Employment in Knowledge-Intensive Activities in European Countries: Gender Perspective

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Abstract - In the modern economy of the 21st century, knowledge and information play the main role in achieving a competitive advantage in the global market. Knowledge-intensive activities (KIAs) present a set of activities that enhance innovation processes that influence on quality and efficiency of the different business functions. In this paper, the authors examine employment in knowledge-intensive services for the year 2017 for selected European countries. The goal of the paper is to investigate differences among employees in total knowledge-intensive activities in European countries regarding gender. Cluster analysis was conducted to identify homogenous groups of selected variables regarding the percentage of total employment in knowledge-intensive activities. Research results showed that the percentage of total employment in general in total knowledge-intensive activities is higher than in business activities, especially for female compared to male. Besides, cluster analysis results showed that developed countries are leaders in KIAs compared to developing countries.

Keywords: knowledge-intensive activities (KIAs), business, gender, Europe, Eurostat, cluster analysis

I. INTRODUCTION

Knowledge economy refers to the usage of innovation and creativity, information, knowledge and ICTs as a source for competitiveness [1]. Highly developed countries based their economic development on knowledge and IT activities which enable them competitive advantage [2]. Knowledge-intensive activities (KIAs) present a crucial factor in the knowledge economy as a source of technological, organisational and social innovation [3]. Besides, KIAs present one of the fastest developing industries in the EU economy [4]. KIAs indicate firms that offer knowledge-oriented products or services. Furthermore, KIAs implicitly highly educated employees and foster knowledge transfer, increase productivity and economic growth [5; 6]. KIAs could be classified into two types of traditional professional services (P-KIAs) and new technology-based services (T-KIAs) [7; 8; 9]. P-KIAs refer to the business, management, marketing activities and accounting, while T-KIAs refer to information and technical issues [1; 2].

The purpose of this paper is to present trends regarding employment in total knowledge-intensive activities, for the year 2017 in selected European countries. To fulfilled the goal of the analysis, data were collected from Eurostat about the employment in knowledge-intensive services for the year 2017, comparing male and female employees. Eurostat data is reliable source of information that allows the comparison of European countries according to various indicators, thus allowing the tracking and development of new policies, such as the ones aiming at fostering scientific research, as well as knowledge-intensive services.

Following variables were used: (i) Percentage of total employment in total knowledge-intensive activities, (ii) Percentage of total employment in knowledge-intensive activities - business industries, (iii) Percentage of males employment in total knowledge-intensive activities, (iv) Percentage of males employment in knowledge-intensive activities - business industries, (v) Percentage of females employment in total knowledge-intensive activities and (vi) Percentage of females employment in knowledge-intensive activities - business industries.

To achieve the goal of the paper, cluster analysis was conducted aiming to identify homogenous groups of selected variables regarding employment in knowledge-intensive activities in 35 European countries. Findings showed that for all examined countries, more female than male are employed in knowledge-intensive activities. Furthermore, there is a higher percentage of male and female in knowledge-intensive activities in Belgium, Ireland, Luxembourg, Malta, the United Kingdom, Iceland, Switzerland and Scandinavian countries.

The paper starts with an introduction presenting a theoretical overview of the topic, the goal of the paper and the methodology. In the second section, literature review is presented. The methodology is described regarding the collected data and statistical analysis in the third section. Research results of descriptive analysis and cluster analysis are described in the fourth section. Study results are discussed in the fifth section. The paper concludes with the main findings, limitations of the study and future implications.

II. LITERATURE REVIEW

Conducted research regarding employment structure among European countries according to KIE index (Knowledge Intensity of the Economy) [2] showed that the proportion of employment in sections like IT, finance and science for developed countries ranges from 12% to 16.5% of total employment while for the countries with a lower
level of knowledge intensity it never exceeds 7%. Furthermore, countries with a high level of knowledge intensity have a higher share of young employees (aged 15-24).

Young people belong to Generation Z are part of modern knowledge-based society and innovation activities are more familiar to them and more available that enable them to be more skilled for jobs in KIAs. Furthermore, the KIA sector has a higher share of SMEs than manufacturing sectors [8]. Besides, the KIA sector employs more women than men comparing to the economy as a whole and employ a higher share of graduates [8]. Research conducted by Badulescu and his colleagues (2020) using data for European countries from 2008 to 2012 showed that the density of KIAs could be a factor that prevents the closing down of the companies and that increase labour productivity [1].

KIAs foster competitive advantage and economic growth through knowledge innovation systems connecting knowledge, creativity and IT skills [4; 10]. Therefore, KIAs could be one of the key drivers of economic growth for European countries. Besides, there is 11% of overall employment in KIAs in Europe [11]. In the period of five years, from 2006 to 2011, the employment in KIAs grew by 2,3% which is higher than the growth of the overall economy (1,5%) [12]. In 2020 employment in KIAs, manufacturing and services, present a share of 36,3% of total employment for the EU28 [13]. The leading country for 2019 is Luxembourg with a share of 56% of total employment, following by Sweden (46,1%), United Kingdom (45,1%) and Belgium (42,5%).

