

Dynamic of urban-rural interface in Romania in transition and post-transition period

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Abstract: This paper analyzes the evolution of the Romanian urban system and its urban-rural interfaces during the transition and post-transition periods, focusing on the demographic shifts between 1992 and 2022. Using data from the Romanian National Institute of Statistics and a rank-size analysis, the study identifies patterns of population growth, decline, and redistribution at various spatial scales, including cities and their surrounding rural areas. The analysis highlights significant trends, such as urban shrinkage in small industrial cities and suburbanization around larger urban centers, while examining how these changes have reshaped the national urban hierarchy. The study also evaluates the impact of policy interventions, economic transitions, and geographical factors on urban dynamics. The findings provide a foundation for local authorities to better understand migration trends and inform policy decisions that promote equitable urban development.

1. Introduction

An urban system represents “a set of interlinked cities and towns set within a specific country territory (e.g., the nation or the globe)” (Gregory et al., 2011). This concept is further refined by Li & Kwan (2018), who highlight the role of hierarchy and specialization in Chinese urban systems through spatial clusters and centrality functions. Alonso (2018) introduces a complementary theory of the urban land market, explaining how economic forces shape the distribution of urban spaces. Koster & Thisse (2024) provide insights into urban systems' economics of agglomeration, highlighting how larger cities tend to attract more resources and people. In this analysis, the urban system as defined above is considered the national urban system, while the urban system in this paper comprises the spatial unit (a city with its surrounding area) that contains all daily flows of people, goods, and information. This way, the definition used in this analysis for the urban system aligns closely with Ortman, Lobo & Smith's (2020) notion of functional urban areas, also paralleling Geyer's (2002) urban daily system definition. In similar terms, Rozenblat and Pumain (2018) discuss how European cities have adopted specialized roles in a polycentric system, illustrating urban dynamics through metropolization and centrality.

Among the characteristics of urban systems are hierarchy, centrality, specialization, and primacy (Ianoș & Humeau, 2000; Yang et al., 2022). Fujita (2020) offers an economic perspective on urban systems, examining how city size and land use dynamics contribute to their hierarchical structure. The spatial structure of urban systems is similarly discussed by Miranda et al. (2020), who explore the emergence of urban centralities in medium-sized historic cities, shedding light on centralization processes that are also relevant in Romanian cities. Veneri et al. (2025) expand on this by analyzing

how spatial structure influences the growth of urban areas, making their research applicable to the evolving Romanian urban system. The limits of an urban system vary depending on the criteria used: population, density, commuting flows, commuting time, type of houses, land use, etc. (Rozenblat & Pumain, 2018; McCann & van Oort, 2019). In line with this, Salvati (2018) highlights the significance of 'niche cities,' where specialization niches determine urban functions, reflecting the complex interplay of local urban dynamics. The relationship between functional urban areas and polycentric systems is also evaluated by Wang et al. (2020), who consider how functional linkages contribute to the emergence of polycentric urban regions.

As there is no universal definition for cities, the urban system (comprising the city and its urban-rural interface) remains equally fluid (Phelps, 2021). Different organizations have developed their own terms and methods to differentiate urban from rural areas. For instance, the European Union, OECD, and World Bank use the term "functional urban area," defined as "a city and its commuting zone," which integrates densely inhabited cities with less dense commuting areas (OECD, 2012). In Romanian legislation, the term "metropolitan area" is used, defined as "an intercommunity development association created on a partnership basis between the Romanian capital or first-rank municipalities and surrounding administrative-territorial units" (OUG 57/2019 art. 5, qq). Zdanowska et al. (2020) explore similar dynamics in Western and Eastern Europe, analyzing the evolution of urban systems and their connectivity. Goodchild & Li (2021) also discusses how spatial networks contribute to urban planning decisions, emphasizing the role of network theory in understanding urban system connectivity. Knox and Mayer (2019) focus on small town sustainability, providing valuable insights into the relationships between urban systems and rural peripheries. The new metropolitan law (Law 246/2022) elaborates further, discussing how co-influence relationships in transport, economy, and society shape metropolitan areas.

The method used for defining the urban system is critical, as it influences all indicators and statistical data (Cottineau, 2017; Bettencourt et al., 2021). This is further emphasized by Gu et al. (2023), who examine how city hierarchies and polycentric urban structures influence megaregions, offering insight into the impact of centrality and functional linkages on broader urban dynamics. The concept of urban hierarchies can also be seen in the work of Li & Kwan (2018), who illustrate the relationship between centrality and urban specialization, reflecting on how such dynamics influence both city sizes and functions. Similarly, Fujita and Ogawa (2020) describe multiple equilibria in urban systems, contributing to the understanding of how urban structures transition between different economic states.

At the national level, there are many small towns, fewer medium-sized cities, and only a few large ones. Larger cities typically offer more specialized products, requiring a higher population threshold to sustain them. This distribution of urban areas by size follows the pattern of Zipf's Law, first described by Zipf in 1949 (Fang et al., 2016). This rule states that the second-largest city has a population equal to half of the largest, the third-largest city has a population equal to a third, and so on (Waugh, 2008). The rank distribution of cities thus forms a loglinear pattern, a concept expanded by Ducruet (2020), who revisits urban hierarchy and specialization from a maritime perspective, linking it to global connectivity. Batty and Marshall (2021) further explore the dynamics of urban growth and scaling laws, offering modern insights that align with Zipf's original theories. In support of these models, Carlucci et al. (2020) investigate how the diversification of urban functions contributes to metropolitan complexity, offering valuable insights into urban dynamics across different geographical contexts.

As an urban hierarchy model, Zipf's law reflects the underlying processes of urban dynamics, regardless of economic, cultural, or political systems (Cura et al., 2017). The relevance of this model to different economic systems is highlighted by Moriconi (1993), who notes that in socialist economies, the curve of city distribution is typically convex, while in market economies, it tends to be concave. This correlation is further explored

by Hussain et al. (2019), who analyze city hierarchies within global networks, offering a comparative perspective that applies to both Romania's socialist past and its current market economy. Similarly, Bartosiewicz and Marcińczak (2020) discuss the impact of different measures of polycentricity on urban systems, illustrating how functional linkages and hierarchy influence urban networks. Pacione (2019) contributes by addressing urban geography from a global perspective, comparing the evolution of urban forms across different nations, with insights applicable to Romania's post-socialist transformation. Clark (2020) provides additional context by exploring the global rise of urbanization and the urban world, linking these trends back to Romania's evolving urban hierarchy.

