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A LIFE FOR SCIENCE: RONAN PADDISON (1945-2019)

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Abstract: Professor Ronan Paddison, co-editor of the Journal of Urban and Regional Analysis (JURA), died suddenly a few months ago on July 8, 2019. He departed at an age when he had sufficient energy to continue his life-long enthusiastic research and editorial duties. The latter included not just JURA, but also the highly regarded Urban Studies. This editorial work not only supported the diffusion of high quality knowledge. Shared and collaborative experiences with journals' co-editors and contributors were also invaluable in pinpointing future research directions within both the geographical world and wider social or environmental regimes. However, we should not underestimate his on-going dedication to original research and contribution to knowledge.

Key Words: *Urban Analysis, editor JURA, Ronan Paddison*

Ronan Paddison and the story of JURA

Cumbers and Philo (2019) have discussed Ronan's legendary contribution to Urban Studies' considerable reputation. Less well known is his essential role in the founding of other journals. He helped founding Space & Polity in 1997. A second one was JURA where Ronan was its co-editor continuously since its inception.

Ronan developed friendly and collaborative relationships with human geographers from several universities in Romania, focussing in particular on social-cultural changes of Romanian urban areas after the fall of the communist regime. Among his first collaborative links, there were those with the Babeş-Bolyai University in Cluj-Napoca (Voicu Bodocan and Vasile Surd), the University of Oradea (Alexandru Ilieș), the Western University of Timișoara (Remus Crețan) and the University of Bucharest (Ioan Ianoş). A delegation of Romanian geographers, especially from Cluj-Napoca, participated in the IGU Congress in Glasgow and it benefited considerably from Ronan's moral and logistic support. Personally, I first met Ronan at an International Conference organized by the University of Oradea in 2002, but I forged my strongest link through a visit, together with three other colleagues, to the University of Glasgow in 2008. We had two meetings there, both in his office, which was loaded with books, journals and manuscripts. He discussed the geography department's work and he provided details of his activities as editor of Urban Studies journal, giving us different printed issues of this prestigious publication.

Having proposed setting up a journal focusing on both urban and regional affairs, I recall Ronan asking me in a friendly way if I realised the complex task of soliciting high quality contributions, vetting their accuracy anonymously, and enhacing the journal's reputation. With the typical enthusiasm of a beginner, I confess that I had not thought through all these issues. With his support and advice, I gained some extremely useful advices. However, I soon realised that Ronan's exceptionally professional talents would be crucial in driving JURA's success. Having secured his participation as co-editor, we focused on selecting a title for the journal, oscillating between JURAnalysis and JURAffairs. Finally, we selected the current name, and

we assigned the entire editing process to CICADIT. Almost simultaneously, we decided to focus on elaborating the journal's development strategy and again Ronan's contribution was extremely important, starting with shaping its purpose. Our focus on high-quality processes was crucial in delivering a sustained increase in the quality of the published works. This, in turn, cemented JURA's growing reputation and its inclusion in such well-known international databases as Scopus (2014) and Clarivate Analytics – ESCI (2018).

A Performant Editor

Ronan's high status as a performant editor for both Urban Studies and JURA rests on his great abilities at a very difficult task. As he himself points out, it is not easy to be a journal editor. First, one needs to check if submitted articles fall within the journal's realm, which must remain true to purpose. Secondly, one must ensure that submitted articles meet the required technical-scientific requirements, whether theoretical, procedural, analytical and so on. Thirdly, it is crucial to appoint relevant referees who are leaders in the relevant field of study (Paddison 2003). Nor is it easy to ensure the regularity of publication, which can be impacted adversely by the lack of a steady stream of relevant article submissions. In addition, editors need to be alert to new research trends in terms of content, analytical methods, and inter-disciplinary participation.

Some remarks on his academic research

In addition to these outstanding contribution just discussed, Ronan Paddison established himself through his own publications as a distinguished researcher on urban affairs. The quality of his scientific work reflects his focus on defining and developing new concepts either alone or working with other researchers. These include "the post-colonial city; urban planning and governance; post-industrial city; city marketing strategies and place competition in city regions; and post-political city" etc., as highlighted and exemplified by Cumbers and Philo (2019: 2611).

While many of his articles were published in Urban Studies (Cumbers and Philo 2019), more of his innovative ideas for research on the city or on other aspects of urban, social, cultural and political geography were published elsewhere. Other journals include: Geoforum, Area, Progress in Planning, Scottish Geographical Magazine, and the Scottish Geographical Journal. Some of this work focused on the analysis of the social and cultural space of representative cities in North Africa, such as Tunis and Rabat, revealing their particularities with effects in their structuring mode.

Ronan's clearly expressed his vision for Urban Studies in one of his last contributions to the development of knowledge in this extremely attractive field (Paddison 2019). However, at the same time he acknowledged many unknown dimensions. Given his particular contribution to maintaining the field as a "vibrant" one, there was probably no other researcher more suited to writing a theoretical synthesis of this field, in the most recent and prestigious encyclopedia: *The Willey Blackwell Encyclopedia of Urban & Regional Studies* (Paddison 2019). In his opinion, urban studies cover several social and humanistic disciplines, offering a wide field of reflection from a multidisciplinary perspective (Paddison 2019). The formidable dynamics of the field led him to formulate a multitude of questions, which have remained unanswered or with partial answers so far. Moreover, he sought to develop another focus of study that connects urban studies to the current social, technological and scientific dynamics. The multitude of debates on the urban research and their interdisciplinary character demonstrates the complexity of city forms and life and it explains their repositioning in the field of contemporary research. New theoretical concepts and research methods emerging in a variety of urban studies have also

contributed to a better understanding of the mechanisms shaping the structure and life of cities. They, in turn, demonstrate the multi-disciplinary nature of urban studies, drawing Paddison's (2015) earlier work about the dynamics and complexity of urban studies.

For his fundamental contribution to the founding of the Journal of Urban and Regional Analysis, for the extremely efficient involvement in the management of this journal, for the generosity shown by offering a part of the issues of the Urban Studies journal to the library of CICADIT, the editorial board and myself, as co-editor, send sincere condolences to the family, keeping a vivid memory of Professor Ronan Paddison.

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COMPOSITE INDEX TO MEASURE THE PERFORMANCE OF TODAY'S CREATIVE CITIES: A HOLISTIC PERSPECTIVE

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Abstract: The urgency to make today's cities competitive has made political decision-makers focus on strategies oriented towards creativity, intelligence and urban sustainability. This scenario has led to the need to measure, assess and monitor the effects of those strategies on cities' performance. Therefore, this study aims to present the scientific and robust weighting of the creativity, intelligence and urban sustainability dimensions in cities' holistic, integrated and overall performance. Implicit in this objective is the previous construction of Composite Indices for each of those dimensions. In this context, the Exploratory Factor Analysis was found to be appropriate to respond to this aim, with empirical evidence being obtained in Portugal. The results show a weighting of 38%, 23.4% and 39.6% for creativity, intelligence and urban sustainability respectively. The contributions and implications for theory and practice, followed by indications for future research and the conclusions are also presented.

Key Words: *creativity, intelligence, urban sustainability, composite index, performance, cities*.

Introduction

Cities are increasingly seen as the main driver of regional and global economic development, irrespective of their population density or geographical context and cities' role in economic development has changed considerably, with them ceasing to be simply places of population density, business and employment (Haberstroh and Pinkwart 2018). However, some duality has persisted in the emphasis of local governments and central political decision-makers regarding the strategies adopted and the inherent investment, for example Silicon Valley, Bavaria Valley (Bavaria), Silicon Glen (Scotland), Silicon Saxony (Dresden, Hospers and Pen 2008), Barcelona, San Francisco, Glasgow (Amin and Thrift 2007), Rotterdam and Amsterdam (Romein and Trip 2009), whose strategies differ from each other. Given this scenario, the European Union, aiming for European cities characterised by competitiveness and territorial and social cohesion, defined strategies to be implemented at micro level – cities – by member countries so that inclusive, intelligent and sustainable growth can become a reality (Eurostat 2019).

In this context, interest has been aroused in the academic community regarding cities and the route they have chosen to grow in all their dimensions. Today's cities are multi-dimensional and pluralist places conciliating the historical past with the future, culture with economic factors, talents, technology and business with sustainability and with creativity (Power and Scott 2011, Ratten 2017), so that wealth creation can be demonstrated and supported by tri-partite pillars – creativity, intelligence and urban sustainability – to allow long-term growth and sustained performance (Rodrigues and Franco 2018). Obviously, this path is an enormous challenge for political decision-makers and local governments, as these objectives imply multiple transformations (Bouton et al. 2013), going beyond the traditional models of economic growth and including both tangible and intangible factors (Romero-Padilla et al. 2016). This means that the strategies implemented and to be implemented in cities should be directed to the strategic governance of spaces and places (Audretsch 2003, Malecki 2007), towards people and not

simply to organisational structures (Audretsch 2003).

For Rodrigues and Franco (2018), a paradigmatic change is found in the vision of the role and future of cities, stimulated by the phenomenon of globalization and it's meant that cities' economic and political importance grew quickly and that political decision-makers understood these help to solve their everyday problems of a social, economic and environmental nature. This vision is shared by the Networked Society City Index (Ericsson 2016) where the aim is for cities to become more inclusive, safe, resilient, creative, intelligent and sustainable, supported by the use of ICT and network connectivity, and by adopting a more sustainable consumption model – the circular economy.

However, this paradigmatic change in the role of today's cities in economic growth has given rise to a vast amount of literature on this topic (Florida 2005, Scott 2006, Mcgranahan and Wojan 2007, Landry 2012, Tranos and Gertner 2012, Cabrita et al. 2013, Ratiu 2013, Letaifa 2015, Girard et al. 2016, FPA 2017, Ortegel 2017, Rahbarianyazd and Doratli 2017, Florida 2019), directed towards creative, intelligent and sustainable cities, to the connection between culture, urban regeneration, collaboration processes and partnerships, and the economic and non-economic factors of multi-dimensional performance of cities today. This heterogeneity of theoretical and empirical studies has stimulated the development of indices to measure cities' performance regarding their creativity (Florida et al. 2007, Giffinger et al. 2007, Kakiuchi 2016, Montalto et al. 2019), intelligence (Picard et al. 2003, Carli et al. 2013, EY 2016, Angelidou 2017) and sustainability (Irungbam 2016, Trivellato 2016, European Commission 2019).

However, these indices have not yet filled the existing gaps in the literature on the measurement of cities' performance as a whole, noting a shortage of studies including the dimensions of creativity, intelligence and sustainability in a single index with the required scientificity. The importance of constructing a composite index was evidenced by Rodrigues and Franco (2018), who claimed that the performance of cities must be measured based on a holistic perspective and objective. In addition, the most studied topics have been global cities, incredible cities, city networks and city paradigms in social, ecological and cultural terms (Nijkamp and Kourtit 2013). In this area, there is a steady production of empirical studies addressing cities' performance (Malecki 2007) through indices showing a compilation of indicators in the various dimensions characterising cities (Borén and Young 2013, Flores and Teixeira 2017), with a great number of variables and for large samples (Çetindamar and Günsel 2012). Another gap identified concerns the relevance of including performance indicators that ally creativity and culture to sustainability, networks and their synergies for cities' sustainable and intelligent performance (Carta 2009, Tranos and Gertner 2012, Walker and Hills 2012, Cabrita et al. 2013, Echebarria et al. 2016, Bifulco et al. 2017, Cohen et al. 2017, Della Lucia et al. 2017, Ferraris et al. 2018). It should be noted that it is underlying in these gaps that creativity allows bridges to be created for the smart axis, as an adjective, as well as for sustainability, supported by the formation of networks, which allow synergies to be created between all city amenities (Ratten 2017). Another fundamental gap identified in the extensive literature concerns filling the existing gap between theory and practice (Lee et al. 2014), leading to Mora et al. (2017) calling for more studies designing holistic models of how current cities are built and about the scientific instruments that can help all actors involved in that construction (Priano and Guerra 2014, Huovila et al. 2017).

Aiming to fill these gaps, this study aims to present the scientific and robust weighting of the creativity, intelligence and urban sustainability dimensions in cities' holistic, integrated and overall performance. More precisely, the following specific objectives are defined: 1) to present an empirical performance measurement study, for sample and large dimension variables; 2) to treat these variables by multivariate statistical techniques, in order to construct a holistic composite index; and 3) with the answer to objectives 1 and 2, it is intended to bridge the gap between theory and practice. In short, this investigation aims to present the scientific and

robust weighting of creativity, intelligence and urban sustainability dimensions in the cities' holistic, integrated and global performance. This objective implies the previous construction of Composite Indices for each of those dimensions. Thus, among the various contributions of this empirical study, the main one lies in presenting a Composite Index for the holistic performance of today's creative cities with the respective scientific weightings.

Literature review

Dimensions of today's creative cities

The new role attributed to today's cities concerning economic growth has caused a certain ambiguity around the concept itself and the dimensions included, which means that studies on cities should be holistic and integrated. The literature on this topic highlights creativity (Scott 2000, Florida 2005, Hospers and Pen 2008, Pratt 2008, Grant and Kronstal 2010, Landry 2012, Kong 2014, Kakiuchi 2016, Ratten 2017, Florida 2019), intelligence (Dodgson and Gann 2011, Nam and Pardo 2011, Letaifa 2015, Mardikyan et al. 2015, Bouk et al. 2017, Ratten 2017) and urban sustainability (Cavalcanti 1995, Camagni et al. 1998, Elkington 2004, Wheeler and Beatley 2014, Pozdniakova 2017) as inseparable dimensions of cities at the present time. These dimensions point us towards simultaneously creative, intelligent and sustainable cities, and these are defined as possessing a creative, diversified, open and tolerant climate, creative talents and relevant cultural dynamics (Florida 2005, Romein and Trip 2009, Grant and Kronstal 2010), provided by participative governance, the adoption of technology, recognition of the social, human, physical, cultural and natural capital in which social and environmental questions are included (Bibri and Krogstie 2017, Ratten 2017). It should be noted that this line of thinking assumes that urban sustainability in cities integrates social development, economic development, environmental management and urban governance, which refers to the management and investment decisions taken by municipal authorities in coordination with national authorities and institutions (Donegan and Lowe 2008, World Economic and Social Survey 2013). In addition, intelligence here is not only related to ICT and its various vectors, but to how urban creativity can be intelligently developed, and so that to emphasize social and human capital (Partridge 2004, Hoyman and Faricy 2009). In this context, what is understood by the intelligence dimension in the present research is that it can also be encompassed by creative and sustainable cities (Rodrigues and Franco 2019a). In this context, current cities' overall performance must be addressed in a tri-partite and holistically integrated way.

This holistic approach to today's cities aims to show that they must be provided with creative/ favourable environments to stimulate the attraction and interaction of talented people and the fulfilment of cultural synergies, in articulation with the co-creation of economic value and with a catalysing effect in promoting urban regeneration and thereby achieving urban sustainability (Furtado and Alves 2012). However, the advantages of intelligence must be indexed to those driving forces in order to make cities even more attractive and entrepreneurial (Caragliu et al. 2011). Furthermore, creativity in cities arises from the catalysing benefit of culture through restoration and regeneration of cultural heritage as a driver of the economy by encouraging synergies, networks and partnerships between all stakeholders in order to obtain economic return in the present and future (Girard et al. 2016); intelligence is shown by the support of value exchange cycles, the circular economy process, the participative and creative process and urban sustainability, by recognizing the importance of their tangible and intangible amenities as predictors of their quality of life and performance (Neirotti et al. 2014). In this sense, Fig. 1 shows the conceptual model of a current city, approached holistically and characterised by multiple dimensions and sub-dimensions. This model is complemented in the following section by indicators and proxies to measure the overall, integrated performance of today's cities.

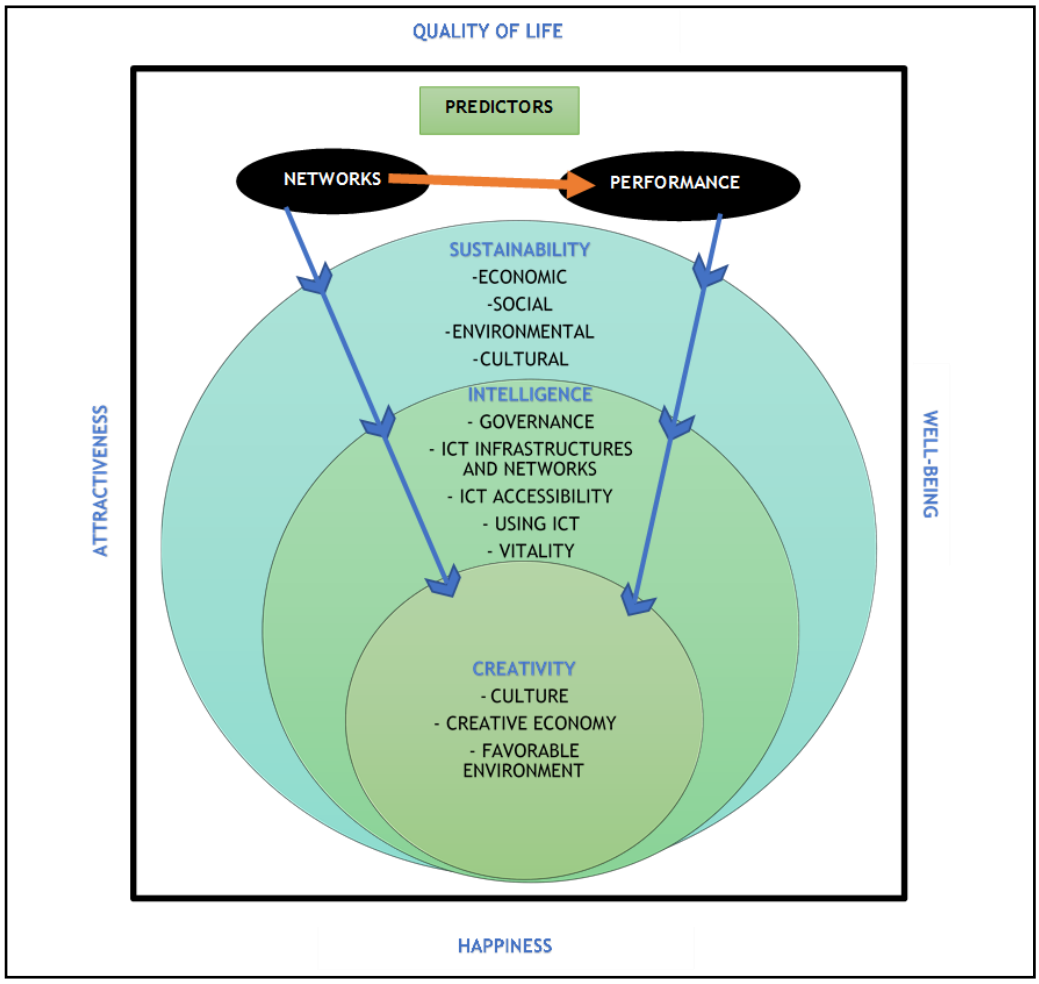

Fig. 1 **– Multi-dimensional design model for currents cities**
Source: *Rodrigues and Franco (2018)*

Creative, intelligent and sustainable performance of creative cities

Cities' global performance should be measured through a multi-dimensional and holistic approach (Ericsson 2016, Girard et al. 2016), due to cities' crucial role in the global economic development as places of connectivity (networks), creativity and innovation associated with social and economic progress, culture, diversity and the environment (European Commission 2011). In other words, cities' performance includes dimensions inherent to their tangible and intangible resources, as argued by Anthopoulos (2017), and it is the reflection of the strategies implemented with a view to giving cities creativity, intelligence and urban sustainability (Davoudi and Sturzaker 2017).

In this context, there is still a dispersion of indices and indicators to measure performance, due to the complexity of managing a city holistically (Albino et al. 2015), despite all of them aiming

to improve citizens' quality of life (Shapiro 2006, ISO 2018). In other words, this performance is measured by a battery of indicators, which are understood as a methodological instrument, since the analysis of the used indicators allows political decision-makers to identify cities' opportunities/threats so that their global performance can improve continuously and sustainably (U4SSC 2017), irrespective of their size. Corroborating this argument, Borsekova et al. (2018) concluded that a city's size does not determine the implementation of strategies emphasizing creativity, intelligence and sustainability, since people are important in their integrated approach (Giffinger et al. 2007, Hollands 2008, Nam and Pardo 2011).

Recognizing that not all existing indices, indicators and proxies to measure cities' global performance have been explored, Table 1 compiles the most used of them by the academic community and by other public and private entities.

Table 1

Index of creativity, intelligence and urban sustainability

Sub-dimension	General indicator	Source
Creativity		
Culture	Places of culture and facilities	Giffinger et al. (2007), Durmaz et al. (2010), Hartley et al. (2012), Lombardi et al. (2012), García Suárez and Pulido Fernández (2015), Kakiuchi (2016), Bosch et al. (2017), European Union (2017)
	Cultural participation and attractiveness	
Creative economy	Creativity and employment	Giffinger et al. (2007), Caragliu et al. (2011), Hartley et al. (2012), Landry (2012), Lombardi et al. (2012), Panal and Yáñez (2012), Joss et al. (2013), García Suárez and Pulido Fernández (2015), Kakiuchi (2016), Bosch et al. (2017), European Union (2017), Skavronska (2017)
	Intellectual property and innovation	
Favourable environment	Human capital and education	Giffinger et al. (2007), Caragliu et al. (2011), Hartley et al. (2012), Landry (2012), García Suárez and Pulido Fernández (2015), Dhingra and Chattopadhyay (2016), EPA (2016), European Union (2017), Skavronska (2017)
	Openness, tolerance and trust	
	Local and international connections	
	Governance	
Intelligence		
Governance	Implementation	Landry (2012), U4SSC (2017)
	Strategy	Landry (2012), Madeira et al. (2016), Angelidou (2017), Bosch
	Best practices	Giffinger et al. (2007), Lombardi et al. (2012), García Suárez and Pulido Fernández (2015), Angelidou (2017), Bloom Consulting (2017), Garau et al. (2017)
ICT infrastructure and networks	Telecommunications	EY (2016), Ericsson (2016)
	Transport	EY (2016)
	Energy	
	Environment	
	Sensors	

ICT accessibility	Tariffs	Ericsson (2016)
	Mobility	EY (2016)
Use of ICT	of technology	Giffinger et al. (2007), Lombardi et al. (2012), Ericsson (2016)
	Individual	Giffinger et al. (2007), Lombardi et al. (2012), Ericsson (2016)
	Public	Giffinger et al. (2007), Caragliu et al. (2011), Lombardi et al. (2012), EY (2016), Ericsson (2016), Madeira et al. (2016), Bloom Consulting (2017)
Vitality	Individual and public	EY (2016)
Sustainability		
Economic	Competitiveness	Giffinger et al. (2007), Caragliu et al. (2011), Lombardi et al. (2012), Devol et al. (2015), Adnan et al. (2016), Arcadis (2016), Bloom Consulting (2017), Bosch et al. (2017), EPA (2016), Ericsson (2016), Trivellato (2016)
	Economic activity	Giffinger et al. (2007), Lombardi et al. (2012), Ericsson (2016), Trivellato (2016), Angelidou (2017), Bloom Consulting (2017)
Social	Population	Giffinger et al. (2007), Lombardi et al. (2012), EPA (2016), Trivellato (2016), Bloom Consulting (2017), Bosch et al. (2017)
	Education	Giffinger et al. (2007), Lombardi et al. (2012), Arcadis (2016), EPA (2016), Ericsson (2016), Trivellato (2016), Bloom Consulting (2017), Bosch et al. (2017)
	Inclusion and cohesion	Giffinger et al. (2007), Trivellato (2016), Bosch et al. (2017)
	Social infrastructure	Giffinger et al. (2007), Lombardi et al. (2012), Ericsson (2016), Trivellato (2016), Bloom Consulting (2017), Bosch et al. (2017)
Environmental	Basic infrastructure	Lombardi et al. (2012), Arcadis (2016), Ericsson (2016), Bosch et al. (2017)
	Emission and production of atmospheric pollution	Giffinger et al. (2007), Lombardi et al. (2012), Joss et al. (2013), Ericsson (2016), Bloom Consulting (2017), Bosch et al. (2017)
	Circular economy	Ligorio (2017), Smol et al. (2017)
	Urbanism	Lombardi et al. (2012), Arcadis (2016), Dhingra and Chattopadhyay (2016), EPA (2016), Ericsson (2016), Bloom Consulting (2017), Artmann et al. (2019)

Methodology

Population

The population observed is represented by the 308 towns and cities in Portugal (NUTS II), where those situated on the coast have a greater population density. The metropolitan areas of Lisbon and Porto have the greatest concentration of population. Table 2 presents the population distribution by region (NUTS III) and Fig. 2 represents the geographical spatiality of these 308 cities and towns.

Data collection, indicators and proxies

The steps in the construction of composite indicators were: theoretical framework (should be developed to provide a basis for the selection and combination of indicators) and data selection (based on the characteristics of a good indicator) (Nardo et al. 2005, OECD 2008). So, after the compilation of all indicators (variables) for the measurement of the holistic performance of cities/towns and, thus, validating the presented conceptual model, it was necessary to adapt them to the Portuguese context and to construct them from a database directed to cities, which

is non-existent in Portugal. The numerical data for each variable was not collected randomly and it met the requirements of a good indicator (Chang et al. 2018).

Table 2

Population distribution in Portugal for 2017

NUTS II	Number of towns/cities	Population (number)
North	86	3 580 390
Centre	100	2 237 640
Lisbon Metropolitan Area	18	2 827 514
Alentejo	58	715 019
Algarve	16	440 543
Autonomous Region of the Azores	19	244 573
Autonomous Region of Madeira	11	254 622
Total	**308**	**10 300 300**

Source: *Pordata (2019)*

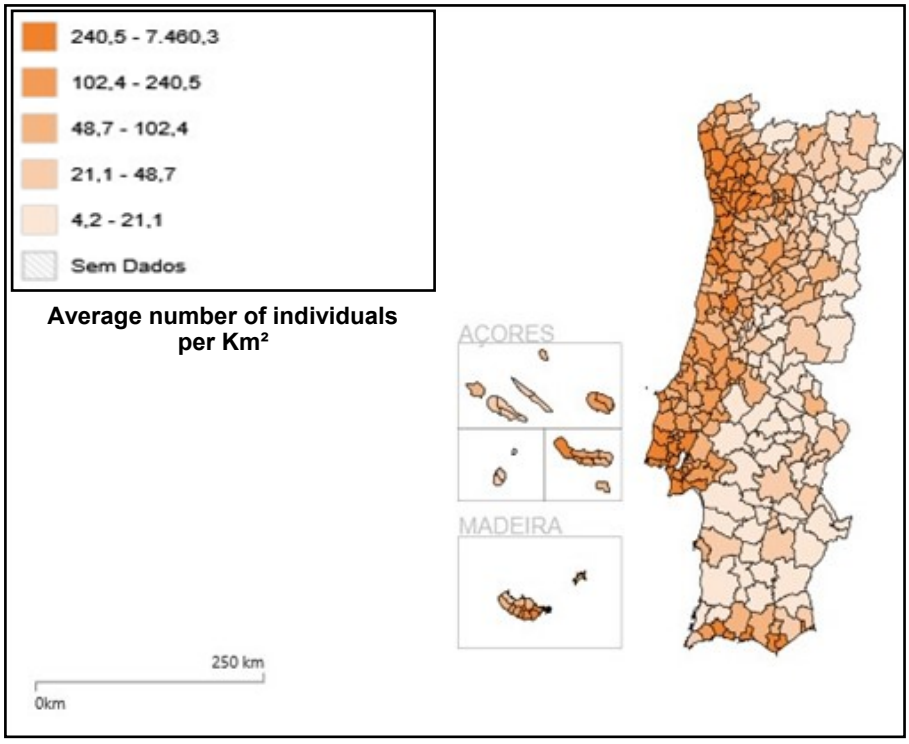

Fig. 2 **– Population density in Portuguese local authorities**
Source: *Pordata (2019)*

The collection of numerical data to produce the analysis is a crucial phase of this study, since the unavailability of data and resorting to various databases are unavoidable factors in the Portuguese context. Therefore, the database was formed by referring to various secondary sources – the National Statistics Institute (INE), PORDATA, and the official websites of various entities/institutions (e.g., Tripadvisor, Montalto et al. 2019) given the lack of a single database.

In these circumstances, the data-collection process began by obtaining the data available in the above-mentioned sources and by associating them with the dimension, sub-dimensions and indicators. This phase was extremely time-consuming and exhaustive so that the obtained database would be credible, reliable and suitable for the appropriate statistical treatment. Furthermore, the adaptation of the available data to the indicators and proxies most commonly used by academics and other entities implied an exhaustive search of theoretical and empirical work in various geographical contexts, so that this phase would be duly supported by scientific articles, minimizing the subjectivity inherent to the process. Therefore, the collected data present quality, reliability and comparability, as essential characteristics of a good indicator (Chang et al. 2018). Aware of the need to observe the requirements of a good indicator, it was also necessary to transform the absolute data obtained into relative data (proxy/resident population per 1000 city inhabitants), in order to allow the subsequent comparison between cities, irrespective of their size (Rodrigues and Franco 2019b).

The formed database is unique in Portugal, as official databases are not targeted at studies on cities, and so the result of this data-collection is a bonus for decision-makers in Portugal and it can be used for various purposes, besides those defined in this research.

Collecting data about the analysed population (N = 308) was a lengthy process through the need to compile data, due to the non-existence of a single database with numerical information about the dimensions of creativity, intelligence and urban sustainability. Added to the dispersion of data was the insufficiency of data when the unit of analysis is represented by the town/city.

