ROMANIA AND THE KNOWLEDGE ECONOMIES IN THE EUROPEAN UNION: STATUS, PROGRESS AND EFFECTS

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ABSTRACT
The present analysis is based on the assumption that the 8 indicators included in the Europe 2020 Strategy for building knowledge economies across Europe can be resumed to one or maximum two synthetic indicators, by performing a Principal Components Analysis, and so clusters of countries can be shown, according to how close each country is to the optimal level of each indicator. Consequently, this paper presents the dynamic evolution of the European countries for the past three years and shows their progress or lack of progress from this point of view. One of the main results shows the current three groups of countries from the point of view of creating the new economies in the European Union. The analysis emphasises the position of Romania, its transit throughtout the European Union and the other knowledge economies and underlines certain important key point for the future. This study is relevant for managers in the Romanian companies, scientists and social analysts, and even political decision making factors, because it shows the cause-effect relation that lead to Romania standing where it stands today.

KEYWORDS: *Romania, European Union, Knowledge Economy, Cluster Analysis, Europe 2020 Strategy.*

JEL CLASSIFICATION: *C82, O11, 052.*

1. INTRODUCTION

The European Union is deeply connected to the environmental changes all over the world, so as in 2000, when the Lisbon Strategy was elaborated, it was one of the first mentions of a "knowledge based economy" worldwide, at such an important hierarchical level. The practice of knowledge management has evolved faster in the microeconomical sector (Bate and Robert, 2002), but theoretical and strategical steps have already been made at national at international levels in order to seen and show the importance of knowledge as the key resource of this century (Geisler and Wickramasinghe, 2009). The concept has already evolved so much that the researchers nowadays acknowledge that we are facing the third generation of knowledge management in private companies (O'Dell and Hubert, 2011).
At a much higher level, the Lisbon Strategy emphasises innovation as the key point in achieving the strategic goal of the European Union: to become the most competitive knowledge society by 2010 (Celikel Esses, Villalba Garcia & Tarantola, 2008). Certain indicators measure this kind of progress, but still, one of the main issues with the implementation of the Lisbon Strategy was the fact that measurement of the progress of each contry, not just of Europe, as a whole, were surprisingly hard to make. Different authors tried to mark such progress with different methods, such as a grading scale (Daianu et al., 2004),but the effective progress of the countries during the 10 years of the strategy was still not clear in the scientific and practical communities and therefore, corrective decision were still not at hand for the European leaders.

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Ten years later, in 2010, the new European Strategy comes with certain improvements from the point of view of measuring progress. Europe 2020 aims to be the viable path to "smart, inclusive and sustainable" future for the EU, by means of " a growth that is: smart, through more effective investments in education, research and innovation; sustainable, thanks to a decisive move towards a low-carbon economy; and inclusive, with a strong emphasis on job creation and poverty reduction" (European Commission, 2010).
The "smart" growth entails two of the five main objectives of the strategy, which are to increase the R&D investements up to 3% and to reduce the rate of early school leaving below 10%, as well as to have at east 40% of the 30-34 years olds achieveing third level education; the "sustainable" growth entails on major objective, with three targets: to reduce the greenhouse gas emission by 20% (or even 30%) in comparison to the year 1990, to increase the procentage of enery coming from renewable sources to up to 20% at least and to have a 20% increase in energy efficiency overall; last, but not least, the "inclusive" growth leads on to two major objectives: first, to have at leat 75% of the 20-64 years olds employed and, secondly, to have at least 20 million less people exposed to poverty and social exlusion by 2020 (European Comission, 2010).
However, the improvement from the Lisbon Strategy comes from the appearance of the national targets which are established for each country. This is avery important and aplicable aspect, because the vulnerabillities and strenghts of each country are taken into consideration and no unrealistic objectives are being set. Though, as far as we know up to this point, there is no way of knowing which country is close and how close to the status of being a knowledge based economy, as the Strategy points out that it seeks, there is no way of having a hierarchy or compare the progress that the countries are making in this dirrection.
Some authors have tried to measure such a progress, both at national (Fucec and Marinescu, 2013) or microeconomical (Fucec, 2012; Fucec and Marinescu, 2013, Ceptureanu et. all, 2012) level, but things are evolving from year to year and we need to know where do we stand at the moment. Besides, the lack of a valid measurement model implies the need to make tests and try to see if models are changing from year to year or not. Other studies glanced at how the two strategies of Europe (Lisbon and Europe 2020) unfold upon the member states. For example, the year 2004 brought along great consideration made by the European Commission in regard to the implementation of the Lisbon Strategy (Fucec, 2012a). Thus, the European Institute of Romania presented in a paper (Voinea, Pauna & Marinescu, 2011), the three main categories of action in the approach of the research-development-innovation trinomial: a modern approach, a traditional approach and a group of countries with peculiar approaches, different ones, hard to add up into one category. Thought Romania was not yet a member of the European Union at the time, still the European Commission considered it to be one of the countries with a special, peculiar approach. Also, it was found that in Romania fundamental academic research comes first and industrial innovation is not enough emphasized. To pursue the present example, this paper will show how Romania is doing in comparison to the other countries of the EU on the path of creating the knowledge economies, also from the point of view of energetic sustainability and inclusive growth.
Another problematic aspect to take into consideration when debating the progress of the countries in the EU comes from the fact that the 5 objectives of the Strategy are upholded by 8 target indicators. This means that for a valid analysis, we need to work in a 8th-dimensional space, which is a very deep and complex issue and process. The present paper tries to reduce the dimension of this mathematical space and show as clear as possible how each state is evolving and how are they doing as a whole, as EU. The methodology used to this concern is briefly introduced as follows.