The Romanian national urban system has a long history of evolution, with the first cities emerging in Antiquity, including Greek cities like Tomis (now Constanța) and Roman cities like Apulum (now Alba Iulia). During the medieval period, new urban centers such as fortresses and trade fairs appeared (e.g., Bucharest, Brașov, Sibiu). Rozenblat (2018) discusses similar historical specializations in cities across Europe, illustrating how such early developments influence contemporary urban systems. Over the last century, the Romanian national urban system has gone through significant transformations, marked by four stages of evolution (Ianoș, 2004).

The first stage, from 1920 to 1970, was a period of concentration. Despite the disruptions caused by the two World Wars, Bucharest emerged as the primate city, with a large population discrepancy from the rest. By 1950, administrative reforms had divided the country into regions, and cities with over 100,000 inhabitants saw significant growth due to industrial investments. Cities like Galati, Craiova, and Constanța experienced similar demographic booms, largely due to large industrial enterprises (Cottineau, 2017). This period mirrors developments in other parts of Europe, as described by Pumain and Rozenblat (2019) and Batty (2019), where urban scaling and centrality reshaped city growth patterns.

The second stage, from 1970 to 1989, was characterized by the rise of intermediate cities. Following the 1968 administrative reforms, 41 cities became county seats, which prompted industrial investments and spurred population growth in these mid-sized urban centers. The period also witnessed a wave of suburbanization, where rural residents began living in the urban-rural interface and working in city cores, a phenomenon echoed in Zhang et al. (2020) study of urban-regionalization in China's Pearl River Delta. This stage marks a shift toward what Meijers (2005) describe as polycentric urban networks, where centrality and specialization become diffused across a broader set of cities.

The third stage, from 1990 to 1995, saw a return to the primacy of large cities, as Romania transitioned from a socialist to a market economy. Migration restrictions were lifted, and larger cities such as Bucharest, Timișoara, and Constanța experienced concentrated growth. This period of re-concentration was not limited to Romania; similar processes are discussed by Wang et al. (2020), who examine how centrality and polycentric urban structures evolved in other post-socialist countries. Romania's shift toward a capitalist economy led to increased mobility and urban migration, mirroring trends across Eastern Europe (Zdanowska et al., 2020).

The post-transition stage, beginning in 1995 and continuing to the present, has been marked by counter-urbanization, where populations move from cities to rural areas, leading to the creation of extensive urban-rural interfaces. This trend is particularly relevant in the context of shrinking towns, where small towns lose population in both their urban core and interface. Rozenblat and Pumain (2018) discuss similar patterns of shrinkage and centrality loss in smaller European cities, providing a useful comparative framework. This stage also reflects Bettencourt's (2021) findings on urban scaling and the changing role of city sizes and networks in global urban systems. Finally, Rodrigue (2020) explores how transport systems influence the spatial structure of cities, further contributing to the understanding of urban dynamics in Romania.

This study focuses on analysing the evolution of urban systems (at system, city and urban-rural interface level) in the last two stages of evolution, with the purpose of understanding the changes that happened in the national urban system and their underlying causes, as well as for predicting future attractive and/or repulsive places for migrants and allowing local authorities to intervene to reverse or encourage those trends. This type of analysis is essential in order to understand the weak links in the national urban system for a cohesive and equitable urban distribution, as well as for understanding the future internal migration trends and improving the local decision-making and governance process based on them.

2. Materials and Methods

This study employs a quantitative approach, utilizing demographic data from the Romanian National Institute of Statistics (INS) for the period between 1992 and 2022. The data covers population changes in Romanian cities and their surrounding areas. To analyze the hierarchical structure of the Romanian urban system, a rank-size rule analysis was applied. The cities were ranked based on their population size, and their rank was plotted against population to examine the conformity of the system with Zipf's Law. Deviations from the rank-size distribution were identified, highlighting the dominance of Bucharest as the primate city and revealing regional disparities in urban growth. In addition to the rank-size analysis, commuting flow data and population density statistics were analyzed to define the urban-rural interface. The urban-rural interface was further characterized by identifying zones of population redistribution, suburbanization trends, and the expansion of functional urban areas. These analyses provide a comprehensive picture of the shifts in urban hierarchy and demographic trends, and how they have shaped Romania's national urban system over the past three decades.

To analyse the Romanian urban systems and their urban-rural interfaces demographic evolution in time, four scales of analysis were used (urban system, city and urban-rural interface). The delineation of the urban systems and of the urban-rural interfaces, as there is no formal one at national level, was processed using

- 1) the World Bank functional urban areas (FUAs),
- 2) the already existing metropolitan areas (in project/design form, as well as already formally created),
- 3) the first (a) and second (b) rings as determined by the new metropolitan areas law (currently in debate at national level),
- 4) my own classification based on proximity to the urban core and the transport infrastructure, as well as field knowledge.

For the analysis, 45 cities were selected: Bucharest, 40 county seats (all except Buftea, Ilfov county, which has a too small population and is part of the Bucharest urban system), and 4 other cities with population over 50,000 inhabitants (Hunedoara, Roman, Barlad, Medias). Of those, only Miercurea Ciuc (county seat of Harghita) has a population below 50,000 inhabitants but was included in the analysis because it already has a metropolitan area, and the World Bank also included it in the FUAs analysis. For their urban systems analysis at all scales of analysis, a further number of 1306 towns and communes were considered.

The population data was extracted from the Romanian National Institute of Statistics website for years 1992, 2002, 2012 and 2022. For the year 1992, some communes had no available data, so in order not to falsely obtain a large population increase in those urban systems, the population from 2002 was also used for 1992.

To calculate the population, increase rate, the formula $r = \frac{p_1}{p_0} \cdot 100$ was used, where p_1 is the population in 2022 and p_0 is the population in 1992.

For the rank-size analysis, the cities were ordered decreasingly in order to determine their rank, after which the predicted population they should have been obtained using

the formula $R_n = P_1/R_n$, where P_1 is the predicted population of the largest city and R_n is the rank of the city n . For the largest city of the urban system, the expected population P_1 is obtained using the formula $P_1 = \sum_{n=1}^i P_n : \sum_{n=1}^i R_n$, where P_n is the population of city n and R_n is the rank of city n .

