IZVIRNI ZNANSTVENI ČLANKI • ORIGINAL SCIENTIFIC PAPERS

THE MAIN CHARACTERISTICS OF THE UNEMPLOYED IN SLOVENIA

Osnovne značilnosti brezposelnih v Sloveniji

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Abstract

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This study analyses the main developments in the labour market in Slovenia. Special attention is paid to the analysis of the duration of unemployment spells based on data obtained from the Employment Office of the Republic of Slovenia. The database consists of the unemployment spells between January 1st, 2002 and November 18th, 2005, with more than 450,000 entries. Different survival analysis techniques are described and the Kaplan–Meier estimates of the survival function are presented. The effects of the factors sex, age and level of education on the duration of unemployment spells are discussed.

Key words: unemployment, duration models, survival analysis, Kaplan-Meier estimator

Izvleček

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V tem prispevku so prikazane osnovne značilnosti trga dela v Sloveniji. Poseben poudarek je namenjen analizi trajanja brezposelnosti na osnovi obsežne baze podatkov Zavoda za zaposlovanje Republike Slovenije, ki v obdobju od januarja 2002 do novembra 2005 zajema več kot 450.000 opazovanj. Prikazane so različne tehnike analiz preživetja. Na osnovi Kaplan-Meierjeve cenilke pa je analiziran vpliv spola, ravni izobrazbe in starosti brezposelnih na trajanje brezposelnosti.

Ključne besede: brezposelnost, modeli trajanja, analiza preživetja, Kaplan-Meierjeva cenilka

JEL: C14, C24, J60, J64

1 Introduction

This paper studies the main characteristics of the unemployed in Slovenia. It begins with an overview of the main developments in the labour market in Slovenia, which were strongly influenced by the transition process and massive lay-offs in the nineties. The structure of the unemployed during the last six years according to sex, level of education and age is examined.

In the second part different survival analyses and duration techniques are discussed. These approaches to analysing survival and duration data originate in biostatistics. In recent years these methods 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. The effects of education on unemployment characteristics in different EU countries are analysed in Kettunen (1994, 1997) for Finland and in van Ours and Ridder (1995) for the Netherlands. McKenna (1996), Schomann and O'Connell (2002) and Pallage and Zimmermann (2005) deal with unemployment comparisons in European, Canadian, and US labour markets, respectively, while Lauer (2005) compares France and Germany.

Slovenian unemployment is analysed by Vodopivec (1995a, 2004), Orazem and Vodopivec (2005) and Orazem, Vodopivec and Wu (2005), but the influence of sex, education and age on the length of unemployment spells is not examined. However, Vodopivec (1995a) does use a duration model for studying the effects of unemployment insurance on the duration of unemployment.

Examples of duration model applications in labour markets can also be found in Green and Riddell (1995), D'Agostino and Mealli (2000), and Arranz and Romero (2003). Among other determinants of unemployment duration, they all also explain the effects of education on the length of unemployment spells for Canada, nine EU15 members, and Spain, respectively.

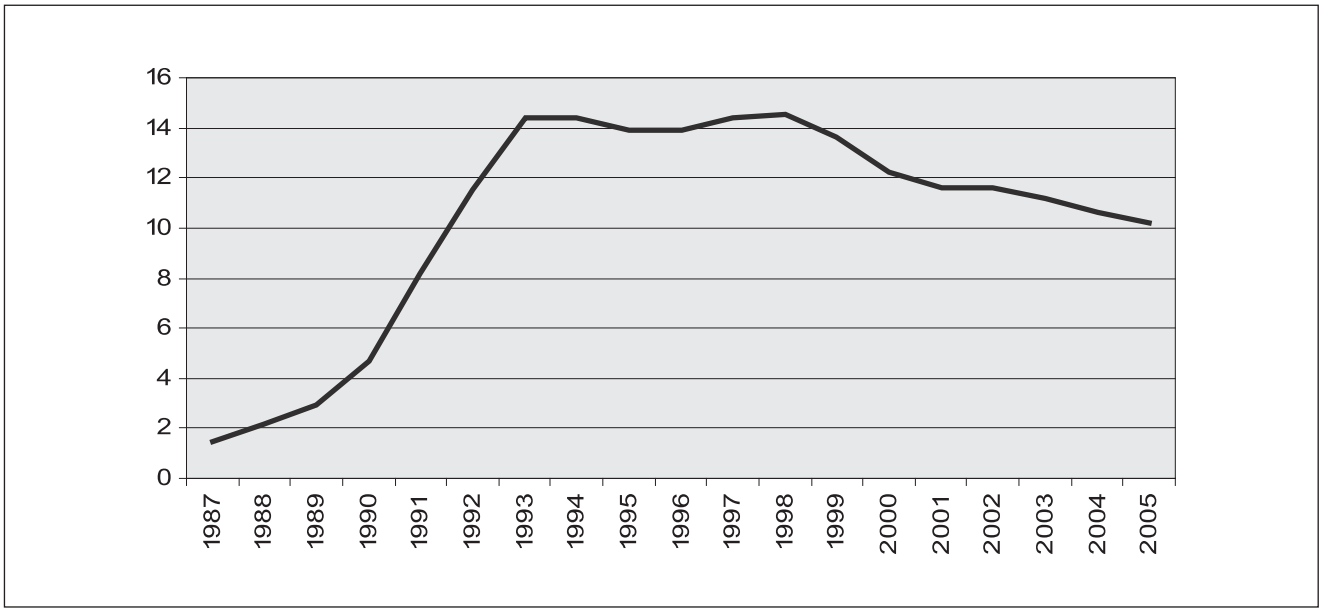
2 An overview of unemployment rate and other characteristics of the labour market in Slovenia

The former system in Slovenia provided assurance in the labour market by striving to achieve full employment and equal distribution of wealth. It required radical regulation of the labour market in providing jobs for practically everyone. The unlimited assurance of employees was even a constitutionally guaranteed right in former Yugoslavia (Vodopivec 1995b). Thus, it is not difficult to explain the low rate of unemployment prior to transition (Figure 1).

The transition brought about significant changes in labour demand and consequently the dramatically high increase in the unemployment rate in the beginning of the nineties.

Young people suddenly had no assurance of getting a job after completing their education. Since the high level of employment in the former system was

Figure 1: *Registered unemployment rate in Slovenia, 1987-2005, in %*



Source of data: Employment Office of the Republic of Slovenia

artificial, they were also unlikely to get a job easily. In striving to achieve higher productivity, most employers started with massive lay-offs. Many older workers became unemployed and were also very unlikely to get a new job.

The relative advantage of highly educated workers increased. These employees had more chances of changing jobs, they were less likely to be laid off, and they were more likely to get a job if unemployed.

It is interesting that women in Slovenia had no disadvantages in the labour market at that time, which was not the case in other transition economies. Vodopivec (1995b) states that in the mid-eighties women had higher share in the two highest vocational classes (managers and leading clerks) in comparison to men.

According to Kajzer (1998a), 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 prolongs long term unemployment;
- the structure of investment and increasing structural discrepancies lower the positive impact of increasing investment activity on employment;
- wage growth, hidden unemployment among the employed in the former system, and employers' caution in employment lower the positive effect of economic growth on employment.

The main features of unemployment in the mid-nineties were (Kajzer 1998b): persistence, a high proportion of long term unemployment and a high proportion of less educated and less skilled unemployed.

Throughout the observed period, people are less motivated to seek a new job mainly because of the relatively generous unemployment compensation. This observation is also confirmed by comparing the difference between the ILO[1] unemployment rate and the registered[2] unemployment rate. In Slovenia, there is a large discrepancy between the two. Table 1 shows the gradually declining difference between the two rates in recent years, but it is still significant.

The main reasons can be found in (Kajzer 2005):

- a relatively high level of informal work;
- a high share of long term unemployed who become passive and do not meet the criteria of actively seeking a job in the Labour Force Survey;
- a relatively generous unemployment insurance system.

