

**Title: Behavioral patterns of European countries from the triple perspective of tertiary education, labour market and digitalization**

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**Abstract**

Multicriterial characterization of European countries from the triple point of view of tertiary education, digitalization, and the situation in the labor market for young people and for those with higher education is essential for understanding and adapting to changes in the contemporary economy and society. The main objective of the research is to identify patterns of behavior among European countries from a three-dimensional perspective, that combines tertiary education, digitalization, and the situation in the labor market for individuals with higher education and young people. This represents the novelty of the work, aiming to fill the information gap in the specialized literature in this regard. To achieve this objective, a unique selection of indicators was utilized to form main components, which subsequently served as criteria for clustering EU member countries. The constructed patterns enabled the identification of strengths and weaknesses, as well as the recommendation of necessary measures to address vulnerabilities, which may be of interest to decision-makers in mitigating the inequalities between country-groups and in optimizing the level of indicators within the groups.

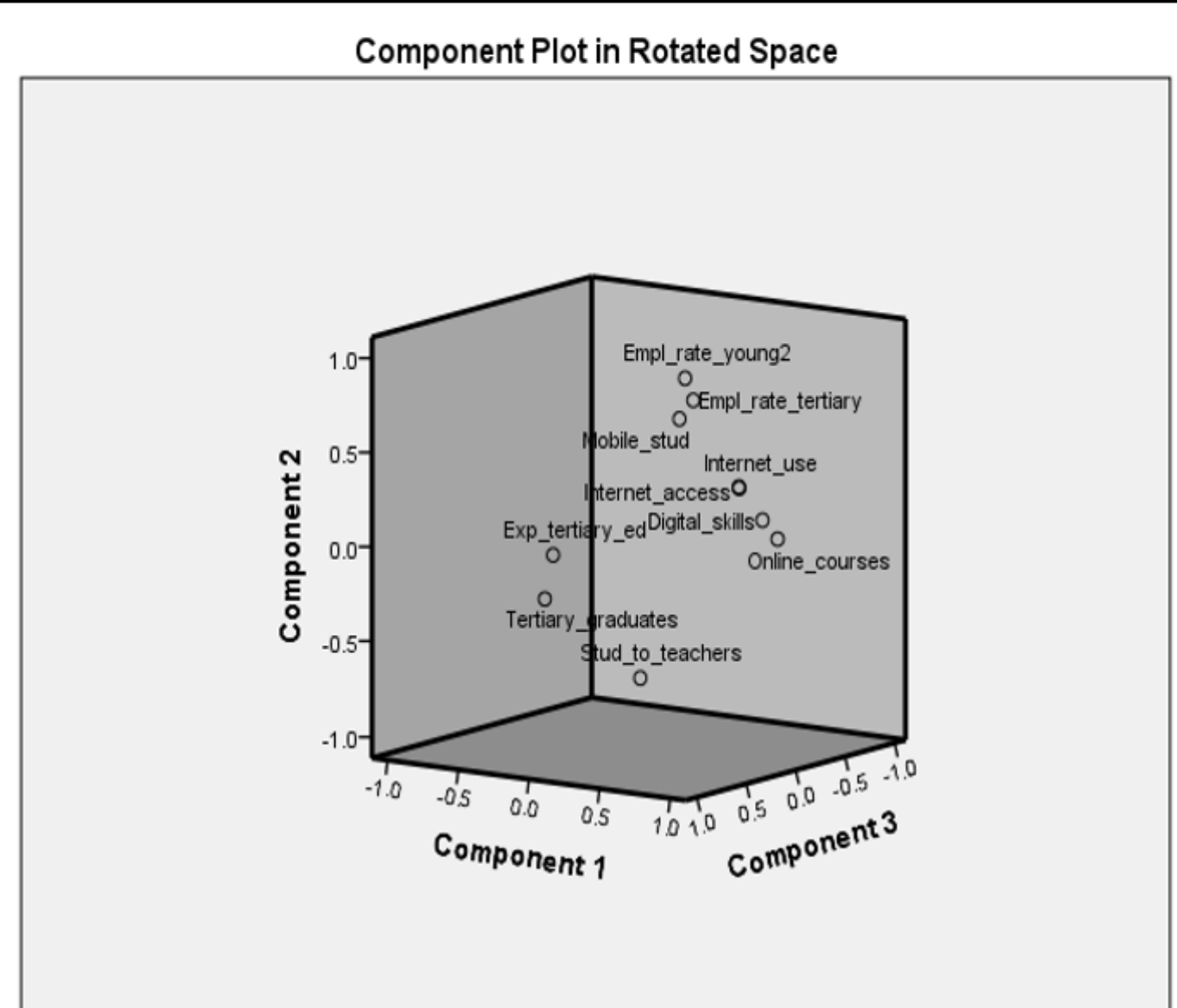
Working hypothesis:

H1: European countries exhibit significantly different patterns of behavior regarding the labor market, digitalization, and tertiary education.

