Fiscal decentralization in the European Countries: a cluster analysis approach

Alicja SEKULA
Gdansk University of Technology, Gdansk, Poland, alicja.sekula@zie.pg.gda.pl

Kamila ADAMOWICZ
Gdansk University of Technology, Gdansk, Poland, kamila.adamowicz@zie.pg.gda.pl

Abstract

The scope of public authority depend on many factors. One of them is a declaration, usually expressed in the constitution of a given country (Sferlea, 2014, Libman, 2010, Nehmelman, Vetzo, 2016) of the application of the decentralisation principle in the performance of public tasks. Despite this declaration, the structure of the public sector and the tasks carried out at different levels in particular countries are not identical. This also applies to the countries of the European Union, although some issues related to legal order are regulated by treaties.

This fact became a premise for undertaking the research presented in this article. Its aim was to compare the extent of fiscal decentralisation in EU countries, creation groups of states with similar levels of decentralization and then identify the characteristics of countries where the level is similar. Data obtained from Eurostat were subjected to statistical analysis – non-hierarchical grouping. For this purpose, the cluster analysis module of the R software was used. Analyse was made for the years 2013-2019 for 27 European countries. United Kingdom was excluded due to not available data in Eurostat for year 2019.

Based on clustering, the following conclusions were drawn: the level of decentralization in the EU increases with the size of the country. Small states are centralized. Due to the second tier of government, federal countries are characterized by a small degree of decentralization, regardless of their size. The highest level of decentralization is in the Nordic countries, in Denmark so large that it formed a separate cluster.

Keywords: decentralization, public finances, local government autonomy, public expenditure, public revenue, European Union;

Decentralization in democratic countries

Currently, the transfer of political and economic power to local governments is a global trend in fiscal policy reforms (Mauro et al., 2018, p. 874), which has its sources in the fiscal decentralisation concepts from the second half of the last century.

The explanation of the notion of decentralisation is relatively well presented in the literature, although some authors say that it is easier to define its antonym – centralisation. Centralisation is defined as a concentration of resources and authorities in the centre. It is also suggested that

decentralisation is not the opposite of centralisation, but its reduction (Săraru, 2018, p. 602). In this context, it means self-limitation of central authorities in favour of other entities with regard to the performance of tasks, disposal of public assets and management of public funds.

From the substance point of view, decentralisation to lower governance levels always involves delegation of tasks. Most often it refers to state structures and concerns the assignment of tasks to local government, however, it needs to be stressed that tasks can also be transferred within private organisations (Poitevin, 2000, p. 878), and in the case of the public sector - the transfer does not necessarily have to take place in the relationship: government sub-sector - local government sub-sector, because tasks can be transferred to institutionally separated parts of state administration. The delegation of tasks according to the above scheme is referred to as sectoral decentralisation, as opposed to territorial decentralisation, which is much more common in the case of local self-governments. From the political system point of view, local authorities are to be not subordinated to the centre, independent and autonomous (Săraru, 2018, p. 602). When solving local public affairs, the starting point for local self-governments is better knowledge of local problems and, thus, greater likelihood of successful implementation of the solutions to these problems (Haček, Grabner, 2013, p. 216). Other advantages of decentralization are as follows:

- bringing power closer to the electorate, increasing knowledge about the needs of the society and the resulting opportunity to satisfy them more quickly and fully (Bulut, Abdow, 2018, p. 183),
- reduction of communication costs, as decision-making is delegated to an agent who has the most relevant information (Poitevin, 2000, p. 878); in the case of the public sector, this agent is usually the local authority, and the delegating entity is a government sub-sector,
- reduction inter-regional disparities (Kyriacou et al., 2017, p. 947).

Of course, it also has drawbacks or potential risks, e.g. coordination problems may arise. Furthermore, decentralised governments are usually larger, although it is not interpreted as a manifestation of inefficiency; instead, it stems from the fact that the transfer of the ability to provide public goods that are more in line with voters' preferences to local authorities is linked to the fact that they receive more management resources (Stein, 1999, pp. 386-388).

Types of decentralisation

There are many divisions of decentralization, due to:

- its nature: it can be understood as a process (transferring of public tasks and financial resources enabling the implementation of these tasks to public sector entities at lower levels of the structure) or as a state (equipping entities below than the central level with tasks and means by which they perform these tasks),

- type of institution: local - if it concerns local government and functional - if it concerns state administration,
- structure: if decentralisation takes place within a specific structure, it is referred to as the internal one, and if the delegation of tasks takes place outside of it, decentralisation is referred to as the external one (Fontana, 2018, p. 758),
- level: it can be at regional and local level; the first concerns voivodships, regions or provinces, the second one - communes, their associations and districts. This division is all the more important due to the fact that extensive decentralisation at the regional level is not a prerequisite for its existence at a local level to the same extent,
- system approach: it can be political, administrative and financial decentralisation.