In these circumstances, the selection of indicators and respective proxies was governed above all by data availability, which did not prevent the selection considering the characteristics necessary for a good indicator, i.e., their clarity, simplicity, reproduction, scientificity, salience, credibility, legitimacy and comparability (Mega and Pedersen 1998, Atabek et al. 2005, Nardo et al. 2005). The listed indicators must have these characteristics, as the quality of a composite index depends on this (Saisana and Tarantola 2002, Stanickova and Melecký 2018), as well as the chosen research method. The appropriate definition of the research method, namely the multivariate statistical techniques, aims to overcome the dissimilarity of the units of measure and the periods of reference for the data by employing more than one indicator (Kľúčik and Haluška 2008, OECD 2008). These authors also explain that the use of multiple indicators endow the obtained results with scientificity, relevance and meaning, as required by this typology of indices.

It was therefore indicated that measuring the global performance of the 308 Portuguese towns and cities should involve the aggregation and weighting methods defined by OECD (2008), i.e., the Exploratory Factor Analysis (EFA). However, a composite indicator is an aggregate of all dimensions, objectives, individual indicators and variables used (OECD 2008). Thus, in this study the composite index is used as an auxiliary means for calculating the weights of each dimension/sub-dimension (Rodrigues and Franco 2019b).

Given the high number of sub-dimensions (8) of used indicators (24 general and 47 specific indicators) and of proxies corresponding to the 154 variables to measure the creative, intelligent and sustainable performance of cities, detailed information on these is found in Appendix 1 (summary of data collection).

Stages of Data Analysis

The statistical treatment of the data to assess the global performance of the 308 Portuguese towns and cities was performed by using the IBM SPSS software (version 25.0) and it covered three distinct stages, as also revealed by various authors (Pestana and Gageiro 2014, Danielis et al. 2018, Marôco 2018), for the studied dimensions: creativity, intelligence and urban sustainability. However, as the intention is to determine the scientific weighting of each of these dimensions in the cities' total performance, i.e., a Composite Index, the data analysis included two more stages (Kubrusly 2001, OECD 2008). The following paragraphs detail the methodological procedures associated with the set of five analysis stages.

The first step was to determine the validity of the 308 observations, and so the analysed observations represent around five times the studied variables, which ensures that no relevant information is lost. However, the heterogeneity of the units of measurement, the periods of reference and the possible omissions of data required data normalization, as any aggregation of data has to be preceded by this (Hair et al. 1995, Kubrusly 2001, Nardo et al. 2005, OECD 2008, Guimarães and Sarsfield Cabral 2010, Pestana and Gageiro 2014, Pituch and Stevens 2016, El Gibari et al. 2018, Marôco 2018).

In this study, *Z*-scores were chosen for data normalization. *Z*-scores converted the variables to a common scale with the mean of zero and the standard deviation of one (OECD 2008, Danielis et al. 2018, El Gibari et al. 2018, Marôco 2018). This means that the degree of dispersion was reduced to around zero for the mean and to one for the standard deviation (Castro-Higueras and de Aguilera-Moyano 2018). This analysis refers to the second stage, of descriptive analysis (mean, standard deviation, variation coefficient and minimum and maximum values), although the transformations arising from the above normalization mean are not presented in this study (OECD 2008, Marôco 2018).

The third stage concerns the calculation of weightings, considering that in building a composite index, the weights to attribute to each indicator have great significance for the total index and the obtained results (El Gibari et al. 2018). Supported by this crucial requirement, all the weightings presented in this study were obtained directly by applying the EFA and the intrinsic Principal Component Analysis (PCA), in order to present a robust Composite Index of quality. This scientific robustness and quality is obtained through the multivariate statistical techniques mentioned above, since they allow towns/cities to be taken as the unit of analysis (Al Sharmin 2011), the grouping of data presenting similar significance in the sample and the restriction of principal components to retain (Stevens 1986, Hair et al. 1995, Guimarães and Sarsfield Cabral 2010, Pestana and Gageiro 2014, Marôco 2018). This technique also allows the obtained weightings to represent the importance of the variables (154) measured by their maximum variance (Kubrusly 2001). The benefits of using EFA and PCA were stated by the OECD (2008), concluding that these can "summarise a set of individual indicators while preserving the maximum possible proportion of the total variation in the original data set", and that the "largest factor loadings are assigned to the individual indicators that have the largest variation across countries, a desirable property for cross-country comparisons, as individual indicators that are similar across countries are of little interest and cannot possibly explain differences in performance" (OECD 2008: 26). It is noted that in this study the unit of analysis is represented by the towns rather than the countries.

Finally, in the third stage, in order to check the acceptability of this technique, we applied the Kaiser–Meyer–Olkin (KMO, Kaiser 1974) sample suitability measure and the Bartlett sphericity test. In order to verify the internal consistency of the eight (sub)dimensions, it is usual to calculate the Cronbach's alpha, but this was not considered here as the "correlations do not necessarily represent the real influence of the individual indicators on the phenomenon expressed by the composite indicator" (OECD 2008: 27).

The factor extraction requires variables in order to have a normal multivariate distribution, in which various more or less heuristic methods can be used to assess the data quality (Marôco 2018). Thus, the most commonly used method is the Kaiser-Meyer-Olkin sampling adequacy measure, as argued by Maroco (2014) and Pestana and Gageiro (2014). In the same sense, Nardo et al. (2005) and OECD (2008) explained that "multivariate normality of data is required for related significance tests. PCA and PFA have no distributional assumptions. Note, however, that a variant of factor analysis, maximum likelihood factor analysis, does assume multivariate normality. The smaller the sample size, the more important it is to screen data for normality. Moreover, as factor analysis is based on correlation (or sometimes covariance), both correlation and covariance will be attenuated when variables come from different underlying distributions (eg., a normal vs. a bimodal variable will correlate less than 1.0 even when both series are perfectly co-ordered)" (OECD 2008: 67).

After carrying out the first three stages for each dimension per se (creativity, intelligence and urban sustainability), we were ready for the next stages (4 and 5), since the weightings obtained for the 154 variables distributed over the analysed dimensions represent the starting point for these.

The fourth stage consisted of calculating the observed value for each town and its 8 sub-dimensions (culture, creative economy, favorable environment, governance, information and communication technology, economic, social and environmental sustainability) and then for the three dimensions (creativity, intelligence and urban sustainability), determined by the sum of the product between the value of each normalized variable by the weighting coefficient obtained for each of them in the previous stages (1, 2 and 3). For the values observed by town, by sub-dimension and dimension, the descriptive analysis was performed. The data obtained at this stage were the variables to be analysed in the next stage, the calculation process being according to the one described by the OECD (2008).

Finally, the fifth stage concerned the application of EFA to the dimensions of creativity, intelligence and urban sustainability in order to obtain the total weight of each in the Composite Index of Portuguese towns/cities' total performance, with the first three stages being repeated.

Results

Following the procedures regarding to the third stage led to obtaining a great volume of statistical information, as all presented in Appendices 2 (creativity dimension), 3 (intelligence dimension) and 4 (urban sustainability dimension). It is important to mention that the values obtained in the KMO test for the sub-dimensions referring to each dimension (Kaiser 1974) show that data quality varies between reasonable, average and good, which means that EFA can be applied to them (Marôco 2018). However, in the creative economy sub-dimension of the creativity dimension, there was found to be a linear dependence between some of the studied variables, of which the Pearson correlation coefficient is 1 (Marôco 2018). Given the values obtained from the analysis of correlation between the variables of this sub-dimension, the variables of ATIC3, ATIC4, ICPIB4, ICPIB5, ICPIB6, TC2 and PP3 were withdrawn, in order to assess data quality through the KMO test.

In addition, the extracted communalities (h^2) respect the required minimum of 0.32% (Costello and Osborne 2005, Tabachnick and Fidell 2019) in all the analysed sub-dimensions (8). Similarly, the 154 analysed variables present loadings above the required minimum of 0.40, and so the explained variances have significant values (Marôco 2018).

Finally, EFA and PCA retained a total of 51 factors for the dimensions of creativity (17), intelligence (12) and urban sustainability (22). Based on the values obtained for each factor, the next step (Kubrusly 2001) was to calculate the "weights from the matrix of factor loadings

after rotation, given that the square of factor loadings represents the proportion of the total unit variance of the indicator which is explained by the factor" (OECD 2008: 90).

Based on these results, the conditions were right to calculate the weightings associated with each variable, obtained from the product between the normalized loadings raised to the square and the value of the explained variance for each factor, as shown in Tables 3, 4 and 5.

Table 3

Creativity dimension

Weights – coefficients of variables[5)]							
Variable	**Factor**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Sub-dimension culture							
LIC1					3.607		
MA1						4.118	
MA2						3.351	
MA3						2.162	
CIN1			4.789				
CIN2			4.908				
CE1							2.785
CE2					3.105		
TEA1		2.112					
RAL1	2.346						
RAL2	5.651						
RAL3	3.149						
DORT1	5.341						
DORT2	0.928						
DORT3	5.420						
VISM1				5.251			
VISM 2				5.095			
ATENC 1		4.432					
ATENC2		4.577					
DCE1							2.608
DCE2		2.250					
OCC1					3.701		
DM1						1.674	
	Hotels and restaurants	**Theatres and similar**	**Cinema**	**Museum visitors**	**Cultural supply**	**Art and museums**	**Cultural premises**

5) Example of calculation for RAL1: (0.276*0.085)*100 = 2.346 (values taken from Appendix 2, Table A)

Table 3

Creativity dimension

Factor					
	1	**2**	**3**	**4**	**5**
Sub–dimension Creative Economy					
EC1		4.657			
ICPIB1		6.450			
ICPIB2				6.998	
ICPIB3		5.794			
ICPIB7		5.498			
ATIC1		3.696			
ATIC2				7.055	
ATIC5					6.728
ID1			4.587		
ID2			6.437		
ID3			4.599		
TC1	5.639				
TC3	3.811				
TC4	6.165				
PP1	5.511				
PP2	5.794				
	R&D in higher education institu-tions	**Creative industries' contribution to GDP**	**R&D in firms**	**Proportion of creative industries**	**Weight of creative industries**
	1	**2**	**3**	**4**	**5**
Sub-dimension Favourable Environment					
CC1	5.721				
CC2	5.645				
CC3	5.937				
CC4	5.508				
CC5	6.422				
CC6	6.503				
CC7	4.209				
CC8	1.946				
PR1	3.427				
TOL1				4.930	
TOL2		5.349			
TOL3		4.006			
TOL4				4.506	
LI1			3.311		
LI2					2.220

Table 3

Creativity dimension

Weights – coefficients of variables[5)]							
Variable	**Factor**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
LL1							5.155
FE1				5.155			
FE2				6.276			
FE3		5.759					
	Higher education	**Population**		**Redevelopment of buildings and airports**		**Foreigners**	**Transport**

Table 4

Intelligence Dimension

Weights – coefficients of variables								
Variable	**Factor**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Sub-dimension governance								
EGOV1				0.81				
EGOV2				5.15				
EGOV3							1.54	
FIN1			6.4					
FIN2				3.14				
FIN3			6.4					
RED1						3.29		
RED2						3.94		
PEL1	6.08							
PEL2	6.31							
PEL3	3.66							
PEL4	5.91							
VIND1		4.58						
VIND2				1.42				
VIND3					3.36			
VIND4		4.93						
VIND5		4.37						
VPUB1							5.45	
VPUB2				0.81				5.04
	Election turnout	**Population vitality**	**Local public debt**	**E-government vs. Density and Income**	**Access**	**Municipal provision**	**Urban networks**	**Tourism**

Table 4

Intelligence Dimension

Sub-dimension ICT				
	1	**2**	**3**	**4**
TEL1	10.96			
TEL2	11.07			
AMB1		10.11		
AMB2		9.12		
AMB3			8.83	
AMB4				10.77
ACES1			5.47	
ACES2	8.75			
PUB1		8.94		
IND1	4.24			
	Communications and internet	**Network infrastructure**	**Energy and mail**	**Waste**

Table 5

Urban Sustainability Dimension

Weights – coefficients of variables							
Variable	Factor						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Sub-dimension Economic sustainability							
CREC1		2.75					
CREC2	0.99						
CREC3	4.12						
CREC4		1.05					
CREC5				1.28			
NEG1		4.58					
NEG2		3.75					
NEG3					3.02		
NEG4			3.58				
NEG5		3.46					
NEG6	3.59						
NEG7	4.71						
NEG8	4.35						
NEG9			1.22				
NEG10				3.39			
EMP1						3.79	
EMP2				2.64			
EMP3			3.09				
EMP4			4.37				
EMP5					3.66		
EMP6							4.85
Total	17.76	15.59	12.26	7.31	6.68	3.79	4.85
	Eco-nomic activity	**Growth and employ-ment**	**Entrepre-neurship**	**Unem-ployment**	**Density of banks and firms**	**New firms**	**Public-private partner-ships**

Table 5

Urban Sustainability Dimension

	1	2	3	4	5	6	7	8
Sub-dimension Social sustainability								
AD1	4.77							
AD2	4.52							
AD3	2.16							
AD4	4.67							
AD5	3.00							
AD6								2.41
AD7	1.97							
ICH1					4.27			0.00
ICH2								3.32
ICH3					4.12			
ICOM1			4.55		0.00			
ICOM2	3.16							
ICOM3	3.08							
ICOM4	3.16							
ICOM5	3.75							
PD1							3.37	
PD2						1.74		
PD3				4.61				
DSA1		3.83						
DSA2	1.34							
DSA3							1.59	
DSA4		3.92						
DSA5				4.10				
DSE1						3.76		
DSE2			4.11					
Total	35.58	7.75	8.66	8.71	8.39	5.50	4.96	5.73
	Demo-graphy and edu-cation	**Health**	**Other**	**Social projects**	**Poverty and criminality**	**Urban renewal (a)**	**Other bene-fits**	**(a)**

Table 5

Sustainability Dimension

Weights – coefficients of variables							
Variables	**Factor**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Sub-dimension Environmental sustainability							
EGA1		7.11					
EGA2		7.42					
EGA3	5.21						
EPAT1	5.34						
EPAT2	5.93						
RR1	3.67						
RR2	3.53						
RR3			6.39				
RR4						7.73	
RR5	3.86						
RR6	3.38						
TER1				5.89			
TER2				5.36			
TER3							4.43
TER4					5.00		
TER5					5.44		
	Management of waste and basic consumption (a)			**Preservation and protection of the environment (b)**		**(a)**	**(b)**

The respective weightings allowed the calculation of the value observed for each town, which was obtained by summing the product of each normalized variable (Z scores), as obtained with the IBM SPSS software by the weighting (the fourth stage). These calculations were made for all the analysed dimensions (3) and sub-dimensions (8). For example, the numerical value of the creativity dimension for a town was obtained as follows:

$$\sum(Zscore\ \ i * weighting\ i) + \cdots (Zscore\ i * weighting\ i)$$
$$= value\ observed\ for\ a\ town\ in\ the\ culture\ sub-dimension\ (1.61926)\ \ Formula\ 1$$

(i = LIC1 to DM1, where i = 23 variables; Z scores obtained through SPSS)

However, in order to calculate the final weighting of each of the 3 analysed dimensions, it was necessary to determine the weight of each sub-dimension analysed in the respective dimension, and so the EFA was applied.

It was then necessary to calculate the numerical value per town for each dimension, resulting from the sum of the product between the value observed per town for each sub-dimension in the dimension. As an example for the creativity dimension, we have the following formula:

$$Culture\ (1.6191^{1} * 0.222^{2}) + Creative\ Economy\ (4.9873^{3} * 0.38) + Favourable\ Environment\ (3.1714^{4} * 0.396)$$
$$= Creativity\ (3.5158)\ Formula\ 2$$

1) Values obtained from formula 1
2) Appendix 5
3) Values obtained from formula 1
4) Values obtained from formula 1

Finally, following the descriptive analysis (Table 6), the values obtained from formula 2 for the 308 Portuguese towns and cities represented the numerical data to enter in SPSS for the creativity (variable 1), intelligence (variable 2) and urban sustainability (variable 3) dimensions in order to apply the EFA (Table 7), aiming to obtain the composite weighting of each dimension in the total performance of Portuguese towns (the fifth stage).

Table 6

Descriptive statistics of the population

Dimensions	N	Mean	Standard Deviation	Minimum	Maximum
Creativity	308	0.000	0.383	-0.3077	3.5158
Intelligence	308	0.000	0.261	-0.6105	0.9299
Urban Sustainability	308	0.000	0.230	-0.4519	1.5015

Table 7

Exploratory Factor Analysis for the dimensions of creativity, intelligence and urban sustainability

Dimensions	h^2	Factor Total Performance	Weights[6)]
		1	
Creativity	0.692	0.832	0.380
Intelligence	0.426	0.652	0.234
Urban Sustainability	0.702	0.838	0.396
Eigenvalue		1.82	
% explained variance		60.65	
Total explained variance		60.65	

Varimax Rotation; N = 308; KMO = 0.613; Bartlett Sphericity Test:=162.366; gl = 3; $p < 0.000$;

Discussion

The analysis results led to obtaining the scientific weighting of each dimension forming the Composite Index for the towns' total performance. So, in the Portuguese context, the intelligence dimension has the least significant weighting (0.234), followed by the creativity dimension (0.380) and the urban sustainability dimension (0.396).

The global reading of these results indicates that political decision-makers and local governments have made relevant efforts to reflect the importance of these three dimensions in their strategies and guidelines, particularly at town level. These efforts represent a constant challenge given the transformations this implies in the various urban spaces, infrastructure, institutions and the implementation and monitoring processes. It is noted that this transformative scenario was mentioned by Bouton et al. (2013), due to economic growth also being stimulated by intangible and tangible amenities (Romero-Padilla et al. 2016). Furthermore, this paradigmatic alteration in the model of economic growth in urban areas led to people and spaces involved in the urban environment being revealed as crucial for cities' urban growth, with positive effects on their total performance (Audretsch 2003, Malecki 2007). In addition, for the Portuguese towns, it was confirmed that there has been a concentration on the endogenous cultural factors associated with the revitalization of places, aiming to develop the

6) Example of calculation for creativity: 0.832^2/1.821628 = 0.380

cultural activities and to also provide the premises for new businesses linked to culture and creativity. This involvement has been mentioned by several authors (Florida 2005, Cabrita et al. 2013, Ortegel 2017, Florida 2019).

The following paragraphs analyse the dimensions of creativity, intelligence and urban sustainability individually, as the weightings obtained for each require this.

The creativity dimension has a weighting of 0.380 in the total performance of Portuguese towns, in which culture has an impact of 0.22, the creative economy 0.38 and the favourable environment 0.40. This means that local governments in the 308 analysed towns and cities have directed their policies towards providing regenerated or even new cultural spaces, pluralist, tolerant and open urban environments, which in turn are attractive amenities for the so -called creative class (Florida 2005, Florida et al. 2007, Mcgranahan and Wojan 2007, Hoyman and Faricy 2009, Lawton et al. 2010, Florida 2019) and the implicit cultural and creative industries (Pratt 2008). This type of city provision was mentioned by Florida (2005), Grant and Kronstal (2010) and Romein and Trip (2009), who highlighted the importance of cities generating a favourable environment and a creative economy associated with the dynamics produced by culture and people's creativity as a lever to direct cities to creativity, intelligence and urban sustainability. Moreover, the factors obtained through EFA and the respective weightings of the variables included in them clearly show the positive impacts of creativity on performance in the 308 Portuguese towns and cities, for example, in the significance of the weightings of creative and cultural industries in the sub-dimension of the creative economy (Table 3), which means this is already happening in Portugal and it is generating economic value. The wealth produced by these industries was shown by Furtado and Alves (2012). These authors also argued that the economic results of cultural and creative industries allow them to contribute to cities' urban sustainability.

Although the intelligence dimension of Portuguese towns still requires action to improve infrastructure and accessibility, urban networks (belonging to inter and intra networks) in those towns are a positive aspect, as a reflection of adopting open, participative governance aiming to improve urban performance. Urban networks as predictors of improved city performance were emphasized by Cohen et al. (2016), Echebarria et al. (2016), Ferraris et al. (2018), in which creativity stimulates the creation of urban networks as a consequence of the adopted governance typology, as well as those networks increasing synergies between all urban agents, with an economic return in the present and future (Girard et al. 2016). Nevertheless, the implementation of ICT in Portuguese towns may fall short of expectations, despite the significant progress being made in terms of e-government. ICT's articulation with cities' governance is fundamental for their improved intelligent performance and for the benefits to be duly enjoyed (Neirotti et al. 2014). In this dimension, it is essential to mention that the obtained statistical results were influenced by the lack of data at the Portuguese town level, and so these could be overestimated.

The urban sustainability dimension is visible in the 308 Portuguese towns in a tri-partite way. Economic sustainability (weighting of 0.386) has been strengthened, for example, by entrepreneurship, which has created new business supported by public-private partnerships, such as living labs, which has contributed to less urban unemployment. Living labs, understood as open networks and collaborative partnerships, have been indicated as a means to extend connectivity inside and outside towns (Girard et al. 2016, Ericsson 2016), allowing the development and implementation of intangible projects with social, environmental and cultural effects, besides the projects with sustainable economic synergies (European Comission 2011, Anthopoulos 2017). Standing out in social sustainability (weighting of 0.245) represents the development of projects promoting cohesion and social inclusion and actions to improve the social infrastructure in Portuguese towns, for example, projects promoted by the healthy town

network and others. This type of social projects and policies aiming for improved infrastructure is necessary to achieve urban sustainability (Giffinger et al. 2007, Arcadis 2016, Trivellato 2016, Bosch et al. 2017). Finally, environmental sustainability (weighting of 0.369), locally in Portugal, has emphasized waste management and actions to preserve and protect natural resources and the environment in general. However, the circular economy model proposed by the European Union is a scenario in need of additional strategies and policies, since it is at an embryonic stage in Portuguese towns. It is clearly necessary for towns to go down this route and thereby to improve their environmental performance even more. The importance of this model for the cities' improved sustainable performance was explained by Ligorio (2017) and by Smol et al. (2017), despite the suggestion that the circular economy should be interlinked with ICT and open governance (intelligence, Neirotti et al. 2014, Girard et al. 2016). Neirotti et al. (2014) also argue that cities with urban sustainability predict their performance positively and raise their residents' quality of life, and, in the case of Portugal, this dimension's weighting is very close to 0.40.

Summarizing, the results obtained show that cities' performance can be measured in a multi-dimensional and holistic way, without losing relevant information and with scientific quality and robustness. Fig. 3 shows the results obtained for the 308 towns and cities in Portugal.

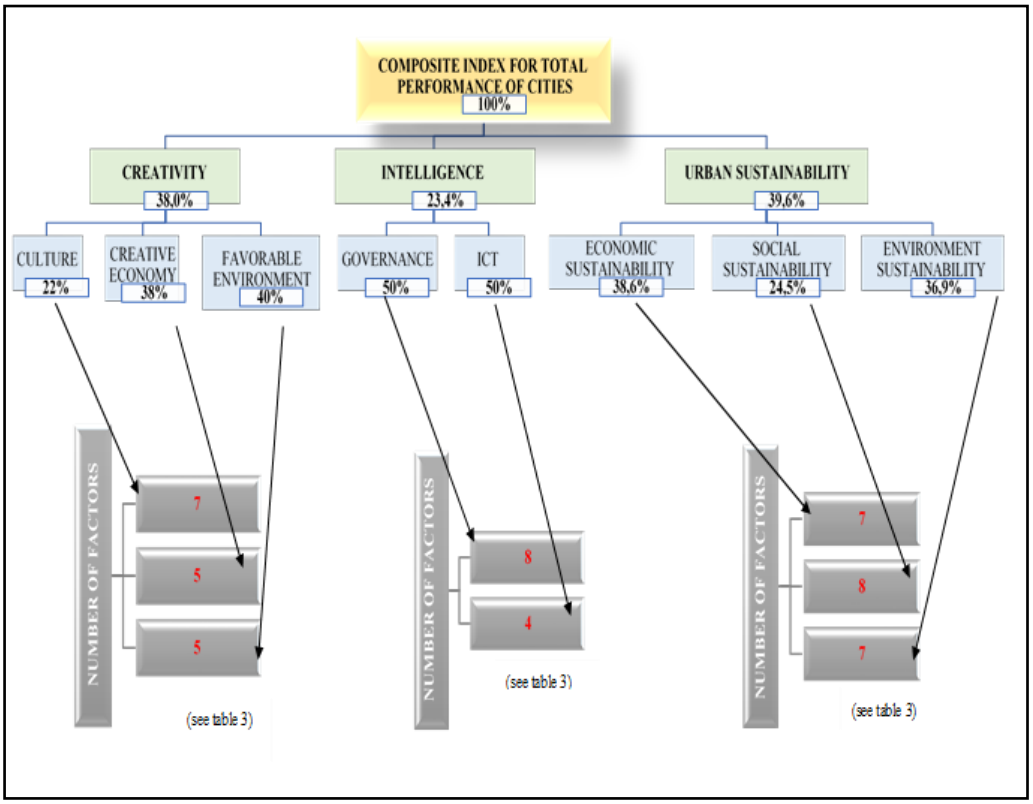

Fig. 3 **– Composite index for the total performance of cities**

Portuguese towns and cities are moving according to the European Union directives towards achieving intelligent, inclusive and sustainable growth (Eurostat 2019), associated with creativity, culture and urban networks, with the last-named being understood as a new intangible factor of the current model of cities' economic growth and a predictor of improved total performance.

The contributions arising from the results obtained in this empirical study have relevant implications for theory and practice, allowing the existing gap between both to be filled (Lee et al. 2014), and this represents the study's general contribution.

The presentation of a theoretical and holistic framework, importance of which was already defended by Mora et al. (2017), is the first contribution of this study with implications for theory. The framework shows that today's towns aim to be simultaneously creative, intelligence and sustainable, and to grow economically in the short and long term in order to provide their residents with quality of life, well-being and happiness, besides improving their total performance predicted by inter and intra networks formed in urban spaces where the intangible effects give a financial return today and in the future.

The second contribution, also with implications for theory, lies in the compilation of indicators from various indices in a single index. This index includes indicators for the dimensions of creativity, intelligence and sustainability, divided in 8 sub-dimensions. Concerning the theoretical implications, a Composite Indicator with 24 general indicators and 47 specific indicators was developed, filling the gap regarding a single index to measure the total performance in all its inseparable dimensions (Malecki 2007, Borén and Young 2013), added to which is the volume of the used variables (Çetindamar and Günsel 2012).

Filling the theoretical gaps was followed by the empirical operationalization of the Composite Index. Consequently, the third contribution lies in the application of that index in the Portuguese context, with robustness and scientific quality being confirmed through the application of EFA (OECD 2008), in order for this to be a methodological instrument to be adopted by cities and/or countries to assess and monitor their total performance. It is highlighted that Composite Indices are an instrument increasingly valued by the political decision-makers and important in discussing economic growth, this being an implication for practice.

Overall, the main contribution of this study lies in the Composite Index for cities' total performance, with the statistical treatment allowing the scientific calculation of the weightings of each studied dimension for the cities' holistic performance.

Like any study, this one is not without limitations. One is the subjectivity presented in selecting the used indices/indicators, which were affected by the limited availability of data about towns and the fact of the choice also having to consider the characteristics of a good indicator. Also, the unavailability of data when the unit of analysis is the town, whatever its population density, is another limitation.

Given the multiplicity of theoretical concepts and implications for theory and practice, measuring cities' total performance does not end with this study, but it continues to be a fertile area for future research. The extensive data treatment carried out allows the elaboration of a ranking of Portuguese towns and cities by size and their total performance, directing future research to the analysis of clusters of Portuguese towns. Another future topic would be the application of other multivariate statistical techniques, for example, the Data Envelopment Analysis (DEA), which allows multiple entries and exits and it could establish a model of multifactor measurement of performance and frontiers in order to measure efficiency. A final

suggestion is to apply the Composite Index in other geographical contexts, leading to comparative studies to determine the factors of cities' success and failure. Another study could take countries as the unit of analysis.

Conclusions

Creative cities in this century included in the so-called European Cities must ally the creativity dimension to those of intelligence and urban sustainability, as their growth is supported by the holistic, determinant pillars of their total performance. In this context, it was demonstrated that this can be scientifically measured through a Composite Index with the respective weightings, which allows its generalized application in any geographical context and unit of analysis. This generalization transforms this index into a scientific instrument for political decision-makers and town planners. It was also proven that when understood and managed as strategic places, cities are able to respond to the major challenge of being the drivers of a country's economic growth. This means that cities that increase their growth according to the premises inherent to creativity, intelligence and urban sustainability, as a whole and without neglecting the importance of urban networks, will show an improved total performance.