The Slovenian labour market is characterized by less educated unemployed, who are difficult to re-employ; high social contributions and low labour productivity (Kos 2001). The main characteristics are low level of employment and high level of unemployment among the less 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).

In comparison to other EU members, Slovenia's unemployment rate (ILO) is relatively low. It was below the EU25 average of 8.9% by 2.4 percentage points in the third quarter of 2005 (Figure 2). Since the highest unemployment

[1] The ILO unemployment rate comes 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: not working for payment, not employed or self-employed (1), actively seeking employment (2), and willing to accept work immediately or within two weeks (3) (Kajzer 2005).

[2] Registered unemployed are those who are listed in the register of unemployed at the Employment Office of the Republic of Slovenia.

Table 1: *Comparison of the number of registered and ILO unemployed*

	ILO unemployed	Registered unemployed	Registered unemployed but not ILO unemployed	
	in 1000	in 1000	in 1000	in %
2000	69	107	54	50.4
2001	57	102	50	49.0
2002	58	103	53	51.4
2003	66	97	44	45.3
2004	64	93	41	44.0
2005q3	65	91	40	44.0

Source of data: Kajzer 2005 and SORS 2006a.

rate is recorded in Poland and Slovakia, it could be expected that the comparison to the EU15 shows a different situation. However, Slovenia's ILO unemployment rate is also below the EU15 average by 2 percentage points. The registered unemployment rate is higher (10.2% in 2005), but it is not internationally comparable.

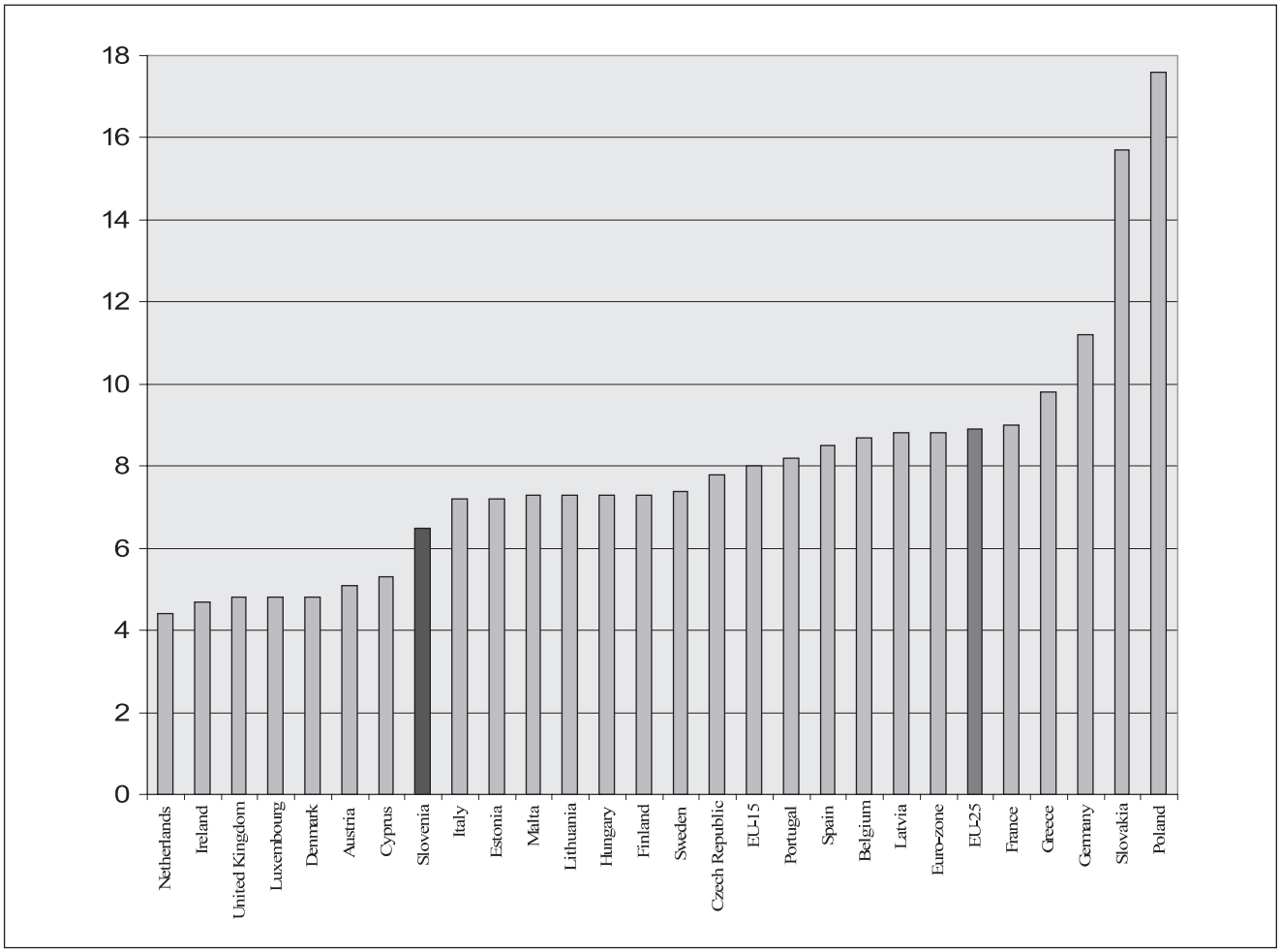
2.1 Analysis of the structure of the unemployed since 2000

In this part of the paper, the structure of the registered unemployed in the period 2000-2005 in Slovenia is presented. The overview starts off with an analysis of gender and continues with a presentation of the main characteristics of the unemployed according to age, level of education, and duration of unemployment.

Figure 3 presents the share of women and men in the total number of registered unemployed in Slovenia. In the period 2000-2005, the share of unemployed women increased by 2.5 percentage points, reaching 53.8% of the total number of unemployed in Slovenia in 2005. The upward trend has continued since the mid-nineties.

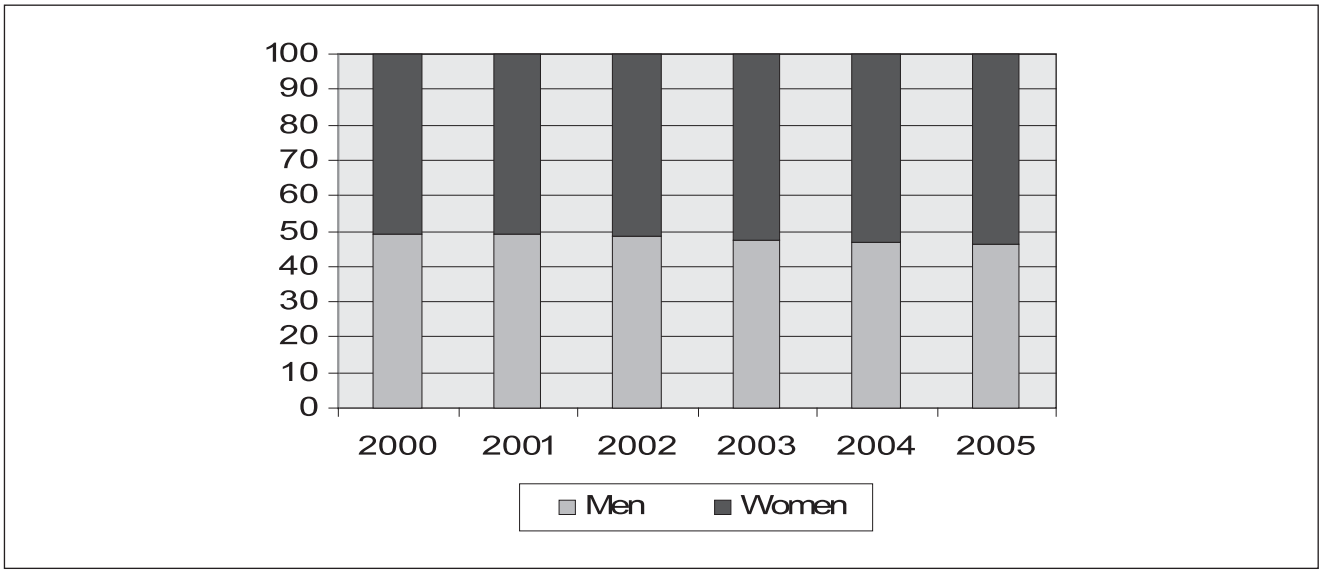
In the last six years, the share of unemployed with no education or who have not completed elementary school (I) has gradually decreased (Figure 4). It fell by 5.4 percentage points and dropped to 35.4% in 2005, which is also the highest share in total number of unemployed by level of education in Slovenia. The down-ward trend was also recorded for the unemployed with elementary school (II), lower or middle vocational education (III) and upper

