



# Exploring the Urban Strength of Small Towns in Romania

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## Abstract

Small towns have long been overshadowed, but in recent years, there is a growing recognition of their territorial role, both on the research agenda and on the European Union level, simultaneously with an increasing awareness of their heterogeneity. In spite of this, studies focused on small towns in Eastern Europe are few in relation to the large numbers in the area and the role of this paper is to contribute at filling in this gap. In Romania, there are 225 small towns (under 20,000 inhabitants), which constitute 70% of the entire urban system. In order to measure their urban characteristics, a multi-dimensional (composite) index was developed, called Index of Urban Strength. For the index, 22 relevant indicators were selected and grouped in three dimensions under the form of secondary indexes (demographic, socio-economic, infrastructure and land-use). Then, a Principal Component Analysis (PCA) integrated with Geographic Information System (GIS) method was applied for each dimension, and the influential variables were identified. Finally, the index was computed allowing the assignment of different levels of urban strength (very low, low, medium and high) to Romanian small towns. The paper provides new insights related to the uneven development of small towns, allowing for comparative analyses and advocating the need to develop specific policies for each of the identified categories. The results indicate a spatial differentiation at the macro-region level, with the small towns with very low or low index of urban strength more prevalent in the East and South of the country than in the Centre and the West.

**Keywords** Urban strength · Small towns · Hierarchy · Political will · Urban status · Romania

## 1 Introduction

For a long time, small towns have been neglected (Bell and Jayne 2009; Vaishar and Zapletalová 2009; Steinführer et al. 2016; Knox and Mayer 2009; Servillo et al. 2017), both as subjects of research and by public policies, at the national and the EU level, attention being given mainly to large cities and metropolitan areas, or exclusively to rural areas (Servillo et al. 2014a; Vaishar et al. 2016; Filipović et al. 2016). One reason for their “invisibility”

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(Bell and Jayne 2009) seems to be the heterogeneity of small towns and the different administrative definitions of what “urban” means in different European states (Servillo et al. 2017; Smith 2017). However, this lack of interest is somewhat paradoxical, especially considering the existence of thousands of small towns that are home to millions of people. It is estimated that 16% of the population of Europe lives in very small towns of less than 5,000 inhabitants (Servillo et al. 2014b).

Small towns are the transition between urban and rural, representing the lowest tier of the urban system (Ianoş 1982). Still, they are by no means “miniature cities” (Vaishar et al. 2016), but closer to a hybrid form with a mixture of urban and rural characteristics (Zamfir et al. 2009). The well-being of small towns is considered essential for mitigating territorial disparities and obtaining “balanced regional development, cohesion and sustainability of the European territory” (European Commission 2011). Despite this, their territorial role and specificities are different, influenced by a broad range of factors, such as geographical location, connectivity, functions and services that they offer, local resources, infrastructure, development potential, etc. In view of that, recent studies have demonstrated that in metropolitan areas, small places are under the influence of bigger cities, the former able to “borrow size”, meaning they have certain advantages that come from their position, which is well embedded in the urban network. This concept of “borrowed size” was coined by Alonso (1973), and reintroduced in more recent studies (Meijers and Burger 2017; Burger et al. 2015; Meijers et al. 2016). According to this theory, small towns located in metropolitan areas can “perform better because they have access to agglomeration benefits of larger neighbouring cities” (Meijers and Burger 2017). Accessibility and connectivity play a key role in overtaking certain functions in small towns, based on increasing spatial interdependences and interactions. On the other hand, metropolitan areas also run the risk of fierce competition. This may lead to small towns becoming residential areas of the big city, offering even less functions than normal—a process known as “agglomeration shadow” (Burger et al. 2015; Cardoso and Meijers 2016). However, even under these circumstances they perform better than their counterparts: they attract new business and develop services for newcomers (Servillo et al. 2014a, 2014b), as they are more appealing to investors (Meijers and Burger 2017). Furthermore, Partridge et al. (2007) observes that the population of towns and rural settlements in metropolitan areas grow faster than those located in other areas.

In comparison, isolated small towns located far from large cities can play an important role in the development of surrounding rural areas, especially in peripheral regions (Zamfir et al. 2009; Vaishar and Zapletalová 2009; Bănică and Camară 2011; Ecovast 2013). These so-called “autonomous self-standing towns” (Sýkora and Muliček 2017) can be true polarising centres, providing jobs and services for their rural hinterland. Belova and Levchenkov (2012) refer to them as an incubator of rural development. They contribute to the stabilisation of the population and increase the quality of life, not only for themselves, but also for nearby villages. But leaving these geographical typologies aside, we are confronted with a diversity of small towns. While some small towns are thriving, others are undergoing a decline and struggling with many challenges, like out-migration, shrinkage, ageing, lack of job opportunities, faulty infrastructure and a shortage of basic services, among other things.

Nevertheless, it should be noted that urban areas are often seen as “engines of growth” (Restrepo Cadavid et al. 2017), having an essential function in the economic and regional development (Henderson 2010; Nijkamp and Kourtit 2013; Clark et al. 2018). This position was rooted in the traditional Christaller central place theory (1933) and growth poles theory of Perroux (1955) developed with a spatial dimension by Hirschman (1958) and

others. In this broader context, small towns are positioned on the lower rank of the urban system, without the attraction power of urban centres higher up in the hierarchy. In spite of this, they are perceived as an important element for the polycentric development (Territorial Agenda of the EU 2020, 2011; Servillo et al. 2014a, 2017; Courtney et al. 2007). In this respect, they are well embedded in the regional systems (Sýkora and Muliček 2017), with a crucial role more visible in large rural areas (Territorial Agenda of the EU 2020, 2011). Moreover, small towns are described as local urban centres, having centrality functions (Wirth et al. 2016; Servillo et al. 2014a) and can act as an “anchor points for new socio-economic development” (de Noronha Vaz et al. 2013). However, in order to fulfill this territorial role it must have certain features meaning an internal capacity or urban strength. This concept was previously investigated (Duan and Zhang 2008), being defined as the set of strengths that a town has in various fields such as economic and social development within a certain period of time. In the same frame, was emphasized that small towns possess an “urban capital and related territorial potential” (Servillo et al. 2014a) which can be valorised for obtaining a territorial performance in interconnection with the governance (Servillo et al. 2014b). Thus, assessing the urban strength of the small towns can be perceived as a prerequisite for understanding their potential to boost territorial development within the nearby area.

The EU’s approach to the problem of small towns is limited, since there is no dedicated policy framework, but there is an awareness of the necessity of creating one (Ecovast 2013; Knox and Mayer 2009). Nevertheless, the difficulty also comes from the fact that the potential, needs and challenges that these places present are so different from one another that it is very challenging to come up with a set of common practices. Still, recent years have brought a growing recognition in the territorial role of small towns, as part of the Territorial Agenda of the EU 2020 (2011), which encourages an integrated place-based approach that considers local resources. The purpose is to improve economic performance of small and medium-sized towns and reduce territorial polarisation of large cities. This framework of place-based policy approach was previously advocated in the Barca Report (2009). More recently, The Latvian Presidency of the EU emphasised the issue of small and medium-sized towns. In this regard, it is mentioned that there isn’t enough information about the challenges and the economic capacity that small towns pose, a lack that in itself calls for a better understanding of their potential territorial role (Valtenbergs et al. 2015).

On the research agenda, analysis of small and medium-sized towns and the production of some typologies was the objective of some transnational ESPON projects<sup>1</sup> (SMESTO,<sup>2</sup> TOWN<sup>3</sup>), but these were mostly targeting Western and Central Europe. Another weak point is the fact the analysis is done on NUTS III level, which leads to a high degree of generalization.

Though there have been some publications focused on Central and Eastern European, there are still too few of them in relation to the large number of small towns in the area. But even the existing scientific literature mostly explores the consequences of transitioning

<sup>1</sup> ESPON projects—ESPO is the acronym for the European Spatial Planning Observation Network and represents an “applied research programme aimed at supporting the formulation of territorial development policies in Europe” (European Commission 2002), supporting research projects.

<sup>2</sup> SMESTO is the acronym for a project called “The role of small and medium-sized towns”, within the framework of ESPON 2000–2006 programme.

<sup>3</sup> TOWN is the acronym for a project called “Small and medium sized towns in their functional territorial context” within the framework of ESPON 2013 programme.

from a centralised economy to a market economy, and its influence on a territorial level (Pirisi et al. 2015; Vaishar et al. 2016). In short, small towns are academically and politically underrepresented. However, some countries are collecting data for small towns, and different researchers have developed general statistical techniques for small area estimation (Ghosh and Rao 1994; Pfefferman 2002; Rao 2003, 2014; Pizarro et al. 2019).

