A C T A U N I V E R S I T A T I S L O D Z I E N S I S
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A MULTI-DIMENSIONAL ANALYSIS OF LOCAL PUBLIC SERVICE COSTS IN CENTRAL EUROPE

1. INTRODUCTION

The research over local public service costs is of particular interest to economists dealing with public management issues as well as for policy makers and service operators responsible for setting up strategic frameworks and day-to-day operations. Spatial analysis is useful for identifying the linkages between cost levels and factors of an economic and social nature across territories.

The regions of Central Europe differ in terms of processes related to economic growth and demography. The areas that are seriously challenged by depopulation, aging and economic decline face an urgent need for the adaptation of local public service policies. Multi-dimensional analysis is a key to offer a much-requested evidence base to decision makers. Therefore, this paper aims at presenting the method, research procedure and exemplary results of the scrutinised set up in order to propose a comparable approach to local public service cost analysis across Central Europe.

The reported procedure depicted bottlenecks that make this kind of comparative studies difficult, especially when it comes to data availability and comparability on local level. For this reason, the tailor-made method was proposed, based on calculation of so-called Proxy Cost Ratio (*PCR*).

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The *PCR*s were further analysed jointly with demographic and economic parameters to find correlations and cluster similar regions.

This paper shows a dedicated research track and creates space for alternative applications of the other methods that can be used in follow-up studies.

2. THE STUDY APPROACH AND DATA COLLECTION

This research paper shares selected results of the ADAPT2DC project (New innovative solutions to adapt governance and management of public infrastructures to demographic change).[1] The main objective of the project was to develop transferable strategies for the provision of innovative solutions to restructure the management of services and infrastructure in shrinking regions and cities. These kinds of challenges are becoming more and more relevant in Central Europe, transforming its regional and local economies. This holds especially true since changes on labour markets, higher mobility of households and the general evolution of social behaviour mean that some places are affected by the challenges of depopulation and aging. The consequences of demographic change and increasing scarcity of public resources thus require a review and adjustment of the management and standards of public services and infrastructure.

One of the first steps was to better understand the relations between shrinkage and local public services costs. Known studies do not necessarily provide a clear answer to the question of how demographic changes influence the costs of provisioning local public services. While some research indicates that low-density developments lead to greater provision costs in most public sector services (Moss 2008; Solé-Ollé, Hortas Rico 2008), others show that there is no significant public cost disadvantage for low populated regions (Büttner, Schwager, Stegarescu 2004). We must take into consideration that local public service and infrastructure costs are related to a set of different factors. It is not only the spatial patterns (urban, rural), environmental issues (for example mountainous regions), but generally costs are linked to the type of service, the volumes consumed and the standards delivered. Therefore,

[1] ADAPT2DC was co-funded by the European Commission within Central Europe (grant agreement 3sCE414P4). The paper reflects the author's views and the Central Europe programme Managing Authority and the programme bodies are not liable for any use that may be made of the information contained therein. The paper contains large excerpts of ADAPT2DC reports. Further information can be found in the project monograph by Baron, Ochojski, Polko (2014).

one needs to consider numerous factors that must be identified for such a study. To start with, these include the national legislative framework, the size of the market, the local contexts of territorial development and practices of service management and finally, last but not least, policy targets.