Figure 2: *ILO unemployment rates in EU, 2005q3*



Source of data: Eurostat and Romans and Harđarson (2006)

Figure 3: *Structure of the unemployed by sex, 2000-2005, in %*

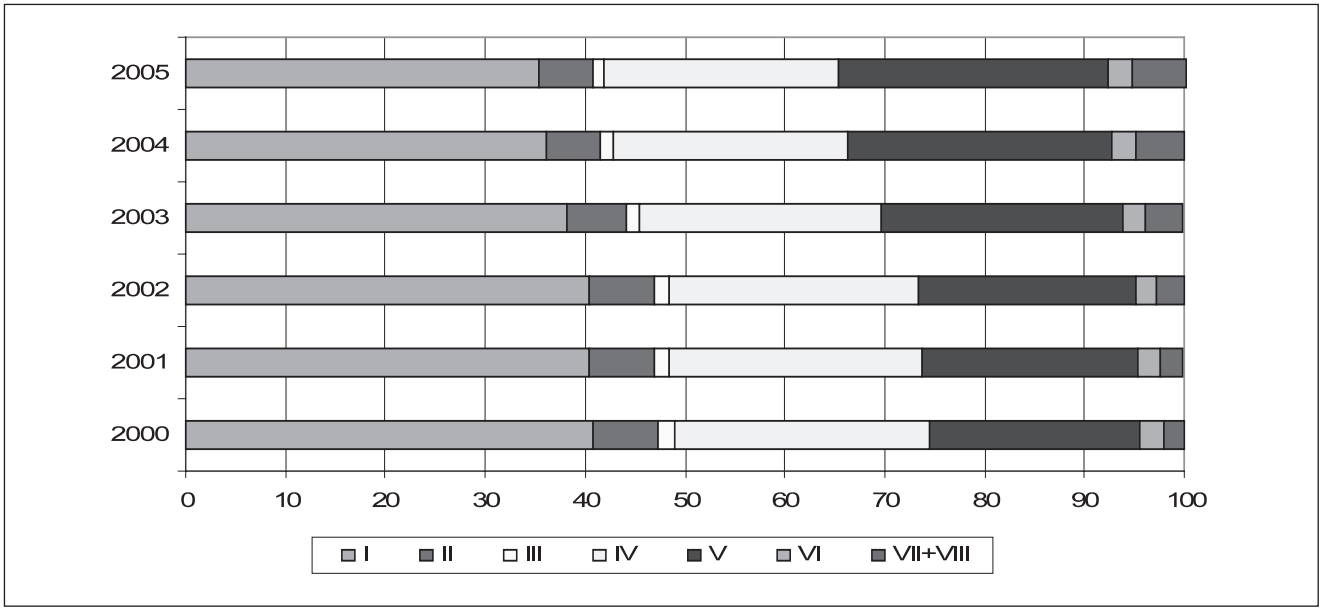


Source of data: Employment Office of the Republic of Slovenia

secondary professional education (IV), the shares fell by 1.1, 0.5 and 2.1 percentage points, respectively. The share of unemployed with post-secondary vocational education (VI) is rather stable with 2.4% in 2005, while the share of unemployed with general upper secondary education (V) and higher professional and university education, specialist post secondary education, master's or doctorate (VII+VIII) is increasing by 6 and 3.2 percentage points, respectively.

The lowest share of unemployed consists of people younger than 18 years and people older than 60 years. This is not surprising since most young people under 18 are still enrolled in secondary education, while most people above 60 are retired. It is worth noticing here that the activity rate of older people in Slovenia is very low, among the lowest in the EU (SORS 2006c). The number of retired people is rising, and nearly doubled in the last ten years. An aging population

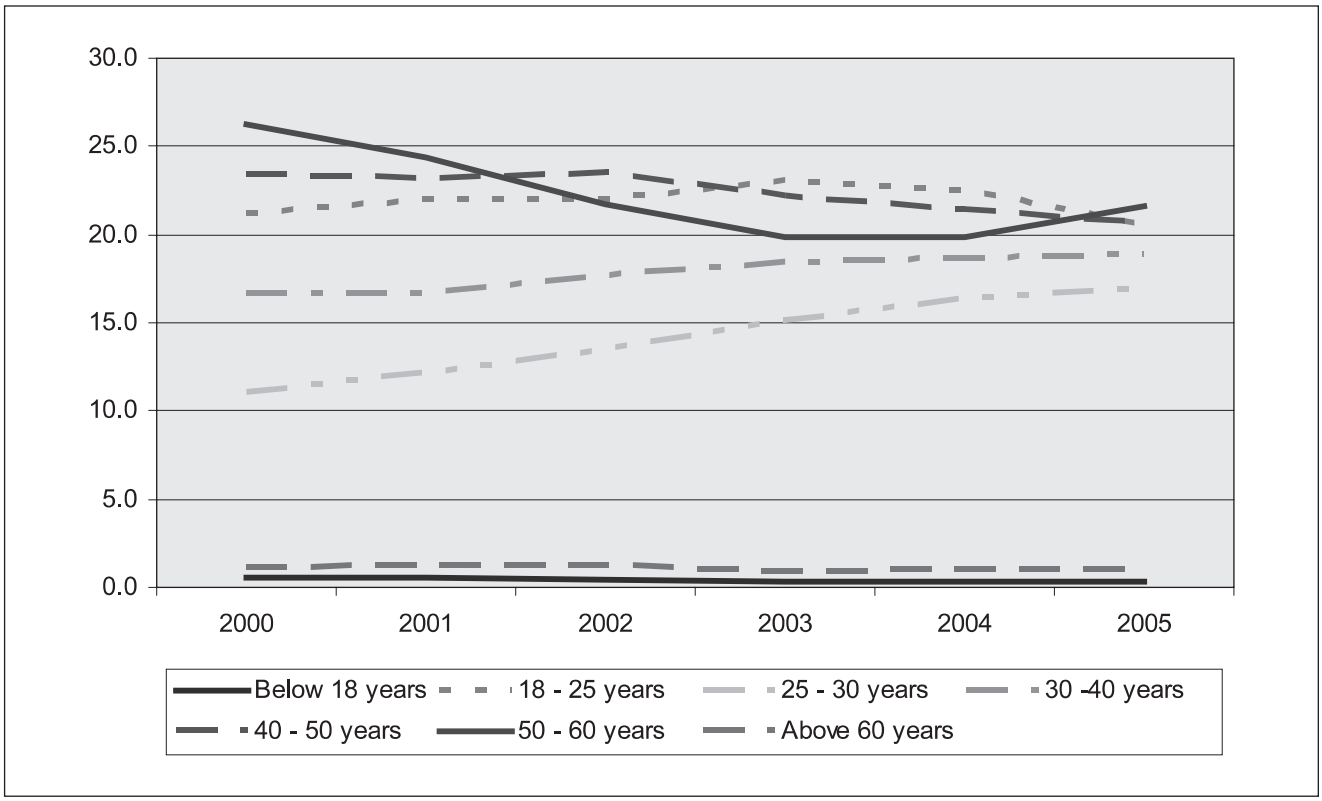
Figure 4: *Structure of the unemployed by level of education[3], 2000-2005, in %*



