

# The Effect of Large Companies on Spatial Structure in Central and Eastern Europe with a Particular Focus on Enterprises in the Technology, Media & Telecommunications Industry

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## SUMMARY

*Many theoretical and practical works aim at describing the spatial structure of Central and Eastern Europe. This article gives an overview of papers describing the spatial structure of Central and Eastern Europe with different methods. Our goal is to contribute to understanding the Central and Eastern European economic spatial structure and within this we examine the role of the Technology, Media & Telecommunications (TM&T) industry. This industry was chosen because it includes the most knowledge-intensive enterprises. We found that this industry plays a small role in the activities of the most important companies in the region. The capital's major economic centres are the capitals. Thus, both the Central European Pentagon and the New Banana spatial models are suitable for describing the spatial structure. The spatial picture of the TM&T industry is basically concentrated on relatively few large cities, and the region's most important centre is Warsaw.*

*Keywords: spatial structure, Central and Eastern Europe, grouping analysis, Technology, Media & Telecommunications industry*

*Journal of Economic Literature (JEL) codes: R10, R12*

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## INTRODUCTION

The importance of multinational and transnational companies has increased in the globalised world and world economy, as well as the effect of supranational and national institutions and of governmental decisions. Big cities, the stage of many of these activities, have become the leading centres of the world economy. In the last few decades, the increasing economic leading role of the cities, the metropolitan concentration of the “new economy” and the political, administrative, cultural and social importance of cities have become determining factors (Enyedi 2003). Companies, institutions, national economies, different territorial units and individuals are continuously taking part in competition. They have to perform well in different race conditions.

According to Enyedi (2012), new spatial forms have appeared lately and the urban agglomeration in its traditional sense has been replaced by the metropolitan region. “Several cities exist without their own agglomerations that cooperate with other cities in a system of special relationships. Cities create networks that serve as a base for regions...” Enyedi (2012, p. 25). The new economy of big cities has a concentrating effect. For companies and institutions, the opportunity to establish relationships, the variety of business services, the formation of “networks promoting interactive learning, creativity and innovation” Enyedi (2012, p. 18) and constant changes require the “closeness” of companies to each other. Therefore clusters, traditional and not traditional economic activities and the related services have become denser in these developed metropolitan regions. It has become accepted that global competition is

actually the competition of big cities and regions as well (Bernek 2000; Lengyel & Rechnitzer 2000; Dicken 2007). At the same time, however, besides the intensive competition, closer cooperation than is also appearing in the economic space. Besides big companies, small and medium sized enterprises also are getting involved in global, regional and urban spaces in large numbers (Lux 2012).

The economic leading role of cities is reflected in the space structure and it has an effect on the appearance of nodes and networks. In our paper, we aimed to model the space structure of Central and Eastern Europe and to particularly examine the role of the Technology, Media & Telecommunications (TM&T) industry – which we consider to be the most innovative – in regional processes.

## THE SPATIAL STRUCTURE OF CENTRAL AND EASTERN EUROPE IN CONSIDERATION OF CITIES

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The regions of Central and Eastern Europe are also included in the literature dealing with the spatial structural forms of Europe. The zones, axes, forms, as well as the polycentric models can be identified for this area as well. Out of the spatial structural forms belonging to the first group, the “Central European Boomerang” may play the most important role. According to Gorzelak (2012), the determinant areas of the form – stretching from Gdansk to Budapest, including Poznan, Wroclaw, Prague, Brno and the triangle of Vienna-Bratislava-Budapest – are the capitals, the real stages of development. The Cucumber model is also linked to this, which is a developmental zone involving Berlin, Prague, Bratislava, Vienna and Budapest (Kunzmann 1998).

The “Red Octopus” of van der Meer (1998) or the “Blue Star” of Dommergues (1992) also include eastern tongues and effects. The other great group of the visualizations of the European space structures emphasizes the explanatory role of the polycentric space structure. According to Kunzmann & Wegener (1991) and Kunzmann (1992, 1996), the polycentric structure of our continent is determined by metropolitan regions (that can be found not only inside the “Blue Banana”) as a Bunch of Grapes. The polycentric idea has become more and more popular and is a key element of ESDP (1999). It has played an increasingly important role in the European regional cohesion policy (Faludi 2005) and it appears intensively in Eastern European examinations (ESPON 2012) as well.