The last one is the most common division. The essence of political decentralisation boils down to the existence of democratically elected public authorities at local government level, which have an ensured political independence from the state. In the opposite situation, i.e. in the case of political system centralisation, central authority has the competence to appoint these bodies, influencing their decisions at the same time.

Administrative decentralisation means that state separates and delegates tasks and powers that, from the organisational point of view, are necessary to perform these tasks to local self-governments. The allocation of tasks has to be performed in accordance with the self-government level.

Decentralisation, when carried out properly, must also take the financial aspect into account. In simple terms, it is called decentralisation of public finances. This means transferring relevant tasks of public resources to local government units, adequate to those decentralised in the administrative sense, and the power to dispose of them. The scope and the degree of financial independence are not unlimited. The limits are national political doctrines and the criterion of efficiency. Main economic justification for allocating expenditures to local self-governments is largely based on considerations related to allocation and efficiency (Ugaz, 1997, p. 6).

Two sets of actions are distinguished in the process of financial decentralisation:

- the first one: equipping self-governments with their own sources of revenue, ensuring conditions for the independent gathering of funds and the possibility of setting their amount,
- the second: the delegation of powers to make decisions regarding the way funds are spent on public tasks.

Such division leads to the separation of revenue and expenditure financial decentralisations (Figure 1), however, in the case of their scope, expenditure decentralisation is greater than the revenue one (Mauro et al., 2018, p. 874). Distinguishing between different types of decentralisation has much broader meaning than just terminological, and it does not only serve the purpose of describing the phenomenon more precisely, e.g. studies on the impact of decentralisation on quality of life have

shown that while greater decentralisation of revenue increases population's satisfaction with life, decentralisation of expenditure is no longer linked to satisfaction with life (Gao et al., 2014, p. 1192).

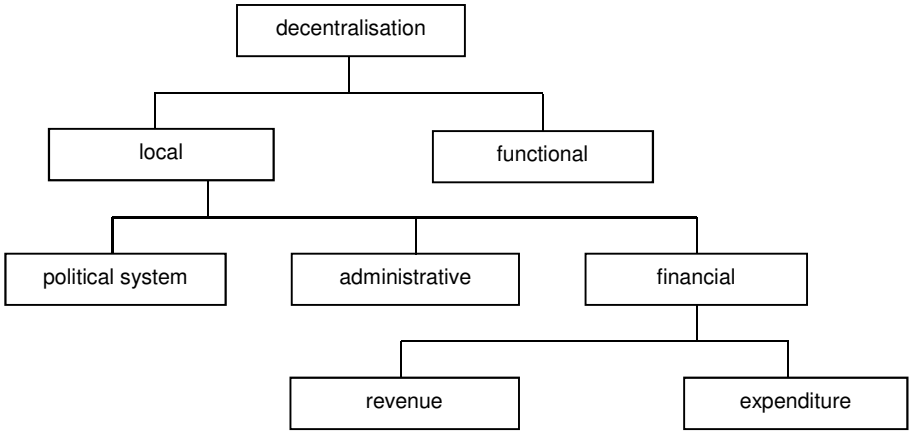

Figure 1 Types of decentralisation

Source: own elaboration

Previous empirical studies

A review of empirical studies dedicated to main issue of the article indicates that apart from those studies which indicate positive economic effects of decentralisation, some researchers also observe a lack of such effects, or, in fact, even the occurrence of negative ones (Mauro et al., 2018, p. 873), and with regard to poverty reduction opportunities, it is observed that decentralisation itself, without strengthening and expanding the mechanisms of responsibility at a local and national level, will not bring results beneficial to the poor parts of society (Crook, 2003, p. 77).

Maličká and Martinková (2018) grouped EU countries into clusters, taking into account data from 1995-2015 and using 4 variables:

- sub-national expenditure to total government expenditure,
- sub-national revenue to total government revenue,
- sub-national tax revenue to sub-national total revenue,
- sub-national grants and transfers received to total sub-national revenues.

EU countries were clustered into 3 groups. Cluster 1 included 12 countries, i.a. Belgium, Germany and Spain. The next cluster comprised 8 unitary countries, including Poland, with multi-tiered local governments. The last cluster comprised 8 unitary countries (the only exception - Austria), e.g. Estonia or Lithuania, with single-tier local governments. Studies focused on the search for the determinants of fiscal decentralisation did not provide a clear answer to the question.

