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## **INTERNET AS THE SOURCE OF INFORMATION USED IN THE PROCESS OF LABOUR RESOURCES ALLOCATION**

## **INTERNET JAKO ŹRÓDŁO INFORMACJI WYKORZYSTYWANEJ W PROCESIE ALOKACJI ZASOBÓW PRACY**

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**Streszczenie.** Celem pracy była próba wskazania czynników wpływających na skłonność do korzystania z internetu w trakcie poszukiwania pracy. Przedstawione dane ilościowe oraz przegląd literatury przedmiotu pozwoliły na sformułowanie wniosku, że okres dopasowania możliwości i oczekiwań osób poszukujących pracy i pracodawców jest funkcją dostępu do informacji. Teza ta stanowi uzasadnienie prowadzonych badań o charakterze bardziej szczegółowym. W pracy podjęto próbę identyfikacji grupy docelowej, która wyraża największe skłonności do wykorzystywania informacji z internetu w procesie poszukiwania pracy. Oszacowane modele ekonometryczne dały podstawy do stwierdzenia m.in., że poszukiwanie pracy z wykorzystaniem internetu istotnie skraca czas pozostawania bez zatrudnienia. Dodatkowo osoby z wyższym wykształceniem, z dużych miejscowości, do 34 roku życia wykazują większe skłonności do pozyskiwania informacji z internetu w trakcie poszukiwania pracy.

**Key words:** information, job search, job market.

**Słowa kluczowe:** informacja, poszukiwanie pracy, rynek pracy.

## **INTRODUCTION**

The information revolution, in which the information technology plays a fundamental role, has led to the formation of a new type of economy and society. The current phase of socio – economic development is referred to as the New Economy. This term relates to changes occurring in modern economies. In this approach, particular importance is attached to the role of information, recognizing it as an economic resource. When using this term it should be noted that until today, there is no commonly recognized definition of information resources as an economic resource (Parlińska 2008).

From the economic perspective, information is treated as a production factor and considered in macroeconomic terms as an economic resource, a good or a demand. J. Oleński states that the demand for information (as a commodity) corresponds to the demand for news, the demand for information services and access to information that are present on the market. Its character, however, is dependent on the information user, the circumstances he is in, the type of information, its function in social and economic systems and its importance for individual consumers. This category should be considered separately depending on the types

of information, user groups and functions that the information fulfills (Oleński 2003). The cited author also concluded that this issue should not be analyzed in isolation from the concept of the system, since information and system concepts are inextricable (Oleński 1997).

With the growing importance of information as a production factor, the role of information technology, especially the Internet, increases. It is thus perfectly natural that the dynamics of this new technology inspires more and more research and studies on the information society (IS). An important definition of this concept, with particular emphasis placed on its economic aspect, is presented in a work by Goban-Klas and Sienkiewicz (1999). They state that the information society has got not only well-developed means of information processing and communication, but also contributes significantly to national income and provides source of earnings for the wider population. On the other hand, Oleński (2000) in his definition draws attention to the economic aspect, emphasizing that the IS is a social system whose main feature is social and economic development that requires from its members to have increasingly more information resources at their disposal.

One of the characteristics of the information society is the ability to provide citizens with access to the information technology and the ability to use it for professional and social activities. This, in turn, contributes to the improvement of skills, knowledge, health and other services affecting the quality of life, such as culture or leisure. It should be noted, however, that IS infrastructure consists not only of access devices, eg. the Internet, but also of information infrastructure, i.e. all services that are provided through new technologies. Therefore, the process of building the IS is often perceived as the computerization of most or even all spheres of life (Społeczeństwo informacyjne 2008).

In recent years, information and communication technologies have spread among the general public. An important limit was exceeded in 2007, when it was reported that the majority of households in the European Union (55%) had Internet access. This percentage was steadily increasing over the following years and in 2013 reached the level of 79%. In all Member States the most popular Internet connection technology is broadband (in 2013, 76% of households used it). In the same year, the highest share of households with Internet access was recorded in the Netherlands, Luxembourg, Denmark and Sweden (Eurostat, <http://ec.europa.eu/eurostat>).

