Employment structure in the Baltic Sea Region EU members as a factor of economic growth

Dr Monika Rozkrut, Dr Dominik Rozkrut
School of Economics and Management
University of Szczecin

Abstract

This research paper tries to make a contribution by presenting the application of data analysis and classification methods that allow for better appraisal of socio-economic cohesion of the Baltic Sea regions. The picture of regional space is analyzed based on the employment structure in the NUTS 2 regions of European Union from the Baltic Sea Region. The analyzed structures are described by the number of employed in four economy sectors in each region. Relations between Gross National Product and employment structure are also analyzed. Some comparisons with other European region are also presented. Results of the study generally show that the employment structure is asignificant diversifying factor in the European Union countries of the Baltic Sea Region. Different methods are used to obtain classifications, which are presented and discussed in the paper. Our approach effectively recovers the classes. We recommend the use of the applied methods as a base for framing, monitoring and appraisal of European regional policies, also in the Baltic Sea Region. This is of special meaning for cohesive development of regions, because the Baltic Sea Region is very important for the European Union, being one of the most extensively integrated regions in Europe, with dynamic states, with very high growth rates compared to the rest of the European Union. The ongoing policies include Interreg II B Baltic Sea Region programme, Trans-European Transport Network and Northern Dimension programme. The efficiency of these policies should be regularly analyzed, using the procedures proposed in the paper.

JEL classification numbers: J21, O15, R11

Keywords: employment structure, regional development, Baltic Sea region

1. Introduction

Within the EU, remarkable resources for regional policy initiatives are distributed and administered through the EU's structural funds and the cohesion funds. The aim of European cohesion policy is to even out differences between the regions of Europe and to create the conditions for improved growth and sustainable development. Focal themes of these policies are economic development, education, research, human resources, environment, public health, cooperation and other. Now most of the countries of Baltic Sea Region are the members of European Union. The new member states are also the main beneficiaries of the policies. Even though these states now are developing very quickly, their economic structures are still adopting to those of old members. Regional policy plays important role in European Union. A lot

of attention is put on framing regional policies. However, effective structural policy requires the use of methods allowing identification of existing disparities in development of regions, and appropriate methods of monitoring the effects of reinforcing development policies. These methods allow for efficiency monitoring.

The methods of correspondence analysis, clustering, and taxonomic measure of development are applied. The paper is organized as follows: first some brief discussion of issues related to labour market analyses is presented. Next, the economic growth and its possible relations with structure of labour force is considered. After that, potential applications of multidimensional statistical methods in the field of employment and economic development analysis are formulated and considered. Then, the application of the selected methods is demonstrated using the data for the Baltic Sea regions with a special emphasis on analysis of employment and economic growth data.

2. Employment structure

One of the most important questions in economics is what factors determine national differences in total output, or productivity. One of the possible answers might be that the distribution of employment is a significant force. Clearly, most employment in advanced economies is in services. The service sector also accounts for the largest contribution to GNP. The analysis of the major world economies reveal shift from goods production to services delivery and the demise of agricultural employment. Actually the more advanced an economy, the more its employment and production is focused on services, while agriculture and manufacturing starts playing a subordinate role. For that reason the analysis of the employment structure can be used in diagnostic function, as one of the indicators of socio-economic development. The first part of research in this paper is devoted to study the employment structure in Baltic Sea region countries, according to traditional Clark's classification based on the primary/secondary/tertiary sector distinction.

All the same, another question arises, what caused the changes leading to shift from agriculture, through industry, to service dominated economies. The answer is the key issues behind are technological innovations, which have enabled to produce more and better with fewer resources used. The source of productivity and growth lies in the generation of knowledge. This change also causes economies to become more complex, with an increasing share going not only to service sector itself but also to new occupations that require higher skills and education. Managerial, professional and technical occupations grow faster than any other positions. Thus, sticking to traditional sector division may be not sufficient when dealing with a “new economies”, and additional factors and more detailed data need to be taken into consideration. Without broadening of the research scope, it may not be possible to effectively recover underlying relations. Two reasons justify it: first, the rapid development leads to more complicated economic structures, and second, considerable differences in economic policies and institutional settings in countries, cases differences in employment structure even in similarly developed countries. For these reasons another four important variables are analysed besides simple employment shares. These are generally related to labour force potential, represented by the shares of employed in high technology manufacturing and knowledge-intensive services, human resources in science and technology and finally, very basic but crucial economic activity rates. Correlation analysis presented here reveals these “new” characteristics are significantly related to GNP per capita.

3. Methodology

Multivariate statistical methods are very useful in economic development studies. This article tries to make a contribution also by presenting the possibilities of using multivariate statistical methods for analysis of employment structure in Baltic Sea region. Among them is the method of taxonomic measure and classification methods. Classification is concerned with the identification of taxonomies. Here, the hierarchical clustering techniques are applied. Cluster analysis can be used as a classification tool or as a way of representing the structure of data through the construction of dendrogram. It is important to notice that cluster analysis is a purely empirical method of classification, with no prior assumptions about important differences within a population. The goal of the clustering method is to organize items into groups whose members are similar. This is done by the use of an algorithm with a set of rules for dividing up a proximity matrix to form groups of similar objects. Proximity measure contained in the matrix is a measure that quantifies similarity of the objects. Hierarchical clustering go forward by either merging smaller clusters into larger ones, or go backward by splitting larger clusters into smaller ones. A tree of clusters (dendrogram) is produced in which the nodes represents subsets of initial set. This initial set is itself the root of the tree. Moving along the axis towards lower values of linkage distance, we get more clusters, up to the point where all objects are separate clusters. By cutting the dendrogram at a desired level of linkage distance, a clustering of objects into disjoint groups is obtained.

The most commonly used agglomerative hierarchical techniques are complete linkage, average linkage, and Ward's minimum variance technique. Comparative studies suggest that Ward's method is one of the more effective methods for recovering underlying structure. The methods differ in the way of combining groups to form a new one. We use Ward's method to obtain clusters of similar regions. The method is usually applied with Euclidean distances used to construct the proximity matrix. Ward's algorithm works by minimizing the variance within clusters at each stage of grouping, what should result in optimum homogeneity of the final clusters. The trees form Ward's method show usually a clear solutions, however the clusters tend to have small size. When analysing the tree it is possible to trade off between the number of clusters and the compactness of clusters. Deciding when to stop determines the number of clusters. Unfortunately there is no formal statistical test, so important question arises, what value of distance measure should be used to stop merging the groups, if one wants to obtain just single grouping instead of the whole tree. Ward's method provides an index of within-group error at each stage of the grouping, hich can help in deciding the best grouping level. When the error index jumps upward significantly, it indicates that relatively disparate groups have been combined at that stage. The analysis of the error index is used in this study to decide the number of clusters.