In a study conducted by Chernov et al. (2019), clustering was one of the methods used to assess the impact of the level of financial decentralisation on the indicators of socio-economic

development of territories. The results of the simulation showed that revenue decentralisation is associated with a stronger effect on economic growth than expenditure decentralisation. Furthermore, high level of financial decentralisation (the original set of 28 EU countries was divided into two clusters) is typical for countries with high level of economic development and high quality of institutional environment and administrative decentralisation. As a consequence, it leads to an increase in the efficiency of public sector operation and economic growth.

Another article (Laboutková et al. 2016) identified the relations between the degree of decentralisation and economic imbalance on the basis of a cluster (exploratory) analysis. Decentralisation was measured using a decentralization index, which contained both quantitative and qualitative components. The article focused on the argument that the degree of decentralisation affects the level of economic inequalities. One of the conclusions was that countries in the groups with a higher degree of decentralisation are among countries with more favourable values of economic imbalance indicators.

In an article dedicated to fiscal decentralisation (Halásková M., 2015), the results of decentralisation of public administration in relation to public expenditures were presented, and a comparison of fiscal expenditure decentralisation in the EU countries in the years 2001, 2005, 2009 and 2012 was provided. A comparison of general government expenditures according to the levels of public administration was made with the use of the cluster analysis method. Three input variables - total general government expenditures (% of GDP), local government expenditures (% of GDP) and local government expenditures (% of the total general government expenditures) - were selected for the comparison. The output of the hierarchical cluster analysis consisted of three clusters; cluster 1 consisted of 10 countries, incl. Germany, Spain and Cyprus. The second cluster consisted of 15 countries, incl. Poland, France and the Netherlands. The last cluster consisted of 3 countries: Denmark, Finland and Sweden.

L. C-H. Liu (2011) in his research took into account 8 components, i.e. political structure and decentralisation, transfer and tax revenue, revenue and expenditure assignment, tax autonomy and borrowing power in 54 countries. Based on the findings he created 6 clusters which were named as follows: high expenditure/revenue assignment fiscally decentralised systems (FDS), e.g. Denmark, Finland; low expenditure/revenue assignment FDS, e.g. Belgium, France; transfer revenue FDS, e.g. Netherlands; politically centralised FDS (there was no EU country); unitary state FDS, e.g. Bulgaria, Poland and Romania. The last one was complete FDS, e.g. Austria, Germany. Sub-national governments in this group possessed a high degree of taxing revenue, taxing power, expenditure/revenue assignment and independence in local affairs. The cluster presented high scores on almost all the variables, except borrowing power.

Measurement of decentralisation

According to the 3 aspects of local decentralisation presented in Figure 1, the indicators for measuring decentralisation are divided into 3 groups, i.e. the indicators for decentralisation of public finances, administrative and political decentralisation.

Apart from assigning the indicators to one of three aspects of decentralisation, they can be divided into qualitative (descriptive) variables and quantitative ones. Quantitative information can be obtained by calculating, among others, the following indicators – the share of:

- local government sub-sector revenue in total public revenue,
- tax revenue of the local government sub-sector in tax revenue of the state budget,
- own revenue in the total revenue of the local government sub-sector (Sanogo, 2019, p. 218),
- local government sub-sector revenue in relation to the GDP (gross domestic product),
- the number of persons employed outside the central government in relation to the persons working for it (Fontana, 2018, p. 761),
- local government expenditure in total public expenditure (Halásková 2015),
- local government sub-sector expenditure in government sub-sector expenditure (Stein, 1999, p. 370),
- local government sub-sector expenditure in relation to GDP (Guziejewska, 2018, p. 110); this indicator is also referred to as functional decentralisation.

Research methodology

Referring to the literature, it can be concluded that the cluster analysis method is suitable for grouping data (Caruso, 2020; Farid et al., 2016). Organising data into sensible groupings is one of the most fundamental modes of understanding and learning (Jain, 2009). The purpose of cluster analysis is to group objects based on a certain set of characteristics that characterise them. Objects with similar characteristics are mathematically clustered into the same cluster (Romesburg, 2004, p. 5).

Cluster analysis is a multidimensional technique used to sort data and place similar observations and objects in the same group called a cluster. Grouping is the separation of groups and subsets on the basis of the identification of natural groups in which objects similar to each other are to be placed in one group, while objects significantly different in different groups (Jain et al, 1999).

There are two types of approaches in cluster analysis: hierarchical and non-hierarchical grouping (Alkarkhi, Alqaraghuli, 2018, pp. 177-186). Cluster analysis has developed a lot after 1960. Over the next 15 years, this technique developed very intensively and numerous tools for conducting cluster analysis were created (Yim, Ramdeen, 2015). Methods are used to divide a set of objects into groups based on their properties. There are several methods to conduct cluster analysis. They can be

classified to categories: hierarchical clustering, centroid based clustering, distribution-based clustering, density-based clustering, partitioning method, grid-based method, model-based method or constraint-based method (Reddy et al., 2017).