One of the reasons for the strengthening of the polycentric characteristics is the fact that there has been a spatial concentration process in Europe since the 1990s, whereby differences in the shrinking traditional industry in the small and medium sized cities and the services and high-tech in big cities have increased. At the mezzo (national) level, it is the division of labour among cities, while at the micro (urban region) level, the urban functions

and the cooperation within the region are emphasized. In the BBSR (2011) work, however, the political, economic, scientific, transport and cultural functions of the urban areas are those that strongly influence the spatial structure. As for big cities and other cities, many classifications and rankings can be found in the literature, of which the demographic, the functional and the hierarchy-based classifications may be the most popular. Several of them include data for the region we examine; the GaWC classifying, based on functions or the ESPON research, stands out among them. The world according to GaWC is a city-centred world of flows, in contrast to the more familiar state-centred world of boundaries. Cities are assessed in terms of their advanced production services using the interlocking network model. Indirect measures of flows are derived to compute a city's network connectivity – this measures a city's integration into the world city network. The GaWC (Globalization and World Cities Research Network) ranked Prague, Warsaw and Budapest as gamma world cities in the region due to their role in the markets of advertising, banking and legal services (Beaverstock et al. 1999, Csomós 2012, 2015). This classification is in line with the classification of ESPON (2005, 2012), where the capitals of the region are listed on the 4<sup>th</sup> MEGA level (Prague, Budapest, Warsaw and Bratislava) followed by cities like Bucharest, Ljubljana, Katowice, Sofia, Lodz and Poznan on the 5<sup>th</sup> Mega level. In the hierarchical classification of the big cities of the world, Erdósi (2003) classified Budapest and Prague as international big cities with regional importance. Besides these classifications, other opinions and examinations also strengthen the leading spatial organising role of the capitals in the Central and Eastern European region (Sassen 1991, Enyedi 2003, Péntzes & Fekete 2014) and their regional economic leading role (Csomós 2011), as is shown in the Central European Pentagon model (Liebenath et al. 2007). Most researchers, however, agree that these big cities fall behind the economic leading role of Vienna or the large German cities (Csomós 2011). It is important to mention the “New Banana” model, which is the potential second European economic core. In this model we supplement the development zone with Berlin, Prague, Bratislava, Vienna and Budapest to Ljubljana and Zagreb (SIC 2006).

## RESEARCH ASPECTS

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In the following sections we examine more thoroughly the background of these spatial structural relations. In our study, we focussed on the following questions: what characterizes the spatial structure of Central and Eastern Europe? What is the regional pattern of the TM&T sector in the region? What are the most important centres, and what spatial structure model can be used to describe the spatial nodes of the sector?

One important aspect in planning the study was to carry out our calculations based on available data that provide

accurate information about the status of the economy. Based on these considerations, we selected the Deloitte Central Europe Top 500 Report list, which includes the 500 most important companies of the examined region based on their estimated revenues. This list does not include banking or insurance companies. Russia and Belarus were not included in the Deloitte Central Europe Top 500 Report due to difficulties in acquiring data from these countries as well as certain doubts concerning the credibility of the available figures (Raźniak et al. 2018). Therefore, 16 countries were included in our study.

The cities that host the headquarters of the companies on the list are included in the examination and the centroids of the cities are shown on our maps. The problem of headquarters and sites arises here, as it often does in statistics. It refers to the fact that the activity of a given company may not be performed in the city where the headquarters are registered. Instead, it may be at another site in many cases. As we did not aim at modelling the spatial distribution of production and its changes but rather the interrelation of the leading role of the centres and the general spatial structural relation through it, we did not deal with this problem, as we assigned the revenues of each company to the city that hosts its headquarters.