The aforementioned data can serve as a reference point for the analysis of the situation in Poland. Unfortunately, in this respect a gap can still be observed between Poland and highly-developed countries, though it is definitely shrinking with the share of Internet-connected households steadily growing. In 2015, three-quarters of Polish households had access to the Internet. The remaining 63.0% declared that they had no Internet access at home since, simply, they did not need it (Central Statistical Office).

Work is a very important aspect of life which may be transferred to the virtual sphere. Of course, this shift has many consequences, e.g. rapid development of a new work organization called „teleworking”. In this context the mechanism of allocation of labour resources is particularly important. This aspect will be the subject of further consideration.

The experience of developed countries shows that the Internet as a source of information about vacancies and potential employers has been gaining popularity. An important role is played here by dedicated job sites that connect both sides of the employment relationship. As the data above imply, the share of Internet users seeking work online increased, although this trend is not dynamic (Fig. 1).

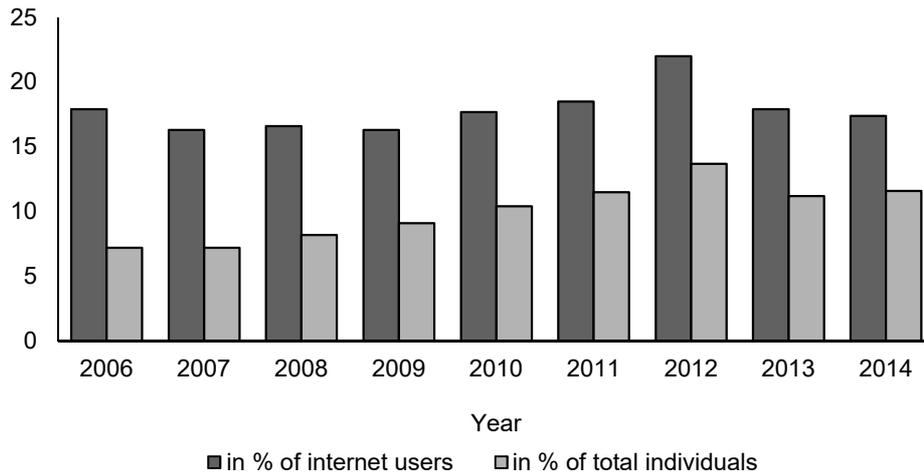


Fig. 1. Job seekers applying online  
Source: own study based on the Polish Central Statistical Office data.

The purpose of this article is to identify groups which have a strong tendency to use Internet for job search. An attempt was also made to assess the role of information as a factor influencing the matching of labour demand with labour supply. The review of subject literature helped to formulate the following research hypothesis: People who use in their job search information obtained from the Internet remain unemployed for a shorter period of time. This thesis is also the basis for the research of a more specific nature.

## INTERNET-BASED JOB SEARCH AND THE DURATION OF UNEMPLOYMENT

The first method used in the data analysis is the Cox model. In most duration analysis methods it is assumed that the hazard ratio depends on explanatory variables. A slightly different approach is used in semi-parametric models. The beginning of this type of approach is associated with the Cox article published in 1972 and titled „Regression models and life tables”. The author proposed a proportional hazard model in which the hazard function of  $j$ -th observation has the form:

$$h(t) = h_0(t)\exp(X_j\beta)$$

where:

$h_0(t)$  – the baseline hazard level, which describes how the hazard function changes over time,

$\beta$  – a vector of regression coefficients,

$X$  – the covariate vector of explanatory variables' values (Cox 1972).

The interpretation of parameters is based on hazard changes caused by the influence of changes on the value of independent variables which results from the following formula:

$$\frac{h(t, X_i)}{h(t, X_j)} = \frac{h_0(t) \exp(\beta_1 x_1 + \dots + \beta_k (x_k + 1) + \dots + \beta_n x_n)}{h_0(t) \exp(\beta_1 x_1 + \dots + \beta_k x_k + \dots + \beta_n x_n)} = \exp(\beta_k)$$

Therefore,  $\beta_k$  parameter determines the relative gain of hazard rate per unit of absolute gain of  $k$ -th explanatory variable, assuming *ceteris paribus*. The  $\beta$  parameters can be estimated using the partial credibility method (Harańczyk 2011).