Studies that measure urban features of small towns are even more scarce, and only examine specific aspects such as their sustainability (Vaishar et al. 2016) measuring the demographic, economic and social pillars through specific indicators: population development, unemployment and educational level. Furthermore, such data are correlated with the small towns' types. Czapiewski et al. (2016) address the small town's role as a service provider for the surrounding rural areas using a service concentration index based on the assessment of nine variables. Filipović et al. (2016) delve into the spatial and demographic characteristics of these small places quantified through five indicators. Others analyse economic performance (Servillo et al. 2014a) based on six variables, correlating with the economic profiles of the towns. The aforementioned studies use some predefined indicators for exploring, mostly sectorial issues, whereas the current research stands out in its more complex approach, on a multidimensional perspective, using several variables.

In Romania, on a national level, there is a very limited amount of papers that deal with the entire system of small towns, while the most investigated subject matter, from diverse perspectives (e.g. demographics, economy) are individual case-studies or studies that focus on certain regions. From the first category, was analysed the dynamics of small towns in the communist era as well as post-communist, from a demographic and economic point of view (Ianoş and Tălângă 1996; Zamfir and Braşhină 2000; Zamfir 2007), identity (Zamfir et al. 2009), and the characteristics of mono-industrial towns (Dumitrescu 2008). Bănică et al. (2013) discuss the crisis of Romanian small towns, investigating some of their features and peripheralization factors. Others (Matei and Caraba 2010; Bănică and Camară 2011) also consider the touristic function of some small towns. On a regional level, there were examined small towns in the Carpathian Mountains (Bănică and Istrate 2012; Matei et al. 2013; Preotesi 2014), North-Eastern and South-Eastern Development Regions (Camară 2011; Trincă 2011).

On a local level, there are more articles that tackle certain small towns in the West of the country, in Bihor County, with an emphasis on changes recorded post-communism (Filion et al. 2011, 2012; Nemeş et al. 2012; Nemeş 2013; Praşca and Olău 2013; Petrea et al. 2013). Similar case-studies have also been conducted for some small towns located in other parts of Romania (Bănică 2010; Nuţu 2008; Puncioiu 2011; Moraru and Muntele 2015).

Considering all of the above, the study of Romanian small towns can be interesting from multiple perspectives. From a theoretical point of view, it answers the need for more scientific literature on the subject of small towns (Knox and Mayer 2009; Servillo and Russo 2017), required for conceptualizing this category of urban settlements (Steinführer et al. 2016). Currently, small towns are under-theorized, in other words, when urban theorists describe "urban form and function", they mostly refer to large cities, ignoring small towns and their distinctive characteristics (Bell and Jayne 2009). Referring solely to the small town level, a "one-size fits all approach" (Valtenbergs et al. 2015) should be avoided, since their wide variety is largely due to national and regional contexts (Valtenbergs et al. 2015; Servillo et al. 2014a; Atkinson 2017; Tacoli 2017; Sýkora and Muliček 2017). Following this line of thought, from an empirical point of view, the relevance of exploring Romanian small towns is that it allows an integrative overall assessment on a country level, but also provides insights into relevant dimensions (demographic, socio-economic, infrastructure and land-use). Moreover, the results can be useful for further comparative analysis in a

broader context. From a political viewpoint, it has been established that certain planning policies were not successful enough precisely because they were not grounded in local characteristics (Tacoli 2017). Hence, this article contributes to increasing awareness of small towns' significance and their diversified strengths and limits as a precondition for policy making processes and further allocation of resources.

As a result, against the backdrop of limited internationally recognised knowledge, this paper subscribes itself to studies aimed at gaining a better understanding of small towns in a formerly communist Eastern European country. Additionally, taking into account the proven usefulness of some indexes in the establishment of applied policies (Michalek and Zarnekow 2012; Abreu et al. 2019; Perchinunno et al. 2019), the objective is to develop a tool—a multi-dimensional aggregate index that explores the diversity of small towns in Romania. This allows their ranking according to urban features (very low, low, moderate, high) using the Index of Urban Strength (IUS).

The study is structured as follows; the next part presents the main characteristics of small towns in relation to local development in Romania. Section three describes the methodology, followed by results and discussion. Section five summarises the main conclusions of the study.

## 2 Small Towns and Local Development in Romania

In Romania, small towns are those with less than 20,000 inhabitants, which represent 70% of a total of 320 urban settlements, comprising about 10% of the country's population (over 2,090,000 residents) (National Institute of Statistics 2018). In terms of size, 60% of small towns have a population of less than 10,000, most of which (47% of the total) are towns of 5,000–10,000 people.

The current network of small towns was configured in three major stages: prior to 1945 (pre-communism), 1945–1989 (communism), and after 1989 (post-communism). There have been some major changes over the years, both in terms of the distribution of the two urban–rural environments and from a political, economic and social standpoint. Only 24% of current small towns gained their town-status before 1945, Romania being a mostly rural country at the time, in which the majority of activities had been predominantly agricultural.

In communist times, about half (51%) of small towns were established through political decisions that were made without consulting the local population, resulting from a centralised planning development policy. The central pillars of the communist doctrine were industrialization and forced urbanisation of the countryside along with collectivisation of agriculture. The industrialisation process was a priority, as it was considered a major catalyst for economic and social progress (Murgescu 2010). As a result, industrial activities, and heavy industry in particular, had become the engine of economic development (Ronnås 1982; Filimon et al. 2011). At the same time, between 1949 and 1962, the collectivisation of agriculture was taking place, aspiring to turn individual property into collective property, followed by the relocation of the workforce from traditional agriculture to industry. In the beginning, industrial investments were directed primarily to large and medium-sized cities, especially those that had administrative functions (Popescu 2000). Gradually they were diverted, also, towards small towns (Ianoş 2004; Benedek 2006). Industrialization was perceived as a precondition for urbanization, considered “a value per se” which ensured society's progress (Popescu 2014). The urban style of living and the working conditions were considered superior to those of rural living (Benedek 2006). As a result, 45

settlements were granted town status between 1945–1967, and in 1968 a new administrative-territorial division law was put in effect, declaring the urban status of 46 small towns. The necessity for these changes was justified by registered positive evolution from the perspective of industrialisation, through which rural areas had acquired new socio-economic characteristics (Dumitrescu 2008; Săgeată 2001; Cucu 1970). After this administrative reform, a lot of resources went into the development of existing towns (Ianoş 2004). In that time, only one new town had been declared—Rovinari, in 1981—for coal mining. However, communist urban policies dictated a “harmonious development” of all parts of the country (Ianoş 2004). This meant homogenous urbanisation of the entire national territory, which would lead to the stabilisation of the population and an increase in quality of life (Cucu 1977). The proposed solution was granting urban status to 22 new towns in 1989, serving as hubs of local polarisation, most of which had agro-industrial functions.

After the fall of communism, the implementation of these urbanisation and industrialisation policies resulted in the highest rate of urbanisation in Romanian history (54%), more than double compared to 1948 (23%). In the new industrialised communist town, a remodel of an intra-urban pattern was taking place through the demolition of private houses in favour of new state-owned apartment buildings that housed factory workers who originated from rural areas. The result of this extensive urbanisation was the formation of “socialist-type urban structures” (Săgeată 2003). This concept refers to towns where the population has grown, but basic infrastructure and urban services remain inferior to traditional urban centres (Săgeată 2003; Mitrică et al. 2014).

In the post-communist phase, after 1990, under new political and socio-economic conditions, the urban pattern was undergoing major changes, strongly impacted by an extensive process of economic restructuring and deindustrialisation. If between 1966–1989 industry helped in the emergence and development of many small towns, after 1990, the dissolution of industry led to the decline of most of them (Zamfir 2007). The most affected by this were mono-industrial towns, which were dominated by a single industry, sometimes even a single factory. In the absence of a coherent industrial policy, many employees were laid off, generating a surplus of work force. The development of the tertiary sector was much slower than the restructuring process (Ianoş and Tălângă 1994), and it was impossible to absorb the available labour force. In the meantime, a process of de-collectivisation and land restitution was taking place, and some of the workers, lacking occupational alternatives, opted to move back to the rural areas. Therefore, the first decade after the fall of communism could be viewed as a reversal of the previous period, meaning a re-ruralisation of the country (Mihalache and Croitoru 2011). As a result, there was a decrease in the rate of urbanisation, partially abated by the declaration of five new towns, namely Teiuş (Alba County), Făget (Timiș County) (1994), Baia de Arieş (Alba County) (1998), Otopeni (Ilfov County) and Geoagiu (Hunedoara County) (2000).