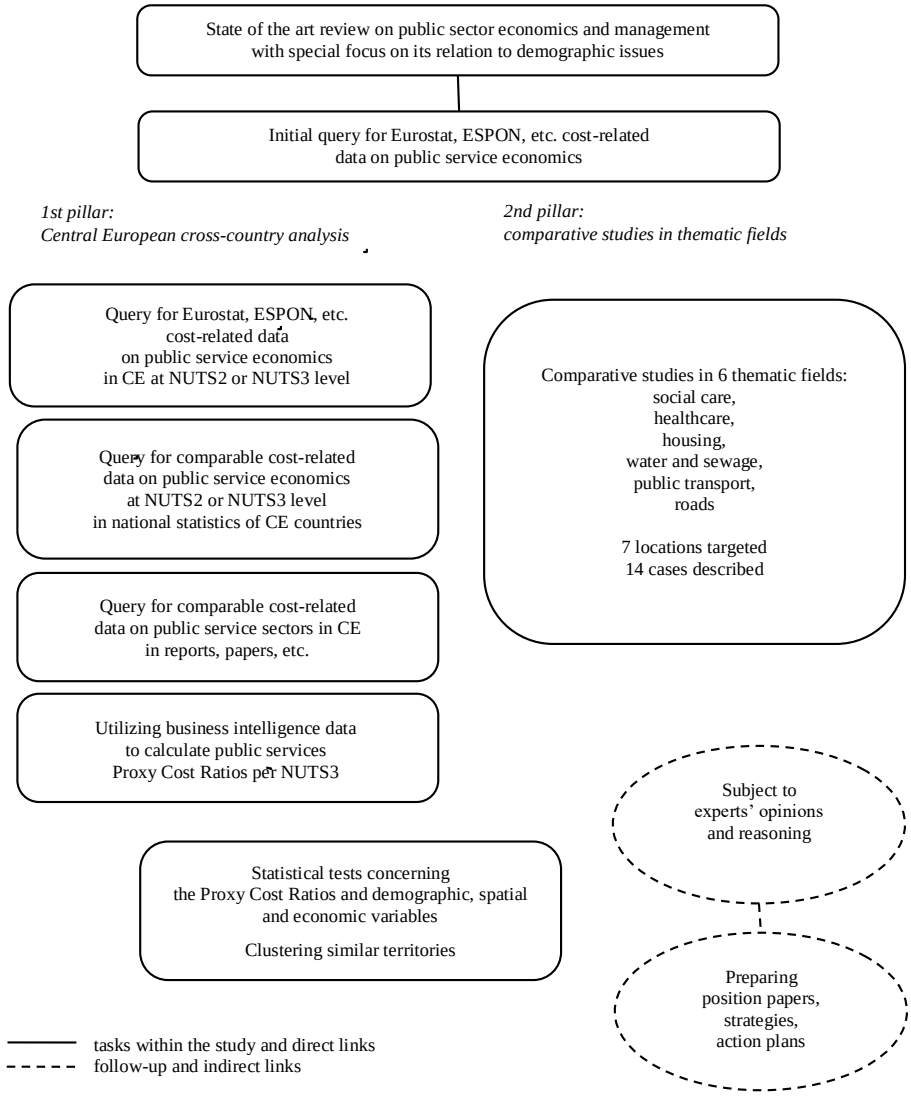

Figure 1. Analysing local public service costs in Central Europe: the approach

Source: Baron, Ochojski, Polko (2014: 47).

The multi-dimensional perspective is set upon quantitative and qualitative costs analysis that we believe should be used in order to better identify the contexts and recognise the in-depth conditions for generating costs to users,

and fixed and current costs carried out by service providers (Figure 1). In this paper we focus on the 1st pillar: Central European cross-country costs analysis.

The results of the primary query showed that, within the thematic scope of the research, data availability on the level of NUTS-3 was limited to regional macroeconomic and demographic statistics. The availability of most of the data on service provision is either related to the technical parameters and unfortunately represents NUTS-0 to NUTS-2 levels or is just a cumulative aggregation provided at the national level that allows observations of general expenditure categories.

A consecutive study at the national level proved that the availability of NUTS-3 level data in national statistical offices, as well as in ministerial and regional repositories, brings different levels of detail and basically uses a variety of definitions to identify the economic and technical aspects of infrastructure and service provision. It can be clearly seen that the timeframes of the available data were not always equal and national methodologies of gathering and aggregating some data might differ even though the dataset names matched.

As a consequence, there is incomplete background data for NUTS-3 regions that could become basic for a database covering all Central Europe countries. Even the simplest approach of comparing general local government expenditures on certain services was impossible. This was due to different delivery systems (especially organising and financing services at different levels), as well as due to unavailability of data in some countries.

Bearing in mind all of the above-mentioned problems and pitfalls, an alternative method has to be suggested based upon access to commercial business intelligence databases. The use of corporate financial statements plus horizontal information on mechanisms and factors shaping the microeconomics of local public service delivery across Central Europe has been targeted with BI data.[2] The primary NACE code was used to filter the Amadeus records and obtain raw data on corporate performance in ADAPT2DC's areas of interest. Even though the records could not be used in a full scope,[3] the database offered data to calculate a proxy that exemplifies the general ADAPT2DC idea of comparable approach to cost levels in service delivery. Even though it is possible to build upon several parameters related to revenues and profits, as well as upon commonly used ratios,[4] two parameters have been selected

[2] This approach is very much alike to the problem and solution described by the OECD study (see: Ribeiro, Menghinello, Backer 2010: 6). The database digests information collected at national official public bodies in charge of recording the annual accounts in a given country. The business activity NACE classification has been used for the purpose of the study.