We considered it important to model both the current spatial structure and its changes in the recent past. We examined the current situation using the Deloitte Central

Europe 500 2015, while we used the 2008 version of this list for comparison.

## RESULTS

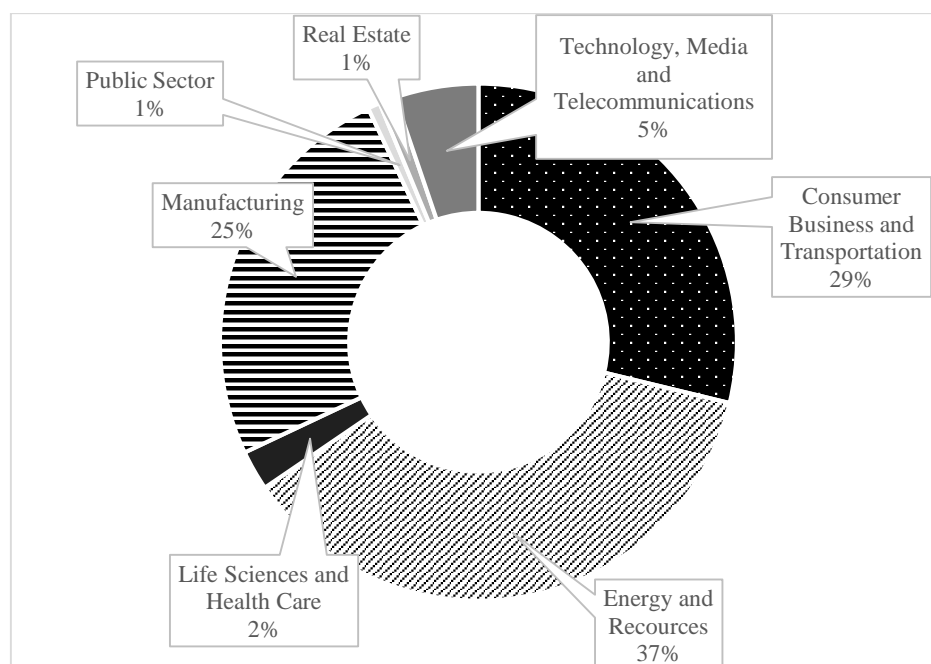
Analysing the data further (Table 1), we find that Poland shares 38%, the Czech Republic 16%, and Hungary 13% of the 500 most important companies of the region in 2015. As far as the revenues are concerned, the situation is similar, with the only exception that the share of Poland is as high as 36%. The sectoral distribution of the companies (Fig. 1) shows that 37% of the revenues comes from firms categorized in the field of Energy and Resources, followed by Consumer Business and Transportation with 29% and Manufacturing with 25%. The share of the Technology, Media and Telecommunication industry, which is the focus of our research, is only 5%.

The list is revealing in the aspect that it does not include several countries of the region. The companies of Albania, Belarus, Moldova and Montenegro are not among the 500 best performing companies of the region because they did not reach the cut-off value. Another important point is that the data of the companies in Austria, despite having the greatest effect on the Central European spatial structure, are not included in the list, so we cannot calculate with their headquarter data, either.

Table 1  
Data of the Deloitte Central Europe Top 500 2015, broken down by country

Countries	Number of companies	Revenues (million EUR)	Average revenues per company (million EUR)
Bosnia-Herzegovina	2	1 033	517
Bulgaria	10	11 705	1 170
Croatia	13	18 894	1 453
Czech Republic	73	109 247	1 497
Estonia	4	3 473	868
Hungary	67	93 573	1 397
Latvia	5	4 675	935
Lithuania	11	14 139	1 285
Poland	183	259 667	1 419
Macedonia	1	1 189	1 189
Romania	46	46 415	1 009
Serbia	7	7 214	1 031
Slovakia	32	45 194	1 412
Slovenia	17	20 073	1 181
Ukraine	29	47 295	1 631
<i>Central and Eastern Europe</i>	<i>500</i>	<i>683 785</i>	<i>1 368</i>

