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Spatial distribution of human capital in Romania

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Human capital reflects the knowledge, competencies, and health people invest in and accumulate throughout their lives. Therefore, investing in people's health, education, and skills is essential to developing human capital. The evaluation of human capital is very important for understanding the premises for future development at a territorial level and the impact that different development trajectories may have on economic performance and population wellbeing. Thus, identifying those areas with lower human capital is crucial for future economic and social prospects allowing authorities to elaborate targeted strategies to protect and invest in people in these areas. This paper aims to evaluate human capital at the national level, focusing on three main components: education, health and workforce. The research methodology is based on statistical analysis using available data on education, employment and health and spatial analysis using GIS. This study's findings show that areas with higher human capital overlap with the most important Romanian cities and their surroundings (Bucharest, Timisoara, Cluj-Napoca, Iași, etc.), while lower human capital indices characterise extended rural areas located in the eastern part of the country and central, south and south-east, thus having different development premises. The present study contributes to a better evaluation and representation of human capital at the spatial level, pointing out the vulnerable areas from the point of view of education, workforce and health. Measures for uniformising and improving human capital will ensure the communities' sustained economic and social development.

Key Words: ***human capital, Romania, education, regional development***

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Introduction

Given the wide variety of definitions for human capital, summarizing the literature refers to all the knowledge, skills and capabilities owned by an individual or members of a community (OECD, 1998; Abraham & Mallatt, 2022; Eide & Showalter, 2010). Moreover, the importance of assessing the allocation of human capital has grown progressively over time as it can explain economic growth disparities between nations and regions (Faggian et al., 2019; Demirgüç-Kunt & Torre, 2022).

Human capital is a concept that has caught specialists' attention for a long time. Adam Smith, in 1776, considers wealth results from education attainment, skills and experience earned over time. Human capital theories were more clearly established in the late 60s (Sweetland, 1996). However, the issue of the allocation of human capital has been developed recently by international organizations such as World Bank (Kraay, 2019) and World Economic Forum (Samans et al., 2017).

It is widely accepted that one of the most important factors of economic development nowadays is human capital (de la Fuente & Doménech, 2006; Li et al., 2015; Lee & Lee, 2016). The new approaches in the theory of economic growth emphasise the importance gained by human capital. For example, Pelinescu (2015) pointed out that in the classical theory of economic growth, labour productivity was dependent mainly on the workforce and physical capital, but with no reference to the role of education. In contrast, the new theory clearly shows the importance of education and innovation as components of human capital that will cause long-term economic development.

A new approach to the spatial distribution of human capital is the causality of what influences territorial disparities. Chani et al. (2012) show that income inequality automatically causes human capital inequality. Also, the investments made in education and the population's health benefit a country. Thus, the ability of poor communities to increase their human capital is constrained by income inequality. This may further result in more severe human capital disparity, exacerbating income inequalities and transforming it into a vicious circle (Cingano, 2014). Funke & Strulik (2022) demonstrate that physical capital contributes significantly to economic growth in the early stages of development. In contrast, human capital accumulation provides growth income per capita when the country has reached higher levels of development. However, regardless of the causality, human capital is a categorically important component of economic growth, and its spatial variations can explain regional development differences (Gennaioli et al., 2013).

Geographers focus on evaluating human capital as a source of uneven development. Therefore, the role of geography is essential in assessing human capital as it can explain differences in regional development, urbanisation distribution and economic activity (Flückiger & Ludwig, 2018). The role of geography in studying human capital has been analysed from the perspective of human capital concentrations and spatial disparities between regions (Rowe, 2013). Liang & Lu (2019) have brought to attention the role of human capital in

urban development. Also, the geographical point of analysis has focused on the distribution factors of human capital to explain the spatial allocation of human capital with a particular focus on urban settlements, effects on economic development and the migration of human capital (Rowe, 2013). The mobility of highly educated people is a critical factor that causes inequalities in the distribution of human capital, as highly skilled migrants are prone to be attracted by countries or places that are more competitive and where opportunities are available (Pagano, 2017).