K. Cluster analysis was used aiming to define homogenous groups of variables. Dividing data into clusters mean that variables in a particular cluster are similar, while variables from other clusters differ one from another. Results of cluster analysis indicated that 35 European countries were divided into five clusters according to employment in knowledge-intensive services.

IV. RESULTS

A. Results of Descriptive Analysis

Table 2 presents descriptive statistics of employment in knowledge-intensive industries for the year 2017. The highest mean values have variables that refer to total knowledge-intensive activities with no differences in gender (TOTAL_ALL: 35,27; MALES_ALL: 28,12; FEMALES_ALL: 43,62).

Variables that present the percentage of females/males employment in knowledge-intensive activities focused on business industries have lower mean values.

Variables that refer to employment in total knowledge-intensive activities with no differences regarding gender or industry the highest mean values where outstanding is the mean value for variable Percentage of females employment in total knowledge-intensive business services (FEMALES_ALL) which is the highest (43,62). Besides, Doroshenko, et al. (2014) indicate that there is a higher percentage of women in knowledge-intensive business services than in the economy as a whole [8].

The lowest and also quite similar mean values are for the following variables: TOTAL_BUSINESS (average 13,90), MALES_BUSINESS (average 14,15) and FEMALES_BUSINESS (average 13,69). These variables refer to a specific industry – business industry in the area of knowledge-intensive industries.

Table 2. DESCRIPTIVE STATISTICS OF EMPLOYMENT IN KNOWLEDGE-INTENSIVE INDUSTRIES, % OF TOTAL EMPLOYMENT, 2017

<table>
<thead>
<tr>
<th>Variable description</th>
<th>Name of the variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of total employment in total knowledge-intensive activities</td>
<td>TOTAL_ALL</td>
</tr>
<tr>
<td>Percentage of total employment in knowledge-intensive activities - business industries</td>
<td>TOTAL_BUSINESS</td>
</tr>
<tr>
<td>Percentage of males employment in total knowledge-intensive activities</td>
<td>MALES_ALL</td>
</tr>
<tr>
<td>Percentage of males employment in knowledge-intensive activities - business industries</td>
<td>MALES_BUSINESS</td>
</tr>
<tr>
<td>Percentage of females employment in total knowledge-intensive activities</td>
<td>FEMALES_ALL</td>
</tr>
</tbody>
</table>

B. Statistical analysis

Data collected from Eurostat include six variables regarding the employment in knowledge-intensive services for the year 2017. To analyse collected data descriptive and cluster analysis were conducted. Results of descriptive analysis refer to the following statistical measures: mean, minimum, maximum and standard deviation. Collected data for all 35 European countries were presented using line graphs.

Cluster analysis was used aiming to define homogenous groups of variables. Dividing data into clusters mean that variables in a particular cluster are similar, while variables from other clusters differ one from another. Results of cluster analysis indicated that 35 European countries were divided into five clusters according to employment in knowledge-intensive services.

TABLE 1. VARIABLE USED IN THE ANALYSIS, % OF TOTAL EMPLOYMENT, 2017

<table>
<thead>
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<th>Variable description</th>
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<tbody>
<tr>
<td>Percentage of total employment in total knowledge-intensive activities</td>
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<td>TOTAL_BUSINESS</td>
</tr>
<tr>
<td>Percentage of males employment in total knowledge-intensive activities</td>
<td>MALES_ALL</td>
</tr>
<tr>
<td>Percentage of males employment in knowledge-intensive activities - business industries</td>
<td>MALES_BUSINESS</td>
</tr>
<tr>
<td>Percentage of females employment in total knowledge-intensive activities</td>
<td>FEMALES_ALL</td>
</tr>
</tbody>
</table>

Source: Authors, Eurostat (2017)
Figure 1 presents the percentage of total employment in total knowledge-intensive activities and total knowledge-intensive activities – business industries for the year 2017. For all 5 selected European countries, there is a higher percentage of total employment in total knowledge-intensive activities compared to knowledge-intensive activities in the business sector.

Countries that are leaders in knowledge-intensive activities are Belgium, Ireland, Luxembourg, Malta, United Kingdom, Iceland, Switzerland and Scandinavian countries (Sweden, Finland, and Norway).

Furthermore, data regarding knowledge-intensive activities – business industries for all selected countries are quite similar, and there are no high oscillations (the lowest percentage can be seen for the following countries: North Macedonia, Serbia and Turkey).

Figure 2 presents the percentage of males and female employment in total knowledge-intensive activities and total knowledge-intensive activities – business industries for the year 2017.

For all 35 selected European countries, there is a higher percentage of male and female employment in total knowledge-intensive activities compared to knowledge-intensive activities in the business sector. However, the highest percentage have all variables that refer to female employment in total knowledge-intensive activities than to male.

Countries that are leaders are Belgium, Luxembourg, Sweden and the United Kingdom. Regarding male employment in total knowledge-intensive activities, Luxembourg is the leading country.

