Convergence Analysis in The European Union Regarding The Progress of The Digital Economy and Society

TALABAN Catrinel Delia

PhD. Student, University of Craiova, Doctoral School of Economics "Eugeniu Carada"

DOI: 10.46609/IJSSER.2024.v09i06.005 URL: https://doi.org/10.46609/IJSSER.2024.v09i06.005

Received: 9 June 2024 / Accepted: 25 June 2024 / Published: 30 June 2024

ABSTRACT

This paper presents the analysis of the similarity of the European Union member states from the point of view of digitalization and technological progress. The research methodology consists of applying cluster analysis with the help of data published by Eurostat and DESI Report, for the year 2022.The variables include indicators both from the infrastructure and digital capital and, also, from the innovation and socio-economic field. Therefore, the purpose of this paper is to show, through the results of the analysis, the importance of digitalization and digital transformation nowadays.

Keywords: Digitalization, Cluster analysis, DESI Report, Labour market, European Union

1. Introduction

Technologies have had a disruptive evolution over time, from their appearance until now, thus there are four great industrial revolutions. These revolutions are called in the specialized literature from Industry 1.0 to Industry 4.0. What is the definition of an industrial revolution? The phenomenon called industrial revolution represents the important transformation of the structure of an economy through actions such as: changing the type of energy used, the use of new machine systems and forms of production organization.

The main objective of this research is to present how the European Union countries (EU-27) can be organized into groups based on similar features, in terms of digitalization, innovation and technological progress. For this purpose, will be applied an econometric cluster analysis method known as hierarchical classification, implemented through the Ward algorithm.

The structure of the paper comprises a brief literature review, presenting ideas about digitalization, digital transformation, the labour market and innovation, then a part of data and methodology, where are presented the variables and the indicators used in the study and the

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

research methods used, and at the final of the paper a part of results and discussions with the conclusions of the research.

2. A brief literature review

Digitalization is the main process that has implications on several fields of activity, such as facilitating the way people have access to information through well-known devices such as mobile phones, tablets, laptops and smart watches. Industry 4.0 or the fourth industrial revolution is, by its essence, an ascending process with a tumultuous development so that, in present, we can say that no enterprise can function without having a digital strategy developed or in development.

The business environment must be prepared to face the changes generated by a number of factors such as: the speed, the volume and also the unpredictability of production, the new relationships between research institutes, the new links between large and smaller enterprises, the new ways of cooperation between all levels of business whether we are talking about design, production, sales, logistics, maintenance, the need for updated and new skills, security, along with new ways of working, as well as closer links between the business environment and the user, all of which are categorized as transformation challenges digital (Grima et al., 2023).

Digital transformation is correlated with better company performance in terms of productivity, management practices, strategic leaderships, innovation, growth and better-paid jobs, so digital transformation must be seen as essential for EU companies if they want to own a competitive advantage (Schlosser et al., 2023). The use of digital technology is leading to important changes in business models. To achieve this, so-called digital innovation is required. To turn a lot of innovations into reality as quickly as possible, the main action is that production must become more flexible.

The development of digital literacy skills is of major importance for securing employment at EU level, as most jobs in the European community are expected to require such skills (Suciu et al., 2019).In the context of technological development and the phenomenon of sustainable development and globalization (Noja et al., 2022), the need to outline the European training profile is emphasized, which involves the acquisition of a number of eight key competences, having the same level of importance, according to the Framework of the 8 key competences, the digital competence is a part of the list(Recommendation 2006/962/EC on key competences for lifelong learning), that define the European training profile and according to Ranieri's (2015) opinion, digital competence involves the responsible use of media and means of communication in every field, starting from education, to the work process and even in free time, so that the activities are done as efficiently as possible.

International Journal of Social Science and Economic Research

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

The process called digital transition is gaining increasing importance as experts in this field point out, "digital transformation is an exciting process and oriented towards economic growth, being less an answer to the questions of if or when and more to the question of how to develop and implement a digital transformation strategy" (Hinterhuber, Vescovi, Checchinatto,2021).

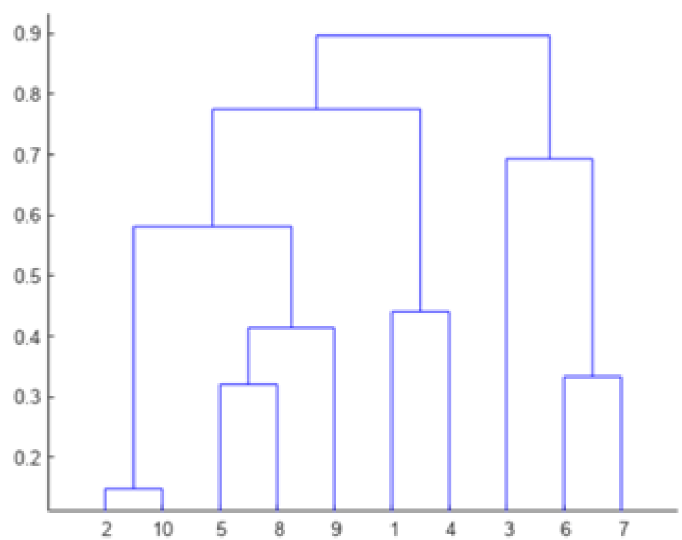
Among the many challenges that involve us nowadays, the most important remains the understanding and modelling of the new technological revolution, which has an impact on humanity, as Klaus Schwab mentions in his work "The Fourth Industrial Revolution" (2016).

3. Data and Methodology

The variables used in the cluster analysis are intended to highlight two complementary sides of the digitization process. This methodology segments the data in a stepwise manner, determining the most appropriate number of groups or clusters through repeated evaluations. The process starts with a single cluster that includes the entire data collection and gradually progresses to a structure composed of n clusters, each including an optimal number of elements. (Cohen, 1988; Aggarwal and Reddy, 2014).