Education plays an essential role in forming human capital, and it has been a theoretical framework to influence individual earnings positively (Becker, 1962; Eide & Showalter, 2010). As it endows individuals with skills and competencies, it has been considered when analysing human capital since the concept was developed (Schultz, 1961; Lim et al., 2018). Health and wellbeing are also other essential components of human capital, as it gives individuals the physical capacity to work and grow productivity (Demirgüç-Kunt & Torre, 2022). International organizations such as World Bank (D'Souza et al., 2019) and World Economic Forum (Samans et al., 2017) have considered this component when calculating the human capital index (HCI). Workforce and employment are other factors that should be integrated into the analysis of human capital as it evaluates the level of participation in economic activities and how productive the population is (Dumitrache, 2015; Samans et al., 2017). However, this component is usually overlooked in the analysis of human capital by other studies.

This exploratory study aims to develop a human capital index (HCI) based on the normalization and aggregation of statistical and demographic indicators related to three relevant components: education, health and wellbeing and workforce and employment. The distribution of the values of HCI at the territorial level will reflect differences in human capital across Romania. These differences result from a combination of factors and conditions that Romania faces: population decline, ageing, out-migration of the skilled labour force, deterioration of health status, and early abandonment of school. Therefore, vulnerable areas need urgent actions to improve this situation (Dumitrache, 2015).

Methodology

The study area for this study is Romania, a country in south-eastern Central Europe. At the last population census in 2011, Romania had 20.1 million people. The country is divided into 41 counties, grouped into eight development regions (North-East, South-East, South, South-West, West, North-West, Central and Bucharest-Ilfov). All administrative units account for 3,181 settlements, out of which 10% (n=319) are urban settlements, and 90% (n=2,862) are rural settlements. Rural areas concentrate 46% (approximately 9.3 mil.) of residents, while more than 10.9 mil. of Romanians (54%) live in urban settlements.

Given the complexity of human capital research, it is challenging to be quantified (Kraay, 2019; Lim et al., 2018). The complexity comes from the fact that there needs to be a clear definition of the indicators that should be integrated when evaluating human capital (Friderichs & Correa, 2022). However, during the development of the research in the field of human capital, different indicators have been used: average years of schooling, school enrolment rate, investments in education and health, mortality rates, etc. (Abraham & Mallatt, 2022; Fraumeni & Christian, 2019; Gu & Wong, 2015). Previous studies adapted the human capital index (Demirgüç-Kunt & Torre, 2022) in order to meet the data availability in each country or region or to evaluate the components of the human capital better and to eventually obtain more consistent results. For example, The World's Bank Human Capital Index integrates data on health and education using the expected years of schooling and the results of international tests (D'Souza et al., 2019). In addition, the World Economic Forum Human Capital Index integrates a higher number of indicators to assess human capital, considering health and education, also employment (Samans et al., 2017).

In this paper, we attempt to assess the human capital distribution in Romania using an aggregate/composite index based on three subindexes or components (education, health and employment), considering indicators proposed by the World Economic Forum. We used statistical data collected at the 2011 census. These data are available on the INS website (National Institute of Statistics). The results of the last census of 2022 will be published by the end of the year.

Figure 1 shows all the indicators considered in the construction of the aggregate human capital index. Education index (EdI) was obtained by aggregation and normalization of the following indicators: population with higher education (% of the population over ten years old), population with secondary education (% of the population over ten years old), population with primary education (% of the population over ten years old), population with no education (% of the population over ten years old) and illiteracy rate (% of the population over ten years old).

These indicators have been considered to evaluate the population's education level and knowledge acquisition. Health index (HI) was obtained from three indicators related to health status: general mortality rate (‰), infant mortality rate (‰) and population ageing (% from the total population). The third component, the employment index (EmI), aims to evaluate how people are integrated into the labour market as a good indicator of how well-trained the population is and how they can use their competencies. It is based on: the unemployment rate (% from the active population), employment rate (% from the total population), youth dependency ratio (% from the adult population), elderly dependency ratio (% from the active population) and maintained population (% from the active population). All data has been normalized by using the Vmax – Vmin method as it better preserves the relationship between the original data (Han et al., 2012). After normalizing all indicators, the aggregate subindexes of education, health and employment were obtained.