Besides, data regarding knowledge-intensive activities – business industries for all selected countries for male and female are quite similar, and there are no high oscillations (the lowest percentage can be seen for following countries: North Macedonia, Serbia and Turkey).

B. Results of Cluster Analysis

Results of Cluster analysis are presented through the graph of cost sequence (Figure 3), Anova analysis (Table 3) and cluster means (Table 4). Graph of the cost sequence indicates that is justified to divide collected data into five clusters (Figure 3).

<table>
<thead>
<tr>
<th>Employment in total knowledge-intensive activities</th>
<th>df</th>
<th>F</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL_ALL</td>
<td>4</td>
<td>84,124</td>
<td>0,000***</td>
</tr>
<tr>
<td>TOTAL_BUSINESS</td>
<td>4</td>
<td>133,906</td>
<td>0,000***</td>
</tr>
<tr>
<td>MALES_ALL</td>
<td>4</td>
<td>44,708</td>
<td>0,000***</td>
</tr>
<tr>
<td>MALES_BUSINESS</td>
<td>4</td>
<td>81,555</td>
<td>0,000***</td>
</tr>
<tr>
<td>FEMALES_ALL</td>
<td>4</td>
<td>38,420</td>
<td>0,000***</td>
</tr>
</tbody>
</table>
Results of cluster mean for six selected variables are presented in Table 4. The highest mean value has Cluster 3 for all six variables: TOTAL_ALL (43.96), TOTAL_BUSINESS (19.91), MALES_ALL (37.56), MALES_BUSINESS (21.76), FEMALES_ALL (51.34), FEMALES_BUSINESS (17.93). Cluster 3 contains seven countries: Ireland, Luxembourg, Malta, Sweden, United Kingdom, Iceland, Switzerland.

### Table 4. Cluster means, K-means clustering; 6 variables, 5 clusters, N=35 countries

<table>
<thead>
<tr>
<th>Online learning indicator</th>
<th>Cluster value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5</td>
</tr>
<tr>
<td>Enterprise provided training to their personnel</td>
<td></td>
</tr>
<tr>
<td>TOTAL_ALL</td>
<td>38.79 29.77 43.96 33.09 22.67</td>
</tr>
<tr>
<td>TOTAL_BUSINESS</td>
<td>15.63 10.13 19.91 12.49 6.9</td>
</tr>
<tr>
<td>MALES_ALL</td>
<td>32.32 21.2 37.56 24.83 18.33</td>
</tr>
<tr>
<td>MALES_BUSINESS</td>
<td>16.8 9.27 21.76 11.8 6.03</td>
</tr>
<tr>
<td>FEMALES_ALL</td>
<td>45.93 39.4 51.34 42.91 29.5</td>
</tr>
<tr>
<td>FEMALES_BUSINESS</td>
<td>14.32 11.12 17.93 13.35 8.23</td>
</tr>
</tbody>
</table>

| Number of countries | 10  5  7  10  3 |

Source: Authors, Eurostat (2017)

### V. DISCUSSION

Figure 4 presents a graph of the cluster means where it can be seen that the highest mean values for all six variables have Cluster 3.

Figure 5 presents a geographical distribution of the countries across clusters. It is visible that there is a substantial level of similarities of neighboring countries in most of the clusters.

### VI. CONCLUSION

KIAs have a crucial role in economic and social development especially in developing countries [15], while they offer knowledge and a learning environment. In other words, KIAs provide creation, accumulation and transmission of knowledge [3; 16].

In this paper, we have investigated differences among employees in knowledge-intensive activities in European countries regarding gender, following the numerous researches about the women and technology, such as [17,
18-19]. The analysis supported the previous research results that there is a higher percentage of women in knowledge-intensive business services than in the economy as a whole [8, 17, 18, 19].

Furthermore, we could state that there is a higher percentage of both male and female employment in total knowledge-intensive activities compared to knowledge-intensive activities in the business sector for all selected European countries [20, 21].

Besides, research results showed that developed countries, which are leaders in ICTs and innovation activities, have a higher percentage of employees in KIAs [22]. This is in comparison with similar research that northern European countries (Sweden, Finland, Denmark) that are leaders in innovation activities, have a higher level of KIAs [4] while low innovation business activities implicit low level of KIAs in economic development [23].

Practical implications should determine how to enhance the level of knowledge and innovation activities to enable a higher level of KIAs, which would lead to economic development competitive advantage of countries and of firms [24]. Practical guidelines should provide policy regarding professional and educational standards for KIAs, especially for the higher educational institutions [7, 25].

This paper presents preliminary research which is the reason that the focus is on data and analysis for one year regarding employment in total knowledge-intensive activities. Further research will include data for more years regarding employment in KIAs in order to conduct statistical analysis and compare data for more years. Furthermore, the limitations of this paper come out of the fact that KIAs could be investigated in broader content, e.g. demographic characteristics of employees, industries, firm size. Therefore, this research can be further improved by implementing additional statistical analysis and data that could lead to better understanding and higher development of KIAs. Besides, future research should focus to various groups that are underrepresented in the KIAs employment, such as small and medium enterprises [26].

REFERENCES