The hierarchical classification technique generates a visual representation called a dendrogram, illustrated in Figure 1. This facilitates the determination of the number of clusters by “trimming” or sectioning the graph at a level decided by the analyst (Bynen, 2012).

Figure 1. Example of a lower level sectioned dendogram



Source: Feur, 2014

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

The cluster estimation process focuses on determining the optimization function, which is expressed in the minimization equation (1) (Ward and Hook, 1963, p. 72):

$$K=\sum_s\left\{\sum_g\sum_r y_{rsg}^2-\sum_g\left[\frac{1}{n_g}\left(\sum_r y_{rsg}\right)^2\right]\right\}, \tag{1}$$

where:

K - represents the minimization function;
s – represents the number of variables;
g - represents the number of groups;
r - represents the number of the object;
y_{rsg}- represents the value of variable s for object r in group g;
n_g - the number of objects in group g.

The standardized distance between groups can be estimated using equation (2) which aims to evaluate the increase in the value of the error term, as a result of informational losses (im Walde, 2006, p. 187):

$$d(C_i,C_j)=d_{ward}(C_i,C_j)=\sum_{x\in(C_i,C_j)} d(x, cen_{ij})-[\sum_{x\in C_i} d(x, cen_i)+\sum_{x\in C_i} d(x, cen_j)], \tag{2}$$

where:

d – distance between clusters;
C_n– the number of clusters;
i, j – notations taken by two distinct clusters;
cen_c- the center of a cluster (or centroid).

The first side is characterized by the representative indicators for infrastructure and digital capital and includes: employment rate, 15-64 years (*ra_15_64_ani*) and labor productivity per employed person (*prod*). The second side includes the following group of representative indicators for innovation and socio-economic impact: Government budgetary allocations for research and development, according to socio-economic objectives (*agbcd*) and people with ICT education (Communication Technology and of Information) depending on the state on the labor market (*tci_edu*).

The interest from the point of view of the research objectives will follow the groupings formed by these categories of indicators, on the Digital Economy and Society Index (iesd_total), at the aggregate level but also by components (connectivity (*conec*), human capital (*human_capital*),

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

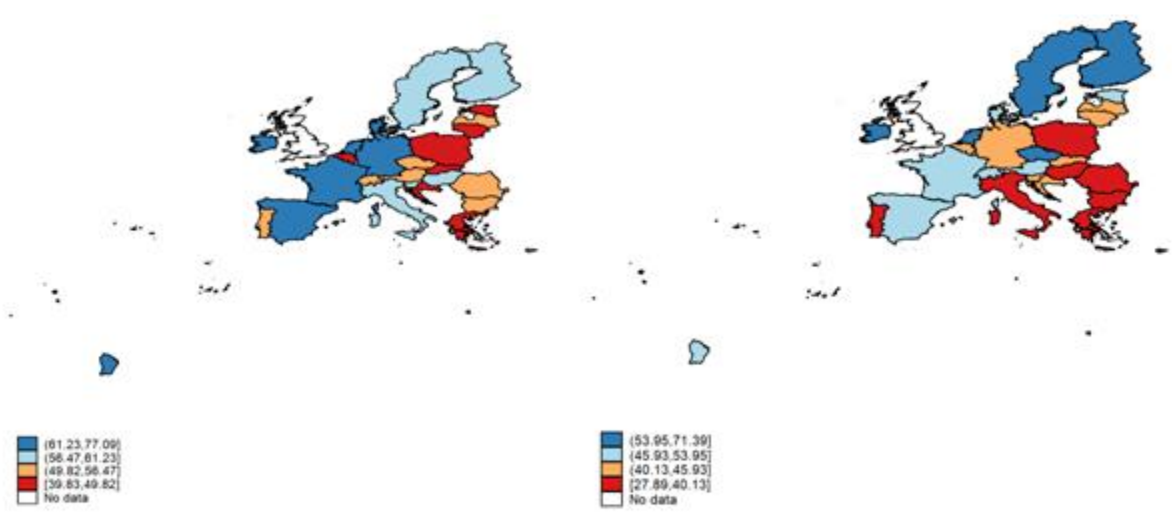
the degree of technology integration digital (*int_teh_dig*), public digital services (*servicii_dig_pub*)) at the level of 2022.

Connectivity and human capital

Connectivity, at the EU-27 level, in 2022, presented the highest values, between 61.23 and 77.09, as a weighted score of the IESD sub-dimension (0-100) in: Denmark, the Netherlands, Spain, Germany, France, Ireland and Italy (Figure 2, left). The next group resulting from the classification with medium-high values (56.47 - 61.23) includes a number of 7 countries (Finland, Sweden, Slovenia, Luxembourg, Cyprus, Hungary and Austria). The next two groups contain the range of medium (49.81 – 56.47) and low (39.83 - 49.82) values and consist of 7 and 6 countries, respectively. The three lowest recorded values for connectivity (conec) were in Belgium (39.83), Estonia (44.45) and Poland (46.52).

Human capital (human_capital), at the level of 2022 (Figure 2, right), presented the highest values, between 53.95 and 71.39, as a weighted score of the IESD sub-dimension (0-100) in: Finland, Ireland, Sweden, Cyprus, Czech Republic, Netherlands and Estonia. Medium to high values (45.93 - 53.95) were recorded in a number of 7 member states (Denmark, Spain, Luxembourg, Austria, France, Malta and Croatia), medium values (40.13 - 45.95) in a similar number of member states, and low values (27.89 – 40.13) in 6 states (Portugal, Hungary, Italy, Poland, Bulgaria and Romania).