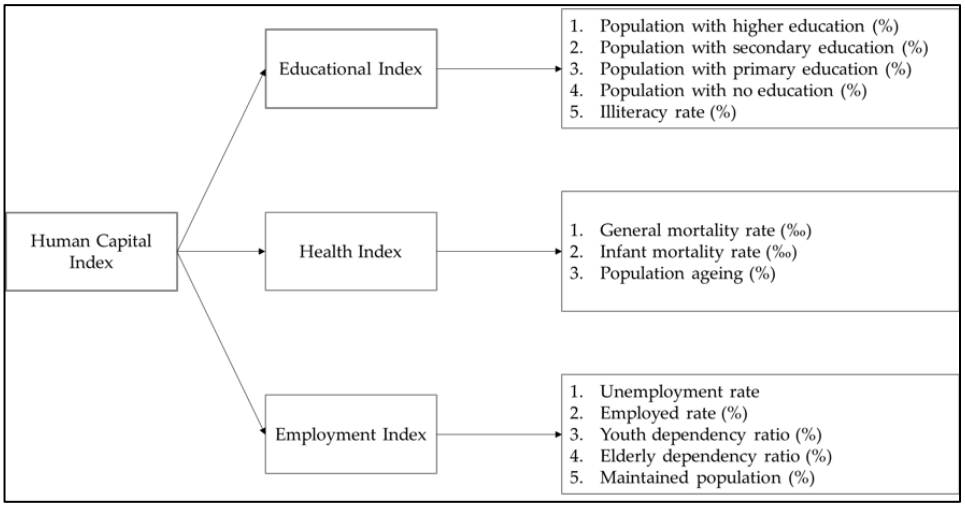

Figure 1. Indicators used in the construction of the Human Capital Index

The average of all three subindexes results in the Human Capital Index (HCI). The formula of the Human Capital Index is:

$$HCI = \frac{EI+HI+EI}{3},$$

where EdI is the education index, HI is the health index, and EmI is the employment index. The human capital index has values ranging between 0 (Low) and 1 (High). All data has been integrated into a GIS (Geographical Informational System) environment using the open-source software QGIS 3.20, and then the results were spatialised on each subindex for a better and broader analysis of the allocation of human capital in Romania.

Results and discussions

Education

The education subindex allocation is uneven across the country, with vast disparities between regions across Romania and high discrepancies between urban and rural settlements (Figure 2). The values range between 0.06 and 0.90, with an average educational subindex of 0.59. The values in urban settlements are consistently higher than in rural ones, with an average value of 0.72 and 0.57, respectively. As the map of the distribution of educational index depicts, very large regions across Romania from the east and north-east part of the country received low scores, as well as in the south and locally in the central part of the country (Figure 2). Also, it is evident that high values of the educational subindex have been recorded around significant urban settlements such as Bucharest, Iaşi, Cluj-Napoca and Timişoara as a result of the concentration of important and high-quality educational opportunities. The concentration of educational facilities

in urban settlements can raise the human capital locally with externalities to the surrounding settlements (Abel & Deitz, 2012).