The idea of the k-means method was developed in the 1950s by T. Dalenius, who presented an iterative procedure for dividing the population into k- groups in order to minimize the intra-group variance (Pietrzykowski, Kobus, 2006). The method of non-hierarchical "k-means" grouping is a method most frequently used iteration-optimization method. As a rule, it is assumed that the number of clusters created is equal to k, hence the name of this method. It is an iterative procedure for dividing objects into k groups, minimizing the amount of intra-group variance. The essence of the method is that the quality function of the division of objects is optimized. The variance of objects in groups measured by means of variance should be as small as possible, and between groups - as large as possible.

The use of the k-means method makes it possible to determine the typology of the studied objects and to define homogeneous objects of analysis, in which it is easier to distinguish systematic factors and possible cause-effect relationships (Pietrzykowski, Kobus, 2006). It is essence consists in reducing a large amount of accumulated information to a few basic categories, thanks to which it becomes easier to orientate in a given phenomenon and draw generalizing conclusions. This K-means algorithm relies on moving objects from a cluster to a cluster as long as the variations inside the clusters and between clusters are optimized. The simplest method of making such an algorithm in traditional way is (Hartigan, Wong, 1979): set the number of clusters, establish the initial centers of clusters, calculate the distances of objects from the centers of clusters, assign objects to clusters.

Manual clustering has been replaced by automated programs. This analysis can be obtained with the aid of the individual statistical and mathematical packages and solvers. The most important aspects are choosing a metric and determining the number of clusters.

One of the main problems of the k-Means method is how to determine the optimal number of clusters k (Gustriansyah et al. 2020). The choice of the number of clusters can also be based on the results of other analyzes. Very popular is Silhouette analysis. The Silhouette Coefficient is calculated using the mean intra-cluster distance and the mean nearest-cluster distance for each sample (Rousseeuw, 1987). Choice of the way to measure objects and distance between each other is very important to conduct proper analysis and decide which objects can be classified to each group (Murtagh, Contreras, 2012). This is a key issue to decide which distance to applied. Most popular distance used are: Euclidean distance, Manhattan distance or Euclidean to a square (Templ et al., 2008). The Euclidean distance was applied in the research. Euclidean distance is a standard metric for geometrical problems(Hu ang, 2008).

Results

To perform analysis 4 variables were taken into consideration: local government sub-sector expenditure to GDP, local government sub-sector revenue to GDP, local government sub-sector expenditure to government sub-sector expenditure, local government sub-sector revenue to government sub-sector revenue in EU countries in 2013-2019 (%). Data used to analysis is shown in Table 1. All data have been subjected to data standardization to get proper results. In order to analyze the results, a clustering analysis was performed in the R program in the package „factoextra" (Kassambara, Mundt, 2020). The K - Means method was used (Li, Wu, 2012). In order to create the distance between the studied objects, the Euclidean distance method was used (Gower, 1995). In order to determine the cut-off point of the optimal number of groups for each year, the analysis of the WSS statistics was used (Hartigan, Wong, 1979), which indicates the total variance of the scores within the designated groups. The lower the value of this statistic, the smaller the variability of the results within the groups under consideration (smaller differences between the observations within the groups) and the greater between the groups (greater differences between the groups of observations) (Makles, 2012). In all analysed years, a sharp jump in the minimization of variance within the groups was observed for 2 clusters. Those 2 clusters, which were visible include division into Nordic countries (Sweden, Finland, Denmark) and the rest of the analysed countries. This shows a very large gap between the Scandinavian countries and the rest of European countries in terms of decentralization. However, a further decrease in within-group variability was observed until the 5 groups were observed. Results are given in Table 2 and also are shown in visual form - graphs are in figures 2-8. Moreover, the results of the WSS optimization analysis are shown in the Figures 1-7 in Appendix. The results of Silhouette analysis are shown in the Figures 8-14 in Appendix.

Table 1 Local government sub-sector expenditure to GDP, local government sub-sector revenue to GDP, local government sub-sector expenditure to government sub-sector expenditure, local government sub-sector revenue to government sub-sector revenue in EU countries in 2013-2019 (%).

