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Central and Eastern European regional centers in the focus of urban rankings and urban indexes

Abstract
The relevance of the paper is predetermined by the fact that nearly 75% of the population in the European Union live in cities, so the European Union is committed to making cities more sustainable. Thus, recent years have seen an increasing need for studies on urban indexes measuring European cities as well as those on the evaluation of the indexes.
The purpose of this paper is to prove that Central and Eastern European medium-sized cities as regional centers are an under-researched area in social science research. While one typical trend of this research is ranking based on various aspects as well as the determination of leading cities, the regional centers of Central and Eastern European countries are only tangentially included in this research.
The research objectives: The analysis examines 94 regional centers in ten Central and Eastern European countries (Austria, Bulgaria, Czech Republic, Croatia, Hungary, Poland, Romania, Serbia, Slovakia, and Slovenia) with regional functions at NUTS2 level based on a total of 41 different economic indexes and rankings. The research was based on the Eurostat Urban Audit database and the keyword search engine of scientific search engines such as Web of Science, Science direct, and Google Scholar. The research question: Which Central and Eastern European regional centers are examined by the different city rankings and indexes?
The research results and conclusions are the following:
1) As a result of the research, it was found that out of the 94 regional centers, the most examined cities are Krakow, Wroclaw and Brno. A randomly selected city is included in only 11% of the studied rankings and indexes.
2) However, half of the Central and Eastern European capitals are considered areas for city rankings and indexes. The most studied capitals are, ranked in order of focus; Budapest and Prague, Vienna, Ljubljana, Bratislava, Sofia, Warsaw and Zagreb.
3) Based on the correlation analysis, we found a strong relationship between two indicators (Cultural Creative Cities Index and Smart Cities Index) which suggests that it would make sense to explore further relationships for which it is indispensable to have the right quality and quantity of data.

All in all, it would be worthwhile creating an economic index measuring the performance of Central and Eastern European regional centers which could help regional and city governments as well as potential investors get an up-to-date and comprehensive picture of regional centers in the region.

Keywords: Regional Centers; Urban Research; City Rankings; City Index; Central and Eastern Europe
JEL Classification: O18; P25
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1. Introduction

According to the European Commission (EC, 2021a, 2021b), the level of urbanization in Europe (i.e. urban land expansion and increasing population density) is an ongoing and observable trend which is expected to increase to approximately 83.7% of urban citizens in 2050 which provides challenges that contemporary European cities and societies will need to tackle. Hence, the European Union is committed to making its cities more sustainable (European Union, 2011). Thus, recent years have seen an increasing need for studies on urban indexes measuring European towns as well as those on the evaluation of the indexes. Good examples of such rankings and indexes are: the European Green Capital Award, the European Green City Index, Urban Ecosystem Europe, and the European Energy Award. Research of this kind helps politicians, city leaders, and urban developers understand how globalization and urbanization affect urban areas, and also serves as a planning and evaluation tool (Meijering, Kristine Kern & Tobias, 2014). As Polyakova and Tsurik (2019) stated recently, the level and pace of socio-economic development of the region is determined by various factors (geographical location, natural resources, human capital, fixed capital, and many others) (Polyakova & Tsurik, 2019). Urban environment quality is one of the most important indicators of the economic status of cities and factors of their development. Urban rankings equally provide important information to potential investors - helping them navigate the world of urban places.

The starting point of the research is the statement of Akande, Cabral, Gomes & Casteleyn (2019), whose analyses conducted in recent years have typically covered capitals. The present study examines whether this statement is also valid in Central and Eastern European countries. The research examines economic rankings and indexes by comparing cities in terms of the extent to which regional centers in Central and Eastern Europe are included as analyzed areas in these rankings and indexes. The core research question of the study is which Central and Eastern European regional centers are included in these rankings and indexes.

The study examines the regional centers of Central and Eastern European countries (Austria, Bulgaria, Czech Republic, Croatia, Hungary, Poland, Romania, Serbia, Slovakia, and Slovenia) based on the economic indexes and city rankings known in the literature. The analysis confirmed that in addition to the regions' capitals, regional centers are an under-examined area, thus it would be of importance to create a city index covering regional centers which can provide an up-to-date and comprehensive picture of the Central and Eastern European region. This economic index would contribute to and help the orientation of potential investors wishing to invest in the region, as well as the regional and city leaders in the development of cities.