The method of taxonomic measure allows linear ordering of objects, replacing description using many variables, by description with one synthetic measure. It is used to compare objects by rankings, and if appropriately constructed, also to compare the changes in time. The method used here is a modification of the development measure proposed in pioneering work by Hellwig (1968). The stages of the procedure may be described as follows. Firstly the set of variables is chosen, which describe different aspects of the economic development of analyzed objects. Some expertise is needed in that part, to make proper choices. The set may sometimes

be partly determined by some specific aims of the study, for example the researcher may intentionally put more stress on some aspects, by choosing particular aggregates. After that, the variables are divided into three major groups. First group consist of variables (called stimuli) of which higher values are connected with higher level of development or just the better situation. Second group is build up of variables (impediments) with opposite interpretation. Third group is composed of variables with a certain preferable values (or ranges), neither higher nor lower. Variables from the second and the third group should be transformed so to have the same property as stimulants. Many techniques are proposed in the literature, which are not discussed here. It is just worth to note that the task is quite easy in case of impediments, and a bit more complicated for the last group. After transforming all variables to stimulants, their values are standardized or normalized (these issues are also not discussed here)[1]. Next, a paragon virtual object is constructed as an object taking the best values in each variable. The distances between paragon and all other objects are calculated. The bigger the distance the worse is the valuation of analyzed object. Many distance measures are used in this stage, the choice usually depends on data characteristics. The distances themselves are very often normalized so to take values from the range [0, 1] where higher values correspond with higher level of development.

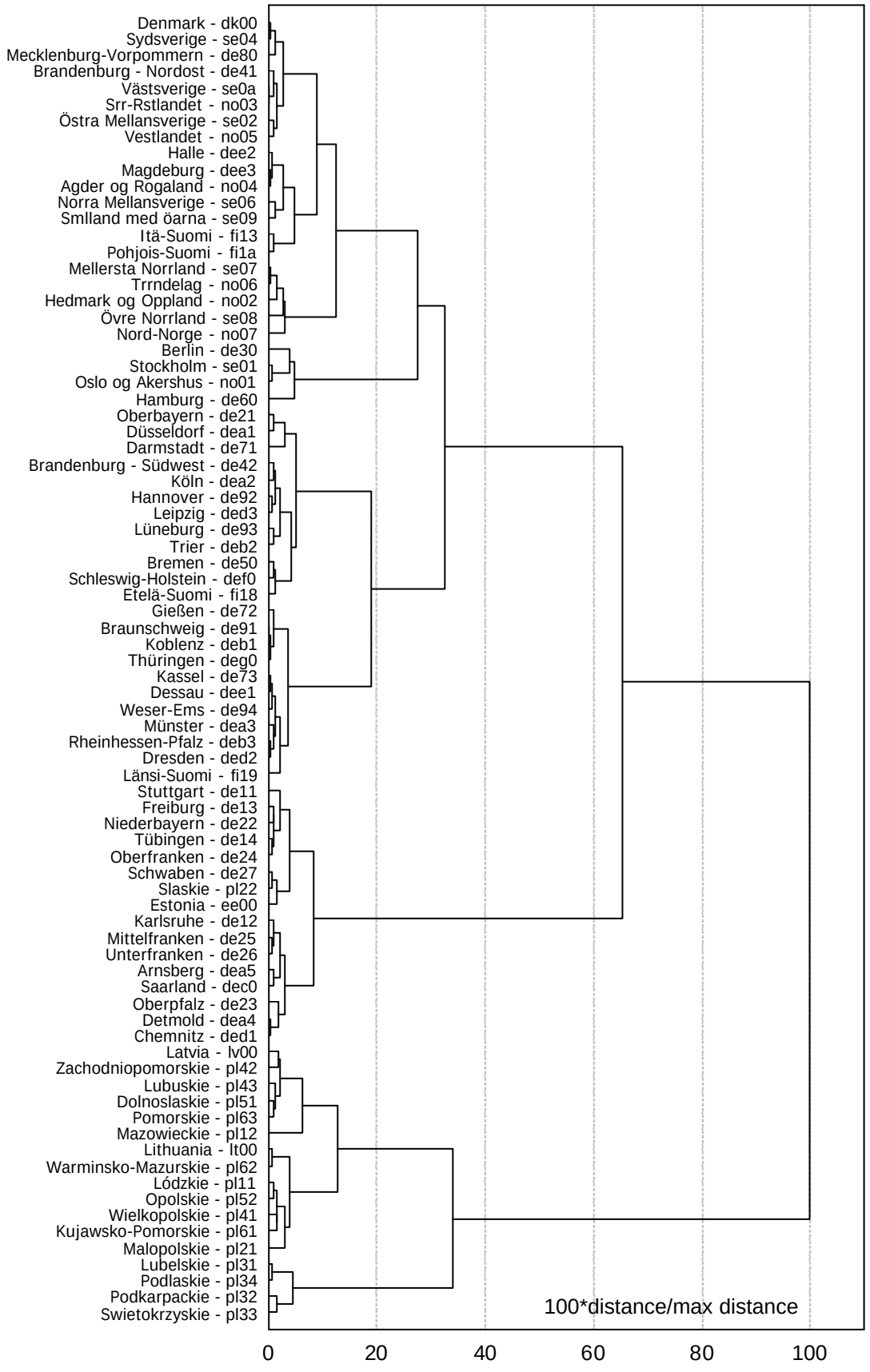
Correspondence analysis using two-way tables was also chosen as the statistical technique to analyze the data. Correspondence analysis is a technique designed to analyze two-way or multi-way tables containing some measure of 'correspondence' between the rows and columns. It can be used to depict associations between two or more categorical variables, and in some sense is similar to the extraction of principal components in factor analysis. The purpose of correspondence analysis is to reproduce the distances between the row (or column) points in a two-way table in a lower-dimensional display. If two dimensions are extracted from the analyzed dataset it is possible to plot these coordinates in a two-dimensional scatterplot, so called perception map. This map allows for interesting visual inspection of the underlying patterns . Put differently, correspondence analysis is a sophisticated technique that gives a powerful representation of association between categorical variables by giving a comprehensive view of the data (in the contingency table) for effective interpretation.