Name of statistical variable	Measurement unit	Data source/online code
Public educational expenditure – tertiary education	% of EU-level	Eurostat/educ_uoe_fine02
Graduates in tertiary education	% of EU-level	Eurostat/educ_uoe_grad01
Share of mobile students from abroad enrolled in tertiary education	%	Eurostat/educ_uoe_mobs03
Ratio of pupils and students to teachers and academic staff in tertiary education	Rate	Eurostat/educ_uoe_perp04
Employment rate of tertiary educated (16-64)	%	Eurostat/lfsa_ergaed
Employment rates of young people not in education and training (18-34)	%	Eurostat/edat_lfse_24
Level of internet access – households	% of households	Eurostat/tin00134
Internet use by individuals (last 3 months)	% of individuals	Eurostat/tin00028
Individuals who have basic or above basic overall digital skills	% of individuals	Eurostat/tepsr_sp410
Individuals using the internet for doing an online course	% of individuals	Eurostat/tin00103

**Table no. 3. Rotated Component Matrix<sup>a</sup> and Component Plot in Rotated Space**

	Component		
	1	2	3
Exp_tertiary_ed	.060	.051	.951
Tertiary_graduates	.000	-.188	.950
Online_courses	.899	.066	-.120
Digital_skills	.875	.181	-.001
Internet_use	.809	.364	.141
Internet_access	.791	.366	.117
Empl_rate_young2	.255	.856	-.104
Empl_rate_tertiary	.345	.755	-.059
Stud_to_teachers	-.105	-.779	-.166
Mobile_stud	.138	.613	-.214

