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The impact of gender on routes for registered unemployment exit in Poland

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Abstract
Research background: Numerous studies show that men's and women's situation on the labour market differs. Women's disadvantageous position on the labour market in Poland has been confirmed by statistical data (*Kobiety…*, 2016). The most common reasons for de-registration from the employment office are finding a job and deleting from the records due to an unjustified refusal to accept an offer by an unemployed person. Additionally, registered unemployed people can for example: retire, apply for invalidity pension, receive early retirement benefits or start full time studies. The above causes are regarded as competing risks of various kinds.
Purpose of the article: The purpose of this article is to assess the effect of the unemployed individual's gender on the probability and intensity of de-registering from the labour office lists due to finding a job, de-registering or other causes.
Methods: In the study the survival analysis methods were used. The assessment of the probability of de-registration due to a specific cause was made by means of the cumulative incidence function. The intensity of de-registration was tested with the Lunn-McNeil model. Differences in the effect of gender on the de-registration possibility were tested with the use of Gray's test. The study was based on individual data of people registered by the Labour Office in Szczecin.
Findings & Value added: Among women, job-finding was the most common cause of de-registration, followed by the removal from the register. In the case of men the order was reversed, the most probable de-registration cause was the removal, followed by job-finding.

The remaining causes were of marginal significance, both for men and women. Women took up a job more intensively than men and were less intensively removed from the register. The differences between males and females in the intensities of de-registering due to the remaining causes were not statistically relevant.

Introduction

Numerous studies confirm the difference between the situation of men and women on the Polish labour market. More difficult situation of women results from several barriers and obstacles that they still have to struggle with. The fact has been corroborated by factors that have persisted for years, such as a lower employment rate, a higher unemployment rate, salary gap between male and female employees, or a low share of women at senior positions and on the company boards. In the recent years the women's situation has been changing gradually. This process is associated with changes on the modern labour market. Still, the disadvantageous position that women have to cope with when seeking jobs results mainly from their double role as professionally active mothers or caregivers (Kotowska, 2007, pp. 21–26). The currently observed changes on the labour market, such as increasingly more popular flexible forms of employment, may turn out beneficial for women. Another important aspect of this process are societal changes such as the shift from a traditional family model to the one based on partnership or the increasing level of women's education.

Women's disadvantageous position on the labour market is illustrated by statistical data. According to BAEL, in the 4th quarter of 2015 the economic activity rate in a group aged 15 plus was 56.5% (48.6% and 65.0% for women and men, respectively). The employment rate was 52.6% (45.2% for women and 60.6% for men). The unemployment rate in that period was 6.9% (women: 7.1%, men: 6.8%). In the 4th quarter of 2015 women prevailed in the group of the economically inactive (61.5%). At the end of 2015 the percentage of women in the total number of the registered unemployed amounted to 52.2%. In the periods of the labour market downturn, it is men rather than women that suffer from its adverse effects, i.e. the number of unemployed men goes up faster, thereby increasing their share in the total of the registered unemployed. The analysis of the mean unemployment time shows that women remain in the labour office records 1.7 months longer than men (i.e. 13.4 months versus 11.7 months). Women are more willing to take advantage of subsidised forms of employment offered by labour offices, they more often join programmes that promote economic activity, even though the effectiveness of these programmes is lower than expected. Research reveals poor results of the Polish labour market policies (Hadaś-Dyduch *et al*., 2016, p. 7). Finding a job is just one of many causes why an individual leaves the labour office register. The registered unemployed have the opportunity to retire, apply for invalidity pension, receive early retirement benefits, or enrol for full time studies. One of the most common causes of de-registration is the unjustified refusal to accept a job offer.

The purpose of this article is to analyse the effect of the unemployed person's gender on the probability of de-registration from the labour office lists due to job-finding, removal from the register or other causes. These three types of causes are different kinds of competing risks. The competing risk is an event whose incidence rules out the incidence of another event or fundamentally alters the probability for this another event to happen (Gooley *et al*., 1999, pp. 695–706). This would be on the assumption that both events are mutually independent, i.e. the incidence of an event of a given type does not influence the probability of any other events to happen (Crowder, 1994, pp. 379–391; 1996, pp. 195–209; 1997, pp. 215–223). The individual under examination is simultaneously exposed to different types of risk. However, the possible event is assumed to result from only one of the factors that are referred to as 'the cause of failure' (Aly *et al*., 1994, pp. 994–999).