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Appendix 1

Index of creativity, intelligence and urban sustainability for cities in Portugal

Specific indicator	Variable	N	Proxies	Databases	Period of reference	Unit of measure
			CREATIVITY			
			I) Culture			
General indicator: 1.1) Places of culture and facilities						
A) Places of historical interest	LIC1	308	1) Places of historical, cultural and artistic interest, such as buildings, religious structures, monuments and statues, churches and cathedrals, bridges, towers and others	Tripadvisor	2018	Number
B) Museums and similar	MA1	308	1) Art galleries: buildings	Pordata	2016	Number
	MA2	287	2) Art galleries: exhibitions			
	MA3	308	3) Number of museums open to the public			
C) Cinema	CIN1	308	1) Capacity			
	CIN2	308	2) Places			
D) Concerts and Shows	CE1	304	1) Number of cultural locations	Pordata	2015	Number
	CE2	179	2) Capacity of cultural locations			
E) Theatres	TEA1	308	1) Theatres	Meloteca.com	2018	Number
F) Restaurants and accommodation	RAL1	308	1) Number of hotel establishments	Pordata	2016	Number
	RAL2	266	2) Number of rooms in hotel establishments			
	RAL3	308	3) Restaurants	Tripadvisor	2018	Number
General indicator: 1.2) Cultural participation and attractiveness						
A) Tourist bednights	DORT1	247	1) Total bednights in hotel establishments	Pordata	2015	Number
	DORT2	244	2) Proportion of foreign guests			%
	DORT3	268	3) Total income from hotel establishments		2016	M.€
B) Museum visitors	VISM1	264	1) Total visitors	Pordata	2016	Number
	VISM2	264	2) Total foreign visitors			
C) Cinema attendance	ATENC1	308	1) Nº of spectators	Pordata	2016	Number
	ATENC2	308	2) Ticket sales			M.€
D) Concerts and shows	DCE1	147	1) Nº of spectators	Pordata	2016	Number
	DCE2	147	2) Ticket sales			M.€
E) Cultural supply	OCC1	308	1) Total cultural premises (local authority)	Annals by region - INE	2016	Number
F) Local authority/ public expenditure	DM1	308	1) Expenditure on cultural activities and similar			
			II) Creative Economy			

General indicator: 2.1) Creative Industries						
A) Creative jobs	EC1	308	1) Jobs in creative and cultural activities	INE	2016	Number
B) Impact of creative industries on GDP	ICPIB1	308	1) Turnover of cultural and creative industries	INE	2016	€
	ICPIB2	308	2) % of creative industries in total economic activity			%
	ICPIB3	308	3) Expenses with staff in cultural and creative industries			€
	ICPIB4	308	4) Production of cultural and creative industries			
	ICPIB5	308	5) Intermediate consumption of cultural and creative industries			
	ICPIB6	308	6) Gross added value, at market prices, of cultural and creative industries			
	ICPIB7	308	7) Gross fixed capital formation of cultural and creative industries			
C) Territorial analysis of creative industries	ATIC1	308	1) Total number of cultural and creative industries	INE	2016	Number
	ATIC2	308	2) Number of people employed in creative and cultural companies, divided by the total of people employed in all economic activities and multiplied by 100	Own calculation		%
	ATIC3	308	3) Total number of industries by city over the total of all cities (concentration) multiplied by 100			%
	ATIC4	308	4) Density per capita of cultural and creative industries (Nº of industries/resident population multiplied by 100)			
	ATIC5	308	5) Weight of cultural and creative industries in the total industries in the city (relevance) multiplied by 100			
General indicator: 2.2) Research & Development						
A) Firms	ID1	308	1) Firms with most expenditure on R&D activities	Dgeec.mec	2016	Number
	ID2	308	2) R&D expenditure of those firms			M.€
	ID3	308	3) Total resources allocated by firms to R&D areas			Number
B) Knowledge transfer	TC1	308	1) R&D units in higher education institutions	Dgeec.mec	2016	Number
	TC2	308	2) Total researchers in those units financed by FCT			
	TC3	308	3) Higher education establishments	Pordata	2017	
	TC4	308	4) Lecturers in higher education	Pordata	2015	
General indicator: 2.3) Intellectual property and innovation						
A) Patent applications	PP1	308	1) Applications for patents and similar	INPI	2017	Number
	PP2	308	2) Applications for patents from higher education institutions			
	PP3	308	3) Applications for patents from other entities			
III) Favourable Environment						

General indicator: 3.1) Human capital and education						
A) Creative class (talent)	CC1	308	1) Number of higher education students enrolled in arts and humanities courses	Pordata	2016	Number
	CC2	308	2) Higher education graduates in arts and humanities			
	CC3	308	3) Number of higher education students enrolled in ICT courses			2016
	CC4	308	4) Higher education graduates in ICT	Annals by region - INE	2016	Number
	CC5	308	5) Higher education graduates	Pordata	2016	Number
	CC6	308	6) Number of students in higher education			
	CC7	308	7)) Number of higher education institutions			
	CC8	308	8) Employed population with average/high qualifications (secondary, post-secondary and higher)		2013	
B) HEIs' presence in rankings	PR1	308	1) HEIs in rankings	Webometrics	2018	Number
General indicator: 3.2) Openness and diversity						
A) Tolerance, social classes and young people	TOL1	308	1) Legally resident foreign population: total	Pordata	2016	Number
	TOL2	308	2) Socio-cultural heterogeneity (social classes) – employees' basic average monthly salary		2013	
	TOL3	308	3) Young population (resident population, estimated at 31 December: 0-25 years)		2016	%
	TOL4	308	4) Marriages solemnized between nationals and foreigners		2017	Number
General indicator: 3.3) Local and international connections						
A) International connections	LI1	308	1) Airports	INE	2017	Number
	LI2	308	2) Passenger arrivals by airport			
B) Local connections	LL1	308	1) Transport and storage companies	INE	2012	Number
General indicator: 3.4) Governance						
A) Endogenous factors	FE1	308	1) Concluded building redevelopment (urban regeneration)	Annals by region - INE	2016	Number
	FE2	308	2) Licensed building redevelopment (urban regeneration)			
	FE3	308	3) Annual population variation (global attractiveness for new residents)			%
INTELLIGENCE						
I) Governance						
General indicator: 1.1.) Implementation						
A) E-government	EGOV1	308	1) Use of electronic commerce	Annals by region - INE	2016	Number : 1-Yes; 0-No
	EGOV2	308	2) Public consultation processes available on the website			
	EGOV3	308	3) Online completion and submission of forms			

General indicator: 1.2) Strategy						
A) Finance	FIN1	308	1) Total debt	Annals by region - INE	2016	M.€
	FIN2	308	2) Municipal income per inhabitant			Euros
	FIN3	308	3) Municipal expenditure per inhabitant			
B) Network	RED1	308	1) Members of national networks	http:// redemunicipios saudaveis; *Webpages* municipais; http:// www.rni.pt/visa; http:// www.inteli.pt www.openliving labs.eu;	2018	Number
	RED2	308	2) Members of international networks			
General indicator: 1.3) Citizen participation						
A) Elections	PEL1	308	1) Presidential – Voter turnout	Annals by region - INE	2016	Number
	PEL2	308	2) Central Government - Voter turnout		2015	
	PEL3	308	3) Local Authority - Voter turnout		2013	
	PEL4	307	4) European Parliament - Voter turnout		2014	
General indicator: 1.4) City vitality						
A) Individual	VIND1	308	1) Renewal index of the population of working age	INE	2013	%
	VIND2	308	2) Population density per residence		2014	Km²
	VIND3	308	3) Newspapers and other regular publications: circulation	Pordata	2016	Number
	VIND4	308	4) Resident population <15 years		2011	
	VIND5	308	5) Inactive population: total		2011	
B) Public	VPUB1	272	1) Area of urban parks and facilities	INE	2013	Ha
	VPUB2	272	2) Land use for tourism			
II) Information and communication technology (ICT)						
General indicator: 2.1) Network infrastructure						
A) Telecommunications	TEL1	308	1) Main public telephones	Pordata	2016	Number
	TEL2	308	2 Residential telephones per thousand inhabitants			%
B) Environment	AMB1	308	1) Quality of the water network for human consumption: safe water	Pordata	2016	%
	AMB2	308	2) Population served by waste water treatment networks (ETAR)		2009	
	AMB3	308	3) Electricity consumption for road lighting	Pordata	2016	Kwh
	AMB4	308	4) Hierarchy index of urban waste management			%

General indicator: 2.2) Accessibility						
A) Mail and internet	ACES1	308	1) Post offices per local authority	Annual reports by region - INE	2016	Number
	ACES2	308	2) Access to broadband internet service at a fixed point			
General indicator: 2.3) Use of ICT						
A) Public	PUB1	308	1) Average number of pupils per computer with internet connection in primary and secondary schools: total	Pordata	2016	%
B) Private	IND1	308	1) Companies providing ICT services	INE	2016	Number
URBAN SUSTAINABILITY						
I) Economic Sustainability						
General indicator: 1.1) Competitiveness and economic activity						
A) Economic growth	CREC1	308	1) Purchasing power per capita	Pordata	2015	%
	CREC2	308	2) Exports		2016	Euros
	CREC3	308	3) Imports			
	CREC4	308	4) Town's employment rate		2011	%
	CREC5	308	5) Total unemployment rate			
B) Business	NEG1	308	1) Firms formed in the period of reference	Pordata	2017	Number
	NEG2	308	2) Firms dissolved			
	NEG3	308	3) Banks and Savings Institutions			
	NEG4	308	4) Non-financial firms		2016	
	NEG5	308	5) Firms			
	NEG6	308	6) Employees in non-financial firms: total and by economic activity			
	NEG7	308	7) Turnover of non-financial firms: total and by economic activity			M.€
	NEG8	308	8) Gross added value of non-financial firms: total and by sector of economic activity			
	NEG9	308	9) Non-financial firms with under 10 employees as a % of all non-financial firms: by sector of economic activity			%
	NEG10	308	10) Youth unemployment rate - Unemployed registered with job centres and in vocational training (annual average): total and by age-group		2017	
C) Entrepreneurship	EMP1	308	1) % of new firms in activity after 2 years	INE	2015	%
	EMP2	308	2) % of employment with higher competences _ Employees: total and by level of education	Pordata	2013	
	EMP3	308	3) % of self-employment (self-employed, but employers)		2011	
	EMP4	308	4) % of self-employment (self-employed, not employers)			
	EMP5	308	5) Density of established firms	INE	2016	Km²
	EMP6	308	6) FABlabs, living labs	www.fablabsportugal.pt/;	2018	Number : 1-Yes; 0-No

II) Social sustainability						
General indicator: 2.1) Population and citizenship						
A) Demographic changes cultural/ historic identity	AD1	308	1) Percentage of population over 65	Pordata	2011	Number
	AD2	308	2) Percentage of population under 15			
	AD3	308	3) Migratory growth – contribution of migratory balance to the population variance		2013	%
	AD4	308	4) Index of dependent elderly		2016	
	AD5	308	5) Index of dependent young people			
	AD6	308	6) Child mortality rate (<1 ano)		2017	
	AD7	308	7) Gross birth rate		2016	
General indicator: 2.2) Education						
A) Infrastructure and competences	ICOM1	308	1) Establishments of pre-school, primary and secondary education	Pordata	2016	Number
	ICOM2	308	2) Pupils enrolled in pre-school, primary and secondary education			
	ICOM3	308	3) Total literacy rate – Resident population of 15 years and over according to the Census: total		2011	
	ICOM4	308	4) Pupils enrolled in pre-school, primary and secondary education as a % of the resident population		2016	%
	ICOM5	308	5) Rate of completion of levels of education – Pupils in regular basic education completing the year: total			Number
General indicator: 2.3) Inclusion and cohesion						
A) Poverty and inequality	PD1	308	1) Recipients of social benefits – Recipients of Guaranteed Minimum Income and Social Insertion Income from Social Security in total active beneficiaries (%)	Pordata	2017	%
	PD2	308	2) Residents at risk of poverty – Beneficiaries of unemployment subsidy from Social Security: total			Number
	PD3	308	3) Equity and citizenship projects	redemunicipiossaudaveis.com	2018	Number
General indicator: 2.4) Social infrastructure						
A) Health	DSA1	308	1) Number of hospital beds – Hospital accommodation	Pordata	2016	Number
	DSA2	308	2) Health centres: appointments per inhabitant		2012	%
	DSA3	308	3) Inhabitants per health centre		2011	
	DSA4	308	4) General and specialized hospitals		2016	Number
	DSA5	308	5) Promotion of physical and mental well-being	redemunicipiossaudaveis.com	2018	

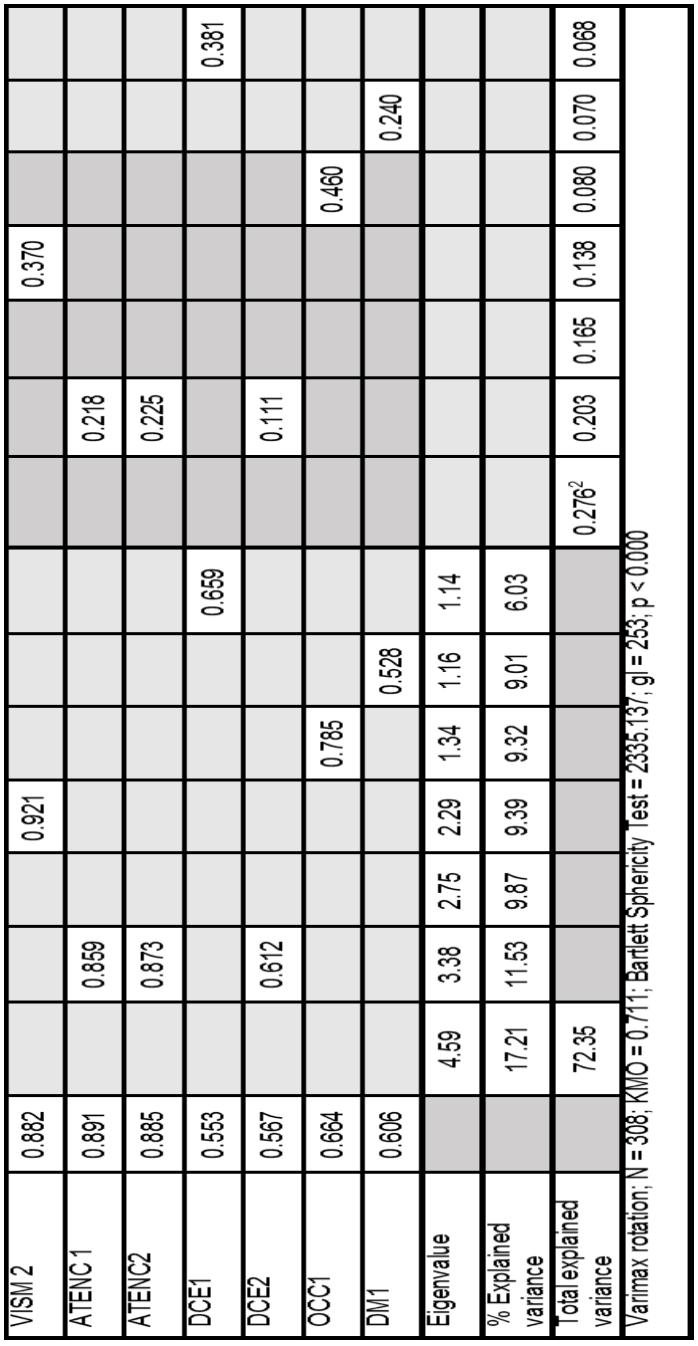
B) Security	DSE1	308	1) Number of crimes: total	Pordata	2016	Number
	DSE2	308	2) PSP and GNR (police) stations	www.psp.pt.http://www.gnr.pt	2018	
III). Environmental sustainability						
General indicator: **3.1)** Basic infrastructure						
A) Energy, Water and Gas	EGA1	308	1) Annual energy consumption per capita – Electricity consumption per inhabitant: total	Pordata	2016	KWH /Inhabitant
	EGA2	308	2) Natural gas consumption per capita - Natural gas consumption per inhabitant			Nm3/ Inhabitant
	EGA3	308	3) Annual water consumption per capita – Water distributed/consumed per inhabitant		2015	m^3/ Inhabitant
B) Emission and production of pollutants	EPAT1	308	1) Undifferentiated urban waste collected (Urban waste: total and by type of collection)		2016	Tons
	EPAT2	308	2) Differentiated urban waste collected (Urban waste: total and by type of collection)			
General indicator: 3.2) Circular economy						
A) Recycling and reuse	RR1	308	1) Income from waste management	INE	2016	M.€
	RR2	308	2) Expenditure on waste management			
	RR3	308	3) Urban waste sent to energy recovery	Pordata		Tons
	RR4	308	4) Urban waste sent to organic recovery			
	RR5	308	5) Urban waste sent to recycling			
	RR6	308	6) Urban waste sent to landfill			
General indicator: 3.3) Environmental protection in urban areas						
A) Territory	TER1	308	1) Income from biodiversity and landscape protection	INE	2016	M.€
	TER2	308	2) Expenditure on biodiversity and landscape protection			
	TER3	308	3) actions of environmental improvement and territorial development	redemunicipiossaudaveis.com	2018	Number
	TER4	308	4) Expenditure on air and climate protection, Protection and recuperation of soil, underground and surface water, protection against noise and vibrations, protection against radiation, R&D and other activities of environmental protection	INE	2016	M.€
	TER5	308	5) Income from air and climate protection, protection and recuperation of soil, underground and surface water, protection against noise and vibrations, protection against radiation, R&D and other activities to protect the environment			

Appendix 2

Exploratory Factor Analysis of creativity dimension

Table A – Sub-dimension Culture															
		Results of Exploratory Factor Analysis							Squared factor loading (scaled to unit sum[1])						
Variable	h^2	Factor							Factor						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
LIC1	0.795					0.775							0.448		
MA1	0.722						0.828							0.591	
MA2	0.587						0.747							0.481	
MA3	0.579						0.600							0.310	
CIN1	0.908			0.893							0.290				
CIN2	0.849			0.904							0.297				
CE1	0.584							0.681							0.407
CE2	0.713					0.719							0.386		
TEA1	0.402		0.593							0.104					
RAL1	0.552	0.625							0.085						
RAL2	0.945	0.970							0.205						
RAL3	0.741	0.723							0.114						
DORT1	0.913	0.943							0.194						
DORT2	0.485	0.393							0.034						
DORT3	0.920	0.950							0.197						
VISM1	0.899				0.935							0.382			

1 Example of calculation for RAL1: 0.625^2/4.59 = 0.085



VISM 2	0.882			0.921								0.370							
ATENC 1	0.891		0.859								0.218								
ATENC2	0.885		0.873								0.225								
DCE1	0.553								0.659										0.381
DCE2	0.567		0.612								0.111								
OCC1	0.664					0.785								0.460					
DM1	0.606						0.528									0.240			
Eigenvalue		4.59	3.38	2.75	2.29	1.34	1.16	1.14											
% Explained variance		17.21	11.53	9.87	9.39	9.32	9.01	6.03											
Total explained variance		72.35									0.276[2]	0.203	0.165	0.138	0.080	0.070	0.068		
Varimax rotation; N = 308; KMO = 0.711; Bartlett Sphericity Test = 2335.137; gl = 253; p < 0.000																			

2 Example of calculation for: 4.59/∑ 4.59+3.38+2.75+2.29+1.34+1.16+1.14 = 0.276

Table B – Sub-dimension Creative economy

Results of Exploratory Factor Analysis							Squared factor loading (scaled to unit sum)				
Variable	h^2	**Factor**					**Factor**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
EC1	0.964		0.797					0.241			
ICPIB1	0.960		0.938					0.333			
ICPIB2	0.971				0.977					0.697	
ICPIB3	0.930		0.889					0.299			
ICPIB7	0.806		0.866					0.284			
ATIC1	0.705		0.710					0.191			
ATIC2	0.979				0.981					0.702	
ATIC5	0.956					0.958					0.987
ID1	0.639			0.791					0.297		
ID2	0.905			0.937					0.416		
ID3	0.774			0.792					0.297		
TC1	0.877	0.887					0.117				
TC3	0.615	0.721					0.079				
TC4	0.945	0.917					0.128				
PP1	0.809	0.867					0.114				
PP2	0.795	0.889					0.120				
Eigenvalue		6.59	2.64	2.11	1.37	0.93					
% Explained variance		25.42	25.12	14.49	13.69	6.52					
Total explained variance		85.25					0.483	0.194	0.155	0.100	0.068
Varimax rotation; N = 308; KMO = 0.723; Bartlett Sphericity Test:= 6244.488; gl = 120; $p < 0.000$											

Table C – Sub-dimension Favourable Environment

Results of Exploratory Factor Analysis							Squared factor loading (scaled to unit sum)				
Variable	h^2	**Factor**					**Factor**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CC1	0.832	0.907					0.115				
CC2	0.821	0.901					0.113				
CC3	0.866	0.924					0.119				
CC4	0.802	0.890					0.110				
CC5	0.934	0.961					0.129				
CC6	0.947	0.967					0.130				
CC7	0.638	0.778					0.084				

Table C – Sub-dimension Favourable Environment

Results of Exploratory Factor Analysis							Squared factor loading (scaled to unit sum)				
Variable	h^2	**Factor**					**Factor**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CC8	0.562	0.529					0.039				
PR1	0.546	0.702					0.069				
TOL1	0.714				0.842					0.496	
TOL2	0.802		0.877					0.306			
TOL3	0.619		0.759					0.230			
TOL4	0.695				0.805					0.453	
LI1	0.560			0.690					0.222		
LI2	0.618					0.565					0.285
LL1	0.794					0.861					0.662
FE1	0.794			0.950					0.422		
FE2	0.925			0.910					0.387		
FE3	0.859		0.896					0.320			
Eigenvalue		7.18	2.51	2.14	1.43	1.12					
% Explained variance		35.93	12.37	12.01	9.08	6.25					
Total explained variance		75.64					0.499	0.175	0.149	0.099	0.078

Varimax rotation; N = 308; KMO = 0.750; Bartlett Sphericity Test:= 6577.490; gl = 171; $p < 0.000$

Appendix 3

Exploratory Factor Analysis of Intelligence dimension

Table A – Sub-dimension Governance

h²	Results of Exploratory Factor Analysis								Squared factor loading (scaled to unit sum)							
	Factor								Factor							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
0.540				0.352								0.085				
0.805				0.887								0.543				
0.486							0.485								0.224	
0.993			0.989								0.520					
0.846				0.693								0.331				
0.993			0.989								0.520					
0.666						0.709								0.445		

Table A – Sub-dimension Governance

h²	Results of Exploratory Factor Analysis								Squared factor loading (scaled to unit sum)							
	Factor								Factor							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
0.736						0.776								0.533		
0.971	0.964								0.208							
0.988	0.982								0.216							
0.818	0.748								0.125							

PEL4	0.955	0.951								0.202							
VIND1	0.785		0.837								0.223						
VIND2	0.694				0.466								0.150				
VIND3	0.581					0.738								0.462			
VIND4	0.880		0.868								0.240						
VIND5	0.897		0.817								0.213						
VPUB1	0.852							0.913								0.794	
VPUB2	0.793								0.878								0.779
Eigenvalue		4.47	3.14	1.88	1.45	1.18	1.13	1.05	0.99								
% Explained Variance		23.53	16.51	9.92	7.64	6.18	5.94	5.52	5.19								
Total explained variance		80.42								0.292	0.205	0.123	0.095	0.077	0.074	0.069	0.065

Varimax Rotation; N = 308; KMO = 0.697; Bartlett Sphericity Test:= 6471.587; gl = 171; p < 0.000

Table B – Sub-dimension ICT									
Variable	**Results of Exploratory Factor Analysis**					***Squared factor loading (scaled to unit sum)***			
	h^2	**Factor**				**Factor**			
		1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
TEL1	0.945	0.961				0.225			
TEL2	0.940	0.966				0.228			
AMB1	0.935		0.923				0.361		
AMB2	0.806		0.877				0.326		
AMB3	0.798			0.863				0.683	
AMB4	0.970				0.953				1.032
ACES1	0.727			0.679				0.423	
ACES2	0.890	0.859				0.180			
PUB1	0.781		0.868				0.319		
IND1	0.648	0.598				0.087			
Eigenvalue		4.10	2.36	1.09	0.88				
% Explained Variance		40.98	23.65	10.94	8.850				
Total explained variance		84.41				0.486[1]	0.280	0.129	0.104
Varimax Rotation; N = 308; KMO = 0.741; Bartlett Sphericity Test:= 2378.938; gl = 45; p < 0.000									

1 Example of calculation for TEL1: 4.10/∑ 4.10+2.36+1.09+0.88 = 0.486

Appendix 4

Exploratory Factor Analysis of urban sustainability dimension

Table A – Sub-dimension Economic sustainability

Results of Exploratory Factor Analysis									Squared factor loading (scaled to unit sum)						
Variable	h^2	Factor							Factor						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
CREC1	0.811		0.665							0.151					
CREC2	0.541	0.399							0.025						
CREC3	0.728	0.813							0.104						
CREC4	0.740		0.411							0.058					
CREC5	0.702				0.454							0.135			
NEG1	0.803		0.858							0.252					
NEG2	0.664		0.776							0.206					
NEG3	0.716					0.697							0.395		
NEG4	0.788			0.758							0.296				
NEG5	0.791		0.745							0.190					
NEG6	0.916	0.759							0.090						
NEG7	0.841	0.870							0.119						
NEG8	0.829	0.836							0.110						
NEG9	0.815			0.443							0.101				
NEG10	0.679				0.738							0.356			
EMP1	0.781						0.780							0.569	
EMP2	0.751				0.651							0.277			
EMP3	0.812			0.704							0.255				
EMP4	0.866			0.838							0.362				
EMP5	0.680					0.767							0.478		
EMP6	0.803							0.883							0.780
Eigenvalue		6.37	2.92	1.94	1.53	1.23	1.07	1.00							
% Explained Variance		30.35	13.88	9.26	7.31	5.84	5.08	4.75							
Total explained variance		76.46							0.397	0.182	0.121	0.095	0.077	0.067	0.062
Varimax Rotation; N = 308; KMO = 0.779; Bartlett Sphericity Test:= 4305.614; gl = 210; p < 0.000															

Table B – Sub-dimension Social sustainability

Results of Exploratory Factor Analysis										*Squared factor loading (scaled to unit sum)*							
Variable	h^2	Factor								Factor							
		1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
AD1	0.934	0.954								0.114							
AD2	0.891	0.929								0.109							
AD3	0.540	0.642								0.052							
AD4	0.902	0.944								0.112							
AD5	0.744	0.757								0.072							
AD6	0.500								0.678								0.430
AD7	0.763	0.613								0.047							
ICH1	0.828					0.903								0.582			
ICH2	0.656								0.796								0.592
ICH3	0.834					0.887								0.562			
ICOM1	0.893			0.932								0.400					
ICOM2	0.860	0.777								0.076							
ICOM3	0.800	0.767								0.074							
ICOM4	0.860	0.777								0.076							
ICOM5	0.799	0.846								0.090							
PD1	0.703							0.802								0.579	
PD2	0.564						0.576								0.263		
PD3	0.888				0.938								0.483				
DSA1	0.777		0.855								0.318						
DSA2	0.492	0.506								0.032							
DSA3	0.518							0.550								0.273	
DSA4	0.762		0.865								0.325						
DSA5	0.899				0.885								0.430				
DSE1	0.784						0.847								0.569		
DSE2	0.883			0.886								0.362					
Eigenvalue		7.95	2.30	2.17	1.82	1.40	1.26	1.11	1.07								
% Explained Variance		31.82	9.21	8.67	7.30	5.58	5.03	4.42	4.26								
Total explained variance		76.29								0.417	0.121	0.114	0.095	0.073	0.066	0.058	0.056

Varimax Rotation; N = 308; KMO = 0.802; Bartlett Sphericity Test:= 9623.441; gl = 300; p < 0.000

Table C – Sub-dimension Environmental sustainability

Results of Exploratory Factor Analysis									Squared factor loading (scaled to unit sum)						
Variable	h^2	Factor							Factor						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
EGA1	0.888		0.925							0.468					
EGA2	0.898		0.945							0.488					
EGA3	0.763	0.792							0.160						
EPAT1	0.740	0.802							0.165						
EPAT2	0.778	0.845							0.183						
RR1	0.619	0.665							0.113						
RR2	0.696	0.652							0.109						
RR3	0.838			0.877							0.466				
RR4	0.956						0.965							0.870	
RR5	0.613	0.682							0.119						
RR6	0.913	0.638							0.104						
TER1	0.716				0.842							0.521			
TER2	0.675				0.803							0.474			
TER3	0.581							0.730							0.555
TER4	0.668					0.776							0.478		
TER5	0.700					0.809							0.519		
Eigenvalue		3.91	1.83	1.65	1.36	1.26	1.07	0.96							
% Explained Variance		24.46	11.42	10.30	8.51	7.87	6.68	6.03							
Total explained variance		75.27							0.325[1]	0.152	0.137	0.113	0.105	0.089	0.080
Varimax Rotation; N = 308; KMO = 0.558; Bartlett Sphericity Test:= 1792.370; gl = 120; p < 0.000															

1 Example of calculation: $3.91/\sum 3.91+1.83+1.65+1.36+1.26+1.07+0.96 = 0.325$

Appendix 5

Calculation of the weightings of each sub-dimension in the dimension

Table D – Exploratory Factor Analysis of the Creativity Dimension and Weights

Subdimensions	h^2	**Factor – Creativity**	**Weights**
		1	
Culture	0.446	0.668	0.22
Creative Economy	0.772	0.878	0.38
Favourable Environment	0.810	0.900	0.40
Eigenvalue		2.03	
% Explained variance		67.59	
Total explained variance		67.59	

Varimax rotation; N = 308; KMO = 0.607; Bartlett Sphericity Test:= 299.642; gl = 3; p < 0.000; h^2 > 67%; loadings>40%

Table E – Exploratory Factor Analysis of the Intelligence Dimension and Weights

Subdimensions	h^2	**Factor – Intelligence**	**Weights**
		1	
Governance	0.566	0.752	0.50
ICT	0.566	0.752	0.50
Eigenvalue		1.13	
% Explained variance		56.55	
Total explained variance		56.55	

Varimax Rotation; N = 308; KMO = 0.500; Bartlett Sphericity Test:= 5.290; gl = 1; p < 0.000; h^2 > 0.5 loadings>0.40

Table F – Exploratory Factor Analysis of the Urban Sustainability Dimension and Weights

Subdimensions	h^2	**Factor – Urban Sustainability**	**Weights** [1)]
		1	
Economic sustainability	0.621	0.788	0.386
Social sustainability	0.393	0.627	0.245
Environmental sustainability	0.593	0.770	0.369
Eigenvalue		1.61	
% Explained variance		53.60	
Total explained variance		53.60	

Varimax Rotation; N = 308; KMO = 0.598; Bartlett Sphericity Test:= 83.775; gl = 3; p < 0.000; h^2 > or near 0.4 loadings>0.40

1 Example of calculation for Economic sustainability: 0.788^2/1.61 = 0.386

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REGIONAL COMPETITIVENESS RESPONSE TO INNOVATION CHANGES: ISSUES OF EVALUATION

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Abstract: Our research addresses regional competitiveness as the function of innovation activity. We use 15 indicators to cluster the Russian regions in five different groups, and to propose and to estimate the composite competitiveness quotient of a region in order to further regress it by innovation activity indicators. We prove that different groups of regions – "potential competitiveness leaders", "traditional competitiveness factor employers", "competitiveness outsiders", "moderate competitiveness regions", "competitiveness leaders" – are prone to respond to innovation parameters change in a different manner, thus uniform regulation and strategies are irrelevant. We contribute to the methodology of regional competitiveness estimation by presenting a ready-to-deploy set of data structures and model propositions. Our measure of competitiveness is economy related and easily adjustable regarding the specific innovation phenomena that influence the corporate and aggregate performance, value or efficiency of regions.