Source: Deloitte Central Europe Top 500



Source: Deloitte Central Europe Top 500

Figure 1. Deloitte Central Europe Top 500 2015 data by economic sector

Table 2  
The share in the revenue of CEE500 enterprises in the Technology, Media & Telecommunications industry from the total country revenues

Countries	2008	2015
Bulgaria	7.9	–
Croatia	13.7	4.8
Czech Republic	8.8	7.8
Estonia	–	34.4
Hungary	14.8	5.5
Latvia	21.5	–
Poland	6.7	4.7
Romania	8.2	6.4
Serbia	16.4	14.1
Slovakia	19.1	5.6
Slovenia	3.1	3.6
Ukraine	7.0	1.2
<i>Total</i>	9.0	5.2

Source: Deloitte Central Europe Top 500

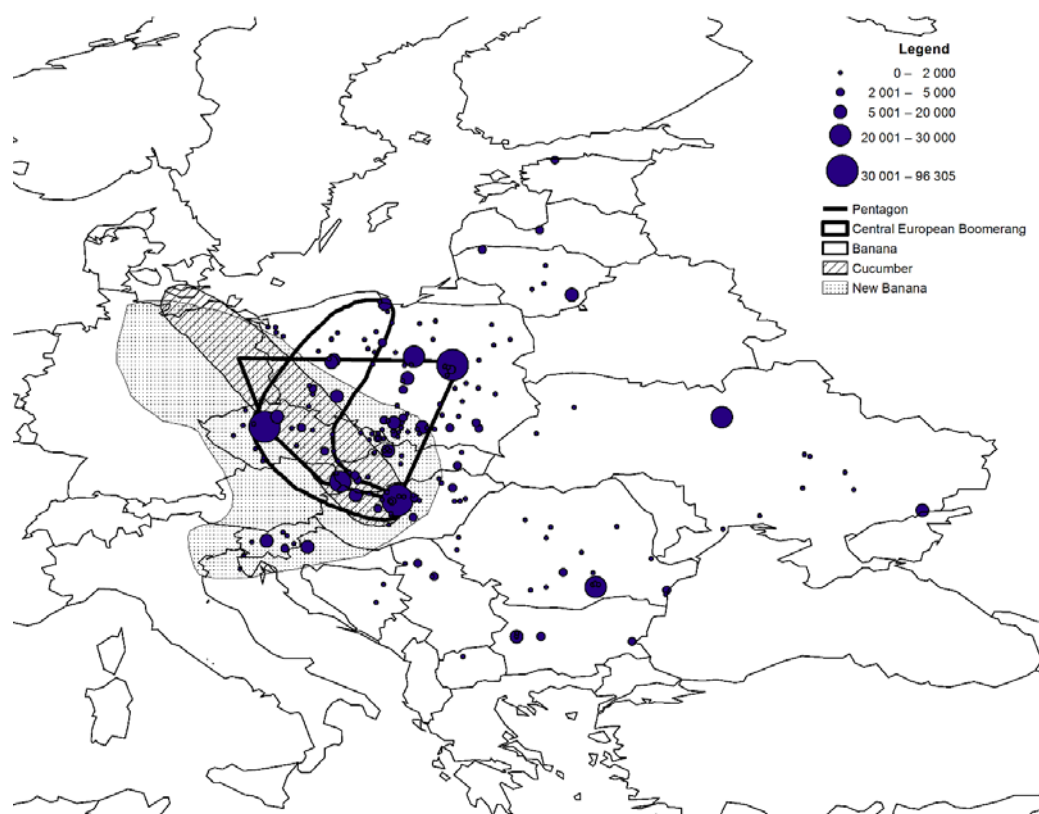
Table 2 shows the share of revenues for Technology, Media & Telecommunication sector of the 500 companies included in the Deloitte Top 500 list. Their share in 2015 was about 5.2%. The share of revenues for Technology, Media & Telecommunication sector are the highest in

Estonia, Serbia and the Czech Republic. With the exception of Estonia and Slovenia, their share in the region decreased slightly during the period under review. Compared to 2008, a decline of about 4 percentage points occurred.