In terms of its structure, the study begins with the tangential presentation of the concept of competitiveness, then it examines the economic indexes and rankings measuring competitiveness from the viewpoint of Central and Eastern European regional centers. The study concludes with a proposal to create a new economic index which is aimed at examining the competitiveness of Central and Eastern European centers.

2. Brief Literature Review

Economic indexes and rankings cannot be explored without an interpretation of the concepts of competitiveness and urban competitiveness in the context of the present study. The concept of competitiveness has been examined by many disciplines such as economics, management, and regional science (Pupp & Filep 2021; Didenko, Valaskova, Artyukhov, Lyeonov, & Vasa 2022; Zhurauliou, Palomino, Gulevych, & Vasa 2023). That is, competitiveness is a widespread concept (Lengyel, 2004), and by now has been embedded in everyday economic discourses (Stryjakiewicz, Gritsai, Dainov & Egedy, 2013). Several studies have been conducted on the various interpretations of the notion of competitiveness and its history of development (Krugman, 1994; Porter, 1998; Camagni, 2002, Lengyel, 2004, 2016). The OECD and the European Commission have summarized the concept as follows: competitiveness is the ability of firms, industries, regions, nations or supranational regions to create a relatively high income and employment level on a sustainable basis, while being exposed to foreign economic (global) competition (OECD 1997; EC 1999). Nevertheless, the concept of territorial competition refers to a form of community action that, by undertaking the economic interests of a given area, provides progress in resource competition with other regions (Cheshire-Gordon 1995, 1996; Vasvári et al., 2020). Shen (2004) summarized the dimensions and factors determining territorial competitiveness, distinguishing between the key elements of country, city, sector, and corporate competitiveness. The regional dimension of the knowledge production and its impact on the city-led regional development is highlighted by Spaller and Vasa (2020).

To measure competitiveness, various organizations such as international governmental and non-governmental organizations, foundations, consulting companies, and the media all create various rankings, and then they present the results of these rankings to the general public through global platforms (Scolari, 2008; Carrera Portugal, 2019). Leff and Petersen (2015) argue that the first city ranking was created in 1970, when the Swiss bank UBS released its first Prices and Earnings Survey to compare the purchasing power of citizens in 72 cities around the world. Since then, the number of city rankings have increased substantially because cities use them to compare and improve their competitiveness (Giffinger, Haindlmaier & Kramar, 2010). The role of rankings is growing with city competition (Seigneur, 2016). Ann, Tuan Lonik & Adam (2020) stated that several indexes and rankings had been created with the aim of defining, measuring and assessing the quality of life and the competitiveness of countries, regions and cities. Rankings and indexes can be grouped by the type of organizations that create them, by sample size, by territorial delimitation (international, national, regional, and city) as well as by the frequency of publication (published annually or irregularly) (Carrera Portugal, 2019). Nevertheless, the range of its variables is also wide. The subjects of the ranking can be people, countries, cities, areas, brands, universities, and other organizations (Perló & Carrera 2007).

As the focus of the present study is put on cities, it deals with city indexes and rankings in more detail. As Begg (1999) pointed out in his study, the analysis of the competitiveness of cities is a topic of importance since they compete with each other at various levels regionally, nationally, and internationally, and their position in urban hierarchy rankings is constantly changing. All in all, the economic success of a city can contribute to the national performance.

Urban competitiveness studies in recent years have typically covered capitals (Akande, Cabral, Gomes & Casteleyn, 2019), thus we propose the creation of a city index covering regional centers which can provide an actual and broad picture of the Central and Eastern European region. This economic index would contribute to the orientation of potential investors wishing to invest in the region and help regional and city management in the development of cities.

3. The purpose

The purpose of the study is to provide a comprehensive picture of economic indexes and city rankings examining Central and Eastern European cities. Having analyzed the literature, the study examines 41 economic rankings and indexes in detail with regard to whether Central and Eastern European regional centers can be considered as research areas or still as less explored areas. The study serves as a groundbreaking study to create an economic index measuring regional centers in Central and Eastern Europe.

4. Materials and Methods

During the analysis, we sought to answer the question of which major Central and Eastern European cities are studied by the various city rankings and urban indexes. The analysis is based on the Eurostat Urban Audit database as well as on urban rankings and indexes. The study examines 94 regional centers with a population of 100,000 and 1 million in 10 countries in the Central and Eastern European region (Austria, Bulgaria, Czech Republic, Croatia, Hungary, Poland, Romania, Serbia, Slovakia, and Slovenia) (Table 1).