	Local goverment sub-sector expenditure to GDP in EU countries in 2013-2019(%)							Local goverment sub-sector revenue to GDP in EU countries in 2013-2019(%)							Local government sub-sector expenditure to goverment sub-sector expenditure in EU countries in 2013-2019 (%)							Local government sub-sector revenue to goverment sub-sector revenue in EU countries in 2013-2019 (%)						
Country	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Belgium	7,50	7,30	7,00	6,90	6,90	7,10	6,90	7,30	7,20	7,10	7,10	7,10	6,90	6,90	15,35	15,06	14,93	14,91	15,34	15,65	15,40	15,92	15,78	16,05	16,28	16,13	15,63	16,07
Bulgaria	7,90	8,90	10,40	6,90	7,10	7,30	7,40	8,30	8,90	9,40	6,90	7,30	7,50	7,30	26,48	25,98	34,54	24,46	25,29	25,05	25,70	28,60	30,69	32,06	24,72	25,30	23,97	23,39
Czechia	11,40	11,60	11,40	10,30	10,70	11,70	11,80	11,70	11,80	11,90	11,30	11,50	12,20	12,50	36,48	37,45	37,19	34,99	37,94	40,71	40,13	39,41	41,00	40,63	38,93	39,89	41,54	42,77
Denmark	35,50	35,30	34,80	34,10	33,50	33,10	32,60	35,80	35,50	35,00	34,50	33,70	33,10	32,80	175,32	177,35	176,30	186,07	196,84	189,88	195,46	190,01	170,02	192,52	192,75	181,12	182,50	161,88
Germany	7,90	7,90	7,90	8,00	7,90	8,10	8,20	7,80	7,70	8,00	8,20	8,20	8,40	8,40	21,27	21,62	21,65	22,06	21,69	22,17	22,32	20,95	20,84	21,49	22,02	22,05	22,32	21,91
Estonia	9,90	9,10	9,20	9,00	9,50	9,50	9,90	9,30	9,00	9,50	9,20	9,30	9,70	9,80	34,81	31,83	30,69	30,07	32,05	31,84	34,08	32,11	31,01	31,62	31,02	31,72	33,48	33,56
Ireland	3,40	2,90	2,40	2,40	2,40	2,60	2,70	3,60	3,00	2,50	2,50	2,40	2,60	2,60	9,21	8,17	8,72	9,36	9,94	11,11	12,33	11,66	9,54	10,07	9,94	10,21	11,13	11,37
Greece	3,60	3,40	3,40	3,50	3,50	3,70	3,40	4,00	3,60	3,70	3,90	3,90	4,00	3,40	6,04	7,08	6,82	7,67	7,84	8,22	7,66	8,79	8,40	8,36	8,32	8,59	8,92	7,49
Spain	6,00	6,10	6,10	5,80	5,90	5,80	6,00	6,50	6,60	6,50	6,40	6,50	6,40	6,30	14,92	15,60	16,01	15,90	16,65	16,33	16,61	20,16	20,30	20,13	20,35	20,41	19,48	19,13
France	11,90	11,80	11,40	11,10	11,10	11,00	11,20	11,50	11,60	11,40	11,30	11,10	11,10	11,10	26,36	25,93	25,10	24,46	24,35	24,60	25,30	27,73	27,67	27,27	27,00	26,26	26,26	27,01
Croatia	12,30	12,90	12,30	11,90	11,70	12,40	12,90	12,30	12,80	12,40	11,90	11,70	12,30	12,50	33,65	35,42	33,53	33,51	34,80	36,84	38,01	39,55	41,41	37,60	34,27	33,92	36,15	35,84
Italy	15,00	14,70	14,60	14,30	13,90	13,90	13,90	15,10	15,00	15,00	14,50	14,00	14,10	13,90	41,82	40,78	41,02	40,97	39,70	40,23	40,19	45,63	45,38	45,95	44,93	43,45	43,78	42,02
Cyprus	1,50	1,60	1,60	1,40	1,40	1,50	1,60	1,70	1,60	1,60	1,40	1,60	2,40	1,60	3,73	3,30	4,12	3,84	3,97	3,56	4,07	4,71	4,13	4,27	3,85	4,20	6,49	4,17
Latvia	10,80	10,70	10,00	10,10	11,00	11,30	10,90	10,30	10,40	10,20	10,30	10,70	10,70	11,50	39,55	37,97	34,77	36,97	39,56	40,45	39,34	38,79	38,66	37,93	37,82	39,28	38,30	43,49
Lithuania	8,30	7,90	7,90	7,80	7,70	8,10	8,50	8,00	8,10	8,20	8,30	7,90	8,20	8,60	30,55	29,63	29,01	29,68	30,42	31,24	32,38	32,31	30,94	30,89	31,87	30,85	31,44	32,22
Luxembourg	4,80	4,70	4,50	4,70	4,70	4,80	4,80	5,20	5,00	4,80	4,90	4,90	5,20	5,20	12,51	12,53	12,06	12,95	12,58	12,81	12,74	13,22	12,92	12,51	12,99	12,52	12,93	13,30
Hungary	7,50	7,80	7,80	6,00	6,20	6,40	6,80	10,00	9,20	7,90	6,30	6,30	6,50	6,70	17,60	18,42	18,21	14,60	15,38	16,31	17,42	26,59	23,95	19,59	16,12	16,53	17,44	18,04
Malta	0,70	0,60	0,50	0,40	0,40	0,50	0,50	0,70	0,60	0,60	0,50	0,50	0,50	0,50	1,71	1,47	1,34	1,27	1,22	1,30	1,30	1,74	1,61	1,53	1,36	1,31	1,37	1,44
Netherlands	13,80	13,50	14,00	13,60	13,20	13,10	12,90	13,40	13,30	13,80	13,70	13,20	12,90	12,70	42,03	41,82	45,75	45,37	45,32	44,88	44,26	44,40	43,70	48,04	45,65	43,11	42,03	41,01
Austria	8,50	8,50	8,50	8,40	8,40	8,40	8,40	8,40	8,50	8,50	8,30	8,30	8,40	8,40	19,57	19,37	20,06	20,13	20,52	20,72	21,04	20,35	20,56	20,49	20,67	20,70	20,65	20,58
Poland	13,30	13,60	12,90	12,90	13,40	14,30	14,30	13,10	13,30	12,90	13,20	13,50	14,00	14,10	44,98	46,65	44,97	45,76	48,03	52,33	52,24	51,14	51,66	49,12	51,56	51,32	51,03	52,34
Portugal	6,60	6,00	5,90	5,70	5,80	5,80	5,70	6,80	6,30	6,30	6,10	6,00	6,00	6,00	15,15	13,04	13,90	14,50	14,73	15,41	15,56	17,75	16,69	16,87	16,67	16,44	16,31	16,40
Romania	9,20	9,10	9,90	9,10	8,80	8,10	8,40	9,30	9,60	10,60	9,30	9,00	8,10	8,30	35,10	34,87	37,57	35,75	35,90	30,39	30,31	38,81	39,39	42,51	41,06	41,29	33,75	35,07
Slovenia	9,60	9,80	8,90	8,20	8,20	8,50	8,40	9,50	9,70	9,20	8,40	8,20	8,30	8,30	19,03	23,88	22,49	21,58	22,79	24,13	24,10	26,21	27,11	25,21	23,34	22,93	23,04	23,58
Slovakia	6,50	6,70	7,40	6,60	7,00	7,10	7,60	6,80	6,60	7,50	7,10	6,90	7,30	7,70	18,02	18,24	19,27	18,28	20,27	20,57	21,50	20,83	19,67	21,19	21,67	20,79	21,75	22,95
Finland	23,20	23,20	23,00	22,40	21,70	21,80	22,00	22,50	22,50	22,40	22,00	21,50	20,90	20,70	69,18	68,06	68,56	67,34	67,82	69,16	70,14	70,90	70,59	70,48	68,76	68,16	66,30	65,64
Sweden	24,70	24,60	24,30	25,00	24,90	25,30	25,10	24,50	24,20	23,90	24,40	24,70	24,60	24,20	91,52	94,43	96,69	100,99	102,63	103,20	103,84	95,72	96,98	93,80	92,76	95,23	94,60	94,12