Source of data: Employment Office of the Republic of Slovenia

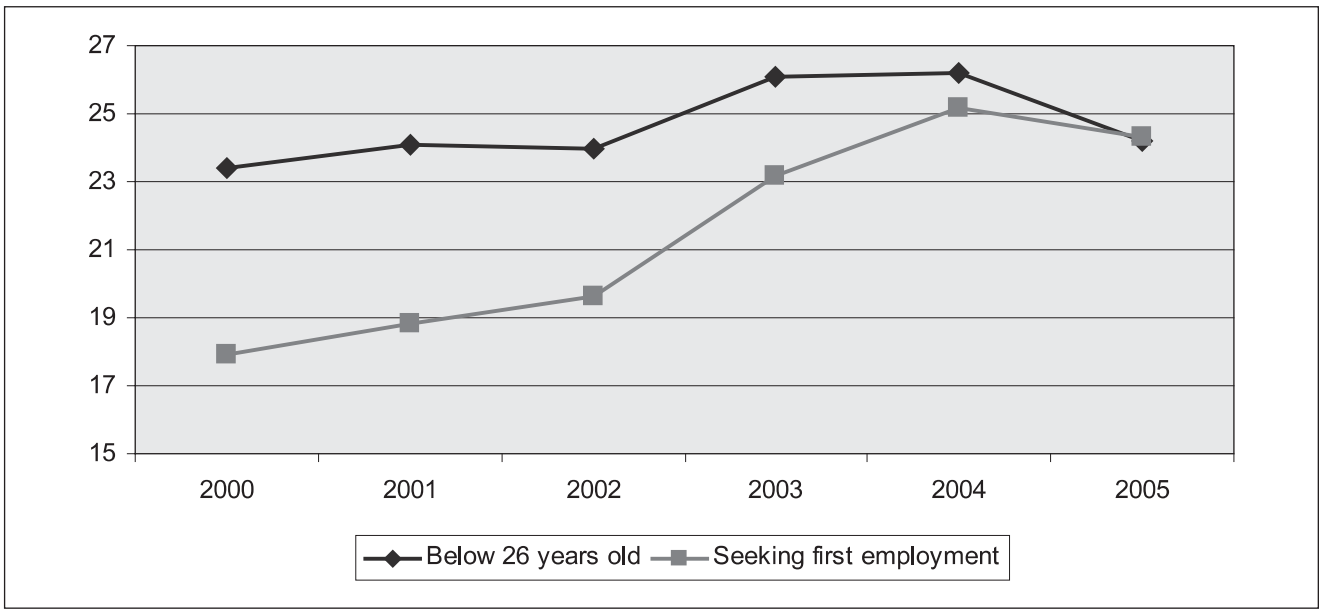
[3] According to the Statistical Office of the Republic of Slovenia and the Employment Office of the Republic of Slovenia, the levels of education are divided as follows: I – No formal education or incomplete elementary school education; II – Elementary school; III – Lower or middle vocational education; IV – Upper secondary professional education; V – General upper secondary education; VI – Post-secondary vocational education; VII – Higher professional and university education; VIII – Specialist postsecondary education, master's degree, doctorate.

Figure 5: *Structure of the unemployed by age, 2000-2005, in %*



Source of data: Employment Office of the Republic of Slovenia

Figure 6: *Share of youth and first job seekers in the total number of unemployed, 2000-2005, in %*

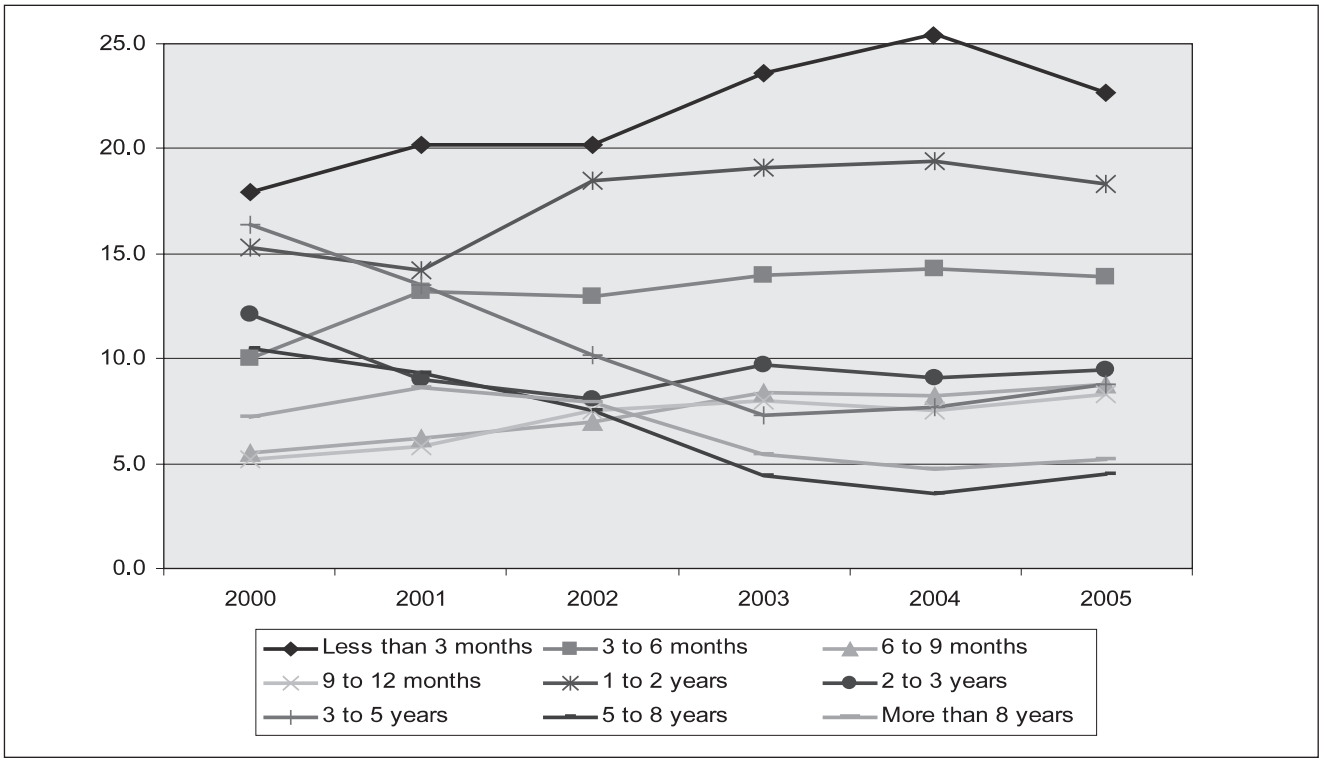


Source of data: Employment Office of the Republic of Slovenia

is not the only reason for this development, but also a labour market policy that promotes early retirement. This situation is not favourable for the pension system, which needs some major changes in order to be sustainable.

The highest share of unemployed people according to age were 25-30 year-olds and 50-60 year-olds (Figure 5). These two groups of unemployed also represent the most troublesome populations. The high share of the latter is typical structural unemployment, as many of this age group have been laid-off in the process of transition, are now relatively inflexible in the labour market, and are thus unlikely to gain new employment easily. On the other hand, the high share of young people among the unemployed in 2005 corresponds to the share of the unemployed looking for their first job (Figure 6). Such information poses a question of whether there is a smooth transition from education to first employment and consequently the

Figure 7: *Structure of the unemployed by duration of unemployment, 2000-2005, in %*



Source of data: Employment Office of the Republic of Slovenia

appropriateness of the education system. It is also worth noting that both of these groups of unemployed have experienced an upward trend in the last six years, with the exception of a fall in youth unemployment in 2005.