Figure 2. Analysis of Connectivity (cone), left, and Human Capital (human_capital), right, 2022, at EU-27 level



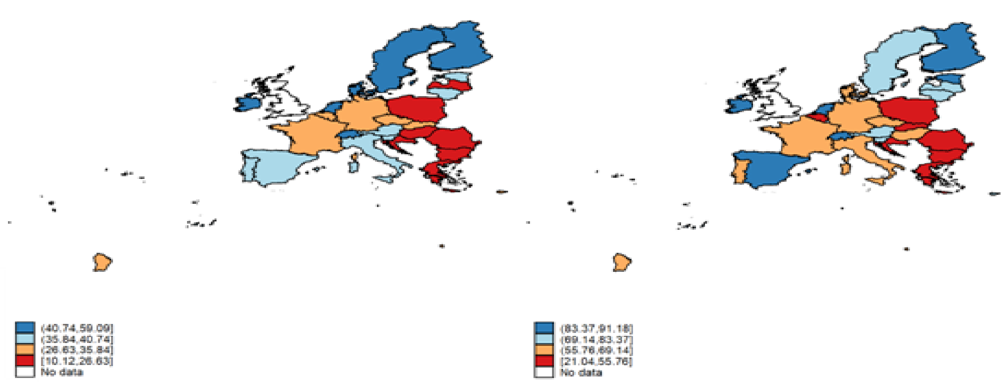
Source: own processing of the data using the econometric package Stata 18, based on Eurostat data

The degree of integration of digital technology and digital public service

The degree of integration of digital technology (int_teh_dig), as can be seen in Figure 3, left, shows the highest values in: Finland (59.09 IESD sub-dimension weighted score), Denmark (57.99), Sweden (56.24), the Netherlands (52.07), Malta (48.13), Ireland (43.32) and Italy (40.74). The countries with medium to high values (35.84 - 40.74 weighted score of the IESD sub-dimension (0-100)), at the level of 2022, were: Slovenia, Austria, Spain, Portugal, Lithuania, Estonia and Germany. Average values (26.63 – 35.84) were recorded for the degree of integration of digital technology in (Figure 3): Cyprus, Luxembourg, Czech Republic, France, Belgium, Slovakia and Greece. The countries with the lowest values, between 10.12 and 26.63 as a weighted score of the IESD sub-dimension, were: Poland (22.88), Hungary (21.58), Croatia (21), Romania (15.15), Latvia (12.62) and Bulgaria (10.12).

Public digital services (servicii_dig_pub), captured in Figure 2.3, right, presented the highest values, as a weighted score of the IESD sub-dimension, at the level of the following member states: Estonia (91.28), Finland (87.37) , Malta (85.81), Netherlands (84.19), Spain (83.52), Ireland (83.45) and Luxembourg (83.37). The member states where average to high values were recorded, at the level of 2022, as can be seen in Figure 3 (right), were: Sweden (82.42), Lithuania (81.8), Latvia (78.81), Cyprus (78.28), Austria (72.12), Slovenia (69.49) and the Czech Republic (69.14). The last two groupings resulting from the generation of the choroplethic maps contain medium values (55.79 – 69.14) formed by 7 countries and respectively the group with low values (21.04 – 55.76) formed by a 7-country mine. The lowest levels for public digital services being recorded in: Slovakia (52), Belgium (45.81), Greece (39.39), Croatia (34.92), Bulgaria (33.04) and Romania (21.04).

Figure 3. Analysis of the Degree of Integration of Digital Technology (int_teh_dig), left, and Public Digital Services (servicii_dig_pub), right, 2022, at EU-27 level



Source: own processing of the data using the econometric package Stata 18, based on Eurostat data

ISSN: 2455-8834

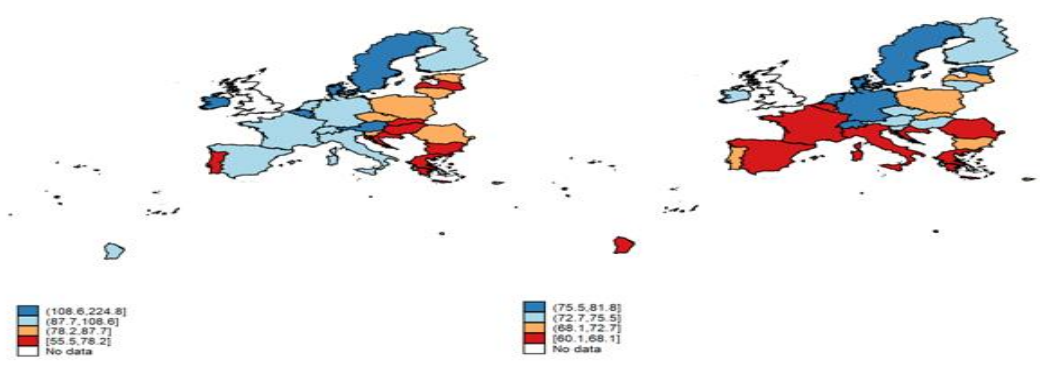
Volume:09, Issue:06 "June 2024"

Labor productivity per employed person and employment rate

Labor productivity per employed person (prod) recorded the highest values, between 108.6% and 224.8%, at the level of 2022, in the following member states (Figure 4, left): Ireland (224.8%), Luxembourg (159.2%), Belgium (130.6%), Denmark (121.2%), Sweden (115%), Austria (114.6%) and France (108.6%). The member states that recorded medium to high values were: Italy (106.5%), Finland (106%), Germany (102.2%), Spain (94.9%), Malta (93%) and Cyprus (87.8%). The member states that recorded average values, in 2022, were: Poland (84.8%), Czech Republic (84.7%), Slovenia (83.5%), Lithuania (82.9%), Estonia (80.8%), Romania (79.1%) and Croatia (78.2%). The lowest values for labor productivity per employed person were recorded in: Portugal (76.7%), Slovakia (76.6%), Latvia (74.4%), Hungary (73.4%), Greece (70.5 %) and Bulgaria (55.5 %).