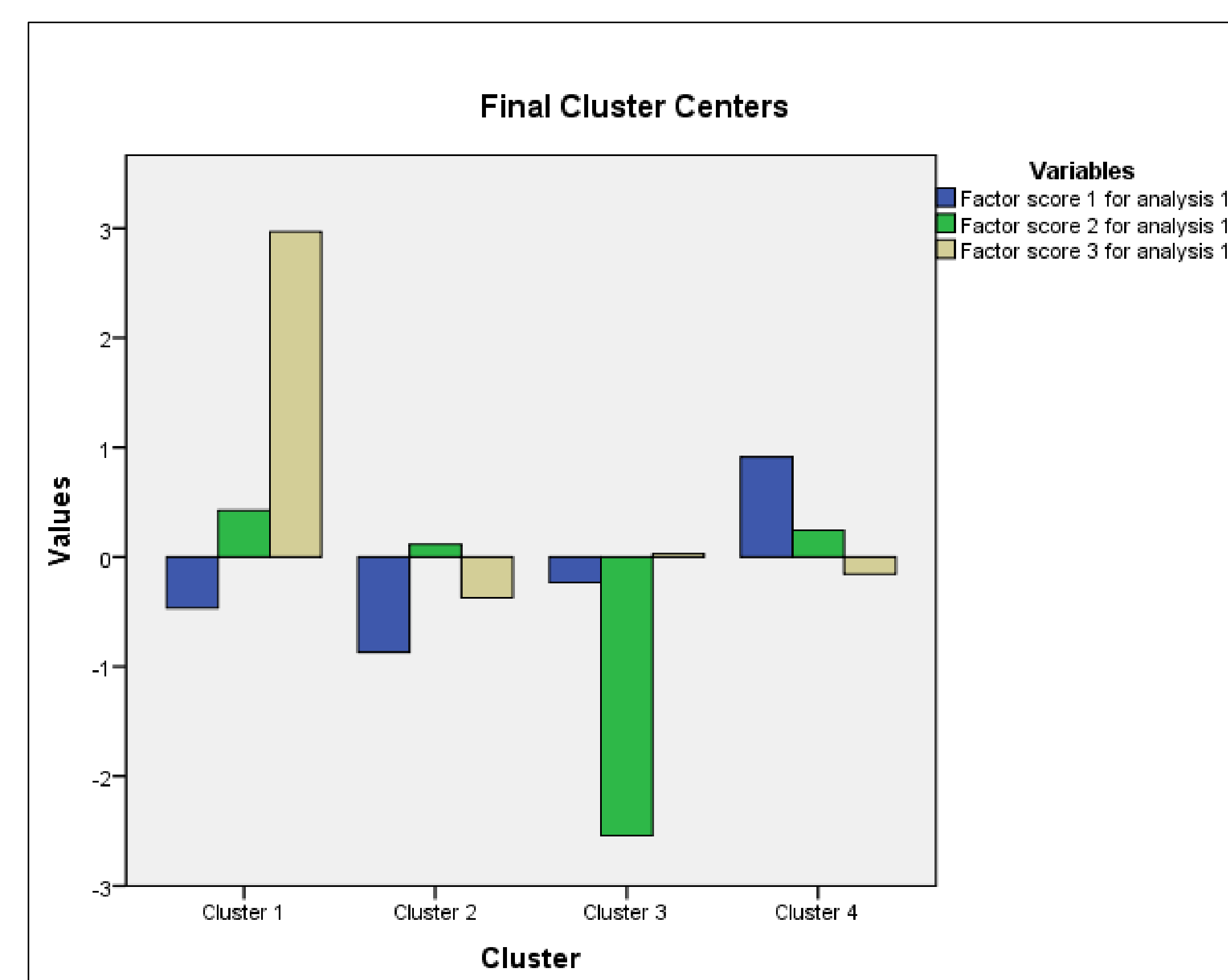
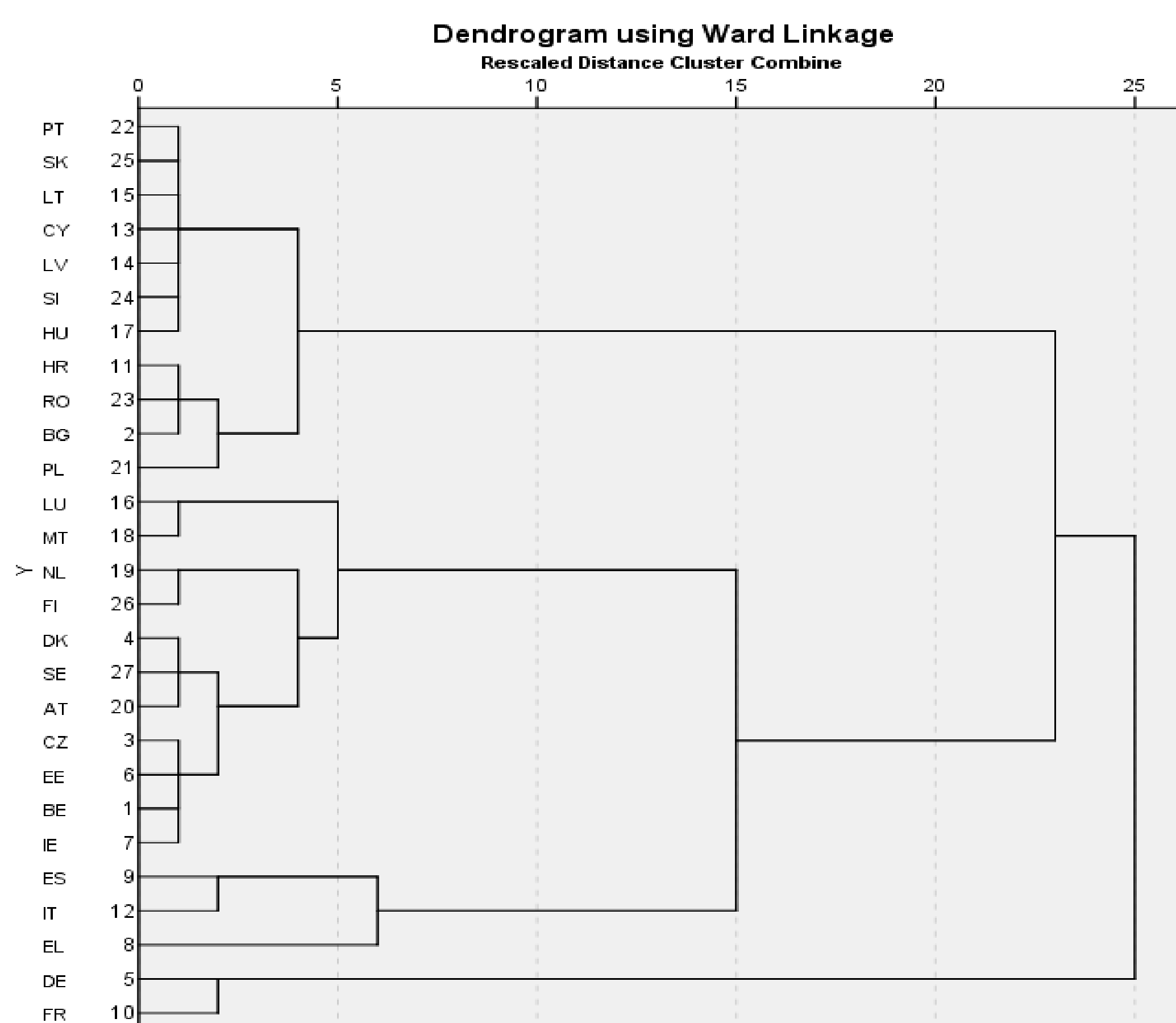