If the duration of unemployment is taken into account (Figure 7), one can notice that most unemployment spells end in three months. The number of people who were unemployed for less than three months was 2,1012, which represented 22.7% of the total number of unemployed in 2005, a 4.8 percentage point increase since 2000. There were 16,983 people who were unemployed for more than 1 but less than 2 years in 2005. Their share in the total number of unemployed has increased by 3 percentage points since 2000. While the number of unemployment spells shorter than 2 years increased in the last five years, there are fewer unemployment spells longer than 2 years. The highest drop was recorded for unemployment from 3 to 5 years, which constituted 16.4% in 2000 and only 8.8% in 2005. Thus, unemployment in Slovenia is still quite persistent. The share of unemployment spells longer than one year is gradually decreasing, but it is still relatively high: 62.9% in total number of unemployed in 2000 and 47.3% in 2005.

3 Mean 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 unemployment spells occurring between January 1st, 2002 and November 18th, 2005, and all of the ongoing spells as of 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 allowed 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 a maximum length of 13,547 days.

In a preliminary analysis, the descriptive statistics for the 348,281 spells which had ended by November 18th, 2005 were calculated. The histogram for the duration of unemployment spells is given in Figure 8. The mean, standard deviation, and the 95% confidence intervals of the mean (for the different levels of the factors sex, education and age) can be found in Table 2.

The distribution of the duration of unemployment spells is asymmetrical, with skewness of 3.38 and kurtosis of 14.47, indicating a very long right tail that can be seen in Figure 8. The mean length of unemployment spells for our sample is approximately 480 days. From the 95% confidence intervals for the mean given in Table 2, one may observe the significant differences among different levels for the factors age and education.

One of the visual aids to present such results is the boxplot. 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.

Figure 8: *Histogram for the variable duration of unemployment spells (in days)*

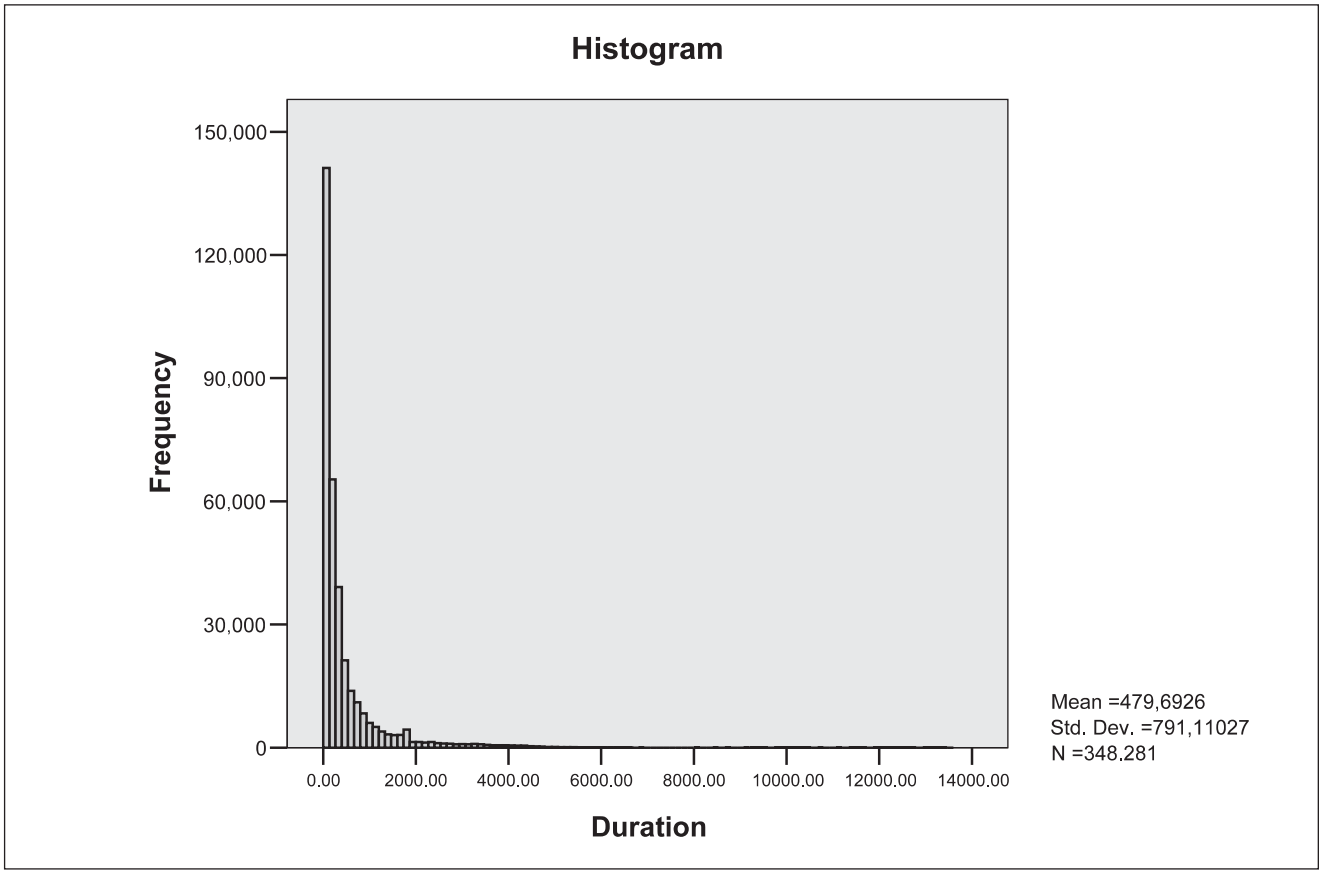
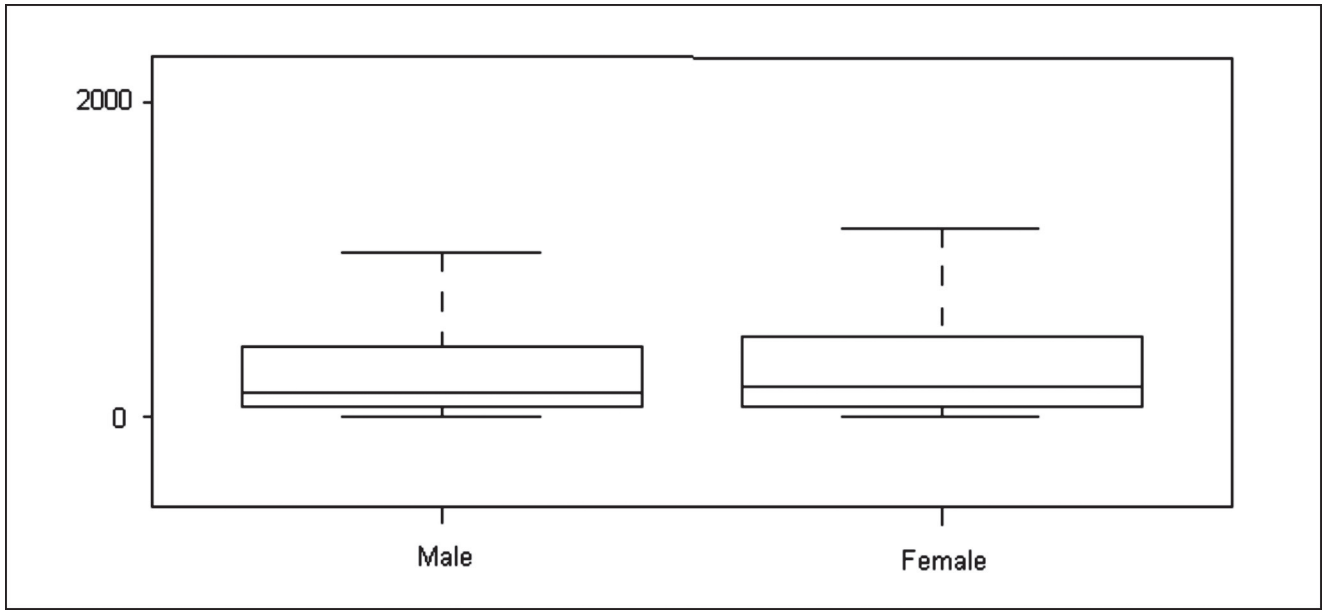


