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The impact of human capabilities on regional well-being in Romania

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Abstract: *Social well-being is a current and globally relevant concept, encompassing not only economic aspects but also social equity, access to basic services, citizen security, and respect for human rights. It aims to enhance living standards, reduce poverty and inequalities, promote solidarity and social cohesion, and foster a safe and respectful environment for all. Measured by indicators such as poverty rates, access to health and education, unemployment rates, and citizen life satisfaction, its promotion is essential not only as an end in itself but also as a means of building a harmonious, cohesive, and sustainable society. The main objective is to ensure equal access to resources and guarantee equal living conditions for all members of society by eliminating discrimination and social exclusion. Statistical data on social well-being are fundamental for governments and organizations in the decision-making process and in the development of policies aimed at improving the quality of life. The concept of social well-being is based on sustainable development and a broad vision of societal progress, including social equity, inclusion and mental health. The concept of well-being reflects the well-being and needs of a population, analysed through a specific system of social indicators. These indicators are not just variables, but are explicitly value-oriented, representing aspects of a good or bad life and, therefore, can be considered value dimensions of well-being. Indicators include, for example, social spending as a percentage of GDP, measures of social differentiation, social organization, as well as indicators of social conditions and concerns. Well-being reflects the satisfaction of population needs and is measured through objective and subjective social and economic indicators. GDP is the most commonly used economic indicator, but it does not directly reflect happiness or sustainability. Complementary indicators are necessary to understand real well-being. This article proposes an analysis of these inequalities through the lens of capabilities theory, using the conceptual contributions of Sen and Nussbaum to build a normative and empirical framework applicable to regional realities in Romania. The main objective of this study is to investigate the impact of human capabilities on regional GDP. The study examines the socio-economic dynamics across the various macro-regions that constitute the Romanian NUTS 2 framework using annual data available for 2015–2023. The data were provided by Eurostat and INS Romania. We used a balanced panel data set, the 8 NUTS2 regions of Romania, observed over a 9-year period, from 2015 to 2023, resulting in a total average of observations. At first glance, these individual variables confirmed the presence of normal temporal trends (almost all showed growth, deprivation decreased, and highways showed slower growth) and persistent regional disparities. These preliminary observations justified the need for a multidimensional approach to aggregate this information into a synthetic index (PCA). To investigate the relationship between the Capability Index and Gross Domestic Product (GDP), a fixed-effects panel regression model was estimated. The result obtained demonstrates a positive and statistically significant relationship between the Capability Index and regional GDP, consistently aligning with the hypothesis that prioritizing the capability set of the population produce economic growth and development in all regions of the country. This study makes a significant original*

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contribution to understanding the factors of regional economic growth in Romania by focusing on the role of human capabilities. A key innovation lies in the construction of a Capabilities Index, derived through Principal Component Analysis (PCA) applied to a set of seven relevant socio-economic indicators, including education and employment rates, health services, internet usage, life expectancy, transport network density, structural socio-economic vulnerability. By adopting this multifaceted perspective, the study overcomes the univariate of single indicators, offering a more holistic measure of human development potential and, implicitly, economic potential, specific to the spatial disparities within Romanian territory. Beyond the originality in capability quantification, the study provides robust and directly policy-relevant empirical evidence. By utilizing a fixed-effects panel regression model with cluster-robust standard errors, applied to data for the eight NUTS 2 regions of Romania over the 2015-2023 period, a positive and statistically substantial correlation between the capabilities index and regional GDP was demonstrated. This finding underscores not only the necessity but also the direct economic benefits of investments in human capital and social well-being, confirming the foundation of capabilities facilitating a sustainable path for territorial wealth accumulation.

***Keywords**: welfare, health, education, inequality,*
***JEL classification**: I32, R11, I15, I24, E24*

1. Introduction

Despite significant economic growth and European integration, Romania continues to face deep regional disparities. Large areas, particularly in Moldova, Oltenia and Southern Muntenia, consistently lag behind the national average in critical socio-economic indicators such as education, health, employment and income. This persistent uneven development highlights the need for a reassessment of the current state of development and a deeper understanding of the factors underlying regional prosperity. The concept of "well-being" extends beyond mere economic prosperity, encompassing a broader set of conditions that contribute to an individual's and society's overall quality of life. As defined by scholars like Pierson (2010), welfare can be broadly categorized into social, economic, and state welfare, each contributing to the collective provision of conditions for a decent life. While economic well-being, often proxied by income or GDP, remains indispensable for meeting material needs, a holistic view of well-being also incorporates access to essential services, social equity, personal achievement, and active community participation. Historically, the notion of a "welfare state," as described by Briggs (1961), underscores the deliberate intervention of governmental authorities to ensure social protection, minimum income, and high standards of public services for all citizens.

Building upon this comprehensive understanding of well-being, particularly the multi-faceted nature of development, this article proposes to analyse regional inequalities in Romania through the lens of capabilities theory. Drawing on the foundational conceptual contributions of Amartya Sen and Martha Nussbaum, this study constructs a normative and empirical framework to assess the actual opportunities and freedoms individuals have to live a life they value, rather than merely focusing on resources (Nussbaum, 2011).

This research aims to quantify the long-term impact of human capabilities on regional Gross Domestic Product (GDP) in Romania. The analysis focuses on the eight NUTS 2 development regions (North-West, West, Centre, North-East, South-East, South-Muntenia, South-West Oltenia, and Bucharest-Ilfov). Utilizing a balanced panel dataset of 72 observations from 2015 to 2023, sourced from Eurostat and the INS, the study examines the dynamic relationship between capabilities and economic output. Preliminary analysis confirmed important temporal trends and persistent regional disparities across the individual socio-economic variables, justifying the necessity of a multidimensional approach to aggregate this information into a synthetic capabilities index. To that end, a PCA served to construct the Capabilities_Index followed by the estimation of a fixed-effects panel regression model to robustly assess its influence on regional GDP.

The welfare state contributes to social and economic stability through a series of measures designed to reduce inequalities and support citizens in periods of vulnerability.

Social welfare is a constant concern for both scientists and governments, being essential for the socio-economic development of society.

This paper proposes an application of the capabilities theory, formulated by Sen Amartya, in the analysis of regional disparities and the design of regional human development policies in Romania. Building on the theoretical framework of capabilities, we succeed to build and test a multidimensional index of human capabilities. The goal is to highlight the disparities in capabilities between regions and identify the significant factors that contribute to them.

Based on the theoretical considerations above, we formulated the next hypotheses:

H1 - The is a positive and statistically significant relationship between the Human Capabilities Index (constructed using PCA) and the level of regional GDP?