4. Empirical study

The methods described above were applied to assess the structure of employment in NUTS 2 units (according to European nomenclature of territorial units for statistics) of Baltic Sea Region countries from European Union. In case of Poland these are for example so called voivodeships. Some of the countries are singular NUTS 2 regions (Denmark, Lithuania, Latvia, Estonia). Total number of the regions in respect was 81, but due to lack of information for Finnish region *Lland*.

[1] See Pociecha J., Podolec B., Sokolowski A., Zajac K. (1988) for more discussion on taxonomic measures of development.

Figure 1. Dendrogram of BSR regions according to employment structure.



Source: own calculations.

Table 1. Basic statistics for employment structure clusters.

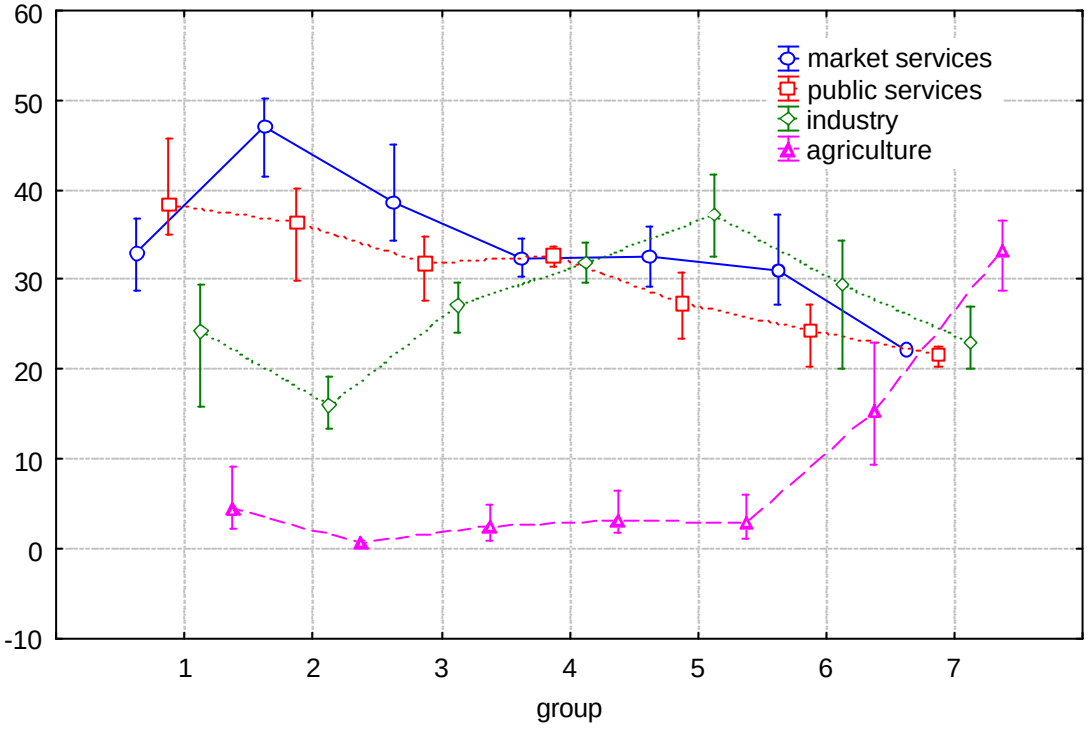
Group	Sector	N	Mean	Std.dev.	Co.of var.	Min	Max	Median
1	market services	20	32,94	2,57	7,8%	28,71	36,89	32,70
	public services		38,37	3,07	8,0%	35,04	45,73	37,45
	industry		24,23	3,35	13,8%	15,78	29,46	24,56
	agriculture		4,40	1,96	44,6%	2,29	9,17	3,75
	GDP		26912	5407	20,1%	17602	36306	27994
2	market services	4	47,06	3,92	8,3%	41,41	50,28	48,27
	public services		36,34	4,44	12,2%	29,95	40,14	37,63
	industry		15,92	2,97	18,6%	13,27	19,08	15,67
	agriculture		0,65	0,09	14,1%	0,53	0,75	0,66
	GDP		40102	11415	28,5%	23371	48900	44068
3	market services	12	38,58	2,76	7,2%	34,44	45,06	38,50
	public services		31,82	2,32	7,3%	27,56	34,71	32,24
	industry		27,10	1,91	7,1%	24,02	29,61	27,21
	agriculture		2,47	1,27	51,6%	0,89	4,90	2,48
	GDP		27763	7109	25,6%	19443	39114	26557
4	market services	11	32,37	1,35	4,2%	30,25	34,52	32,45
	public services		32,66	0,65	2,0%	31,48	33,67	32,47
	industry		31,84	1,45	4,6%	29,70	34,04	31,30
	agriculture		3,12	1,32	42,4%	1,69	6,46	2,76
	GDP		22696	2760	12,2%	17506	26025	22845
5	market services	16	32,58	2,04	6,3%	29,27	35,81	32,78
	public services		27,35	2,14	7,8%	23,33	30,69	27,35
	industry		37,22	2,72	7,3%	32,50	41,80	36,72
	agriculture		2,84	1,38	48,5%	1,04	5,88	2,46
	GDP		24464	7730	31,6%	6004	32582	26526
6	market services	13	30,94	3,45	11,1%	27,29	37,34	29,57
	public services		24,30	2,34	9,6%	20,20	27,31	24,91
	industry		29,42	3,48	11,8%	20,03	34,27	29,65
	agriculture		15,32	4,07	26,6%	9,41	22,86	15,85
	GDP		5181	967	18,7%	4147	8091	4921
7	market services	4	22,16	0,41	1,9%	21,59	22,57	22,24
	public services		21,68	0,90	4,1%	20,39	22,44	21,94
	industry		22,90	3,03	13,2%	20,12	26,87	22,31
	agriculture		33,26	3,67	11,0%	28,77	36,49	33,89
	GDP		3890	208	5,3%	3706	4135	3860

Source: own calculations.