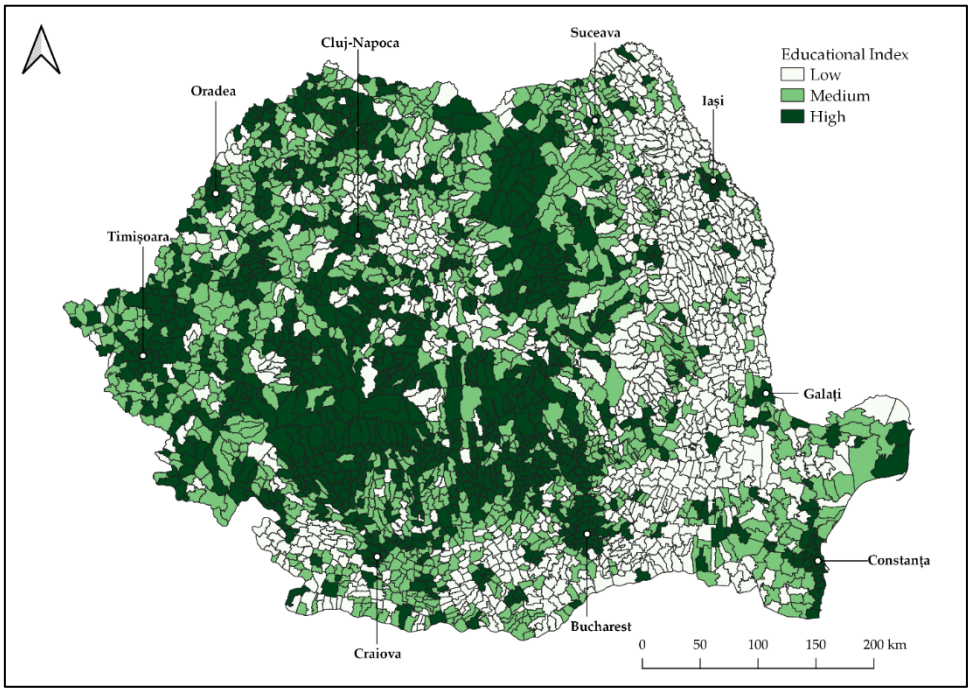

Figure 2. Education Index in Romania

Areas with low educational incomes are more vulnerable as this can influence the population's ability to get well-paid jobs, resulting in limited access to goods and services. This can create a vicious cycle that will eventually increase the social deprivation of the vulnerable population in those areas. Significant illiteracy rates in rural settlements and large shares of the population only completing primary education represent a big problem in Romania that faces outstanding educational-related issues related to increasing drop-out school rates. The lack of highly educated, highly-trained people in some areas (East and South of Romania) might result from the well-skilled population's migration to more economically attractive areas, such as large urban settlements that cluster a considerable diversity of employment opportunities. This component of human capital is essential and should receive more attention from the perspective of the allocation of educational facilities and their quality.

Areas with high values of the education index are usually urban settlements or suburban settlements, which concentrate the educational facilities such as elementary schools, high schools and universities that are both accessible and qualitative. Besides providing good education to the population, these settlements also accumulate valuable work opportunities and attract human capital from surrounding areas. The mismatch between demand and supply causes large urban settlements to act as polarization centres for the highly skilled population.

Health

The health component, as well as the education one, plays a vital role in constructing human capital, but contrary to the education component, its allocation is different. The health index follows the urban-rural pattern distribution, where urban settlements have higher scores and rural settlements have lower scores (Figure 3).