Key Words: *regional competitiveness, innovation, change, value*.

Introduction

Competitiveness is a multidimensional characteristic of the quality of a region's socioeconomic space. It determines the efficiency of regional resources' use and it is reflected by the improvement of the quality of life in a region. Innovation is often considered as a driver of competitiveness, or at least as a significant contributor to it. Innovation patterns change both gradually and drastically, yet they always depend on the global phenomena that drive the change. Further way down to regions or enterprises, the propagation of innovation impact depends on the object-specific features such as innovation receptivity and preparedness, on the one hand, and resistance to change, on the other hand.

Economic competitiveness is a complex phenomenon that is addressed to on different levels, including national and regional levels. The problem of intranational competitiveness is relevant to federations with a multitude of entities – regions that are often characterized by significant differentiation and asymmetry determined both by natural, historical and cultural, and synthetic factors. The existing factor differences make uniform policies inappropriate to address the issues of a given region thus diluting resources and, quite often, further fertilizing the asymmetry. Still, the general path of innovation can be considered fruitful for every region, but the content and drive of innovation need to be different, which means it must be identified and measured.

Methodology advances in measuring competitiveness fall out of the scope of our research. Quite sure, another attempt to propose a new metric for any level of competitiveness will highly likely replicate an existing approach or clarify it by eliminating its critical drawbacks. Furthermore, many authors are focused on the issue of competitiveness assessment using complex indicators, while instruments to enhance it are the matter of a much moderate discussion. We introduce an instrumental way to get an informative measure of competitiveness with a higher extent of explanatory power. To do that, we employ an integral

indicator approach preceded by the objects' multidimensional classification.

Estimates of regional competitiveness, both statically and dynamically, are extremely important since they provide a key to proper comparisons with the other regions' relevant indicators and they offer a distinct measure of the possible mismatch between the current strategies of social and economic development and the obvious trends in the development: it allows to revise either the objective or means of its achievement. Another important use of the regional competitiveness estimates is represented by measuring the general performance of a regional authority since its primary objective is to maintain the balanced development of a territory that would result in the increase of efficiency and quality of life promotion. Given the latter, at least two directions of research are actual. The first one is the traditional look-up of factors that determine the competitiveness of a region today and in a strategic perspective. The second direction is the development of mechanisms for the manageable and predictable influence on those factors to enable the growth of competitiveness.

We seek to prove the following research hypothesis: the Russian regions, given the existing level of differentiation and asymmetry, benefit from innovation differently in terms of their competitiveness as an integral characteristic of their relative performance and development. The different receptivity to innovation undermines any uniform policy and strategy that could be applied and it requires custom development models that provide the maximization of value return on the investment in innovation and the quality-of-life return on the investment in innovation. Therefore, we structured the research in the following manner:

1. We assumed that the 80 Russian regions had been significantly different, but not to the extent that would require 80 specific models – there had been a certain extent of homogeneity that allowed to derive a distinct typology and apply analytical procedures to several groups' averages. To get the groups, we:
    1.1. collected the database of various indicators that characterized the regions;
    1.2. censored the indicators to exclude multicollinearity and to get a more compact model design;
    1.3. applied the k-means clustering technique to get the regions in groups;
    1.4. analyzed cluster properties and cross-cluster differences to label them according to their competitiveness level.
2. We introduced the competitiveness quotient and estimated its values for all the regions.
3. We found the quotient average values for regions in each cluster in order to assign the dependent variable in the model. An analysis of the quotient dynamics explained the model type choice.
4. Using the official statistics, we decomposed "innovation" in measurable factors in order to include it in a regression model.
5. Having regressed the competitiveness quotient by innovation factors, we concluded on the hypothesis plausibility.

Literature review

Regions are the primary spatial units of organization that compete to attract investment; thus, the attention has turned to competitiveness at a more regional level (Huggins et al. 2016). Competitiveness is a multidimensional and complex category that characterizes a market economy. Regional competitiveness acts as an independent theoretical category described in different studies.

Porter (1998, 2003) plays a significant role in studying competitiveness of territories. His key concept is the thesis that the most important competitive advantages in the global economy often depend on the cluster's location (Porter 1998). So, according to Porter (2003: 571), "many of the essential determinants of economic performance appear to reside in regions",

thus regional competitiveness is represented by the productivity with which a region uses its resources – "the productivity of all the clusters in which the region has a meaningful position" (Porter 2003: 568). Further developments and linkages of regional competitiveness with the related concept of cluster are present in Pessoa (2013) whose contribution was to reframe the regional to spatial competitiveness emphasizing the gap between theory and policy implementation in managing regional competitiveness beyond Porter's (2003) approach to identify clusters as competitiveness drivers. Approximately the same attitude is found in Fundeanu and Badele (2014: 405) who prove that "innovative clusters are most likely to provide a new type of economy based on innovation, by means of producing dense knowledge flows for strengthening entrepreneurship by stimulating the formation of new businesses, thereby influencing the regional economic performance". Still, the cluster approach to regional competitiveness management is often used in a widely criticized manner: top-down cluster identification prevails over the bottom-up approach.

The attempts to define regional competitiveness vary significantly, but the researchers are unanimous in factor-based representation. They treat competitiveness as a specific combination of institutional factors (Krueger et al. 2018) or having the potential to ensure a high standard of living and quality of life in a region, according to national and global standards (Prokop and Stejskal 2015). Thus, one tier of studies considers competitiveness as a set of advantages used to maximize certain economic indicators and it interprets it as the ability of a region to discover, create and employ competitive advantages in comparison with other regions. This is the competitiveness phenomenon that it is currently used to explain the determinants of uneven development across regions, as supported, e.g., by Gavurova et al. (2017) or Huggins and Thompson (2017). In line with the latter, Roșu and Dona (2016: 445) define macroeconomic-level competitiveness as "the obtained results, materialized into labour employment and income levels, as well as the factors that determine them".

Compared to the EU, the Russian legislation has no regulations on the formal definition of competitiveness or any uniform methodology of measuring regional competitiveness like RCI in Europe. In the Russian scientific discourse, regional competitiveness is considered as the ability for sustainable socioeconomic development based on the productive use of resources and with regard to the long-term development objectives. Beyond that generalization, the following aspects of the Russian research of regional competitiveness are notable:

– the relative performance of a region's resources employment (Polyakova et al. 2018);
– the combination of region-specific conditions and factors of production, regarding the aggregate competitiveness of enterprises located and functioning in a region (Kolmakov et al. 2018);
– a region's ability to achieve and maintain high quality of life in line with the national and global standards by developing the new resource potential that outperforms the other regions and generates long-term and resilient competitive advantages (Chaynikova 2010).
– Golovikhin and Nezhivenko (2012) argue that the many attempts to define regional competitiveness are bound to the artificial or mechanistic adaptation of the concept to the specific research or policy task without proper analysis or critique. Yet, they agree that regional competitiveness represents the formalized measure of "one region being better than another" as well as the ability of a region to outperform another one in the foreseen future by employing the competitive advantage.

Summarizing the former and the latter, we strive to follow the definition of Žítek and Klímová (2015): regional competitiveness is a multidimensional characteristic of the socioeconomic space's quality, that determines the productivity of using territorial resources and it is reflected by a higher quality of life in the region. Leading competitive positions require relevant strategies, based on the efficient use of the productive and resource potential to build competitive advantages, to be developed and adapted. Considering the modernization tasks in

the economy, the implementation of such strategies is reasonable as part of the spatial approach that is widely implemented in European convergence/divergence studies with respect to competitiveness and growth. According to Alexa et al. (2019), the relationship between the regional competitiveness index and growth becomes highly significant when spatial interdependence is accounted for. Given that, we can conclude on the existence of the "growth – innovation – competitiveness" triad with a proven pairwise strong correlation.

The search for the sources and drivers that create competitive advantages plays a leading role in regional competitiveness. Competitive advantages should be considered as a set of conditions in a region that facilitate social and economic development and explain the differences from other regions. The following classification of competitive advantages is seen as the most rational: factor, organizational, strategic and innovation advantages (Zhai and Zhang 2012).

Innovation, as a factor of competitiveness, is critical at all levels of competitive relationships. One of the fundamental areas of regional economic development is the active use and development of regional scientific and technological potential that can ensure stable competitive advantages for specific regions. Innovation's impact on economic systems' competitiveness has been in scope of academic research since the early introduction of Porter's (1998, 2003) five forces framework. The contemporary research makes an emphasis on technological and ecological innovation to influence growth and development. The former can be found in Polyakova et al. (2019), and the latter in Ratten (2018), both considering the practical implication of the strategic level of innovation to the management of competitiveness. According to Huggins et al. (2014: 241), "each region has hugely increased its competitiveness through improvements in the capacity to absorb and diffuse knowledge". The assessment of research and development impact and the relations between R&D, innovations and competitiveness are present in Tiguint and Hossari (2018). However, the innovation receptivity of regions is presumably different due to the specific features of territories and their competitive specialization identified and measured in our recent paper (Kolmakov et al. 2019). On the other hand, innovation change may have different scenarios and be driven by different forces. In addition to technological modernization and product innovations that are widely discussed in the literature, we notice the brand-new phenomena of business-processes' redesign or assets employment mode changes associated with the sharing economy. This is why we address the issues of regional competitiveness sensitivity to changes in parameters of regional innovation activity.

Methodology

Classification of regions

Our hypothesis required to derive several notably different groups of regions that would be significantly homogenous within a group. Cluster analysis was found to be the proper solution for the task (Gavurova et al. 2017), given we needed to get a multidimensional and time-steady classification of regions.

The set of indicators to use in clustering was obtained through the two-step procedure. The first step was to use the content analysis of publications that dealt with competitiveness estimations and to get a wide list of indicators after the simple availability check. Žítek and Klímová (2015) used a composite index of 14 partial indicators divided into three groups – input factors, output factors and outcome factors. Alternatively, Yan et al. (2015: 153) provide "a new competitiveness evaluation index system (…) that measures comprehensive capacity, industrial output capacity, research capacity and environmental protection capacity". Huggins et al. (2014) present a rationale and method for quantifying the global competitiveness of regions.

In numerous Russian and foreign papers, we found evidence of using 42 indicators for the purpose of measuring competitiveness (excluding the ones that were not published by the Russian Statistics Authority). All indicators represented different aspects of regional development (Table 1).

Table 1

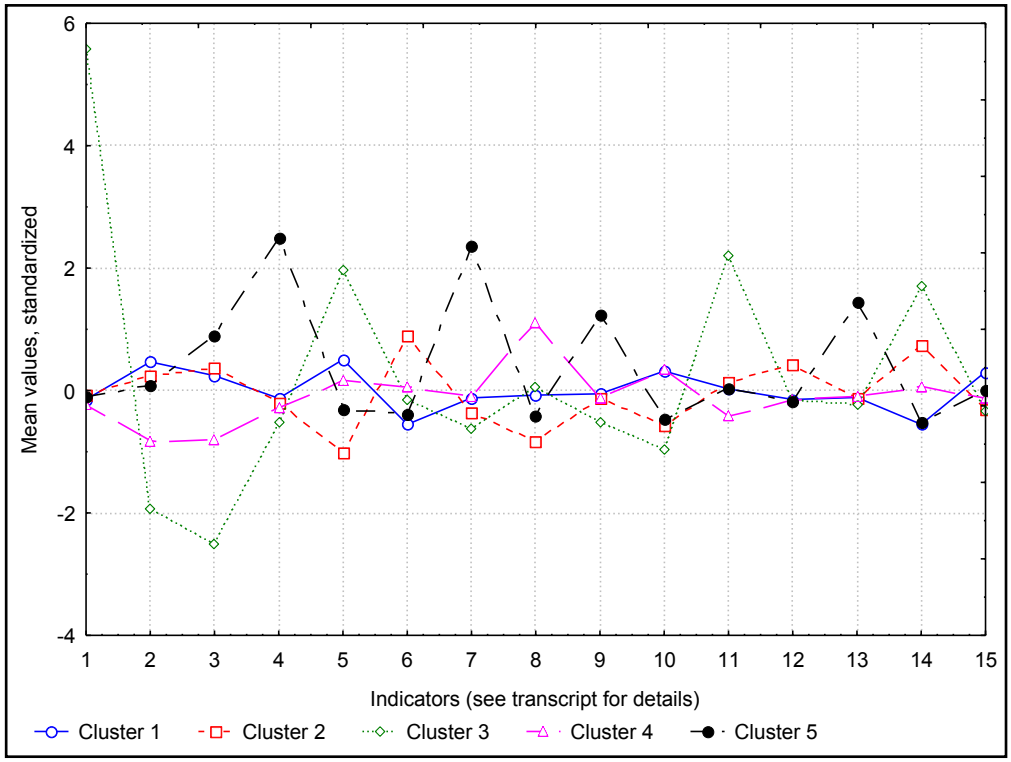
The extended set of indicators for the typology of Russian regions[1)]

	Indicator	Item	Indicator
1	Quantity of higher education institutions (units)	22	Total imports (millions of US dollars)
2	Number of higher education graduates (thousands of people)	23	Population (thousands of people)
3	Length of railways per 1000 square km of territory (km)	24	Sickness cases per 100 000 people
4	Density of roads per 1000 km of territory (km)	25	Crimes per 100 000 people
5	Value of fixed assets (millions of rubles)	26	Visits to theaters (thousands of people)
6	Depreciation of fixed assets (%)	27	Annual average employment (thousands of people)
7	Foreign capital enterprises' turnover (billions of rubles)	28	Registered unemployment level (%)
8	Industrial output index	29	Average employment by foreign capital enterprises (thousands of people)
9	Agricultural output index	30	Air pollution (thousands of tons of exhaust)
10	Electricity generation (billions of kWh)	31	Number of newly registered enterprises
11	Value of construction works (millions of rubles)	32	Number of newly registered enterprises with foreign capital
12	Retail turnover (millions of rubles)	33	Number of PCs per 100 employed people
13	Consolidated budget revenue (millions of rubles)	34	Number of technology export contracts
14	Proportion of loss-bearing enterprises (%)	35	Number of technology import contracts
15	Gross regional product per capita (rubles)	36	Value of technologies exported (thousands of US dollars)
16	Fixed capital investment (millions of rubles)	37	Value of technologies imported (thousands of US dollars)
17	Fixed capital investment per capita (rubles)	38	Number of technologies in use
18	Fixed capital investment per enterprise (thousands of rubles)	39	Innovation activity: number of enterprises implementing innovation as a percentage to total number of enterprises
19	Foreign investment inflow (thousands of US dollars)	40	Technology innovation expenditure (millions of rubles)
20	Consumer price index	41	Innovation goods and services output (millions of rubles)
21	Total exports (millions of US dollars)	42	Innovation products share in the total output (%)

On the second step, all indicators' data were standardized and checked for multicollinearity to exclude the irrelevant and highly correlated ones. After censoring, the residual set contained 15

1) The data were sourced from the Russian Federal Statistics Repository; the time interval was 2007-2017 (the latest available) in order to maintain comparability.

uncorrelated indicators that were used to classify the total of 80 Russian regions. We used the k-means clustering algorithm to test the outcomes of different clusters and to finally get the set of five groups significantly different from each other. Refer to Fig. 1 for the cluster averages across each of the 15 indicators, as well as the explication of the remaining indicators.



1. Registered unemployment; 2. Sickness per 100 000 people; 3. Crimes per 100 000 people; 4. Air pollution; 5. Depreciation of fixed assets; 6. Industrial output index; 7. Electricity generation; 8. Length of railways per 1000 square km of territory; 9. Technology innovation expenditure; 10. Innovation products share in the total output; 11. Proportion of loss-bearing enterprises; 12. Fixed capital investment per capita; 13. Foreign investment inflow; 14. Consumer price index ; 15. Number of technology export contracts.

Fig. 1 **– Cluster average values**

In several cases, the cross-cluster differences were not obvious which required to get the intra-cluster indicators' relative ranking (Table 2).

The cluster differences require several comments. We see that Cluster 3 can be characterized as the "competitiveness outsider". It contains only two regions that were the "troublemakers" in the 90s: Ingush Republic and Chechen Republic, which were the territories of the active warfare until 2003 and counter-terrorist operations until much later periods. It is not necessarily the development problem of the fact that the two regions have the worst values, as it might also be the drawback of statistic data collection that was obviously handicapped. But still, the financial and economic indicators are the worst of all; the best values in the social and ecological spheres can be argued since the minimum air pollution can be the evidence of

Table 2

Standardized values of indicators across clusters

Indicator (driver of competitiveness)	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Registered unemployment (lower rates mean labor market efficiency and attractiveness for quality migration)	-0.145	-0.063	5.580	-0.237	-0.100
Sickness per 100 000 people (the lower the value is, the more efficient the social policy is)	0.469	0.248	-1.938	-0.818	0.080
Crimes per 100 000 people (the lower the value is, the more efficient the social policy is)	0.244	0.382	-2.493	-0.797	0.891
Air pollution (bivariate indicator: a low emission can indicate a high extent of modernization or the low extent of industrialization together with a low performance of economy)	-0.126	-0.209	-0.507	-0.282	2.492
Depreciation of fixed assets (the more assets are worn out, the lower is the competitiveness due to the lack of technology advantage; also, an indicator of low investment appeal)	0.506	-1.011	1.970	0.169	-0.299
Industrial output index (a straightforward indicator of economic performance directly related to competitiveness)	-0.553	0.891	-0.151	0.055	-0.396
Electricity generation (a straightforward indicator of economic performance directly related to competitiveness)	-0.119	-0.352	-0.625	-0.093	2.369
Length of railways per 1000 square km of territory (cargo accessibility is the core factor of production facilities allocation)	-0.075	-0.830	0.048	1.104	-0.405
Technology innovation expenditure (as the function of “recent success” and indicator of strategic resilience)	-0.053	-0.115	-0.504	-0.121	1.247
Innovation products share in the total output (the extent of market conjuncture dependency – older products are more volatile in terms of demand stability and substitutes pressure)	0.318	-0.577	-0.960	0.345	-0.457
Proportion of loss-bearing enterprises (the statement of economic policy long-term retrospective, unless in crisis)	0.026	0.141	2.197	-0.417	0.030
Fixed capital investment per capita (reflects the willingness and ability to invest, even though it may be the indicator of a “resource-doomed” region)	-0.146	0.423	-0.161	-0.148	-0.179
Foreign investment inflow (as the function of transparency and market perspectives)	-0.112	-0.120	-0.215	-0.109	1.436
Consumer price index (the relative performance of a “small” economy in terms of resources reevaluation under transportation and other expenditures)	-0.552	0.734	1.712	0.071	-0.525
Number of technology export contracts (the degree of the “new economy” development)	0.308	-0.304	-0.343	-0.124	0.000

Legend:

Minimum	Below average	Average	Above average	Maximum

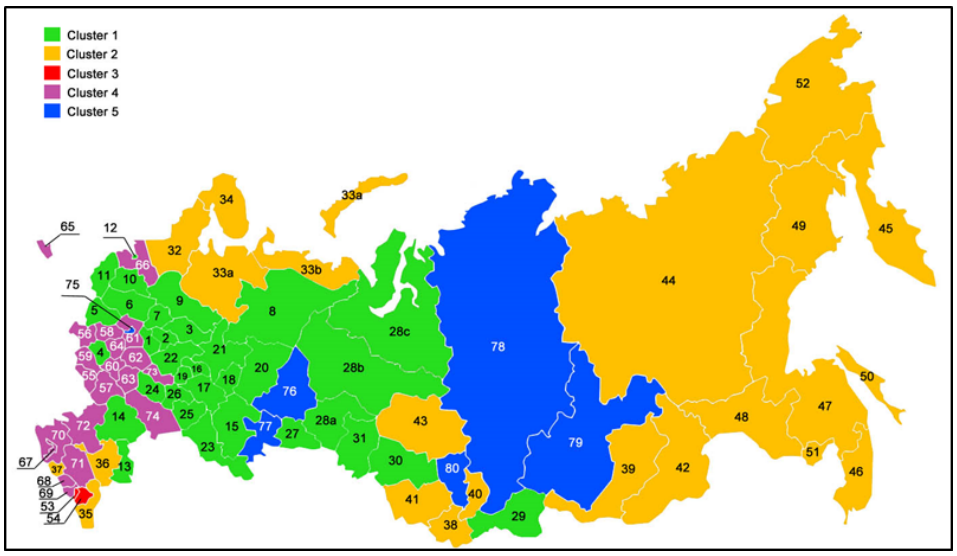


Fig. 2 **– Cluster constituents on the administrative map of Russia**

Table 3

Standardized values of indicators across clusters

Cluster number	**Regions** (number on the map)
Cluster 1. "Potential competitiveness leader"	Vladimir oblast (1), Ivanovo oblast (2), Kostroma oblast (3), Orel oblast (4), Smolensk oblast (5), Tver oblast (6), Yaroslavl oblast (7), Republic of Komi (8), Vologda oblast (9), Novgorod oblast (10), Pskov oblast (11), city of Saint-Petersburg (12), Astrakhan oblast (13), Volgograd oblast (14), Republic of Bashkortostan (15), Republic of Mari-El (16), Republic of Tatarstan (17), Udmurtia Republic (18), Chuvash Republic (19), Perm krai (20), Kirov oblast (21), Nizhegorodskaya oblast (22), Orenburg oblast (23), Penza oblast (24), Samara oblast (25), Ulyanovsk oblast (26), Kurgan oblast (27), Tyumen oblast (28a, includes Khanty-Mansi Autonomous Okrug 28b and Yamal-Nenets Autonomous okrug 28c), Republic of Tyva (29), Novosibirsk oblast (30), Omsk oblast (31)
Cluster 2. "Traditional factors employer"	Republic of Karelia (32), Arkhangelsk oblast (33a, includes Nenets Autonomous okrug 33b), Murmansk oblast (34), Republic of Dagestan (35), Republic of Kalmykia (36), Karachay-Cherkessia Republic (37), Republic of Altai (38), Republic of Buryatia (39), Republic of Khakassia (40), Altai krai (41), Transbaikal krai (42), Tomsk oblast (43), Sakha Republic(44), Kamchatka krai (45), Primorsky krai (46), Khabarovsk krai (47), Amur oblast (48), Magadan oblast (49), Sakhalin oblast (50), Jewish autonomous oblast (51), Chukotka autonomous okrug (52)
Cluster 3. "Outsider"	Ingush Republic (53), Chechen Republic (54)
Cluster 4. "Moderate competitiveness"	Belgorod oblast (55), Bryansk oblast (56), Voronezh oblast (57), Kaluga oblast (58), Kursk oblast (59), Lipetsk oblast (60), Moscow oblast (61), Ryazan oblast (62), Tambov oblast (63), Tula oblast (64), Kaliningrad oblast (65), Leningrad oblast (66), Republic of Adygea (67), Kabardino-Balkar Republic (68), Republic of north Ossetia (69), Krasnodar krai (70), Stavropol krai (71), Rostov oblast (72), Republic of Mordovia (73), Saratov oblast (74)
Cluster 5. "Competitiveness leader"	City of Moscow (75), Sverdlovsk oblast (76), Chelyabinsk oblast (77), Krasnoyarsk krai (78), Irkutsk oblast (79), Kemerovo oblast (80)

industrial stagnation, lack of manufacture and no energy generation, and the *lowest sickness and crime rates might be the consequence of bad statistics or the effect of significant* federal investment in the social sphere. Thus, all competitiveness components show the two regions being outsiders. Due to the significant underperformance, this cluster was excluded from further consideration.

The number of regions in clusters is significantly heterogenous: the biggest in number is Cluster 1 (38.75% of regions), while clusters 2 and 4 contain 26.25% and 25.0% respectively. The remaining 10% regions shape up Cluster 5 (7.5% or 6 regions) and Cluster 3 (2.5%, 2 regions, Fig. 2, Table 3).

Competitiveness quotient introduction

We used the integral quotient approach to competitiveness measurement since it is justified by a vast variety of papers presenting different combinations of composite indices. A comprehensive review of different methods of competitiveness evaluation can be found in Kovalska (2013).

The general expression of the integrated regional competitiveness quotient is the following:

$$CQ_{ij} = E_{ij} \times IA_{ij}$$

$$E_{ij} = GRP_{ij} / FA_{ij}$$

where CQ – competitiveness quotient of region *i* in year *j*; theoretical $CQ \in [0;\infty)$, actual $CQ_{ij} \in [0;14.12]$.
E – output efficiency index of region *i* in year *j*; theoretical $E \in [0;\infty)$, actual $E_{ij} \in [0.11;0.86]$.
IA – innovation activity in region *i* in year *j*; theoretical $IA \in [0;1]$; actual $IA_{ij} \in [0;0.33]$. See item 39 in Table 1 for explanation, "zero" or not available for regions of Cluster 3.
GRP – gross regional product of region *i* in year *j*, rubles.
FA – total fixed assets in region *i* in year *j*, rubles

Regarding the regions' distribution by clusters, we can trace the differences between them. Fig. 3 provides the cluster-average values of the regional competitiveness quotient in dynamics. Cluster 3 values are omitted since innovation activity values are zero or missing.

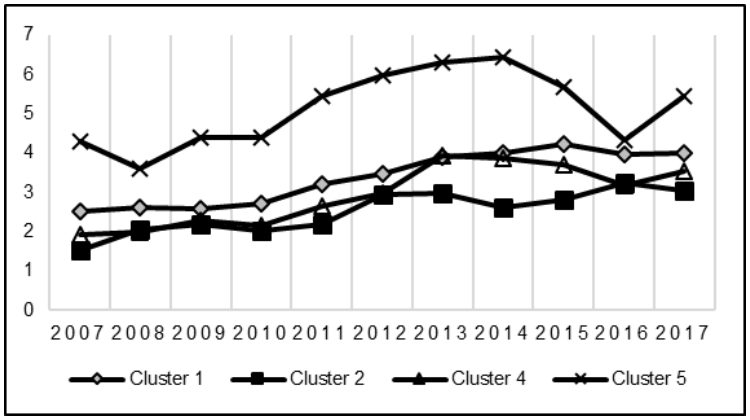


Fig. 3 **– Average values of the integrated competitiveness index by clusters**

The visualization enables several verification conclusions on the set of indicators used for the clustering. Thus, clusters 1, 2 and 4 fall in approximately the same range of competitiveness quotient values, even though the clusters are quite different from each other. This means that their competitiveness is driven by different factors. Cluster 5 stands out as an outlier compared to all the rest groups.

Regression model design

Linear regression models, including the lagged ones, allow the comprehensive evaluation of the processes and phenomena causality and their impact-response on power estimates. Regression coefficients are easily interpreted and compared. Our choice of linear regression is based on the "one way causality" proposition: innovation can influence competitiveness, but it is highly unlikely that the change of competitiveness (no matter how we measure it) could influence innovation since enterprises make their decisions to invest, modernize or spend more on innovation regarding on their own considerations of the market, product, technology, etc., but not on the performance of a region they are located in.
The general model of competitiveness quotient dependence on innovation development parameters can be described as follows:

$$CQ = f(X1; X_2;\ldots X_n),$$

where X1; X2;…Xn – parameters of regional innovation development.

Regional innovation development parameters are taken formally to fit the data availability constraints. We took the following three indicators, denoted by the Russian Statistics Authority, as the key ones: number of advanced technologies in use, technological innovation expenditure, and investment in fixed assets.

The linear type of a model, in contrast to the non-linear model, was chosen due to the data time series characteristics (a linear trend is rather obvious) and the linearity assumption that follows the forecast of the Russian economy moderate growth in terms of GDP and global competitiveness.

Results and Discussion

The modelling results prove the initial hypothesis: regions' competitiveness responds to innovation change in different manners. Investment in fixed assets is found to be the most significant influencer in the three clusters (Cluster 1, 2 and 5). Cluster 1 is the only group of regions that, on average, benefits from the advanced technologies use intensification and expansion, while all the other clusters have negative values of the respective regression coefficient. Compared to the "current leaders", the "potential leaders" are still far from the performance boost dilution effect but spending more on technology will undermine the total competitiveness surplus. It means that the regions from the groups with traditional competitiveness factors and moderate and leading competitiveness have not reached the stage yet when "quantity transforms into quality", i.e. their production systems are not able to become more efficient through the increase in the number of used technologies (Table 4).