H2 - Is there a positive and significant correlation by individual components of the Human Capabilities Index - including economic and social well-being (measured by the employment rate and material deprivation), health (life expectancy and access to healthcare), and knowledge (education rate and internet usage) - and the level of regional GDP?

2. Literature review

Spiker analyses the society and social relations and shows that well-being is achieved and maintained through social action; people live in society and have obligations to each other, and for the state, the well-being of the people is the supreme law. The analysis of social policies involves value judgments and moral norms (Spiker, 2000).

Stiglitz redefines the concept of social well-being, shifting the emphasis from purely economic indicators to quality of life, equity, and sustainability. He advocates for public policies that reduce inequalities and create a society where the economy serves the people and not vice versa. Stiglitz is one of the most influential contemporary economists and a critic of traditional approaches to social well-being. His contributions focus on redefining how we measure and understand well-being in a society. Stiglitz co-chaired, along with Amartya Sen, the "Sarkozy Commission", which aimed to redefine the tools for measuring citizen well-being, going beyond the analytical shortfalls of conventional metrics. He argues that social well-being cannot be reduced to income levels or the quantity of goods owned but must include aspects such as quality of life, individuals' real opportunities, equity, and sustainability. He proposes a "progressive capitalism" approach, where the economy serves society, not the other way around. This model emphasizes equity, sustainability, and responsible governance, with the goal of promoting general well-being, not just economic growth. Stiglitz argues that public policies must aim to reduce inequalities and ensure and guarantee the impartial availability to opportunities, health and pedagogical assets. In his view, social well-being is closely linked to how public and private institutions collaborate to ensure a balanced system that protects the interests of all members of society, not just a secluded elite. He recommends the development and use of alternative and complementary indicators to GDP for measuring well-being. These complementary indicators should capture essential aspects of healthy life, such as medical assistance, education, economic security, and the environment. He proposes the use of composite indices, such as the Human Development Index (HDI), which integrates multiple dimensions of well-being (Fitoussi et al., 2010).

Stiglitz's concept of social well-being promotes a deeper and more complete understanding of well-being, which transcends traditional economic measures and takes into account multiple dimensions of human life. His multidimensional approach and emphasis on equity and sustainability offer a valuable direction for public policies and the evaluation of social progress.

Fitoussi argued that the welfare state must be understood not just as a mechanism for income redistribution, but as a complex system that ensures social inclusion, economic stability, and the protection of the vulnerable, through active public policies and adapted fiscal and monetary interventions. He was a critic of austerity and a supporter of demand and redistribution policies as effective means to promote social well-being and reduce inequality, social well-being being a combination complex system that ensures social inclusion, economic stability, and the economy must serve the common good, not just the maximization of economic growth. Fitoussi believes that by redistributing income and social inclusion as part of economic governance, austerity can be mitigated through a participatory framework of fiscal coordination, which also includes the social dimension, and not through rigid rules, the negative effects of market fluctuations and recessions can be mitigated. The concept of collective well-being in Fitoussi's thought is a comprehensive one, going beyond mere

economic measurement and integrating social, political, and moral dimensions, emphasizing the indispensable nature of institutional involvement and collective responsibility in shaping a fair and affluent civilization (Fitoussi et al., 2010; Coast et al., 2008).

Pigou developed new insights into the mechanisms of collective welfare and patterns of economic instability, business cycles, unemployment, public finance, price index, and national output measurement. He is particularly known for developing the concept of "externalities," which describes the side effects of economic activities on other people or entities. Pigou also proposed the use of taxes bearing his name - Pigouvian taxes - as a means of correcting inefficiencies in resource allocation in a competitive economy. Rather than advocating concrete policies, Pigou was a rigorous analyst of economic policy, primarily aiming to provide useful analytical tools for their evaluation and understanding. In contrast to other theories of social well-being, which may emphasize broader aspects such as social equity, social rights, income distribution, access to services, or quality of life, Pigou was more of an analyst of market mechanisms and precise corrective interventions, without advocating extensive or universal social policies. He believed that well-being could be measured and compared through individual utility, but with inherent limitations related to differences between individuals and their levels of well-being. Thus, compared to non-welfarist theories that include multiple factors influencing well-being (leisure time, access to services, social conditions), Pigou remained anchored in the microeconomic analysis of the market and specific interventions for market correction, without extending the concept of social well-being to broader institutional or cultural dimensions. Pigou was a theorist of market corrections through economic instruments (taxes, subsidies) to achieve efficiency and well-being, while other theories of social well-being also address more complex normative, social, and political dimensions, aiming at equity and social inclusion at the collective level (Pigou, 1952)

Amartya Sen have significant contributions to the concept of social well-being, especially through the development of capabilities theory. He defines capabilities as the set of functionings a person is able to achieve. These represent the real freedoms an individual possesses to lead a life they consider valuable. Capabilities refer to the real and practical possibilities to achieve certain states or activities, such as good health, education, participation in social, political, and economic life. Amartya Sen's concept of social well-being focuses on individuals' capacities and functionings, i.e., on what people can effectively do and be in their lives. From Sen's perspective, development is a suite of choices and human freedoms in contrast to those who evaluate well-being through technological and material progress. Although economic development can be an important means of expanding freedoms, they are also conditioned by factors such as access to education and health and civil political rights (freedom of expression and public participation). Thus, viewing development as the expansion of substantial freedoms helps us better understand the true goals of development, and if freedom is the essence of development, then we should focus on it as the primary goal, rather than on the specific means that can support it, as Sen emphasizes (Sen, 1982).

Sen's work has had a profound and multidimensional impact across various fields of social sciences. In welfare economics, he revolutionized the traditional approach, focusing on expanding human capacities and freedoms, rather than merely maximizing utility or accumulating resources. His contributions to social choice theory have also brought clarity to how collective decisions can be evaluated from the perspective of justice and equity. In development economics, Sen emphasized the importance of real freedoms and effective opportunities in assessing progress, going beyond conventional economic indicators. Furthermore, he integrated ethical considerations and human rights into economic analysis, offering a holistic perspective on well-being. His influence is also reflected in practical tools, such as the HDI of the UN Development Programme, which combines social-economic indicators (life expectancy, education, and income) to assess human well-being and progress, thus demonstrating the lasting relevance of his ideas in policy and research.