The study applies selected methods of the survival analysis that employ censored observations. The competing risks are assessed by means of the cumulative incidence function (*CIF*). The event intensity is evaluated with the Lunn-McNeil model. The study is based on individual data of the unemployed local residents registered by the Poviat Labour Office in Szczecin. The data were generated from the SYRIUSZ system.

Research methodology

The survival analysis methods, commonly used in demography and medical sciences to measure human life expectancy, can also be applied in studies on the duration of social and economic phenomena. What is analysed here is the individual's survival time in a specific state (random variable T) until a specific endpoint event occurs. This can be, for example, the company lifetime, the unemployment spell or the credit repayment time. We can use the survival analysis methods to examine duration of firms (Markowicz, 2013, pp. 23–36), population's economic activity (Landmesser, 2009, pp. 385–392), poverty duration in households (Sączewska-Piotrowska, 2015, pp. 44–55), credit risk (Wycinka, 2015, pp. 527–536) or duration of unemployment (Bieszk-Stolorz & Markowicz, 2015, pp. 167–183).

The elementary term used in the survival analysis is a duration function, also called a survival function (Bieszk-Stolorz, 2015, pp. 22–33):

$$S(t) = P(t > T) = 1 - F(t) \tag{1}$$

where:
T – the event duration,
$F(t)$ – the cumulative distribution function of the random variable T.

The survival function $S(t)$ specifies the probability that the event will occur at least by the time t. In demography and medical sciences the analysed event is the individual's death and what is estimated is the probability of their survival. Depending on the defined event, sometimes it is more convenient to analyse the cumulative distribution function $F(t)$, which expresses the probability for the event to occur by the time t the latest. In this case, a good example is the study on the unemployment spell duration. When the event is defined as finding a job by a registered unemployed individual, then the survival function estimator specifies the probability of remaining in the labour office register, while the estimator of the cumulative distribution function designates the probability of finding a job.

Usually, a study using survival models is based on the observation of individuals belonging to a specific cohort, i.e. to a set of objects singled out from a population due to an event or process simultaneously occurring for the whole set. The cohort should be distinguished basing on statistically relevant attributes and must be homogenous in terms of these attributes. For each individual, the time of survival in a given state or the time of duration of a given process are observed. If in the study the period of individuals' observation is fixed, some part of them can fail to survive by the end of this period. In such cases, the individual survival time is known only partially. Such observations are referred to as right censored. In scientific research the right censored observations are also the situations when the examined individual disappears from the field of observation or the endpoint event occurs which rules out the incidence of the appropriate event (Pepe, 1991, pp. 770–778) (i.e. the competing risk). In medical studies a typical example is the analysis of the cause of death. For example, in the case of cancer death, it may occur due to the relapse or during the process of remission (caused by the administered therapy). Making a distinction between these two causes has a fundamental meaning for the whole process of treatment. In engineering, the competing risk is associated with the influence of individual components on the whole system. The failure of any of these components results in the failure of the system in general. Therefore, the observation covers the time of failure as well as the faulty component and the extent to which it affected the system. In the research practice, observations concluded with a competing risk can be treated as right censored. What is interesting, however, is the application of competing risk models (Klein & Moeschberger, 1984, pp. 50–57; Klein & Bajorunaite, 2004, pp. 291–312).

Let T and C be continuous random variables describing the time to event and the time to censoring, respectively. When there are K types of competing risks, the observation encompasses the pairs (X, δ), where $X = \min(T, C)$ and $\delta = 0, 1, \ldots, K$. If a given observation is censored, then $\delta = 0$ and $\delta = 1, \ldots, K$ for the observations ending with an event (one of the K competing-risk ones). In this context, one of the K events can be considered the event of elementary importance, while all the remaining ones – the competing-risk events.

The estimator of the cumulative incidence function was first proposed by Kalbfleisch and Prentice (2002, pp. 247–275). It is a cumulative probability of the incidence of an event due to the cause k by the time t, basing on the assumption that the individual is exposed to any of the competing risks k (Bryant & Dignam, 2004, pp. 182–190). The cumulative incidence function is written (Klein & Moeschberger, 2003, p. 52):

$$CIF_k(t) = P(t \leq T, \delta = k) = \int_0^t S(u)\,dH_k \text{ for } k = 1, 2, 3, \ldots, K \tag{2}$$

where:
$H_k(t)$ – specified (for a fixed k) function of cumulative hazard function,
$S(t)$ – survival function.