The analysis starts with the analysis of employment structure according to traditional sector division. The dendrogram of hierarchical clustering presented on Figure 1 is based on four variables: share of employment in industry, agriculture, market and public services. The distinction between the last two seems to be reasonable, as they differ a lot, with the former being market oriented. The aim of the clustering was to group regions with similar employment structure. After inspection of an index of within-group error at each stage of the grouping, we decided to discriminate seven clusters. In table 1 basic characteristics of found groups are presented. The table also contains the statistics for gross domestic product per capita. The employment structure is also illustrated by means of Figure 2, with points representing arithmetic means and whiskers for maximum and minimum values in groups. The first and the largest group is characterized by relatively high level of employment in market services (the third level), but also by the highest observed public services share and a bit higher share of agriculture compared to other groups except the last two ones. This group consist of seven Swedish regions (Östra

Mellansverige, Sydsverige, Norra Mellansverige, Mellersta Norrland, Övre Norrland, Smlland med öarna, Västsverige), six Norwegian provinces (Hedmark og Oppland, Srr-Rstlandet, Agder og Rogaland, Vestlandet, Trrndelag, Nord-Norge), four German areas (Brandenburg–Nordost, Mecklenburg-Vorpommern, Halle, Magdeburg), two Finnish (Itä-Suomi, Pohjois-Suomi) and Denmark. The second cluster consist of only four clearly distinctive districts: Berlin, Hamburg, Stockholm and Oslo og Akershus. These are typified by the largest share of public services, relatively high level of public services (second place in a ranking). One Finnish region (Etelä-Suomi) and eleven German regions (Oberbayern, Brandenburg – Südwest, Bremen, Darmstadt, Hannover, Lüneburg, Düsseldorf, Köln, Trier, Leipzig, Schleswig-Holstein) are the in the third cluster. These show rather similar structure to the previous group, but with a bit closer values of market, public services and industry.

Figure 2. Means plot with min-max values of employment shares in selected groups.



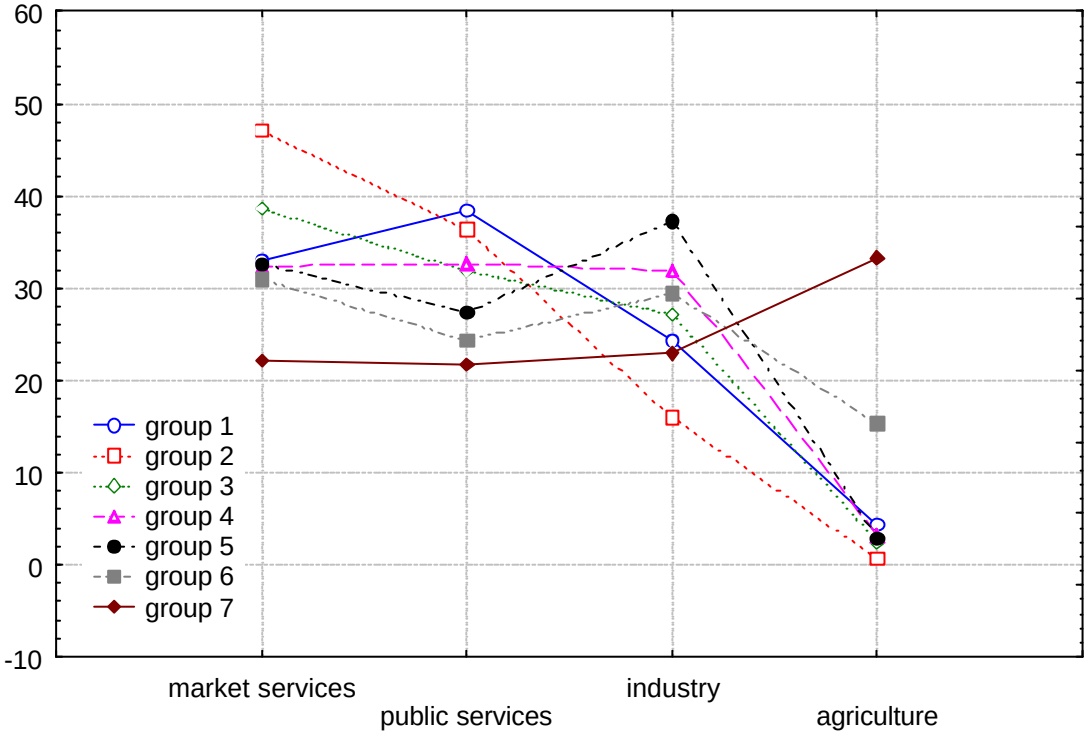
Source: own calculations.

The next group consist of eleven regions, with a very interesting feature – almost equal share of employment in market, public services and industry. The regions in the cluster are Gießen, Kassel, Braunschweig, Weser-Ems, Münster, Koblenz, Rheinhessen-Pfalz, Dresden, Dessau, Thüringen (Germany), and Finnish Länsi-Suomi. The fifth group features the highest share of industry employment observed, with market services and public services below. Estonia, Polish Slaskie voivodeships are in a group together with German Stuttgart, Karlsruhe, Freiburg, Tübingen, Niederbayern, Oberpfalz, Oberfranken, Mittelfranken, Unterfranken, Schwaben, Detmold, Arnsberg, Saarland, Chemnitz. The sixth cluster is characterised by generally lower shares of services and industry, with the last one being slightly more important than public services, and significantly larger share of agricultural employment. The group consist of Latvia, Lithuania and eleven Polish voivodeships: Lódzkie, Mazowieckie, Malopolskie, Wielkopolskie, Zachodniopomorskie, Lubuskie,

Dolnoslaskie, Opolskie, Kujawsko-Pomorskie, Warminsko-Mazurskie, Pomorskie. The last group of four Polish voivodeships (Lubelskie, Podkarpackie, Swietokrzyskie, Podlaskie). These are the only ones with employment in agriculture dominating over other sectors.

Figure 3 allows for similar inspection of interactions between variables, but is more group oriented. The difference between the seventh group and the others is clear, as the interaction line have the different slope. Also the fourth group is quite distinctive with its industrial orientation, whereas the most clearly service oriented is the second group dominated by Scandinavian regions.