Our conclusion regarding Cluster 2 to denote it as a "traditional factor employer" was confirmed: the massive technological change is costly, that is why the number of technologies in use should not grow. The expenditure to support one or two modern technologies in traditional sectors will be combined with the capital investment expansion in the favor of "the known" technological mode support. The production systems of the regions with traditional competitiveness factors have an insignificant dependence on the number of innovations. These regions are inert, which largely clarifies the wave nature of their competitiveness quotient that

changes according to the transformation of the Russian economy competitiveness being "tied" to it. In addition, it is obvious that the regions with leading values and innovation outperformance have the best opportunities to fund these innovations, to create a significant backup, and to postpone the impact from the innovation development.

Table 4

General description of the degree of impacts from the studied factors on integrated regional competitiveness

Cluster	Factor's name and impact degree (in relevant scale)			
	Number of advanced technologies in use	**Technological innovation expenditure**	**Investment in fixed assets**	**Other factors**
1. Potential competitiveness leaders	5.08 (0.39)	-4.05 (-0.54)	9.33 (0.91)	-20.77 (-1.55)
2. Traditional competitiveness factor employers	-0.27 (-0.044)	2.14 (0.131)	5.58 (0.415)	-9.41 (-0.689)
4. Moderate competitiveness	-1.11 (-0.15)	0.30 (0.03)	-0.32 (-0.025)	-10.64 (-0.84)
5. Competitiveness leaders	-14.51 (-0.74)	29.19 (1.66)	22.71 (1.78)	-103.40 (-8.3)

The indicator "technological innovation expenditure" demonstrates the opposite situation: it has a negative impact on regional competitiveness in the first cluster, but it positively influences the other regions. In fact, it means that there are competitive production systems in the "potential competitiveness leader" regions, and there is no need for a dynamic increase in the number of advanced technologies through additional technological innovation expenditure. In terms of quantity, it means that a decrease in technological innovation costs by 1m rubles in the first cluster regions can lead to an increase of the integrated competitiveness indicator by 0.54, all other things being equal. By increasing technological innovation costs by 1m rubles, "competitiveness leaders" could improve the competitiveness index by 1.66, excluding the impacts from counterfactors.

The intercept in a regression equation should be considered as well. It reflects (with certain conditionality) the influence on the regional competitiveness quotient of factors and random processes that are not included in the model. In all cases, the intercept is negative. Considering the dimensionality of this parameter, we can claim that the sensitivity to "other factors" is the lowest among the regions with traditional factors and moderate competitiveness. In other words, factors included in the model have the least impact on the studied phenomenon among all models, and all other factors do not ensure the translation movement. By contrast, leaders and potential leaders demonstrate "manageable competitiveness" when the instruments and mechanisms of influence on innovation development to change regional competitiveness can be applied.

Possible verification can be derived from the European cases indicating that regional competitiveness is presumed to be enhanced by entrepreneurship development, raising FDI, and by the territorial concentration of R&D centers, but in fact is the most significantly influenced by the GDP per capita, the employment rate and the labor productivity (Török 2017). Lower levels of regional competitiveness are attributed to regions with more labor intensive output, while regions with a higher level of education, innovation and productivity enjoy their greater contribution to the regional economy's growth (Romão and Nijkamp 2017).

Conclusions

The problem of pluralism in identifying categories of regional competitiveness can be solved not through theories but through management practice, especially at strategic level. There are reasons to suppose that the approach that is promoted by many researchers and it is based on the "removal" of competitiveness from a set of relatively interrelated indicators of socioeconomic system development is incorrect because the competitiveness characteristic does not determine the phenomenon on its own. That is why the phenomenon should be considered as an attribute to the regional strategic management construction: slogan-like formal strategies that are implemented in the multitude of the Russian regions require significant revision. If we want to manage competitiveness, a proper performance indicator is needed. The one we propose in this paper can be instrumental.

The interrelation between the level of competitiveness and the parameters of regional innovation development was estimated and proved plausible. The insights about the nature and strength of such interrelations will allow the justification of the selected use of competitiveness management instruments, depending on the regions types and based on the parameters of competitive specialization, the efficiency of regional production systems, the levels of innovation activity and the innovation development parameters.

The further research pathway is to seek the ways to integrate competitiveness into strategic management mechanisms not at the level of the aims and objectives but at the level of the fundamental philosophy of "total competitiveness management", akin to the well-known "total quality management".

Greater concern is represented by the innovation policy and strategy adjustments designed to enhance competitiveness. We prove that the uniform rule of technological modernization and innovation technology implementation is going to cause different outcomes in terms of overall competitiveness, regional performance or value creation. The latter is discussed in our forthcoming papers: we suggest the regional free cash-flow indicator (Kolmakov and Polyakova 2019) to be used for measuring the regional performance response to different triggers including innovation pattern changes. The two surveys results' combination will contribute to the more precise model specification that would consider "innovation triggers" allowing to get initial estimates for response surface tests' parametrization and will enable other computational approaches to get more specific outcomes.

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ASPECTS OF SELF-ESTEEM IN THE TOURISM DEVELOPMENT IN KARO REGENCY, NORTH SUMATERA, INDONESIA

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Abstract: Due to its positive effects on the economy, tourism is a significant aspect in the development of a country. Therefore, it is necessary to improve facilities at tourism destinations as well as to especially increase the local people's self-esteem in order to maintain such destinations. The study aims to examine self-esteem referring to the assessments given by tourists and residents in which such assessments can be used to improve the maintenance of tourist attractions in a region. As one of the regencies in North Sumatera Province, Karo owns great tourism potentials due to its various natural attractions as well as cultural richness. However, many of these attractions are not well maintained so self-esteem is considered as a solution. This study has measured four aspects namely evaluation, pride, attachment, and commitment which must become parts of Karo's identity. This study used the mix method which utilized a combination of 360 questionnaires and in-depth interviews. The findings show that the aspects of pride, attachment, and commitment became the positive features by the local residents although the assessment to the aspect is poorly evaluated. Moreover, the quality of infrastructures available at main tourism destinations was proved to increase also the residents' quality of life.

Key Words: *self-esteem, tourism, place identity, Karo regency*.

Introduction

Tourism has a strong contribution to the national and international advancement of a city and a nation. This sector is exceedingly prominent because it can improve the economy and the quality of life of the people (Ginting and Wahid 2015). Considering its profits and benefits, self-esteem in the tourism areas is the key aspect to determine people's positive or negative evaluation of the place (Wang and Xu 2015). This study aims to investigate the perceptions of citizens and tourists on the self-esteem aspect and its influences to the tourism development (henceforth TD) in Karo regency (henceforth KR) while the results can then be used for a tourism development program that leads to the improvement of the regional economy.

Karo is one of the regencies in North Sumatra (NS), which has various natural as well as cultural tourism attractions. It is also well-known for its agricultural products, such as fruits and vegetables, which local people and tourists can buy in the fruit markets (North Sumatera Culture and Tourism Office 2011). However, such wealthy resources have not been well-maintained to its optimal value. One evidence of this is the lack of arrangement and maintenance of tourism objects to serve the tourists in the most desirable way. In addition, it is still difficult for tourists to find common facilities at tourist destinations (TTDs). Therefore, this study aims to examine a key principle which is called self-esteem in the TTDs and its important role in establishing identity of TTDs in KR. This research emphasizes the identification of self-esteem in some TTDs; the self-esteem is based on the aspects of evaluation, pride, attachment, and commitment. These findings will be used for assessments and references by the local governments to issue policies for the development of TTDs. It is believed that having well maintained TTDs based on the identity of the TTDs will benefit KR and its people, particularly those who occupy land around the research areas.

Literature review

Place identity is a result of human responses to the changes of the physical environment in order to maintain a relationship with the place (Bonaiuto et al. 1996, Gustafson 2001) and its existence roots in many forms, both tangible and intangible, and it contributes to the identity of its society (Ginting and Rahman 2016a). This perception is essential to the TTD as a place-based phenomenon whose outcome involves place identity (Wang 2016, Ginting et al. 2017).

Self-esteem is a term referring to self-evaluation (Ginting and Rahman 2016b) in which people in an area measure themselves by giving a positive or negative appraisal to a place and how the place affects their feelings. The term relates to a person's sense of worth or of social value (Twigger-Ross and Uzzell 1996). For example, people feel proud of a place that has special characteristics (Ujang and Zakariya 2015). The appraisal does not only affect the identity of the surveyed person but also of the place (Proshansky et al. 1983) to make it more valuable. For example, a person or a group of people prefer a place having its physical characteristics that can increase their self-esteem compared to a place giving them bad effects to their esteem (Hauge 2007, Bajracharya 2015). Thus, visible symbols or characteristics as well as the historical value of a place will advance tourism because it can generate pride both for the tourists and the local people. Furthermore, as more tourists visit a place, they will be surprised with the pleasant neighborhood and therefore it can support their self-esteem (Twigger-Ross and Uzzell 1996). A person will feel close to a place through a process and what he/she feels may reflect his/her behavioral, cognitive, and emotional experiences towards the social and physical environments (Bernardo and Palma 2005). Commitment to a place is addressed to a discussion on the intensity of the desire to live in a city and on the attention to the development of a place in the future (Lalli 1992, Shabak et al. 2015). In short, self-esteem is divided into four variables, namely evaluation, pride, attachment and commitment (Table 1).

Table 1

Variables of self-esteem principle

Self-Esteem Principle			
Evaluation	***Pride***	***Attachment***	***Commitment***
- Respondent's perceptions to a positive assessment of a place	- Perceptions of respondents to the history of a place or past memories - Perception of respondents to physical symbols / characteristics	- Perceptions of respondents to feelings bound to a place - Respondents' perceptions of the sense of belonging to a place	- Respondent's perception on the intensity of desire to stay - Respondents' perceptions on the development of a place in the future

Methodology

Research area

The research was conducted in Karo regency which becomes one of the main TTDs in NS and it is rich in natural and cultural attractions. Located in the highland area, it has local commodities such as fruit and vegetable gardens that flourish through the region. There are twenty tourism attractions in the regency and the study examined five of them, which were chosen from nine original samples based on the pilot research completed by researchers and students at University of Sumatera Utara. The selected five TTDs are Bukit Gundaling, Pasar Buah (Fruit Market), Sipiso-piso Waterfall, Desa Lingga, and Bukit Kubu, which have high numbers of visits from the tourists (Fig. 1).

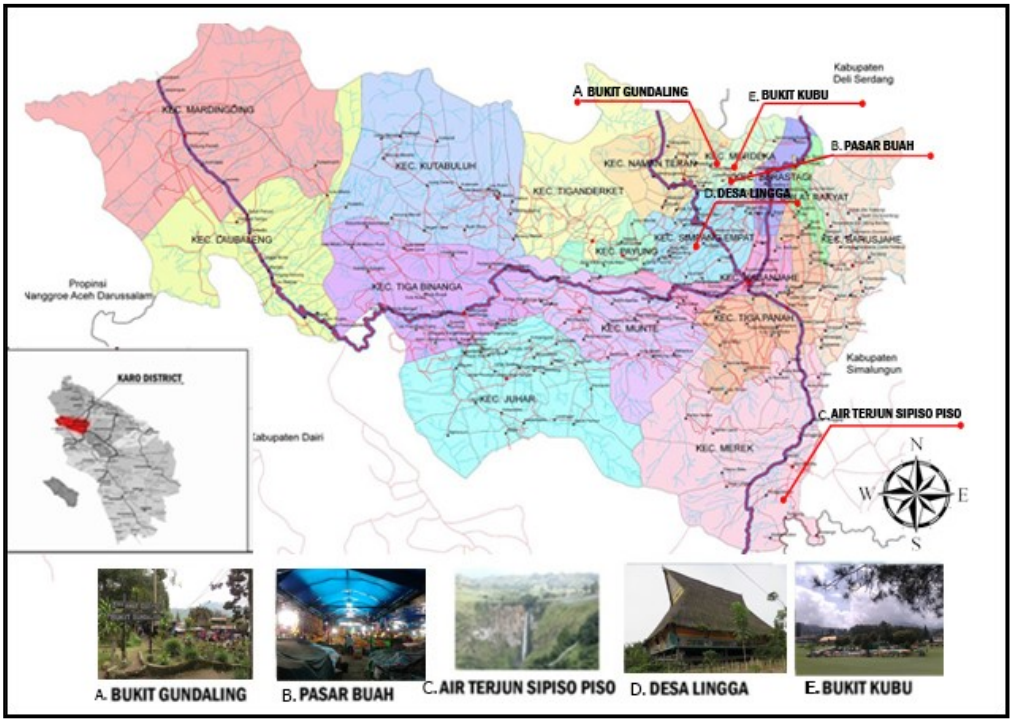

Fig. 1 – **Research Areas**
Source: *Ginting (April and May 2016)*

Bukit Gundaling is the highest plateau after Sibayak and Sinabung mounts. The Pasar Buah is located in the Berastagi down town and it becomes a place for various fruits sale. The Sipiso-piso Waterfall, one of the largest waterfalls in NS, posits at an altitude of about 800 meters above the sea level and it is surrounded by green pine forests. The Desa Lingga is a historic village where a traditional house aged for more than 250 years remains available, and the last DDT is Bukit Kubu which is placed on a wide hill.

Methods

The research was conducted in natural TTDs having different people's behaviors towards the TTDs and different levels of knowledge, attitude and culture as well. It combined qualitative and quantitative methods when the respondents' perceptions on the aspects of self-esteem were collected. The first method involving eight in-depth interviews were addressed to tourism stakeholders, such as travel agents, academics, community leaders, government, and respondents who were directly or indirectly engaged in tourism. Meanwhile, field observations were focused on physical data, for instance, physical characteristics, community activities, traditional buildings, facilities, and pedestrian intensity. The second research method involved the questionnaire distribution to 360 respondents, both local people and tourists, and each questionnaire included information on the respondents' profiles (age, gender, status, education, job, occupation, and nationality), their tourism activity (goal, intentions, frequency of visits, and duration), the local tourism events or activities, and on their perceptions on self-esteem aspects (evaluation, pride, attachment, and commitment).

Results and Discussion

The study involved 360 respondents in five tourism sites, each represented by 72 respondents comprising of 36 local residents, 22 domestic tourists, and 14 foreign tourists. The foreign tourists dominantly came from Malaysia (54%) and the rest from Europe (9%). The respondents had ages ranging from 25-49 years old (46%) and from 18-24 years old (36%), while 53% of them were males. They mostly travelled with friends (44%) or in groups (32%).

Self-esteem in this study has four variables, namely evaluation, pride, attachment, and commitment. Overall, the self-esteem in TTDs obtained positive assessments from both tourists and local residents (3.22, Table 2).

Table 2

Respondents' perception and the self-esteem principle in research area

	Statements	Pasar Buah		Gunda-ling		Sipiso-Piso		Desa Lingga		Bukit Kubu		
		Local People	Tourists	Local People	Tourists	Local People	Tourists	Local People	Tourists	Local People	Tourists	Total
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
E	Easy to find public toilet	2.64	2.94	2.88	2.39	3.00	2.72	2.33	2.39	3.11	3.28	2.77
E	Easy to find information center	2.86	2.72	2.97	2.67	2.69	2.72	2.36	3.00	3.25	3.25	2.85
E	Easy to find an inn	3.11	3.33	3.16	3.25	2.78	3.08	2.36	2.69	3.47	3.58	3.08
E	Easy to find restaurant	3.11	3.33	2.94	2.92	2.75	2.97	2.69	2.92	3.25	3.56	3.04
E	The cost of lodging at this place is affordable	3.00	3.31	2.86	3.11	2.78	3.08	2.66	3.08	3.31	3.28	3.05
E	The cost of things in this place is affordable	2.83	3.28	3.02	3.11	3.19	3.14	2.86	3.22	3.25	3.19	3.11
E	The cost of food/ beverages in this place is affordable	2.78	3.33	2.97	3.19	3.14	3.08	2.97	3.17	3.33	3.33	3.13
P	I am proud with the history of this place	3.06	3.33	3.25	3.31	3.19	3.44	3.47	3.72	3.33	3.53	3.36
P	I am proud with the physical symbols/ characteristics of this place	3.06	3.61	2.91	3.42	3.28	3.33	3.44	3.58	3.22	3.53	3.34
A	I feel that I am a part of this place	3.25	2.94	3.16	2.83	3.44	3.11	3.61	2.53	3.39	3.36	3.16
A	This place is important to me	3.14	3.14	3.22	2.72	3.25	3.03	3.55	2.86	3.56	3.44	3.19
A	This place speaks alot about me	3.03	2.81	3.02	2.39	3.22	2.86	3.47	2.36	3.33	3.06	2.95
A	I feel happy when I am in this place	3.22	3.36	3.33	3.25	3.31	3.39	3.55	3.39	3.56	3.89	3.42
A	I feel the same with this place	3.28	3.08	3.19	2.89	3.28	3.06	3.5	2.81	3.69	3.50	3.23
A	I'm sad if the characteristics of this place are gone	3.47	3.75	3.58	3.58	3.47	3.53	3.86	4.06	3.86	4.03	3.72
A	I feel sad if the characteristics of this place are gone	3.39	3.75	3.63	3.58	3.50	3.58	3.88	4.06	4.03	4.19	3.76
C	If I could, I want to spend more time in this place	3.19	3.56	3.33	3.31	3.31	3.28	3.38	3.39	3.64	3.75	3.41
C	I want to contribute to the development of this place	3.00	3.17	3.38	3.11	3.47	3.36	3.61	3.25	3.53	3.94	3.38
	E = Evaluation P = Pride A = Attachment C = Commitment Value Format: 1 = strongly disagree, 5 = strongly agree											3.22

The self-esteem in the fruit market was well-appreciated by the residents and tourists who gave a high value on the tourist attraction and they felt proud of it. Indeed, they would feel sad if the market disappeared or it was destroyed. Similarly, the residents and tourists also had positive responses to Bukit Gundaling. In the Sipiso-piso Waterfall, the local residents and tourists were happy and proud of the attraction. Last, in Desa Lingga, the tourists and the local residents felt proud of the history and characteristics of the village. In fact, a stronger sense of belonging, pride, and ties will grow by the involvement of the local communities in the preservation of historic areas (Ginting 2014). For instance, the travelers and residents stated that they would feel sad if Desa Lingga was lost or it was destroyed. This became high assessments of self-esteem for the tourist site. Furthermore, a person would be happy with a place with physical symbols that made them feel proud of and it would avoid a place that caused no pride (Twigger -Ross et al. 2003). With regard to the findings, Bukit Kubu was awarded to have a good rating from the residents and tourists because they felt the TTD liked a home because they could perform daily activities, i.e., playing, picnic, eating in the restaurant and outbounds.

A positive or negative evaluation of a place indicates whether or not the place is worth visiting, so it can make the area better (Twigger-Ross and Uzzel 1996). The identity of a place affects the visitor's attitude to the impact of tourism resulting in a positive and negative evaluation (Wang and Xu 2015). In a tourism destination, this evaluation involves many factors (Suwantoro 2004) and it relates to the visitor's satisfaction to the place (Sulistiyana et al. 2015, Sivalioğlu and Berköz 2016). Thus, it is vital to the development of tourism in an area.
As one of the factors in evaluating a place, public toilets contribute to creating a comfortable environment (Ja'afar et al. 2012). In the studied area, the easiness of finding public toilets obtained poor rating by the average respondents. The public toilets in the fruits market were not available at strategic locations (Fig. 2), making them difficult for travelers to find them and there were no signs guiding the tourists to the public toilets. Furthermore, the ease to find the information center was also poorly rated in the studied tourist sites. Moreover, the quality of services and facilities, as well as the satisfaction to the two aspects would improve the long-term relationship with the tourists and it made them comfortable to the place. Therefore, the further improvement of facilities was required.

Fig. 2 – **Public toilet in Pasar Buah**
Source: *Ginting (May 2016)*

In contrast, the study found that accommodations for foreign and domestic tourists were at easy access especially in Bukit Kubu. The restaurants in Bukit Kubu also got a high assessment rating from the respondents although small places selling food required further management (Fig. 3). Lastly, the costs of lodging in TTDs were quite affordable. In Bukit Kubu, there were accommodations available for tourists with affordable costs and the following is an

example of interview with a respondent: “The cost of lodging in Bukit Kubu is quite affordable, and it has good tourism attractions. Tourists can also enjoy the panorama of the Green Hill from the inn there” (Main respondent: Tourism Figures).

Fig. 3 – **Lodgings in Bukit Kubu and stores in Bukit Gundaling**
Source: *Ginting (May 2016)*

Prices could also influence the respondents’ perception that determined the kind of experience they expected during their visits to a TTD (Middleton et al. 2009). The research shows that prices of goods in tourism sites were affordable for tourists; meanwhile, local people gave a low assessment for goods in tourism sites. The following is an interview with a key respondent: “The admission price to the tourism attractions in Karo Regency is affordable for domestic and foreign tourists, and so are the prices of goods, food, and beverages” (Main respondent: Tourism Figures).

In general, the price of goods, as well as food and beverages, gave a positive evaluation towards the area. Moreover, food and beverages in the tourism attractions were also easy to find as indicated by the number of restaurants and stalls available around the tourism spots.

People will be happy with a place with visible symbols that gives them a sense of pride and they will avoid the area that gives them the opposite situation (Twigger-Ross et al. 2003). Furthermore, the existence of historic buildings also gave them a feeling of proudness to the society due to the memories of the past which enhance the sense of pride and of belonging to the place. In Karo’s TTDs, respondents felt generally proud of the history of the place, and among the five objects of research, Desa Lingga received the highest rating regarding to its status as a traditional village in Karo with its traditional houses that have been existed for around 250 years. The following is an interview with a key respondent: “The historical attraction in Karo Regency is Desa Lingga which have been granted facilities by the Government and will be soon renovated. The whole indigenous culture is in Desa Lingga with historical potentials, such as the traditional houses” (Main respondent: Karo District Government Leader).

Historic buildings will give a sense of pride for tourists and residents (Ginting et al. 2018) and Desa Lingga even becomes the main attraction for tourists to visit (Fig. 4). In addition, the physical symbols or characters in Karo tourism sites were considerably high for the respondents. The low level of public and tourists’ participations were due to the absence of confidence in the function of the tourism attraction (Rao and Kumar 2017).

Respondents gave positive ratings of pride only to Desa Lingga. The cultural village still maintained relics of unique Karo traditional houses that made tourists and residents feel proud of the place. It proves that cultural symbols would increase the bonding to a place (Shabek 2015).

Fig. 4 – **Physical symbols and characteristics of traditional houses in Lingga village**
Source: *Ginting (April 2016)*

The main characteristics of place attachment becomes someone's desire in order to manage an intimacy with an object (Brown and Perkins 1992). It also describes a particular feeling to a place (Hidalgo and Hernández 2001). In the studied areas such as Berastagi and Sipiso-piso waterfall, people in the TTDs felt that they were part of the place. They enjoyed and felt happy when they were in the locations. However, it can be seen that some tourists still considered themselves as strangers to those places, like Pasar Buah, Bukit Gundaling, and Desa Lingga. The results show that the five tourism attractions brought less meanings to the foreign tourists, but not to the domestic tourists. Another factor of attachment, that is functional and emotional attachment, also holds significant roles in establishing place identity (Ujang and Dola 2009, Ginting et al. 2017).

In general, respondents were happy in the TTDs. The attachment shows visitors some privacy and family togetherness (Harris et al. 1996). This particularly becomes obvious in Bukit Kubu, where domestic and foreign tourists and local people were very happy to perform various activities together with their families (Fig. 5). This is supported by the following interview with a key respondent: "The most popular tourism attraction by domestic tourists in Karo Regency is at Bukit Kubu. It is often used for meeting place which enables tourists to refresh all day and spend the weekend in Bukit Kubu. It seems that the current tourism attraction trend in Karo Regency is Bukit Kubu" (Main resource: Hotel Manager at Berastagi).

Fig. 5 – **Tourist Activities in Bukit Kubu**
Source: *Ginting (May 2016)*

Furthermore, respondents also feel merged with the tourism attraction in five TTDs and, as a consequence, they felt sad if the TTDs characteristics were lost. Desa Lingga got the highest rating among the respondents who felt very sad if the village disappeared or it was destroyed. This is supported by an interview with the main respondent: "If Desa Lingga is demolished, we will have difficulties to observe Karo culture. In fact, our weakness in Karo regency is the absence of data or information about the Karo culture, and there are only two real forms of the culture, namely in Dokan and Lingga village. Of course, I will feel such grief if Lingga village's

characteristics are lost or destroyed" (Main resource: Academician).

Local residents and tourists also felt sad when the tourism attractions in Karo diminished or were destroyed because for them it would be difficult to find attractions and Desa Lingga got the highest rating from the respondents.

Individuals with high self-esteem tend to be more committed than the ones with low self-esteem (Bankone and Ajagun 2014). In order to establish or create a commitment to a place, self-esteem, thus, must be improved. As more tourists visit a site, it will likely become a favorite neighborhood and enhance its self-esteem (Twigger-Ross and Uzzell 1996). Indeed, the rising tourism quality, as well as the commitment of visitors to a particular destination, will motivate them to visit the place more frequently and consequently make the local people more comfortable to live there. This will, in the end, grow a desire to develop the tourism (Fig. 6). In general, tourists and residents in the study area wanted to spend a significant time in the tourism area, and the five locations mostly get a high rating from the tourists and the residents.

Fig. 6 – **Desa Lingga traditional houses**
Source: *Ginting (May 2016)*

The research also indicated that the respondents were willing to contribute to the development of TTDs and the five locations mostly got a high rating from the tourists and the residents. They especially gave the highest rating for their commitments in Bukit Kubu, even though it is still well managed until now. However, they wanted the area to be well-developed in the future. It happens similarly to Desa Lingga although it does still need new management for the traditional houses from the government and the local residents as indicated by the following interview: "How do we improve the land of Karo? Throughout the study, seminars and so on, just on this year glance? At the land of Karo and tourism attraction in Desa Lingga, this will be a blow to us that we have to go back there to manage it?" (Main respondent: Academician / Cultural Leader). The increase of self-confidence that grows in the tourism sector has a positive impact on the quality of their lives (Yusof et al. 2012).

Conclusions

The pride attachment commitment is positive, but the evaluation aspect needs to be raised in quality. In the aspect of evaluation reviewed regarding the ease of finding public toilets is still lacking in Karo District, the capacity also is still insufficient and not strategic, so it needs additional public facilities in tourist locations. Nonetheless, in case of evaluation, tourism in Karo is considered poor since the tourists feel it difficult to find public facilities such as toilets or information centers; therefore, there is a need for an evaluation of the physical quality of the environment which should be improved to support the tourism development.

In the aspect of pride, local and foreign tourists feel very sad to see their TTDs uninteresting or destroyed but they are proud of the history and physical symbols available in the TTDs; therefore, they are committed to the development of tourism. In the aspect of attachment, in general, people in the TTDs felt that they were part of the place and they enjoyed and felt

happy when they were in the locations, but some tourists still considered themselves as strangers to the places. Attachment was found to Lingga village and not in the 4 TTDs, so it needs buildings with a unique character and local people with a high meaning; attachments for tourists are not too important as they are more important to the community and the local tourists are not too important to the outside tourists. In the aspect of commitment in general, tourists and residents wanted to spend a significant time in the tourism area while the five locations mostly get a high rating from the tourists and the residents.

As Basnezhin (2015) argued, the quality of facilities in the tourism attraction supports the creation of pride and of long-term relationships with the tourists which makes them willing to come back. The preservation of traditional buildings in Desa Lingga Village will avoid it from losing its character. We recommend further research on self-esteem in the other TTDs in Karo regency.

Moreover, the physical symbols of a typical character should be improved, because they can distinguish the place from other places, increasing the unique character. High pride is found in the special characters of social buildings. The evaluation is low but it can be improved while some are interesting. It turns out that because the place is unique, they are proud while the tourists are also proud and satisfied. Besides that, they have a commitment, even though they are physically improved; the local attachments are high and they feel a lack of attachment but they are committed. We recommend further research on attachment and evaluation on the commitment in the other TTDs in Karo regency.

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ROMANIAN URBAN AREAS: TERRITORIAL, ECONOMIC AND SOCIO-CULTURAL HALLMARKS OF THE CHINESE MINORITY

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Abstract: Since 1990s, many Chinese immigrants have come to Romania and they are numbering, nowadays, 2 017 people (83% of the total legal Chinese residents live in urban areas). The aim of this paper is to analyze the territorial, economic and socio-cultural hallmarks of the Chinese minority established in the Romanian urban areas. To meet this objective, both qualitative (interviews and observations) and quantitative (selecting, structuring and valorizing the statistical raw data) methods were used. This study is important due to its multi-territorial levels approach and to its results (e.g. revealing that the economic hallmark influences and shapes the territorial traces of the Chinese minority, identifying the Chinese children as being a sort of ”driving force” which would facilitate the social and linguistic integration of the Chinese minority into the Romanian society) which could support and suggest new topics for the geographical research.