Table 2: *Descriptive statistics for the duration of unemployment spells*

	N	*Mean*	*Std. Dev.*	*95% confidence interval for the mean*
Total	348,281	479.69	791.11	(477.07, 482.32)
Factor: Sex				
Male	177,103	471.33	818.35	(467.52, 475.14)
Female	171,178	488.34	761.81	(484.73, 491.95)
Factor: Education				
Elementary school	102,256	657.90	1027.61	(651.61, 664.20)
2-year lower vocational education	21,248	510.12	877.61	(498.32, 521.92)
3-year lower vocational education	3,893	583.17	891.21	(555.16, 611.17)
Middle vocational education	92,294	443.56	731.90	(438.84, 448.28)
Secondary education	94,143	379.14	550.78	(375.63, 382.66)
Post-secondary vocational education	8,371	440.63	653.01	(426.64, 454.62)
Higher professional education	8,185	220.88	239.66	(215.68, 226.07)
University degree	17,117	253.34	379.32	(247.66, 259.02)
Master`s degree	571	291.17	511.57	(249.12, 333.22)
Doctorate	203	262.48	443.15	(201.15, 323.81)
Factor: Age				
18 years or less	4,506	636.89	1087.20	(605.14, 668.65)
Over 18 to 25 years	113,087	301.65	488.81	(298.80, 304.50)
Over 25 to 30 years	63,912	299.94	566.41	(295.55, 304.34)
Over 30 to 40 years	68,912	500.57	934.47	(493.59, 507.54)
Over 40 to 50 years	65,075	825.19	1054.87	(817.09, 833.29)
Over 50 to 60 years	31,928	700.37	736.30	(692.30, 708.45)
60 years and over	861	417.23	357.14	(393.34, 441.12)

In Figure 9, boxplots for male and female unemployed are shown. The differences are less pronounced than in the case of the factors level of education and age in the following two figures. As already mentioned, women in Slovenia had no disadvantages in the labour market during the mid-eighties and early nineties, which was not the case in other transition economies. Vodopivec (1995b) explains that in the mid-eighties women represented a higher share in the two highest vocational classes (managers and leading clerks) in comparison to men. The situation in the labour market at

Figure 9: *Boxplot depicting the duration of unemployment spells (in days) for both sexes*



the beginning of the 21st century is slightly worse from the female point of view, but still better than in many European countries.

Figure 10 depicts the duration of unemployment spells for several levels of education. The difference between the last four levels, starting with higher education on one hand

Figure 10: *Boxplot depicting the duration of unemployment spells (in days) for different levels of education*

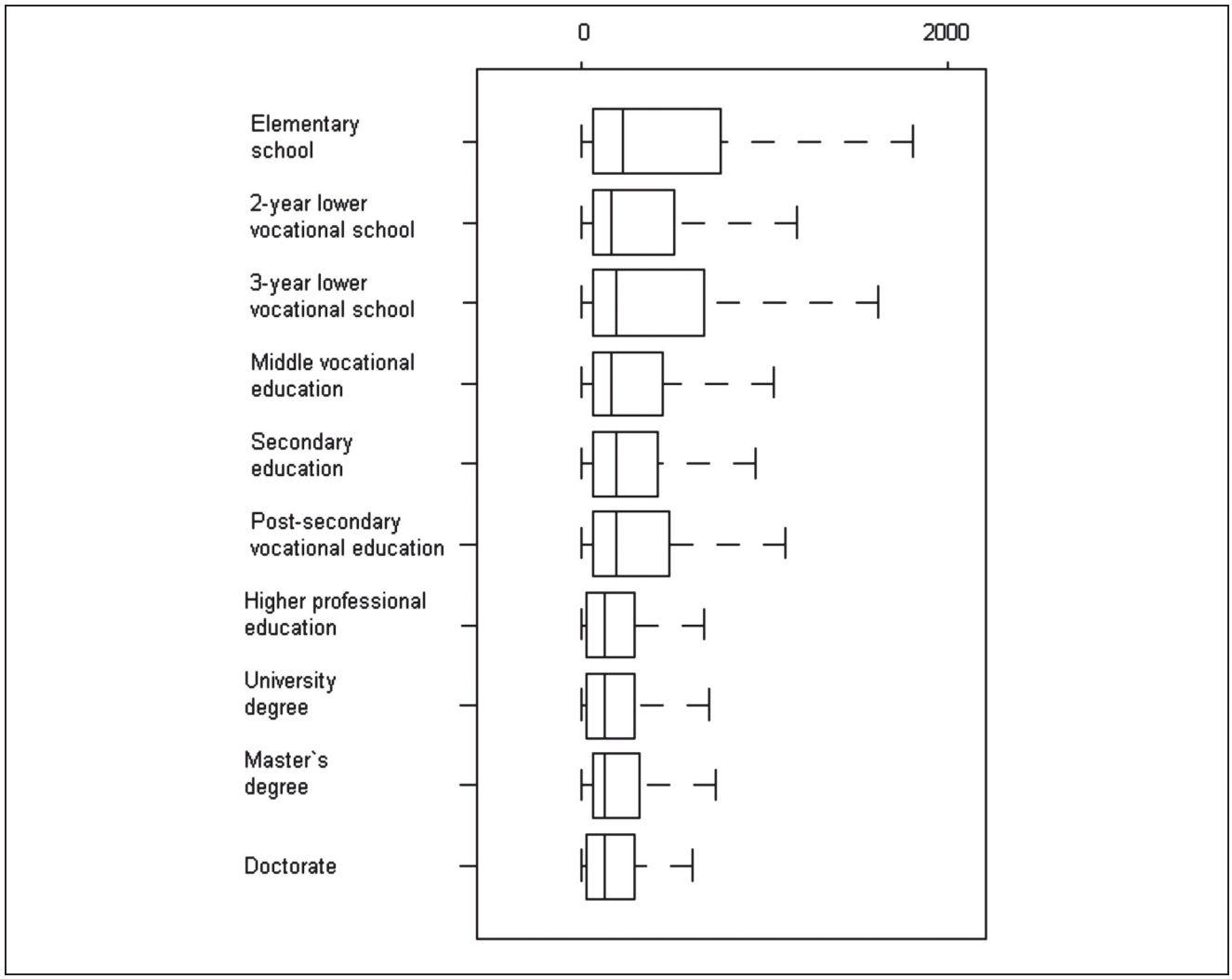
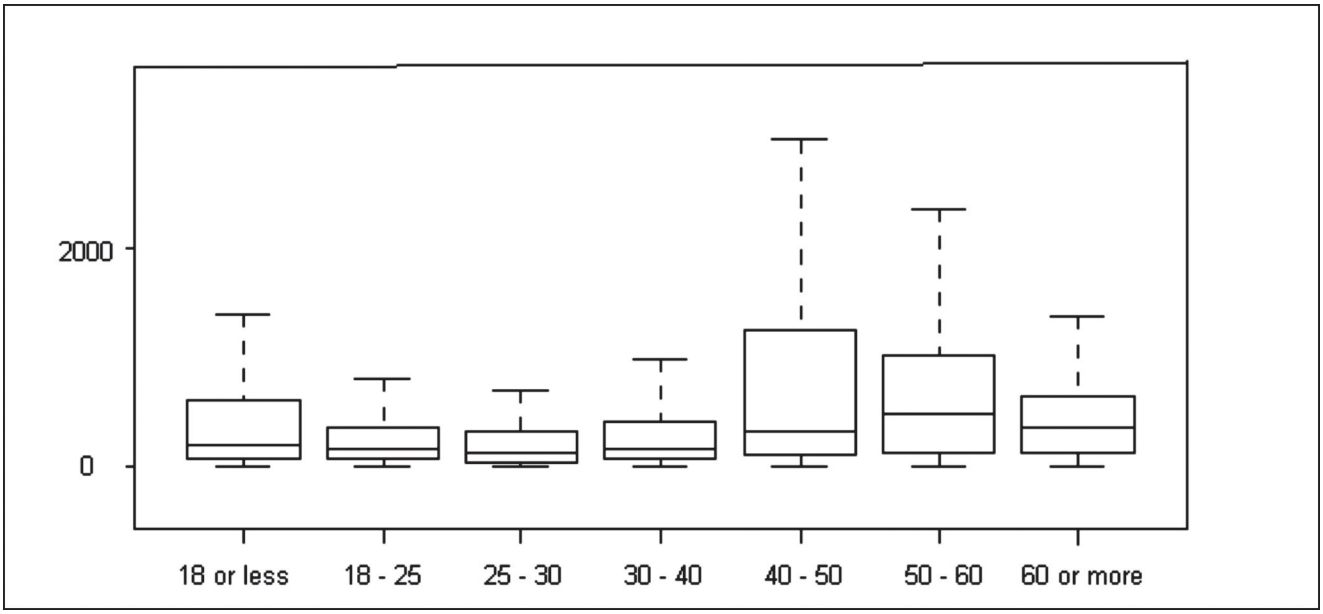