Table 1:
Cities involved in the research

Country	City
Austria	Graz, Linz, Salzburg, Innsbruck, Klagenfurt
Bulgaria	Plovdiv, Varna, Burgas, Pleven, Ruse, Stara Zagora
Czech Republic	Brno, Ostrava, Plzen, Olomouc, Liberec
Croatia	Rijeka, Split, Osijek
Poland	Lodz, Krakow, Wroclaw, Poznan, Gdansk, Szczecin, Bydgoszcz, Lublin, Katowice, Bialystok, Kielce, Torun, Olsztyn, Rzeszów, Opole, Gorzów Wielkopolski, Zielona Góra, Czestochowa, Radom, Plock, Kalisz, Koszalin, Gdynia, Sosnowiec, Gliwice, Zabrze, Bytom, Bielsko-Biala, Ruda Slaska, Rybnik, Tychy, Walbrzych, Elblag, Wloclawek, Tarnów, Chorzów, Legnica, Dabrowa Górnicza
Hungary	Miskolc, Nyíregyháza, Pécs, Debrecen, Szeged, Győr, Kecskemét, Székesfehérvár
Romania	Cluj-Napoca, Timisoara, Craiova, Braila, Oradea, Bacau, Arad, Sibiu, Târgu Mures, Constanta, Iasi, Galati, Brasov, Ploiesti, Pitesti, Baia Mare, Buzau, Satu Mare, Botosani, Piatra Neamt, Suceava, Ramnicu Valcea, Drobeta-Turnu-Severin
Serbia	Subotica, Novi Sad, Nis, Kragujevac
Slovakia	Kosice
Slovenia	Maribor

Source: Own compilation

Among the ten countries, Poland has the highest proportion of population living in a large city - nearly one out of four Polish citizens live in a large city. The same proportion is 23% in Romania, and 28% in Bulgaria (EU Urban Audit, 2019). Figure 1 illustrates the number of large cities and the ratio of their inhabitants in proportion to the total population.

The research focused on to what extent Central and Eastern European large cities are studied via the various urban indexes and rankings. During our research, we reviewed several international indexes and rankings; indexes and rankings were selected by using keywords (city ranking, city index, Europe, Central-Eastern-Europe, medium-sized cities) in scientific search engines (Web of Science, Science direct, Google Scholar) based on three starting points. The quantity and the quality (to be presented in detail later) of the data collected this way predicts the research question, namely, that a new index needs to be created. Table 2 includes the examined city rankings and indexes.