Let $t_1 < t_2 < \ldots < t_i < \ldots < t_n$ be event times. Similarly to the standard cumulative hazard function in the survival analysis, the cumulative hazard function $H_k(t)$ for the cause k can be expressed by the Nelson-Aalen estimator:

$$\hat{H}_k(t) = \sum_{j:t_{j\leq t}} \frac{d_{kj}}{n_j} \tag{3}$$

where:
d_{kj} – number of events that have occurred due to the cause k,
n_j – number of individuals at risk at the time t_j.

If the distribution time of the analysed phenomenon is not known, the survival function is usually estimated by means by the Kaplan-Meier estimator (Kaplan & Meier, 1958, pp. 457–481):

$$\hat{S}(t) = \prod_{j: t_j \leq t} \left(1 - \frac{d_j}{n_j}\right) \tag{4}$$

where:
d_j – the number of events at the moment t_j,
n_j – the number of individuals at risk by the moment t_j.

Having combined the above two estimators (3) and (4), we can estimate the function of the cumulative incidence due to the cause k (Marubini & Valsecchi, 1995, pp. 331–364) as:

$$C\hat{I}F_k(t) = \sum_{j: t_j \leq t} \hat{S}(t_{j-1}) \frac{d_{kj}}{n_j} \tag{5}$$

The cumulative incidence function helps determine the patterns of the event incidence due to the cause k, as well as estimate to what extent each of the causes contributes to the total failure.

Since $\sum_{k=1}^{K} d_{kj} = d_j$, then the following relation is true:

$$\sum_{k=1}^{K} C\hat{I}F_k(t) = 1 - \hat{S}(t) \tag{6}$$

In the absence of competing-risk events, we have:

$$C\hat{I}F(t) = 1 - \hat{S}(t) \tag{7}$$

In the case of competing risks, the equality of cumulative incidence functions for K sub-groups is verified by the Gray test (Gray, 1988, pp. 1141–1154) which compares weighted means of the hazards of the cumulative incidence function. The null hypothesis assumes the absence of differences between the cumulative incidence functions determined for the subgroups. The test statistic has a chi-square distribution with $K-1$ degrees of freedom. In the absence of competing risks, the Gray test is reduced to an ordinary log-rank test.

In order to estimate the relative intensity of the incidence of a given event by the time t, we can use the Lunn-McNeil model. In this model data needs to be grouped in a specific way. If there are K types of risk, the output data must be duplicated K times. Each observation (including the duplicated one) is attributed with the status e_i which informs about the allocation of the object i to a specific risk group: e_i equals 1 if the observation of the object i ended with an event of the type k ($k = 1, 2, \ldots, K$); otherwise it equals 0. In the case of a censored observation, e_i equals 0 for each $k = 1, 2, \ldots, K$. We introduce to the model the dummy variables $D_1, D_2, \ldots, D_K$ that represent K types of risk: D_k equals 1 for the k type risk and 0 for the remaining risk types.

If $g = 1, 2, \ldots, K$ denotes the strata being the risk types, the Lunn-McNeil model (the alternative version) can be defined as a stratified Cox regression model with interactions (Kleinbaum & Klein, 2005, p. 423):

$$h_g(t, X) = h_{0g}(t)\exp\left(\sum_{k=1}^{K}\sum_{j=1}^{p}\delta_{kj} D_k X_j\right) \tag{8}$$

where:
$X_1, X_2, \ldots, X_p$ – the explanatory variables,
$D_1, D_2, \ldots, D_K$ – K dummy variables.
The strata $g = 1, 2, \ldots, K$ correspond to K competing risks.

In the Lunn-McNeil model we do not interpret the parameters δ_{kj} directly, but we choose their $\exp(\delta_{kj})$ form. If X_j is an explanatory dichotomous variable, then:

$$HR_{g=k}\left(X_j = 1 / X_j = 0\right) = \exp\left(\delta_{kj}\right) \tag{9}$$

is interpreted as the relative hazard (relative intensity) of the incidence of the k-type event.