The employment rate, 15-64 years (ra_15_64), presented, in 2022, the highest values in the following countries (75.8% – 81.8% of the population): Netherlands (81.8%), Malta (77.6 %), Sweden (77.1%), Germany (76.9%), Denmark (76.8%), Estonia (76.4%) and the Czech Republic (75.5%). The Member States with medium to high values, as can be seen in Figure 2.4, right, were: Hungary (74.4%), Finland (74.3%), Austria (74%), Lithuania (73.8%), Ireland (73.2%), Slovenia (73.1%) and Cyprus (72.2%). Average values between 68.1% and 72.7% were recorded in the following Member States: Portugal (71.4%), Latvia (71.3%), Poland (71.3%), Slovakia (71.3 %), Bulgaria (70.4%), Luxembourg (70.1%) and France (68.1%). The Member States with the lowest values for the employment rate, 15-64 years (ra_16_64), as can be seen in Figure 2.4, right, were: Belgium (66.5%), Croatia (64.9%), Spain (64.4%), Romania (63.1%), Greece (60.7%) and Italy (60.1%).

Figure 4. Analysis of Labor Productivity per employed person (prod), left, and the Employment Rate, 15-64 years (ra_15_64), right, 2022, at EU-27 level



Source: own processing of the data using the econometric package Stata 18, based on Eurostat data

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

Budgetary government allocations for research and development, according to socio-economic objectives, human resources in science and technology, people with ICT education (Communication and Information Technology) depending on the state on the labor market

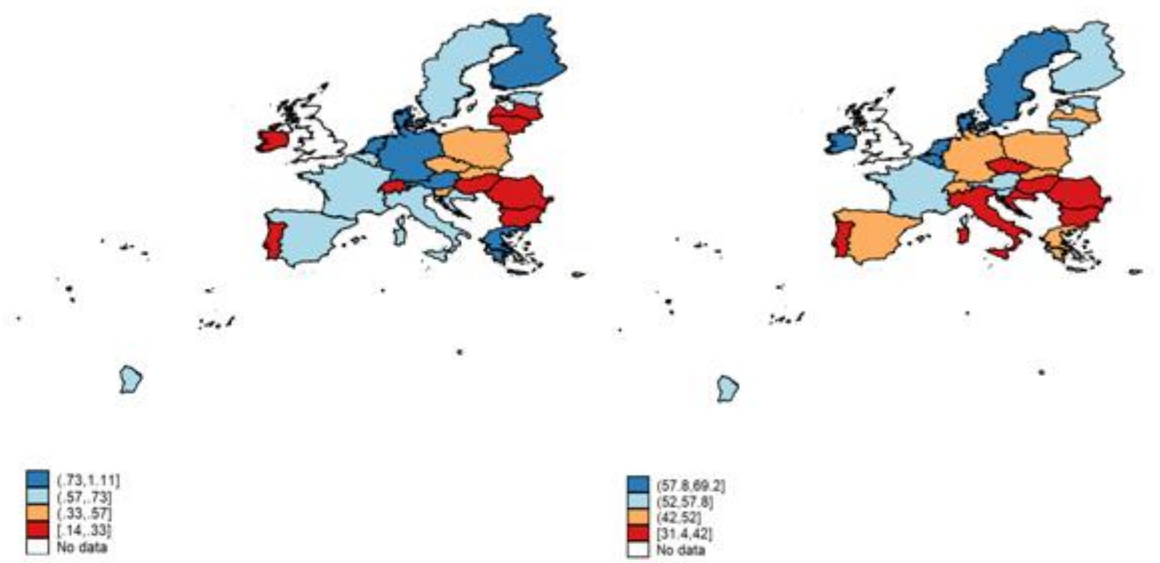
Government budgetary allocations for research and development (agbcd), according to socio-economic objectives, recorded the highest values, as can be seen in Figure 5, left, between 0.73% and 1.11% of GDP, in the following Member States at: Germany (11.1%), Finland (0.9%), Denmark (0.82%), Austria (0.81%), the Netherlands (0.79%), Greece (0.74 %) and Sweden (0.73%). Average to high values were recorded in 2022, between 0.57% and 0.73% of GDP, in the following member states: Estonia (0.72%), Belgium (0.69%), France (0.68%), Italy (0.66%), Croatia (0.65%), Spain (0.59 %) and the Czech Republic (0.57 %). Average values were recorded, as can be seen in Figure 5, left, in the rumored EU-27 member states: Luxembourg (0.56 %), Slovenia (0.54%), Poland (0.42%), Cyprus (0.41%), Slovakia (0.38%) and Lithuania (0.33%). The lowest values for government budget allocations for research and development (agbcd), according to socio-economic objectives, were recorded in the following member states: Portugal (0.33%), Hungary (0.31%), Latvia (0.24%), Bulgaria (0.22%), Malta (0.21%), Ireland (0.19%) and Romania (0.14%).

Human resources in science and technology (rust), presented the highest values, at the level of the EU-27 member states, in 2022, between 57.8% and 69.2% of the total employed population, in the following countries: Luxembourg (69.2%), Sweden (64.1%), the Netherlands (64%), Ireland (63.6%), Denmark (60.2%), Belgium (59.3%) and Finland (57.8%). The countries with medium to high values, between 52% and 57.8%, as can be seen in Figure 5, right, were: France (55.8%), Lithuania (55.7%), Cyprus (55.5%), Estonia (55.2%), Slovenia (55%), Austria (53.5%) and Germany (52%). The Member States where average values between 42% and 52% of the total employed population were recorded in 2022 were: Latvia (49.7%), Spain (48.9%), Malta (48.3%), Poland (47.4%), Greece (43.3%), Slovakia (42.8%) and Hungary (42%). The Member States that had the lowest values in 2022, at the EU-27 level, were (Figure 5, right): Czech Republic (41.9%), Portugal (41.8%), Croatia (38.7%), Bulgaria (38%), Italy (37.4%) and Romania (31.4%).