Figure 11: *Boxplot depicting the duration of unemployment spells (in days) for different age groups*



and secondary education and lower levels on the other hand, is obvious. The mean length of unemployment spells for the unemployed with an elementary school education is, for example, 658 days, whereas the lowest mean reported for the group with higher professional education is only 221 days. Level of education is thus crucial when searching for a job.

The boxplot showing the duration of unemployment spells for different age groups can be found in Figure 11. The groups 18 – 25 years and 25 – 30 years have the greatest advantage in the labour market, with mean length of unemployment spells of 302 and 300 days, respectively. The unemployed between 40 and 50 years of age are in the worst position, as they have to wait 826 days on average to find a new job.

To test the null hypotheses that the mean duration of unemployment spells is the same for each of the levels of the factors sex, age and education, respectively, we performed the nonparametric Kruskal–Wallis test. ANOVA is inappropriate in our case because the distribution is asymmetrical. The null hypothesis is strongly rejected for each of the factors since the p–values are lower than 10^{-6}.

4 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. In recent years these techniques have also gained popularity in the social sciences to model the length of unemployment spells and strike duration. One of the unavoidable problems encountered when analyzing duration data is so-called *censoring*. Since the event under observation (i.e. death or the end of an unemployment spell) has often not occurred until the end of the study, it is only possible to estimate the lower bound of the survival time. This kind of censoring is called *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). The derivation of the Kaplan–Meier estimator can be found in Greene (2003) and in Zeileis (2002).

4.1 Basic notions

Let the random variable T denote *survival time*. The distribution function of T is defined by the equation

$$F(t) = P(T < t) \tag{1}$$

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:

$$f(t) = F'(t). \tag{2}$$

The *survival function* S(t) denotes the probability of survival until time t or longer and is given by

$$S(t) = P(T \geq t) = 1 - F(t). \tag{3}$$

The limit

$$\lambda(t) = \lim_{\delta \to 0} \frac{P(t \leq T < t + \delta \mid T \geq t)}{\delta} \tag{4}$$

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*

$$\Lambda(t) = \int_0^t \lambda(u)du. \tag{5}$$

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

$$\lambda(t) = \lim_{\delta \to 0} \frac{P\left(t \le T < t+\delta \mid T \ge t\right)}{\delta} = \\ = \lim_{\delta \to 0} \frac{P\left(t \le T < t+\delta\right) / P\left(T \ge t\right)}{\delta} = \\ = \frac{1}{S(t)} \lim_{\delta \to 0} \frac{F(t+\delta) - F(t)}{\delta} = \frac{F'(t)}{S(t)}. \quad (6)$$

It follows from the definition of the survival function S(t) given by equation (3) that $F'(t) = -S'(t)$, therefore

$$\lambda(t) = \frac{-S'(t)}{S(t)} = -\frac{d \log S(t)}{dt}. \quad (7)$$

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

$$-\log S(t) = \int_0^t \lambda(u)du = \Lambda(t), \quad (8)$$

therefore

$$S(t) = e^{-\Lambda(t)}. \quad (9)$$

We have observed the fact that $\log S(0) = \log 1 = 0$ since $P(T \ge 0) = 1$. The relationship between the survival function and the cumulative hazard function given by equation (9) is the basis for the derivation of the Fleming–Harrington estimator of the survival function.

4.2 Parametric and semiparametric approaches

Taking into account the relationships between survival time, the survival function, the hazard function, and the cumulative hazard function, one may decide to model any one of them and estimate the others from the derived equations. When modelling the hazard function, the simplest approach assumes the function to be constant, namely $\lambda(t) = \lambda$, implying that the conditional probability of death in the observed short interval of time does not vary with time. From equations (8) and (9) one obtains

$$S(t) = e^{-\lambda t}. \quad (10)$$

This is the well-known exponential distribution usually applied to model the time until failure of electronic devices, especially light bulbs. Other distributions often used in practice include the Weibull, the lognormal, and the loglogistic distribution.

An alternative to the previously described parametric approach is the so-called *Cox proportional hazard model,* a semiparametric method of analyzing the effects of different covariates on the hazard function. Assuming *n* individuals under observation, the model is of the form

$$\lambda_i(t) = e^{-x_i'\beta} \lambda_0(t), \quad i = 1, 2, \ldots, n, \quad (11)$$

where x_i is the vector of covariates for the individual *i* and $\lambda_0(t)$ is *the baseline hazard*. Thus, the baseline hazard corresponds to an observation with $x_i = 0$. By using *Cox's partial likelihood estimator*, it is possible to estimate the parameter vector β without specifying and estimating the baseline hazard.

4.3 Nonparametric methods

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.

4.3.1 Kaplan–Meier estimator

This estimator of the survival function is also called the *product limit estimator* for reasons that shall 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:

$$\hat{S}(t) = 1 - \hat{F}(t) = \frac{n - \sum_{j=1}^{s} d_j}{n}, \qquad t_s \le t < t_{s+1}. \quad (12)$$

If the numerator and the denominator of the previous expression are successively multiplied by factors of the form $n - d_1 - d_2 - \ldots - d_i$, $i = 1, 2, \ldots, s - 1$, one obtains

$$\hat{S}(t) = \frac{n-d_1}{n} \cdot \frac{n-d_1-d_2}{n-d_1} \cdot \ldots \cdot \frac{n-d_1-d_2-\ldots-d_s}{n-d_1-\ldots-d_{s-1}}. \quad (13)$$

Let r_i, $i = 2, \ldots, p$, denote the number of individuals whose observed survival time is at least t_{i-1} and let $r_1 = n$. 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

$$\hat{S}(t) = \left(1 - \frac{d_1}{r_1}\right) \cdot \ldots \cdot \left(1 - \frac{d_s}{r_s}\right) = \prod_{j=1}^{s} \left(1 - \frac{d_j}{r_j}\right), \quad t_s \le t < t_{s+1}. \quad (14)$$

4.3.2 Fleming–Harrington estimator

Another nonparametric intuitive approach uses the *Nelson estimator* of the cumulative hazard function, namely

$$\hat{\Lambda}(t) = \sum_{j=1}^{s} \frac{d_j}{r_j}, \quad t_s \le t < t_{s+1}, \quad (15)$$