In 2001, the issuance of a new law (350/2001, Romanian Parliament 2001a) introduced quantitative and qualitative criteria for declaring new towns for the first time since 1945. Based on this act, between 2002 and 2006, 52 new small towns were established, most of them (36) in 2004, which led to an increase in urbanisation level back to what it had been in the early 1990s (54%). The legal mechanism for acquiring an urban status was different to the one used in communist times, as it was initiated “by local councils, consulting the local population by means of referendum, and with the support of the involved institutions and respecting minimal quantitative and qualitative indicators” (Law 351/2001, art. 3.1,

Romanian Parliament 2001b). But even with all these precautions, the law wasn't upheld, with some of the rural localities that had been declared as towns not qualifying in terms of the legal requirements of minimal values of indicators. In this case we can talk about a central political will to artificially increase the degree of urbanisation. Unlike the communist system of granting urban status, this time the decision to turn villages into new towns was made with the participation of local population and the local authorities. Unfortunately, more often than not, acquiring urban status wasn't backed by investments, so the mere change in title wasn't enough to transform settlements into functioning local development centres capable of stabilising the population and revitalising their economy or the surrounding rural areas. Moreover, investments were directed mainly at large and medium-sized cities, since there was no viable strategy for the development of small towns. An example of such a top-down approach was the identification of some disadvantaged areas (many of which mono-industrial) at the end of the 90 s, which also included some small towns (38 in 2008 and 28 in 2003). In these places, investors were allowed the fiscal facilities to develop new areas of activity. However, this didn't yield the expected results, as it created only 15,000 new jobs in ten years (for a population of about one million) (Bănică et al. 2013). One of the challenges was that the work force, comprised of farmers who turned into workers in communist times, wasn't educated or professionally prepared for such a transformation (Preotesi 2014). Converting to a different vocation wasn't easy, especially lacking appropriate professional training (Mihalache and Croitoru 2011). Those disadvantaged areas were eventually dissolved in 2007, when Romania joined the EU.

In some cases, the loss of jobs and the dissolution of local economy affected a town as a whole, generating a spill-over effect, like the decrease in the local budget's tax income. This led to cutting out some public services and inability to maintain infrastructure, diminishing and eventual disappearance of other businesses, degradation of buildings, pollution, etc. This kind of general climate breeds another trend: a mass exodus of the workforce outside the country. This only intensified after Romania joined the EU (2007), while others moved, albeit in smaller numbers, to the big cities. The desertion of young adults led to a process of population ageing, decrease in available labour force and birthing rates, etc., with consequences in the medium and long term.

The current level of development in small towns is varied and tied to the way the towns reacted to the changes that took place after 1990 and their ability to adapt to a market economy. Some of them were capable of reinventing themselves and evolving (especially towns that have touristic potential or towns located around large cities), while others have entered a stagnation phase or even complete degradation (economy, social, infrastructure, etc.), aggravated by the economic crisis after 2008.

### 3 Methodology

#### 3.1 Data Collection and Analysis

The sample group of small towns (under 20,000 inhabitants) was chosen based on the total population as reflected in the last census from 2011. The study used a series of statistical data obtained from the National Institute of Statistics (NIS), extracted from the Population



and Housing censuses (1992, 2011) and from the TEMPO-online database,<sup>4</sup> for LAU 2<sup>5</sup> (NUTS V), which represents the lowest administrative level.

The design of this methodology stemmed from the call for comprehensive studies that would allow comparative analysis of small towns in Europe, within and between countries (Porsche et al. 2019; Servillo et al. 2014a; Steinführer et al. 2016, etc.). With this in mind, we focused on finding a method, easy to replicate, for ranking small towns on the basis of statistical data, according to their urban features, as depicted in the legislation. Therefore, the goal was to go beyond the generalized statements about small towns and to investigate them in a multidimensional perspective at the country and macro-regional level.

The starting point for the construction of the Index of Urban Strength was Romanian legislation, which defines an urban settlement as one where most of the work force is employed in non-agricultural activities with a certain level of equipment, exercising a constant and significant socio-economic influence over its surroundings (Law 351/2001, annex I, Romanian Parliament 2001b). As a result, the aim of the index was to quantify the characteristics cited in the law, and for this, 22 indicators have been selected (depending on the relevance and availability of statistical data). These were calculated based on statistical data, for the last available year: 2017 for population density, health, living floor per inhabitant, modernised streets, land use, and the last census (2011) for population age structure, labour force, education and dwellings. To follow the dynamics of some processes, two comparative years have been analysed (population changes, employment and dwellings changes). In addition, the average value was computed for two indicators (net migration rate, vitality index), considering inter-annual fluctuations. Afterwards, variables were normalised (OECD 2008). During the normalization process transformations were made such as “small” versus “large” values have the same significance for each variable, in order to eliminate the potential influence of polarity, discussed in detail later, and permit the interpretation of the values of aggregated indexes.

The selection of the aforementioned variables was set up on the basis of consecrated indicators in various fields (e.g. geography, demography, spatial planning). Furthermore, we considered that each of the variables should be representative, measurable, and computed based on easily obtained data, in order to be used for comparison and application in further publications.

The indicators were grouped in three dimensions or sub-indexes: demographic sub-index; socio-economic sub-index; infrastructure and land-use sub-index, as described in Table 1. Previous studies on territorial analysis proposed different dimensions: economy, demography, infrastructure and life quality (Ianoş et al. 2013); economy, demography, infrastructure, and environment (Petrişor 2014); demography, socioeconomics, land-cover and geography (Serra et al. 2014). Likewise, the Latvian Presidency of the EU identified the development challenges of small and medium-sized towns as demographic, economic, services, infrastructure (Valtenbergs et al. 2015). Moreover, as suggested by Abreu et al. (2019), the usage of several dimensions or sub-indexes is more relevant for developing an index. As a result, in the present study, the three dimensions were chosen in relation to the national policies indicated above and the availability of local data, as comprehensive as

<sup>4</sup> TEMPO-online database is a statistical database which contains a wide range of information carried out by the National Institute of Statistics in Romania.

<sup>5</sup> LAU2 is the acronym for Local Administrative Units, used by Eurostat (Statistical Office of the European Union), referring to the municipalities and communes in the European Union.



**Table 1** Description of the variables grouped in three sub-indexes. Source: own elaboration, based on data from National Institute of Statistics (NIS)

No	Variable name	Description of the variable	Source of data	Year	Unit
<i>Demographic sub-index</i>					
V1	Population change	Changes in the number of inhabitants between 1992 and 2017; indicates the evolution of the population and the demographic sustainability	NIS - Tempo*	1992, 2017	%
V2	Net migration rate	Difference between immigration and emigration, the average for 1992–2017; reflects the attractiveness of a town and represents a driving force of the population change	NIS - Tempo	1992–2017	%
V3	Share of the population from secondary built-up areas	Population from secondary built-up areas (outside the main urban core) as share of the total population; indicates the intra-urban distribution of the population, considering these distanced parts often register rural characteristics	NIS - PHC**	2011	%
V4	Share of the population aged 65 or over	Population aged 65 or over as a share of the total population; reflects the ageing process and the demographic profile	NIS - PHC	2011	%
V5	Vitality index	Ratio between live births and deaths, average for 1992–2017; the high values (over 100) express a tendency of population increase	NIS - Tempo	1992–2017	%
V6	Population density	Persons per Km <sup>2</sup> of the total land area; high values denote a concentration tendency associated with urban features	NIS - Tempo	2017	Inhabitant/ Km <sup>2</sup>
<i>Socio-economic sub-index</i>					
V7	Number of physicians per 1000 inhabitants	Measure the health care services	NIS - Tempo	2017	Physicians/ 1000 inhabitants
V8	Number of hospital beds per 1000 inhabitants	Reflects the capacity of providing health care; included in the basic health care system	NIS - Tempo	2017	Hospital beds/1000 inhabitants
V9	Population with tertiary education	Population aged 10 and over with tertiary educational as share of the total population of the same age; reflects the level of education and the population's specialised skills	NIS - PHC	2011	%

Table 1 (continued)

No	Variable name	Description of the variable	Source of data	Year	Unit
V10	Illiteracy rate	Population aged 10 and over without the ability of reading and writing as share of the total population of the same age; indicates lack of basic education	NIS - PHc	2011	%
V11	Activity rate	Share of economically active population aged 15–64 in the total population of the same age; reflects the potential of the labour force in the economy	NIS - PHc	2011	%
V12	Employment rate in agriculture	Ratio between the population employed in agriculture and the total of employed population (aged 15–64); expresses the economic profile of local economy	NIS - PHc	2011	%
V13	Employment rate in industry	Ratio between the population employed in industry and the total of employed population (aged 15–64); reflects the economic profile	NIS - PHc	2011	%
V14	Employment change	Changes in the employed population between 1992 and 2011; denote the dynamics of the working force	NIS - PHc	1992, 2011	%
V15	Labour substitution index	Ratio between people aged 15–29 to people aged 30–44; express the renewal capacity of working-age population; super-unitary values suggest that the labour force preserves its vitality over time	NIS - PHc	2011	Number of persons
<i>Infrastructure and land-use sub-index</i>					
V16	Dwellings change	Changes in the number of dwellings between 1992 and 2017; reflects the attractiveness of a territory	NIS - Tempo	1992, 2017	%
V17	Share of dwellings connected to the public sewerage system	Dwellings connected to the public sewerage system as share of the total number of dwellings; expresses the basic urban infrastructure	NIS - PHc	2011	%

Table 1 (continued)