People with ICT (Communication and Information Technology) education according to the state on the labor market (tci_edu), as can be seen, based on the choropletic map in Figure 5, left, at the level of 2022, recorded the highest values, in the dark blue colored areas. The Member States with the highest values are: the Czech Republic (99.4% of the total population active on the labor market), Malta (98%), Romania (98%), Germany (97.5%), Hungary (97.5 %), Slovenia (97 %) and Poland (96.8 %).

The Member States with medium to high values, between 95.5% and 96.8%, at the level of 2022, were: Slovakia (96.7%), Croatia (96.4%), the Netherlands (96%), Cyprus (95.9%), Luxembourg (95.8%), Austria (95.8%) and Ireland (95.5%). Average values were recorded for people with ICT education, between 93.3% and 95.5%, in the following countries: Bulgaria (95.4%), Sweden (95.1%), Lithuania (94.7%), France (94.6%), Belgium (94.5%), Estonia and Denmark (93.3%). The lowest values were recorded, as can be seen in Figure 5, left, in the following countries: Latvia (92.9%), Finland (88.9%), Portugal (89.9%), Spain (88.7%), Italy (88.5%) and Greece (84.2%).

Figure 5. Analysis of AGBCD according to socio-economic objectives (agbcd), left, and Human Resources in Science and Technology (rust), right, 2022, at EU-27 level



Source: own processing of the data using the econometric package Stata 18, based on Eurostat data

The digital economy and society index

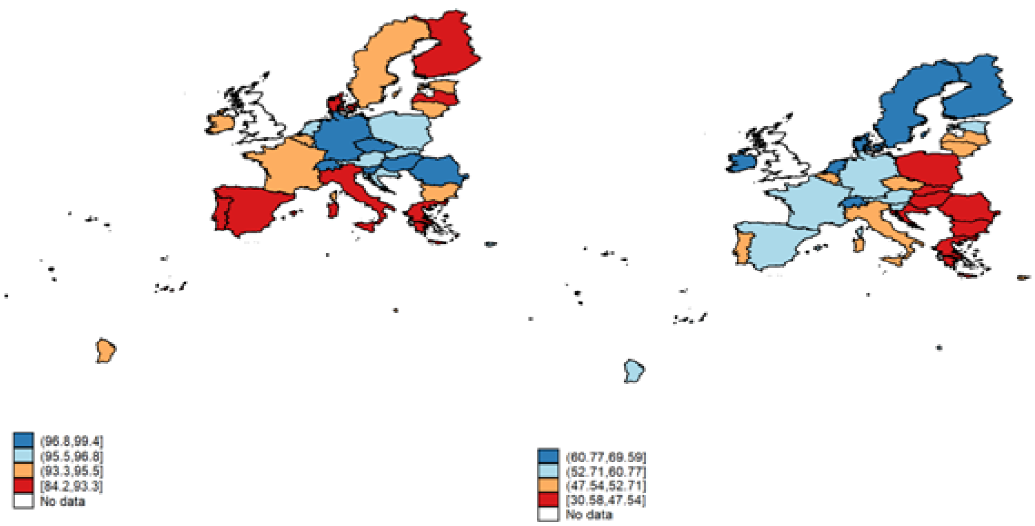
The digital economy and society index (iesd_total), at the level of the EU-27 Member States, as shown in Figure 6, right, recorded the highest values, between 60.77 and 69.59 as a weighted score of the IESD dimension, in (Figure 6, right): Finland (69.59), Denmark (69.33), Netherlands (67.36), Sweden (65.22), Ireland (62.73), Malta (60.88) and Spain (60.77). Average to high values, between 52.71 and 60.77, were recorded in the following countries: Luxembourg (58.85), Estonia (56.51), Austria (54.67), Slovenia (53.37), France (53.32), Germany (52.88) and Lithuania (52.71). For the digital economy and society index (iesd_total), average values were recorded in the following countries: Portugal (50.75), Belgium (50.3), Latvia (49.71), Italy (49.25), Czech Republic (49.14), Cyprus (48.35) and Croatia (47.54). The lowest values were

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

recorded in the following countries (Figure 6, right): Hungary (43.75),Slovakia (43.44), Poland (40.54), Greece (38.93), Bulgaria (37.67) and Romania (30.58).

Figure 6. Analysis of persons with ICT education by state on the labor market (tci_edu), left, and the Digital Economy and Society Index (iesd_total), right, 2022, at EU-27 level



Source: own processing of the data using the econometric package Stata 18, based on Eurostat data

Therefore, based on the information presented, the statistical interpretation of the choropletic maps will be performed, as a first step in the data analysis using the clustering model.