2. RESEARCH METHODOLOGY

For the analysis, we chose to perform a Principal Components Analysis (PCA), which has been explained as a methodology in a previously cited paper of the same author (Fucec, 2012a). Basicaly, the PCA helps to reduce the dimension of the mathematical space where we run the analysis, by

reducing the redundant data and only keeping nonredundant new indicators in the results (Ruxanda, 2001; Smith, 2002). To comprehend better the result of the analysis, the PCA was considered the strating point and then, the trully important results come from the Cluster Analysis, which is performed on the eigenvalues we retrieved from the PCA. The analysis was run thourgh the software instrument Statistica 10.1, on data on the 28 European countries in the year 2013, with some exceptions. The data was retrieved from the European Commission's website, refering to the 8 target indicators for the 5 main objectives of the Europe 2020 Strategy (Eurostat, 2012):

- Employment Rate (EmplR): expresses the employment rate in each country (%);
- Gross Expenditure on Research and Development (GERD): represents the percentage of GDP spent on R&D (%);
- Greenhouse Gas Emissions (GrGE): expressed correlated to the value from the year 1990, considered to have the value 100;
- Renewable Energy (RenEn): gives the share of renewable energy in the gross final energy cnsumption (%);
- Primary oil consumption (TOE): a measure for the real energy comsumption, expressed in " tones of oil equivalent", values retrieved for the year 2012, because of the lack of information regarding the year 2013;
- Early Leavers from Education (ELvEd): percentage of population aged 18-24 leaving school early (%);
- Tertiary Education Attainment (TrEdA): percentage of population aged 30-34 with tertiary education (%);
- People at Risk of Poversty or Social Exclusion (PrP/SE): expressed as a percentage from the total population of the country (%).

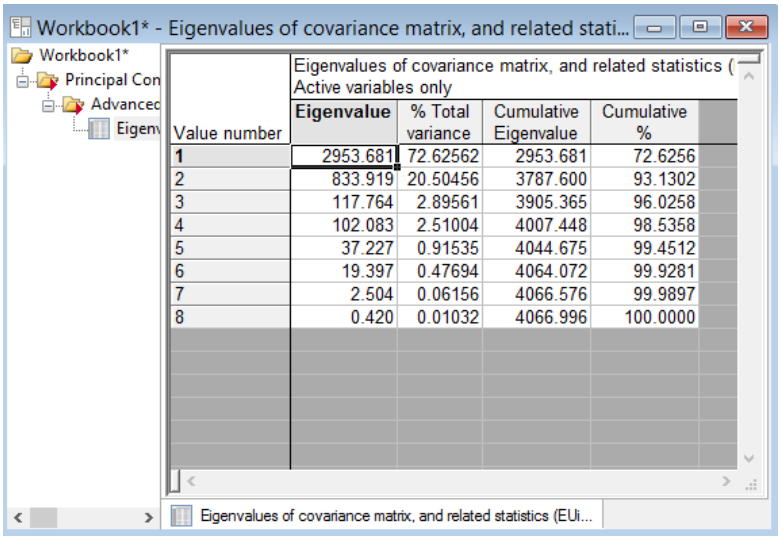
3. RESULTS AND DISSCUSSION

3.1. Principal components analysis (PCA)

The PCA gives many important analythical themes, but we will explain in this papar the following results: the meaning of the eigenvalues and importance of the Factor Matrix.