As there was no need for the purposes of this study to present the regression of the tested variable, the semi-parametric Cox model was used. The analysis of the employment search period was carried out on the basis of individual data collected from the study titled "Social diagnosis – the conditions and quality of life in Poland" for the year 2013. The timeframe considered was from 0 to 24 months. Those who did not find employment within this period included the right-censored observations. Such observations represented 56.4% of the sample. The total of 3604 cases of people were analyzed.

Table 1. The results of estimation

	B	Standard error	Wald	df	Significance	Exp (B)
Internet job search	-1.070	0.058	336.519	1	0.000	0.343

Source: own study based on data from the Social Monitoring Council (2013).

In subject literature, there are many studies relating to the job search time determinants. The most important individual characteristics affecting the job search process are sex, age and education. It is assumed that men have greater chances of employment. Older people look for a job longer than young ones, and naturally, the better the education, the higher the chances of finding employment. The situation on the labour market is also geographically diversified. It is believed that in the case of residents of large cities and the countryside, the job search duration is shorter (Landmesser 2013). Despite existing extensive research, it is difficult to find studies which take into account Internet usage as a part of the job search process. Table 1 above presents results of the authors' own empirical research conducted on the basis of data obtained from the aforementioned database. With the application of the model, the hazard rate corresponding to each variable was set. It can be concluded that people who do not use the Internet during their job search are by 66% less likely to find employment than others.

## THE INCLINATION TO USE THE INTERNET IN THE JOB SEARCH PROCESS AND INDIVIDUAL TRAITS OF RESPONDENTS

Micro-data belong to a specific group of data collected through surveys. They usually refer to individual units, e.g.: company's customers, households or businesses. Models containing qualitative variables constitute econometric tools applicable to this type of data analysis. The study used a logit model for a binary variable. It is used for modeling decisions, choices and events of dichotomous nature. The dependent variable Y may in such cases only have two values (typically 1 or 0). The functional form can be formulated as follows:

$$P_i = \frac{1}{1 + \exp(X_i^T \beta)}$$

Parameters  $\beta$  are generally estimated using the maximum likelihood method, however, the interpretation of results is different from that of a linear model. For this purpose, the term called odds ratio is used  $\frac{P_i}{1-P_i}$ . It defines the ratio of the probability that Y = 1 to the probability that Y = 0. It can be formulated also as  $\frac{P_i}{1-P_i} = \exp(X_i^T \beta)$  therefore,  $\exp(\beta)$  tells how many times the odds ratio increases if the variable Xj increases by one unit (assuming *ceteris paribus*). The odds ratio increases where  $\exp(\beta) > 1$  and decreases when  $\exp(\beta) < 1$ .

In the case of binary choice models, the measure of assessing the quality of their suitability for empirical variables can be used. In this case, the accuracy of prediction tests can be applicable since the quality of the model is very often determined by the accuracy of forecasts obtained based on them. The most commonly used is the count  $R^2$  measure :

$$R^2 \text{ measure} = \frac{n_{00} + n_{11}}{n}$$

The estimates of parameters obtained by the maximum likelihood method are also subjected to statistical verification. To verify the significance of the entire model the likelihood statistic ratio is used.

The number of observations used to build the model was 14 160. They were also derived from the report "Social diagnosis – the conditions and quality of life in Poland" for 2013. The selected information related to the age of the surveyed people, sex, their educational background and the place of residence. The category of place of residence was grouped according to the authors' own classification. All calculations were made using Gretl software and Excel.

Table 2. The variables used in the model

Variable	Values	Share in percentage [%]
Sex	women	54.49
	men	45.51
Education	primary and lower (1)	3.91
	vocational/middle school(2)	28.45
	secondary (3)	36.67
	higher, post-secondary (4)	30.97
Age	up to 24 years (I)	22.07
	25–34 (II)	22.08
	35–44 (III)	21.31
	45–59 (IV)	23.97
	60–64 (V)	5.61
	65 years and above (VI)	4.96
Place of residence category	cities with a population of 500 thousand and more	9.82
	200–500 thousand	10.01
	100–200 thousand	7.52
	20–100 thousand	19.29
	below 20 thousand	12.66
	countryside	40.69
Searching for a job via the Internet, online job application	Yes	50.64
	No	49.36

Source: as in Table 1.