3. Results

First, only by comparing the growth rate of the cities, their urban-rural interfaces, and the whole urban systems, we can notice that there is no city in Romania that grows, while its interface decreases (Table 1). This shows that growth is concentrated mainly at the periphery, with the following three situations:

- Both the city and the urban-rural interface grow: in Alba Iulia, Baia Mare, Cluj Napoca, Iasi (the strongest growth both inside the city and at the periphery), Ramnicu Valcea, Suceava, Tulcea, Vaslui. Those are Romanian middle cities, that managed to transition to capitalism and to service economy successfully, becoming poles of attraction for population.
- The city is decreasing, but the urban-rural interface is increasing faster (so the urban system is expanding): in Bucharest, Bacau, Brasov, Constanta, Medias, Oradea, Galati, Piatra Neamt, Pitesti, Sibiu, Timisoara. Those are either cities that managed to create a new functional profile after the communist period, transitioning from industry to services (Sibiu, Brasov, Timisoara), or cities where the industry survived due to location advantages (Pitesti, Galati, Constanta). Bucharest is a special case, as the city is declining due to overcrowding and expensive rents and prices of land, with the periphery turning into satellite dormitory villages.
- The urban-rural interface is increasing without compensating for the city's decline (so the urban system is contracting): in Arad, Botosani, Braila, Ploiesti, Satu Mare, Targu Jiu, Targu Mures, Zalau. Those are middle size cities that did not manage to overcome their industrial past completely, with the collapse of industry causing an urban depopulation. However, those cities still have a strong influence in their area, which attracts population, in search of opportunities.

Table 1. Scores* of urban system and its components population growth rate on all 5 scales of analysis used: functional urban areas (FUA), existing metropolitan areas (MA), proposed metropolitan areas – first ring (MA_1_project) and second ring (MA_2_project) of localities, and own classification.

	City score	Urban rural interface score						Urban system					
		own						own					
		FUA	MA	MA_1_project	MA_2_project	classification	average	FUA	MA	MA_1_project	MA_2_project	classification	average
-													
Alba Iulia	6	6	6	6	5	7	6	6	6	6	5	6	5,8
Alexandria	1	2		1	1	1	1,25	1		1	1	1	1
Arad	3	7	7	9	7	6	7,2	5	5	5	5	4	4,8
Bacau	5	7	7	10	7	8	7,8	6	6	6	6	6	6
Baia Mare	6	6	6	7	5	7	6,2	5	5	5	4	4	4,6
Barlad	3			3		2	2,5			3		3	3
Bistrita	8	6		7	6	9	7	7		7	7	8	7,25
Botosani	4	10	8	9	4	6	7,4	5	5	5	4	5	4,8
Braila	2	7	10	7	3	5	6,4	2	3	2	2	2	2,2
Brasov	3	10	10	10	10	10	10	6	6	5	6	6	5,8

Bucuresti	5	9	10	10	10	10	9,8	6	7	7	7	7	6,8
Buzau	3	3	7	7	5	7	5,8	3	4	4	4	3	3,6
Calarasi	4	5	5	6	5	6	5,4	4	4	4	4	3	3,8
Cluj Napoca	7	10	10	10	10	10	10	8	9	10	8	9	8,8
Constanta	3	9	10	10	10	10	9,8	6	6	6	6	6	6
Craiova	5	2	4	9	3	7	5	4	4	5	4	5	4,4
Deva	2	4	2	2	2	2	2,4	4	2	2	2	2	2,4
Drobeta Turnu													
Severin	3	4	3	7	3	6	4,6	3	3	4	3	4	3,4
Focsani	3	4	4	6	4	4	4,4	4	3	3	3	3	3,2
Galati	5	5	9	10	7	10	8,2	5	6	6	6	6	5,8
Giurgiu	2	1		2	1	1	1,25	1		2	1	2	1,5
Iasi	10	10	10	10	10	10	10	10	10	10	10	10	10
Medias	2		7	8		6	7		2	3		3	2,66
Miercurea Ciuc	4	1	1	3	2	3	2	2	2	3	3	3	2,6
Oradea	5	5	10	10	9	10	8,8	5	6	6	6	6	5,8
Piatra Neamt	3	6	5	7	5	5	5,6	4	3	4	4	4	3,8
Pitesti	4	6	10	10	8	10	8,8	5	6	6	6	7	6
Ploiesti	3	4	6	9	6	6	6,2	3	3	4	4	4	3,6
Ramnicu Valcea	6	3	7	10	6	9	7	4	6	7	6	7	6
Resita	2	3	3	3	2	1	2,4	2	2	2	2	2	2
Roman	2		2	5		3	3,33		2	3		3	2,66
Satu Mare	3	5	4	8	5	8	6	4	3	4	4	4	3,8
Sf Gheorghe	3	2	2	9	6	4	4,6	3	3	5	5	4	4
Sibiu	5	10	10	10	10	10	10	7	8	7	7	7	7,2
Slatina	4	1		2	1	2	1,5	2		3	3	3	2,75
Slobozia	4	1		1	1	3	1,5	2		2	2	4	2,5
Suceava	7	10	6	10	7	7	8	8	7	9	7	7	7,6
Targoviste	4	3	8	4	4	4	4,6	3	5	4	4	4	4
Targu Jiu	5	4	4	4	5	6	4,6	5	5	5	5	6	5,2
Targu Mures	3	8	10	10	8	9	9	5	5	5	5	5	5
Timisoara	4	10	10	10	10	10	10	7	8	8	8	8	7,8
Tulcea	3	3		3	2	6	3,5	4		3	2	3	3
Vaslui	3	3	2	3	1	3	2,4	3	2	5	2	3	3
Zalau	5	5	4	7	4	6	5,2	5	4	6	4	6	5

*score values: 1 – decline >20%, 2 – decline 15-20%, 3 – decline 10-15%, 4 – decline 5-10%, 5 – decline 0-5%; 6 – increase 0-5%; 7 – increase 5-10%; 8 – increase 10-15%; 9 – increase 15-20%; 10 – increase >20%

Besides those situations, there is also the category in which both the urban-rural interface and the city decline rapidly, with the urban system facing an accelerated shrinking process. In this category can be included Alexandria, Barlad, Buzau, Calarasi, Craiova, Deva, Drobeta Turnu Severin, Focsani, Giurgiu, Miercurea Ciuc, Resita, Roman, Sfantu Gheorghe, Slatina, Slobozia, Targoviste. Those urban systems are the smallest in the analysed group of cities and the collapse of industry and lack of capacity to

transition to a new service-based economy led to a depopulation not only of the city, but also of their surrounding areas. The two exceptions in this category are Craiova and Slatina, which are large cities with still functional industry (cars in Craiova, aluminium in Slatina). However, the proximity to Bucharest and the lack of personal and professional opportunities compared with the capital, caused a strong outward migration from those cities.