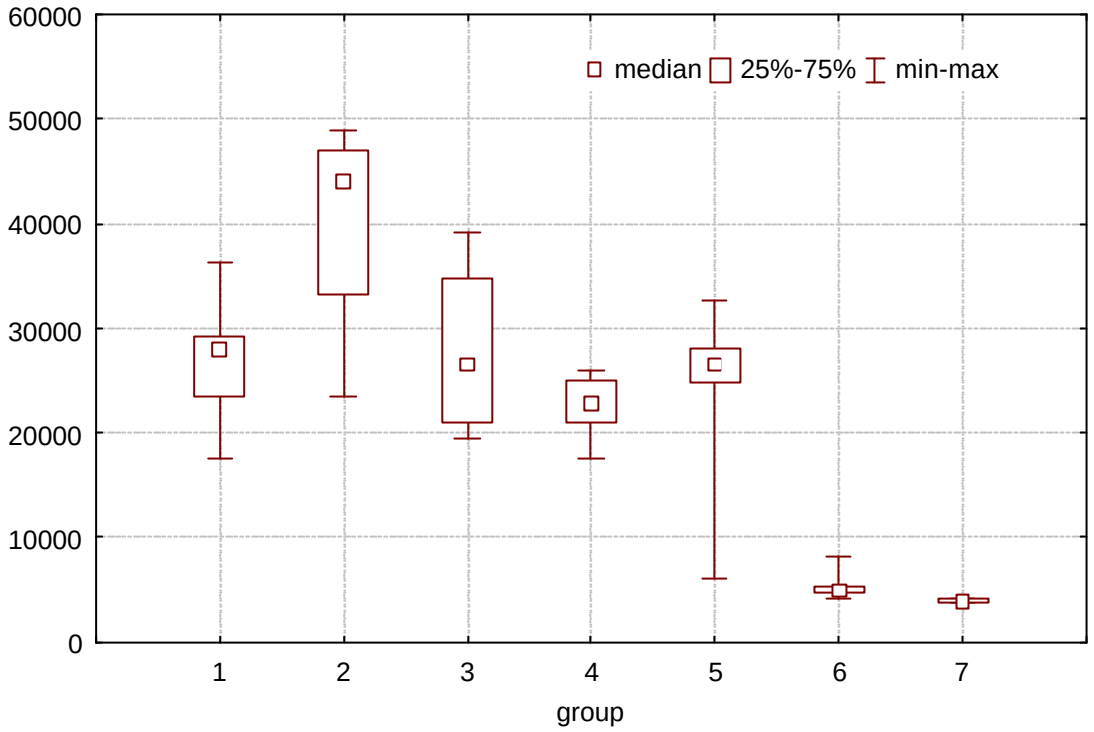
Figure 3. Means plot of employment shares in selected groups.



Source: own calculations.

Pure sector employment structure doesn't seem to be sufficient base for analysis, as also the overall number of employed and the share of economically active population provide additional information about analysed economic system. Without the additional information regarding the size of employment in the economy, similar employment structure may lead to recognize rather differently developed regions as members of the same cluster (as for example was probably the case in the first group). Thus to follow the new theories of post-industrialism, the second part of research focus on the share of economically active population and characteristics of modern employment and its resources, being with the line of Lisbon Agenda. Four variables were chosen for further analysis. These are presented in the second part of the Table 2. Economic activity rate represents general economic potential of the population. Core human resources in science and technology correspond to the potential for future development of economy. Employment in high and medium high technology manufacturing sector and employment in knowledge intensive services represent already achieved level of development of "new economy".

Figure 4. Box-and-whisker plot for regional gross domestic product in classified groups.



Source: own calculations.

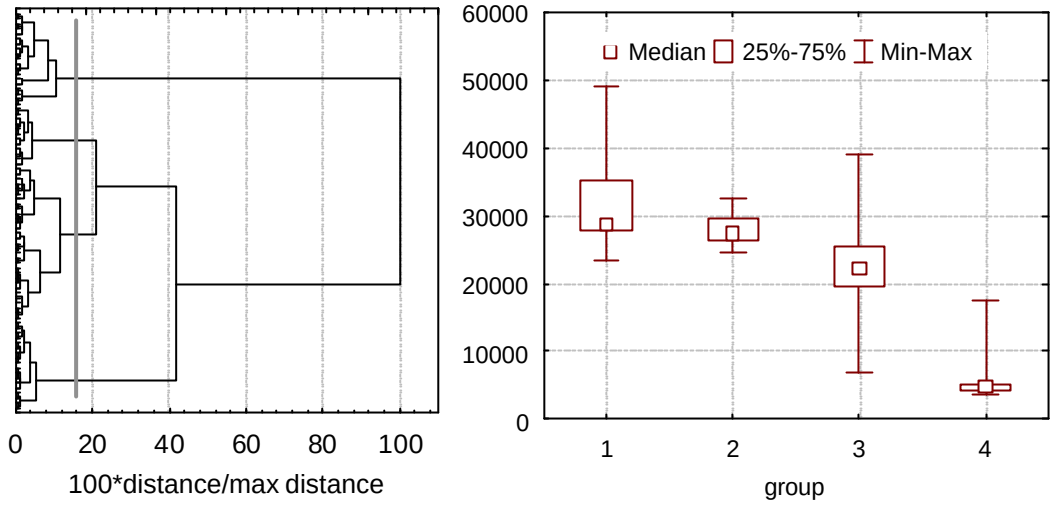
The correlations presented in Table 2, suggest even stronger influence of services, though now only knowledge-intensive services, on general output level. Another strong relation is between human resources for science and technology and output. The coefficient for economic activity rate is also significant. The lowest value is for employment in high technology manufacturing, additionally stressing the increasing role of modern services in economies.

Table 2. Correlation coefficients between Gross Domestic Product and selected employment characteristics.

Correlation coefficient	GDP
market services	0,64
public services	0,60
industry	-0,18
agriculture	-0,73
economic activity rate	0,56
human resources in science and technology - core	0,73
high and medium high technology manufacturing sector *	0,38
total knowledge-intensive services *	0,79

Source: own calculations. All coefficients are significant.
* percentage of total employment

Figure 5. Dendrogram and box-and-whisker plot of GDP for selected groups.



Source: own calculations.

Table 3. Basic statistics for labour force potential clusters.