No	Variable name	Description of the variable	Source of data	Year	Unit
V18	Share of dwellings with an indoor bathroom	Dwellings with an indoor bathroom as share of the total number of dwellings; indicates the dwelling quality and access to basic urban facilities	NIS - PHc	2011	%
V19	Share of modernized streets	Modernized streets as share of the total number of streets; expresses the quality of transport infrastructure	NIS - Tempo	2017	%
V20	Living floor per inhabitant	Total floor area (m <sup>2</sup> ) of a dwelling per inhabitant; denotes the dwelling comfort and living conditions	NIS - Tempo	2017	m <sup>2</sup> /inhabitant
V21	Share of built-up area	Percentage of the built-up area out of the total land area; reflects land use	NIS - Tempo	2017	%
V22	Share of agricultural land	Percentage of agricultural land out of the total land area; reflects the land use with the assumption that larger surface of agricultural land means more rural characteristics	NIS - Tempo	2017	%

\*NIS -Tempo - National Institute of Statistics (NIS), TEMPO-online database, \*\*NIS - PHc - National Institute of Statistics (NIS), Population and Housing censuses (1992, 2011)

**Table 2** Summary statistics for each variable presented in the study

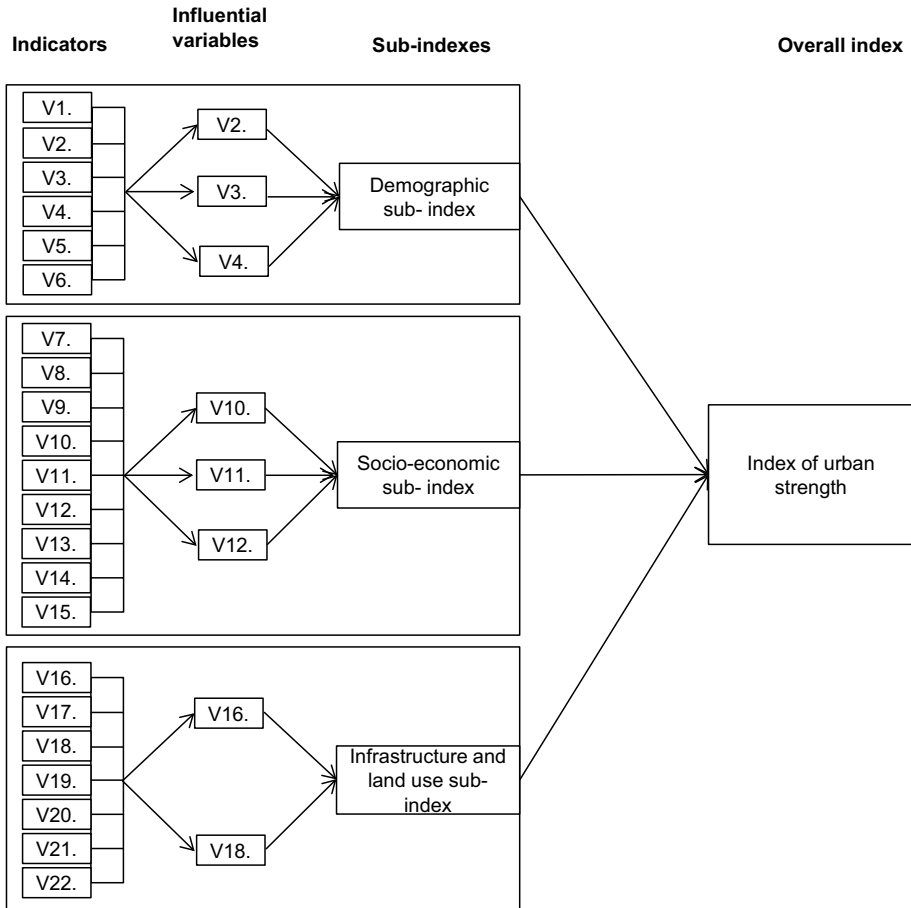
Variable	Median	Mean	Var	Std Err	Std Dev	Kurtosis	Skewness	Range	Min	Max
V1	-5.6	-2.8	340.7	1.2	18.5	39.4	4.5	223.3	-47.7	175.7
V2	-2.2	-0.7	82.2	0.6	9.1	2.7	1.3	56.4	-18.0	38.4
V3	-20.4	-24.7	482.6	1.5	22.0	-0.5	-0.7	86.9	-86.9	0.0
V4	-14.7	-15.1	10.8	0.2	3.3	0.9	-0.1	23.0	-25.9	-2.8
V5	91.7	99.3	1290.9	2.4	35.9	10.3	2.4	281.6	41.6	323.2
V6	103.0	184.0	77,750.2	18.6	278.8	37.2	5.4	2611.5	13.0	2624.5
V7	1.4	1.8	2.4	0.1	1.6	5.0	1.7	10.8	0.0	10.8
V8	2.9	7.0	149.5	0.8	12.2	25.3	4.2	105.3	0.0	105.3
V9	9.7	10.2	18.3	0.3	4.3	2.3	1.0	27.9	2.7	30.6
V10	-1.2	-1.7	3.3	0.1	1.8	13.0	-3.2	12.7	-12.7	0.0
V11	63.5	63.4	47.7	0.5	6.9	1.2	0.4	43.9	46.1	90.0
V12	-11.8	-17.7	212.2	1.0	14.6	1.7	-1.4	74.9	-76.1	-1.2
V13	25.0	25.8	117.0	0.7	10.8	-0.4	0.2	57.0	1.0	58.0
V14	-22.1	-19.2	447.0	1.4	21.1	27.3	3.6	226.4	-58.2	168.2
V15	0.8	0.8	0.0	0.0	0.1	6.6	1.4	0.8	0.6	1.4
V16	13.0	17.0	588.5	1.6	24.3	85.3	7.6	329.0	-27.4	301.6
V17	74.3	69.2	400.0	1.3	20.0	-0.3	-0.7	82.0	16.7	98.7
V18	67.8	64.3	394.4	1.3	19.9	-0.6	-0.5	81.8	15.8	97.6
V19	62.5	61.1	560.3	1.6	23.7	-0.9	-0.2	98.1	1.9	100.0
V20	66.5	70.4	1124.3	2.2	33.5	13.7	2.5	327.5	-11.3	316.2
V21	9.1	14.3	378.0	1.3	19.4	26.4	4.5	174.2	0.7	174.9
V22	-63.2	-58.3	563.6	1.6	23.7	-0.7	0.6	91.3	-93.4	-2.1

*Var* Variance, *Std Err* Standard Error, *Std Dev* Standard Deviation, *Min* Minimum, *Max* Maximum

possible. It should be noted that data scarcity at the local level is characteristic not only to Romania, but also to other countries (Serra et al. 2013, 2014).

Summary statistics for all variables are presented in Table 2.

The approach used for the data analysis is “Principal Component Analysis integrated with GIS (Geographic Information System)” (Petrişor et al. 2012). By its nature, Principal Component Analysis (PCA) is an exploratory statistics method, and its main function is data mining, and not a cause-effect relationship. However, since the selection of variables used to assess the level of urban strength results directly from the concept of “principal components”, this model is reflective, according to the classification proposed by Diamantopoulos et al. (2008). Similarly, since it does not operate with variables as a whole, but with their “principal components”, which conceptually result from the aggregation of “parts” of the variables into new variables, the method can be considered “compensatory” under the classification proposed by Casadio Tarabusi and Guarini (2013), since the principal components are weighted arithmetic means of the original (standardized) variables. Despite its statistical limitations, this study used the PCA based on two arguments provided by Mazziotta and Pareto (2019), concerning: (1) data visualization, particularly the detection of clusters with similar characteristics, and (2) the ability to compare the empirical dimension of the factors with the three dimensions (demography, socioeconomics, and infrastructure and land use).



**Fig. 1** Conceptual model of Index of Urban Strength

Essentially, the approach is comprised of (1) PCA to all variables used to characterise a given area consisting of territorial subunits (in this study—small towns), using the subunit data for each variable to determine the most influential variables, and the share of overall variability explained by each one, (2) use the share of variability, adjusted to sum up to 100%, as weight for each variable in building up an overall index, and (3) rank the values for each dimensional index and the overall one in four classes (high, medium, low, very low values) defined by the quartiles; and (4) map the values of the index for each territorial subunit using GIS to draw a choropleth (graduated colour) map of the area.

With respect to the second step, an important issue, affecting the validity of the results of aggregation, relates to the polarity, i.e., sign of the relationship between each variable and the urban strength (Mazziotta and Pareto 2017, 2019). This issue was addressed by adding the variables with a positive relationship and subtracting those with a negative relationship when building up each sub-index from the results of PCA.