Source: Own elaboration based on Eurostat data: epp.eurostat.ec.europa.eu

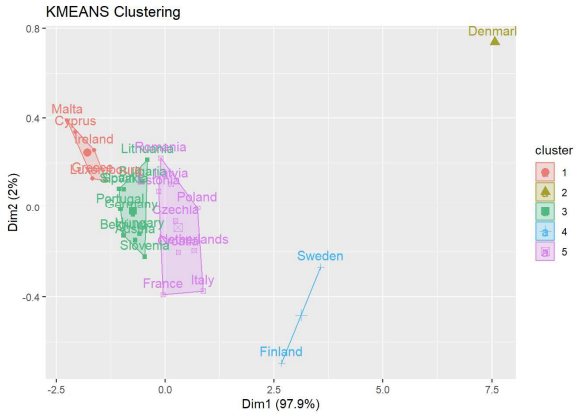

Figure 2 K-means for 2013

Source: Own elaboration in the R software on the basis of Eurostat data: epp.eurostat.ec.europa.eu.

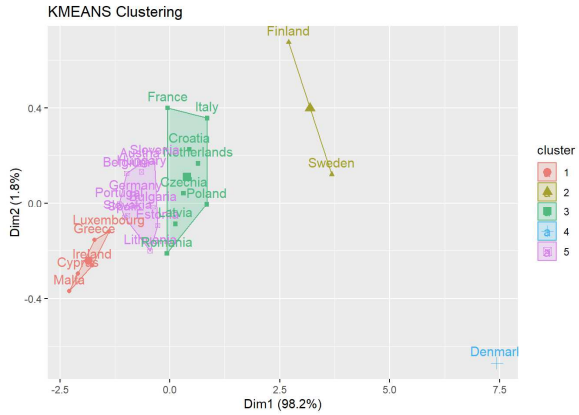

Figure 3 K-means for 2014

Source: as in Fig. 2.