*Table 3*  
*The ten most important cities based on CE TOP 500*

Rank	Headquarters, 2008	Revenues 2008 (EUR million)	Share from the revenues of the top 500 companies, 2008	Headquarters, 2015	Revenues 2015 (EUR million)	Share from the revenues of the top 500 companies, 2015
1	Warsaw	85 452	15.3	Warsaw	96 306	14.1
2	Prague	48 655	8.7	Prague	67 710	9.9
3	Budapest	39 105	7.0	Budapest	55 486	8.1
4	Kiev	31 446	5.6	Kiev	29 629	4.3
5	Bratislava	20 314	3.6	Bratislava	25 365	3.7
6	Bucharest	19 402	3.5	Bucharest	25 290	3.7
7	Plock	18 748	3.3	Plock	22 040	3.2
8	Zagreb	13 398	2.4	Zagreb	17 690	2.6
9	Donetsk	11 874	2.1	Gdańsk	14 272	2.1
10	Ljubljana	10 262	1.8	Ljubljana	12 210	1.8

Source: Own compilation from Deloitte Central Europe Top 500



Source: Deloitte Central Europe Top 500

*Figure 2. Revenues (million EUR) of TOP 500 companies in Central and Eastern Europe, 2015*

In Figure 2 we labelled settlements with more than 5 billion euro in corporate revenues. The 500 companies with the highest revenues belonged to 170 settlements in 2008, and to 196 in 2015.

The data highlight the outstanding role of capitals and capital regions. The dominance of the cities in the Visegrád countries (Poland, Czech Republic, Slovakia and Hungary) is clear based on the map. Nonetheless, although there are visible spatial clusters, the spatial location of the

examined companies is relatively scattered. The differences between the most important spatial structure models will be discussed later.

In essence, we can see this in the table of the 10 most important cities. In addition, the sweep of Plock is also remarkable (largely due to the energy sector) in 2015. For the years under review, the list has changed only on the 9th place, so the order between the big cities can be considered stable (Table 3).

In this article we assume that the control function in the economy of Central and Eastern Europe is performed by cities that are home to at least three top corporate headquarters. The same minimum number for the Command and Control Index in the world economy was listed by Csomós and Derudder (2014). In this article, this yields an Eastern European Command and Control Index

(EECCI). The EECCI employs a standardization method based on the mean and the standard deviation of financial values for each corporation studied used by Csomós (2013) to create the Command Control Index (cited by Raźniak et al. 2017).