Those demographic evolutions are also reflected in the rank changes of the cities, their urban-rural interfaces, and the urban systems.

Regardless of the scale of analysis, the rank-tile analysis shows a primacy of Bucharest, with the next 3-5 cities being underpopulated for a uniform demographic distribution. The next cities follow a logarithmic distribution close to the one predicted through the rank-tile analysis, with the middle cities being slightly overpopulated for their rank.

At city level (figure 1), the rank-tile distribution showed very few changes during the analysed period, with most differences being caused by the redistribution of population from one city to another. The primacy of Bucharest is even more prominent with the pass of time, while the next 4-5 cities showed very small rank changes while population remained relatively constant: Iasi (from rank 5 in 1992 to rank 2 in 2022), Cluj Napoca (from rank 6 to rank 3), Timisoara (from rank 3 to rank 4), Constanta (from rank 2 to rank 5), Galati (from rank 7 to rank 6). The highest fall in rank was of 4 positions and it was seen in Brasov (from rank 4 to rank 8) and Resita (from rank 26 to rank 30), while the increases were even of 6-7 rank positions in case of Zalau (from rank 41 to rank 35), Alba Iulia (from rank 39 to rank 32) and Bistrita (from rank 32 to rank 25). An interesting observation is that the cities from rank 13 to rank 18 (Arad, Pitesti, Sibiu, Targu Mures, Baia Mare, Buzau) kept their same rank over the past 30 years.

At urban-rural interface level, the first general observation is that the difference between Bucharest and the second rank city is much smaller. However, the first 4-5 interfaces in the analysis, regardless of the delineation method, are underpopulated according to their rank and with very small population differences between them (figures 2-4).

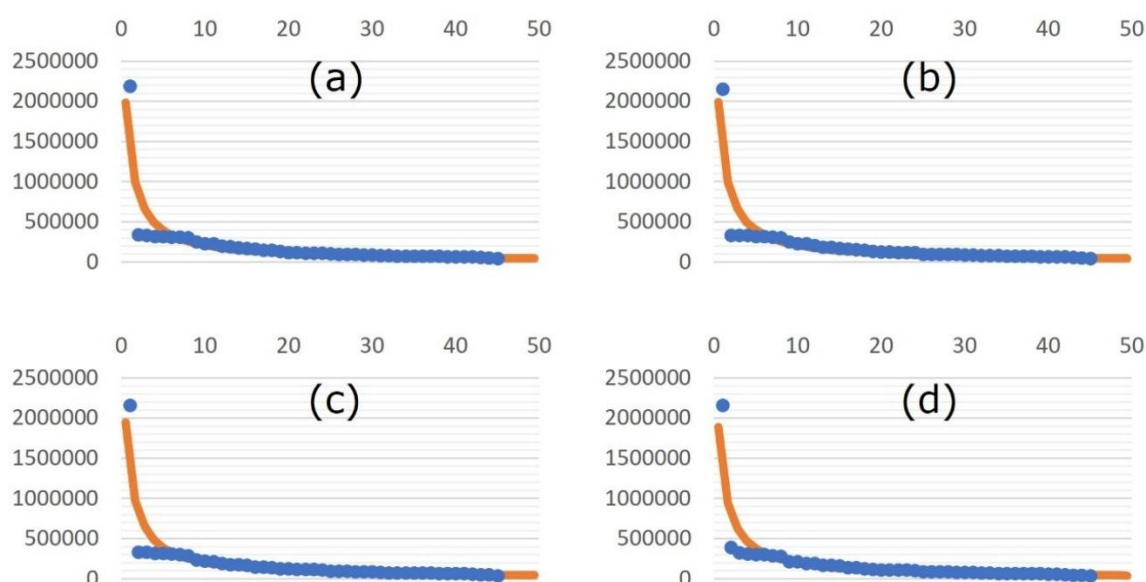


Figure 1. Rank-size analysis on Romanian cities for (a) 1992 (b) 2002 (c) 2012 (d) 2022
(Source of data: Romanian National Institute of Statistics, 2022)

Using the functional urban area as a delineation method (Figure 2), the changes from 1992 to 2022 were significant. Only the first 3 cities of the 2022 analysis are still

underpopulated for their rank (Bucharest, Constanta, and Ploiesti), compared with 6 in 1992 (Bucharest, Ploiesti, Constanta, Brasov, Timisoara, Pitesti). The middle part of the cities sample is significantly overpopulated, with only the last 12 cities close to the predicted values. Regarding rank changes, only Iasi showed a very steep increase, from rank 19 to rank 6. There were also 2 rank decreases of 5 positions in case of Buzau and Ramnicu Valcea, and 2 rank increases of 5 positions in Sibiu and Suceava.