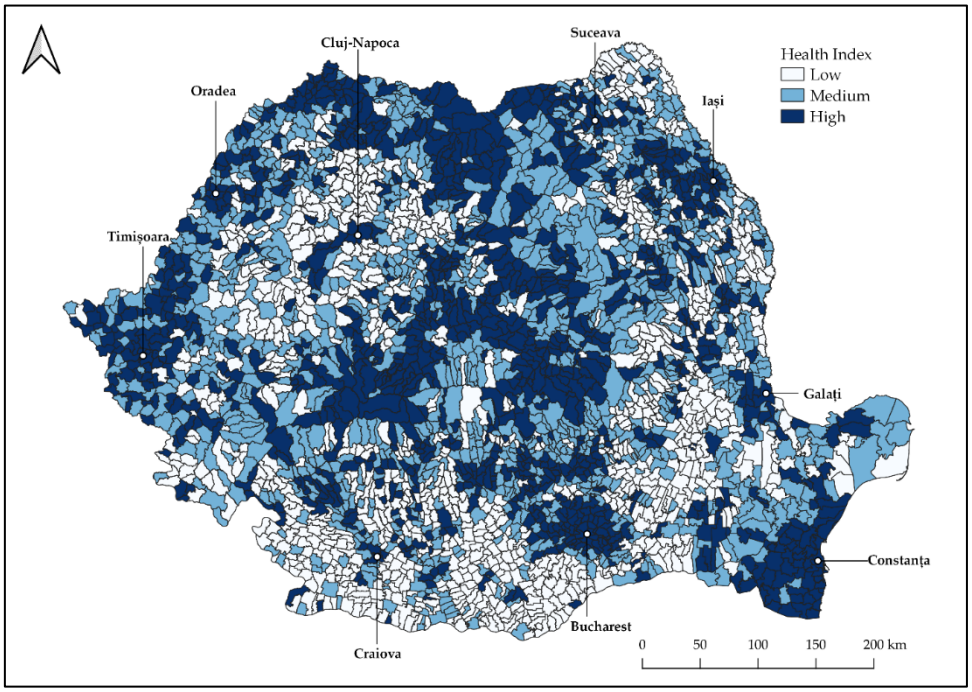

Figure 3. Health Index in Romania

The concentration of hospitals and health facilities in large urban settlements causes people living in rural settlements to have limited access to health (Dumitrache et al., 2020). Thus, results of the health component show that large cities register high scores. However, some remote rural settlements also show high levels of the health component. This might be the case as the indicators considered for the analysis, such as infant and general mortality, vary greatly in space and time. So, rural settlements that have not registered births in 2011 (and, therefore, zero infant mortality rates) might have artificially received high health component scores. This issue represents a limit of the study and highlights the importance of integrating more health-related indicators in the analysis of the health component of human capital.

However, the spatial distribution of the health subindex varies between 0.974 and 0.392, with an average score of 0.780. This highlights that most settlements have received high scores on health. Also, the low health levels can be associated with the intensification of the population ageing process in remote rural

settlements from where the adult population has migrated progressively to urban settlements or abroad.

High scores of the health subindex are found in large cities and their surrounding settlements, such as the case of Bucharest, Timişoara, Oradea, Constanţa and Iaşi. Also, the health situation in the central part of Romania shows positive levels. On the other hand, the south and north-western parts of the country are facing significant issues regarding the health component, with the population's ageing and the general mortality rates being the factors that cause low values of the health subindex (Figure 3).

Employment

The employment component, which is meant to evaluate the productiveness of the population as a vital component of human capital, also shows spatial variation across the country (Figure 4). The results vary between 0.17 and 0.97, with an average score of 0.75, indicating that values in this component are generally higher than the other two components. Results show that the highest scores for the employment component are specific to the eastern settlements of the country as well as the southern part. The lowest values are found in the central part of Romania as well as among the south-eastern settlements.