**Table 3** Results of the Principal Component Analysis for the demographic sub-index: variation explained

Component	Initial eigenvalues			Extraction sums of squared loadings			
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Adjusted share
1	2.325	38.755	38.755	2.325	38.755	38.755	52.501
2	1.103	18.383	57.139	1.103	18.383	57.139	24.903
3	1.001	16.679	73.817	1.001	16.679	73.817	22.595
4	.781	13.022	86.839	–	–	–	–
5	.546	9.092	95.931	–	–	–	–
6	.244	4.069	100.000	–	–	–	–

**Table 4** Results of the Principal Component Analysis for the demographic sub-index: correlations between the Principal Components and variables

Correlated variable	Component		
	1	2	3
V <sub>1</sub>	.634	.407	–.361
V <sub>2</sub>	.305	<b>.747</b>	.479
V <sub>3</sub>	.441	–.308	<b>.713</b>
V <sub>4</sub>	<b>.895</b>	.029	–.008
V <sub>5</sub>	.786	–.180	–.349
V <sub>6</sub>	.466	–.502	.107

Bold-italic values show the indicator that corresponds to each component

**Table 5** Results of the Principal Component Analysis for the socio-economic sub-index: variation explained

Component	Initial eigenvalues			Extraction sums of squared loadings			
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Adjusted share
1	2.752	30.574	30.574	2.752	30.574	30.574	44.803
2	1.886	20.954	51.528	1.886	20.954	51.528	30.706
3	1.504	16.713	68.241	1.504	16.713	68.241	24.491
4	.926	10.287	78.528	–	–	–	–
5	.652	7.240	85.768	–	–	–	–
6	.575	6.389	92.157	–	–	–	–
7	.364	4.041	96.198	–	–	–	–
8	.213	2.364	98.562	–	–	–	–
9	.129	1.438	100.000	–	–	–	–

It is worth being mentioned that in the preliminary phase, PCA was applied (1) for all variables at ones, and (2) for each set corresponding to the sub-indexes separately. The rationale beyond the second version of the method was to ensure a more specific selection of variables from within each dimension, and the representation of all dimensions in the overall index. When mapping the overall index that was computed using the

**Table 6** Results of the Principal Component Analysis for the socio-economic sub-index: correlations between the Principal Components and variables

Correlated variable	Component		
	1	2	3
V <sub>7</sub>	.691	.367	-.488
V <sub>8</sub>	.546	.315	-.634
V <sub>9</sub>	.773	.328	.242
V <sub>10</sub>	.349	.103	<b>.645</b>
V <sub>11</sub>	-.301	<b>.795</b>	.274
V <sub>12</sub>	<b>.805</b>	-.418	.154
V <sub>13</sub>	.404	-.619	.296
V <sub>14</sub>	-.184	.469	.336
V <sub>15</sub>	-.567	-.350	-.301

Bold-italic values show the indicator that corresponds to each component

**Table 7** Results of the Principal Component Analysis for the infrastructure and land-use sub-index: variation explained

Component	Initial eigenvalues			Extraction sums of squared loadings			
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Adjusted share
1	2.710	38.719	38.719	2.710	38.719	38.719	63.579
2	1.553	22.180	60.899	1.553	22.180	60.899	36.421
3	.921	13.152	74.052	-	-	-	-
4	.753	10.764	84.815	-	-	-	-
5	.575	8.215	93.030	-	-	-	-
6	.464	6.631	99.662	-	-	-	-
7	.024	.338	100.000	-	-	-	-

**Table 8** Results of the Principal Component Analysis for the infrastructure and land-use sub-index: correlations between the Principal Components and variables

Correlated variable	Component	
	1	2
V <sub>16</sub>	.350	<b>.707</b>
V <sub>17</sub>	.878	-.349
V <sub>18</sub>	<b>.892</b>	-.324
V <sub>19</sub>	.475	-.360
V <sub>20</sub>	.419	.661
V <sub>21</sub>	.526	.507
V <sub>22</sub>	.586	-.042

Bold-italic values show the indicator that corresponds to each component



first version, the results were inconclusive and did not reflect the reality very well. For this reason, these results were ignored in the subsequent analyses. As anticipated, the second method provided realistic results, which are the ones presented in the article.

### 3.2 Construction of the Index of Urban Strength (IUS)

The application of PCA determined groups of influential variables, along with the possibility of assessing influence using the share of overall variability explained by each one (Fig. 1). The influential variables were those identified by the PCA as having a strong influence on each sub-indicator of the urban strength, by explaining most of its variation. The results of applying PCA to each domain (demography, socio-economics, and infrastructure and land-use) are presented in Tables 3, 4, 5, 6, 7 and 8.

For each sub-indexes, two tables are presented, as resulted from the PCA. The first one presents the share of variation explained by each component, and the second identifies the components with the variable most correlated to it (based on the absolute value of the correlation coefficient). Therefore, the tables corresponding to each sub-index are: 3 and 4 for the demographic one, 5 and 6 for the socio-economic one, and 7 and 8 for the infrastructure and land-use one.

In this study, the PCA was applied separately for each set corresponding to the demographic, socio-economic and infrastructure and land-use sub-indexes. The corresponding formulae for each of the three sub-indexes, i.e.,  $I_d$  (demographic sub-index),  $I_s$  (socio-economic sub-index), and  $I_l$  (infrastructure and land-use sub-index) are provided below.

$$I_d = \frac{(52.501 \times V_4) + (24.904 \times V_2) + (22.595 \times V_3)}{100}$$

$$I_s = \frac{(44.803 \times V_{12}) + (30.706 \times V_{11}) + (24.491 \times V_{10})}{100}$$

$$I_l = \frac{(63.579 \times V_{18}) + (36.421 \times V_{16})}{100}$$

The rationale behind it was to ensure a more specific selection of variables from within each dimension. In order to ensure the significance of the values of indices (i.e., low values indicate a “bad” situation for each variable), some of the variables were recoded as needed. The overall index was constructed by combining the sub-indexes for the three dimensions with equal shares (1/3). Equal shares were preferred after assessing other alternatives (e.g., Delphi-weighted expert opinions) due to their simplicity, intuitiveness, and better ability to replicate. Therefore, the overall index uses the influential variables determined by the PCA, their adjusted share, and a sign resulting from the type of correlation between the principal component and each individual variable (positive or negative) obtained from the three separate PCAs that were run for each dimension:

$$\frac{I_d + I_s + I_l}{3} = \frac{[(52.501 \times V_4) + (24.904 \times V_2) + (22.595 \times V_3)] + [(44.803 \times V_{12}) + (30.706 \times V_{11}) + (24.491 \times V_{10})] + [(63.579 \times V_{18}) + (36.421 \times V_{16})]}{300}$$

Previous studies have shown that an index should ensure an exploratory analysis based on the used indicators (Mitrică et al. 2017; Michalek and Zarnekow 2012; Hagerty et al. 2001).

Thus, the resulted categories of each sub-index were mapped and explained. Subsequently, for a more in-depth analysis, the IUS categories were interpreted in correlation with the period in which the small towns gained their urban status (before 1945, between 1945 and 1989, after 1989) and with their spatial distribution at a macro-region level.

## 4 Results and Discussion

Based on the above-specified methodology, the three sub-indexes and the component influential variables were analysed for each small town, followed by an investigation of the Index of Urban Strength.

*The demographic sub-index* includes three influential variables, the highest weight being assigned to the share of the population aged 65 years or over, then net migration rate and lastly the share of the population from the secondary built-up areas (outside the main urban core).

The share of the population aged 65 years or over is a relevant indicator for the demographic ageing process, one of the most worrying trends in the modern world (Graycar 2018). In the long run it is considered one of the driving forces of urban shrinkage in Romania (Bănică et al. 2017). The threshold for an ageing population is 12% (Rosset 1964), and 84% of small towns in Romania have already passed it. The average value is around 15%, ranging between 2.8% in Rovinari (Gorj County) and 25.9% in Bălcești (Vâlcea County). The small proportion of the elderly population in the case of Rovinari and other mining towns (Motru in Gorj County, Uricani in Hunedoara County) is attributed to an in-migration wave of young people in the 1980s, who came to work in the newly opened mines (Ianoș and Tălângă 1994).

Net migration rate is perceived as a determinant factor of population development (Fertner et al. 2015) and of the attractiveness of towns (Buch et al. 2014). Additionally, negative values observed over long periods of time contribute to depopulation (Zhitin et al. 2018). Net migration rate has a slight negative average value ( $-0.7\%$ ), but its range is very wide: from 38.4% in Cernavodă (Constanța County) to  $-8\%$  in Jimbolia (Timiș County). The first hosts the only nuclear power plant in Romania, the operation of which requires a highly educated work force from other places. Still, most small towns (62%) display negative values of net migration rate, some even less than  $-10\%$  (around 9%).

The share of the population living in secondary built-up areas (outside the main urban core) was selected as an indicator because the remote parts of a town often exhibit rural characteristics (Zamfir and Braghină 2000; Vaishar et al. 2016). In Romania, only 20% of small towns contain a single compact urban core. Conversely, in 15% of small towns, over half of the population lives in secondary built-up areas. The most significant recorded values for secondary built-up area living exceed 80% (Stefănești in Argeș County and Ulmeni in Maramureș County). This category includes many towns located in mountainous or isolated areas, like some of the post-communist towns whose rural origins have not yet been wiped out completely.