[3] For reasons and dataset selection criteria, see: Baron, Ochojski, Polko (2014).

[4] E.g.: *EBIT* (earnings before interests and taxes) margin, *ROE* (return on equity), *ROA* (return on assets).

for further investigation. These are sales and costs of goods sold. Both of them are simple, clear and comparable proxies of demand-side costs (costs for public service beneficiaries paid either by the beneficiary or via public budgets) or supply-side costs (costs that service operators need to cover in direct linkage to service delivery). Unfortunately, the aspect of the costs of goods sold is not sufficiently represented through corporate reporting and in all targeted countries. Therefore, the sales value in defined NACE classes serves as a key proxy of costs in further analyses. The method proposed for data aggregation was based upon the average sales referred to population. NUTS-3 was the territorial level of analyses. The Proxy Cost Ratio applied in the study was calculated as follows:

$$PCR = \frac{\sum_{i=1}^{n} \bar{S}}{\bar{P}}, \tag{1}$$

where: *PCR* – is a Proxy Cost Ratio in NUTS [EUR/person]; *n* – is a number of business entity records in relevant NACE class registered in NUTS; $\bar{S}$ – is an average annual sales value of a business entity in 2007–2011 [EUR]; $\bar{P}$ – is an average annual population in NUTS in 2007–2011 [persons].

The subsequent methodological steps were undertaken in order to calculate the *PCR* out of the existing Amadeus data sets:

1) preparing the database by dividing it into thematic fields (i.e.: records filtering and extraction, records review, removing records containing missing data or removing misleading groups of records);
2) inflation adjustment for annual sales values (all values were converted into 2007 prices);
3) calculation of sales averages per business entity (done in order to minimise the risk of utilising the unspecific observation of one year, the period of 2007–2011 was used as it allowed the widest possible coverage according to the data provided by Amadeus);
4) aggregation on the ZIP code level (to obtain average sales values per ZIP areas);
5) ZIP code based sales values reclassified towards the NUTS-3 level (to obtain average sales values per NUTS-3 areas);
6) linking the NUTS-3 sales database to the population database, including average population (the period of 2007-2011 was used in accordance with data provided by Amadeus);
7) calculating the *PCR*s and integrity cross-check; and
8) applying Eurostat's Price Level Index to the *PCR*s (to enable better reasoning upon the results of the cross-analyses of local public service costs in Central Europe, the *PCR_PLI* ratios were calculated to allow cross-country

comparisons). The *PCR_PLI* is a *PCR* re-calculated with accordance to Eurostat's Price Level Index (*PLI*).

The *PLI* is a part of estimations of purchasing power parity that show how many currency units a given quantity of goods and services costs in different countries. Thus, the effect of price level differences across countries is eliminated in comparative studies.

Two types of investigations were run. First of all, Spearman's rank correlation coefficient was applied to test the dependence between *PCR*s and the other variables. It was selected as an alternative to Pearson's correlation coefficient as it allows a better description of the relationship between two variables in a situation of many anomalies (outlying observations). The variables used for testing are presented in Table 1.

Table 1. Variables used for *r*-Spearman correlation tests with *PCR*s / *PCR_PLI*s

Abbreviation	Name	Nature
POPCH_11_91	Long term population change (2011/1991)	Presents the demographic performance of a territory. Population in 2011 divided by population in 1991.
POPCH_10_00	Population change (2010/2000)	Presents the demographic performance of a territory. Population in 2010 divided by population in 2000.
AVCBD_10_00	Average rate of natural increase (2000-2010)	Presents the demographic performance of a territory. Average of crude birth rate minus the crude death rate of a population.
OADR_08	Elderly to active population ratio (2008)	Presents the demographic performance of a territory. Population aged 64 or over divided by population in working age (15–64 years).
DENS_08	Population density (2008)	Presents the spatial characteristic of a territory. Total population in a territory divided by its area.
GDP_08	GDP per capita in PPS (2008)	Presents the economic performance of a territory.

Source: Baron, Ochojski, Polko (2014: 57).

Secondly, to enable a better future transfer of solutions and best practices among Central European regions, taxonomy has been based upon the commonly

used Ward's method and *k*-means algorithm. Having assumed that these kinds of processes work best if applied to territories that share resembling characteristics, the identification of clusters of similar territories vis-à-vis the tested variables was applied.

3. ANALYSIS OF LOCAL PUBLIC SERVICE COSTS ACROSS CENTRAL EUROPE

The analysis was based upon the calculation of proxy cost ratios (*PCR*s) for:

- social services and infrastructure (social care, healthcare and public housing); and
- network services and infrastructure (public transportation, roads, water and sewage).