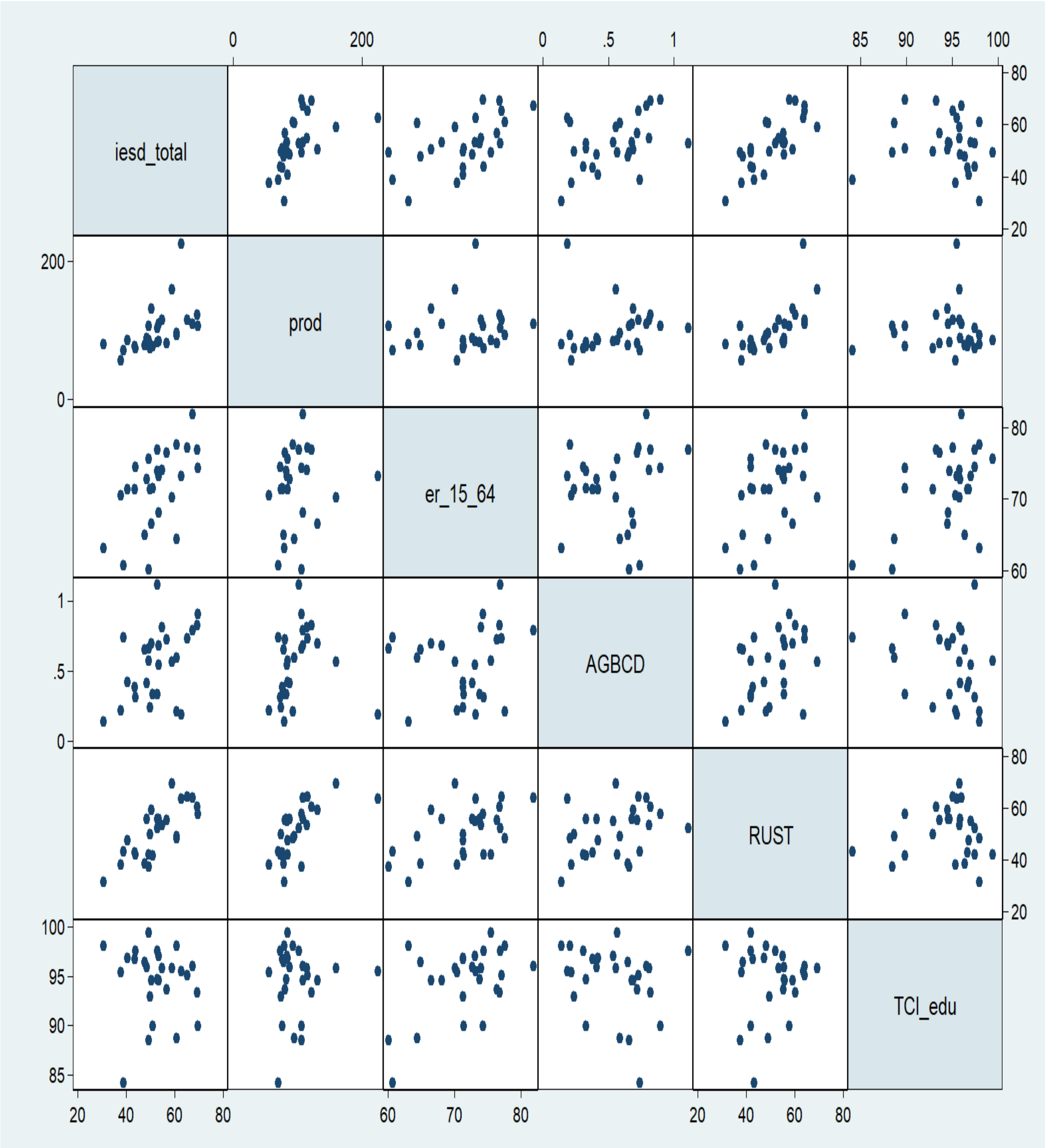
3. Results and discussions

The cluster model applied in order to analyze the convergence, at the EU-27 level, regarding the representative indicators for infrastructure and digital capital and the representative indicators for innovation and socio-economic impact, using the Ward grouping method, at the level of 2022, on the digital economy and society index aggregate, but also by components (connectivity (conec), human capital (human_capital), degree of integration of digital technology (int_teh_dig), public digital services (servicii_dig_pub)). A first step in the cluster analysis model includes making the correlation matrix to determine the relationships between the variables. The correlogram, for the digital economy and society index (iesd_total), shows medium to low values (Figure 7) in connection with the selected indicators, considering the differences present at the level of EU-27 Member States. Similarly, the correlogram was generated for the economy and digital society index components (Figure 8).

ISSN: 2455-8834

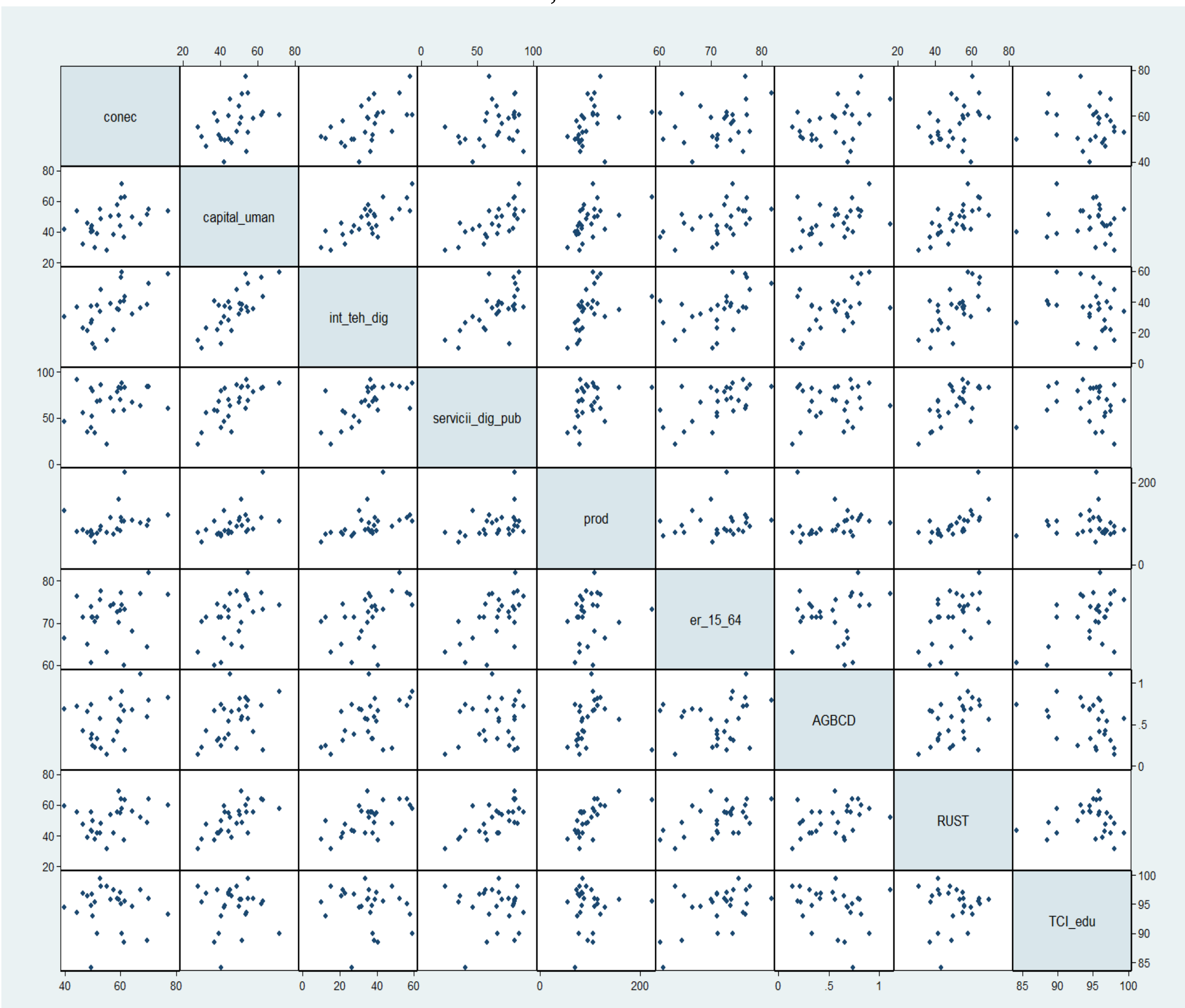
Volume:09, Issue:06 "June 2024"