$$EECCI_{xy} = \sum_{i=1}^{n_{xy}} \frac{R_{ixy} + S_{ixy}}{2}$$

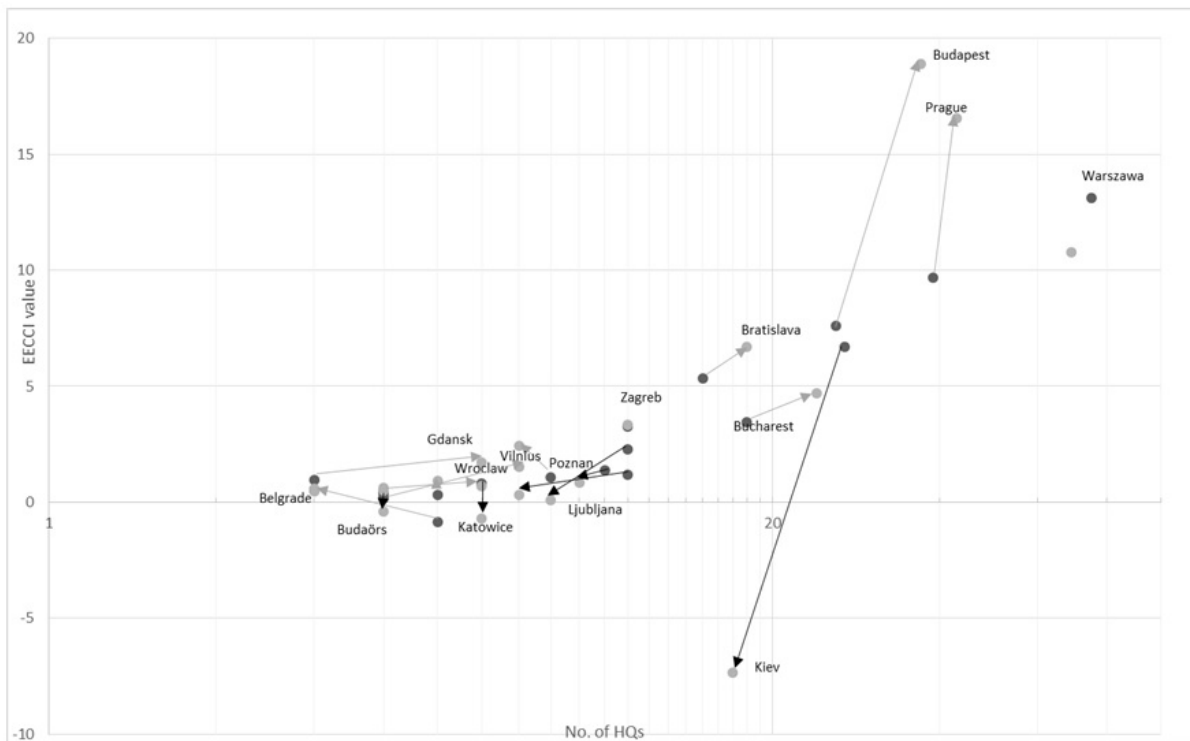
where:

R<sub>ixy</sub> = proportion of revenues from sales in the total dataset;

S<sub>ixy</sub> = proportion of net income in the total dataset;

i = number of company headquarters per city in a given year (i ≥ 3);

n = total number of companies headquartered in city x in year y.



Source: Own compilation based on Deloitte Central Europe Top 500

Figure 3. Cities hosting the headquarters of three or more top-ranked corporations

Figure 3 contains of the names of cities that are home to three or more top-ranked corporations as well as corresponding EECCI index values. The largest number of corporate headquarters and the highest EECCI values for 2008 and 2015, which indicate the highest economic potential and the strongest command and control functions, were noted for the capital cities of the five largest countries in Central and Eastern Europe: Budapest, Prague, Warsaw, Bratislava and Bucharest. Of the 22 cities, 13 showed an increase in the EECCI index value over the study period, with the biggest increase for Wroclaw (327% relative to 2008). The number of corporate headquarters in Budapest increased over the

time period to the greatest extent. Several cities in the region experienced a decline in EECCI: Plzeň (-2%), Warsaw (-18%), Poznan (-40%), Sofia (-72%) and Ljubljana (-98%). Thirteen cities (including Budapest, Prague, Bucharest, Bratislava and Zagreb) experienced an increase in EECCI values, and nine cities experienced a decrease in EECCI values.

We next studied the competitiveness of cities having three or more headquarters. In this approach, development (revenues per capita), efficiency (revenues per net income), profitability (net income per headquarters) and embeddedness (headquarters per capita). The formula can be seen below.

$$\frac{\text{Revenues}}{\text{Population}} = \frac{\text{Revenues}}{\text{Net income}} \frac{\text{Net income}}{\text{No. of headquarters}} \frac{\text{No. of headquarters}}{\text{Population}}$$

We consider those cities to be competitive where the revenue per capita is higher than the average, while cities that are below the average in this value are at a competitive disadvantage. A complex competitive advantage is established when the revenues per capita and all three components of development for the given city have above average values. We can also speak of a multi-factor advantage if revenues per capita and two factors are above average, or a single-factor competitive advantage if just one factor meets this condition.