Beside the unconditional competing risks, some authors describe the conditional models of competing risks. In the former case, their independence is assumed, while in the latter type of events, the probabilities of transition from one status to another depend not only on the explanatory variables, but also on the time and type of remaining in the previous status.

Data used in the study

The study uses anonymous individual data obtained from the Poviat Labour Office (PUP) in Szczecin (Poland). The study covered 22 078 unemployed individuals registered in 2013 and observed by the end of 2014. The event that terminated each observation was the moment of their de-registration from the labour office list. The analysis focused on the time between the registration and de-registration due to a specific cause. The implementation of SYRIUSZ software in Polish labour offices made it possible to collect extensive data about the unemployed individuals. Today, the registers provide information on several dozens of de-registration causes, such as job-finding, retirement or invalidity pension, continuation of university studies or emigration. The causes were categorized into three groups according to competing risks involved: job-finding, removal from the register and other. Some observations did not end with an event, i.e. with the de-registration during the analysed period of time. Such observations are considered right censored. The sizes of all the groups are shown in Table 1.

Each of the major de-registration causes is composed of several sub-causes (Table 2). The job-finding (Job) consists of three main subgroups: finding a job or another form of employment; taking up a government subsidised form of employment; economic activity. The Removal from Register category includes the unemployed individual's reluctance to cooperate with the labour office and have been removed from the register through their own fault or on their own request. The remaining causes of de-registration (Other) are less numerous and, as previous research showed, each of them had a marginal effect on the probability of de-registration. Therefore, they have been considered to form a separate group.

Analysis of gender effect on causes of de-registering from labour office

The analysis consisted of two stages. In the first stage, the event cumulative incidence function (CIF_k) was used to estimate the probability of the unemployed men's and women's de-registration from the labour office lists. With the assumed absence of competing risks, the cumulative incidence estimator equals the complement to unity of the Kaplan-Meier estimator ($1 - KM$). The analysis of de-registering from the labour office due to any cause is such a case ($k = 1$). The censored data are those observations that had not been completed by the end of 2014. When analysing the plots of both the estimators (Figure 1), we can see that the probability of the de-registration due to any cause is slightly higher for the unemployed men than women.

The relevance of differences between the plots was confirmed by the Gray test (χ^2 = 77.644; p = 0.000). The probability of remaining in the labour office register after 12 months from registration was 0.16 for men and 0.19 for women. This is also the probability of transition to long-term unemployment. More detailed conclusions concerning the causes of de-registration can be provided by the analysis of competing risks that addresses various causes of de-registration (i.e. competing risks). Subsequently, three types of endpoint events were adopted: job-finding, removal and other, being the competing risks. As in the previous stage, the censored data were those observations which had not been concluded by the end of 2014. That allowed for the estimation of the probability of the major causes of de-registration of the unemployed men and women.

Taking up a job was the most frequent cause of de-registration among women throughout their whole unemployment spell (Figure 2). The second most common cause was the removal from the labour office register. As far as men are concerned, the most probable de-registration cause was the removal (staring from the 4th month from registration), followed by job-finding (Figure 3). Other causes were on the third position both in the male and female group and were of marginal importance. The Gray test indicates differences in the plots of the cumulative incidence functions determined for each gender group (Table 3). After 24 months of being registered, the probability of women's de-registration due to job-finding was at 0.51 (men 0.41), due to removal from the list — at 0.35 (men 0.49) and due to other causes — at 0.084 (men 0.071).

It is worth noticing that the plots of the estimators of the de-registration cause described as Job are regularly curved. The estimators of Removal and Other do not have such a property. In their plots sudden leaps in value can be observed. In the Other category a slight jump in value is seen in the 7th month after registration, for men and women alike. A detailed analysis of data reveals that it was caused by an increased number of de-registrations due to granting the unemployed individuals with the right to an early retirement benefit/allowance. In the case of Removal, a marked leap within the first month after registration was a result of a higher number of de-registrations because of the failure to appear in the labour office in due time. The above causes of de-registration concerned both men and women.