3.1.1. Eigenvalues of the original variables

The first and most important result of the PCA is the eigenvalues of the original variables. What these values (in column 1, Figure 1) show is how much nonredudant information is available in each of the variables. If we pursue the analysis with only the first eigenvalue, we will be able to express how the 28 countries are evolving from the point of view of the 8 target indicators by using only one indicator, the actual eigenvalues, and the information loss would be less than 28%; the information compounded in the first eigenvalues is 72.6256. If we also take into consideration the second variable, the information loss decreases significantly (only 6.9%) and we could express the progress and evolution of the countries by using two new factors (the first two eigenvalues), with 93.19 information retained. Depending on how much information we want to retain for the analysis, we can choose these two variables or we can pursue more relevant results, such as taking into consideration 3 eigenvalues (with 96.02% of the initial information) or even 4 eigenvalues (containing 98.53% of the information), but with each new factor we include, we also increase the number of space dimension for our analysis. So, we decided to continue the analysis with two eigenvalues, which means that we will run the cluster analysis for the initial data minus 6.9% information loss, but within a bidimensional space, which is much more easier to grasp, understand and even draw than an 8th dimensional space.



Workbook1* - Eigenvalues of covariance matrix, and related stati...

Eigenvalues of covariance matrix, and related statistics (
Active variables only

Value number	Eigenvalue	% Total variance	Cumulative Eigenvalue	Cumulative %
1	2953.681	72.62562	2953.681	72.6256
2	833.919	20.50456	3787.600	93.1302
3	117.764	2.89561	3905.365	96.0258
4	102.083	2.51004	4007.448	98.5358
5	37.227	0.91535	4044.675	99.4512
6	19.397	0.47694	4064.072	99.9281
7	2.504	0.06156	4066.576	99.9897
8	0.420	0.01032	4066.996	100.0000

Figure 1. Eigenvalues of the variables

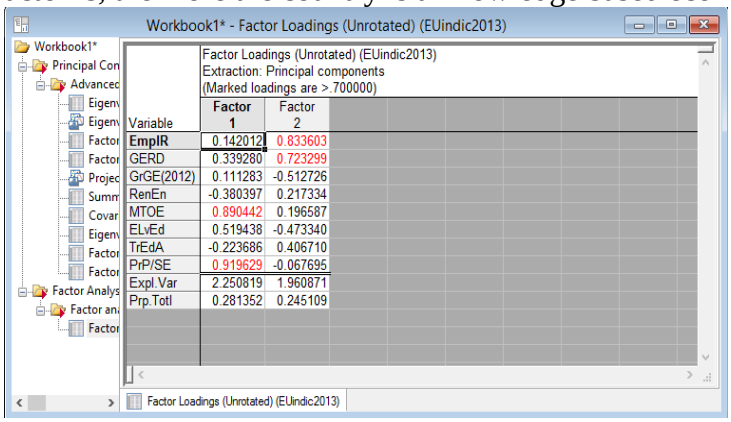
Source: the author, using the software tool Statistica 10.1

3.1.2. The Factor Matrix

The Factor Matrix comes to complete the previous results we explained. As mentioned above, we decided to pursue the analysis with 2 factors (the first two eigenvalues), which contain 93.13% of the initial information included in the 8 target indicators of the Europe 2020 Strategy. But these two factors are, at the moment, abstract factors, only mathematical values. It is the Factor Matrix that helps us give economicaly significant names and meaning to these variables.

The first eigenvalue is correlated positivelly with PrP/SE (People at risk of Poverty or Social Exclusion) and with the MTOE (million tones of oil equivalent), which can lead to the significance that the indicator shows the wellfare of a country by measuring it against the number of poor people in the country. In a metaphorical way, this means that we can call the indicator "Subsistance indicator (SI)". The bigger the values of the indicator, the less closer the country is towards the phase of the knowledge economy. The consumption of energy is also important, as can be seen from the figures, but it is difficult to put in the same indicator a small number of poor people and also large energy consumption, so for the purpose of this research, we will consider the importance of the first factor to be higher, because of the higher correlation between the values.