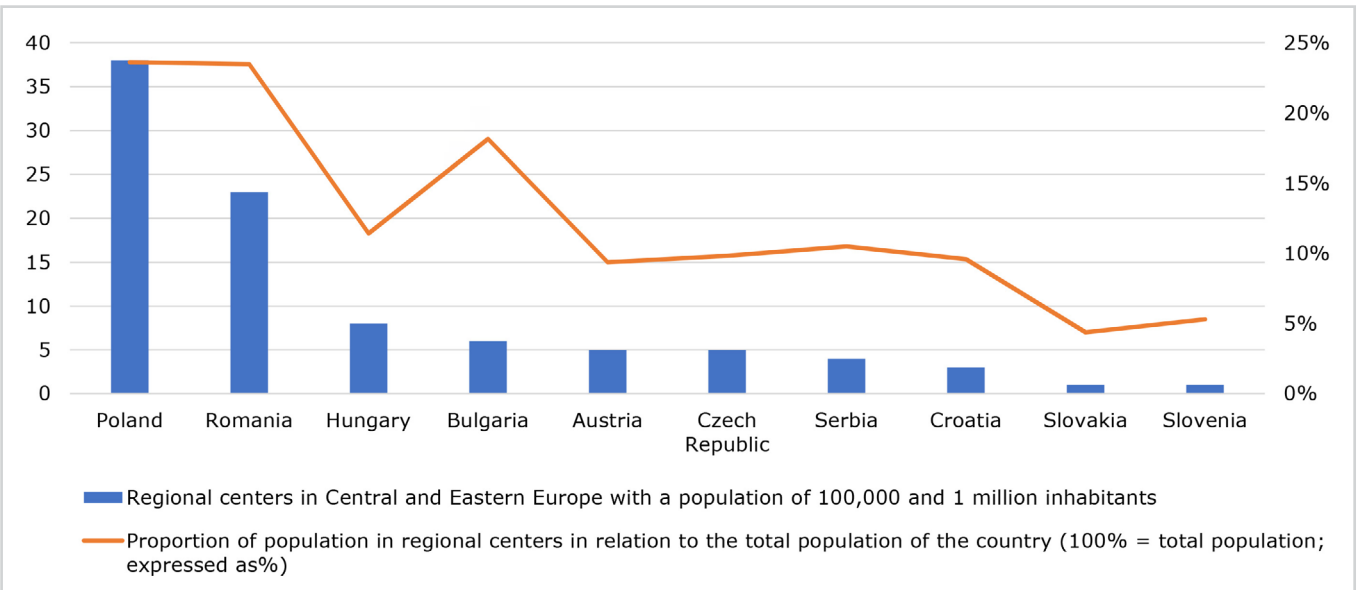

Figure 1:
Regional centers and their criteria in Central and Eastern Europe
Source: Own compilation based on the EU Urban Audit (2019)

Table 2:
Examined city rankings and indexes

1	QS Best Student Cities 2020
2	QS World University Rankings 2020
3	Numbeo Cost of Living Index 2021
4	Numbeo Rent Index 2021
5	Numbeo Groceries Index 2021
6	Numbeo Restaurants Index 2021
7	Numbeo Cost of Living Plus Rent Index 2021
8	Numbeo Local Purchasing Power 2021
9	Numbeo Current Crime Index 2021
10	Numbeo Safety Index 2021
11	Numbeo Pollution Index 2021
12	Numbeo Traffic Index 2021
13	Numbeo Time Index in minutes 2021
14	Numbeo Time Exp Index 2021
15	Numbeo Inefficiency Index 2021
16	Numbeo CO2 Emission 2021
17	Europe Backpacker Index 2022
18	Post Office Travel Money, UK 2020
19	European Capitals of Culture 1985-2023
20	UNESCO's Creative Cities Network 2016
21	UNESCO's Creative Cities Network 2019
22	Cultural and Creative Cities Monitor 2017
23	Cultural and Creative Cities Monitor 2017 Creative Vibrancy
24	Cultural and Creative Cities Monitor 2017 Creative Economy
25	Cultural and Creative Cities Monitor 2017 Enabling Environment
26	Cultural and Creative Cities Monitor 2019
27	Innovation Cities ™ Index 2018
28	Innovation Cities ™ Index 2019
29	Smart Cities Monitor 10 2007 (Giffinger et al, 2007)
30	Smart Cities Monitor 20 2013 (Giffinger et al, 2013)
31	Smart Cities Monitor 30 2014 (Giffinger et al, 2014)
32	Smart Cities Monitor 40 2015 (Giffinger et al 2015)
33	Report on the Quality of life in European Cities 2020
34	World best cities - Best Cities is the home of Resonance Consultancy's exclusive ranking of the world's top urban destinations 2020
35	Economist Safe cities index 2015-2018
36	UNESCO World Heritage 2020
37	Global Destination Cities Index 2019
38	European Green City Index 2009
39	NESTA European Digital City Index 2016
40	Lloyd's City Risk Index Europe 2018
41	fDi European Cities and Regions of the Future 2020-21

Source: Own compilation

With regards to time series city rankings and indexes that are compiled based on the same methodology, we always considered the most up-to-date records, thus a total of 41 city indexes and rankings were included in the research. However, as there were special indexes and rankings, the methodology or sample of which had changed over the years, we included all of them in the research. Such cases included, for example, Giffinger et al. (2007, 2013, 2014, 2015), Smart Cities Monitor 1.0, 2.0, 3.0 and 4.0., where we examined whether the sample of the ranking (Smart Cities ranking 1.0 - 4.0) included the given large city. Another special case was the UNESCO Network of Creative Cities, founded in 2004, which was first expanded in 2016 and then in 2019 with 66 cities, thus today there are 246 cities on the list. Currently, there are only three Central and Eastern European cities in the network, namely Katowice, Krakow and Wroclaw. In the case of the Cultural and Creative Cities Monitor (2017) and its sub-indicators, creative attractiveness, creative economy and environment, as well as of the 14 different sub-indexes of Numbeo (included in Note 3), we examined if the study covered cities examined by us.

The analysis was first carried out in connection with the 94 regional centers of Central and Eastern Europe, and then regarding Central and Eastern European capitals based on a total of 41 different city indexes and rankings.

Finally, we performed a correlation analysis to figure out whether there is a relationship between the indicators based on existing data. For the correlation analysis between each city index and ranking, we first determined which indicators have a sufficient number of cases so that the correlation analysis could be interpreted.