A map for water and sewage (Figure 2) is shown to illustrate the results of analysis. Further summaries of the outcomes obtained in the other sections following.[5]

For healthcare the greatest spatial disparities in terms of *PCR_PLI* were recorded in Germany, while Italy, Slovenia and Hungary were countries with the smallest differences. However, it is worth mentioning that Germany has the most fragmented NUTS-3 territorial structure. *PCR_PLI* for healthcare showed some regularity. The highest values in most countries were usually in large urban areas (Bratislava, Kosice, Graz, Budapest, Kraków and Poznań), which may be a result of specialised care offered to patients from outside the area. The maximum value of the ratio was reported in Rhön-Grabfeld, Bavaria, where several spa-towns are located are located. Bad Neustadt is where the headquarters of Rhön Klinikum AG, the leading private hospital group in Germany, are located.

PCR_PLI, due to incomplete data, could only be computed for most regions in Poland and some parts of Germany. In the case of Poland, the average value is approximately 16 EUR per inhabitant. The values of the ratio are higher (about 40–80 EUR per inhabitant) only in some large urban areas such as Gdańsk, Warsaw, Katowice, Wrocław, Szczecin. In Germany, *PCR_PLI* is more spatially diverse. The highest values are in Frankfurt am Main and Frankenthal (Pfalz). It is probably caused by location of large firms, which supply houses and housing facilities.

[5] Complete results for Central Europe as well as for individual countries, including maps can be found in: Baron, Ochojski, Polko (2014).

The most diverse level of *PCR_PLI* ratio in social care services can be observed in Germany. In case of Austria, Hungary and Italy, the ratios are in the first numerical interval (between approximately 1 EUR and 200 EUR per inhabitant). However, when analysing the average values for countries we can see the differences between Austria and Italy, where the average value is much higher than for example in Hungary.

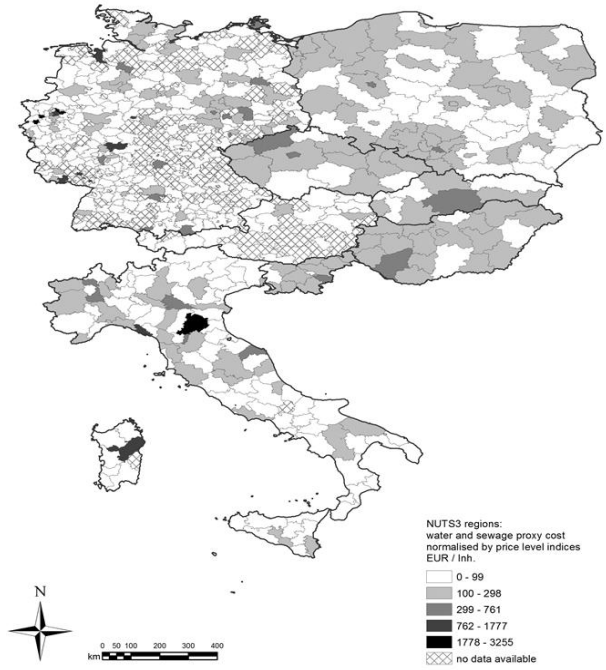

Figure 2. *PCR_PLI* for the water and sewage sector in Central Europe

Source: Baron, Ochojski, Polko (2014: 69).

In the case of water and sewage, *PCR_PLI* levels are quite diverse in Central European countries. The maximum value of the ratio was observed in Bologna. This was caused mainly by location of HERA (Holding Energia Risorse Ambiente). HERA operates in the distribution of gas, water, energy, and waste disposal in the provinces of Bologna, Ferrara, Forlì-Cesena, Modena, Ravenna, Rimini, Pesaro and Urbino, as well as in some municipalities of Florence and Ancona. This is the same reason for the highest values in Germany. The location of the headquarters of large firm which also supply products to other regions makes the highest values. For example, Energie- und Wasserversorgung Mittleres Ruhrgebiet is located in Bochum. This kind of firm operates on several markets including both water supply and energy resources.

Finally, *PCR_PLI*s concerning public transport reached the highest value in western parts of Austria and some regions in Germany. This is caused by location of large firms which operate on different sectors (transport and others). For example, in Frankfurt it is DB Energie GmbH. In this case, the large diversification of business activities distorts the results. In other countries, the values of ratio are pretty average.