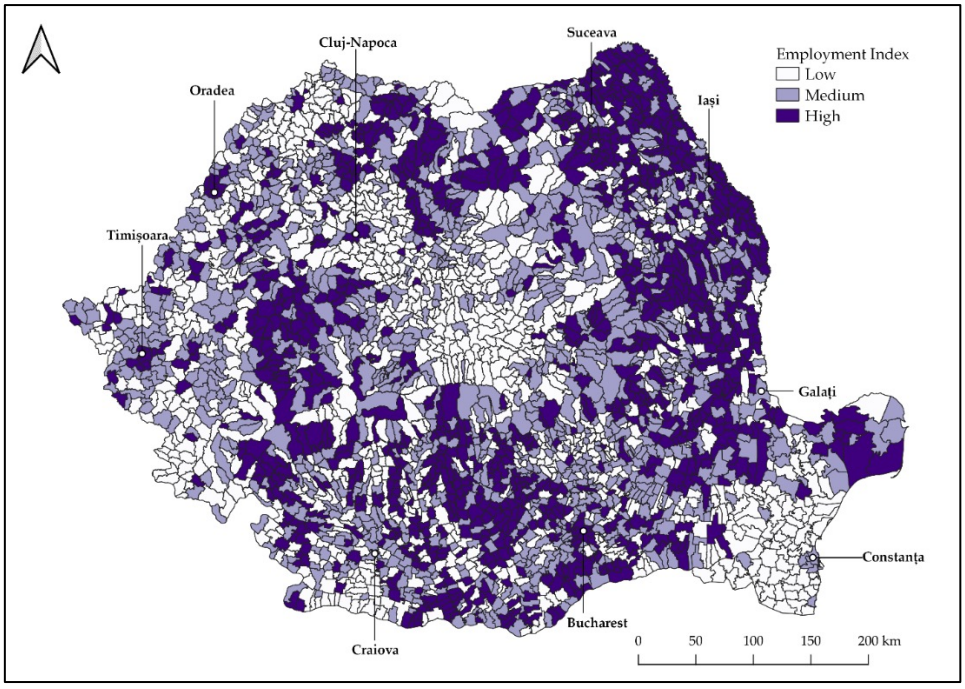

Figure 4. Employment index in Romania

The low levels of the employment index show that: either there is a scarce endowment of skills and competencies specific to the labour market or there is a lack of employment opportunities for the population, forcing the people with a

medium to a high level of training to migrate to other regions that are more attractive. Regions with high employment subindex scores show that people have a large variety of employment opportunities that might also vary according to their level of studies. For example, the eastern settlements, regardless of their low education subindex scores, have low unemployment rates and low dependency ratios. This explains very well the need to integrate more indicators in the evaluation of human capital, as, in this case, education attainment does not explain employment, but differences in earnings might be a more relevant indicator that should be linked to the educational level of the individuals.

However, medium to high scores of the employment component are found in large cities in Romania as well as in the settlements around them, as they converge numerous job opportunities. Low levels of the employment component are located in central Romania, as well as in the south-east, around Constanţa county.

Human capital index

The Human Capital Index distribution of the settlements in Romania is depicted in the map in Figure 5. The results show the spatial distribution of human capital after aggregating the three different subindexes that account for the evaluation of human capital. The results show a very diverse allocation of human capital across the country, with some concentrations of human capital forming in the south of the country as well as in the central south and west. However, it is clear that the highest scores resulted in urban settlements, especially in big cities.

The highly skilled population accumulated in big cities will promote the growth of urban wages and urban population, not only by higher labour productivity rates but also by generating externalities, which will improve productivity. This would mean that investment in human capital will generate externalities that will sustain continuous growth and improvement of the community's wellbeing and the communities surrounding the big cities. As the map shows, all the big cities as well as the settlements around them, show high levels of human capital (Bucharest, Timișoara, Oradea, Iași and Constanța). These urban settlements concentrate a very big part of the human capital available in their surroundings as they provide numerous opportunities, whether they are educational or job-related. On the other hand, low human capital levels are located in the central, eastern and south-eastern settlements, usually in rural areas. This can be very easily attributed to rural settlements generally lacking in providing qualitative and diverse educational services as well as health or employment opportunities.

These regions of low human capital levels should be prioritized for concrete actions by the authorities in the key fields influencing the human capital formation and therefore make investments in education, health and employment that will eventually increase human capital quality. Otherwise, the gap in development between urban (suburban) and rural settlements might become increasingly more extensive.