Allardt have a multidimensional approach to well-being, which goes beyond mere economic measurement and includes social and psychological dimensions. In his emblematic work "Having, Loving, Being: An alternative to the Swedish model of welfare research", Allardt proposes a comprehensive framework consisting of three essential dimensions: "having" (material conditions), "loving" (social relationships), and "being" (personal development and autonomy). Subsequently, in "Social Structure and Change: Finland in a Comparative Perspective" (1981), he analyses social transformations in Finland in a Nordic and European context, addressing aspects such as social

stratification and welfare policies. He also coordinated the volume "Welfare in the Nordic Countries: Studies in Comparative Sociological Research" (1989), which offers comparative perspectives on Nordic social policies. Allardt's research has influenced the development of social indicators for quality of life and emphasized the importance of sociological tools that capture more than economic performance. Through his comparative studies, he highlighted how social policies and structures shape well-being and quality of life, having a significant impact on sociological research and social policies in the Nordic countries and beyond (Allardt, 1976).

This holistic perspective offers a more complex and complete understanding of human well-being. Individuals' life chances differ, for example, by income, health, education level, or employment. The question is whether these living conditions impact people's subjective well-being or whether life satisfaction is largely independent of social inequality. This means, first, that life satisfaction is determined by individual income. People in the highest income group are happier than those in other income groups. Those with low incomes are the most dissatisfied with their lives. Moreover, we see once again that the level of life satisfaction depends on a country's economic prosperity. In every income group, people in rich countries are happier than those in poor countries. This means that low incomes in rich EU countries can be associated with higher life satisfaction than high incomes in poorer countries. Therefore, life satisfaction depends both on an individual's position relative to the national wealth structure and on a country's absolute prosperity position (Böhnke & Kohler, 2008).

Beyond potentially universal individual needs for a happy life, country-specific framework conditions determine restrictions and options. Inglehart also allows conclusions to be drawn about the normative and culturally rooted determinants of life satisfaction: individuals' needs and desires develop in a specific cultural and national environment and, therefore, must differ. Inglehart explores how cultural changes, especially the transition from materialistic to post-materialistic values, influence the social development, well-being, and political stability of modern societies. He argues that the evolution of cultural values has a transformative influence for a multidimensional well-being and subjective well-being, highlighting the close link between culture and social progress (Inglehart, 1997).

Richard Layard, a labour economist, highlights that, in the last five decades, the happiness level of Western man has not increased, despite a significant rise in material prosperity. Layard attributes this stagnation to intense competition among individuals, where everyone aspires to achieve more than others, which has led to the deterioration of essential aspects for happiness, such as family stability, job satisfaction, and the quality of social and community relationships. These effects are reflected in increased divorce rates, professional stress, and crime. To restore social balance, Layard argues that equality of opportunity in the opportunity to generate income is more important than equality of income (Clark et al., 2018).

Layard defines the field of well-being science and demonstrates how it can complement traditional economics, providing a broader perspective on factors influencing human well-being (Layard & De Neve, 2023).

Ruut Veenhoven is one of the pioneers of research on life satisfaction and subjective well-being, placing these concepts at the center of understanding quality of life. He distinguishes between cognitive life satisfaction, which represents an individual's rational evaluation of their own existence, and happiness as an affective state, reflecting the person's emotional involvement in the life experience. Veenhoven argues that life satisfaction is a general and essential indicator of subjective well-being, evaluated through the fulfilment of needs and the absence of tensions. Furthermore, he introduces the concept of "Happy Life Years", an index that combines life expectancy with the average level of happiness in a society, thus offering an integrated measure of quality of life. Within research on subjective well-being, Veenhoven (1989) places satisfaction, happiness, and contentment at the center of quality-of-life assessment. Life satisfaction ("overall happiness") reflects a global cognitive evaluation, performed through a rational process, while happiness ("hedonic level of affect") expresses an affective appreciation, based on emotional states. Thus, the difference between the two indicators lies in the nature of the evaluation: cognitive for satisfaction, affective for happiness, both contributing to the subjective understanding of quality of life (Veenhoven, 2000).

3. Methodology and data

The Capability Approach, proposed by Amartya Sen, argues that economic well-being and human development should not be measured solely by GDP, but rather by the genuine freedoms people have to choose a life they consider valuable in order to achieve a desired level of well-being. These capabilities represent the real opportunities and freedoms a person has, namely the ability to be healthy, to be educated, to be employed, to read a book, or to participate in social life. The chosen variables are not measured directly in monetary terms, but in capabilities and essential "functionings" for achieving well-being, thus moving beyond the simple measurement of well-being through GDP and looking at life as a whole.

This section presents the research methodology used to assess the correlation between human capabilities and regional GDP dynamics in Romania, together with the characteristics of the dataset used.

The study uses a balanced panel dataset covering 8 NUTS 2 development regions of Romania, observed over a 9-year period, from 2015 to 2023. This resulted in a total of 72 observations (8 regions x 9 years). The panel data approach is preferred as it allows for controlling both time-series variation and inter-regional heterogeneity, offering a more robust perspective on economic dynamics.

To construct a multidimensional index of human capabilities, seven socio-economic variables were selected, deemed relevant for human and regional development within the Romanian context. These variables, collected from Eurostat and the National Institute of Statistics (NIS), cover various dimensions of well-being and individual and collective opportunities: Motorways Network: Length of the motorway network in each region (in km); Individuals Regularly Using the Internet: Percentage of individuals who regularly use the internet; Employment Rate: Percentage of the employed population within a specific age group (15-64 years); Education Rate: A measure of the education level attained by the population; Health Access: Percentage of the population who can afford to go to the doctor, serving as a proxy for healthcare accessibility; Life Expectancy at Birth: Average number of years a person is expected to live at birth; Severe Material and Social Deprivation: Percentage of the population facing at least 7 out of 13 elements of material and social deprivation.

The set of indicators used in the model are essential, high-quality, and available at the regional level, covering the most important dimensions of the Capability Approach, as identified in specialized literature. A model that was too complex, with a very high number of variables, could have introduced multicollinearity problems. The selected variables (e.g., education rate, employment rate) are internationally recognized as pillars of human development. We considered that this set of variables provides a balanced and representative picture without overcomplicating the econometric model.

To capture the multidimensional nature of human capabilities and to mitigate multicollinearity issues that might arise from directly including multiple correlated variables in a regression model, PCA was resolved. The process of index construction involved the following stages: Initial variables were standardized to eliminate the effect of differences in scale and units of measurement, ensuring that each variable contributed proportionally to the variance analysis. PCA was calculated based on the ordinary correlation matrix. To create a unique and easily interpretable synthetic index of "human capabilities," it was decided to exclusively use the PC1. This component reflects the largest proportion of variance of the variable set and, therefore, represents the dominant dimension of the capabilities concept as reflected by the selected data. PC1 was named Capabilities_Index.