Group	Sector	N	Mean	Std.dev.	Co.of var.	Min	Max	Median
1	X_1	19	67,97	5,254	7,7%	58,50	76,20	69,70
	X_2		14,31	2,928	20,5%	11,00	21,30	13,80
	X_3		5,65	1,970	34,9%	2,42	9,25	5,74
	X_4		45,39	3,305	7,3%	40,98	54,74	45,41
	GDP		32163	6862	21,3%	23371	48900	28727
2	X_1	12	58,48	2,414	4,1%	53,10	60,80	59,40
	X_2		9,04	1,502	16,6%	6,70	10,90	8,80
	X_3		16,08	2,613	16,3%	11,89	22,24	15,29
	X_4		29,94	2,409	8,0%	25,81	33,66	30,06
	GDP		27885	2586	9,3%	24504	32582	27328
3	X_1	31	56,37	2,579	4,6%	51,20	61,90	56,90
	X_2		9,66	1,766	18,3%	7,00	13,00	9,20
	X_3		8,08	2,579	31,9%	3,11	13,79	8,32
	X_4		33,01	3,493	10,6%	27,49	41,18	32,24
	GDP		22960	6730	29,3%	6914	39114	22279
4	X_1	18	55,011	2,033	3,7%	51,20	57,90	54,90
	X_2		6,422	0,937	14,6%	5,10	9,00	6,40
	X_3		4,698	1,887	40,2%	1,42	7,99	4,58
	X_4		23,112	2,683	11,6%	18,52	26,72	22,89
	GDP		5463	3074	56,3%	3706	17506	4803
all	X_1	80	59,14	6,02	10,2%	51,20	76,20	57,70
	X_2		9,94	3,35	33,7%	5,10	21,30	9,15
	X_3		7,94	4,34	54,7%	1,42	22,24	6,91
	X_4		33,26	8,37	25,2%	18,52	54,74	31,62
	GDP		21947	11120	50,7%	3706	48899	24759

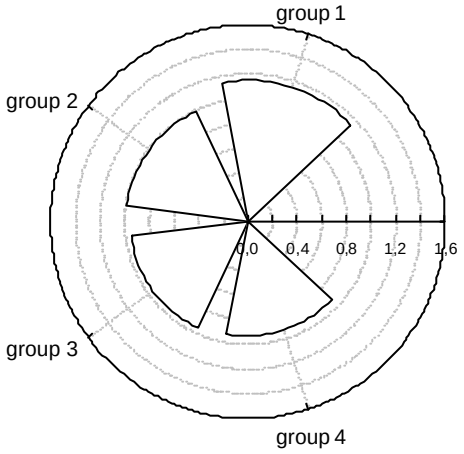
Source: own calculations.
X_1 – economic activity rates;
X_2 – human resources in science and technology – core;
X_3 – percentage of total employment in high and medium high technology manufacturing sector;
X_4 – percentage of total employment in knowledge-intensive services.

The regions were put through clustering procedure again, this time using the new four variables. The dendrogram is presented in Figure 5, with a similar cut value of linkage distance as previously, four groups were build up for further analysis. The members of the clusters are listed in Table 4. Table 3 presents main statistics for the

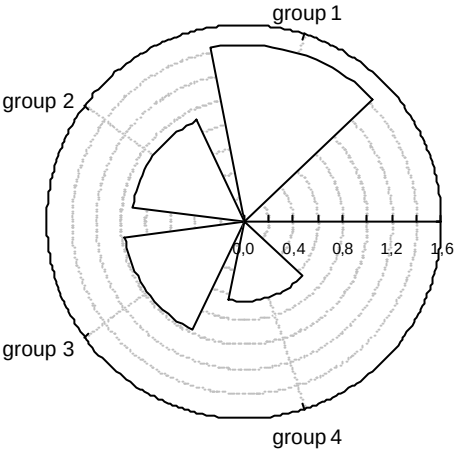
groups. The meaningful characterization of groups is illustrated by means of charts in Figure 6. These are constructed in a special way, as presenting the relation of the arithmetic averages in each of the group to the overall means. As statistics from Table 3 are considered, it is important to note that the first group is characterized by the highest mean economic activity rate, the largest mean for human resources in science and technology, and the largest mean of the share of employment in knowledge-intensive services. This coincidence must result in nothing different than the biggest average regional GDP. This group might be called as Scandinavian model of economy.

Figure 6. Charts of relations to the overall mean for selected variables.

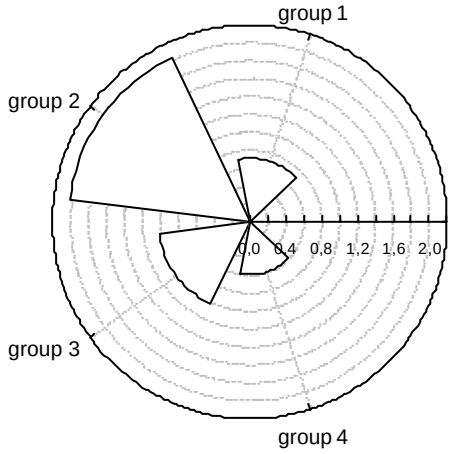
Economic activity rates



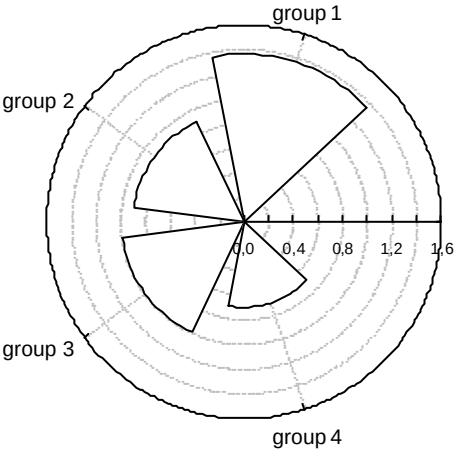
Core human resources in science and technology



Percentage of total employment in high and medium high technology manufacturing sector



Percentage of total employment in knowledge-intensive services



Source: own calculations.

Figure 6 shows clearly the way in which the first group differentiate itself from the others. The main characteristics of the second group is its relatively large percentage of total employment in high and medium high technology manufacturing sector. This group is completely German. The fourth group consist of Polish voivodeships with Lithuania and Latvia. The only new member of European Union which is in other group is Estonia. The third group consist of countries with 'balanced' values of analyzed variables compared with the 'extreme' service oriented Scandinavian model and manufacturing oriented German model.

Table 4. The classification of regions using Ward's method.