The statistical analyses of *PCR_PLI*s and the variables listed in Table 1 are offered to identify correlations with demographic change in a spatial and economic perspective. The analysis for all available *PCR_PLI* observations in Central Europe (Table 2) shows that *PCR_PLI*s are for all cases negatively correlated with *POPCH_11_91* (not significantly for social care) and positively correlated with *DENS_08* (not significantly for water and sewage). *PCR_PLI* for housing is significantly correlated with all variables. *PCR_PLI* for healthcare is significantly correlated with all variables but *OADR_08*.

Moreover numerous contextual and qualitative premises pinpoint that public service provision relies heavily upon the spatial characteristics of the territory. For this reason, statistical tests have been done with reference to predominantly urban regions, intermediate regions and predominantly rural regions, according to the classifications provided by Eurostat. The *r*-Spearman correlation test for predominantly urban territories shows that *PCR_PLI*s are negatively correlated with *POPCH_11_91* in all cases apart from water and sewage. Additionally, *PCR_PLI*s are rather strongly, significantly and positively correlated with *DENS_08*. There are no significant correlations of *PCR_PLI*s with *AVCBD_10_00* and *OADR_08*. For predominantly rural territories, *PCR_PLI* in general shows a limited number of significant correlations. *PCR_PLI* for housing is significantly correlated with all analysed variables but *DENS_0*8. All *PCR_PLI*s except the case of healthcare are significantly correlated with *OADR_08* and *GDP_08*. *PCR_PLI* for healthcare, housing, and water and sewage show significant negative correlations with *POPCH_11_91*.

Table 2. *r*-Spearman correlation test: CE countries, *PCR_PLI*s, socio-economic variables

VARIABLE	PCR_PLI_HEA	PCR_PLI_HOU	PCR_PLI_SOC	PCR_PLI_WAT	PCR_PLI_TRA
POPCH_11_91 Long term population change (2011/1991)	-0.161**	-0.251**	-0.051	-0.260**	-0.176**
POPCH_10_00 Population change (2010/2000)	-0.222**	-0.165**	-0.066	-0.142**	0.009

VARIABLE	PCR_PLI_HEA	PCR_PLI_HOU	PCR_PLI_SOC	PCR_PLI_WAT	PCR_PLI_TRA
AVCBD_10_00 Average rate of natural increase (2000-2010)	-0.102*	-0.334**	-0.088*	-0.144**	0.024
DENS_08 Population density (2008)	0.385**	0.281**	0.388**	0.036	0.121**
OADR_08 Elderly to active ratio (2008)	0.056	0.314**	0.196**	-0.081	-0.170**
GDP_08 GDP per capita PPS (2008)	0.223**	0.317**	0.266**	-0.128**	0.114**
N	623	291	563	527	655
Countries included in calculations	*AT, CZ, DE, HU, IT, PL, SK, SL*	*DE, PL*	*AT, DE, HU, IT*	*AT, CZ, DE, HU, IT, PL, SK, SL*	*AT, CZ, DE, HU, IT, PL, SK, SL*

* – correlation coefficient significant at the 0.05 level of significance; ** – correlation coefficient significant at the 0.01 level of significance. Disclaimer: *PCR* calculations are based upon the best available data set extracted from Amadeus by Bureau van Dijk. *PCR*s are not backed up by the complete territorial data. Individual observations concerning particular NUTS-3 territories may be over- or underestimated.

Source: Baron, Ochojski, Polko (2014: 71).

4. CLUSTERS OF SIMILAR REGIONS IN CENTRAL EUROPE

It needs to be stressed that public service cost comparisons across the Central European countries should not be done in any kind of direct way. Thus, one should not draw conclusions that lower *PCR* levels are better than higher ones, or vice versa. The *PCR* is rather "*neutral*" in the sense that it shows a certain comparable value of service delivered to citizens. This allows one to show the value of a service sold in any of the investigated fields and in NUTS-3 regions. It is not the price of the service, but it shows sales of specific services per inhabitant of the territory. By saying this, we are aware that the efficiency issue is basically conditioned by much more than that, e.g. organisational settings, legal schemes, spatial characteristics, technical standards and novelty. Thus, qualitative studies following the "*pure*" statistical

picture might offer a much better and proper insight into the issues of public service economics.