Key Words: *Chinese minority, urban areas, Bucharest, Romania.*

Introduction

The links between the two main issues approached in this paper (the Romanian urban areas and the diverse hallmarks of the Chinese minority) are related with many topics and events. The downfall of the Communist regime in Central and Eastern Europe created the premises for closer and easier international links between the urban systems from this part of Europe and the other worldwide urban systems (Robertson 2000, McFarlane 2006, Săgeată, 2014a). The long process of forced industrialization linked with an unbalanced and unfounded general development process completed the historical and socio-economic backgrounds in which the Central and Eastern European urban systems were radically transformed (Holmén 1997). Cities polarized and oriented the various flows within the territory but their development could not compensate the industrial and demographic decline and nor the negative social consequences (Friedman 1994, Featherstone 2000). Industry, as the main factor of urbanization for almost all of Romania’s cities and towns, was overcome by the tertiary sector, a phenomenon specific to the large cities which strengthened their coordinating positions in the territory (Ianoş and Tălângă 1994, Ianoş 2004, Ianoş and Heller 2006).

Since the early 1990s, the political and economic systems have opened simultaneously, while the premises for a change in the ethnic structure of Romania was created (Ungureanu and Ianoş 1996). Perceived as a bridge to Western Europe, and as an outlet for Asian products (especially from China and the Near East), Romania has become a point of immigration and transit for Asian and African fluxes of population (Alexe and Păunescu 2011). The new ethnic minorities’ locations could be the result of increasing social segregation (Petsimeris 1998, Creţan and Turnock 2008) inside the urban space but also at the level of urban-rural linkages, which are dependent upon the capacity of the urban system to absorb the globalizing fluxes (Kaplan 1998, Ianoş et al. 2016). Like other worldwide cities, the large Romanian cities tend to assume the attributes of cosmopolitan cities due to ethnically diversity. Inside these large cities, the development of specialist services and the large-scale assimilation of global consumerist

goods, basically products and services which go beyond the so-called "geo-cultural spaces" (Cosgrove 1989, De Lotto 2008) were important trends (van Kempen and Özüekren 1998, Săgeată 2014b).

The international literature devoted to ethnic segregations in urban areas and to ethnic economies as a result of international migrations is rich. In particular, beginning with the last decade of the 20th century, the incidence of such studies increased and diversified: e.g. issues of ethnic economy (Kaplan and Li 2006) and the spatial structure of the urban ethnic economy (Kaplan 1998, Ianoş et al. 2016, Vesalon and Creţan, 2019), diversity in urban entrepreneurship (Baycan Levent et al. 2003), ethnic segregation of urban areas (Málovics et al. 2019, Mionel 2019) and the social integration of ethnical stigmatization groups (Creţan and Turnock 2008, Creţan and Powell 2018). Within this context, theoretical approaches about the Chinese diaspora (Li 1998, Pieke 2012, Chan and Koh 2018) and its territorial, economical (Huang 2012, Men 2012, Jacoby and Korkut 2016, Hui 2018, Vangeli 2018), geopolitical (Chun 2017, Pavlićević 2018) and socio-cultural (Zhao 2010, Huang 2011, Eyferth 2012, Yang and Ortmann 2018) hallmarks in the European adoptive cities are numerous.

Chinese minority in Romania. An overview

In 2019, Romania and the People's Republic of China celebrated 70th years since the establishment of their diplomatic relations. Given the context of bilateral trade agreements encouraged by both countries, the officials of Romania and China paid mutual visits beginning with 1950 (according to Chen 2010, in the first half of the 1980s, more than four thousand Chinese experts came to Romania). Since 1990, many Chinese immigrants would come to Romania, currently constituting the third largest group of migrants in this country (Ondreicsik 2012). The results of the 2002 Population and Housing Census (National Institute of Statistics) revealed the Chinese minority as being registered officially in Romania (2 249 persons). According to the latest official statistics (the 2011 Population and Housing Census, National Institute of Statistics), there are 2 017 Chinese who live in Romania, but their real number is by far greater, given that many of them are living here without legal forms. Wundrak (2010) quotes the Romanian Office for Immigration which advances the figure of 8 253 people – four times more than the official statistics. In February 2017, the Immigration General Inspectorate announced a total of 7 727 asylum-seekers from China (with 12% more than in 2015).

The Chinese minority, one of the recently established in Romania during the last three decades, has raised the interest of Romanian scientists (Păcurar 2004, Săgeată 2014c, Săgeată 2015, Săgeată 2017). Their studies complete the national scientific literature on historical minorities (e.g. Germans, Hungarians, Roma, etc.) with the approach on "new" minorities (e.g. Chinese, Arabs). Despite this trend, the academic research on the growing Chinese community is underdeveloped, focusing especially on economic aspects (Chen 2010, Wundrak 2010) and on the history of Chinese immigrants to Central European Countries and to Russia (Nyiri 2007).

This study attempts to enlarge the current body of literature by identifying and studying the territorial, economic and socio-cultural hallmarks of the Chinese minority in the Romanian urban areas. Namely, the aims of this paper are: (i) to estimate how the Romanian urban economies were influenced by the Chinese investments; (ii) to show in which ways the local urban landscape and the everyday urban life were changed by the presence of the Chinese persons and their activities; and (iii) to reveal a particular hallmark emerged from the relationships between the Chinese children and their Romanian nannies. To meet these targets, the paper firstly analyzes the Chinese minority established in the entire Romanian urban environment after 1990 (national level) and in Ilfov County and the city of Bucharest (county level), in terms of quantitative (the number of Chinese people, the size of their economic activities) and qualitative aspects (the structure of Chinese active persons by

economic activities, the territorial concentration of Chinese persons and of some economic indicators). Secondly, as long as no direct contact with the members of the Chinese minority has been established (mainly because of the linguistic barrier), the evidences in terms of socio-cultural and economic hallmarks are approached as they appear from the field research done within some parts of Bucharest (local level, in Sector 2) and from the official data-base provided by different national and local institutions. Thirdly, a special hallmark is studied, namely, the one resulted from the interaction between the Chinese children and their Romanian nannies inhabiting several streets of Tei neighborhood (Sector 2, Bucharest). This study concentrates on a specific research question: Does the Chinese minority setting within Romanian cities and towns contribute to hallmarking certain urban areas/landscapes in terms of specific territorial, economic and socio-cultural aspects?

Methodology

In order to meet the research objectives of this study, both qualitative and quantitative methods were used. The interviews and field observations as tools of qualitative research were used to explore the Chinese minority in Bucharest and its socio-cultural and territorial traces within the Romanian society. Statistical raw data were selected (from a national data-base published by the National Institute of Statistics and by different other institutions – the National Trade Register Office), structured (by different criteria, e.g. ethnicity, gender, specific economic activities, etc.) and used to construct tables with processed data, further valorised through graphs and maps (Fig. 1).

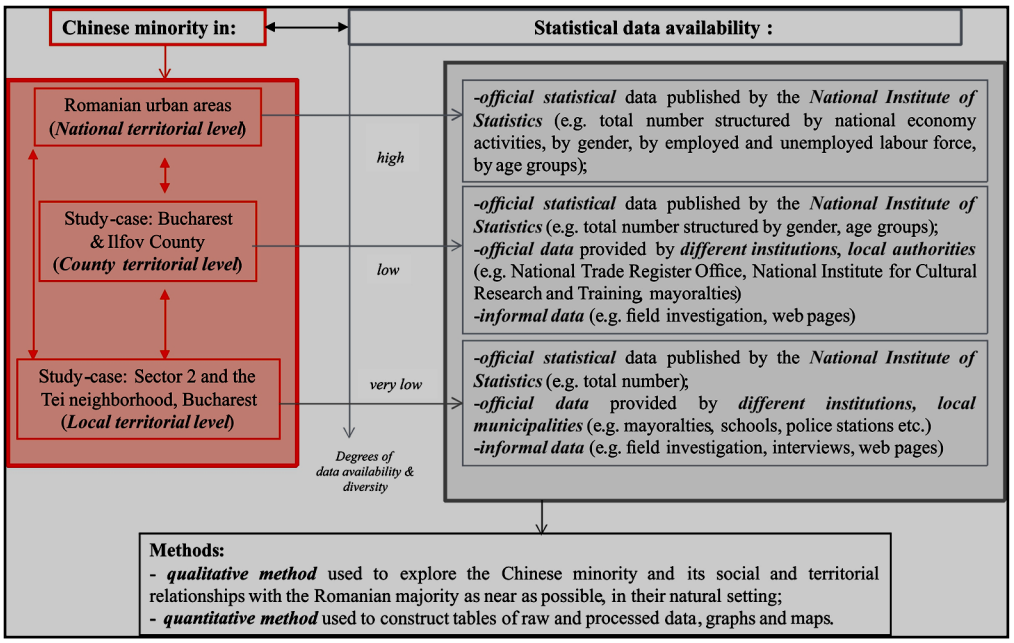


Fig. 1 **– Sources of data and methods used for a multi-level territorial approach on the Chinese minority in Romania**
Source: *authors' design*

Except for the official results of the 2002 and 2011 Population and Housing Censuses, there are few official statistical data on the Chinese population in Romania, and especially data-bases structured by urban and rural areas are missing. At national level, the data-base is structured into quantitative and qualitative data (e.g. by national economic activities, by gender, by the employed and the unemployed labour force, by age groups). Despite this relative diversity of statiscal data, the separate data-base on urban and rural areas presents some deficiences in terms of gender and age groups. As the territorial analysis is getting closer to the local level, the data-base is poorer. Completing these gaps, other data sources were used and valorised in this paper (e.g. the results of field investigations and interviews; other local official public documents).

The interviews were conducted in 2017 and 2018 with several local official actors of Sector 2 (Bucharest) involved in managing the issues emerged from the establishment of the new minorities in this urban area (e.g. representatives of Sector 2 Mayoralty and of local police stations, teachers and principals from kindergartens, schools and high schools, a general practitioner).

Also, some local public documents (Mayoralty of Sector 2 2017), specialized studies (Institutul Național pentru Cercetare și Formare Culturală 2015) and a project webpage (Asociaţia Mişcarea pentru Acţiune şi Iniţiativă Europeană 2015) were analyzed for extracting, interpreting and valorizing the information related to the Chinese minority in Bucharest. In view of the missing data, these informal data sources were very useful for investigating, and especially for revealing, the local socio-cultural traces of the Chinese minority.

The observation method involves systematic and long-term recording of observable interactions and/or behavior in a "natural" setting (Gorman and Clayton 2004), its main strength being that it provides direct access to the social phenomena under consideration (Salmon 2015). The unstructured observation, able to monitor all the aspects of the phenomenon that seems relevant to the problem at question (Crowther and Lancaster 2014), was used to study the interactions between the Chinese minority (e.g. Chinese children) and the Romanian majority (e.g. the nannies), but also the hallmarks between these two parts. In respect of this tool of qualitative research, the researcher's specific posture is very important. In this study, researchers had different roles during the observation: non-participation, complete observer and observer-as-participant (typology according to Adler and Adler 1994, Gorman and Clayton 2004, Baker 2006, Spradley 2016). During and after the field observation stage, another research stage consisted in writing down the field notes. In adapting and reinterpreting the sketch of field notes (Mulhall 1998, Mulhall 2003), those used for this paper tackle several aspects such as: structural and organizational features (e.g. the urban/neighborhood tissue, the street landscape), notes on the locals (e.g. ethnical groups, general behavior, inter-personal and territorial interactions, connections between the community and the local authorities), daily activities (general and ordinary population flows within the urban/neighborhood area). The field observation and interviews as tools for applying qualitative research methods are associated to some issues of ethics. Carrying out the present study has ensured the informed consent of the respondents, who were to be correctly informed on the purpose of research – the participants were informed about the use of collected data and on their privacy protection.

Results and Discussion

The Chinese – territorial and economic traces in the Romania's urban areas

The Chinese, as a new urban minority in Romania, are approached in terms of number, territorial distribution and economic features. The Chinese minority was attracted by the urban areas: in 2002, the great majority (99%) of the legal Chinese residents was territorially concentrated in cities and towns. According to the latest official statistical data on the Chinese

population in Romania (the 2011 Population and Housing Census), a total numer of 86 local administrative units (LAU) recorded legal Chinese residents, of which 64 LAU were urban areas (Fig. 2), cummulating 1 668 Chinese people (83% of the total legal Chinese residents), meaning that the Chinese minority is one of the most urban minorities in Romania (Schreiber et al. 2017). According to the latest official statistical data, other urban nuclei of Chinese minority in Romania are located in: Ilfov County towns (Voluntari: 359 legal Chinese residents, Pantelimon: 11 Chinese persons); Deva, Hunedoara County (27 Chinese); Arad, Arad County (21 Chinese); Timișoara, Timiş County (16 people); and in Brașov, Braşov County (14 Chinese legal residents).

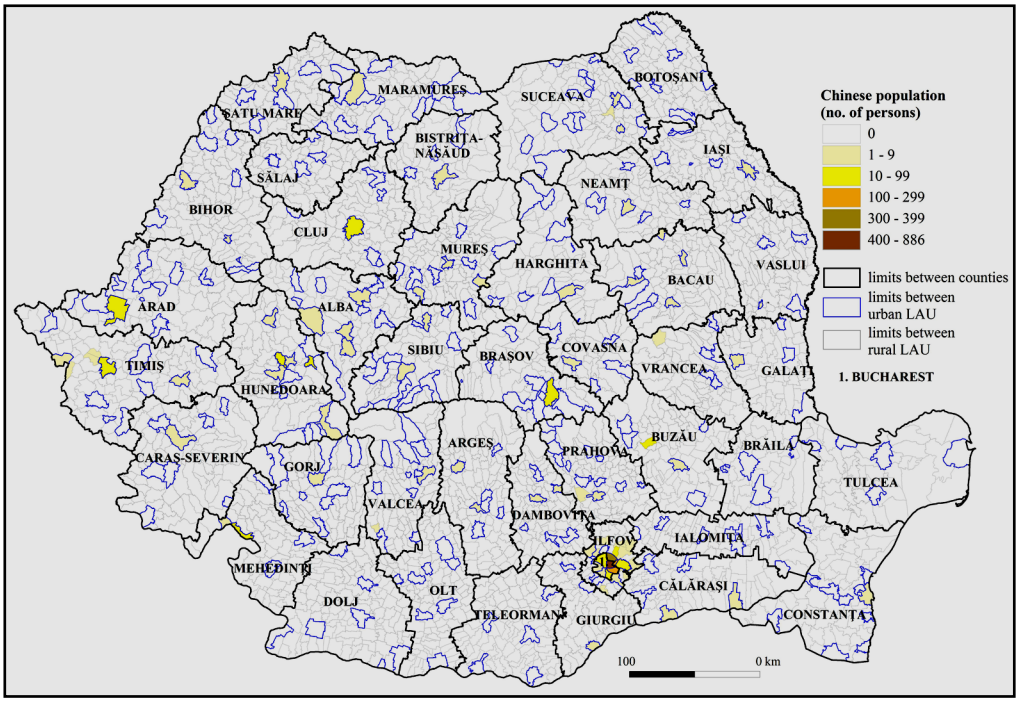


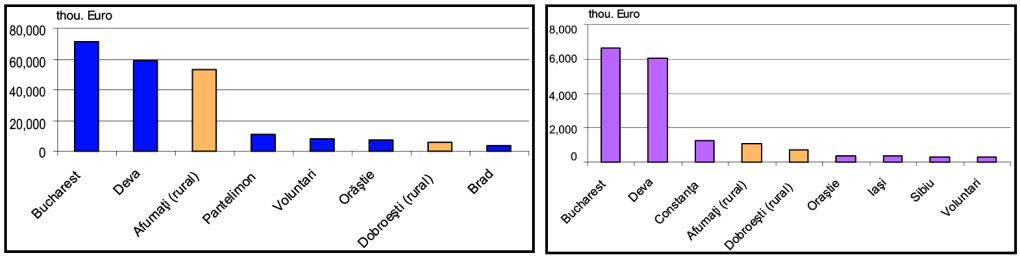
Fig. 2 **– The Chinese minority in the Romanian urban and rural local administrative units (LAU)**

Source: *2011 Population and Housing Census; data processed and mapped by the authors*

The economic hallmarks of Chinese investments in Romania are well-known and very often revealed and positively presented by the mass-media and the politicians. The good general opinion related to the investments with Chinese involvement (e.g. they are very large, with a significant positive impact on the national and regional economies) is more the result of the media, the politicians' and the officials' attention (Drahokoupil et al. 2017). Still, Romania, together with Bulgaria, has been relatively marginal to the overall investment flows from China (McCaleb and Szunomár 2017). The deficit between Romania and China trade relationships remains a huge one: in 2011, Romanian imports amounted to some 2.5 billion Euro, six times more than the exports to China (390 million Euro). Since 2010, the commercial exchanges (both in terms of export and import flows) between Romania and China registered an upward trend, determining a total trade increase (which amounted to nearly USD 4.5 billion by the end

of 2015, becoming over 19% larger than in 2010) (Pencea and Oehler-Şincai 2014, Pencea 2017). According to Drahokoupil et al. (2017), because of shifting to Poland, the Czech Republic, Hungary and to some other EU member-states in the South of Europe (e.g. Portugal, Casaburi 2017), the share of Chinese investors in Romania has declined after 2005. Thus, in 2015 (according to the Chinese statistics quoted by McCaleb and Szunomár, 2017), Romania received USD 161.09 million of Chinese foreign direct investments (representing 0.83% of the total FDI). Some of the high-profile Chinese investments in Romania are: Huawei, ZTE Corp., Shantuo Agricultural Machinery Equipment, China Tobacco International Europe Company SRL, DHS (motorcycles), China Shipping, COSCO, Yuncheng Plate-Making (McCaleb and Szunomár 2017). The number of firms with Chinese capital in Romania is around 10 000 – McCaleb and Szunomár (2017) note that this value represents almost 5.6% of the total number of commercial companies with foreign capital (the highest in the region), but most of them are small firms operating in the services or retail sectors.

According to the National Trade Register Office (ECONOMICA.net 2017), in 2016, the first 20 largest companies owned by Chinese in Romania registered a total turnover of nearly 214 million Euro (99.2% of the total was declared by the urban Chinese companies) and a total net income of about 6.4 million Euro (of which 89.3% was produced by urban companies). These first 20 largest companies owned by the Chinese in Romania activate in the tertiary sector. In terms of turnover, these Chinese firms were located especially within cities, Bucharest and Deva (Hunedoara County) occupying the first places in the turnover hierarchy (the two cities cumulated almost 60% of the total turnover declared by the top 20 Chinese companies and also 61% of the total turnover declared by the urban Chinese firms located in Romania). In terms of net incomes, the same territorial concentration is observable: Bucharest and Deva – 75% of top 20 Chinese companies of Romania, while almost 84% of top 20 Chinese firms from urban areas are active (Fig. 3 A. and B.).



A. **B.**

Fig. 3 **– The Top 20 largest companies owned by the Chinese in Romania (territorial distribution): turnover (A.) and net income (B.) in 2016**
Source: *National Trade Register Office (ECONOMICA.net 2017); data processed by the authors*

In the Top 20, the largest Chinese companies have firms located in towns (Pantelimon and Voluntari, in Ilfov County, appear in the Top 20 by turnover), but also in two rural settlements (Afumaţi and Dobroeşti, in Ilfov County – the Top 20 by net income), located near Bucharest. In terms of turnover, except for Bucharest (occupying the first place in Top 20 largest Chinese companies in Romania), this hierarchy is dominated by Chinese firms located in some medium towns (Deva, Hunedoara County) and small towns (Pantelimon and Voluntari, in Ilfov County; Orăştie and Brad, in Hunedoara County). One rural settlement is present in this Top 20, namely Dobroeşti (Ilfov County) registering two Chinese firms. On the contrary, in the Top 20 by the net income, there are present Chinese firms located in large Romanian cities, such as Constanţa, Iaşi and Sibiu.

In terms of socio-economic features, in Romanian cities and towns, a total of 1 263 Chinese

are employed while 1 064 persons (84.2% out of all) are occupied in wholesale and retail trade. Only 4.75% (85 persons) of all the Chinese employed in Romania are engaged in manufacturing and 4.2% (53 persons) in accommodation and food services. Construction, transport and storage, information and communication and real estate activities register almost 1% out of all the Chinese employed in the Romanian urban economies. In terms of the urban employment gender structure, the Chinese employed personnel (1 263 persons) is unequally divided by gender, being dominated by males: 63.8% of all the employed Chinese, 62.9% of all the Chinese employees and 65.9% of all the Chinese employers.

The effects of these Chinese investments on occupancy are not so easy to explore because of the shortcoming of statistical data. Unfortunately, the initial numbers of jobs provided in the business plans were not totally accomplished. For example, the Hoyo Chinese Company, located in Râşnov (Braşov County), with the purpose to be the main producer of agricultural machinery in Eastern Europe (an initial investment of 20 million USD, creating 500 new jobs), went bankrupt in 2017: the declared 500 jobs never existed and during the "economic boom" of Hoyo Râşnov (in 2010), only 45 new jobs were created (BizBraşov 2018). Several local and central newspapers offer examples of Chinese companies' insolvency and bankruptcy, but some positive situations are mentioned too: e.g. Huawei Romania registers 1 500 employees, recording an increase of 5% of employees in all divisions (Ziarul Financiar 2017); Eurosport DHS Deva employed 400 persons recruited from Deva, Petroşani, Petrila, Hunedoara, Boşorod and Călan, all in Hunedoara County (Ziarul Financiar 2018).

The Chinese in Bucharest and Ilfov County – hallmarks at regional level

The Chinese community in Romania, established in the 1990s, settled mostly in Bucharest: 2 038 persons in 2002 and 1 032 persons in 2011. The decreasing value number is a proof of the changes registered by this minority trends in territorial preferences, implicitly linked to the economic interests. Comparing the situation of 2002 to that of 2011, Bucharest remains the main urban area of territorial concentration for the Chinese, both in number of people and economic activities, but it is not anymore the single favorite city of the Chinese minority in Romania. At the beginning of 2000s, 90.8% of all Chinese persons were living in Bucharest (concentrating 91.4% of the urban Chinese dwellers); after ten years (in 2011), only 51% of the Chinese who officially live in Romania were staying in Bucharest. An important part of the other Chinese people had chosen Ilfov County as their interest area in terms of dwelling and economic activities: in 2002, there were only 10 Chinese persons in this county (5 people in Buftea and 5 other people in the rural settlements of Afumaţi, Cernica, Dobroeşti and Dascălu), but, in 2011, their number increased up to 681 persons. So that, there is an important concentration of Chinese people near Bucharest, especially in Dobroeşti, a rural settlement, where 210 Chinese are registered (2.25% of the total local population). This was the highest share of Chinese persons per total local population registered by a local territorial administrative unit in Romania (Săgeată 2017) (Fig. 4).

According to the latest Census (2011), Ilfov County and Bucharest account for 85% of all Chinese people who officially live in Romania. The unofficial data-sources (Wundrak 2010, Toader 2011) advance a three-time bigger figure: in 2010, Wundrak (2010) estimates about 3 900 Chinese people in Bucharest, while Toader (2011), in his study on the former Chinese workers who had applied for asylum in Romania, advances such figures as 1 540 Chinese merchants and 1 088 Chinese people looking for a job in Bucharest. According to the Ilfov County Statistics Office (2011), most Chinese residents are located in the town of Voluntari (359 persons) and in two rural settlements (Dobroeşti – 210 persons and Ştefăneştii de Jos – 72 persons) (Săgeată 2017).

The hallmarks, in terms of time and space, of the Chinese migrant group settling in Bucharest and in Ilfov County and the reasons for the present territorial concentration of this minority are

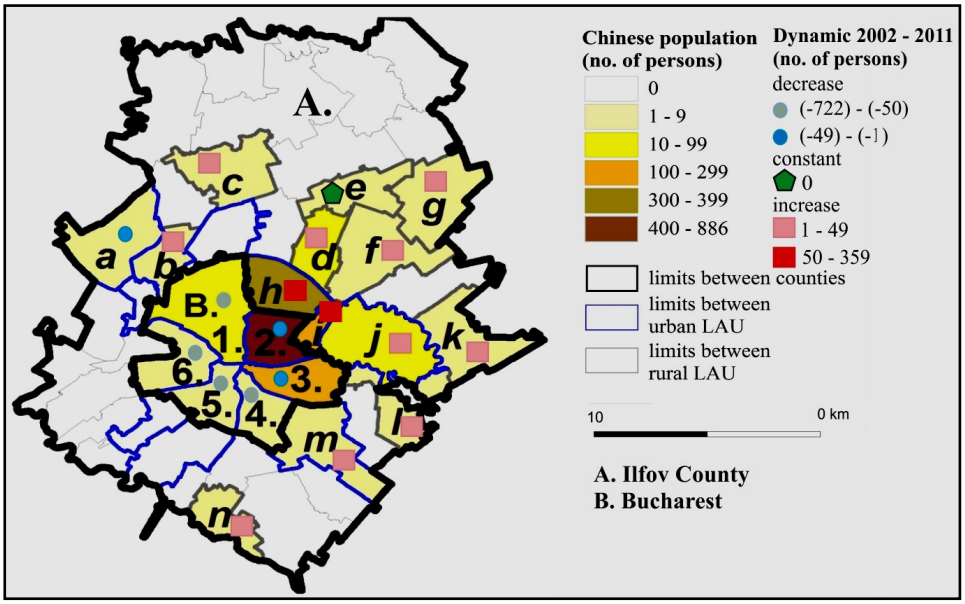


Fig. 4 **– The Chinese minority in Bucharest and in Ilfov County (territorial distribution and temporal dynamics)**
*(Legend: **a** = Buftea, **b** = Mogoşoaia, **c** = Baloteşti, **d** = Ştefăneştii de Jos, **e** = Dascălu, **f** = Afumaţi, **g** = Petrăchioaia, **h** = Voluntari, **i** = Dobroeşti, **j** = Pantelimon, **k** = Brăneşti, **l** = Cernica, **m** = Popeşti Leordeni, **n** = 1 Decembrie; **1.** = Sector 1, **2.** = Sector 2, **3.** = Sector 3, **4.** = Sector 4, **5.** = Sector 5, **6.** = Sector 6)*
Source: *2011 Population and Housing Census; data processed and mapped by the authors*

synthetically presented in Fig. 5. The authors outline the time-periods of relatively stable characteristics, considering the main occupation (i.e. trade) of Chinese immigrants in Romania since the 1990s, as the outstanding factor and socio-economic hallmark in determining their level of education, economic interests and territorial preferences.

The driving-force behind the Chinese settling in Romania was and still is of an economic nature. In the early 1990s, the first Chinese immigrants, who were merchants, settled in Bucharest – the largest market within the country. Since then, despite the fact that the flows of Chinese merchants have not been numerically constant, yet they have always been present in Bucharest. The initial location of the Chinese merchants, inside (Colentina and Tei neighborhoods) and outside (Dobroeşti rural settlement and Pantelimon town, both in Ilfov County) Bucharest, shaped the new flows' choices. Not all Chinese merchants who came to Romania in the 1990s were successful, as in many cases they had to liquidate their firm and to go back to China (Băncilă 2010). But, generally speaking, for the small Chinese merchants who stayed in Romania, business went well and very well. During their stay in Romania, they rented apartments (some even bought them) and founded families.
The Europa trade centre in Bucharest represents the place where the Chinese have established a very profitable business (Wundrak 2007, Chen 2010). During the last decades, Europa was the first place where the Chinese merchants offered their wholesale goods to the Romanian consumers. The second one was the Red Dragon (Fig. 6), opened in 2002, at a distance of about 10 kilometers from the city centre of Bucharest, being located in Dobroeşti, Ilfov County. The Red Dragon, a simple market-seeking investment (Drahokoupil et al. 2017),

became one of the most important trading complexes for Chinese goods in Romania, the products being distributed not only throughout the country, but also in the neighboring states – Serbia, Bulgaria and the Republic of Moldova (Wundrak 2010, Ondreicsik 2012).

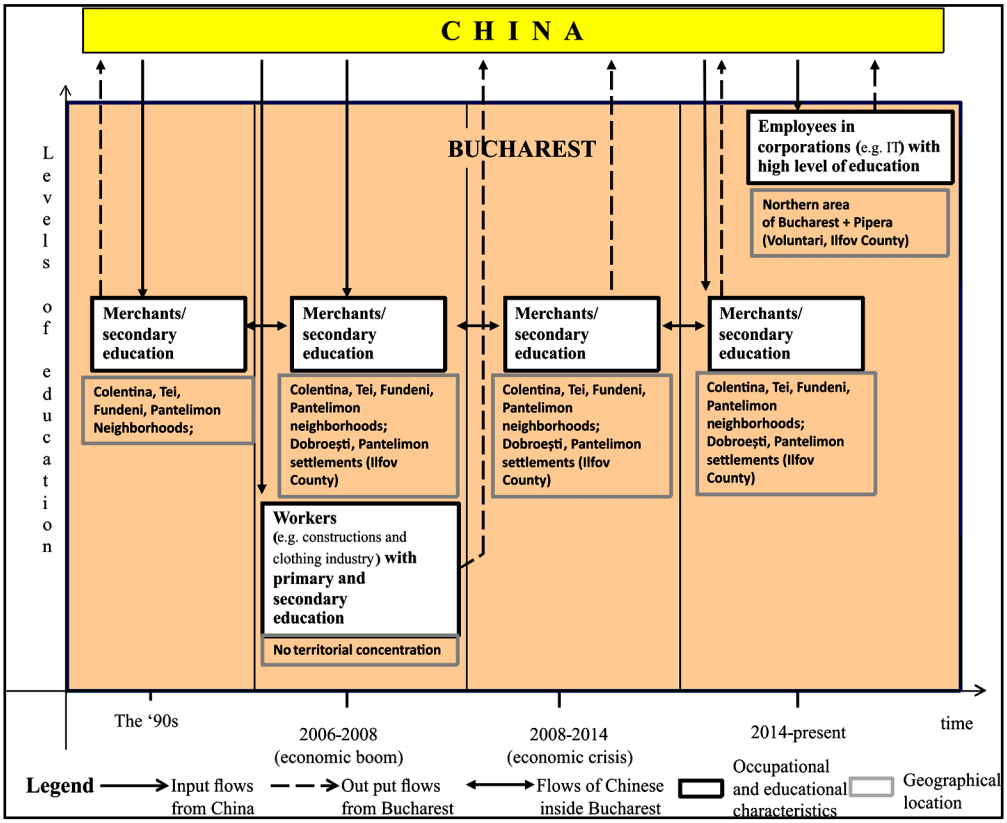


Fig. 5 **– Chinese occupational groups and their general educational level (temporal and territorial dynamics in Bucharest and in Ilfov County)**
Source: *authors' design*

Fig. 6 **– The Red Dragon commercial complex – territorial, economic and cultural hallmarks of the Chinese minority in Ilfov County**
Source: *www.dragonulrosu.ro; Săgeată (2017)*

During the economic boom, new flows of Chinese immigrants joined the flow of merchants (e.g. workers in various fields, mainly in constructions and in the garment industry), settling in Bucharest and in other Romanian cities and towns and rural locations. These workers represented a cheaper labour force than the local one and a way to meet the demand for it, given the massive emigration of Romanians abroad. The workers came in compact groups from China under labour contracts with Romanian companies or with European ones operating in Romania. After the economic boom ended, the majority of female workers in the garment industry left Romania, either because their contracts had finished or the employing firms ceased/suspended their production. Also, the rising salaries in China, the language barriers, the Chinese producers' preference for US customers (who choose simpler models and a bigger production volume than the Europeans do) were other reasons for leaving Romania. Within this context, the merchants become again the most important category of Chinese immigrants established in Bucharest and in its neighboring area (Ilfov County), but also in others parts of Romania.