5. Results

5.1. Results regarding regional centers

As a result of the research, it was ascertained that a randomly selected city out of the 94 cities is included in 11% of the rankings and indexes examined. The minimum amount of randomly selected cities is zero and the maximum is 90%. Moreover, there is no city which is included in all indexes and city rankings. The largest cities that reached the highest efficiency were: Krakow (90%), Wroclaw (65%), Brno (60%), Graz, Katowice, Poznan, Timisoara (40%), Cluj-Napoca, Gdansk, Kosice (35%), Linz, Lodz, Maribor, Split (30%), Iasi, Novi Sad, Pécs, Plovdiv, Salzburg, Varna (25%), Ostrava, Sibiu (20%), Brasov, Lublin, Olomouc, Plzen, Rijeka, Szeged, Torun (15%), Burgas, Craiova, Debrecen, Győr, Innsbruck, Osijek, Ruse, Szczecin (10%), Arad, Baia Mare, Bialystok, Bydgoszcz, Constanta, Gdynia, Klagenfurt, Liberec, Nis, Oradea, Pleven, Ploiesti, Rzeszow (5%). The other 43 cities were not included in any of the city rankings and indexes, therefore their efficiency is zero. Figure 2 demonstrates the efficiency rate of the regional centers.

We also examined the efficiency of the cities by country (Figure 3). It is clear that two out of the first three most efficient regional centers are Polish: Krakow and Wroclaw, whereas the third is a Czech city: Brno. Furthermore, there were 43 cities which were not included in any of the indicators, so their efficiency is 0%. Only one city was included in 90% of the indicators, and this was Krakow.

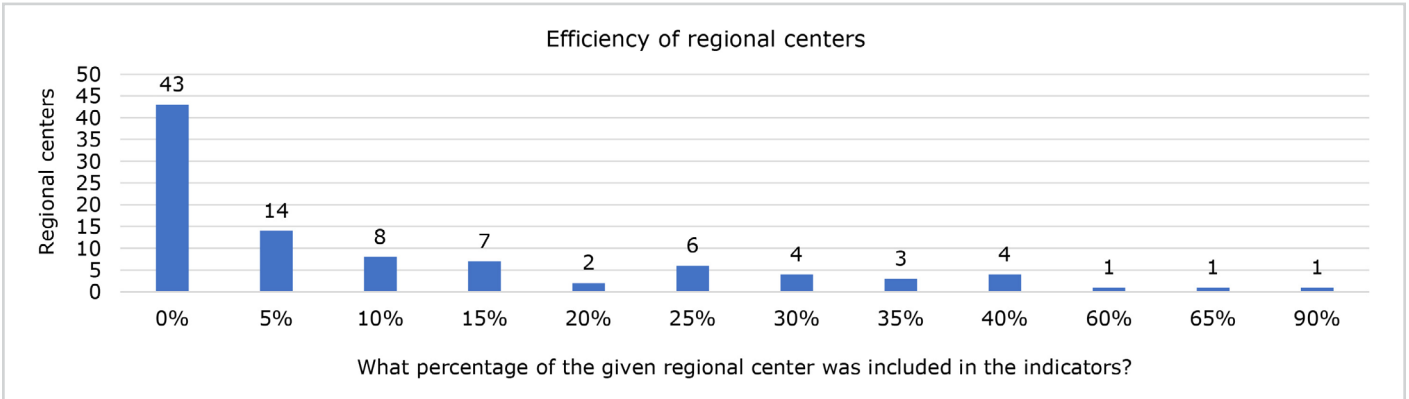

Figure 2:
The efficiency rate of the regional centers in the examined indexes and rankings (number of cities)
Source: Own compilation