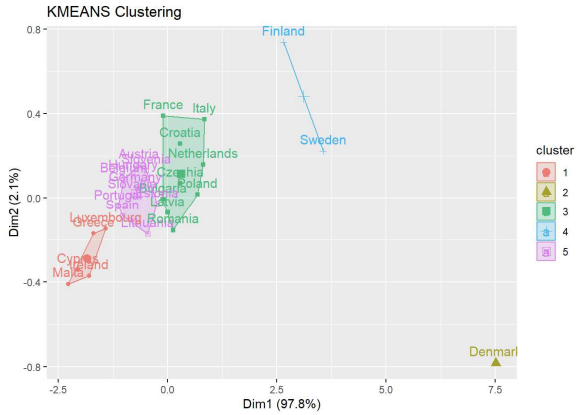

Figure 4 K-means for 2015

Source: as in Fig. 2.

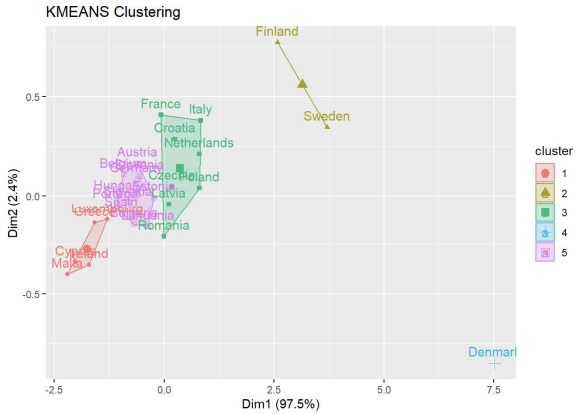

Figure 5 K-means for 2016

Source: as in Fig. 2.

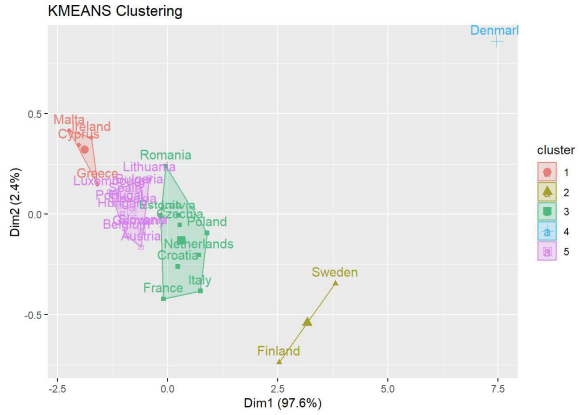

Figure 6 K-means for 2017

Source: as in Fig. 2.

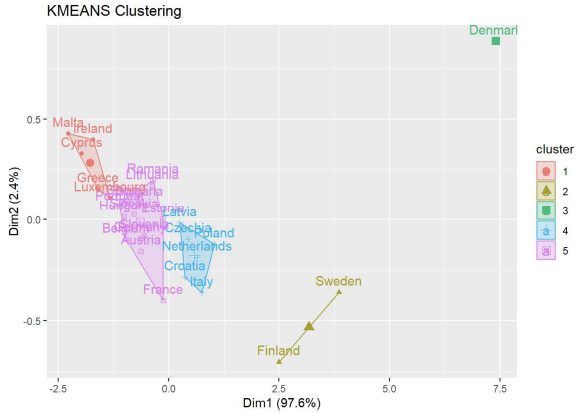

Figure 7 K-means for 2018

Source: as in Fig. 2.

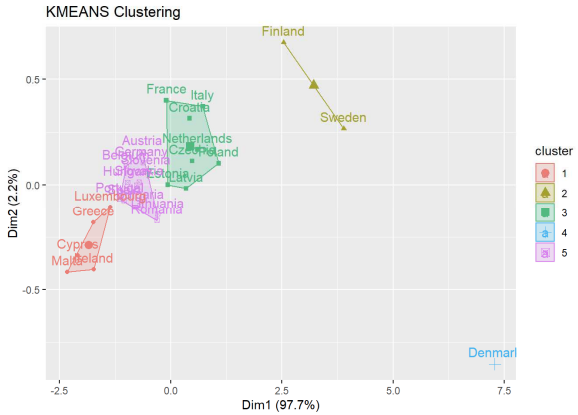

Figure 8 K-means for 2019

Source: as in Fig. 2.