The second eigenvalue is most strongly correlated with the Employment Rate (EmplR), which makes it obvious that we can call it "Employment Rate (ER)". Though, the employment rate as an eigenvalues is not to be confused with the real employment rates economically speaking. The employment rate as a eigenvalues and a principal component is different and contains nonredundant data. The higher this factor is, the more the country is a knowledge based economy.



Workbook1* - Factor Loadings (Unrotated) (EUindic2013)

Factor Loadings (Unrotated) (EUindic2013)
Extraction: Principal components
(Marked loadings are >.700000)

Variable	Factor 1	Factor 2
EmplR	0.142012	0.833603
GERD	0.339280	0.723299
GrGE(2012)	0.111283	-0.512726
RenEn	-0.380397	0.217334
MTOE	0.890442	0.196587
ELvEd	0.519438	-0.473340
TrEdA	-0.223686	0.406710
PrP/SE	0.919629	-0.067695
Expl.Var	2.250819	1.960871
Prp.Totl	0.281352	0.245109

Figure 2. The Factor Matrix

Source: the author, using the software tool Statistica 10.1

3.2. The Cluster Analysis

We performed the following cluster analysis on the two principal components retained in the analysis, because of the increased effectiveness. This part of the study is the one that gives the guidelines to create the groups of countries accordingly to their evolution, based on the two principal components of the original target indicators. The following results of the Cluster Analysis will be explained: the Distance Matrix, the amalgamation Schedule and the Dendogram.

3.2.1. The Distance Matrix

The Distance Matrix is very important in essence because it shown which is the calculated Manhattan distance between the analysed cases (the countries). In Figure 3, we only presented part of the Matrix, because it is very extended.

Data: Spreadsheet5 (28v by 32c)

	EUindic2013										
	1 Belgium	2 Bulgaria	3 Czech Re	4 Denmark	5 Germany	6 Estonia	7 Ireland	8 Greece	9 Spain	10 France	11 Croatia
Belgium	0.00000	54.09533	27.49023	30.13141	190.68969	69.98011	48.60910	42.28335	85.67170	123.29795	31.28448
Bulgaria	54.09533	0.00000	26.60510	23.96393	229.10531	15.88478	54.19699	56.33969	139.76703	177.39328	29.84043
Czech Re	27.49023	26.60510	0.00000	17.95154	202.50020	42.48988	54.18435	47.85860	113.16193	150.78818	33.70012
Denmark	30.13141	23.96393	17.95154	0.00000	205.14138	39.84871	36.23281	32.37576	115.80311	153.42935	15.74858
Germany	190.68969	229.10531	202.50020	205.14138	0.00000	244.99009	239.29878	232.97303	183.39881	78.21509	218.81455
Estonia	69.98011	15.88478	42.48988	39.84871	244.99009	0.00000	70.08177	72.22447	155.65181	193.27806	38.69564
Ireland	48.60910	54.19699	54.18435	36.23281	239.29878	70.08177	0.00000	6.32575	85.57004	161.08369	31.38614
Greece	42.28335	56.33969	47.85860	32.37576	232.97303	72.22447	6.32575	0.00000	83.42734	154.75794	33.52884
Spain	85.67170	139.76703	113.16193	115.80311	183.39881	155.65181	85.57004	83.42734	0.00000	105.18371	116.95618
France	123.29795	177.39328	150.78818	153.42935	78.21509	193.27806	161.08369	154.75794	105.18371	0.00000	154.58242
Croatia	31.28448	29.84043	33.70012	15.74858	218.81455	38.69564	31.38614	33.52884	116.95618	154.58242	0.00000
Italy	90.27607	144.37141	117.76630	120.40748	112.31519	160.25619	126.98359	120.65784	71.08362	34.10010	121.56055
Cyprus	97.81381	99.52937	103.38906	85.43752	288.50349	102.94386	49.20471	55.53046	105.10468	210.28840	69.68894
Latvia	75.51146	21.41613	48.02123	45.38006	250.52144	6.41153	75.61312	77.75582	161.18316	198.80941	44.22699
Lithuani	70.61414	16.51881	43.12391	40.48274	245.62412	4.20061	70.71580	72.85850	156.28584	193.91209	39.32966
Luxembou	45.77541	47.49097	51.35067	33.39913	236.46510	54.54967	15.53211	17.67481	101.10215	158.25000	17.65055
Hungary	38.52078	15.57455	11.03055	11.60567	213.53076	31.45933	47.83848	41.51273	124.19248	161.81873	27.35425
Malta	107.75178	109.46734	113.32704	95.37549	298.44147	112.88183	59.14268	65.46843	115.04266	220.22637	79.62691
Netherla	27.22064	81.31597	54.71087	57.35205	184.65266	97.20076	54.64612	48.32037	58.45106	106.43757	58.50512
Austria	25.19674	63.17096	36.56586	39.20703	215.88643	79.05574	23.41235	17.08660	76.59607	137.67134	40.36011
Poland	31.18403	85.27936	58.67426	61.31543	164.25591	101.16414	75.04287	68.71712	54.48767	92.11392	62.46850
Portugal	49.20942	64.03636	54.78468	40.07244	239.89911	79.92114	9.83937	7.69667	75.73067	161.68401	41.22551
Romania	49.29764	22.00985	21.80741	36.10170	224.30761	20.68248	72.33451	66.00876	134.96933	172.59558	51.85028