Figure 7. Correlation matrix for the digital economy and society index, in 2022, EU-27



Source: Author contribution based on analyzes performed in the Stata 18

Figure 8. Correlation matrix at component level for the digital economy and society index in 2022, EU-27



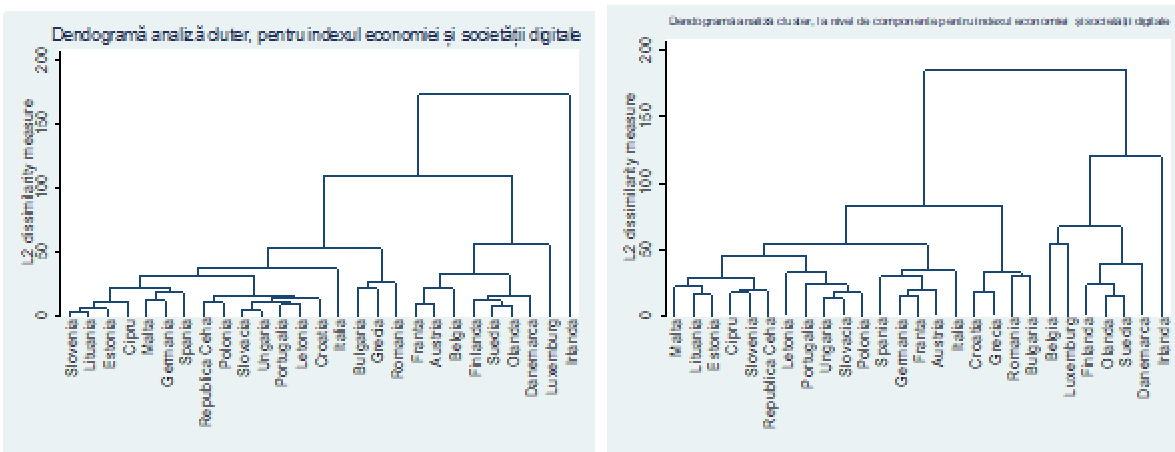
Source: Author contribution based on analyzes performed in the Stata 18

The econometric model, estimated based on the Ward clustering algorithm, for the year 2022 (Figure 9, left, and Table 1), resulted by sectioning the dendogram into 8 homogeneous groupings or clusters, for the digital economy and society index (iesd_total) under the influence representative indicators for infrastructure and digital capital and representative indicators for innovation and socio-economic impact. At the component level, the groupings resulting from the application of Ward's algorithm included 9 groupings or clusters (Figure 9, right, and Table 2).

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

Figure 9. Cluster analysis dendrogram for the digital economy and society index (left) and at component level for the digital economy and society index (right), for the year 2022, EU-27



Source: Author contribution based on analyzes performed in the Stata 18

Table 1 contains the groupings formed following the application of the Ward method, with small differences for the resulting cluster numbers, for the target indicator, both at the aggregate level and on the components. The first estimated model, shown in Figure 9, left and Table 1, resulted in a number of 8 groupings or clusters. The countries that can be classified with a low alignment according to the digital economy and society index (iesd - total), through the indicators representative indicators for infrastructure and digital capital and the representative indicators for innovation and socio-economic impact, are found in 3 clusters (Cluster 1, 3, 4) and include: Malta, Spain, Germany, Lithuania, Estonia, Cyprus, Slovenia, Italy, Greece, Romania and Bulgaria.

Table 1. Clusters associated with the digital economy and society index at total level (left) and by components (right), for the year 2022, at EU-27 level

Clustere (C) 2022	Countries	Cluster analysis results using the Ward method		Countries	Clustere (C) 2022
		Digital economy and society index (iesd-total)	Digital economy and society index – on components (conec, capital_uman, int_teh_dig,servicii_pub_dig)		
Cluster 1 (C1)	Malta, Spain,Germany, Lithuania,Estonia, Cyprus, Slovenia	High	Low	Malta, Estonia, Lithuania, Slovenia,Cyprus, Czech Republic	**Cluster 1 (C1)**

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

Cluster 2 (C2)	Latvia, Croatia, Portugal, Hungary, Slovakia, Czech Republic, Poland	Medium	Low	Latvia, Poland, Hungary,Portugal,Slovakia	**Cluster 2 (C2)**
Cluster 3 (C3)	Italy	Low	Medium	Spain, Germany, Italy, Austria, France	**Cluster 3 (C3)**
Cluster 4 (C4)	Greece, Romania, Bulgaria	Low	Mediun	Bulgaria, Romania, Greece, Croatia	**Cluster 4 (C4)**
Cluster 5 (C5)	France, Belgium, Austria	Medium	High	Belgium	**Cluster 5 (C5)**
Cluster 6 (C6)	Finland, Holland, Sweden, Denmark	High	High	Luexmbourg	**Cluster 6 (C6)**
Cluster 7 (C7)	Luxembourg	High	High	Finland, Sweden, Holland	**Cluster 7 (C7)**
Cluster 8 (C8)	Holland	High	High	Denmark	**Cluster 8 (C8)**
-			High	Ireland	**Cluster 9 (C9)**