Starting with 2013-2014, a new flow of Chinese workforce arrived in Romania: those employed by corporations, especially in IT and telecommunications. The Chinese corporatists came to Bucharest on a contract-base concluded with the multinational companies (Asociaţia Mişcarea pentru Acţiune şi Iniţiativă Europeană 2015). These companies are mostly located in the north of the city. Generally, since they are not well integrated into Bucharest's urban life, their daily life is going on especially in the northern area of the city, living in apartments rent by the corporations, working within the companies which rent those apartments, going shopping and spending leisure time somehow confined to the north of Bucharest, the so-called "Pipera area" in the neighbouring town of Voluntari, Ilfov County. Usually, after their employment contracts come to an end, they go to another European or Asian country.

Economically, Bucharest and Ilfov County concentrated important shares of the top 20 largest companies owned by the Chinese in Romania. In terms of turnover, Bucharest (4 Chinese firms) concentrated almost 48% of the turnover declared by the Chinese firms located in Bucharest and Ilfov County; Sector 3 of Bucharest (a single Chinese firm) concentrated 48%. Near Bucharest, in Afumaţi rural settlement, in 2016, the 6 Chinese companies registered 36% of the total turnover declared by the Chinese firms located in Bucharest and Ilfov County. Other territorial concentrations of Chinese firms designated by their turnover were located in Pantelimon (1 Chinese firm, 7% of the total turnover), Voluntari (3 Chinese firms, 5% of the total turnover) and Dobroeşti (2 Chinese firms, 4% of the total turnover). Generally, these Chinese companies discharge such activities as the repair of computers and communication equipment and wholesale trade, except of motor vehicles and motorcycles (Fig. 7).

Within the Top 20 Chinese firms in Romania by their net income in 2016, a total of 12 companies are located in Bucharest and in Ilfov County. A number of 3 Chinese firms located in Bucharest Sector 3, with economic activities in wholesale trade and electricity, gas, steam and air conditioning supply, cumulated 62% of the total net income registered by the Chinese companies located in Bucharest and Ilfov County.

The Chinese minority in Sector 2, Bucharest – territorial, economic and socio-cultural hallmarks at local level

From the administrative and statistical viewpoints, Bucharest is divided into six sectors. The Chinese are concentrated in Sector 2 (located in the north-eastern part of the city), where 886 Chinese persons (85% of all those who live in the Capital city) were registered. The National Institute for Cultural Research and Training (Institutul Național pentru Cercetare și Formare Culturală 2015) made a study on multiculturalism devoted to ethnical minority groups, based on the inhabitants' participation in cultural events. In terms of the locals' cultural involvement

(Mayoralty of Sector 2 2017), Sector 2 ranks the first (2.4% of the inhabitants participated in different cultural events), compared with Sectors 5 and 3 (e.g. 1.1%).

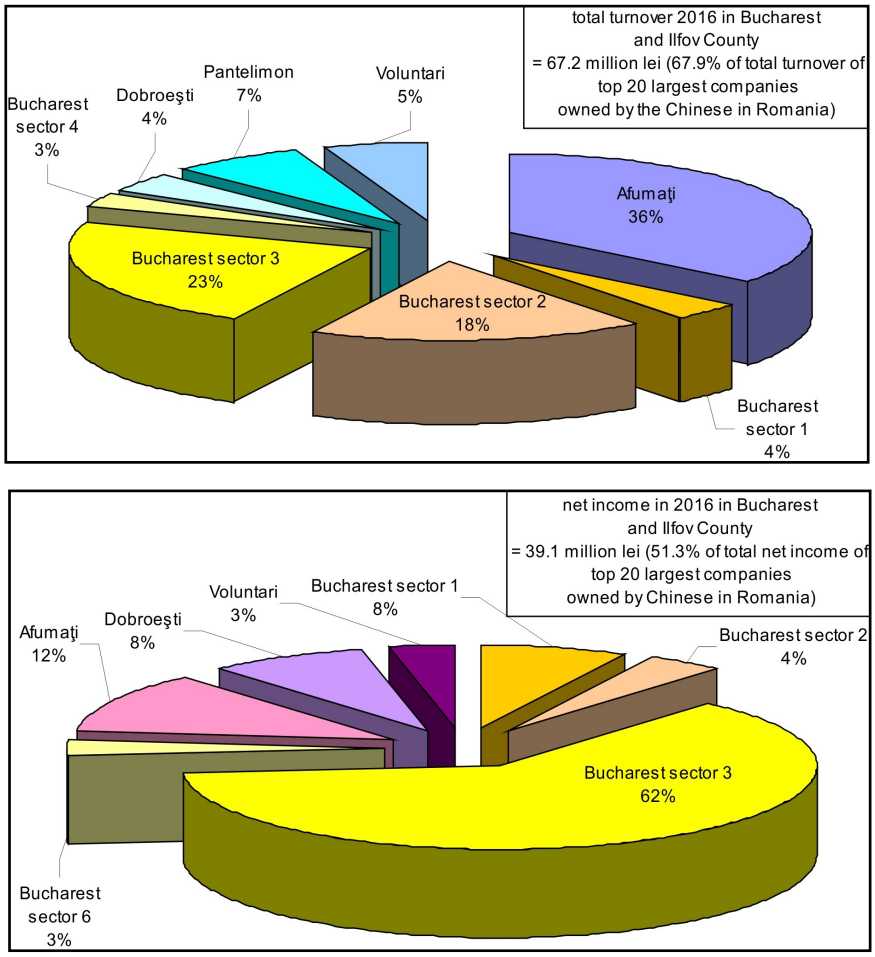


Fig. 7 **– Turnover and net income in 2016 – territorial distribution in Bucharest and in Ilfov County**

Source: *National Trade Register Office (ECONOMICA.net 2017); data processed by the authors*

Monitoring the public information data-base of Sector 2 Mayoralty during the field investigation, some concrete actions were identified targeting the Chinese minority, which might be assimilated as some socio-cultural and institutional hallmarks: (i) the first Chinese language teaching school in Bucharest is functioning within the "Pantelimon" Complex for Recreational Activities and Education; (ii) the educational offer of School No. 46 includes Chinese language courses for the Romanian pupils in the gymnasium cycle; (iii) since 2013, on the initiative of the Bucharest "Confucius" Institute, the Economic College "A. D. Xenopol", introduced the Chinese language as a study-discipline for 120 pupils (Fig. 8); (iv) the Bucharest Police Department had the initiative to employ Chinese persons at the police stations in three Sector 2 departments (public order patrol/prevention, economic police, thefts and robberies). These

field notes indicate that the local authorities and the public institutions of Sector 2 are aware of the importance of creating and maintaining social relations with and for the Chinese ethnical minority. Also, the Chinese part manages at least two organizations which support cultural and economic activities and initiatives in Bucharest (as well as in Romania): The Romanian Chinese House (the Friendship Association, located in Sector 2) and The Confucius Institute of the University of Bucharest (located in Sector 1, Bucharest), as part of Hanban – the headquarters of the Confucius institutes over the world.

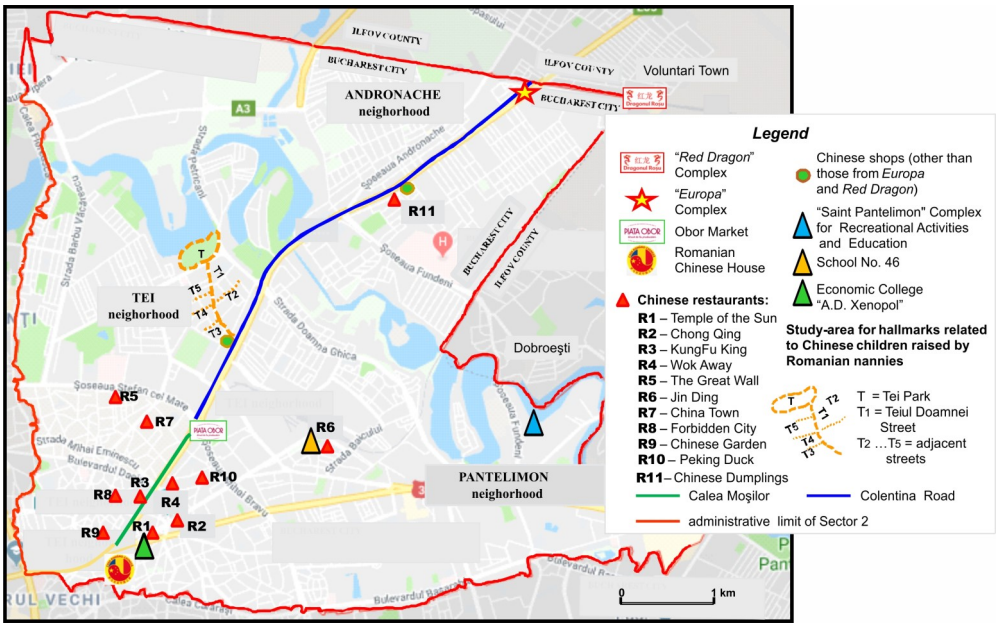


Fig. 8 **– The Chinese minority in Bucharest – territorial, economic and socio-cultural hallmarks mapped within Sector 2**
Source: *authors' content on Google Maps*

The field research and notes offer the possibility to sketch and analyze three types of hallmarks related to the social and cultural urban life of the Chinese minority in Bucharest, to the urban territory and to some aspects of the urban local economy (Fig. 9).
The locations of Europa commercial centre in Sector 2 and of the Red Dragon in the neighbourhood rural settlement of Dobroeşti (Ilfov County) represent the territorial hallmarks of the Chinese group in this part of the Capital City. Those two "signs" in the urban and rural tissue have influences on the everyday life of both the Chinese minority and the Romanian majority. The Red Dragon represents a vast commercial complex, formed of 10 "pavilions" hosting 5 500 shops in a 500 000 m^2 built-area. The Chinese residents make daily journeys to Europa and the Red Dragon for their own business while many Romanians frequently shop in these two trade centres as this area benefits from good public and private transportation (a tramway line and three bus lines continued with other five minibus routes).

The Chinese shops in the streets and boulevards of Sector 2 are not very numerous because they are territorially concentrated in Europa and Red Dragon commercial centres. However, several Chinese shops are mapped on the Colentina Boulevard – one of them (25B Colentina

Boulevard), showing visible signs of deterioration (a pagoda ornamental roof almost completely destroyed), commercialises Chinese traditional objects (decorative vases, Chinese fans, jewellery, etc.).

The presence of Chinese restaurants in Sector 2 constitutes another territorial hallmark which changes the ordinary street landscape, conferring to it a locally Asian "reach". This Asian "air" is not necessarily in accordance with the urban landscape of the old city of Bucharest, or with the place that some historical buildings should occupy in the cultural, historical and architectural patrimony of Bucharest (e.g. one of the Chinese restaurants, located in Mihai Eminescu Street, operates in the house where the concert piano player Cella Delavrancea lived).

The hallmarks related to the local urban economy are deeply interlinked with the presence of Europa and Red Dragon commercial centres. Europa represents an urban landmark of consumption (Asociaţia Mişcarea pentru Acţiune şi Iniţiativă Europeană 2015), this statement being true also for the Red Dragon commercial centre. As already mentioned, the Red Dragon is not located in Sector 2, but nearly its administrative limit, impressing strong traces in the economic life of the Chinese minority and also of the Romanian locals in the Sector 2 of Bucharest. Unfortunately, the economic activities unfolded by the Chinese businessmen within Europa and Red Dragon commercial centres have as hallmak the fraudulent transactions in the supply of goods and merchandise without adequate documents – e.g. the most recent event (on March, 11, 2019), under the "Integrum" operation, unfolded by the National Agency for Fiscal Administration, referred to a total of 105 inspectors from the General Anti-Fraud Directorate who sealed 1 038 storage goods facilities in the Red Dragon centre (Mediafax 2019).

Other economic hallmarks are linked with the Chinese companies which activate in Sector 2. A Chinese company (engaged in the repair and maintenance of all types of computers and peripheral equipments) concentrates 37.4% of the total turnover declared by the Chinese companies located in Bucharest and a single Chinese firm, activating in the wholesale trade and electricity, cumulates only 5.2% of the total net income registered by the Chinese companies located in Bucharest.

In the three supermarkets located along the Colentina Boulevard (two Carrefour and one Kaufland), the Chinese people use to shop frequently (weekly and even daily) and in large quantities, buying all kinds of products, but especially several products traditionally associated to the Chinese type of consumption (e.g. rice, sesame oil, vegetables such as Chinese cabbage, kohlrabi, different kinds of meat, Chinese spices). Despite the fact that the representatives of these supermarkets declared that there is no special supply for meeting the particular Chinese demands, this commercial behavior was highlighted during a long-time observation period in these three supermarkets.

The hallmarks related to the social and cultural urban life are reflected by the presence of the Chinese people on the streets, in parks, in some kindergartens and in some healthcare units. In their everyday life, the Chinese interact with the locals: their economically active life takes place in Europa and the Red Dragon, where the main customers are Romanians. Regarding their family life, the adults live with other Chinese families, their own children being raised by Romanian nannies within Romanian families.

Particular hallmarks emerged from a special relationship between the Chinese children and their Romanian nannies – a showcase from Tei neighborhood (Sector 2, Bucharest)

The field investigation within the study-area (e.g. Teiul Doamnei Street and the adjacent

streets, Tei neighborhood) offered the opportunity to reveal some special territorial, economic and socio-cultural hallmarks related to the Chinese children and their very earlier years of childhood within the Romanian families. The concrete situation of Chinese families, with both parents fully engaged in trade activities, represents a constraint for the pursuit of everyday life (Eyles 1989) and it implies the identification of a solution for their own children's raising and early education. The Chinese parents' socio-economic statute (e.g. fully engaged in commercial activities, their income allowing paying a permanent nanny for their child) and cultural behaviour let them choose a Romanian nanny for raising their own children: the Romanian nanny is full-time involved in the Chinese child-care, meaning day and night, seven days per week and almost twelve months per year (only a few leisure days, during the Chinese celebrations, family events and journeys to China). Given the permanent and diverse interactions between the Chinese children and their Romanian nannies, the hallmarks identified are deeply traced in the urban everyday life of the Chinese children, the respective nanny and her family, and, not least, of the Chinese parents. These everyday life evidences are approached in terms of territorial, economic and socio-cultural characteristics.

The territorial traces of Chinese children involve daily routes to the kindergartens (there are three in the study-area, each of them registering Chinese children in all age-cycles), frequent walkings in the neighbouring parks and occasionally travels to different neighbourhoods of Bucharest or to other rural or urban settlements in Romania. The hallmark in terms of economic aspects is materialised by the additional income at the nanny's family budget. As a result of the relationship between the Chinese children and their Romanian nannies, some socio-cultural hallmarks have been also identified. Within the everyday local urban life and in the nanny's family and household, the Chinese child has the occasion to socialise, to develop various interpersonal relations with other Romanian children (e.g. in the kindergarten, parks and on the neighborhood's streets) and adults (e.g. in the general practitioner's consulting room and in the kindergarten). The cultural traces involved by the Chinese childcare come especially from the nannies: evidently, the Romanian nannies do not speak Chinese, so the games, songs and poetry for children are learned in Romanian, while the Chinese children are developing skills to communicate into Romanian. Thus, they make this language more familiar to their Chinese parents, who, generally, have communication problems in the Romanian language. Also, several socio-cultural hallmarks are related to food/nutrition (generally, these Chinese children have Romanian meals, and only occasionally Chinese food, during the visits to their parents' home), education (within the Romanian public education system), health-care (within the Romanian public health-care system), and with playing and spending the leisure time within the Romanian neighbourhood.

Conclusions

Based on the present stage of knowledge related to the various hallmarks linked to the presence of the Chinese minority within Romanian urban areas, the research conclusions can approach different aspects. So that, the national level information shows that the official number of the Chinese population in Romania decreased by 10.3% between the 2002 and the 2011 censuses. This trend was accompanied by a change in terms of territorial preferences, related to economic interests. The analyses at county and local levels reveal that the location of two large trade centres (Europa and Red Dragon) on the northeastern outskirts of Bucharest induces major spatial reconfigurations of the Chinese group. In other words, the economic hallmark influences and shapes the territorial traces of the Chinese minority, and implicitly several other socio-cultural signs in the everyday urban life. The territorial and economic hallmarks in the study-area have emerged from the approach of socio-cultural traces. The Chinese parents' everyday life strategy to solve the complex and important issue of raising and educating a child consists in hiring (without legal forms) a Romanian nanny. Thus, the various deep-going relationships established between the Chinese children and their Romanian

nannies reveal the mutual cultural influences and also, their interlinked reflections in the urban tissue, in the street landscape and in the everyday urban life. So, this territorial level of analysis reveals unexpected and interesting hallmarks imprinted on places and locals, somehow or other, linked to the Chinese minority in Bucharest.

The Chinese represent a closed community in Romania, only their everyday ecommercial activities, administrative and basic services (e.g. healthcare, education) being opened towards the Romanian majority; their personal relationshisps are running predominantly within their own ethnical group. A distinctive place within these relationships is that established between the Chinese children and the Romanian nannies committed to their growth and education. In this way, some connections are established between the Chinese and the Romanians in which the Chinese children represent a sort of driving force which would make the integration of the Chinese minority into the Romanian majority easier if the intention and interest for it would exist.

Approaching the issues of territorial, economic and socio-cultural hallmarks related to the Chinese people's presence in certain places of Romania suggests several other future potential research topics in various geographical branches (e.g. urban and rural, economic and demographic issues). Also, the issues emerged from the study of social and cultural hallmarks deserve a special interest from the researchers activating in the fields of social and cultural geography.

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NONPARAMETRIC CORRELOGRAM TO IDENTIFY THE GEOGRAPHIC DISTANCE OF SPATIAL DEPENDENCE ON LAND PRICES

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Abstract: The spatial autocorrelation measurement of land prices uses a covariance function to describe the spatial dependence and it can be identified as a geographic distance on the correlogram. The geographic distance of spatial dependence can state that land prices are interdependent to each other and scattered in the research area. Therefore, the purpose of this research is to define the geographic distance of spatial dependence on land prices using a nonparametric correlogram. A nonparametric approach to covariance functions using the composition of Bessel and Gaussian-type functions are adopted because they correspond to the positive definite characteristics. The cubic spline interpolation is used to refine the curve fitting, while the intersection between the nonparametric correlogram value C(h) against the horizontal axis is determined using the Jenkins Traub algorithm. The results showed that the nonparametric correlogram identified a geographic distance of land prices smaller than the correlogram used so far. A small distance means that the land price in a location is greatly affected by the neighbors compared to a larger distance.

Key Words: *geographical distance, land prices, nonparametric correlogram, spatial dependence.*

Introduction

A collection of empirical and theoretical studies have been conducted to model the effect of environmental impacts on land prices using the hedonic method. Some of these studies show that land prices are influenced by the infrastructure and socio-economic features (Barreca et al. 2018), by the geographic and geometric accessibility (Morales et al. 2019), and by structure and accessibility variables (Chica-Olmo et al. 2019). These studies have examined the spatial effect on urban land prices from the influence of externalities. However, this research has not shown how important the geographical distance is as a spatial influence in modeling urban land prices.

In the analysis of urban land prices, they can be considered as variables that have a spatial dependence. Spatial dependence is a form of assessing the correlation of a variable connected with the spatial location. This means that the ability of spatial dependence is a measure that states the relationship between the variations in land price properties and the spatial proximity or the geographic distance can be expressed by the continuous function of numerical differences in property compared to the distance. Thus, one can see that the closer the two locations are, more differences will be in the weak property (or the greater the similarity). This function also allows dependence on land prices where distance plays an important role in the concept of geographic distance and distance decay functions. This concept can be identified using a variogram or correlogram in calculating the spatial dependence. It should be noted the use of the words spatial dependence and spatial autocorrelation – both are closely related, as a spatial autocorrelation is a common form of spatial dependence. In its development, spatial dependence has its definition of distance (Legendre and Legendre 2012).

Some research on land prices with regards to geographic distance has been observed by Chica-Olmo et al. (2019) using the variogram, Morales et al. (2019) with the multivariate regression, Barreca et al. (2018) using the spatial autocorrelation, while Crosby et al. (2018) performs the variogram fitting on land prices, and Shaker (2018) shows that Conditional Autoregressive (CAR) residuals were assessed by Moran's I spatial correlogram, etc. The basic problem of this research of the spatial dependence is how to clearly and analytically determine the spatial dependence at a certain distance. Usually, the concept of this problem can be described through a correlogram that uses the covariance function. Correlogram as a plot of covariance function that changes with the distance against locations is very important to describe the spatial dependency.

Before a statistician performs spatial the predictions, traditionally under stationary principles, two main things must be considered to estimate the correlation (Gorsich and Genton 2000). First, it is the estimation of correlation values at a certain lag or distance based on the stochastic process. If the process is isotropic, the correlogram is only a function of distance, so it can be estimated using several estimators (Cressie 2015). Second, the correlogram values are estimated and fitted using parametric models. This can be carried out because the estimated point does not guarantee the definite positive nature of the correlogram or the continuous nature of the correlogram is unknown. The disadvantage of this method is that researchers must choose their preferred model and determine their respective parameters (Genton and Gorsich 2002).

For fundamental reasons like this, a nonparametric estimator for a correlogram is very important so the selection of parametric models is no longer needed. In development, several studies have been carried out that attempt to eliminate the selection of models and parameters on the correlogram. Such as the nonparametric curve fitting by Shapiro and Botha (1991), based on the spectral representation of isotropic or definite positive functions by Yaglom (1957). However, Hall et al. (1994) criticize the approach taken by Spahiro and Botha because it turns out that the definite positive estimator only applies discretely and not continuously, so they propose their estimators through the kernel method approach. The realization of the kernel method approach is made clear by Bjørnstad and Falck (2001) by proposing the use of a nonparametric kernel estimator where the asymptotic kernel function is the B-Spline cubic, which is called a correlogram spline. One important thing to remember is that not all functions can be used as candidate covariance functions because they must fulfill the positive properties of semidefinite. The nonparametric method here is based on the isotropic spectral representation of the positive definite function properties derived by Yaglom (1957), based on Bochner's theorem.

The use of the correlogram itself has been applied to various fields, such as the detection of: TB case notification rates (CNR) in Bangladesh (Rood et al. 2019); neighborhood and spillover effects on rice farmers (Villanueva et al. 2017); landscape in Moldova (Shaker 2018); copper mining area (Nguyen et al. 2016); land prices (Jiao and Liu 2012); genetics (Diniz-Filho et al. 2009); semiconductors (Jeong et al. 2008) and ecology (Bjørnstad and Falck 2001). In the research on land prices, Jiao and Liu (2012) used an index on the spatial correlogram (Moran Index and Geary's Index) derived from monoton variance plots. However, the use of Moran Index as a correlogram function has the disadvantage of not having definite positive characteristics. Though not all data has a variance plot that is monotonous but non-monotonous, where the plot of variance decreases to a minimum then rises, or vice versa. But unfortunately, for non-monotonous cases, the availability of literature and research on the spatial dependence analysis, more specifically to the value of using a correlogram, is still difficult to find. The covariance function to describe the case of the non-monotone hole effect is found in several previous studies, for example Ye et al. (2015) and Weku et al. (2019) which use the Bessel and Gaussian-type functions, and Yang and Shao (2018), using Bessel and Gaussian functions. Although the correlogram is fundamentally not the main key in the concept

of spatial statistics, it is also useful in conducting exploration and as a descriptive tool. For this reason, the correlogram can help the variogram to provide richer information.

Therefore, in this study, in order to improve the ability of previous correlograms, it is proposed to use the non-parametric covariance function with the general class. The nonparametric covariance function also applies to variogram classes for all dimensions and it is a definite positive. Since the form used is nonparametric, we refer to this modification as a correlogram nonparametric. To test the effectiveness of the nonparametric correlogram, it is applied to the land price data in the city of Manado. This is intended to determine the geographical distance from the spatial dependence of land prices from the locations that are mutually influential and have similarities.

Literature review

The spatial correlogram is very good for checking patterns of spatial autocorrelation in data or residual models. It also shows how the correlation of spatial observations when the lag increases. Based on the direction, the spatial correlogram is divided in two. First, non directional spatial autocorrelation, such as the traditional spatial correlates using the autocorrelation index (Moran I or Geary c) will be plotted against the distance or the Spline Correlogram with non-parametric covariance functions with distances plotted kernels have also been introduced by Bjørnstad and Falck in 2001. Second, the directional spatial autocorrelation such as windrose correlogram. This procedure calculates directional correlation using a method introduced by Oden and Sokal (1986). In the traditional spatial correlogram, the pairs of points are inserted into separate classes/bin based on the distance between the points, while the correlational windrose, class/bin is based on distance and direction. For example, a point pair that is 50 km away with an angle of 60° between them will be placed in a separate bin from a point pair that is 50 km away at an angle of 20°. However, windrose correlograms require large samples rather than nondirectional correlograms. To handle small-sized samples, a bearing correlogram is introduced using a bearing procedure that is combined with a windrose correlogram (Rosenberg 2000).

Correlogram Estimation

Spatial data is data obtained from the measurement results of a location. Spatial data comes from different spatial locations that indicate dependencies between the measurement values and the location of lands. Expressed that {Z(s): s∈D} is a spatial process for *D* of a particular nature and $D \subset R^2$, Euclidean space of the two dimensions and *s* is the position of the location (Cressie 2015).

The classic estimator for variogram proposed by Matheron in 1962 used the moment method as follows (Weller and Hoeting 2015, Luo et al. 2018):

$$2\hat{\gamma}(h) = \frac{1}{|N(h)|}\sum_{N(h)}\left(Z(s_i) - Z(s_j)\right)^2 \quad (1)$$

where $N(h) \equiv \{(i,j): s_i - s_j = h\}$ and $|N(h)|$ limited number of elements from $N(h)$.

Like the variogram, the covariogram can also be estimated using (Bjornstad and Falck 2001):

$$\hat{C}(h) = \frac{1}{n}\sum_{N(h)}(Z(s_i) - \bar{Z})\left(Z(s_j) - \bar{Z}\right) \quad (2)$$

where $\bar{Z} = \frac{1}{n}\sum_{i=1} Z(s_i)$ is the average sample of land prices from observation. Equation (2) .

is more often used because it guarantees positive definite form estimates on $\mathbb{R}^1$

Nonparametric Covariance Function

The property of the definite positive function is (Zastavnyi and Porcu 2017):

$$\sum_{i=1}^{n}\sum_{j=1}^{n}\lambda_i\lambda_j C(h) \geq 0 \tag{3}$$

for all λ_i , *h* and *n*, then *C(h)* is a covariance function.

One of the main keys in nonparametric modeling for a correlogram is the theorem given by Bochner. He provides an approach through spectral representation for any positive definite function. Bochner's theorem states that a function can be used as a covariance function if it conforms with the positive definite properties and can be solved in a fourier transformation from *F(w)* as a positive measure unbounded to finite, written as follows (Yao 1999, Weller and Hoeting 2015):

$$C(h) = \int_{\mathbb{R}^d} e^{2\pi i h \cdot w} dF(w) \tag{4}$$

where *h* represents the distance.

It is assumed that the correlogram is isotropic, meaning that it depends only on the distance and not on the direction of the vector lag *h*. Nonparametric estimations of isotropic correlograms use the series given by Yaglom (1957) as a representation of Bochner's theorem, as follows:

$$C(h) = \sum_{j=1}^{\infty} p_j \Omega_d(b_j h) \tag{5}$$

where p_j is a positive coefficient, scalar b_j reppresents the nodes and Ω_d is the basis for the function on $\mathbb{R}^d$ expressed as (Golinskii et al. 2018):

$$\Omega_d(h) = \left(\frac{2}{h}\right)^{\frac{d-2}{2}} \Gamma\left(\frac{d}{2}\right) J_{\frac{d-2}{2}}(h) \tag{6}$$

$\Gamma\left(\frac{d}{2}\right)$ is gamma function dan J_v is first kind of Bessel function with *v* orde.