The next part of the study consisted in the analysis of variables affecting the likelihood of using the Internet for the job search. The selection of the variables was made by elimination method of statistically insignificant variables. Initially, the model included all explanatory variables. Next, the variable with the most likely p-test probability was eliminated and the model was re-assessed. In result, a group of variables affecting significantly the duration of unemployment was determined.

As a result of the maximum likelihood method the estimations of  $\beta$  parameters shown in Table 3 were obtained. The study sample was balanced which also contributed to satisfactory results (count  $R^2$  measure = 64.7%). The likelihood statistic ratio shows that the model is statistically significant.

Table 3. The logit model: the dependent variable is " Internet-based job search, online job application"

Specification	Coefficient	Standard error	z	P-value	Significance level	Odds ratio
Const	-0.72	0.1185	-6.0814	< 0,00001	***	
Sex	-0.15	0.0366	-4.0568	0,00005	***	0.86
Education_1	-0.64	0.0990	-6.5055	< 0,00001	***	0.53
Education_2	-0.60	0.0514	-11.5830	< 0,00001	***	0.55
Education_3	-0.24	0.0456	-5.2189	< 0,00001	***	0.79
Age group I	2.40	0.1086	22.0884	< 0,00001	***	11.00
Age group II	2.49	0.1070	23.2482	< 0,00001	***	12.02
Age group III	1.88	0.1062	17.7355	< 0,00001	***	6.57
Age group IV	1.12	0.1056	10.6382	< 0,00001	***	3.08
Age group V	0.42	0.1301	3.2626	0,00110	***	1.53
Place of residence	-0.12	0.0111	-10.8944	<0,00001	***	0.89
Number of "positive prediction" cases = 9159 (64.7%)						
Likelihood ratio test: chi-squared test (10) = 1797.51 [0.0000]						

Source: as in Table 1.

To enable comprehensive interpretation of the estimated parameters, the odds ratios were calculated. The above formula showed that the unit increase of  $X_{ij}$  value was associated with  $\exp(\beta_m)$  – fold increase of the odds ratio. For example, if  $X_m$  is a dummy variable, the  $\exp(\beta_m)$  tells how many times the chance that  $Y_i = 1$  for the "1" category of  $X_m$  variable increases in comparison to the same ratio for the "0" category of  $X_m$  variable (Mikroekonometria 2010). Therefore, one can draw the following conclusions:

- women are less prone to use the Internet when looking for a job than men by 0.14%;
- people with primary, vocational and secondary education have less chances to use the Internet from the others, respectively by 47%, 45% and 21%. In addition, it can be concluded that the higher the education, the bigger the chances of success;
- a reverse situation occurs in the case of different age groups. The strongest tendency to turn to the Internet for job searching can be observed in the first two age groups (below 25 and in the 25–34 group). The chances are respectively 1000% and 1102%. For remaining groups this likelihood falls significantly. Moreover, it can be concluded that in the above 35 age group this inclination is decreasing;
- residence in a smaller town is also associated with reduced likelihood of online job search.

## CONCLUSIONS

When analyzing labour market transactions, one should be aware of their specific nature which, *inter alia*, is related to information asymmetry. Any market dysfunctionality is a result of unequal access to information about job vacancies and the specifics of their location. It should

be noted that the process of filling a job vacancy is not that straightforward. It is influenced by, among others differences between job seekers' qualifications and qualifications demanded by employers, the spatial distribution of human resources and jobs, and also incomplete and asymmetric information about the labour market. The theory which examines the impact of these factors on the new job creation is called the search and matching theory. It was developed by the P. A. Diamond, D.T. Mortensen and Ch. A. Pissarides. According to its pioneers, a period of matching qualifications and expectations of job seekers and employers is the function of access to information. Lack of this information extends significantly the job search time, and generates additional costs and risks. The numerous applications of the model and conclusions which can be drawn from them prove that the model based on microeconomic interpretation of labour market processes can be widely adopted to business practice, especially to the improvement of the matching process. On the one hand, it should consider the expectations and skills of unemployed, and on the other hand, job vacancies and employers' needs. This also tackles the problem of incomplete information (Pissarides 2012).