To assess the impact of Capabilities_Index on regional Gross Domestic Product (GDP), a panel regression model was estimated. A Fixed Effects (Cross-section fixed) model was adopted to control for unobserved and region-specific heterogeneity that might be correlated with the explanatory variable. This type of model allows for robust estimation of the effects of time-varying variables by eliminating the influence of long-term constant factors. To verify the soundness of the statistical conclusion and to address potential issues of heteroskedasticity and autocorrelation in errors (indicated, for example, by the low Durbin-Watson statistic of 0.369387 in the regression output), the White cross-section (period cluster) standard errors & covariance method was utilized. This technique adjusts standard errors to account for potential error correlations within the same region over time, providing more reliable estimates of coefficient precision.

4. Research results and comments

The current section presents the analytical findings of the study, encompassing the results of descriptive statistics of individual variables, the construction and interpretation of the Capabilities Index, and the econometric regression results.

In order to have a more comprehensive picture of the data analyzed, the trends and regional disparities for each of the seven constituent variables of the Capabilities Index were visually analyzed over the 2015-2023 period. These visualizations, presented in Annex 1, highlight the heterogeneity and specific dynamics of each region and variable.

Education rate: While showing a general upward trend throughout the analyzed period, the Education Rate exhibits a more pronounced increase, especially after 2020, in the North-West region. This growth signifies an overall improvement in human capital, an essential factor of capabilities. Notable differences persist between regions, with Bucharest-Ilfov generally having a higher education rate, while other regions might start from lower levels or experience slower growth.

Employment rate: The employment rate appears relatively stable, with a slight increase in most regions despite economic fluctuations, leading to improved capabilities through labor market participation and livelihood provision. Regions like North-West and Bucharest-Ilfov tend to have higher employment rates, whereas South-West Oltenia or South-East show lower levels, reflecting the structure of local labor markets.

Health access: As a fundamental component of human capabilities directly influencing quality of life and labor productivity, Health Access displays significant regional differences.

Individuals regularly using the internet: This variable exhibits the strongest and most consistent upward trend across all regions. From 2015 to 2023, the percentage of individuals regularly using the internet increased steadily and significantly in all regions, indicating accelerated digitalization. Nevertheless, substantial differences remain between Bucharest-Ilfov and other regions. Access to and use of digital technology are vital components of modern capabilities, facilitating access to information, education, and economic opportunities.

Life expectancy at birth shows a general upward trend, with a slight decrease around 2020 (probably influenced by COVID-19), after which the trend is recovering. Persistent regional differences reflect inequalities in lifestyle, healthcare access, and socio-economic conditions. Increased longevity indicates an improvement in the living conditions and health of the population, an essential pillar of well-being and capabilities.

Motorways network: This variable demonstrates gradual but slower and more uneven growth across regions compared to other variables. Some regions show notable progress, while others remain with limited infrastructure. The development of road infrastructure is important for connectivity and access to economic opportunities, thereby enabling the development of human capabilities.

Severe material and social deprivation: Contrary to the other variables, this indicator shows a general downward trend in most regions, signalling an improvement in living conditions and a reduction in social exclusion. However, significant differences remain, with some regions still facing higher levels of deprivation. A decrease in deprivation directly indicates an increase in capabilities, as more individuals gain access to resources and fully participate in economic and social life.

The descriptive statistics (Table 1) further reveal considerable variability (relatively large standard deviations and wide ranges) across most variables, reflecting substantial heterogeneity among Romanian regions and/or variation over time. This justifies the use of panel data. The Jarque-Bera test indicates that several variables (Education_rate, Employment_rate, Motorways network) are not normally distributed. The presence of positive or negative skewness indicates data concentration towards a specific part of the distribution and the presence of extreme values. Education_rate and Employment_rate exhibit positive skewness, suggesting that most observations are at lower levels, with a few regions showing higher rates. Individuals_regularly_using_internet and Life_expectancy_at_birth show slight negative skewness.

Table 1. Descriptive statistics

	Mean	**Median**	**Maximum**	**Minimum**	**Std Dev**	**Skewness**	**Kurtosis**	**Jarque-Bera**
Education_rate	2.575	1.4	8.5	0.6	2.430832	1.262067	3.082789	19.1343
Employment_rate	63.04583	61.35	75.1	55.6	5.149674	0.675159	2.432153	6.437424
Health_acces	0.067986	0.0685	0.102	0.043	0.014478	0.232123	2.403272	1.714824
Individuals_regulary_using_internet	71.22389	73.435	93.35	45.64	13.15249	-0.346443	1.968777	4.630537
Life_expectancy_at_birth	75.01667	75.05	77.6	72	1.212958	-0.308365	3.048252	1.148055
Motorways network	107.5417	75	259	0	92.10113	0.540868	1.91129	7.066326
Severe_material_andsocial_deprivation	26.93472	25.2	48.1	11.1	9.455681	0.36331	2.171531	3.643013

Source: generated by EViews.

Construction and interpretation of the Capabilities Index

PCA was chosen to address the multidimensionality of the human capabilities concept, as defined by Amartya Sen. Instead of analyzing each variable (education, health, employment, etc.) individually, PCA allowed for their aggregation into a single synthetic index. This is crucial because human well-being cannot be reduced to a single indicator; it's a complex phenomenon composed of multiple interconnected dimensions. The selected variables are often correlated with each other (e.g., a high education rate is often associated with a high employment rate). Using PCA enabled us to identify and eliminate this redundancy. The method extracts the PC, which are new, uncorrelated variables and that represent the majority of the variance in the initial data. We used the first principal component as our index, as it captures the most information from the entire dataset, providing a robust measure of regional capabilities.

Table 2. Principal Component Analysis

Number	Value	Difference	Proportion	Cumulative value	Cumulative proportion
1	2.403570	0.652107	0.3434	2.403570	0.3434
2	1.751463	0.772598	0.2502	4.155033	0.5936
3	0.978865	0.238770	0.1398	5.133899	0.7334
4	0.740095	0.086046	0.1057	5.873994	0.8391
5	0.654049	0.381414	0.0934	6.528043	0.9326
6	0.272635	0.073314	0.0389	6.800679	0.9715
7	0.199321	...	0.0285	7.000000	1.0000

Source: author computation using EViews.

Following the generation of the Principal Components Analysis output (Table 2 for PCA loadings), which included 72 observations, the analysis supported the selection criteria. According to Kaiser's rule, two principal components (PC1 and PC2) could be retained, as their eigenvalues are 2.403570 and 1.751463, respectively, both exceeding 1. PC3 has an eigenvalue of 0.978885, which is below 1. Cumulatively, PC1 and PC2 explain 59.36% of the total variance.