Figure 3. The Distance Matrix

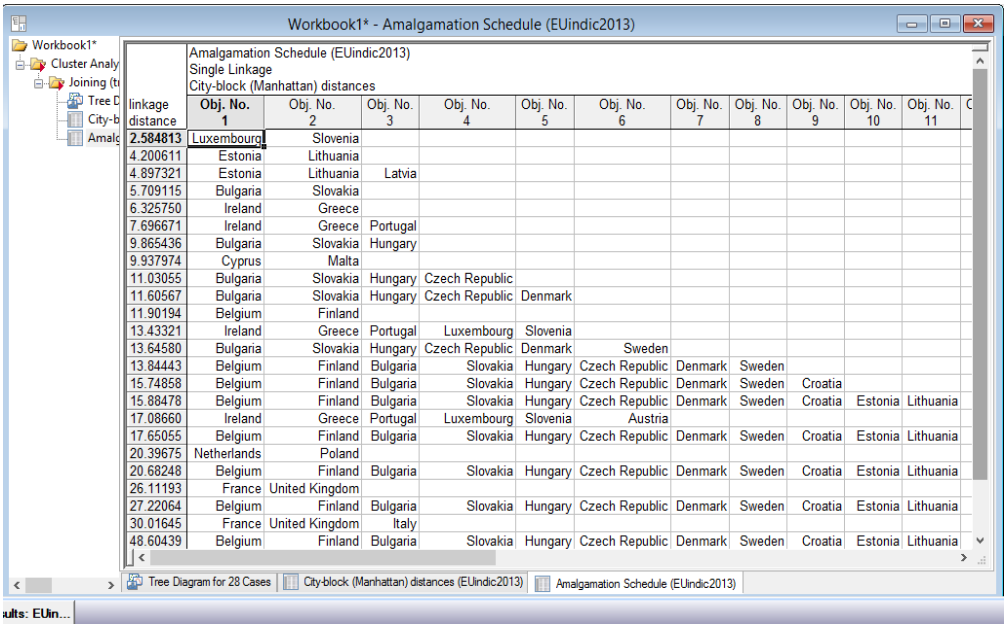
Source: the author, using the software tool Statistica 10.1

By scanning it, we can say wich countries have a similar distance among them from the point of view of the analysis. For instance, the distance between Bulgaria and the Czech Republic is 26.60, but the distance between Bulgaria and Belgium is 54.09, which is double than the firstly mentioned distance. It as also important to look at the other distances in the table, such as Germany and Island, for example, with evolutions of 239.29 points. In this new perspective, Bulgaria, Czech Republic and Belgium don't seem to be so different and we shall keep this point in mind when grouping the countries in the sequent cluster analysis. Another important aspect to notice, for example, is the huge differences among Germany and other countries, in general. This says, mathematically speaking, that the evolution of Germany towards the creation of the knowledge economies is at a more advanced level than the other countries submitted to the analysis.