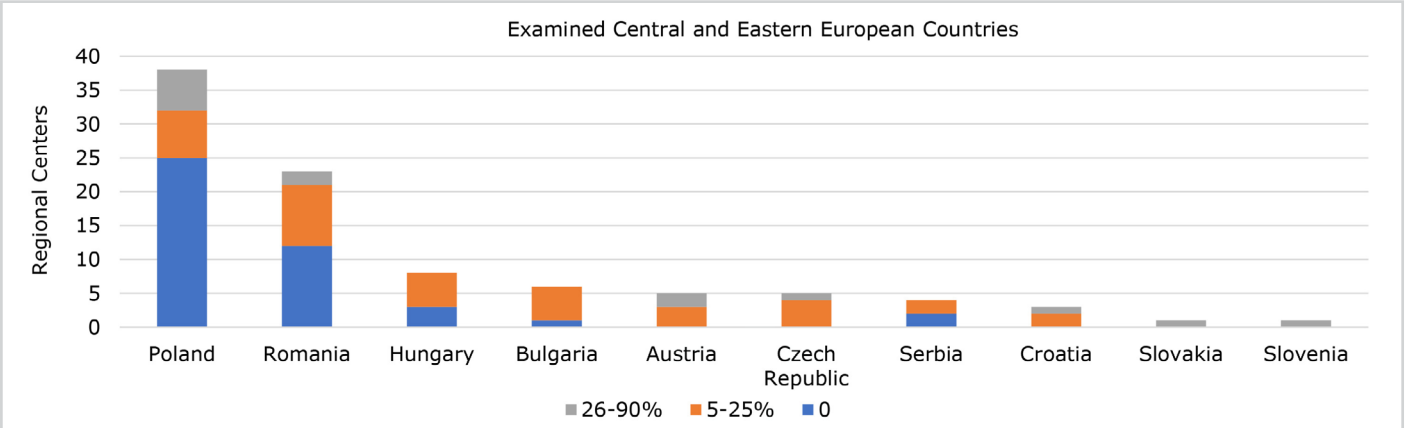

Figure 3:
Regional centers grouped according to their efficiency in the examined indexes and rankings by country (0%- ineffective, 5-25%- moderately effective, 26-90% effective)
Source: Own compilation

5.2. Results regarding Central and Eastern European capitals

As the research examines the Central and Eastern European region, we studied the frequency with which the capitals of this region occur as studied areas in these rankings and indexes. As Figure 4 shows, the analysis proved that capitals are considered as studied areas.

Figure 5 illustrates the efficiency of Central and Eastern European capitals. With regard to capitals, it was found that they occur as studied areas in at least half of the indexes and rankings. Budapest and Prague occurred in the majority of the cases (two thirds), then Vienna did so in 70% of the indicators, whereas the other five capitals (Ljubljana, Bratislava, Sofia, Warsaw and Zagreb) occurred in 65% of the indicators.

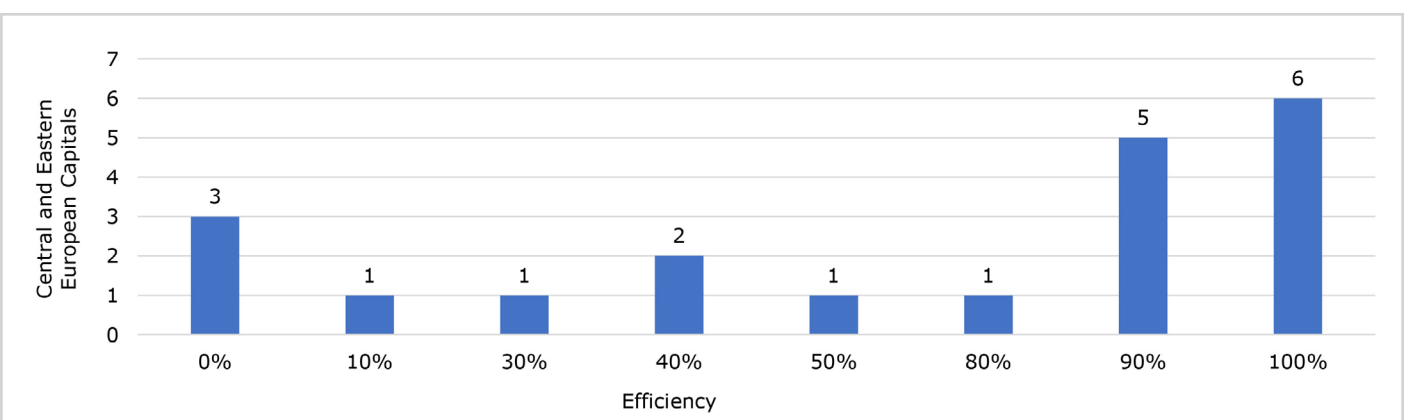

Figure 4:
The occurrence of Central and Eastern European capitals in the examined city rankings and indexes (100%= all 10 capitals are included in the index and ranking)
Source: Own compilation

5.3. Correlation analysis

The analysis of the correlation between each city's index and ranking indicates the occurrence of the 94 large cities with regard to the involved indicators.