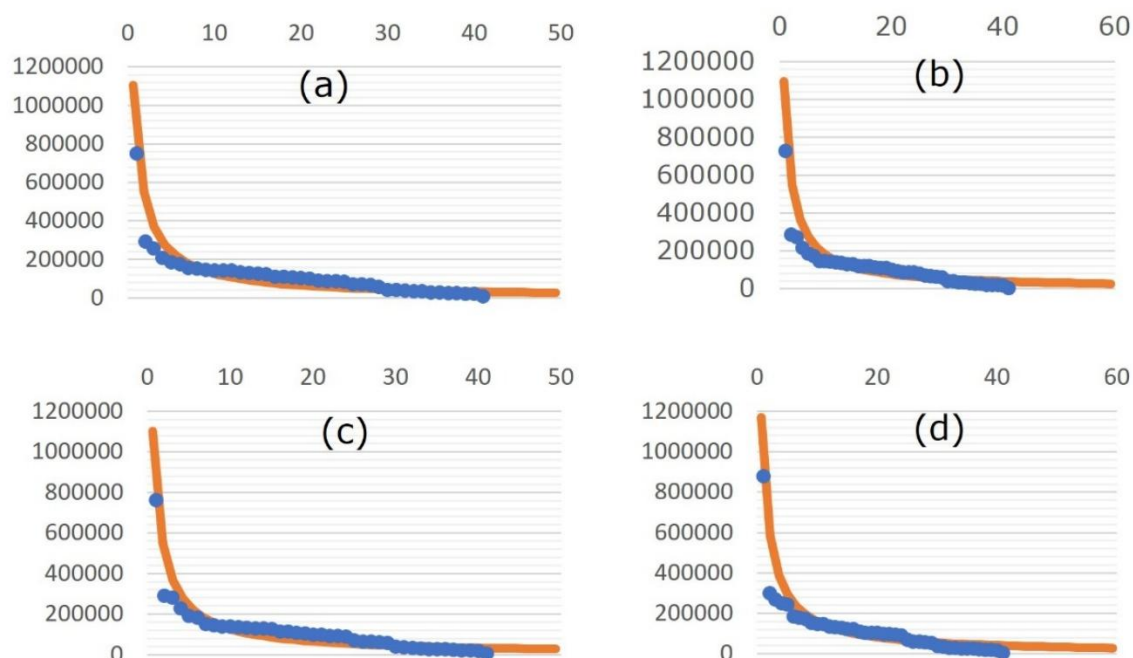


Figure 2. Rank-size analysis on Romanian urban-rural interfaces based on functional urban areas for (a) 1992 (b) 2002 (c) 2012 (d) 2022 (Source of data: Romanian National Institute of Statistics, 2022)

Considering the proposed metropolitan areas law currently in debate, there can be two delimitations of the urban-rural interfaces based on the distance from the city core: a first ring (Figure 3) and a second ring (Figure 4). Regardless of which one is chosen, the primacy of Bucharest can be seen again in the analysis, although the capital is still underpopulated based on the predicted population value it should have. The first ring analysis also follows the predicted population values line more closely, with the middle size interfaces being overpopulated when including the second ring also. Compared with the previous analysis, the changes are also larger and more dramatic in rank. When using only the first ring for the analysis, 13 cities showed a rank change of more than 5 positions: a decline in Deva (from rank 2 to 7), Alba Iulia (from rank 7 to 13), Satu Mare (from rank 10 to 16), Buzau (from rank 12 to 18), Baia Mare (from rank 14 to 19), Alexandria (from rank 16 to 27), Slobozia (from rank 22 to 31), Vaslui (from rank 29 to 34) and Miercurea Ciuc (from rank 31 to 37); and an increase in Iasi (from rank 8 to 2), Timisoara (from rank 21 to 6), Cluj Napoca (from rank 24 to 8) and Galati (from rank 41 to 32). By including the second ring of localities, the changes are not so numerous in rank positions, but the differences are grater: a decline in Deva (from rank 4 to 11), Resita (from rank 11 to 19) and Alexandria (from rank 17 to 27), and an increase in Iasi (from rank 12 to 3), Timisoara (from rank 20 to 6), Sibiu (from rank 21 to 12), Targu Mures (from rank 22 to 16), Oradea (from rank 31 to 25). This delimitation method clearly shows a. the agricultural and industrial cities from the communist times struggled with the transition, and the population in their first and second ring of localities migrated; and b. the largest cities (Iasi, Cluj Napoca, Timisoara, Sibiu, Constanta) had very small urban-rural interfaces for their size, and their success in transitioning to a capitalist

economy attracted population in the areas surrounding them, strongly increasing the demographic size of their urban-rural interfaces.

The same conclusions can be drawn when using the already existing metropolitan areas (implemented or just on design/proposal stage) (figure 5), as increases of rank can be seen in Iasi (6 positions), Cluj Napoca (7 positions), Timisoara (13 positions) and Sibiu (9 positions), while Deva, Roman, Mirecurea Ciuc, Focsani and Vaslui lost between 5 and 7 rank positions each.

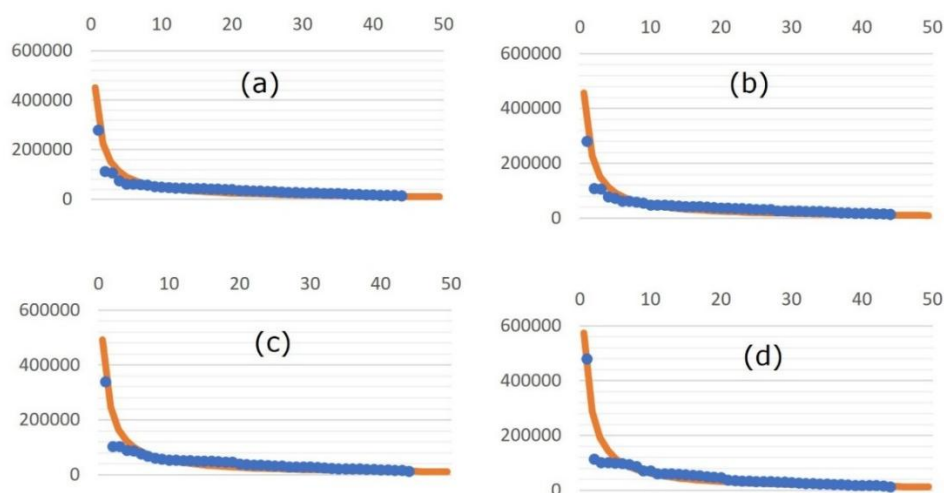


Figure 3. Rank-size analysis on Romanian urban-rural interfaces based on proposed metropolitan areas for the first ring of localities for (a) 1992 (b) 2002 (c) 2012 (d) 2022 (Source of data: Romanian National Institute of Statistics, 2022)