*Table 4*  
*The competitiveness of cities with 3 or more large corporate headquarters*

Cities	Competitiveness 2015	Change in competitiveness 2008/2015
Belgrade	0100	0000
Bratislava	1011	1011
Bucharest	0010	1011
Budaörs	1001	0000
Budapest	1011	1011
Gdańsk	1110	1101
Katowice	1001	1001
Kiev	0000	0000
Kraków	0010	0010
Ljubljana	1001	0000
Lódz	0100	1101
Plzeň	0011	0010
Poznan	0101	0100
Prague	1011	1011
Riga	0010	1011
Sofia	0000	0000
Székesfehérvár	1011	0011
Torun	0010	1010
Vilnius	0010	1011
Warsaw	1101	0100
Wroclaw	0100	1001
Zagreb	1011	1100

Source: Own compilation based on Deloitte Central Europe Top 500

First, we can state that competitiveness is largely determined by embeddedness (Table 4) (we have quantified with the headquarters per capita). Using this approach, we found that there is no cities in this region with a complex competitive advantage. Bratislava, Budapest, Gdansk, Prague, Székesfehérvár, Warsaw and Zagreb are in the best position with a multi-factor

competitive advantage. In a dynamic analysis (on the change from 2008 to 2015) there is no cities in this region with complex competitive advantage, either. Bratislava, Bucharest, Budapest, Gdansk, Lódz, Prague, Riga, Vilnius and Zagreb each have a multi-factor competitive advantage.

Next, the investigation was limited to the cities involved in the TM&T sector (Table 5). The calculations were then made only on the basis of data from this industry. Embeddedness is also the most important factor in this case. In the case of Bratislava, Pardubice, Warsaw and Zagreb, we see a multi-factor competitive advantage based on 2015 data, while in Bucharest and Ljubljana the same is true for change.

*Table 5*  
*The competitiveness of cities hosting CEE500 enterprises in the Technology, Media & Telecommunications industry*

Cities	Competitiveness 2015	Change in competitiveness 2008/2015
Belgrad	0000	1001
Bratislava	1011	0010
Bucharest	0101	1101
Budapest	0100	0010
Kiev	0000	0010
Ljubljana	1011	1011
Pardubice	1101	1001
Praha	0011	0011
Warsaw	1101	1100
Zagreb	1011	0010

Source: Own compilation based on Deloitte Central Europe Top 500

We also analysed the extent to which conclusions can be deduced from the previously reported models and the revenues of cities affected by the CEE500. As can be seen from the data in Table 6, the New Banana model covers the largest area in the region and is characterized by most of the company's revenues, with 2015 data accounting for nearly half of the revenue. If we narrow down our research to companies in the TM&T sector (Table 7), we can see the superiority of the New Banana and the Central European Pentagon.

*Table 6*  
*The share of cities affected by each model from the revenue of CEE500 enterprises*

Year	Central European Boomerang	New Banana	Cucumber	Central European Pentagon
2008	32	45	20	35
2015	37	49	22	36

Source: Own compilation based on Deloitte Central Europe Top 500

*Table 7*  
*The share of settlements affected by each model from the revenue of CEE500 enterprises in the Technology, Media & Telecommunications industry*

Year	Central European Boomerang	New Banana	Cucumber	Central European Pentagon
2008	39	57	44	58
2015	44	50	45	49

Source: Own compilation based on Deloitte Central Europe Top 500

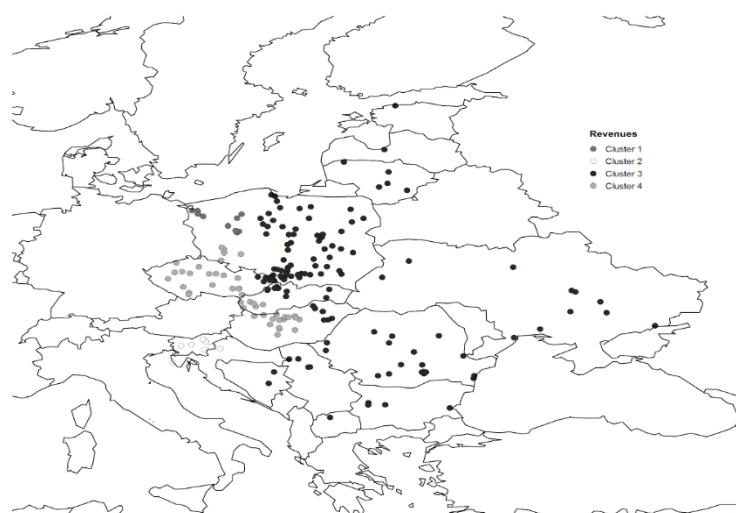
With GIS methods we have attempted to group the settlements on the list in order to determine their spatial pattern and to analyse how these cities effect the spatial structure of the region. In our work we used the ArcGIS 10.1 Grouping Analysis module. In the grouping process, we took into account the income, profits and the population of the given settlements. Several attempts were made to clearly distinguish the delimitation of the four clusters and to characterize them by the formation of groups. In terms of neighbourhoods, the relationship between the nearest 4 neighbours was considered relevant in the calculations.

