis of the duration of unemployment spells based on a comprehensive dataset, with more than 450,000 observations in the period from January 2002 and November 2005 yielded the following results. Regarding the region of the unemployed, the probability of re-employment is the lowest for the unemployed from Podravska, Savinjska, Zasavska and Jugovzhodna Slovenija. The unemployed from Gorenjska region have a far better position in the labour market. The probability of remaining unemployed for the latter region is slightly lower than for the unemployed from Goriška region. The two extreme regions with the lowest and the highest mean length of unemployment are Gorenjska and Podravska region, where the unemployed have to wait for 376 and 565 days on average to find a new job, respectively. The differences between the Kaplar-Meier survival function estimates are highly significant. The probability of re-employment for the unemployed from Gorenjska is the highest among all regions, while being the lowest for the unemployed from Podravska.

The analysis has proven that the characteristics of duration of regional

unemployment are specific. The reasons for significant regional disparities can be found among low internal migration and high level of wage rigidity. The results can help to identify potential target groups of unemployed in different regions in order to improve the efficiency of an active employment policy. Furthermore, one of the prime policy objectives should be to enhance migration by, for example, providing a more attractive real estate market in the regions with high employment rates. Slovenia has lately experienced a lack in using EU structural funds. There is an obvious need for a more effective structural funds policy. Thus, the results of this study can help in identifying regions which fulfil the requirements and have high needs for structural funds usage. Despite high wage rigidity to unemployment rates, the wage levels differ across regions, resulting in different levels of unemployment benefits, which also contribute to different regional incentives for the unemployed to find new jobs.

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Notes

1 Based on data provided by Employment Service of Slovenia (http://www.ess.gov.si/slo/Dejavnost/StatisticniPodatki/Kazalci/GibanjeRegBP.htm).

2 ILO unemployment rate streams from the Labour Force Survey conducted by the Statistical Office of the Republic of Slovenia according to International Labour Organisation (ILO) instructions. It is internationally comparable. ILO unemployed are those who meet the following criteria: are not working for payment, are not employed or self-employed (1), actively seek for employment (2) and are willing to accept work immediately or within two weeks (3) (Kajzer 2005). On the other hand, registered unemployed are those who are listed in the register at the Employment Office of the Republic of Slovenia.

3 According to Eurostat long term unemployed are those who are unemployed for 12 months or more.

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