In the further part of the study the Lunn-McNeil model (the alternative version) was used to examine the effect of gender on the intensity of various routes of unemployment exit. For the dychotomous Gender variable and for three types of competitive risk the model takes the form:

$$h_g(t, X) = h_{0g}(t)\exp\left(\sum_{k=1}^{3}\delta_k D_k X\right) \tag{10}$$

where X is the explanatory Gender variable adopting the value of 1 for women and 0 for men (the reference group).

The dummy variables D_k specify the type of competitive risk and adopt the value of 1 for the risk number k and 0 in any other case. For the sake of this study, the risks were numbered in the following way: $g = 1$ for Job, $g = 2$ for Removal and $g = 3$ for Other. The parameter significance level was adopted at 0.01. The results of the model parameter estimation are shown in Table 4. The conducted analysis reveals that women took up a job 14% more intensively than men and were removed from the labour office register with intensity a little higher than 35%. The intensities of de-registering for other causes were similar in both groups (the lack of significance of the parameter δ_3).

With a view to summarise the study findings, the estimators of the cumulative incidence function were summed up in a way demonstrated in Figures 4 and 5. If all the observed individuals had been de-registered by the end of 2014, then the sum of the CIF_k estimators for all the risk types in the 24th month would have been equal 1. However, some of the observations were censored, therefore the sum was less than 1. The resulting non-zero difference allows to determine the probability of remaining in the labour office register longer than 24 months after registration. That probability was 0.05 for women and 0.04 for men.

Distances[1] between the plots are equal to the probability of de-registration due to a specific cause. The distance between the plot III and the line whose value is 1 is equivalent to the probability of remaining in the register. As we can see, this probability was decreasing over time. As it has been mentioned above, after 12 months after registration, it was at 0.19 for women and 0.16 for men. It follows that women were exposed to a higher probability to enter long-term unemployment.

The differences in the gender effect on the routes of unemployment exit were also confirmed by the Lunn-McNeil model parameters. Over the whole period of observation, women were taking up jobs more intensively than men, while men were more intensively removed from the labour office register. The unemployed individual's gender did not have any effect on the intensity of de-registration due to other causes.

[1] The distance between curves is measured by means of the metric: $d((x_1,y_1),(x_2,y_2))=|y_2-y_1|$.

Conclusions

The assistance provided to the unemployed individuals in finding a job is one of the main objectives of labour offices. The initial analysis of individual data obtained from the Poviat Labour Office in Szczecin has revealed that taking up a job was generally the most common cause of de-registering from the labour office list. The study conducted with the aid of the cumulative incidence function helped thoroughly examine and compare the de-registration odds due to specific causes in groups distinguished by gender. The analysis pointed to differences in the plots of the de-registration causes (CIFk). Job-finding was the most probable cause of de-registering in the group of women, while Removal — in the group of men. The obtained results imply that the will to take up a job was not the only impulse to register in the labour office. Other causes were of marginal importance.

The presented study has brought up an interesting methodological point. If there are different types of endpoint events, it seems worthwhile to distinguish competing risks and estimate the probability of their incidence. From the point of view of the labour market policies, it is important to analyse not only the job-finding events, but also the determinants of other routes of unemployment exit. Models of cumulative incidence make it possible to estimate the probability of job-taking and to compare them with other causes of de-registration. The Lunn-McNeil model can be used to determine the relative intensity of de-registration due to many causes.

The study is an important contribution to the process of creating a labour market policy. It allows the policy-makers to select from the pool of the registered unemployed a group of individuals who should be covered by activation programmes. It would be interesting to extend the study and examine the impact of the unemployed Poles' other attributes on the reason for deregistration. Unfortunately, the restricted access to individual data is a serious limitation.

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Annex

Table 1. Size of groups of specific de-registration

Groups	De-registration causes				Censored observations	Total
	Job	Removal	Other	Total		
Women	4809	3264	784	8857	913	9770
Men	4824	5701	840	11365	943	12308
Total	9633	8965	1624	20222	1856	22078