The results of the demographic sub-index show that the highest values are characteristic of settlements with a single urban core, low or relatively low share of population over 65 and a positive net migration rate (e.g. Cernavodă in Constanța County, Babadag in Tulcea County, Ghimbav in Brașov County, Plopeni in Prahova County, Râșnov in Brașov County, Bragadiru in Ilfov County) (Fig. 2). Other towns from this category have a reduced population in secondary built-up areas (e.g. Rovinari in Gorj County, Cislădie in Sibiu County,



**Fig. 2** The demographic sub-index

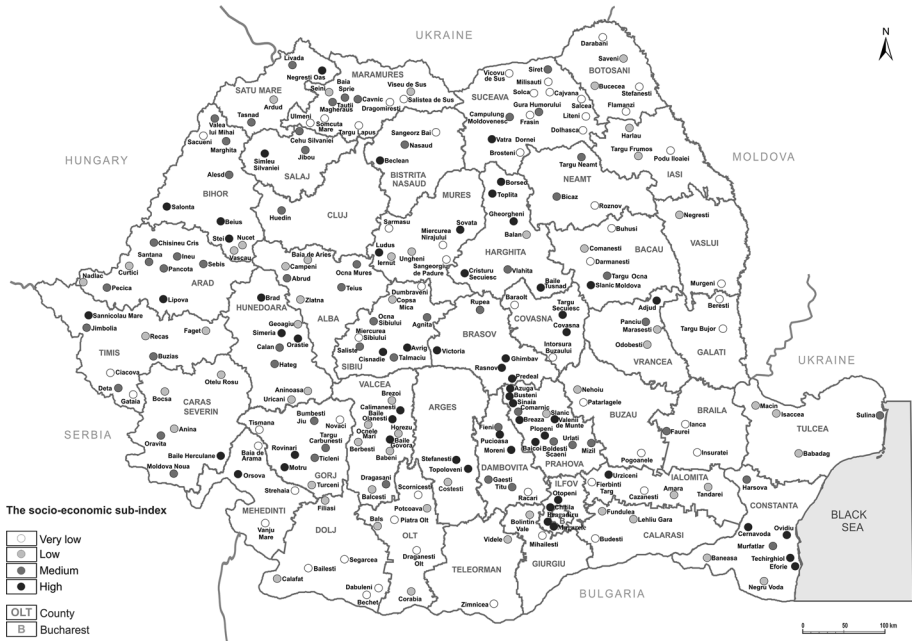
Beclean in Bistrița-Năsăud County, Otopeni in Ilfov County) or a higher share of population over 65 (Azuga in Prahova County, Techirghiol in Constanța County, Sulina in Tulcea County), but also a high net migration rate.

In contrast, the lowest values of the demographic sub-index are typical of towns that have a high percentage of population aged 65 or over, and a larger proportion of inhabitants in secondary built-up areas, combined with a negative net migration rate (e.g. Ștefănești in Botoșani County, Pătărlagele in Buzău County, Tismana in Gorj County, Breaza in Prahova County, Dolhasca in Suceava County), or those with slightly positive net migration rates (Fierbinți-Târg in Ialomița County, Ștefănești in Argeș County, Broșteni in Suceava County).

Regarding territorial distribution, at the county level, town clusters (over four) with a high IUS are common in a continuous zone that spans Prahova County, Brașov County and Sibiu County, in South-East Constanța County and Bihor County in the West. On the opposite end is the group of towns that have a very low IUS, clusters of which are widespread in three main areas, respectively Suceava County (South and East) and Maramureș County (South-West), both in the Northern part of Romania, Alba County and Mureș County in the Centre and Vâlcea County in the South.

The *socio-economic sub-index* includes three influential variables, with the highest weight assigned to employment rate in agriculture, followed by activity rate and illiteracy rate.

The employment rate in agriculture is a useful indicator for the formation of an economic typology (Vaishar et al. 2016; Zamfir 2007). In Romania, according to Law 351/2001 (Romanian Parliament 2001b), an urban settlement has to have values below 25%, a threshold that is fulfilled by only 74% of small towns. The highest weights of over 50% employment in agriculture are only observed in 5% of small towns, which present



**Fig. 3** The socio-economic sub-index

a dominant agricultural profile (e.g. Cajvana, Dolhasca and Liteni in Suceava County, Dăbuleni in Dolj County).

The activity rate demonstrates the potential of the labour force (Mitrică et al. 2019), which is relevant for understanding town performance and its socio-economic profile (Servillo et al. 2014b; Hamdouch et al. 2017). The average value for small towns is 63.4%, which is lower than the national average (67.3%) and the urban average (67.9%). The highest values (over 80%) are reached, surprisingly, in small towns that acquired this status after 1990, with an agricultural profile (Tismana in Gorj County, Liteni and Cajvana in Suceava County, Sălișteea de Sus in Maramureş County). The explanation for this is that statistical data includes self-employed persons in farming occupations, even if it is mainly subsistence agriculture.

A high illiteracy rate is associated with small earnings, lower-quality jobs and even a negative impact on health, to some extent (Green and Riddell 2007). Moreover, the level of education is one of the indicators for human capital, with an influence on work productivity and economic development (Coulombe and Tremblay 2006), but also the growth of individual earnings and the reduction of poverty (Bruns et al. 2015). The average illiteracy rate in small towns is 1.7%, but around 11% of small towns have an illiteracy rate higher than 3%, or in some cases even 10% (Bolintin-Vale in Giurgiu County, Babadag in Tulcea County in correlation with a high percentage of Roma population). The lowest rates of illiteracy, under 0.5%, are characteristic of about 21% of small towns.

*Socio-economic sub-index* results show that the highest values correspond with towns where smaller shares of the population work in agriculture, with the illiteracy rates in those towns being close to 0, and a high activity rate (Otopeni and Bragadiru in Ilfov County, Borsec in Harghita County, Sinaia in Prahova County, Ghimbav in Braşov County, Cîsnădie in Sibiu County) (Fig. 3).



**Fig. 4** The infrastructure and land-use sub-index

The lowest values are typical of towns where a large percentage of the population works in agriculture, coupled with medium or high rates of illiteracy (Cajvana and Dolhasca in Suceava County, Dăbuleni and Bechet in Dolj County, Însurăței in Brăila County, Flămânzi in Botoșani County).

When it comes to territorial distributions of towns with high values, an axis of economic development can be observed from South to North, spanning from Bucharest and Ilfov County through Prahova County, all the way to Brașov County. On the other end of this spectrum we notice a territorial grouping of towns with a very low degree of socio-economic development in the Southern part of the country along the border with Bulgaria, and in the East and North on the borders with Moldova and Ukraine. The exception for this is Constanța County, which includes several towns with significant economic activity. In addition, previous studies have demonstrated that the Western part, where Romania borders Hungary and Serbia, is more developed than the rest of the country (Mitică et al. 2017). At the same time, the West and Centre of the country perform better economically compared to the East, which is traditionally less developed.

The *infrastructure and land-use sub-index* includes two influential variables, with the highest weight assigned to the share of dwellings with an indoor bathroom.

The share of dwellings with an indoor bathroom is considered a relevant indicator for quality of life (Voicu and Voicu 2005). In this regard, a lack of an indoor bathroom is associated with severe housing deprivation (Eurostat 2015). Romania occupies the last place in the EU, with only 70.3% of the dwellings having an indoor bathroom (Eurostat 2015). Small towns present an even lower average (64.3%) with extreme values ranging between 15.8% (Liteni in Suceava County) and 97.6% (Ștei in Bihor County). The worst of it, with less than a third of households having an indoor bathroom, can be found in 6% of small towns.



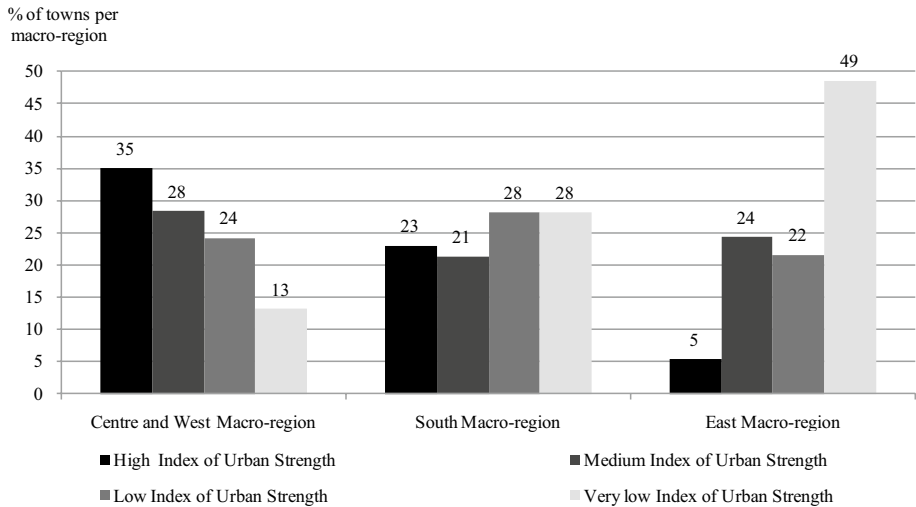
**Fig. 5** Index of Urban Strength (IUS)

Dwellings change, even if it is an infrastructural indicator, also reflects economic dynamics (Hamdouch et al. 2017), the impact of local public policies (Ashna et al. 2015; Virdol et al. 2015) and town attractiveness (Pichler-Milanovich 2001; Lux 2003). The average value for this is only 17%, which indicates a rather low degree of attractiveness for small towns. Still, this figure is made up of a wide range spanning between -27.4% in Ciacova (Timiș County) and 301.6% in Bragadiru (Ilfov County). The least attractive towns have seen a descendant trend (6% of the total).