The four clusters are shown in Figure 4. The first cluster consists of settlements located in the northwest of Poland, while the second consists of Slovenian and Croatian cities. The fourth cluster comprises a significant proportion of southwestern Poland, Czech, Slovakian and Hungarian cities, while the third one includes all other cities outside of it. By examining the features of the four clusters, we can state that the third has more than half of the income and nearly eight tenths of the population. In the case of net revenues, however, Cluster 4 is the most dominant. Cluster 4 is the most decisive factor for both per capita income and per capita revenues which is the region's dominant spatial unit (Table 8).

*Table 8*  
*The share of clusters, 2015*

Cluster	Revenue	Net income	Population	Revenue per capita	Net income per capita
Cluster 1	3.6	1.1	1.9	187.5	57.2
Cluster 2	5.5	4.8	3.0	182.7	156.7
Cluster 3	56.7	20.0	77.9	72.8	25.6
Cluster 4	34.1	74.2	17.1	199.3	433.3
Total	100.0	100.0	100.0	100.0	100.0

Source: Own compilation based on Deloitte Central Europe Top 500



Source: Own compilation based on Deloitte Central Europe Top 500

*Figure 4. Clusters of settlements in the 2015 CEE500 list*





Source: Own compilation based on Deloitte Central Europe Top 500

Figure 5. Clusters of settlements in the Technology, Media & Telecommunications industry of CEE500 enterprises, 2015

Table 9  
The share of clusters in TM&T industry, 2015

Cluster	Revenue	Net income	Population	Revenue per capita	Net income per capita
Cluster 1	26.8	16.9	12.9	207.3	130.9
Cluster 2	30.7	14.8	10.4	294.8	141.6
Cluster 3	42.5	68.3	76.6	55.4	89.1
Total	100.0	100.0	100.0	100.0	100.0

Source: Own compilation based on Deloitte Central Europe Top 500

We can distinguish three clusters for TM&M. The first cluster belongs to Warsaw, which can be considered as the regional centre of the sector. The second cluster is the capitals of the region (except Ljubljana) supplemented with Rzeszów. The remaining cities can be classified in the third cluster. The characteristics of the clusters are shown in Table 9.

## CONCLUSION

In our work, we tried to outline the economic structure of Central and Eastern Europe. We have proven that the Central European Pentagon and the New Banana model are best able to describe the region's economic structure. We indicated that the highest economic potential and the strongest command and control functions were noted for the capital cities of the five largest countries in Central and

Eastern Europe: Budapest, Prague, Warsaw, Bratislava and Bucharest.

It can be concluded that the role of the TM&T industry within the 500 most important companies in the Central and Eastern Europe region is relatively small. Currently the role of this sector in the 500 most important enterprises appears to be declining, in contrast to the general trends of the world economy. This, in turn, is a general, but in our opinion, short-term – trend in the region, and we consider it important to study as one of the keys to future spatial structure processes.

In terms of the TM&T industry, the importance of the cities in the region, including Warsaw, can be highlighted, which capital is not only this industry but also in general the most important economic centre of the region. From

the point of view of spatial structure, the western part of the region can be characterized by positive processes, which correspond most closely to the area bounded by the New Banana spatial structure model.

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