Table 3. Eigenvectors (loadings)

Value	Education_rate	Employment_rate	Health_acces	Individuals_regulary_using_internet	Life_expectancy_at_birth	Motorways network	Severe_material_andsocial_deprivation
PC1	0.368433	0.409677	0.365600	0.520637	0.240777	-0.009559	-0.483353
PC2	-0.378751	0.463993	0.482322	-0.336692	0.207869	-0.451667	0.219203
PC3	-0.373340	-0.063527	-0.099639	-0.117272	0.750366	0.488755	-0.175983
PC4	-0.095137	0.302082	0.378797	-0.116377	-0.440662	0.732277	0.110688
PC5	0.602845	-0.185874	0.279776	-0.083075	0.367563	0.126857	0.604696
PC6	-0.004464	0.622004	-0.572663	0.287305	0.079039	0.066051	0.438171
PC7	-0.457087	-0.316462	0.272157	0.706281	-0.015332	-0.018402	0.342705

Source: author computation using EViews.

For the purpose of constructing a single, easily interpretable "capabilities index," the First Principal Component (PC1) was exclusively utilized. This component captures the largest proportion of variance (34.34%) and represents the dominant dimension of human capabilities as reflected by the selected data. PC1 was thus named Capabilities_Index.

The loadings for PC1 (detailed in the Methodology chapter) reveal strong and consistent positive contributions from Employment_rate (0.409677), Individuals_regularly_using_internet (0.520637), Education_rate (0.368433), Health_access (0.365600), and Life_expectancy_at_birth (0.24077). Conversely, Severe_material_and_social_deprivation has a strong negative loading (-0.483353), meaning that a higher value of the capabilities index is associated with lower material and social deprivation, which aligns with theoretical expectations. Motorways network (-0.009559) has a loading close to zero on PC1, suggesting its negligible contribution to this primary dimension of human capabilities, although it might contribute to other dimensions (e.g., PC3 (0.488755) and PC4 (0.732277)). In conclusion, the newly constructed Capabilities_Index coherently captures various aspects of well-being and human development at the regional level.

The evolution and regional distribution of the Capabilities_Index are visually illustrated in Annex 3. This graph provides an accessible representation of both structural inequalities and the overall positive trend in human capabilities across Romania's regions, showing the annual evolution for each of the 8 NUTS 2 regions from 2015-2023. Bucharest-Ilfov consistently ranks highest in the capabilities index, demonstrating clear superiority compared to other regions, which likely reflects the concentration of resources, opportunities, and infrastructure in the capital and its surrounding area. In contrast, regions such as South-West Oltenia and South-East consistently record the lowest capabilities index values, remaining at the bottom of the ranking throughout the studied period. This underscores the persistence of significant disparities in human capability development across different parts of the country. A key observation is the general upward trend of the Capabilities_Index over 2015-2023, suggesting an aggregate improvement in capabilities at the national level, likely driven by progress in education, access to technology, and overall living conditions. Even regions with the lowest values show a gradual improvement. The graph also allows for the identification of periods of accelerated growth or stagnation for certain regions; for instance, some lines exhibit a steeper slope towards the end of the period, indicating faster capability development in those regions.

Econometric regression results

To assess the impact of the Capabilities_Index on regional Gross Domestic Product (GDP), a panel regression model was estimated. The general equation of the estimated model is:

$GDP_{it} = \beta_0 + \beta_1 \text{Capabilities\_Index}_{it} + \alpha_i + \epsilon_{it}$

Where:

GDP_{it} = Gross Domestic Product for region i in year t.

CAPABILITIES_INDEXit = Capabilities Index for region i in year t.

β_0 = Constant.

β_1 = Coefficient measuring the impact of Capabilities_Index on GDP.

α_i = Region-specific fixed effects, capturing unobserved and time-invariant heterogeneity for each region.
ϵ_{it} = Error term.

Table 4. Main characteristics of the series

Variable	c	Capabilities_Index
Coefficient	27961.350	5673.140
Std Error	534.245	506.358
t-Statistic	52.3381	11.20381
Prob.	0.0000	0.0000

Source: author computation using EViews.

According to the Fixed Effects (Cross-section fixed) output (Table 4), the coefficient for Capabilities_Index is "+" and significant (p-value = 0.0000, well below 0.01). Its reveals a highly resilient positive correlation within the capabilities index and regional GDP.

Table 5. PLS fixed effects - effect specification

Cross-section (dummy variables)			
R-squared	0.923364	Mean dependent var	27961.35
Adjusted R-squared	0.913632	S.D. dependent var	15425.18
S.E. of regression	4533.216	Akaike info criterion	19.79272
Sum squared resid	1.29E+09	Schwarz criterion	20.07730
Log likelihood	-703.5379	Hannan-Quinn criterion	19.90601
F-statistic	94.88317	Durbin-Watson stat	0.369387
Prob(F-statistic)	0.000000		

Source: author computation using EViews.

Specifically, for every one-standardized-unit increase in the Capabilities_Index (as the index is a standardized PCA score), regional GDP is estimated to increase by approximately 5673.14 units, holding region-specific fixed effects constant. This result strongly supports the primary hypothesis: human capabilities, as measured by the new index, are positively correlated with significant progress in terms of economic growth in the territory.

Table 6. Main characteristics of the series

	c	**Capabilities_Index**
Coefficient	27961.35	5673.14
Std. Error	311.9891.	460.5964
t-Statistic	89.62283	12.31694
Prob.	0.0000	0.0000

Source: author computation using EViews.

The R^2 (0.923364) and Adjusted R^2 (0.913632) values are extremely high, indicating that the model explains a large proportion (over 92%) of the variance in regional GDP. The F-statistic is very large (94.88317), and its associated p-value is 0.0000. This indicates that the model is statistically significant, which leads to the rejection of the null hypothesis and we confirm that they are different from zero. The Durbin-Watson statistic, with a very low value of 0.369387, indicates positive autocorrelation of the residuals. This underscores the importance of using robust standard errors (Table 6)

Table 7. PLS Fixed Effects. White cross-section (period cluster) standard error& covariance (d.f.corrected). Standard error and t-statistic probabilities adjusted for clustering

Cross-section (dummy variables)			
R-squared	0.923364	Mean dependent var	27961.35
Adjusted R-squared	0.913632	S.D. dependent var	15425.18
S.E. of regression	4533.216	Akaike info criterion	19.79272
Sum squared resid	1.29E+09	Schwarz criterion	20.07730
Log likelihood	-703.5379	Hannan-Quinn criterion	19.90601
F-statistic	94.88317	Durbin-Watson stat	0.369387
Prob(F-statistic)	0.000000		

Source: author computation using EViews.