Table 2. Characteristics of major de-registration causes

Major causes	Sub-causes
Job	Finding a job or other form of employment, job subsidized by PUP (being hired for intervention or public works, a job under individual social employment scheme, a job created under government loan scheme for employers, a job for 50+ created under government subsidy scheme for employers), economic activity (starting a non-agricultural economic activity, being granted single resources for taking up an economic activity, starting a business activity subsidised from resources of the State Fund for the Rehabilitation of the Disabled (PFRON))
Removal	Refusal without a duly justified reason to accept a job offer or other paid work, intervention or public work or refusal to take up a training course, internship or on-the-job apprenticeship; failure to report to PUP in due time and to inform the Office about the justified reason to do so within 5 days; failure to submit a medical certificate attesting the jobseeker's incapacity to work; unjustified refusal to participate in The Activation and Integration programme (PAI), lack of notification of being available to work over at least 10 days; drop-out from training or internship programme or from other form of subsidised employment, PAI scheme implemented or commissioned by PUP; the jobseeker's application for cancellation of their registration by PUP.
Other	Taking up residence outside the area of the local PUP's authority; incapacity to work due to medical condition or addiction treatment in a closed rehabilitation establishment for the uninterrupted period of over 90 days; taking up a training programme implemented by an entity other than PUP; death; military service; taking up full time education; residence abroad longer than 30 days; becoming entitled to permanent disability allowance or a rehabilitation benefit; a jobseeker receives a permanent social benefit or is covered by retirement or disability insurance on account of permanent employment as a household member in an agricultural holding; the jobseeker continues to be unemployed and receives an attendance allowance or a single parent allowance; the jobseeker receives a guardian's allowance; becoming entitled to an early- retirement allowance;

Table 3. Gray test results for groups of the unemployed by gender

De-registration causes	Gray test (chi-square)	*p*
Any cause	77.644	0.000
Job	190.786	0.000
Removal	413.120	0.000
Others	10.932	0.001

Table 4. The results of the Lunn-McNeil model parameter estimation

Parameters	Assesment of parameters	Standard error	Wald statistics	*p*	Hazard ratio
δ_1	0.1270	0.0204	38.8026	0.0000	1.1354
δ_2	–0.4389	0.0220	399.2858	0.0000	0.6448
δ_3	0.0390	0.0500	0.6168	0.4322	1.0398
$\chi^2 = 451.836$, $p = 0.0000$					

Figure 1. Estimators of cumulative function of incidence of events of de-registration due to any cause by men and women

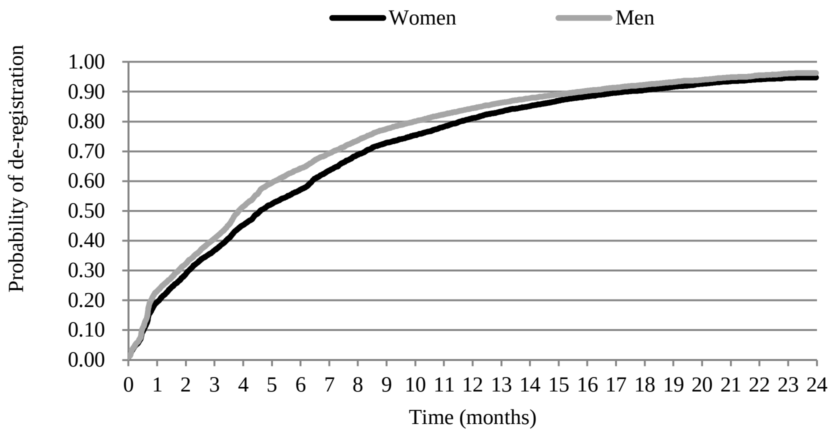


Figure 2. Estimators of cumulative incidence function (CIF_k) by different causes of de-registration of unemployed women

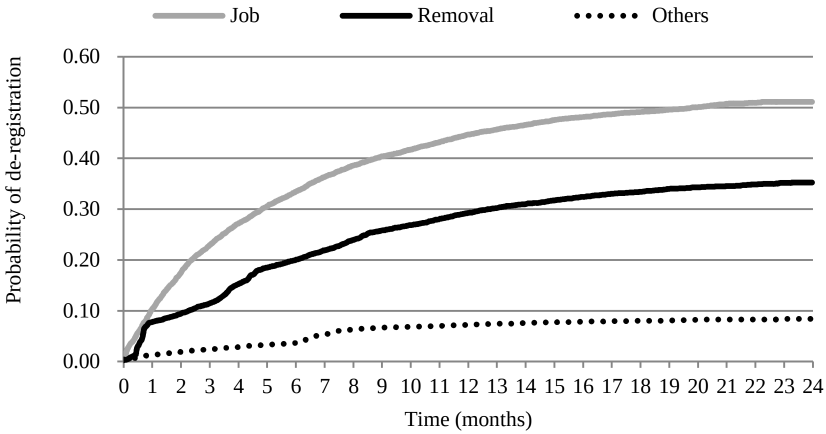


Figure 3. Estimators of cumulative incidence function (CIF_k) by different causes of de-registration of unemployed men