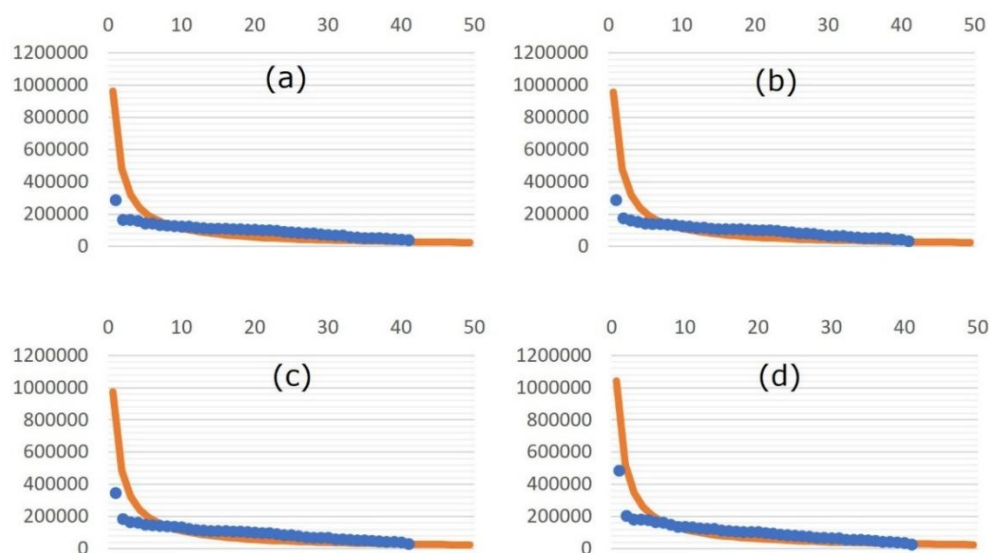


Figure 4. Rank-size analysis on Romanian urban-rural interfaces based on proposed metropolitan areas for both rings of localities for (a) 1992 (b) 2002 (c) 2012 (d) 2022 (Source of data: Romanian National Institute of Statistics, 2022)

According to my own delimitation method (figure 6), based on transport infrastructure and proximity to the city, the differences in rank are much smaller in number, with only Oradea showing an increase of more than 7 positions (from rank 22 to 16), and Deva, Targu Neamt, Galati and Targoviste a rank demotion of 5 or 6 positions. This shows that the areas in very close proximity to the cities and close to the main road networks were relatively stable demographically in the analysed period.

By comparing on all scales of analysis the rank of the urban-rural interface with the rank of the city, there can also be observed two situations (table 2 A-E):

- The city has a much higher rank than its urban rural interface: Craiova, Galati, Braila, Drobeta Turnu Severin, Tulcea, Resita, Braila, Oradea, Pitesti, Piatra Neamt, Bacau, Botosani, Calarasi, Bistrita – mostly cities that base their economy on secondary sector activities (mainly industry), or cities where transition to the service economy is still undergoing.

- The urban-rural interface has a much higher rank than the city it surrounds: Deva, Focsani, Roman, Vaslui, Medias, Alexandria, Satu Mare, Zalau, Miercurea Ciuc, Targoviste, Slobozia – mainly cities in poor counties, where the rural population is predominant due to lack of working opportunities inside the city. This also shows that in case of those cities the criteria using the fewest number of localities for delimitation of the urban-rural interface is the most appropriate. Deva is the exception of this category, as both the functional urban areas delimitation and the proposed metropolitan area include Hunedoara city in its urban-rural interface, thus distorting its rank.

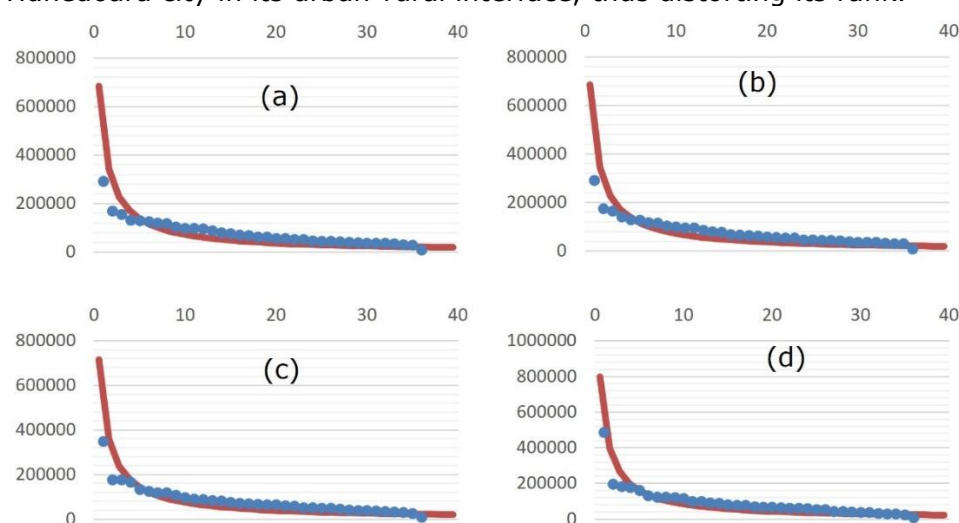


Figure 5. Rank-size analysis on Romanian urban-rural interfaces based on existing metropolitan areas for (a) 1992 (b) 2002 (c) 2012 (d) 2022 (Source of data: Romanian National Institute of Statistics, 2022)

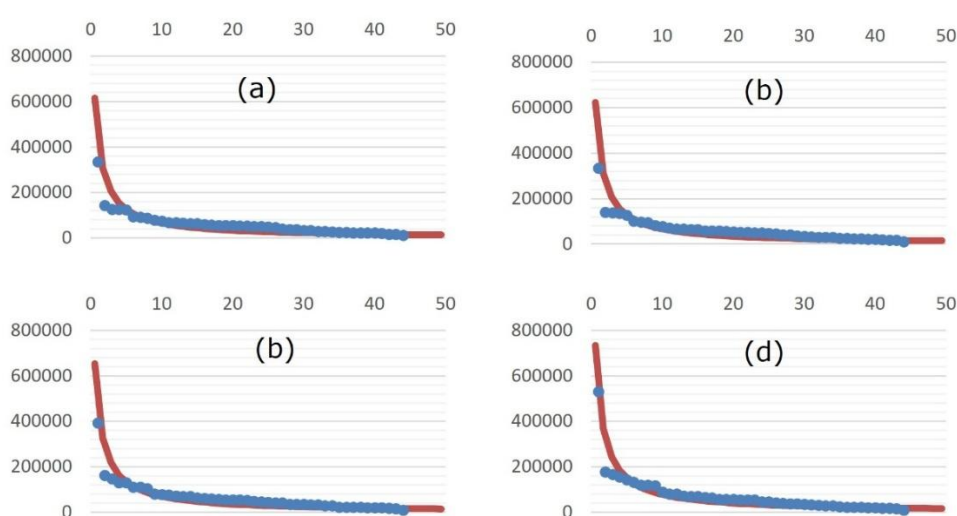


Figure 6. Rank-size analysis on Romanian urban-rural interfaces based on existing metropolitan areas for (a) 1992 (b) 2002 (c) 2012 (d) 2022 (Source of data: Romanian National Institute of Statistics, 2022)

Alba Iulia is an interesting case, as with the widest delimitations of the interface it fits in the second category, while when considering only the localities in the nearby proximity it fits in the first category.

