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## Gender as Determinant Factor of Routes for Registered Unemployment Exit

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**Gender as Determinant Factor of Routes for Registered  
Unemployment Exit**

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## Gender as Determinant Factor of Routes for Registered Unemployment Exit

**JEL Classification:** *C41; J64*

**Keywords:** *competing risk; cumulative incidence function; the Lunn-McNeil model; unemployment; gender*

### 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 has been confirmed by statistical data. Finding a job is just one of many causes why an individual is crossed out from the labour office register. The registered unemployed can retire, apply for invalidity pension, receive early retirement benefits or start full time studies. One of the most common causes of de-registering is the unemployed person's unjustified refusal to accept a job offer. 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.

**Methodology/methods:** The study made use of the survival analysis methods. 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:** 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. According to BAEL in the 4th quarter of 2015 the economic activity rate in a group aged 15 plus was 56.5% (women: 48.6%, men: 65.0%). The unemployment rate in that period was 6.9% (women: 7.1%, men: 6.8%). 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). More difficult situation of women results from several barriers and obstacles that still have to struggle with. 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 *et al.*, 2007, pp. 21-26). Currently observed changes on the labour market, such as increasingly more popular flexible forms of employment, may turn out women beneficial for. 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 these programmes is lower than expected. Research reveals poor results of 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 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, 1996, pp. 195-209). 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 Poviast Labour Office in Szczecin.

## Research Methodology

The survival analysis methods can 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. 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) or duration of unemployment (Bieszk-Stolorz & Markowicz, 2015, pp. 167-183).

The elementary term used in the survival analysis is a survival function:

$$S(t) = P(t > T) \quad (1)$$

where  $T$  is the event duration.

$S(t)$  specifies the probability that the event will occur at least by the time  $t$ . 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.

Usually, the 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. 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. 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). What is interesting, however, is the application of competing risk models (Klein & Moeschberger, 1984, pp. 50-57; Klein & Bajorunaite, 2004, pp. 291-312).

Cumulative incidence 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):

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

where:

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

Let  $t_j$  be event times,  $d_j$  – number of events,  $d_{kj}$  – number of events that have occurred due to the cause  $k$ ,  $n_j$  – number of individuals at risk at the time  $t_j$ . The cumulative hazard function  $H_k(t)$  for the cause  $k$  can be expressed by the Nelson-Aalen estimator:

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

$S(t)$  is usually estimated by means by the Kaplan-Meier estimator (Kaplan & Meier, 1958, pp. 457-481):

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

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

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

The  $CIF_k$  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.

In the case of competing risks, the equality of  $CIF_k$  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  $CIF_k$  determined for the sub-groups. The test statistic has a chi-square distribution with  $K - 1$  degrees of freedom.

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. We introduce to the model the dummy variables  $D_k$  that represent  $K$  types of risk:  $D_k$  equals 1 for the  $k$

type risk and 0 for the remaining risk types. If  $g = 1, 2, \dots, K$  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):

$$h_g(t, X) = h_{0g}(t) \exp \left( \sum_{k=1}^K \sum_{j=1}^P \delta_{kj} D_k X_j \right) \quad (6)$$

where:

$X_j$  – the explanatory variables,

$D_k$  – dummy variables.

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

$$HR_{g=k}(X_j = 1 / X_j = 0) = \exp(\delta_{kj}) \quad (7)$$

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

## Data used in the study

The study uses anonymous individual data obtained from the Poviats Labour Office (PUP) in Szczecin. The study covered 22 078 unemployed individuals registered in 2013 and observed by the end of 2014. The analysis focused on the time between the registration and de-registration due to a specific cause. Today, the registers provide information on several dozens of de-registration causes. 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. 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 con-

sidered to form a separate group (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, emigration, death, military service, taking up full time education, a disability allowance or a rehabilitation benefit; a permanent social benefit, disability insurance, retirement allowance).

**Table 1.** Size of groups of specific de-registration

| Groups       | De-registration causes |         |       | Censored observations | Total |
|--------------|------------------------|---------|-------|-----------------------|-------|
|              | Job                    | Removal | Other |                       |       |
| Women        | 4809                   | 3264    | 784   | 913                   | 9770  |
| Men          | 4824                   | 5701    | 840   | 943                   | 12308 |
| <b>Total</b> | 9633                   | 8965    | 1624  | 1856                  | 22078 |

Source: own study.