For the policy and strategic management issues, we argue here that the possible notion of best practices that can be easily transferred to the other territory might be totally misleading. In order to minimise the risks of one-fit-all solutions a regional classification can be introduced. The core of the idea is to cluster similar regions. Thereafter, we can search for solutions in this groups; being enrooted in positive economy convey the findings into normative. A Ward's general agglomerative hierarchical clustering procedure and *k*-means algorithm has been applied.[6] All clusters have been identified by joint computation of a specific *PCR_PLI* as well as *POPCH_11_91*, *AVCBD_10_00*, *DENS_08*, *OADR_08*, *GDP_08*[7].

Again, the healthcare sector has been offered as an example of the study.[8] *DENS_08*, *OADR_08* and *AVCBD_10_00* emerged as the main criteria to decide upon the grouping presented in Table 3 and Figure 3.

Table 3. Clusters of similar regions in Central Europe (healthcare)
PCR_PLI_HEA, POPCH_11_91, AVCBD_10_00, DENS_08, OADR_08, GDP_08

Cluster	Characteristics
HEA_1 TYPE A	***Spatial characteristics:***
	19 predominantly urban regions, 77 intermediate regions, 62 predominantly rural regions.
	Statistical characteristics:
	The clustered territories show *OADR_08* much higher than average and low values of *AVCBD_10_00* and *POPCH_11_91*.
HEA_2 TYPE B	***Spatial characteristics:***
	46 predominantly urban regions, 131 intermediate regions, 72 predominantly rural regions.
	Statistical characteristics:
	The clustered territories show the highest values of *POPCH_11_91*.
HEA_3 TYPE C	***Spatial characteristics:***
	52 predominantly urban regions, 21 intermediate regions, 3 predominantly rural regions.
	Statistical characteristics:
	The clustered territories show the highest *PCR_PLI_HEA, DENS_08* (much above the average) and high *GDP_08* values.

[6] In this work, in order to demonstrate a group of objects that are similar in the context of the variables subject to examination, one of the hierarchical clustering methods, Ward's method, was utilised. This method is believed to be an effective procedure for clustering although it tends to generate small clusters. Additionally, a non-hierarchical method – *k*-means method was used (as one of the most frequently employed taxonomic clustering methods in practice). The standardisation of the variables was done by means of zero unitarisation. Moreover, arithmetic means were used in this research to answer the following question: Which of the features selected have decided creation of particular classes and which features are of domineering nature in the classes?

[7] *POPCH_10_00* was not used for clustering due to its small variability.

[8] For the results of clustering for the other sectors (see: Baron, Ochojski, Polko (2014)).

Table 3. Continuation

HEA_4 TYPE D	***Spatial characteristics:***
	4 predominantly urban regions, 19 intermediate regions, 36 predominantly rural regions.
	Statistical characteristics:
	The clustered territories show the lowest *PCR_PLI_HEA* and *GDP_08* and *AVCBD_10_00* values.
HEA_5 TYPE E	***Spatial characteristics:***
	13 predominantly urban regions, 32 intermediate regions, 37 predominantly rural regions.
	Statistical characteristics:
	The clustered territories show the lowest values of *OADR_08* and *DENS_08* as well as the highest *AVCBD_10_00*.

Disclaimer: *PCR* calculations are based upon the best available data set extracted from Amadeus by Bureau van Dijk. *PCR*s are not backed up by the complete territorial data. Individual observations concerning particular NUTS-3 territories may be over- or underestimated.

Source: Baron, Ochojski, Polko (2014: 71).

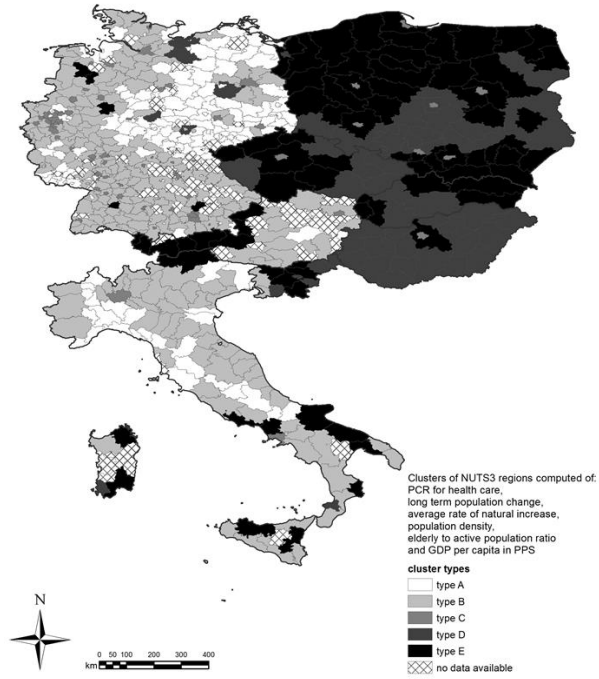

Figure 3. Clusters of similar regions in Central Europe (healthcare)

Source: Baron, Ochojski, Polko (2014: 79).