In Figure 6, we disregarded the indicators that reached 0%, moreover, a total of four indicators reached a number of cases above 20%. The highest number of cases (40%) was reached by the Numbeo Cost of Living 2021 indicator, which means that 40% of the 94 large cities were examined in the Numbeo Cost of Living 2021 index. In the case of the indicators that reached a number of cases above 20%, it is worth carrying out a correlation analysis, therefore we present an example of this in the following section.

In the course of the correlation analysis, we looked at whether there is a relationship between the two indicators based on existing data. For example, is there a relationship between the index

of Numbeo Cost of Living (2021) and QS University (2020) rankings? Table 3 illustrates the result of this correlation analysis.

60% of the cities examined in the QS University Rankings (2020) are also included in Numbeo Cost of Living (2021) ranking. Moreover, 40% of the cities examined in Numbeo Cost of Living (2021) ranking are not included in the QS University Ranking (2020). This means that there is a strong relationship between the two indicators. The relationship revealed by the presented correlation analysis clearly illustrates that it would make sense to explore further relationships, for which it is essential to possess data of adequate quality and quantity.

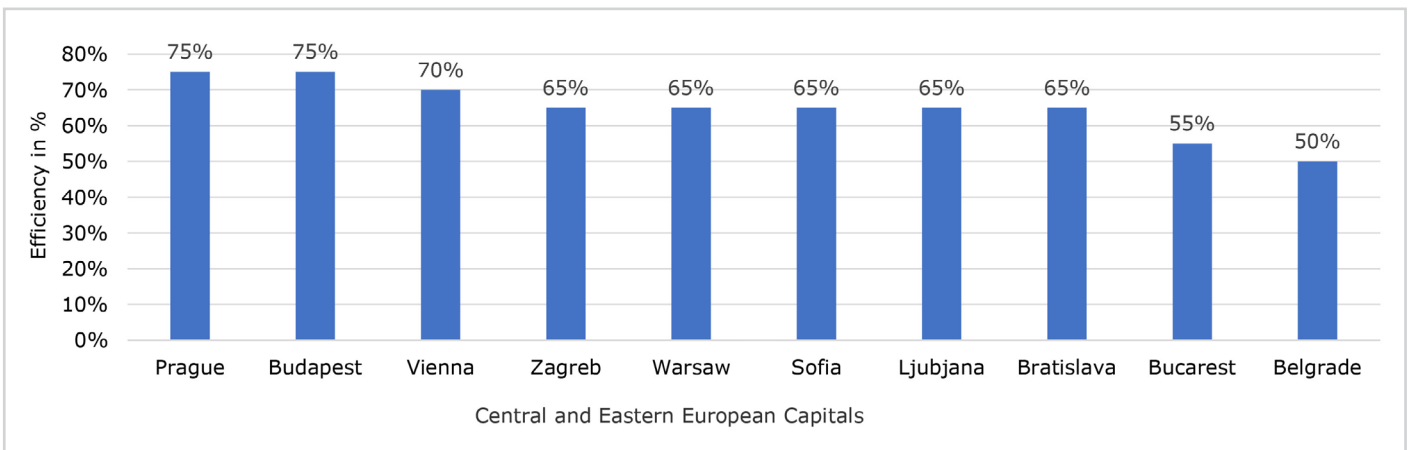

Figure 5:
The efficiency of the Central and Eastern European capitals in the examined rankings and indexes (100% = included in all rankings and indexes)
Source: Own compilation