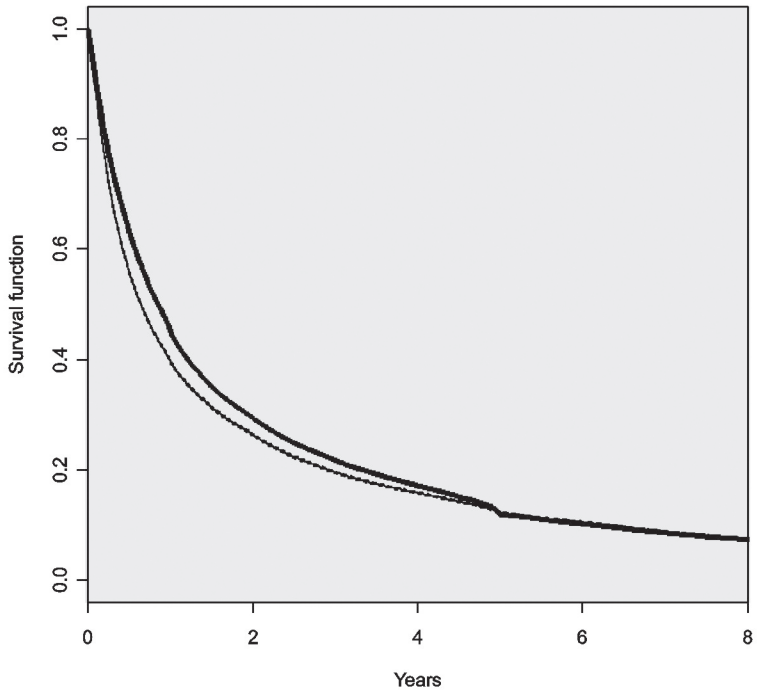
and then derives the Fleming–Harrington estimator of the survival function with the help of equation (9):

$$\hat{S}_{FH}(t) = e^{-\hat{\Lambda}(t)}. \quad (16)$$

4.4 Comparing survival estimates

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 an unemployment spell to last until

Figure 12: *Survival function estimates for male and female unemployed (in bold)*



time t or longer is measured. In Figures 12, 13 and 14 the Kaplan–Meier estimates of the survival functions for the three factors studied previously are shown. The Fleming–Harrington estimator yields very similar results. For the factors education and age, only the two extreme levels with the highest and lowest probability of survival are displayed to make the figures easier to read. The survival function estimates for other levels lie between the two extremes.

The Kaplan–Meier survival function estimates for male and female unemployed are displayed in Figure 12. During the first four years of unemployment, a difference between

Figure 13: *Survival function estimates for the unemployed with an elementary school education and the unemployed with a higher professional degree (in bold)*

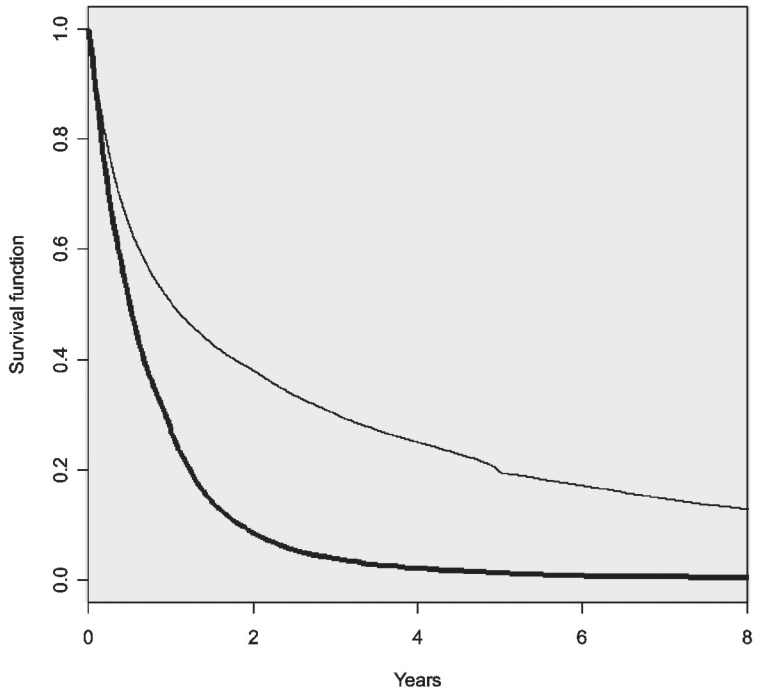
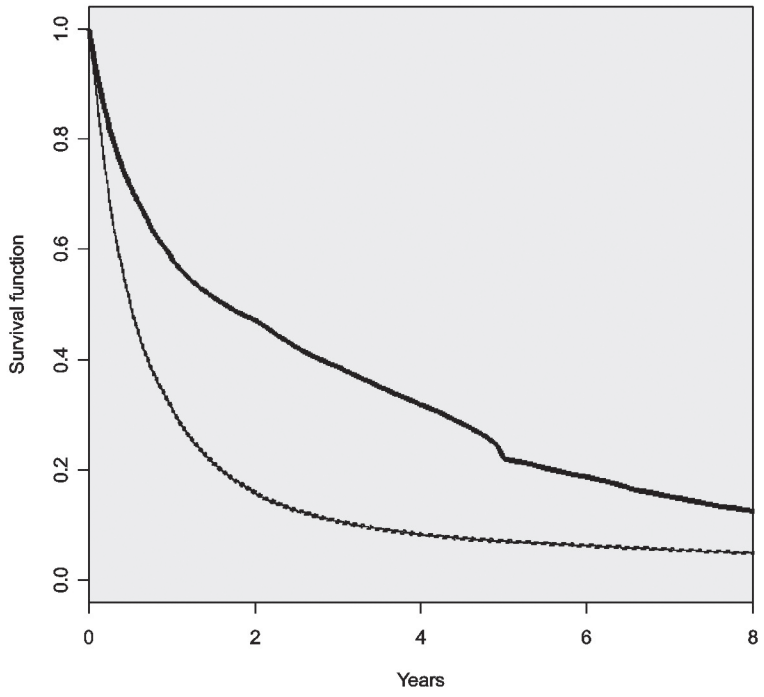


Figure 14: *Survival function estimates for the age groups 25-30 years and 40-50 years (in bold)*



the two curves may be observed, with a moderate advantage for the male unemployed over the female unemployed, whereas the curves coincide from six years onward.

Figure 13 depicts the survival function estimates for the unemployed with an elementary school education and the unemployed with higher professional education (in bold). One can see that in the second case the probability of unemployment at time t or later decreases much more rapidly, indicating that the unemployed with the higher professional education have a far better position in the labour market, as expected.

In Figure 14 below, the Kaplan–Meier survival function estimates for the age groups 25-30 years and 40-50 years (in bold) are displayed. The two extreme age groups with the lowest and the highest mean length of unemployment spells were chosen. The differences between the survival function estimates are clearly visible. The estimate of the unemployed from 40 to 50 years of age decreases to 0 at a much slower rate.

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 χ^2 - distribution under the null can be used. When performed for our data using the factors sex, age, and education, the highly significant p–values (lower than 10^{-6}) confirm the results derived graphically from the Kaplan–Meier estimates of the survival functions.

5 Conclusion

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 to November 2005, yielded the following results.

During the first four years of unemployment, a moderate advantage for male unemployed over female unemployed may be observed. The difference vanishes in the sixth year of unemployment.

Taking into account level of education, the probability of re-employment is the lowest for the unemployed with only an elementary school education. The unemployed with a higher professional education are in a far better position in the labour market. The probability of remaining unemployed for the latter level of education is even slightly lower than for the unemployed with a university degree, master's degree, and doctorate.

Regarding the age of unemployed, the two extreme age groups with the lowest and the highest mean length of unemployment are 25-30 year-olds and 40-50 year-olds, respectively. The differences between the Kaplan-Meier survival function estimates are highly significant. The probability of re-employment for the unemployed aged 25-30 years is the highest among all age groups, while the lowest is for the unemployed aged 40-50 years.

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