In the case of the healthcare sector, Austria and Slovenia are most diverse countries taking into account clusters types. At the general level, we can observe a clear division of Central European countries with a group dominated by type E and D clusters and a group with a majority of type A and B clusters. The first group consists of Poland,

Slovakia, Czech Republic and Hungary. The second group consists of Germany and Italy. The size of the regions in the countries may be important to fully explain the results of the study.

5. CONCLUSIONS AND POSSIBILITIES FOR FURTHER APPLICATION

The study provided may become a partial answer to the data shortage in public statistics. A similar attempt has already been introduced by the OECD for microanalyses across countries. For the initial phase of the study, the *PCR* could only be calculated as a static picture covering average values of the last five years due to limitations in business intelligence data. Therefore, it is believed that this method could be further improved and transformed into a dynamic model. This is a challenge for research groups or partnerships between researchers and Eurostat set up within the framework of Horizon 2020 or ESPON. The lessons of the study and the proposed research method are assumed as a meaningful attempt that, with all known bottlenecks, can be further developed and utilised by Eurostat (as a methodical approach). The direct comparisons between the countries may be misleading due to different national contexts of service delivery and therefore a specific taxonomy – *PCR* based clustering was introduced. In similar regions, similar cost-saving strategies of service and infrastructure delivery can be introduced. The suggested taxonomy creates an opportunity for policy actors and service operators for the clustered territories to consequently pursue, inform and share relevant knowledge and best practises primarily needed to adapt to demographic change.

The unique data introduced and tested in the presented paper should be further utilised in terms of spatial (esp. sub-regional, regional and national) analyses. The public and private financial representation and nearly full territorial coverage of the estimated *PCR* data on transportation and water, even with known limitations (but still relatively easy to explain when it comes to the peaks or other locally and qualitatively-bound exceptions) endeavour to seek for various types of analytical models.

The popularity of concentration and specialisation indices can be explained due to fact that they offer relatively broad insights into the agglomeration of a given characteristic. Therefore, the values of *PCR* in the regions can be further used to test the correlation of a concentration index in a given characteristic across the regions. For example, the concentration of variables defining specific spatio-economic categories, such as dominance of urban or rural functions, or size of the territory or its economic growth can be identified to further

see whether it correlates with the high/low values of *PCR* in water. It would be interesting to see such positive correlations in highly rural areas (high water usage) or in metropolitan regions (suburban growth increasing the cost of infrastructure development and maintenance).

The introduction of the other analytical model – Trend Surface Analysis, as developed by O. Levorson – can provide an interesting estimation, allowing one to test if there are any specific coverage patterns of public transport *PCR* across Central Europe countries. The interpretation of analysed data can be used to identify the general trend of public transport *PCR* in CEEC and to see local diversities. It may show to what extent the *PCR* values "*lean*" towards for example peripheral regions or to what extent the local peaks are in line with topography of the regions. It can also provide an answer to what extent the proxy cost decreases in N-S or W-S geographic directions.

Additionally, the application of Local Indicators of Spatial Association could be interesting in describing the territorial concentration of the *PCR* values. The Local Moran's *I* Statistic, for example, could bring further and new observations to the clustering approach already introduced. It definitely allows the highlighting of clusters of high or low values, or to present untypical issues across the investigated territory. We believe this approach could possibly inspect the hypothesis of relatively high transportation proxy costs in agglomerating subregions/metropolitan cities and their surrounding subregions.

Finally, the gravity models represent another interesting research direction that may be useful to test the mutual interdependencies over territorial units. The models could be very promising with regards to identifying the links between a region's demographic size and transportation costs.

These and other, not listed but still welcomed, research ideas can extend knowledge on the spatial characteristics of spending on local public services. As a consequence, we believe they can add value to regional studies by means of practical application of spatial analyses and explanation of various hypotheses of an economic and social nature.

REFERENCES

Baron M., Ochojski A., Polko A. (2014), *Economics and Strategic Management of Local Public Services in Central Europe. Towards multidisciplinary analysis of infrastructure and service costs*, Institute of Sociology, Academy of Sciences of the Czech Republic, Prague.

Büttner T., Schwager R., Stegarescu D. (2004), *Agglomeration, Population Size, and the Cost of Providing Public Services. An Empirical Analysis for German States*, "Public Finance and Management", 4 (4).