When analysing the urban system using the rank-size analysis, the primacy of Bucharest is very clear, with the same underpopulation for their rank for the next 4-5 cities, regardless of the delimitation method. The rest of the cities, however, do not show the overpopulation in the middle part of the graph that could be seen when analysing the urban-rural interfaces, but follow the predicted population line more closely. The changes in rank that exceed 5 positions are also fewer on all scales of analysis, which shows a consistency of the urban systems, that suffered very few demographic changes when seen as a whole (the city plus its urban-rural interface). The increases of more than 5 rank positions can be seen in Iasi, Suceava, Bistrita, Alba Iulia, Zalau and Ramnicu Valcea, while the decreases in Alexandria and Resita.

Table 2. Rank of urban systems and their components (urban-rural interface and urban core) in the national hierarchy by population in 2022 using as a delimitation (a). functional urban areas; (b). proposed metropolitan areas – first ring of localities; (c). proposed metropolitan areas – both rings of localities; (d). existing metropolitan areas (design, project or implemented); (e). author delimitation

	URBAN SYSTEM	URBAN- RURAL INTERFACE	URBAN CORE
BUCURESTI	1	1	1
CONSTANTA	2	2	5
IASI	3	6	2
TIMISOARA	4	5	4
BRASOV	5	4	8
CLUJ	6	8	3
NAPOCA			
PLOIESTI	7	3	10
GALATI	8	22	6
CRAIOVA	9	17	7
ORADEA	10	10	9
PITESTI	11	7	14
ARAD	12	9	13
SIBIU	13	11	15
BACAU	14	23	11
TARGU	15	16	16
MURES			
BUZAU	16	12	18
RAMNICU	17	14	22
VALCEA			
BAIA MARE	18	24	17
SUCEAVA	19	19	19
SATU MARE	20	21	21
BRAILA	21	38	12
TARGOVISTE	22	15	27
ALBA IULIA	23	13	32
FOCSANI	24	20	28
PIATRA	25	25	23
NEAMT			
DEVA	26	18	36
BISTRITA	27	28	25
TARGU JIU	28	27	26
BOTOSANI	29	36	20
SLATINA	30	29	31
DROBETA	31	35	24
TURNU			
SEVERIN			
CALARASI	32	30	33
TULCEA	33	39	29
ZALAU	34	31	34
MIERCUREA	35	26	41
CIUC			
VASLUI	36	33	35
SFANTU	37	34	38
GHEORGHE			
RESITA	38	41	30
SLOBOZIA	39	32	39
GIURGIU	40	40	37
ALEXANDRIA	41	37	40

(a)

	URBAN SYSTEM	URBAN- RURAL INTERFACE	URBAN CORE
BUCURESTI	1	1	1
CONSTANTA	2	4	5
BRASOV	3	3	8
IASI	4	2	2
TIMISOARA	5	6	4
CLUJ NAPOCA	6	8	3
CRAIOVA	7	24	7
GALATI	8	32	6
PLOIESTI	9	10	10
ORADEA	10	20	9
BRAILA	11	42	12
ARAD	12	12	13
BACAU	13	17	11
PITESTI	14	14	14
SIBIU	15	9	15
TARGU MURES	16	15	16
TARGOVISTE	17	5	27
BAIA MARE	18	19	17
BUZAU	19	18	18
DEVA	20	7	38
SATU MARE	21	16	21
SUCEAVA	22	11	19
PIATRA NEAMT	23	26	23
BOTOSANI	24	28	20
RESITA	25	23	30
RAMNICU	26	29	22
VALCEA			
FOCSANI	27	25	28
TARGU JIU	28	21	26
DROBETA	29	41	24
TURNU SEVERIN			
ALBA IULIA	30	13	32
BISTRITA	31	22	25
TULCEA	32	39	29
SLATINA	33	40	31
VASLUI	34	34	36
ALEXANDRIA	35	27	43
CALARASI	36	33	33
ROMAN	37	36	37
BARLAD	38	43	35
MEDIAS	39	30	41
GIURGIU	40	44	39
SLOBOZIA	41	31	42
SF GHEORGHE	42	35	40
ZALAU	43	38	34
MIERCUREA	44	37	44
CIUC			

(b)

	URBAN SYSTEM	URBAN- RURAL INTERFACE	URBAN CORE
BUCURESTI	1	1	1
IASI	2	3	2
CLUJ NAPOCA	3	4	3
BRASOV	4	2	8
CONSTANTA	5	5	5
TIMISOARA	6	6	4
PLOIESTI	7	7	10
GALATI	8	32	6
CRAIOVA	9	31	7
PITESTI	10	8	14
BACAU	11	15	11
ARAD	12	10	13
ORADEA	13	25	9
SIBIU	14	12	15
BAIA MARE	15	9	17
TARGU MURES	16	16	16
SUCEAVA	17	14	19
BUZAU	18	17	18
BRAILA	19	40	12
SATU MARE	20	20	21
BISTRITA	21	13	25
RAMNICU	22	24	22
VALCEA			
DEVA	23	11	36
PIATRA NEAMT	24	23	23
BOTOSANI	25	26	20
FOCSANI	26	21	28
TARGU JIU	27	22	26
RESITA	28	19	30
ALBA IULIA	29	18	32
SLATINA	30	30	31
TARGOVISTE	31	33	27
DROBETA	32	39	24
TURNU SEVERIN			
VASLUI	33	28	35
TULCEA	34	35	29
ZALAU	35	29	34
ALEXANDRIA	36	27	40
CALARASI	37	36	33
SF GHEORGHE	38	34	38
SLOBOZIA	39	37	39
GIURGIU	40	41	37
MIERCUREA CIUC	41	38	41

(c)