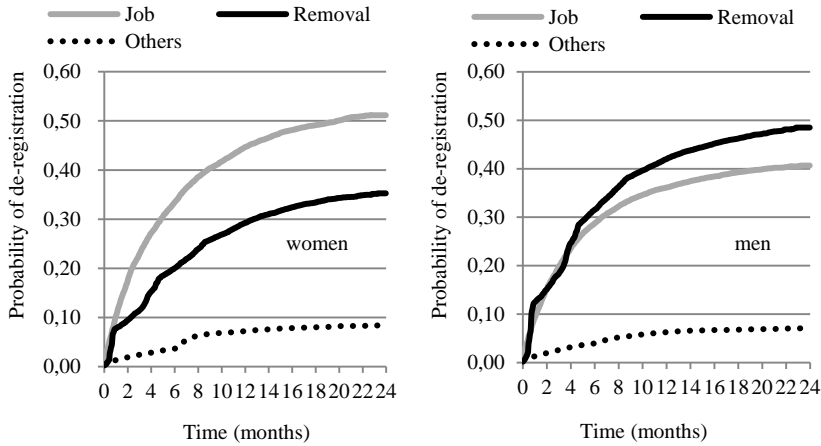
### Analysis of gender effect on causes of de-registering from labour office

The analysis consisted of two stages. In the first stage,  $CIF_k$  was used to estimate the probability of the unemployed men's and women's de-registration from the labour office lists. Three types of endpoint events were adopted: job-finding, removal and other, being the competing risks. 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. 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 (starting from the 4th month from registration), followed by job-finding. Other causes were on the third position both in the male and female group and were of marginal importance (Figure 1). The Gray test indicates differences in the plots of the  $CIF_k$  determined for each gender group (Table 2). 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).

**Figure 1.** Estimators of  $CIF_k$  of unemployed women and men





Source: own study.

**Table 2.** Gray test results for groups of the unemployed by gender

| De-registration causes | Gray test (chi-square) | <i>p</i> |
|------------------------|------------------------|----------|
| <b>Job</b>             | 190.786                | 0.000    |
| <b>Removal</b>         | 413.120                | 0.000    |
| <b>Others</b>          | 10.932                 | 0.001    |

Source: own study.

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 dichotomous Gender variable *X* (1 for

women and 0 for men) and for three types of competitive risk (Job:  $g = 1$ , Removal:  $g = 2$ , Other:  $g = 3$ ) the model takes the form:

$$h_g(t, X) = h_{0g}(t) \exp \left( \sum_{k=1}^3 \delta_k D_k X \right) \quad (8)$$

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. The parameter significance level was adopted at 0.01. The results of the model parameter estimation are shown in Table 3.

**Table 3.** The results of the Lunn-McNeil model parameter estimation

| Parameters                     | Assesment of parameters | Standard error | Wald statistics | $p$    | Hazard ratio |
|--------------------------------|-------------------------|----------------|-----------------|--------|--------------|
| $\delta_1$                     | 0.1270                  | 0.0204         | 38.8026         | 0.0000 | 1.1354       |
| $\delta_2$                     | -0.4389                 | 0.0220         | 399.2858        | 0.0000 | 0.6448       |
| $\delta_3$                     | 0.0390                  | 0.0500         | 0.6168          | 0.4322 | 1.0398       |
| $\chi^2 = 451.836, p = 0.0000$ |                         |                |                 |        |              |

Source: own study.

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  $\delta_3$ ).

## Conclusions

The assistance provided to the unemployed individuals in finding a job is one of the main objectives of labour offices. 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  $CIF_k$  pointed to differences in the plots of the de-registration causes. 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.

If all the observed individuals had been de-registered by the end of 2014, then the sum of  $CIF_k$  estimators for all the risk types in the 24<sup>th</sup> 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. The probability of remaining in the register was decreasing over time. It was at 0.19 for women and 0.16 for men after 12 months after registration. 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.

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.

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