Moss T. (2008), "*Cold spots*" *of Urban Infrastructure: "Shrinking" Processes in Eastern Germany and the Modern Infrastructural Ideal*, "International Journal of Urban and Regional Research", Volume 32/2.

Ribeiro S. P., Menghinello S., Backer K. D. (2010), *The OECD ORBIS Database Responding to the Need for Firm-Level Micro-Data in the OECD*, "OECD Statistics Working Papers", No. 2010/01.

Solé-Ollé A., Hortas Rico M. (2010), *Does urban sprawl increase the costs of providing local public services? Evidence from Spanish municipalities*, "Urban Studies", 47 (7).

ABSTRACT

A multi-dimensional approach to understanding spatial differences of public service costs in Central Europe is at the heart of the study. It has become especially challenging to identify the linkages to demographic, economic and other territorial aspects. The paper provides an implemented investigative model on service costs. It proves the success of overcoming local data technical and methodological bottlenecks; yet, unavailable across the European territory. The research is offered as a conceptual and empirical solution especially targeted at national and international statistical agencies supporting the policy-making processes.

Business intelligence data has been obtained in pursuit of reliable estimations. Financial records of local service providers originating from private and public sectors across Central Europe have been analysed, allowing for the NUTS-3 aggregation of micro-data unavailable elsewhere. The analysis is based upon the calculation of proxy cost ratios (*PCR*) for social services and infrastructure (social care, health care and public housing) as well as network services and infrastructure (public transportation, roads, water and sewage). Consequently, the *PCR*s are tested against the correlation with demographic change, population density, GDP per capita and other socio-economic variables. Spearman's rank correlation coefficient has been used to test the dependence between variables. Compared to Pearson's correlation coefficient, it allows better description of relationship between two variables in a situation when there are many anomalies (outlying observations). The final step allows identification of clusters of similar territories regarding tested variables. The taxonomy has been based upon Ward's method and *k*-means algorithm. Further possibilities of interpretative spatial research have been offered.

WIELOWYMIAROWA ANALIZA KOSZTÓW LOKALNYCH USŁUG PUBLICZNYCH W EUROPIE CENTRALNEJ

ABSTRAKT

W niniejszym artykule naukowym zainteresowania badawcze koncentrują się na analizie porównawczej, której celem jest zrozumienie zróżnicowań przestrzennych w zakresie kosztów świadczenia usług publicznych w krajach Europy Centralnej. Szczególnie istotnym wyzwaniem jest identyfikacja powiązań zachodzących pomiędzy kosztami i czynnikami demograficznymi oraz gospodarczymi przedstawionych w wymiarze terytorialnym. W wyniku przeprowadzonego badania naukowego wypracowano propozycję modelowej analizy kosztów usług publicznych. Ponadto ważnym elementem prac była próba przezwyciężenia technicznych i metodologicznych przeszkód związanych z dostępnością danych na poziomie europejskim. Badanie oferuje wskazówki zarówno w sferze koncepcyjnej, jak i praktycznej możliwe do wykorzystania przez instytucje gromadzące dane statystyczne oraz podmioty wspierające procesy decyzyjne.

Chcąc uzyskać bardziej wiarygodne dane wykorzystano bazy biznesowe (*ang. business intelligence data*). Dane finansowe dostawców usług publicznych z krajów Europy Centralnej zostały zagregowane na poziomie NUTS3 umożliwiając uzyskanie informacji niedostępnych przy wykorzystaniu innych źródeł. Analiza oparta jest na kalkulacji wskaźników kosztów (*ang. proxy cost ratios – PCR*) dla usług i infrastruktury społecznej (opieka społeczna, zdrowie

i mieszkalnictwo publiczne) oraz usług i infrastruktury sieciowej (transport publiczny, drogownictwo, sektor wodno-kanalizacyjny). W drugim etapie zbadano korelację wskaźnika *PCR* z czynnikami demograficznymi oraz GDP per capita. W badaniu wykorzystano współczynnik korelacji rang Spearmana, który w porównaniu do współczynnika korelacji Pearsona pozwala na lepszy opis relacji pomiędzy zmiennymi w sytuacji występowania wielu anomalii. W ostatnim etapie pracy zidentyfikowano skupienia terytoriów podobnych ze względu na analizowane zmienne. Taksonomia oparta została na metodzie Warda oraz algorytmie *k*-średnich. Przedstawione zostały również dalsze możliwości interpretacyjnych badania przestrzennego.