To correct the autocorrelation of the residuals and ensure the validity of the statistical results, we applied corrections to the White cross-section (period cluster). White cross-section (period cluster) standard errors & covariance were applied (Table 7). With this robust approach, the coefficient for Capabilities_Index remains positive and statistically significant (p value = 0.0000, well below 0.01). The conclusion remains unchanged and is now even more robust, given the use of cluster-robust standard errors. This means that a one-unit increase in the capabilities index (PC1) is associated with an average increase of 5673.14 units in regional GDP, controlling for region-specific fixed effects. The R^2 (0.923364) and Adjusted R^2 (0.913632) values remain unchanged and extremely high, indicating excellent explanatory power of the model. The F-statistic (94.88317) and its Prob(F-statistic) (0.000000) continue to show that the model is, overall, statistically significant. The Durbin-Watson statistic (0.369387) still indicates strong positive autocorrelation of the residuals. The use of robust standard errors is essential to mitigate this problem and obtain valid inferences, even if autocorrelation persists.

Conclusively, the calculated index emerges as a pivotal factor that positively modulates the trajectory of regional GDP. The empirical evidence reveals a stable and robust correlation between the composite capabilities index and territorial economic output. A one-unit (standard deviation) increase in the Capabilities_Index is associated, on average, with an increase of 5673.140 units in regional output, controlling for the specific and territorial entities. This finding strongly supports the hypothesis that investments in human capabilities yield considerable economic returns at the regional level.

5. Conclusion

This study investigated the role of human capabilities in stimulating regional economic growth in Romania, utilizing a panel dataset for the period 2015-2023. By adopting a multidimensional approach to the concept of capabilities and applying a robust econometric methodology, this research offers new perspectives and relevant empirical evidence for regional development.

The research confirmed the central hypothesis that the development of human capabilities represents an essential driver of regional economic growth. Based on Principal Component Analysis (PCA), a Capabilities Index (Capabilities_Index1) was constructed, a synthetic indicator integrating various dimensions of well-being and individual opportunities, such as education, employment, health access, digitalization, and the reduction of material deprivation. Visual analysis of this index highlighted persistent regional disparities, with Bucharest-Ilfov consistently ranking at the top, while regions such as South-West Oltenia and South-East recorded significantly lower values. Nevertheless, a general upward trend in capabilities was observed across most regions throughout the analysed period, indicating positive national evolution.

From an econometric perspective, the estimation of a fixed-effects panel regression model with robust standard errors revealed a positive and statistically relevant statistical interdependence between the composite indicator Capabilities_Index1 and the dynamics of GDP at the regional level. The estimated coefficient for Capabilities_Index1 (5673.140) suggests that an improvement in human capabilities at the regional level is associated, according to our empirical estimations, with a substantial and sustained increase. The high explanatory power of the model (R-squared over 91%) underscores the relevance of the controlled factors within the model.

This study makes a significant original contribution by consolidating the theoretical framework of Amartya Sen's capabilities approach with robust empirical analysis in the specific context of Romania. Firstly, the development of a multidimensional capabilities index through PCA provides an innovative and more comprehensive tool for assessing human development potential at the regional level, overcoming the limitations of unilateral indicators. Secondly, by utilizing panel data for Romania's NUTS 2 regions and applying a rigorous methodology (fixed-effects model with robust standard errors), the study furnishes solid and reliable quantifiable proof of the direct influence of human capabilities on economic dynamics. This complements existing literature, offering a contextualized perspective and validating, for Romania, the argument that investments in people are, equally, investments in economic prosperity.

The results of this analysis underscore the strategic necessity of prioritizing investments in human capabilities as a central pillar of regional economic development strategies in Romania. Given the positive and significant impact of the capabilities index on regional GDP, public policies should improve the quality and accessibility of education, expand access to adequate health services, stimulate labor market participation, and accelerate digitalization. Addressing persistent regional disparities is particularly important; by tailoring interventions to the specific needs of regions with low capability levels, this can contribute to reducing development gaps and promoting harmonious national development that prioritizes social integration.

The present study, though robust, has certain limitations. The time period (2015-2023) could be extended in the future to capture longer-term trends and to analyse the impact of specific economic shocks. Furthermore, the availability of more granular data or additional variables could allow for a finer analysis of sub-dimensions of capabilities or other factors influencing the relationship between capabilities and GDP. Subsequent academics endeavors could also explore models by which the capabilities influence economic growth (e.g., through innovation, entrepreneurship) or could utilize advanced methodologies to address potential endogeneity between capabilities and GDP.

The study operates at the NUTS 2 level due to the non-availability of harmonized data at a finer spatial resolution (NUTS 3), which remains a notable constraint for capturing intra-regional disparities. An analysis at a more granular level of aggregation, such as NUTS3, would offer a much more detailed perspective and better capture local disparities, which are essential in the context of human development. Extending the current research to the NUTS 3 level in the future once the necessary and adequate data become available is a logical progression, aimed at elucidating internal asymmetries that may be masked by aggregated NUTS 2 data. This will allow for a more nuanced evaluation of capabilities at the regional level and contribute to a deeper understanding of development dynamics.