	URBAN SYSTEM	URBAN- RURAL INTERFACE	URBAN CORE
BUCURESTI	1	1	1
GALATI BRAILA	2	22	2
IASI	3	5	3
CONSTANTA	4	3	6
BRASOV	5	2	8
CLUJ NAPOCA	6	9	4
TIMISOARA	7	10	5
CRAIOVA	8	13	7
ARAD	9	4	12
PLOIESTI	10	6	10
BACAU	11	8	11
ORADEA	12	23	9
BAIA MARE	13	11	16
SATU MARE	14	7	20
SIBIU	15	18	14
PITESTI	16	25	13
TARGU MURES	17	17	15
SUCEAVA	18	16	18
BUZAU	19	20	17
RAMNICU	20	24	21
VALCEA			
DEVA	21	12	33
BOTOSANI	22	28	19
ROMAN	23	14	32
ZALAU	24	15	30
ALBA IULIA	25	19	28
FOCSANI	26	26	26
PIATRA NEAMT	27	34	22
DROBETA	28	32	23
TURNU SEVERIN			
TARGOVISTE	29	29	25
TARGU JIU	30	30	24
CALARASI	31	27	29
RESITA	32	33	27
MIERCUREA CIUC	33	21	36
VASLUI	34	31	31
SF GHEORGHE	35	35	34
MEDIAS	36	36	35

(d)

	URBAN SYSTEM	URBAN- RURAL INTERFACE	URBAN CORE
BUCURESTI	1	1	1
IASI	2	5	2
CONSTANTA	3	2	5
TIMISOARA	4	4	4
BRASOV	5	3	8
CLUJ NAPOCA	6	8	3
PLOIESTI	7	6	10
CRAIOVA	8	21	7
GALATI	9	27	6
PITESTI	10	9	14
ORADEA	11	16	9
BACAU	12	13	11
SIBIU	13	10	15
ARAD	14	12	13
TARGU	15	11	16
MURES			
BRAILA	16	36	12
BAIA MARE	17	19	17
SUCEAVA	18	15	19
DEVA	19	7	38
BUZAU	20	18	18
SATU MARE	21	17	21
PIATRA	22	23	23
NEAMT			
RAMNICU	23	24	22
VALCEA			

	URBAN SYSTEM	URBAN- RURAL INTERFACE	URBAN CORE
FOCSANI	24	14	28
BOTOSANI	25	28	20
TARGU JIU	26	20	26
TARGOVISTE	27	22	27
BISTRITA	28	31	25
DROBETA	29	35	24
TURNU SEVERIN			
ROMAN	30	25	37
VASLUI	31	26	36
SLATINA	32	34	31
CALARASI	33	33	33
BARLAD	34	32	35
TULCEA	35	43	29
ALBA IULIA	36	42	32
RESITA	37	44	30
MEDIAS	38	30	40
ZALAU	39	39	34
ALEXANDRIA	40	29	42
SF	41	40	39
GHEORGHE			
GIURGIU	42	41	38
SLOBOZIA	43	38	41
MIERCUREA CIUC	44	37	43

(e)

Source of population data: Romanian National Institute of Statistics

4. Discussion

The Romanian urban-system, when seen at city level or urban system level is a clear case study of primacy in the rank-size analysis. This is a direct result of the fact that government direction imposed the urban growth, instead of market forces. The government tried to control the growth of the largest cities by developing urban centres lower on the hierarchy. This process failed, as people instead of moving in the large cities (where it was prohibited for them to migrate), they establish their residence at their periphery.

The next 4-5 cities are underpopulated based on their expected population for the size of the Romanian urban system, which can also be seen at urban-rural interface level. However, the middle size cities, even though they are slightly underpopulated for their rank, they have a larger than expected population in the urban-rural interface, which is a direct result of 1. the demographic explosion after becoming industry and county seats centres in 1968; 2. not being able to successfully transition to a market economy and attracting a large population in the city after 1990; and 3. the Land law from 1991, which gave people land in the area surrounding the cities, directly affecting the medium and small urban centers. For the small cities, the expected population both for the cities and their urban-rural interfaces is close to the expected one.

When comparing the rank of the city, with the rank of its urban-rural interface, there can be seen that 1. the large cities show very small fluctuations in the last 30 years of maximum 1-2 rank positions; 2. the intermediate cities have a much higher urban-rural interface for their size, with some very strong rank increases and decreases; 3. the smallest city included in the analysis showed the smallest fluctuations in rank and total populations. Regarding the urban-rural interfaces the fastest and strongest growth is concentrated in the 1st tier of cities below the capital: Iasi, Cluj Napoca, Timisoara, Constanta. Craiova and Galati are the exception, as even though they have very high populations, their urban-rural interfaces are very small and showing a net demographic decrease.

Lastly, with some few exceptions where both the city and the urban-rural interface are increasing (Alba Iulia, Baia Mare, Bistrita, Cluj Napoca, Iasi, Suceava, Tulcea, Ramnicu Valcea, Vaslui – cities with a strong and large sphere of influence in their area, and that successfully transitioned to service economy, becoming attractive areas for population), all other analysed cities have a net decrease in population in their urban core. This decrease in the city is associated with an increase in the urban-rural interface in most analysed cities, but there are also some cities where the surrounding area also faces a depopulation phenomenon (Alexandria, Barlad, Buzau, Calarasi, Craiova, Deva, Drobeta Turnu Severin, Focsani, Giurgiu, Miercurea Ciuc, Resita, Roman, Sfantu Gheorghe, Slatina, Slobozia, Targoviste – those shrinking urban systems are the least populated in the analysed sample, where mostly monoindustrial or agricultural cities during the communist period, and did not manage to successfully transition to a service economy after 1990).

The main limitation of the rank-size analysis is that it does not show the relations established in the urban systems. This can be seen for instance in case of Braila and Galati, which have competing industries, not complementary. Those competing spheres of influence, together with their proximity, is the main reason why both have much smaller urban-rural interfaces compared with their urban population.

5. Conclusions

The findings of this study underscore the need for targeted urban planning policies that address the distinct challenges faced by Romania's small and medium-sized cities, many of which are experiencing population decline due to industrial restructuring and economic shifts. Policymakers should focus on revitalizing these urban areas through

strategies that attract investment in emerging industries and enhance infrastructure, particularly in cities with high potential for economic diversification.

Additionally, the trend of suburbanization around larger cities presents both opportunities and challenges. Local authorities should prioritize sustainable development in suburban areas, ensuring that housing developments are accompanied by sufficient public services, transport infrastructure, and environmental protections to mitigate urban sprawl.

A comparative approach, integrating lessons from other Eastern European countries undergoing similar transitions, could also provide valuable insights into managing urban shrinkage and fostering balanced regional development. Future research should focus on further refining the definition and boundaries of functional urban areas, utilizing more dynamic, real-time data to adapt urban policies in a rapidly evolving demographic landscape.

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