*Infrastructure and land-use sub-index* results indicate that the highest values are characteristic of towns that have a high percentage of dwellings with an indoor bathroom and a positive trend of dwellings change (Otopeni and Bragadiru in Ilfov County, Eforie and Techirghiol in Constanța County, Cislădie in Sibiu County) (Fig. 4). On the other side of the spectrum, the lowest values are seen in: (a) towns with negative values of dwellings change and low rates of dwellings with an indoor bathroom (e.g. Budești in Călărași County, Bălcești in Vâlcea County, Ciacova in Timiș County, Solca and Milișăuți in Suceava County); (b) towns with a slightly positive trend of dwellings, but with reduced values of the second indicator (e.g. Pogoanele in Buzău County, Poteoava in Olt County, Dăbuleni in Dolj County, Însurăței in Brăila County).

In terms of spatial distribution, as with the case of the socio-economic index, it is observed that the same general trend of diminished development is kept in the East of the country and the most Southern parts, close to the Bulgarian border, compared to the rest of the country. The exception to this is, again, Constanța County, which includes many towns with a high infrastructure and land-use sub-index. Territorial clusters in Western Romania, namely the counties of Bihor and Hunedoara, also enjoy a similar favourable disposition, as does the aforementioned Bucharest-Brașov development axis.





**Fig. 6** Distribution of small town IUS per macro-region

Using the overall Index of Urban Strength (IUS), we registered values between  $-403$  (Dolhasca, in Suceava County) pointing to a low level of urban strength, and  $6,172$  (Bragadiru, in Ilfov County) indicating a high level of development (Fig. 5). Based on this hierarchy, four levels of urban strength were identified: very low ( $-403-1020$ ), low ( $1021-1560$ ), medium ( $1561-1970$ ), and high ( $1971-6172$ ).

Within the best category, 45% of small towns present high values in all three sub-indexes, while 8% demonstrate a weaker frame for one of the analysed dimensions, especially the demographic one. High IUS values are typical for:

(a) Small towns located near big cities like Bucharest (Otopeni, Chitila, Măgurele, Bragadiru in Ilfov County), Constanța (Ovidiu in Constanța County), Brașov (Ghimnav and Râșnov in Brașov County), Sibiu (Cisnădie in Sibiu County), etc. These cases confirm the process of borrow size, in which the development of the small towns is influenced by the presence of large urban centres, and they're characterised by relocated economic activities and in-migration.

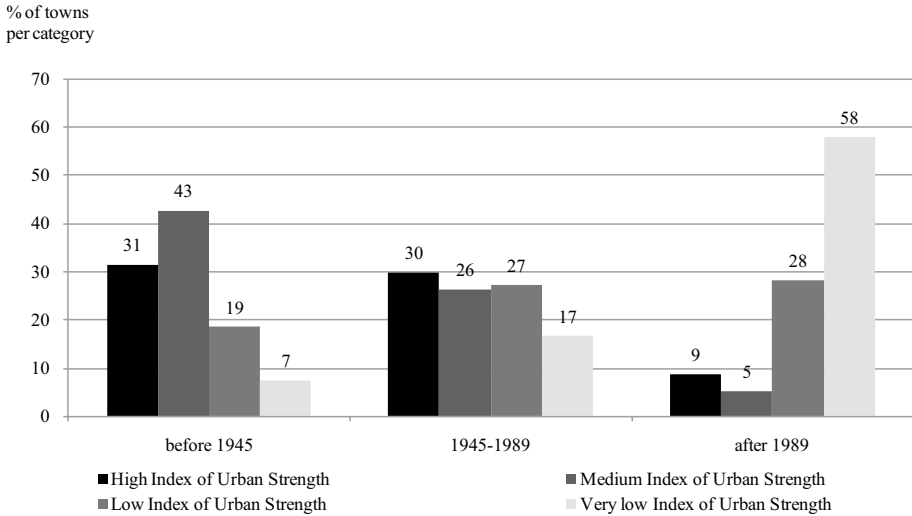
(b) Old touristic resorts with facilities (e.g. Eforie and Techirghiol in Constanța County; Bușteni, Azuga and Sinaia in Prahova County; Predeal in Brașov County).

(c) Traditionally industrial towns (e.g. Rovinari and Motru in Gorj County, Nucet and Ștei in Bihor County, Plopeni in Prahova County) or other secondary sector economic activities (Cernavodă in Constanța County), that benefitted from many investments.

Bragadiru (IUS 6172) and Otopeni (IUS 3832) are in the first two spots. The first has relatively good connections with Bucharest and an elevated attractiveness level especially in recent years, both economically and residentially. Otopeni is home to the largest airport in Romania, which generates many connected activities, but many other unrelated businesses from diverse fields of activity have chosen to settle there as well.

After analysing the group of towns with very low IUS, we established that 38% of the towns in this category have the lowest values for all three sub-indexes (e.g. Liteni and Milișăuți in Suceava County, Ștefănești in Botoșani County, Murgeni in Vaslui County, Piatra Olt in Olt County). Nevertheless, over half of these (52%) are positioned in a superior category in one of the sub-indexes, usually demography (e.g. Bechet in Dolj County,





**Fig. 7** Distribution of small towns IUS in relation to the timing of their emergence

Însurăței in Brăila County, Berești in Galați County). The worst positioned ones are towns whose activity is predominantly agricultural (Dolhasca in Suceava County, Flămânzi in Botoșani County, Pogoanele in Buzău County, Dăbuleni in Dolj County).

Investigating spatial differentiation in macro-regions, only 13% of towns in the Centre and West of the country have a very low urban strength level (Fig. 6). Meanwhile, in the East the share is much higher, 49%, which indicates a lower level of economic development. In fact, this area is considered one of the poorest in the EU, with one of the lowest GDP/inhabitant (Eurostat 2018). Only two towns in East Romania have a high IUS, namely Târgu Frumos in Iași County and Gura Humorului in Suceava County. In comparison, the West of the country presents the highest percentage of small towns with a high IUS (35%) and medium IUS (28%).

In the South Macro-region, the distribution of small towns into those four categories of index of urban strength is the most balanced. However, over half (56%) exhibit either a low or very low IUS. In this regard, at the county level, the South-Western part (Dolj, Mehedinți and Olt County) stands out, as the southern side of this area is affected by severe weather conditions, especially the aridity process (Prăvălie 2013). This means the degradation of arable land and the diminishing of agricultural productivity (Dumitrașcu et al. 2018; Peptenatu et al. 2013). Another county with low-IUS small towns is Buzău in the North-Eastern part. On the other hand, the most developed counties are Ilfov and Constanța, as well as Prahova County, especially in the North where it connects to the Southern part of Brașov County. In the Centre and West Macro-region, the analysis of urban systems at the county level shows territorial groupings (over four small towns) in Harghita County, Bihor County and even Hunedoara County with a high IUS. The most problematic counties in the East are Suceava and Botoșani, which both include the largest clusters of small towns with low IUS in the entire country.

Having identified a correlation with the timing of the appearance of small towns, we found that those declared after 1990 often enter the category of very low IUS (58%) and

low IUS (28%). In fact, of those declared after the fall of communism, only five demonstrate a very high IUS (Bragadiru, Chitila, Măgurele, Otopeni in Ilfov County, Ghimbav in Braşov County), which are geographically located in suburban areas. These findings point to a generally lower level of urban strength in post-communist towns (Fig. 7).

The best positioned category is that of traditional towns that gained their urban status prior to 1945, the majority of which exhibit high and medium values of IUS (31% and 43% respectively). The group of towns formed between 1945 and 1989 paint a much more balanced picture, with 56% of the towns having high or medium IUS.

The IUS results are significant because they allow the investigation of urban features of small towns in Romania and their uneven development, thus establishing a hierarchy. This could be a starting point for further elaboration of policies and development strategies. On this line, the study contributes to increasing the awareness of the complexity of the small town issue, drawing the attention to the need to take action not just for themselves, but also for ensuring the wellbeing of their hinterlands. Additionally, this paper is part of the national trend of rethinking legislation in this field. In this regard, measures have been taken to change Law 351/2001 (Romanian Parliament 2001b), which symbolises the current system's inefficiency in establishing urban status and the inexistence of specific government policies (MDRAP 2016a, b).