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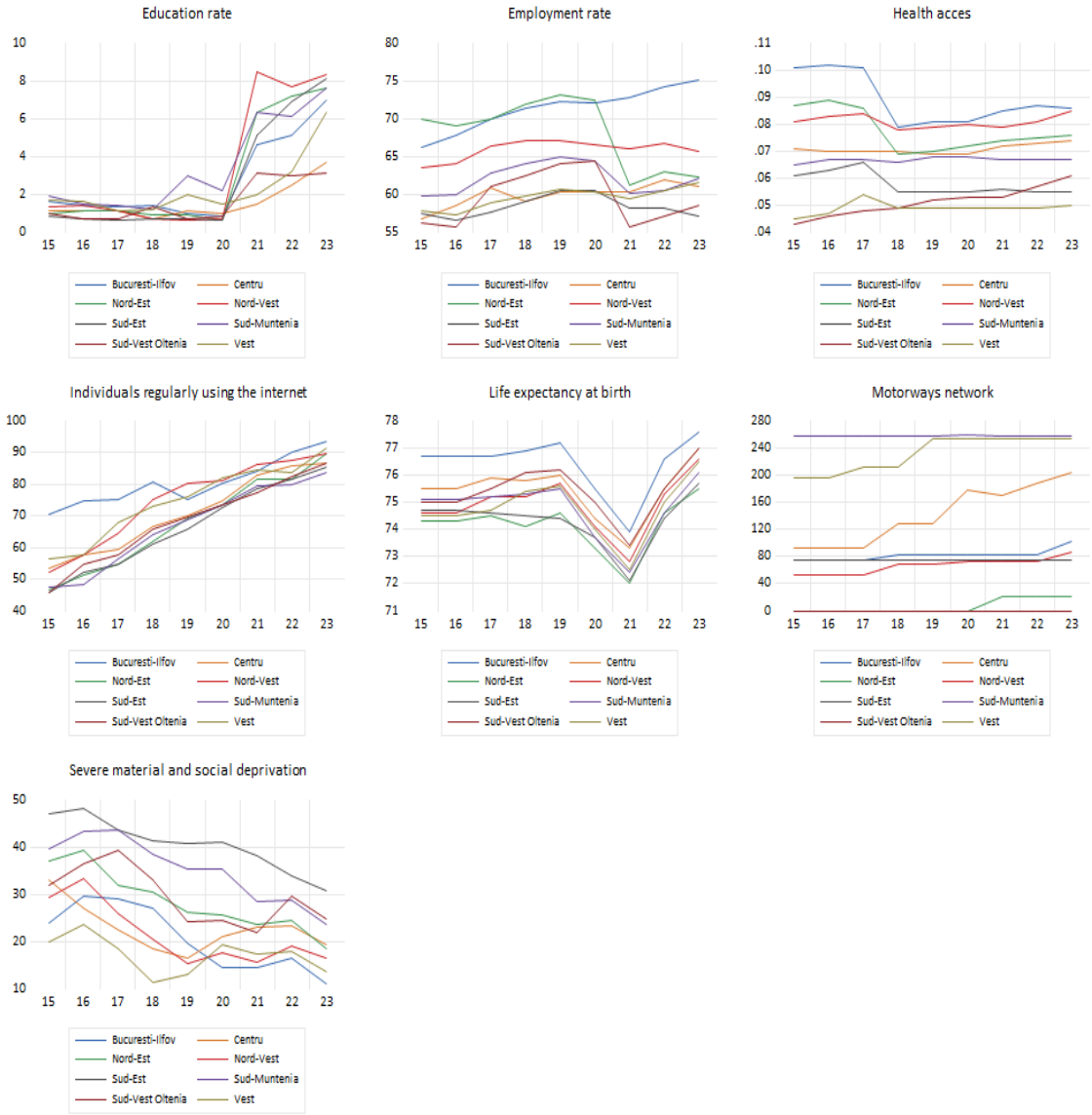
Annexes

Annex 1. Principal Component Graphic



Source: EViews output.