3.2.2. The Amalgamation Schedule

After analysing the Distance Matrix, the software programme gives us the alignament of all the distances in the Matrix, in a rising scale and by creating small clusters with each step of the analysis. As we can see in Figure 4, the smallest distance among 2 countries is 2.58, between Luxembourg and Slovenia. This means that they are the most similar two contries in the analysis, from the point of view of the evolution toward the knowledge economies, based on the identified eigenvalues. The second closest countries are Estonia and Lithuania. Then, it is interesting to observe that Latvia joins the small group initially formed by Estonia and Lithuania. The distance

between the group of Estonia and Lithuania is at a 4.89 distance away from Latvia. After this, a new small cluster is formed, between Bulgaria and Slovakia, separated by a mathematical distance of 5.709. So on and so far, in the order of the distances, each country joins the country (or the group of countries) it is the closest to. As can be see, after Bulgaria and Slovakia form their group (cluster), Hungary joins, then, Czech Republic, then Denmark, later Sweden and so on and so far. At one point, the groups join together, as can be seen at the point where Belgium and Finland (as a group) are united with the group in the revious examle: Bulgaria, Slovakia, Hungary, Czech Republic, Denmark and Sweden. Because of the high dimension of this Amalgamation Schedule and because what we eventually seek is to have two or three goups of countries which present simillarities within the group and differences among groups, we also analyse the Dendogram.



linkage distance	Obj. No. 1	Obj. No. 2	Obj. No. 3	Obj. No. 4	Obj. No. 5	Obj. No. 6	Obj. No. 7	Obj. No. 8	Obj. No. 9	Obj. No. 10	Obj. No. 11
2.584813	Luxembourg	Slovenia									
4.200611	Estonia	Lithuania									
4.897321	Estonia	Lithuania	Latvia								
5.709115	Bulgaria	Slovakia									
6.325750	Ireland	Greece									
7.696671	Ireland	Greece	Portugal								
9.865436	Bulgaria	Slovakia	Hungary								
9.937974	Cyprus	Malta									
11.03055	Bulgaria	Slovakia	Hungary	Czech Republic							
11.60567	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark						
11.90194	Belgium	Finland									
13.43321	Ireland	Greece	Portugal	Luxembourg	Slovenia						
13.64580	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark	Sweden					
13.84443	Belgium	Finland	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark	Sweden			
15.74858	Belgium	Finland	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark	Sweden	Croatia		
15.88478	Belgium	Finland	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark	Sweden	Croatia	Estonia	Lithuania
17.08660	Ireland	Greece	Portugal	Luxembourg	Slovenia	Austria					
17.65055	Belgium	Finland	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark	Sweden	Croatia	Estonia	Lithuania
20.39675	Netherlands	Poland									
20.68248	Belgium	Finland	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark	Sweden	Croatia	Estonia	Lithuania
26.11193	France	United Kingdom									
27.22064	Belgium	Finland	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark	Sweden	Croatia	Estonia	Lithuania
30.01645	France	United Kingdom	Italy								
48.60439	Belgium	Finland	Bulgaria	Slovakia	Hungary	Czech Republic	Denmark	Sweden	Croatia	Estonia	Lithuania

Figure 4. The Amalgamation Schedule

Source: the author, using the software tool Statistica 10.1

3.2.3. The horizontal hierarchical Tree Plot (the Dendogram)

The Dendogram is a graphical design, a simple picture, of all the distances and relations explained above. This is the point where the analysis becomes subjective, because we will separate the countries in groups and this separation is "in the eye of the researcher", just as business oportunities are (Nicolescu & Nicolescu, 2008).

As the Dendogram shows, we observe the following clusters of countries:

Cluster 1: Belgium, Finland, Bulgaria, Slovakia, Hungary, Czech Republic, Denmark, Sweden, Croatia, Estonia, Lithuania, Latvia, Ireland, Greece, Portugal, Luxembourg, Slovenia, Austria and Romania.

Cluster 2: Netherlands, Poland, Cyprus, Malta.

Cluster 3: Spain, France, United Kingdom, Italy, Germany.

Within each cluster, the countries are evolving at a similar pace toward the knowledge economy phase, whilst there are several difference among the clusters. Cluster 3 is at the best position, which is obvious because of the component countries. Cluster 1 could be submitted to further analysis, because it is rather extensive and certain countries there have previously been on different positions.