**Principal Component Analysis and Cluster Analysis**

**Component 1** is determined by indicators characterizing access to electronic resources and their usage, as well as the digital skills of users (Household Internet access, Individual Internet usage in the last 3 months, Proportion of individuals taking online courses, Proportion of individuals with basic or above basic digital skills). This component could be named the **Digital Component**. All variables are strongly and positively correlated with this component (correlation coefficients between 0.791 – 0.899).

**Component 2** contains indicators characterizing two aspects: the employment of young people and of those with tertiary education in the labor market (Employment rate of tertiary-educated individuals, Employment rate of young people), as well as certain facets of the education system, such as international visibility (Proportion of international students enrolled in tertiary education) or participation in education (Student to teacher ratio and academic staff in tertiary education). This component could be named the **Education-Labor Market Correlation Component**. All included variables are fairly strongly and positively correlated with this component, except for the student-to-teacher ratio, which has an inverse correlation with Component 2.

**Component 3** consists of indicators characterizing, on one hand, financial efforts (Expenditure on tertiary education), and on the other hand, the outcomes of the educational system (Number of tertiary education graduates). This component can be named the **Tertiary Education Component**, and it is highly strong and directly correlated with the subordinate variables



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**Pattern 1**, consisting of two EU countries with strong economies, true engines of the European economy (France, Germany), is distinguished by the highest level of the tertiary education component (Component 3). These countries have recorded the highest expenditures on tertiary education (a cluster-level average of 22.41% of the EU total), the highest share of tertiary education graduates (17.78% of the EU total), and the lowest number of students relative to teaching staff, indicating a high number of employees in the academic field. The countries in this cluster hold the second-best position among the indicators within Component 2 (Education-Labor Market Correlation) and Component 1 (Digital Component), with high rates of employment among the tertiary-educated population and youth, as well as high levels of internet access, internet usage, digital skills, and online course participation.

**Pattern 2**, composed of countries with emerging economies, in the process of development, originating from the former socialist bloc (BG, HR, CY, LV, LT, HU, PL, PT, RO, SI, SK), has the lowest level of indicators within Component 3 (Tertiary Education), with the lowest level of expenditure on tertiary education (less than 1%, on average, of the EU total) and the lowest number of tertiary education graduates (only 1.87% of the EU total). Regarding the digital and education-labor market correlation components, countries in this cluster have among the lowest indicator values.

**Pattern 3** consists of Southern European countries (Italy and Greece), which share the common trait of having the most unfavorable position under numerous aspects of digitalization (the lowest proportion of households with internet access and internet usage), as well as education-labor market correlation (lowest employment rates among youth and tertiary-educated individuals, lowest proportion of foreign students attending courses in these countries, highest student-to-teacher ratio). However, these countries rank second-most favorably regarding the tertiary education component, in terms of the proportion of public expenditure on tertiary education and the number of tertiary education graduates relative to the EU total.

**Pattern 4** generally consists of developed EU countries, among which Nordic countries stand out, with a recognized efficiency of the tertiary education system (BE, CZ, DK, EE, IE, ES, LU, MT, NL, AT, FI, SE). These countries have the highest level of the digital and education-labor market correlation components, but record more modest levels of the tertiary education component in terms of expenditure on tertiary education and the number of tertiary education graduates.