One of the main aspects the research conducted in line with the search and matching theory focuses on is the economics of information, and more specifically, its asymmetry and incompleteness. The primary objective of this theory is to determine such behavior pattern that leads to optimization of decisions made under conditions of incomplete information about the labour market. As confirmed by tests carried out so far, arriving at the best employee-employer match can be a time-consuming process, implying, in turn, a permanent imbalance. This justifies the efforts taken in this direction of research.

This article assessed the impact of Internet-based job search on the chances of finding a job. The hazard model used proved to be an appropriate tool for the analysis. The results achieved show that people who have access to online information resources are more likely to be hired quicker. The analysis of empirical data and subject literature confirmed the correctness of the hypothesis about the relationship between the employee-employer matching period, and access to information. In addition, the econometric model, created in the latter part of the study, allowed to calculate the likelihood of using the Internet for the job search for specific groups of people. The findings show that the main determinant here was education and age. Better educated and younger people are more prone to use the Internet in the job search process.

## REFERENCES

- Cox D.R.** 1972. Regression models and life tables (with discussion). *J. Royal Stat. Soc.* 34(2), 187–220.
- Eurostat**, <http://ec.europa.eu/eurostat>, access: 15.06.2015. [in Polish]
- Goban-Klas, T., Sienkiewicz P.** 1999. *Spółeczeństwo informacyjne. Szanse, zagrożenia, wyzwania.* Kraków, Wydaw. Post. Telekom. [in Polish]
- GUS 2010.** 2014. *Spółeczeństwo informacyjne w Polsce*, <http://stat.gov.pl/>, access: 05.07.2015. [in Polish]
- Harańczyk G.** 2011. Modelowanie czasu trwania – model proporcjonalnego hazardu Coxa. *StatSoft Polska*, [www.statsoft.pl/czytelnia.html](http://www.statsoft.pl/czytelnia.html), access: 20.09.2015. [in Polish]
- Landmesser J.** 2013. Wykorzystanie metod analizy czasu trwania do badania aktywności ekonomicznej ludności w Polsce. Warszawa, Wydaw. SGGW, 156. [in Polish]
- Mikroekonometria. Modele i metody analizy danych indywidualnych.** 2010. Ed. M. Gruszczyński. Warszawa, Oficyna a Wolters Kluwer Business, 67–69. [in Polish]
- Oleński J.** 1997. *Standardy informacyjne w gospodarce.* Warszawa, Wydaw. UWarsz. [in Polish]

- Oleński J.** 2000. Elementy ekonomiki informacji: podstawy ekonomiczne informatyki gospodarczej. Warszawa, Wydaw. UWarsz. [in Polish]
- Oleński J.** 2003. Ekonomika informacji. Metody. Warszawa, PWE, 249–250. [in Polish]
- Parlińska M.** 2008. Rola informacji w gospodarce rynkowej na podstawie wybranych rolnych rynków hurtowych. Warszawa, Wydaw. SGGW, 25. [in Polish]
- Pissarides Ch. A.** 2012. Teoria bezrobocia w stanie równowagi. Przekł. Z. Matkowski. Warszawa, PWE. [in Polish].
- Rada Monitoringu Społecznego.** 2013. Diagnoza społeczna – warunki i jakość życia Polaków, <http://www.diagnoza.com/>, access: 20.09.2015. [in Polish]
- Społeczeństwo informacyjne.** 2008. Ed. J. Papińska-Kacperek. Warszawa, PWN, 18. [in Polish]

**Summary.** The aim of this study was to identify the factors affecting the tendency to use Internet for job searching activities. The quantitative data presented herein and the literature review let the authors conclude that the matching of expectations between jobseekers and potential employers is a function of access to information. This hypothesis forms the basis of the research conducted. The paper attempted to identify the group that demonstrated the strongest inclination to use information in the job search process. The econometric models applied by the authors justify the conclusion that, *inter alia*, Internet-based job search significantly reduces the duration of the unemployment period. Moreover, unemployed university graduates from large towns and below 34 years of age, show a greater tendency to conduct an online job search.