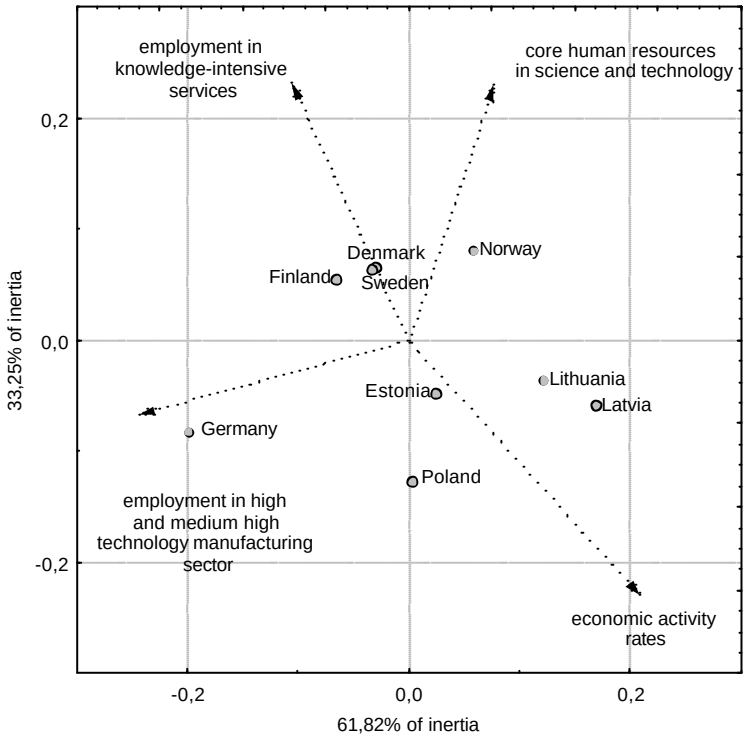
group 1	group 2	group 3	group 4
no04, Agder og Rogaland	de91, Braunschweig	dea5, Arnsberg	dee1, Dessau
de30, Berlin	de13, Freiburg	de41, Brandenburg - Nordost	pl51, Dolnoslaskie
dk00, Denmark	de12, Karlsruhe	de42, Brandenburg - Südwest	pl61, Kujawsko-Pomorskie
fi18, Etelä-Suomi	de25, Mittelfranken	de50, Bremen	lt00, Latvia
de60, Hamburg	de22, Niederbayem	ded1, Chemnitz	lv00, Lithuania
no02, Hedmark og Oppland	de24, Oberfranken	de71, Darmstadt	pl11, Lódzkie
se07, Mellersta Norrland	de23, Oberpfalz	dea4, Detmold	pl31, Lubelskie
no07, Nord-Norge	deb3, Rheinhessen-Pfalz	ded2, Dresden	pl43, Lubuskie
se06, Norra Mellansverige	de27, Schwaben	dea1, Düsseldorf	pl21, Malopolskie
no01, Oslo og Akershus	de11, Stuttgart	ee00, Estonia	pl52, Opolskie
se02, Östra Mellansverige	de14, Tübingen	de72, Gießen	pl32, Podkarpackie
se08, Övre Norrland	de26, Unterfranken	dee2, Halle	pl34, Podlaskie
se09, Smlland med öarna		de92, Hannover	pl63, Pomorskie
no03, Srr-Rstlandet		fi13, Itä-Suomi	pl22, Slaskie
se01, Stockholm		de73, Kassel	pl33, Swietokrzyskie
se04, Sydsverige		deb1, Koblenz	pl62, Warminsko-Mazurskie
no06, Trrndelag		dea2, Köln	pl41, Wielkopolskie
se0a, Västsverige		fi19, Länsi-Suomi	pl42, Zachodniopomorskie
no05, Vestlandet		ded3, Leipzig	
		de93, Lüneburg	
		dee3, Magdeburg	
		pl12, Mazowieckie	
		de80, Mecklenburg-Vorpommern	
		dea3, Münster	
		de21, Oberbayern	
		fi1a, Pohjois-Suomi	
		dec0, Saarland	
		def0, Schleswig-Holstein	
		deg0, Thüringen	
		deb2, Trier	
		de94, Weser-Ems	

Source: own calculations.

As an addition, providing interesting insight into differences between BSR countries, the correspondence analysis was applied. However it has to be stressed that the potential classification done that way relies only on visual inspection of figure, which may be considered as disadvantage. On the other hand the analysis of perception map may itself be very interesting, visualising the underlying relations between countries and factors together in two-dimensional space, i.e. not only row but also column points from the contingency table are plotted, so it is possible to group

the objects and compare them directly with point representations of variables on the figure. To make the charts more clear instead of presenting columns of contingency table as points, these are represented as directions. In that case the arrowheads may be interpreted as (nonexistent) region in which synthetic measure of labour potential is completely "concentrated" in one of the variables. The obtained preference maps for analyzed units are presented on figure 7. The chart is based on the data for 2005 in contrast with the rest of the study (data on country level are available more quickly). What may be observed are the positions of the row and column profiles of the contingency table, especially the different directions of arrows. In that space we find the countries. Scandinavian countries are characterised by the 'knowledge-intensive services' and 'human resources in science and technology' dimensions. The main characteristic of Germany is employment in technology manufacturing sector, confirming its different employment concentration. The four new members of EU constitute the group for themselves. The placement of countries partly bear a resemblance to the results from hierarchical clustering.

Figure 7. Preference map of correspondence analysis for BSR countries.



Source: own calculations.
Data for 2005.

Taxonomic measure of labour force potential for regions is based on following variables: X_1 – economic activity rates; X_2 – human resources in science and technology – core; X_3 – percentage of total employment in high and medium high technology manufacturing sector; X_4 – percentage of total employment in knowledge-intensive services. All of them are stimuli and were normalized through dividing by their maximum values, so the region with the value of one was the best one in regard to analysed variable. As an aggregation formula arithmetic mean was used to calculate the measure. This measure which takes the value of 1 for the paragon object, and the value of 0 for some nonexistent object taking the value of 0 in all variables. This is a simplified method in which our implicit distance measure from paragon object (which

is not calculated directly) is defined as the average difference (distance) in all variables between analyzed object and paragon object. Making it this way resulted in no need for additional normalization of obtained measure. The values of the measure are presented in table 5.

Table 5. Ranking of Baltic Sea regions in 2004 according to labour force potential.