The four resulting categories of the index emphasise major differentiations which can be explained by different historical backgrounds. Thus, some towns had always had a strong agricultural component which they have kept, and they shouldn't have been declared towns without a clear and adequate development plan that would have allowed them to acquire urban features. Meanwhile, although other towns demonstrated significant industrial activities, they suffered from a de-industrialisation process in the absence of viable work alternatives. At the other end of the spectrum are towns that have been successful in reviving certain economical activities. As a result, we can discuss a different potential for development. In this regard, the outcomes reveal the necessity for developing specific policy for each one of the four categories, taking local conditions into consideration. Policy makers should acknowledge the significance of small towns, and local and central authorities should make an effort to provide small towns with smart strategies and measures of support through a place-based mechanism (Barca 2009; Valtenbergs et al. 2015).

The current research confirms previous studies on the crisis afflicting many small towns (Bănică et al. 2013; Pirisi et al. 2015), preventing them from fulfilling their role as a developing force for the surrounding rural area. The most problematic situation seems to be that of small towns where the principal activity is agriculture, mainly as a means of subsistence, facing different problems when ensuring basic services and infrastructure. Along with most post-communist small urban settlements, towns with dissolved industrial activities find themselves in a similar predicament, especially those based on a single industry. These outcomes attest to a degradation process of the local features (Dumitrescu 2008; Matei and Caraba 2010; Preotesi 2014) in their attempt to find new paths for development (Zamfir et al. 2009).

The spatial distribution map allows for identifying clusters of small towns with the most alarming condition, meaning low and very low IUS. In this regard, the findings have the potential of being used as a guide for investments and for area-based actions, e.g. for providing proper facilities.

Although previous researches conducted in Romania were focused on case-studies or even on some perspectives at the national level, this index has the advantage of providing, for the first time, a useful, multi-dimensional assessment of the entire system of small towns. Additionally, the index can serve for comparing the Romanian situation

with the international one, especially with other post-communist countries. In this context, the IUS results confirm the general pattern composed by a great diversity of small towns confronted with different limitations and strengths (Fertner et al. 2015; Steinführer et al. 2016; Servillo et al. 2014b). Among the most prosperous small towns, the ones located near Bucharest stand out. This is in line with other researches highlighting a strong urban development near national capital cities (Pirisi et al. 2015; Vaishar et al. 2016; Yaskal et al. 2018). This statement proved valid for some of the ones located near other large cities, which tended to have a faster development (Vaishar et al. 2015; Hamdouch et al. 2017). Yet the conclusions of our work only partially support this evidence, since not all small towns located in close proximity to large urban centres register a high IUS. We can attribute this to some factors that obstruct their development, such as competition with nearby settlements or their relatively recent promotion to urban status.

However, prior analysis outlines that a positive trend was also registered by small towns that are not located near significant urban centres (Knox and Mayer 2009; Fertner et al. 2015; Filipović et al. 2016; Czapiewski et al. 2016). These findings were validated in Romania, too, showing a correspondence mainly between settlements with a high IUS and the invigoration of some traditional economic activities (especially industrial or touristic). In any case, tourism was identified as a niche strategy for the local economy of several small towns (Pirisi et al. 2015).

There is a noticeable difference concerning the group of towns declared after 1990 which register predominantly (86%) a low and very low IUS, in contrast to other former communist states which don't seem confronted with a similar situation (Filipović et al. 2016). However, as previously stated, nowadays, many small towns face decline and structural changes (Wirth et al. 2016; Porsche et al. 2019; Vaishar and Zapletalová 2009). In Romania, some of them failed to shift from their inherited economic activities to new ones. Consequently, these cases are in accordance with other studies that have found that these small towns lost some of their urban characteristics (Bănică et al. 2013) and basic functions (Vaishar et al. 2015). Meanwhile, for towns with a dominantly agricultural profile, we can notice the buffer character of agriculture as a source of main income, traditionally attributed to rural areas (Abreu et al. 2019; Mihalache and Croitoru 2011; Mocanu et al. 2018).

Regarding the applied methodology, a paper published by Duan and Zhang (2008) may seem similar because it also uses PCA to construct three sub-indexes to assess the urban strength in the case study region (Tarim basin, China). Nevertheless, there are considerable differences, like the selection of other variables (13) adapted to the specificities of the national urban system and to the much larger size of the towns. The latter demands a particularly prudent discussion, given the variation of city size across different countries and continents. Despite the fact that their methodology seems to be more complex from a statistical viewpoint—employing the construction of weighted Voronoi diagrams on the breakpoints based on the spatial distribution of the central cities—the authors do not build an overall index that offers a better comparability of the urban strength within the study area. Thus, we employed a simplified methodology, one that is easier to understand, which is extremely important for a more detailed interpretation of the results.

The comparison above is in line with previous conclusions about the complexity of this category of settlements and their variety in different parts of the world, which renders a unanimous approach impossible (Vaishar et al. 2015; Tacoli 2017; Porsche et al. 2019; Hamdouch et al. 2017).

Thus, our framework provides a more comprehensive multi-dimensional method for measuring small towns' features in this region of the world with an integrated overview of the Romanian situation.

Taking into account the more general utility of the Index of Urban Strength, further research should tackle with each of the four identified categories using more in depth analyses. Future studies can focus on small towns with similar characteristics but with different trajectories for identifying the driving forces behind their success or failure.

## 5 Conclusions

The IUS is a tool created especially for small towns, representing the first integrated index that covers a multi-dimensional perspective at the national level. Even if the IUS was built in relation to Romanian conditions, it may be used in other countries with similar contexts, employing minimal adjustments, with the goal of deriving findings that are useful to policy makers and scientists.

Applying the IUS to assess the urban condition of Romanian small towns led to the formation of a hierarchy that groups them in four major categories. The analysis confirms that some small towns in proximity to big cities borrow size and perform better than ones located in more peripheral areas. Additionally, small towns with diverse types of economic activity, especially tourism or industry, which attract people and new investments, also exhibit a high IUS. Nonetheless, there are small towns with similar geographical location and resources but with different urban strength. This suggests a relation between the IUS rank and the capacity of local authorities to value local resources and opportunities properly, as indicated in other studies (Bănică et al. 2013).

A very low IUS is correlated mainly with socio-economic and infrastructure underdevelopment, but also with demographic decline, expressing a deurbanisation process. Furthermore, small towns demonstrate more and more rural characteristics, meaning a decline of urban features, revealed even on the policy agenda (MDRAP 2015). Nevertheless, the considerable presence of post-communist towns in the category of towns with a very low IUS indicates the unsustainability of giving them town status without allocating proper financial resources for their development. In terms of spatial distribution at the macro-regions level, in accordance with previous researches (Mitrică et al. 2017; Ianoş 1998), the Central and Western parts of the country are more developed and exhibit better connectivity with Central and Western European countries. In addition, we noticed an axis of territorial development that connects Bucharest with Braşov County, through Ilfov County and Prahova County. In the South Macro-region, another territorial cluster of small towns with a high IUS is Constanţa County, which enjoys access to the Black Sea and significant economic activities. Meanwhile, the East Macro-region is left behind, the reason being its geographical location on the Eastern bounds of the European Union, with insufficient transport infrastructure and limited accessibility, which makes it even less likely to attract investors.

The findings provide new insights on the overall situation of Romania, the index being a promising tool both for exploring the features of small towns, but also for quantitatively assessing the effectiveness of applied policies and financial resources. Based on the IUS results and on the recognised crucial role small towns play in achieving balanced territorial development, there is a real need for meaningful policies and strategies. In this regard, policy makers should take the different categories of small towns into account through a place-based approach that also considers local potential. In Romania's Territorial Development

Strategy for the 2035 horizon (2016), aiming for a polycentric structure, small towns were defined as urban poles for providing rural settlements. However, our hierarchy highlights large areas composed of several small towns with a very low or low IUS, which indicates their need for additional support in order to fulfil their assigned territorial role. Still, this raises a question about the sustainability of such a decision seeing as financial resources are limited. In this line, an identified alternative, derived from IUS results, could be the designation of some key centres (Atkinson 2017), with further priorities in terms of access to funds. This solution would make sense also for Romania, considering the density of small towns in some areas and the dominant agricultural profile of others.

In addition, the established ranking can be used for identifying bundles of shortcomings, in an integrated framework or on each of three sub-indexes, which should be addressed together. In this sense, small towns face different challenges. For example, some towns with a high IUS, located near big cities, have to cope with an influx of population and new economic activities. In such areas it is essential to develop policies and strategies based on cooperation and partnership. Another group of small towns, overcrowded touristic spots, have to deal with the increasing pressure on services, housing and environment. Meanwhile, towns with a low or very low IUS affected by deindustrialized or located in isolated areas struggle with loss of population and difficulties in ensuring jobs and basic facilities. These results confirm the conclusions of other studies, that different small towns require different approaches and types of support (Knox and Mayer 2009; Servillo et al. 2014a; Atkinson 2017). Thus, in view of their wide diversity and the fact that this category of settlements was largely neglected, we are advocating for prioritizing them and creating designated strategies and funds for helping them to deal with their challenges. This can be justified by their lower capacity to compete with urban settlements higher up in the hierarchy, and on their potential to strengthen territorial cohesion.

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## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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