Source: Author contribution based on analyzes performed in the Stata 18

For the countries classified with an average alignment, a number of two clusters resulted (Cluster 2 and Cluster 4), being formed, as can be seen in Table 2.1, from the following member states: Latvia, Croatia, Portugal, Hungary, Slovakia, Czech Republic, Poland, France, Belgium and Austria. Finally, the Member States with the highest values for the Digital Economy and Society Index (iesd-total), were categorized into a number of 3 groups (Cluster 6, 7, 8), based on the influences from the representative indicators for the infrastructure and digital capital and representative indicators for innovation and socio-economic impact, namely (Table1): Finland, the Netherlands, Sweden, Denmark, Luxembourg and the Netherlands.

5. Conclusion

The paper analyzes the elements of similarity at the level of the Member States of the European Union, in terms of digitalization, digital transformation and technological progress, topics that are gaining more and more importance in any field of activity and life, as the results obtained speak for themselves. Thus, there are clusters with low, medium and high values resulted, in terms of the integration of the digital economy and society index, both overall and at the level of components.

One of the limitations of this research is the lack of data, the fact that at the level of the year analyzed, respectively 2022 data are not available for several representative indicators for digital economy and society. For a clear and better understanding of this phenomenon, future research will be based on the analysis of the impact of artificial intelligence at the level of EU member

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

states and the close correlation between artificial intelligence, digital transformation and innovation.

References

Aggarwal, C.C., & Reddy, C.K. (Eds.). (2014). Data Clustering: Algorithms and Applications (1st ed.). *Chapman and Hall/CRC*. https://doi.org/10.1201/9781315373515;

Bynen,E.,J. (2012). Cluster analysis: Survey and evaluation of techniques.*Springer Science & Business Media*, pp. 1-124

Cohen, J. (1988). Statistical Power Analysis for the Behavioral Sciences (2nd ed.). Routledge. https://doi.org/10.4324/9780203771587;

European Commission. (2023). The Digital Economy and Society Index (DESI). Available at: https://digital-strategy.ec.europa.eu/en/policies/desi

European Commission. (2023). Eurostat Database. Available at: https://ec.europa.eu/eurostat/en/web/main/data/database

Feur E.J. (2014).Clustering of trend data using joinpoint regression models,*Statistics in Medicine*, *33*(23),4087-4103,https://doi.org/10.1002/sim.6221

Feild, H. S., & Schoenfeldt, L. F. (1975). Ward and Hook Revisited: a Two-Part Procedure for Overcoming a Deficiency in the Grouping of Persons. *Educational and Psychological Measurement*, *35*(1), 171-173. https://doi.org/10.1177/001316447503500122;

Grima, S., Thalassinos, E., Cristea, M., Kadłubek, M., Maditinos, D., & Peiseniece, L. (Eds.). (2023). *Digital Transformation, Strategic Resilience, Cyber Security and Risk Management* (*Contemporary Studies in Economic and Financial Analysis, Vol. 111A*), Emerald Publishing Limited, Leeds, pp. i-xxvi. https://doi.org/10.1108/S1569-37592023000111A018

Hinterhuber, A., Vescovi, T., & Checchinato, F. (Eds.). (2021). Managing Digital Transformation: Understanding the Strategic Process (1st ed.). Routledge. https://doi.org/10.4324/9781003008637;

Noja, G.G., Cristea, M., Sîrghi, N., &Vădăsan, I. (2022). "The Role of Digitalisation in Reducing Risks and Bridging Regional Economic Welfare Gaps within a Sustainable Development Framework: The Case of Romania", Grima, S., Özen, E., & Romānova, I. (Eds.) *Managing Risk and Decision Making in Times of Economic Distress, Part B* (*Contemporary Studies in Economic and Financial Analysis, Vol. 108B*), Emerald Publishing Limited, Leeds, pp. 131-142. https://doi.org/10.1108/S1569-37592022000108B037

ISSN: 2455-8834

Volume:09, Issue:06 "June 2024"

Paillé, P., Raineri, N., &Valeau, P.J. (2015). Professional Employee Retention: Examining The Relationships Between Organizational Citizenship Behaviorand Turnover Cognitions. *Journal of Applied Business Research*, *31*, 1437-1452;

Recommendation 2006/962/EC on key competences for lifelong learning, *Official Journal of the European Union*, LexUriServ.do (europa.eu);

Schlosser, K.P., Volkova, T., Noja, G.G., Cristea, M., & Maditinos, D. (2023). "Strategic Leadership Attributes for Adopting Digital Technology and Ensuring Organisational Resilience", Grima, S., Thalassinos, E., Cristea, M., Kadłubek, M., Maditinos, D., & Peiseniece, L. (Eds.) *Digital Transformation, Strategic Resilience, Cyber Security and Risk Management* (*Contemporary Studies in Economic and Financial Analysis*, *Vol. 111A*), Emerald Publishing Limited, Leeds, pp. 159-173. https://doi.org/10.1108/S1569-37592023000111A011

Suciu, M.C., Pelinescu, E., Cristea, M., &Noja, G.G. (2019, October). Digital transformation and the EU labour markets. In *ECIAIR 2019 European Conference on the Impact of Artificial Intelligence and Robotics* (pp. 321-330). Academic Conferences and Publishing Limited.

Scwab, K., "The Fourth Industrial Revolution". *Encyclopedia Britannica*, 31 May. 2023, Available at: https://www.britannica.com/topic/The-Fourth-Industrial-Revolution-2119734