No.	Code	Region	TM	No.	Code	Region	TM
1	se01	Stockholm	0,79	41	de73	Kassel	0,55
2	no01	Oslo og Akershus	0,75	42	deg0	Thüringen	0,55
3	se0a	Västsverige	0,72	43	ded1	Chemnitz	0,55
4	de11	Stuttgart	0,71	44	de41	Brandenburg - Nordost	0,54
5	no05	Vestlandet	0,69	45	dea1	Düsseldorf	0,53
6	se02	Östra Mellansverige	0,68	46	deb1	Koblenz	0,52
7	de21	Oberbayern	0,68	47	def0	Schleswig-Holstein	0,52
8	no04	Agder og Rogaland	0,68	48	de24	Oberfranken	0,52
9	fi18	Etelä-Suomi	0,67	49	de93	Lüneburg	0,52
10	no06	Trrndelag	0,67	50	dec0	Saarland	0,52
11	se04	Sydsverige	0,67	51	fi13	Itä-Suomi	0,52
12	de14	Tübingen	0,67	52	de42	Brandenburg - Südwest	0,51
13	dk00	Denmark	0,66	53	dee2	Halle	0,51
14	de12	Karlsruhe	0,66	54	dea4	Detmold	0,51
15	de71	Darmstadt	0,66	55	dea3	Münster	0,51
16	no07	Nord-Norge	0,66	56	de94	Weser-Ems	0,50
17	no03	Srr-Rstlandet	0,65	57	dee3	Magdeburg	0,50
18	se09	Smlland med öarna	0,65	58	dea5	Arnsberg	0,50
19	de13	Freiburg	0,64	59	deb2	Trier	0,49
20	de30	Berlin	0,63	60	de80	Mecklenburg-Vorpom.	0,48
21	se08	Övre Norrland	0,62	61	pl12	Mazowieckie	0,48
22	de25	Mittelfranken	0,62	62	ee00	Estonia	0,48
23	deb3	Rheinhessen-Pfalz	0,62	63	dee1	Dessau	0,47
24	se06	Norra Mellansverige	0,61	64	pl63	Pomorskie	0,45
25	de91	Braunschweig	0,60	65	pl51	Dolnoslaskie	0,44
26	de27	Schwaben	0,60	66	lt00	Lithuania	0,44
27	fi19	Länsi-Suomi	0,59	67	pl61	Kujawsko-Pomorskie	0,44
28	se07	Mellersta Norrland	0,59	68	pl42	Zachodniopomorskie	0,43
29	no02	Hedmark og Oppland	0,59	69	pl22	Slaskie	0,43
30	de26	Unterfranken	0,59	70	pl52	Opolskie	0,42
31	de60	Hamburg	0,59	71	pl41	Wielkopolskie	0,42
32	de23	Oberpfalz	0,59	72	pl21	Malopolskie	0,42
33	ded2	Dresden	0,59	73	pl43	Lubuskie	0,40
34	fi1a	Pohjois-Suomi	0,58	74	lv00	Latvia	0,40
35	dea2	Köln	0,58	75	pl11	Lódzkie	0,40
36	ded3	Leipzig	0,57	76	pl31	Lubelskie	0,39
37	de22	Niederbayern	0,57	77	pl32	Podkarpackie	0,38
38	de72	Gießen	0,57	78	pl34	Podlaskie	0,38
39	de92	Hannover	0,56	79	pl62	Warminsko-Mazurskie	0,38
40	de50	Bremen	0,55	80	pl33	Swietokrzyskie	0,36

Source: own calculations.

The results provide a strong support for previous conclusions. The new members of European Union (Estonia, Latvia, Lithuania and Poland) have a long road ahead of them, with the lowest values of the synthetic measure. The highest positions on the list of 80 regions occupy Mazowieckie together with Estonia (61 and 62). Eight out of the first ten positions are taken by Scandinavian regions, with Stockholm on the top of the list.

5. Conclusion

Results of the study generally show that the employment structure is a significant diversifying factor in the European Union countries of the Baltic Sea Region. It is also a very important indicator of the economic or development potential. As study suggests, significant relations seem to exist between the employment structure and gross domestic product, both when the traditional sector classification is analyzed, as well as the technology and knowledge-intensive employment are taken into consideration. The analysis of correlations with total output reveals stronger relations with knowledge intensive employment. This is a strong argument supporting the slow shift in the economic system from the simple post-industrial "service economy" to more advanced knowledge-based or information economy. Indeed knowledge and information became major source of productivity and growth in developed economies.

Our approach effectively recovers the classes of regions. We find four general classes of economies: first might be called Scandinavian, as most regions from Norway, Sweden Finland and Denmark itself belong to this group. This group is more service oriented. Next, so called German group, which consist of selected regions form Germany only. This group achieved significant level of high technology manufacturing. The third class of regions with more balanced importance of analyzed factors, and forth class of regions from new members of European Union (Poland, Lithuania, Latvia). Only Estonia and Polish Mazowieckie Voivodeship slipped to the third group.

The important driving force, leading to sharp differences in employment structure, but also labour force potential is the economic policy environment as determined by business taxes, employment security laws, promotion of self-employment, the pension system, wage-setting institutions and others. Also the distribution of size of the firms is important. These factors differ greatly across countries. We recommend the use of the applied methods as a base for framing, monitoring and appraisal of European regional policies, also in the Baltic Sea Region. This is of special meaning for cohesive development of regions, because the Baltic Sea Region is very important for the European Union, being one of the most extensively integrated regions in Europe, with dynamic states, with very high growth rates compared to the rest of the European Union. The ongoing policies include Interreg II B Baltic Sea Region programme, Trans-European Transport Network and Northern Dimension programme. The efficiency of these policies should be regularly analyzed, using the procedures proposed in the paper.

References:

Gershuny, J. I.; Miles, I. D. (1983). *The new service economy: The transformation of employment in industrial societies.* London, Pinter.

Grabinski T., Wydymus S., Zelias A. (1989). *Methods of Numerical Taxonomy in Socio-Economic Modeling*. Warszawa: PWN, (in Polish).

Greenacre M. J. (1984). *Theory and applications of correspondence analysis.* New York: Academic Press.

Greenacre M. J., Hastie T. (1987). *The geometric interpretation of correspondence analysis.* Journal of the American Statistical Association 82: 437-447

Hartigan J. A. (1975). *Clustering Algorithms.* Wiley, New York

Hellwig Z. (1968). *Application of the taxonomic method for classification of countries with regard to their level of development and the structure of qualified personnel*. Przeglad Statystyczny 4, (in Polish)
Jajuga K., Walesiak M., Bak A. (2002). *On the General Distance Measure*. In: Schwaiger M.,Optiz O. (eds). *Exploratory Data Analysis in Empirical Research*. Berlin, Heidelberg: Springer-Verlag.
Pociecha J., Podolec B., Sokolowski A., Zajac K. (1988). *Taxonomic Methods in Socio-Economic Research*. Warszawa: PWN, (in Polish).
Ward J.H. (1963). *Hierarchical groupings to optimize an objective function*. Journal of the American Statistical Association 58: 234-244.
Zelias A. (ed) (2004). *Level of living in Poland and European Union*. Warszawa: PWN, (in Polish).