Table 2 Clusters for years 2013-2019

Year	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
2013	Cyprus, Malta, Luxemburg, Ireland, Greece	Belgium, Bulgaria, Germany, Spain, Lithuania, Hungary, Austria, Portugal, Slovenia, Slovakia	Czechia, Estonia, France, Croatia, Italy, Latvia, Netherlands, Poland, Romania	Finland, Sweden	Denmark
2014	Cyprus, Malta, Luxemburg, Ireland, Greece	Belgium, Bulgaria, Germany, Estonia, Spain, Lithuania, Hungary, Austria, Portugal, Slovenia, Slovakia	Czechia, France, Croatia, Italy, Latvia, Netherlands, Poland, Romania	Finland, Sweden	Denmark
2015	Cyprus, Malta, Luxemburg, Ireland, Greece	Belgium, Germany, Estonia, Spain, Lithuania, Hungary, Austria, Portugal, Slovenia, Slovakia	Bulgaria, Czechia, France, Croatia, Italy, Latvia, Netherlands, Poland, Romania	Finland, Sweden	Denmark
2016	Cyprus, Malta, Luxemburg, Ireland, Greece	Belgium, Bulgaria, Germany, Estonia, Spain, Lithuania, Hungary, Austria, Portugal, Slovenia, Slovakia	Czechia, France, Croatia, Italy, Latvia, Netherlands, Poland, Romania	Finland, Sweden	Denmark
2017	Cyprus, Malta, Ireland, Greece	Belgium, Bulgaria, Germany, Spain, Lithuania, Luxembourg, Hungary, Austria, Portugal, Slovenia, Slovakia	Czechia, Estonia, France, Croatia, Italy, Latvia, Netherlands, Poland, Romania	Finland, Sweden	Denmark
2018	Cyprus, Malta, Luxemburg, Ireland, Greece	Belgium, Bulgaria, Germany, Spain, Estonia, France, Lithuania, Hungary, Austria, Portugal, Romania, Slovenia, Slovakia	Czechia, Croatia, Italy, Latvia, Netherlands, Poland	Finland, Sweden	Denmark
2019	Cyprus, Malta, Luxemburg, Ireland, Greece	Belgium, Bulgaria, Germany, Spain, Lithuania, Hungary, Austria, Portugal, Romania, Slovenia, Slovakia	Czechia, Estonia, France, Croatia, Italy, Latvia, Netherlands, Poland	Finland, Sweden	Denmark

Source: Own elaboration in the R software on the basis of Eurostat data: epp.eurostat.ec.europa.eu.

Discussion and Conclusions

As a result of the analyzes discussed above, 5 clusters were created. It can be easily noticeable that Denmark in years 2013-2019 is the only country, which has separate cluster – no 5. It means that it is the most decentralized country to compare to the others and also, it has been noticed that other countries have far distance to Denmark. Also, cluster 4, which group Sweden and Finland, is being separated in each year from 2013 till 2019. Those two countries have similar position in case of decentralization and are in the closest position to Denmark. It can be concluded that the Nordic countries are the most decentralized (Iceland and Norway

were not included in the analyzes as they are non-EU countries, but it can be assumed that the level of decentralization would be similar). The results are in line with earlier studies, according to which countries with a very high level of decentralisation, e.g. Finland, are characterised by a high degree of autonomy of local governments and a broad spectrum of their own resources (Sekuła, Śmiechowicz, 2016, p. 731).

Smaller countries such as Cyprus, Malta, Luxembourg, Ireland, Greece form the cluster 1 with the minor exception in 2017, when Luxemburg turned out to be more decentralized and moved to a different group. Countries where the level of decentralisation is the lowest can be described as centralised ones. Their characteristic feature is a relatively small area and small population. Therefore, it seems that central distribution of public funds does not slow down management of a country to a significant extent.

Second cluster, the largest one (on average, it is made up of 11 states), consists of countries such as Bulgaria, Lithuania, Hungary, Portugal, Slovenia, Slovakia. Most of these countries are medium-sized Central and Eastern European counties that joined the EU in 2004. It also includes all federal member states of the EU, i.e. Austria, Belgium and Germany and Spain, which is not a federal state, but finances of Spanish autonomous regions are separated from those of its local governments.

Another group (cluster 3) consists of countries such as Czechia, France, Croatia, Italy, Latvia, Netherlands, Poland and Romania. This group is quite heterogeneous, but some of the countries that are included in it (France, Italy, Poland) are relatively numerous EU countries. Obviously, there are small changes between groups from year to year. However, most often these countries show similarities in the k-means analysis.

Most of the obtained results are in line with those obtained by Halásková (2015), especially in the countries where the level of decentralisation is the lowest (Malta, Cyprus, Ireland, Greece, Luxemburg) or the highest (Finland, Sweden, Denmark). The difference between the previously obtained results concerns the number of clusters. Both in the research by Halásková (2015) and Maličká & Martinková (2018) 3 groups were distinguished, although the second article included a comment stating that in the first cluster there were 3 countries (Malta, Greece and Cyprus) forming an isolated sub-cluster.

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