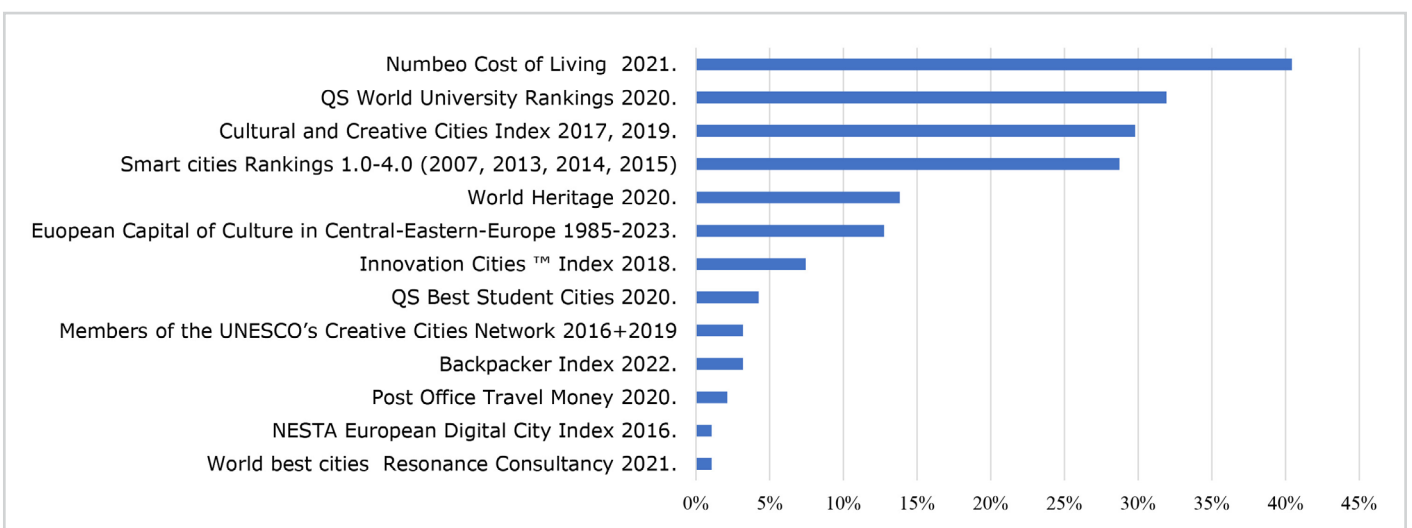

Figure 6:
City indexes and rankings included in the research in light of Central and Eastern European large cities (expressed in %)
Source: Own compilation

Table 3:
Correlation analysis between the rankings of Numbeo Cost of Living (2021) and QS University Rankings (2020)

	Not included in Numbeo Cost of Living (2021)	Included in Numbeo Cost of Living (2021)
Not included in QS University Ranking (2020)	80%	40%
Included QS University Ranking (2020)	20%	60%

Source: Own compilation

6. Discussion

In Central and Eastern Europe, the analysis of regional centers lags far behind capitals, a reason for which is the lack of official data on each city. Since having looked at the Eurostat database, we could see that the data on medium-sized cities are incomplete. According to us, another reason is that there is no uniform reporting obligation, as, for example, Poland provides data every year up to NUTS3 level, whereas in the case of Serbia or Bulgaria, shortcomings have been experienced for years. If we want to use data of the statistical offices of each country, it is important to review the detailed methodological description and to apply a uniform methodology. However, in many cases, data collection varies from country to country. These facts highly complicate the more in-depth analysis of regional centers.

7. Conclusion

To sum up the results of the study, the author agrees with Carrera Portugal's (2019) statement that there is a need for creating further city rankings and indexes. In particular, the author supports the elaboration of measurements that include variables deriving from the social, multicultural and participatory dimensions of urban structure. The present study tried to verify the timing and necessity of creating an economic index examining the regional centers of Central and Eastern Europe through the executed examination of city indexes and rankings.

As a result of present research, it can be concluded that the studies concerning Central and Eastern European regional centers focus mainly on the capitals; firstly, on Vienna, Budapest and Prague, and then on Ljubljana, Bratislava, Sofia, Warsaw and Zagreb, and finally on Belgrade and Bucharest. The analysis of regional centers lags far behind that of the capitals, a reason for which is the lack of official data on each city. In terms of regional centers, the following cities were among the ten most surveyed cities: in Poland: Krakow, Wroclaw, Poznan, Katowice, Gdansk, in the Czech Republic: Brno, in Austria: Graz, in Romania: Timisoara, Cluj-Napoca, and in Slovakia: Kosice.

It is important to note that the Central and Eastern European region, as well as its regional centers, where nearly a quarter of the population lives, has a high concentration of functions and spatial capital and is an area with important economic potential. However, we recommend the creation of an economic index that focuses on Central and Eastern European regional centers; helping them catch up with their Western European counterparts so that investors wishing to establish a new location can assess the potentials of these centers and gain a more comprehensive picture of these cities. This way, more success stories would be revealed in Central and Eastern Europe such as Katowice, Wroclaw, Poznan, Szczecin, Debrecen, Miskolc and Nis which were ranked among the top 10 investment destinations in the world in 2021 in the authoritative international FDI ranking (in the category of large European city: Katowice (5), mid-sized European city: Wroclaw (4), Poznan (8), Szczecin (10), and in the category of Small European City: Debrecen (2), Miskolc (5), Nis (6)) (European Cities and Regions of the Future 2020/2021).

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