If $C(h)$ isotropic, then Bochner's theorem can be written as follows (Gorsich and Genton 2000):

$$C(h) = \int_0^{\infty} \Omega_d(bh) F(dt) \tag{7}$$

Here $F(t)$ is a limited-not increase function and $\Omega_d(h) = \left(\frac{2}{h}\right)^{\frac{d-2}{2}} \Gamma\left(\frac{d}{2}\right) J_{\frac{d-2}{2}}(h)$. When *d = 1*, then $C(h) = \cos(bh)$, when *d = 2*, then $C(h) = J_0(bh)$; when d = 3 then $C(h) = \sin(bh)/bh$, when $d \rightarrow \infty$, then $C(h) = exp\{-(bh)^2\}$ (Gorsich and Genton 2000, Ploner and Dutter 2000).

The periodicity function has a weak hole effect structure when *d* increases and becomes a Gaussian function when $d \rightarrow \infty$.

For two dimensional random field *(d = 2)*, when $J_v(\cdot)$ which is the first form Bessel function with order *υ* and $v = \left(\frac{d}{2}\right) - 1$, then the idea becomes $v = \left(\frac{d}{2}\right) - 1 = 0$. Therefore $C(h) = J_0(bh)$ which can be expressed as:

$$C(h) = J_0(bh) = \sum_{k=0}^{\infty} \frac{(-1)^k}{k!^2} \left(\frac{bh}{2}\right)^{2k} \quad (8)$$

where *b* is number of sign.

Methodology

Proposed Model: Nonparametric Correlogram

To identify the geographical distance of urban land prices, we develop a nonparametric model of covariance functions in place as a correlogram. This Correlogram works based on equation (8) which uses the Bessel function to fit the covariogram. Because of the properties of the linear combination $C(h) = C_1(h)\, C_2(h)$, which $C_1(h) = J_0(bh) = \sum_{k=0}^{\infty} \frac{(-1)^k \left(\frac{kbh}{2}\right)^{2k}}{(k!)^2}$ and $C_2(h) = exp\left(-\left(\frac{h}{r}\right)^m\right)$.

Our multiplication correlogram model can be written as:

$$C(h) = C_1(h)C_2(h) = \sum_{k=1}^{p} J_0(kbh)\ exp\left(-\left(\frac{h}{r}\right)^m\right) \quad (9)$$

Note, that the nonparametric correlogram depends on the bin size. The more bin is chosen, the more smooth the curves will be, but this will cause the pair to decrease in some places (keeping in mind that there is a limit of at least 30 sample pairs for each bin). It is important to choose the bin carefully.

Research Area

This research was carried out in the city of Manado which is the capital of the province of North Sulawesi (Fig. 1). Geographically, Manado is located on the Manado Bay and it is surrounded by a mountainous terrain. The population in 2017, based on BPS data, is of 430 133

inhabitants. The large population in the city of Manado caused a high population density. With an area of 157.26 km^2, the population density reaches 2736 people/km^2. The city of Manado is located at the edge of the northern peninsula of the island of Sulawesi, at a geographical position of 124°40′ - 124°50′ East and 1°30′ - 1°40′ North.

Fig. 1 **– Localization of Manado City, North Sulawesi Province, Indonesia**

Data preparation

In this study, we use processed data obtained from the BP2RB (Regional Tax and Retribution Management Agency) of Manado which is listed in the Source of Taxpayers' Association according to the book category of Manado municipality for 2018. In this, processed data with attributes consisted of: taxpayers interests, the object tax number, the taxpayer's address, the object of land and building tax, each of which is divided into the object area, object class and NJOP (Nilai Jual Objek Pajak – Tax Object Selling Value), as well as the property tax provisions.

There are 150 spatial locations that were selected to be used in this research (Fig. 2). The locations of land prices to be observed are considered as dependent variables. The legend on the map illustrates the land price in rupiahs, where the red color indicates the high land price (30000-3500000), while the bright color states that the land price is low (0-500000). High land prices are near shopping and service areas, while low land prices are on the outskirts of Manado.

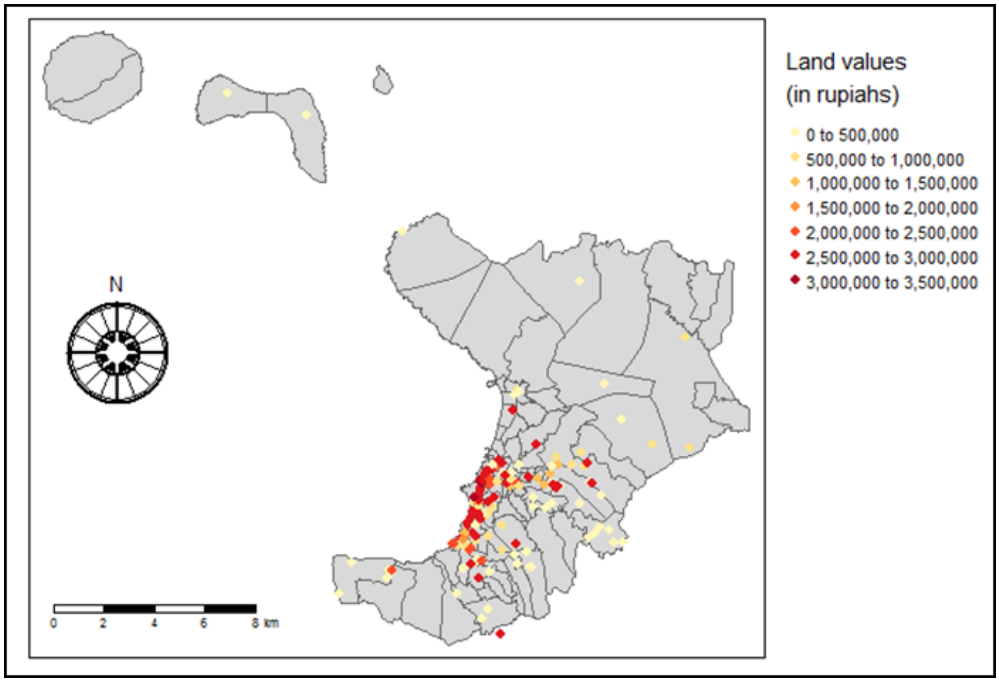


Fig. 2 **– Administrative map of Manado city and the 150 observation points**

Results

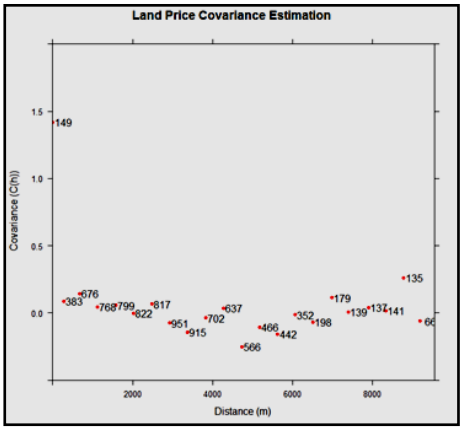
The first step is to estimate the covariogram. Based on equation (2), a calculation is made to estimate the covariogram, where the results are as shown in Table 1 and Fig. (3a). It appears that the estimation curve oscillates around C(h) = 0, it decreases to local minima at C(h) = -0.1043 and it rises again pass through C(h) = 0 while it reaches the local maxima at C(h) = 0.1146. In Table 1, it is stated that the first distances located at the interval [1577.7304, 2022.0978] have a strong correlation. This value of C(h) was carried out through the principle of curve fitting using the nonparametric covariance functions.

The second step is fitting the covariance value C(h) with the correlogram. There are two correlograms that are often used so far – the spatial correlogram and the correlogram spline (Fig 3b, 3c). The spline correlogram with non-parametric covariance functions using kernel was plotted against the distance, while the traditional spatial correlogram using autocorrelation indices (Moran I or Geary c) has also been plotted against the distance. Both of them shows that the land price correlation decreases when the lag increases and it has intercepts at a certain distance when the correlation is 0. Note that both the monoton spline and the spatial correlogram cannot fit the estimation curve given by equation (2) to the maximum distance of (9174.1743 m) at class 21. These correlograms may identify only one intercept of C(h) = 0, even though after a distance of 4000 meters, the correlogram should fluctuate over C(h) = 0.

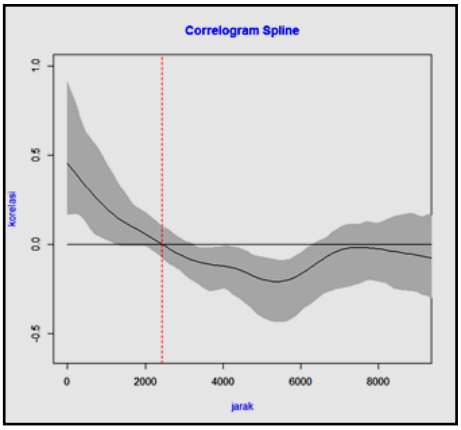
Table 1

Classes, data pairs, distances and covariance values based on equation (2)

Bin Classes	np	dist	C(h)		Class	np	Dist	C(h)
1	383	274.9404	0.0877		12	466	5168.0557	-0.1043
2	676	678.4604	0.1455		13	442	5621.5478	-0.1559
3	768	1119.8843	0.0459		14	352	6061.8550	-0.0129
4	799	1577.7304	0.0576		15	198	6505.1697	-0.0681
5	822	2022.0978	-0.0001		16	179	6977.5815	0.1146
6	817	2477.9712	0.0676		17	139	7391.2285	0.0089
7	951	2919.6496	-0.0741		18	137	7891.1404	0.0408
8	915	3363.5502	-0.1420		19	141	8326.1946	0.0170
9	702	3821.0236	-0.0367		20	135	8772.5338	0.2610
10	637	4263.9529	0.0358		21	66	9174.1743	-0.0599
11	566	4729.4027	-0.2497					



a



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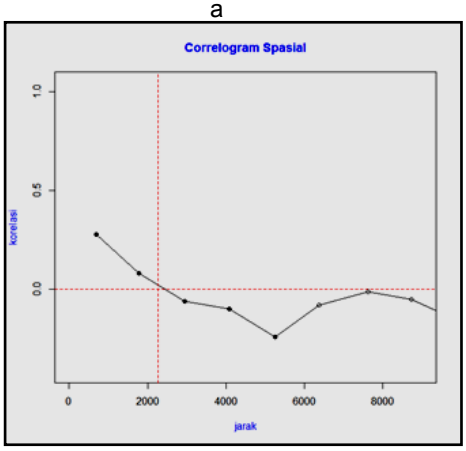

c

Fig. 3 **– (a) The covariogram estimation for land prices using equation (2) in $\mathbb{R}^1$; plot on the relationship between the spatial correlation to distance for land price data** (using the R software-gstat package) with (b) Spline Correlogram; and (c) Spatial Correlogram

Then we applied the nonparametric correlogram model to overcome the periodicity problem on the covariogram. This model is a combination of multiplication of Bessel and Gaussian-type functions as stated in equation (8). The use of spline cubic interpolation to approach the results of the combination approach looks much better than the use of smoothing curves using LOWESS on spatial correlograms and spline correlograms with cubic B-spline as asymptotic kernel functions. By taking p=1, 2, ... , 5, in equation (2), the results of estimation and curve fitting is shown as in Table 2 and Fig. 4 with a periodicity which passes C(h) = 0.

According to the calculations made with the R program, the intersection between the correlogram curve with the horizontal axis occurs at h = 2433.812 (correlogram spline) and h = 2265.832 (spatial correlogram). This means that the correlation at the distances will be very strong, while when the distance is increasing, then the correlation of the location of land prices will be weaken. Where the locations are close to each other in the range of the distance, this will give a strong influence on the land prices.

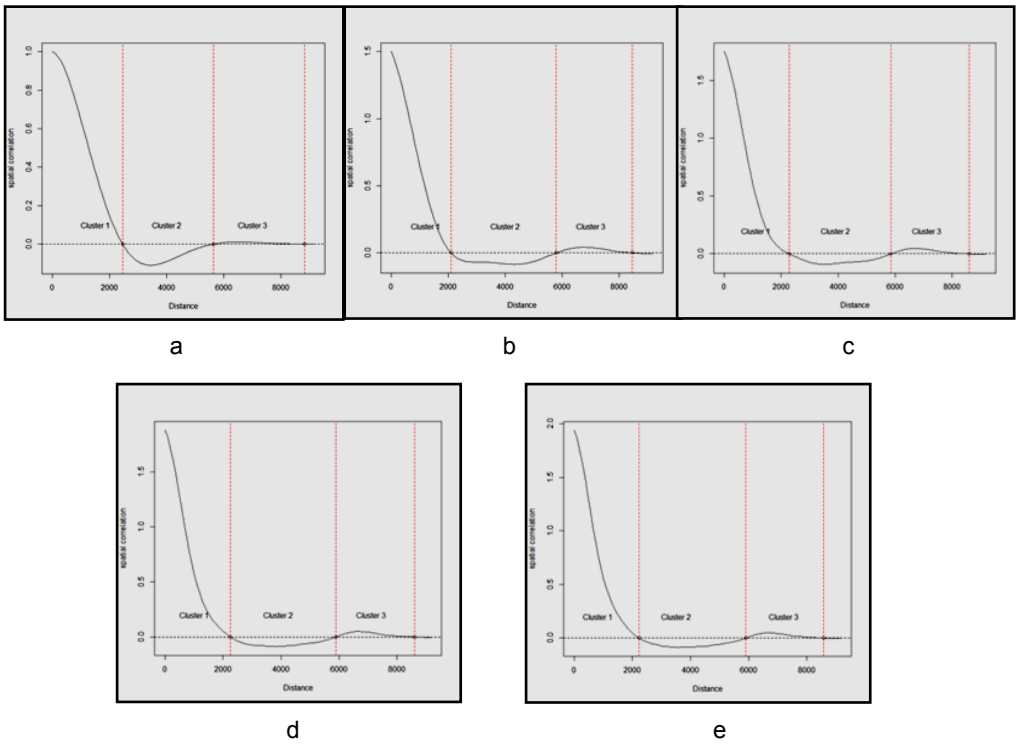

Fig. 4 **– Nonparametric Correlogram with different bases to plot the correlation of land prices against the geographic distance**

The availability of function *C(h)* and data pairs (distance, correlation) make it easy to determine the intersection. There are 3 points intercept at *h* when *C(h) = 0* which divides the distance into 3 parts. Intersections can occur together with the changes in the value of spatial autocorrelation from positive to negative and from negative to positive. The nonparametric Correlogram shows the existence of three distance clusters that affect the high and low prices of land. The first cluster shows a strong distance correlation, while the second cluster and the third cluster show a less strong correlation because the lag distance increases.

Table 2

Correlogram values for each model of 21 bin classes

Bin Classes	Lag distance (m)	p=1	p=2	p=3	p=4	p=5
1	274.9404	0.8975	1.3218	1.5144	1.5978	1.6317
2	678.4604	0.7147	0.9565	1.0017	0.9892	0.9716
3	1119.8843	0.4994	0.5382	0.4787	0.4489	0.4485
4	1577.7304	0.2895	0.2028	0.1603	0.1752	0.1836
5	2022.0978	0.1204	0.0174	0.0351	0.0471	0.0393
6	2477.9712	-0.0060	-0.0553	-0.0232	-0.0356	-0.0334
7	2919.6496	-0.0811	-0.0678	-0.0662	-0.0699	-0.0670
8	3363.5502	-0.1146	-0.0690	-0.0890	-0.0800	-0.0841
9	3821.0236	-0.1150	-0.0768	-0.0857	-0.0861	-0.0841
10	4263.9529	-0.0940	-0.0842	-0.0746	-0.0805	-0.0797
11	4729.4027	-0.0609	-0.0772	-0.0676	-0.0652	-0.0673
12	5168.0557	-0.0285	-0.0515	-0.0541	-0.0508	-0.0493
13	5621.5478	-0.0003	-0.0135	-0.0213	-0.0238	-0.0239
14	6061.8550	0.0187	0.0203	0.0188	0.0173	0.0163
15	6505.1697	0.0286	0.0396	0.0444	0.0465	0.0475
16	6977.5815	0.0302	0.0406	0.0434	0.0436	0.0433
17	7391.2285	0.0260	0.0299	0.0280	0.0263	0.0259
18	7891.1404	0.0172	0.0132	0.0103	0.0108	0.0114
19	8326.1946	0.0086	0.0022	0.0026	0.0036	0.0032
20	8772.5338	0.0007	-0.0034	-0.0012	-0.0018	-0.0018
21	9174.1743	-0.0045	-0.0048	-0.0039	-0.0046	-0.0042

The geographical distance can be determined by observing the fluctuations that occur around the zero horizontal axis. For p=1, the geographic distance is between class 5 and class 6 at interval [2022.0978, 2477.9712], and after that the autocorrelation is negative until the classes 13 and 14 at interval [5621.5478, 6061.8550], then there is a rise with positive autocorrelation until classes 20 and 21 at interval [8772.5338, 9174.1743]. For p = 2,3,4,5, it gives slightly different results. In particular, the last fluctuation occurred between classes 19 and 20 at interval [8326.1946, 8772.5338].

Optimal Geographic Distance

The measurement of geographical distance is considered important because it always appears in the urban analysis and population geography. Our next concern is how to determine the optimal geographical distance which is located at each interval previously mentioned. The geographical distance can be calculated using the nonparametric correlogram as the smallest correlation value for h, such that $C(h) = 0$. In general, there are two patterns of autocorrelation that are formed, such as the positive and negative autocorrelation. If the land price has similarities with its neighbors, then there will be a positive autocorrelation, and vice-versa for a negative autocorrelation.

The optimal geographic distance measurement is calculated from the correlogram $C(h)$ as the smallest value for h such that $C(h) = 0$. The determination of this distance can be established when the correlogram curve passes through the abscissa for ordinate correlation at 0. For example, when p = 1, the geographical distance is between 2000 and 3000, and after that distance of the autocorrelation is negative and then it fluctuates around the zero line. The

fluctuation of the curve around the zero axis *(C(h) = 0)* can be considered as a nonlinear equation, so that we can determine the h from the equation. The Jenkins-Traub algorithm can be used to solve nonlinear equations in order to obtain the h or the optimal geographical distance.

The geographic distance plot shows that the low-pass component of the land price is the most important thing to analyze. The geographic distance in the first cluster shows that there is a positive autocorrelation until it reaches the upper bound and it forms the periodicity (Table 3). For example, for base *p=1*, it has 3 clusters of geographic distance, where the first cluster (0<h<2451.376) and the third (5626.905<h<8820.882) are positive autocorrelations, while the second cluster (2451.376<h<5626.905) is a negative autocorrelation. The first geographical distance cluster shows that there is a strong correlation between the locations at a distance of 2451.376 to land prices, then the correlation of locations to land prices will decrease slowly after that geographical distance. An interesting finding is that the geographical distance will approach the correlogram spline for p = 1, while p = 3 causes the geographical distance to approach the spatial correlogram.

Table 3

Radius estimation (meters) with nonparametric, spline and spatial correlogram

	Nonparametric Correlogram					Spline	Spatial
Cluster	**base1**	**base2**	**base3**	**base4**	**base5**		
1	2451.376	2091.351	2269.686	2251.173	2221.306	2433.812	2265.832
2	5626.905	5782.948	5850.338	5880.357	5892.046		
3	8820.882	8455.558	8601.896	8608.763	8578.312		

The important thing about the nonparametric correlogram is the determination of the autocorrelation value as a geographical distance. When the geographical distance decreases, this means that there is a close autocorrelation between the locations that have similarities. Another consequence is that there will be a certain distance that does not have a significant correlation between the locations of observations separated by that distance. A further application to analyze land prices, this autocorrelation value is useful for determining the geographic radius of land prices that are close together or, in other words, the maximum distance where the spatial interaction of land prices is still significantly influential.

Spatial Dependency with Geographic Distance Clustering

The next step is to visualize the geographic distance cluster based on *p*. The geographic distance is important in looking at the effect of distance in the spatial dependency so that land prices are interrelated. The distance with a positive spatial autocorrelation is a different form of geographic distance with a negative spatial autocorrelation and it will form individual clusters (Fig. 5). The first distance cluster (colored in red) is represented by a geographic distance and a positive spatial autocorrelation; it has several points of location for the value of isolated land that does not have a spatial influence. This first distance cluster is the optimal cluster because it is close to the origin. This states that the location of land prices at a distance of 0 meters to 2451,376 meters has a high land price that is affected by the adjacent locations with a high land price. The second distance cluster (blue) is represented by a distance and negative spatial autocorrelation, located at a distance of 2451,479 meters to 5627,115 meters. This cluster indicates that high land price are influenced by the low land price, and vice-versa. And the third distance cluster (green), with radius and positive spatial autocorrelation, is located at a distance of 5626,905 meters up to 8820,882 meters. This cluster indicates that high land prices are influenced by the high land price, and vice-versa. This third distance cluster is not optimal because it is far from the origin point compared to the first distance cluster.

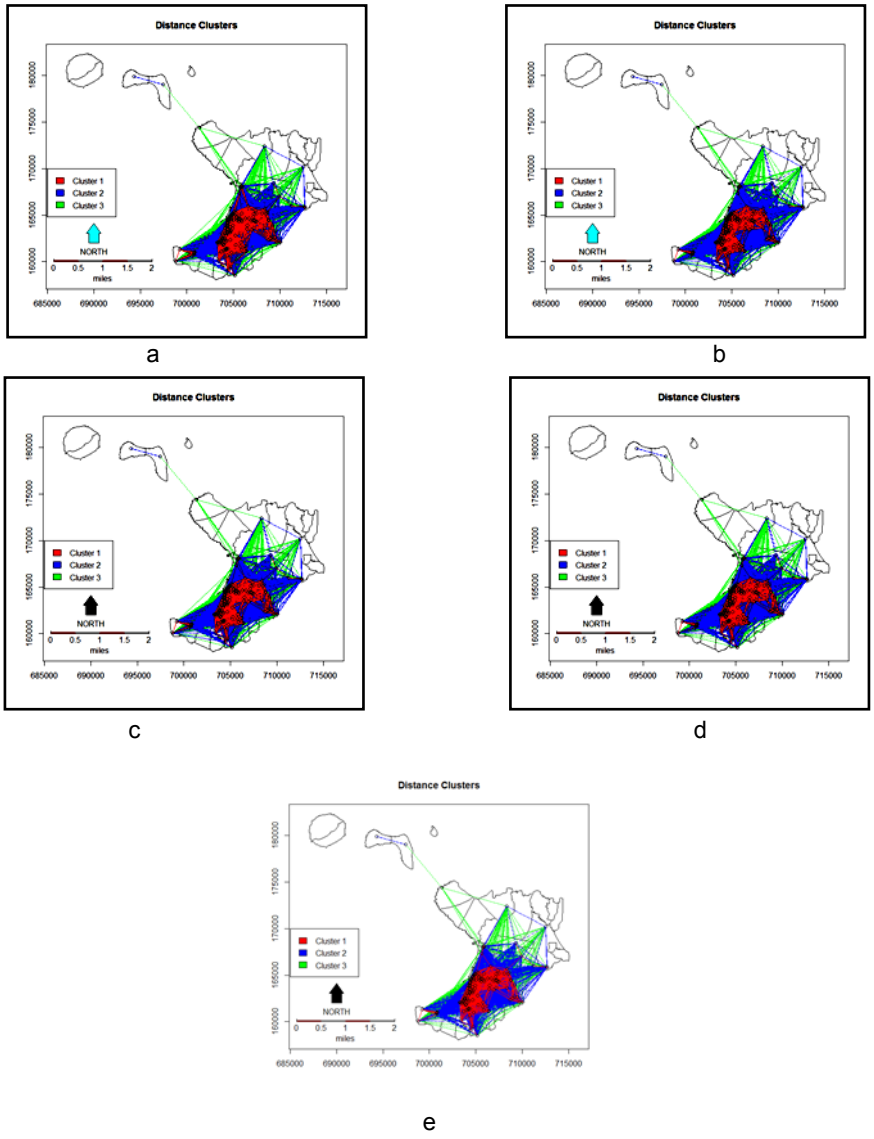

Fig. 5 **– Distance clusters of mutually influential observation locations**

The last stage is how to determine the optimal geographical distance. In this section we use the Moran Index which can determine the level of strength for the spatial autocorrelation. The size of the distance will be calculated by the Moran Index in exploring the size of the correlation object observation. In other words, this index will measure how the land price object in one location is similar to the other around it (Table 4).

Table 4

Moran I and linear gradient forming the Moran scatter plot

Basis	p=1	p=2	p=3	p=4	p=5
Distance	2451.3760	2091.3510	2269.6860	2251.1730	2221.3060
Moran I	0.1853	0.2267	0.1939	0.1952	0.2075
Gradien	0.0721	0.0524	0.0656	0.0650	0.0566

For a larger base (p → 5), it is known that the distance is getting smaller but not so with Moran's I. From all bases, we can see that the largest distance is 2451.3760 meter at base p = 1, while the smallest distance is 2091.3510 at base p = 2. Furthermore, by considering the largest Moran Index value (0.2267), the distance = 2091.3510 meters is chosen with the base model p = 2 to illustrate the correlation between the pairs of spatial observations when the lag increases. This means that the distance = 2091.3510 meters states that there is a strong correlation between the location of the land price of the adjacent land compared to the other geographic distances.

Discussion

As we already know in the analysis of spatial dependence, the price of the land of a location is influenced by the price of the surrounding neighbors. The core of this research is to find out how far the geographical distance in Manado, so that all areas within the geographical distance, will have a strong influence on each other in determining the land prices.

In the results that have been done using a nonparametric correlogram, the optimal geographical distance is 2091.3510 meters. This means that each location of land within this geographical distance has a strong influence or correlation to one another. On the other hand, each location outside the geographical distance has a less powerful influence in determining land prices.

In the discussion of this study, the relationship between the geographical distance and land prices is analyzed. The main findings of this relationship can be explained as follows:

1. Accessibility (distance from the economic center), meaning that the easier access to the economic center to be reached, the more valuable the land will be. For example, the city of Manado has the highest land price in the city center or what is known as the city's business district. This is due to the closeness between the community and economic activities and the workplace. The factors that influence land price movements are the most important in making various models of land prices.

2. Infrastructure/facilities, here means that the price of land is influenced by the availability and closest distance to the facility, for example offices, education, health facilities, traditional or modern markets. Proximity to this facility will save time in accessing the location of the facility, resulting in an increase in the price of land in locations close to the infrastructure.

3. A property that is in a geographical area with high infrastructure facilities or high economic activity will increase land prices. For example, the distance to transportation facilities and the existence of a highway will increase the efficiency of community work, and it will reduce the level of congestion.

These findings have many implications for the urban society. In the Central Business District, it

is seen that high land prices (red colors) dominate in the region because the centers of economic activity, services, shopping, health, etc. are indeed centralized in the area. While low land prices (bright colors) are on the edge of the city of Manado. Therefore, for people who have high income levels, it is not a problem to choose to live in that geographical distance. Conversely, people who have a low income will choose to stay on the edge of the city of Manado that exceeds the geographical distances due to low land prices. For people who have activities close to the city center, for example the government employees, the service providers, or the infrastructure (offices, schools, modern and traditional markets, health centers), they will choose to stay within the geographical distance. So it is not surprising, if the land price in the downtown of Manado is so high and mutually influential among its neighbors.

People who have high income levels or have jobs that are close to the Central Business District can buy land to work or live in the areas marked in red (within geographical distances that have strong correlations). Meanwhile, those with a low economic capacity can live in areas far from the CBD or on the edge of the city of Manado, which are marked by green areas.

Because the outermost area of the city is a location with low land prices, so the region is still less populated, this could be due to the lack of infrastructure. Therefore, it can be a concern for the city government to equalize the infrastructure development so that land prices are evenly distributed throughout the city of Manado. For the development of the city in the future, it is strongly recommended to carry out development in the suburbs. Because land is still widely available at relatively lower prices compared to land prices close to the city center.

Conclusions

In this study, Bessel and exponential covariance functions have been used which play a very important role in estimating the correlogram in a nonparametric manner. The form of multiplication and additive composition applied has met the requirements of positive definite functions in the spectral representation. The form of periodicity (oscillation) can be well fulfilled by the composition of covarince functions. With this nonparametric correlogram model, a researcher has the advantage of not having to choose the model first. The nonparametric correlogram curve fitting using the spline cubic interpolation produces a smooth curve so it can fit the results of the covariogram method of the moment, things that cannot be done by spatial correlograms or correlogram splines. The larger the bin size, the more curved the resultant as the smaller bin size. The geographical distance occurs when C(h) = 0 is determined by using the Jenkins Traub algorithm.

In applying for a land prices dataset, the nonparametric correlogram provides the optimal geographical distance for land prices given when the covariance value is zero. The oscillating covariance with a distance interval can be considered as a cluster form. The formed cluster illustrates the important relationship between the geographical distances with a positive spatial autocorrelation and a negative spatial autocorrelation. The Moran index can be used to determine the strength of the land price autocorrelation that occurs at a distance = 2091.3510 meters with a composition model of Bessel base p = 2 and a Gaussian-type function. At this optimal distance, it can be said that two locations in Manado with identical attributes will have similar prices if they are adjacent to each other rather than if they are far apart (larger than 2091.3510 m). The location of land which is within the geographical distance has a dependency or correlation to each other in order to determine and change land prices. The use of spatial dependence with geographical networks can represent a basis for determining land prices in the future.

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