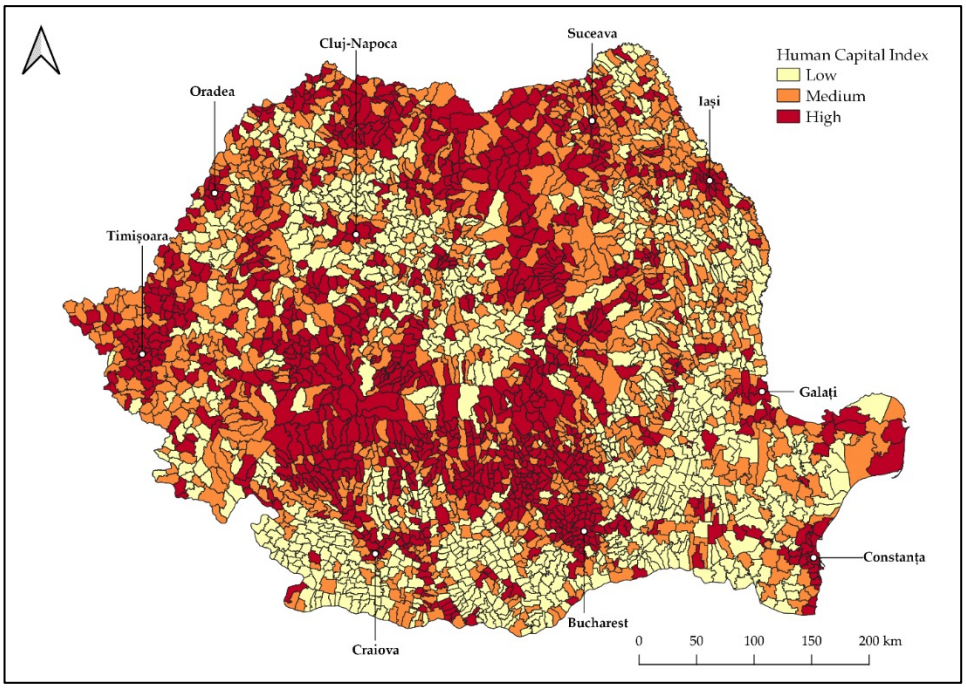

Figure 5. Human Capital Index in Romania

As an exploratory study, this paper is prone to the occurrence of limitations. Firstly, the usage of out-of-date population data from the census in 2011 does not reflect the current state of the country's human capital. However, this can serve as an example for further studies, so the need to have comparable data on human capital allocation overtakes the age of the data. Moreover, due to the lack of reliable data, the limited number of indicators that have been considered in the analysis might not reflect a perfect image of some subindexes, such as the health component, which has been influenced by the lack of relevant health indicators. Finally, the vast majority of the studies in the field of human capital analyse the situation at a national level between the states. In contrast, a limited amount of studies have assessed human capital at a local level, not having a methodological framework adapted to the regional scale of the analysis, creating some methodological challenges.

Conclusions

The present exploratory study aimed to analyse the spatial distribution of human capital across Romania at a local level and to point out regions and areas that are vulnerable in terms of the availability of human capital. The adapted human capital index has been applied for each administrative unit in Romania, based on three subindexes relevant to human capital accumulation: education, health and employment.

Results show that there are significant differences between regions on all of the three components of human capital. Notable discrepancies have been found in the education component, with urban settlements having the highest scores in the educational subindex. In contrast, the rural settlements, especially those isolated or located far from big academic cities, experienced lower scores. The health subindex has shown a similar pattern, with urban settlements having the highest scores as well as some rural settlements. However, this is the case as the indicators used to determine the index are variable, and higher scores were obtained artificially, not meaning that those areas exceed urban settlements in health provision. The employment component follows the same established trend and shows high values in urban settlements, while many rural settlements have low values. The human capital index is very well concentrated in urban settlements, especially in big cities as well as in the surrounding settlements, as externalities of human capital in the neighbouring administrative units.

As a first-stage study, it aims to explore the possibilities of assessing human capital inside national boundaries and explain regional territorial development discrepancies. Also, the causality of human capital gaps is fundamental in order to understand the driving forces of this indicator that quantifies the abilities of individuals and communities. The importance of this kind of study lies in its capacity to highlight vulnerable regions and use them as an example in order to take suitable actions for the uniformazation of human capital allocation. Thus, this paper might serve as support for government policymakers.

Further studies are needed in order to develop a more adequate and complete human capital index that integrates more relevant indicators. Also, the need to compare data with the results from the next census is imperious as it might show very interesting spatial and temporal evolutions.

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