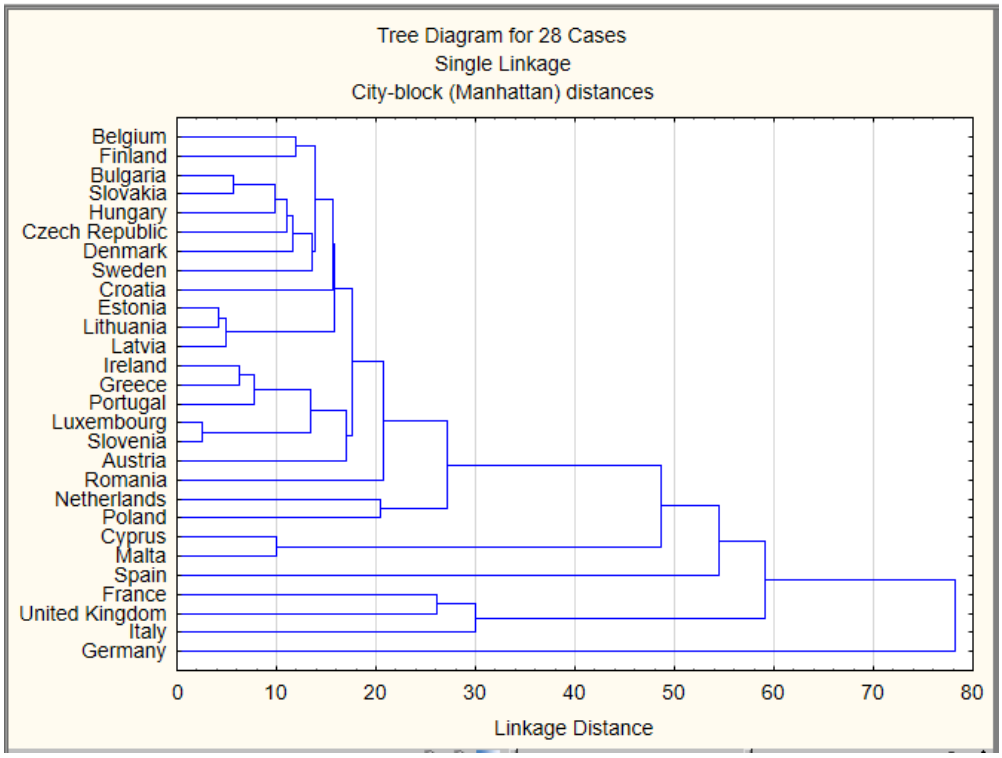


Figure 5. The Dendogram

Source: the author, using the software tool Statistica 10.1

4. CONCLUSIONS

Due to difficulties in measuring the progress of both Lisbon Strategy and Europe 2020 Strategy, we performed a PCA and a Cluster Analysis, in order to see, as simply as it gets, how the countries are evolving. One of the main results of this study shows that the indicators assigned to the objectives of the Europe 2020 Strategy can be nonredundandtly synthetised into two indicators, which retain 93.13% of all the information in the 8 initial target indicators. These two news indicators are methaphorically named "Subsistance Indicator" and "Employment Rate". Starting from this point, the sequently performed Custer Analysis shows the main three groups of countries, based on the two new indicators and showing the pace in which they evolve to being knowledge economies. In a previous papar of the same authors, one year ago, the situation looked a bit different (Fucec, 2014):

Cluster 1: Belgium, Czech Republic, Ireland, Spain, Finland, Bulgaria, Lithuania, Grecee, Latvia, France, Romania, Great Britain, Estonia;

Cluster 2: Cyprus, Portugal, Austria, Netherlands, Slovenia, Poland, Denmark, Slovakia;

Cluster 3: Luxembourg, Sweden, Malta, Italy, Hungary, Germany.

The main elements to notice are the that Romania, Poland and Cyprus hold their position in the slowest moving cluster, Denmark, Slovakia have enhaced their evolution, by moving from Cluster 1 to Cluster 2, Portugal and Austria have moved from cluster 2 to cluster 1, which shows a delay in evolution in 2013. Luxembourg jumped from cluster 3 to cluster 1, which should rise question marks (an explanation could be the slow evolution of the indicators); the same case stands for Hungary and Malta. Italy and Germany are hanging on to strong positions in cluster 3.

The defficiencies of this study reside in the use of the 2012 values for one indicator (energy consumption) and also the subjectivity of the researcher when forming the clusters. The countries at the edge of each cluster could easily be places in the neighbourhooding cluster. Still, the analysis shows clear indicators by which we can see how the countries are evolving to a new economy and how things are changing from year to year.

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