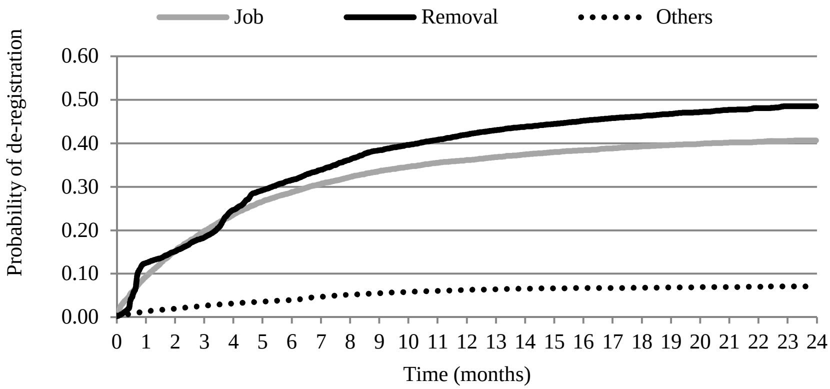
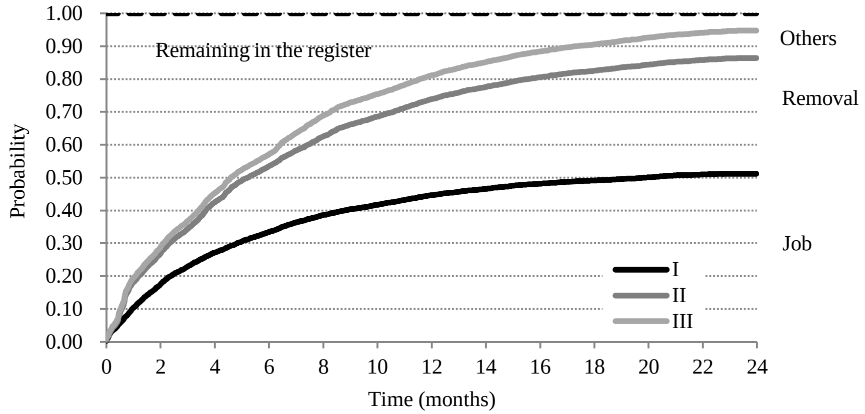
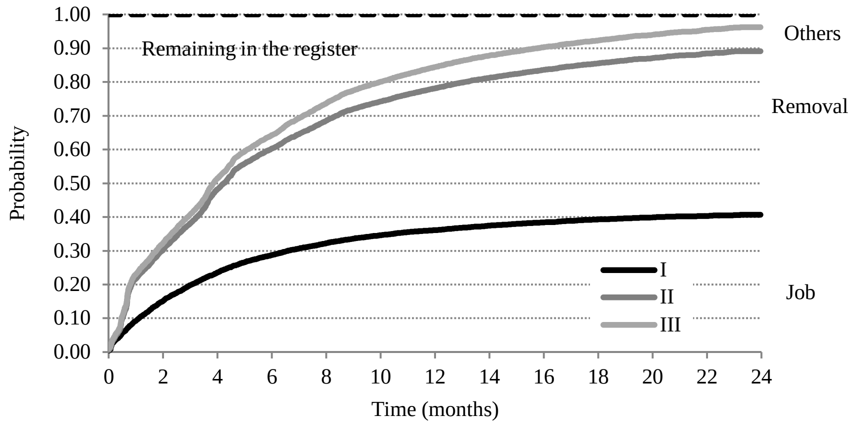


Figure 4. Summed up estimators of cumulative incidence function (CIF_k) for women



* I – Job, II – Job + Removal, III – Job + Removal + Others

Figure 5. Summed up estimators of cumulative incidence function (CIF_k) for men



* I – Job, II – Job + Removal, III – Job + Removal + Others