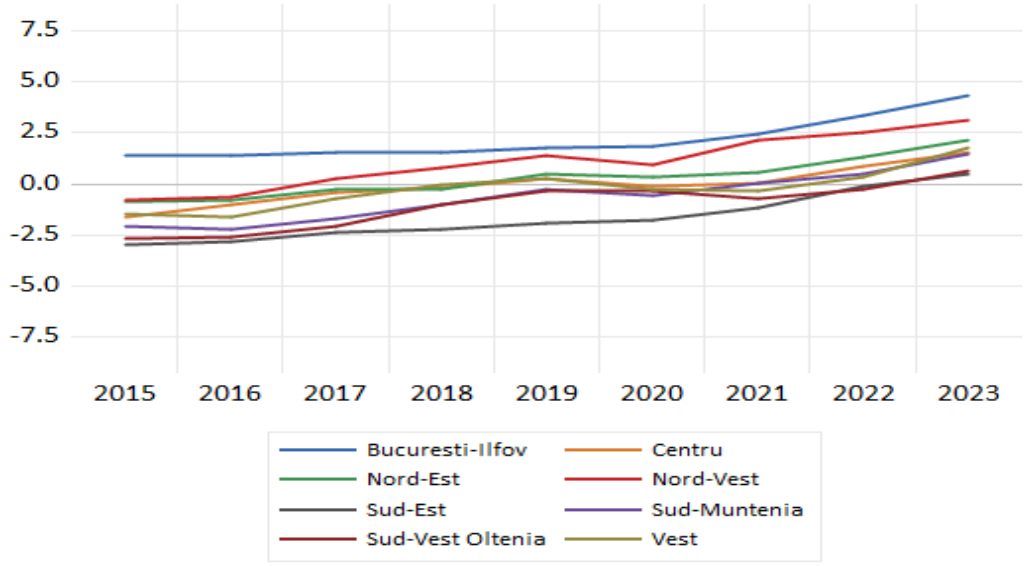
Annex 2. Capabilities Index by NUTS2

	EDUCATION RATE	EMPLOYM...	HEALTH A...	INDIVIDUA...	LIFE EXP...	MOTORW...	SEVERE ...
Bucuresti-Ilfov - 15	1.6	66.2	0.101	70.53	76.7	75	24
Bucuresti-Ilfov - 16	1.4	67.8	0.102	74.55	76.7	75	29.7
Bucuresti-Ilfov - 17	1.3	70	0.101	75.08	76.7	75	29
Bucuresti-Ilfov - 18	1.4	71.3	0.079	80.84	76.9	83	26.9
Bucuresti-Ilfov - 19	1	72.3	0.081	74.92	77.2	83	19.6
Bucuresti-Ilfov - 20	0.8	72.1	0.081	80.05	75.5	83	14.4
Bucuresti-Ilfov - 21	4.6	72.7	0.085	84.0699999...	73.9	83	14.4
Bucuresti-Ilfov - 22	5.1	74.2	0.087	90.16	76.6	83	16.3
Bucuresti-Ilfov - 23	7	75.1	0.08599999...	93.35	77.6	102	11.1
Centru - 15	1.1	56.7	0.07099999...	53.4	75.5	93	33.1
Centru - 16	1.1	58.4	0.07000000...	57.77	75.5	93	27
Centru - 17	1.1	60.8	0.07000000...	59.15	75.9	93	22.5
Centru - 18	0.7	59	0.07000000...	66.49	75.8	129	18.5
Centru - 19	1.1	60.2	0.069	69.91	76	129	16.3
Centru - 20	1	60.3	0.069	74.65	74.4	178	21.1
Centru - 21	1.5	60.3	0.072	82.91	73.3	170	23.1
Centru - 22	2.5	61.9	0.073	85.6800000...	75.5	188	23.3
Centru - 23	3.7	61	0.074	86.64	77	204	19.2
Nord-Est - 15	1	69.9	0.087	46.58	74.3	0	36.9
Nord-Est - 16	1.1	69	0.089	51.4	74.3	0	39.2
Nord-Est - 17	1.1	69.9	0.08599999...	54.55	74.5	0	32
Nord-Est - 18	0.9	71.8	0.069	62.12	74.1	0	30.4
Nord-Est - 19	0.9	73.1	0.07000000...	68.9599999...	74.6	0	26.1
Nord-Est - 20	0.6	72.5	0.072	73.28	73.3	0	25.6
Nord-Est - 21	6.3	61.1	0.074	81.63	72	20	23.6
Nord-Est - 22	7.2	63	0.075	81.64	74.6	20	24.4
Nord-Est - 23	7.6	62.2	0.076	89.56	75.5	20	18.3
Nord-Vest - 15	1.3	63.4	0.081	51.96	74.6	52	29.2
Nord-Vest - 16	1.4	64	0.083	57.7	74.6	52	33.3
Nord-Vest - 17	1.1	66.3	0.084	64.48	75.2	52	25.9
Nord-Vest - 18	0.7	67	0.078	75.25	75.2	68	20.4
Nord-Vest - 19	0.6	67	0.079	80.33	75.7	68	15.4
Nord-Vest - 20	0.7	66.5	0.08	80.98	74.1	73	17.7
Nord-Vest - 21	8.5	65.9	0.079	86.33	72.8	73	15.7
Nord-Vest - 22	7.7	66.7	0.081	87.42	75.3	73	18.9
Nord-Vest - 23	8.30000000...	65.7	0.085	89.39	76.6	86	16.3
Sud-Est - 15	0.8	57.5	0.061	45.86	74.7	74	46.9
Sud-Est - 16	0.7	56.5	0.063	52.23	74.7	74	48.1
Sud-Est - 17	0.6	57.6	0.066	54.89	74.6	74	43.5
Sud-Est - 18	0.7	59.1	0.055	61.04	74.5	74	41.3
Sud-Est - 19	0.7	60.4	0.055	65.7900000...	74.4	74	40.7
Sud-Est - 20	0.6	60.5	0.055	72.73	73.7	74	41.1
Sud-Est - 21	5.1	58.1	0.056	78.39	72.1	74	38.1
Sud-Est - 22	6.9	58.2	0.055	81.5400000...	74.4	74	34
Sud-Est - 23	8.1	57	0.055	85.13	75.7	74	30.8
Sud-Muntenia - 15	1.9	59.7	0.065	47.33	75.1	258	39.6
Sud-Muntenia - 16	1.5	59.9	0.067	48.47	75.1	258	43.2
Sud-Muntenia - 17	1.4	62.8	0.067	56.51	75.2	258	43.6
Sud-Muntenia - 18	1.2	64	0.066	64.22	75.3	258	38.5
Sud-Muntenia - 19	3	64.9	0.068	68.5400000...	75.5	258	35.3
Sud-Muntenia - 20	2.2	64.4	0.068	73.35	73.7	259	35.2
Sud-Muntenia - 21	6.3	60.1	0.067	79.3	72.4	258	28.4
Sud-Muntenia - 22	6.1	60.5	0.067	79.99	74.6	258	28.8
Sud-Muntenia - 23	7.6	62	0.067	83.45	76.1	258	23.7
Sud-Vest Oltenia - 15	1	56.2	0.043	45.64	75	0	32
Sud-Vest Oltenia - 16	0.7	55.7	0.046	54.62	75	0	36.5
Sud-Vest Oltenia - 17	0.7	61	0.048	57.62	75.5	0	39.2
Sud-Vest Oltenia - 18	1.3	62.5	0.049	65.67	76.1	0	33
Sud-Vest Oltenia - 19	0.7	64	0.052	69.4	76.2	0	24.1
Sud-Vest Oltenia - 20	0.8	64.4	0.053	73.52	75	0	24.5
Sud-Vest Oltenia - 21	3.1	55.6	0.053	77.31	73.4	0	21.8
Sud-Vest Oltenia - 22	3	57.1	0.057	82.52	75.5	0	29.6
Sud-Vest Oltenia - 23	3.1	58.5	0.061	86.72	77	0	24.8
Vest - 15	1.7	57.7	0.045	56.45	74.5	195	19.8
Vest - 16	1.6	57.2	0.047	57.84	74.5	195	23.6
Vest - 17	1.1	58.9	0.054	67.94	74.7	211	18.5
Vest - 18	1.2	59.7	0.049	72.87	75.4	211	11.3
Vest - 19	2	60.6	0.049	76.03	75.6	254	12.9
Vest - 20	1.5	60.3	0.049	82.05	74	253	19.2
Vest - 21	2	59.4	0.049	84.64	72.5	253	17.2
Vest - 22	3.2	60.4	0.049	83.6800000...	75	253	18
Vest - 23	6.3	61.6	0.05	91.13	76.5	253	13.7

	CAPABILITIES_INDEX
Bucuresti-Ilfov - 15	1.40668179...
Bucuresti-Ilfov - 16	1.39659527...
Bucuresti-Ilfov - 17	1.58931106...
Bucuresti-Ilfov - 18	1.52613665...
Bucuresti-Ilfov - 19	1.79581624...
Bucuresti-Ilfov - 20	1.88161569...
Bucuresti-Ilfov - 21	2.45180636...
Bucuresti-Ilfov - 22	3.38382582...
Bucuresti-Ilfov - 23	4.31324571...
Centru - 15	-1.5866038...
Centru - 16	-0.9876361...
Centru - 17	-0.4287534...
Centru - 18	-0.1592634...
Centru - 19	0.26205192...
Centru - 20	-0.1282949...
Centru - 21	0.03156757...
Centru - 22	0.87582161...
Centru - 23	1.55980028...
Nord-Est - 15	-0.8351516...
Nord-Est - 16	-0.7673908...
Nord-Est - 17	-0.2353993...
Nord-Est - 18	-0.2418402...
Nord-Est - 19	0.48169126...
Nord-Est - 20	0.37677097...
Nord-Est - 21	0.55819034...
Nord-Est - 22	1.35214866...
Nord-Est - 23	2.18416434...
Nord-Vest - 15	-0.7973022...
Nord-Vest - 16	-0.6653571...
Nord-Vest - 17	0.26967257...
Nord-Vest - 18	0.82289318...
Nord-Vest - 19	1.39289127...
Nord-Vest - 20	0.98068439...
Nord-Vest - 21	2.15405652...
Nord-Vest - 22	2.52536675...
Nord-Vest - 23	3.10942314...
Sud-Est - 15	-2.9914623...
Sud-Est - 16	-2.8438277...
Sud-Est - 17	-2.3718442...
Sud-Est - 18	-2.1777174...
Sud-Est - 19	-1.8733285...
Sud-Est - 20	-1.7644530...
Sud-Est - 21	-1.1842406...
Sud-Est - 22	-0.1305407...
Sud-Est - 23	0.52417770...
Sud-Muntenia - 15	-2.0505022...
Sud-Muntenia - 16	-2.1845464...
Sud-Muntenia - 17	-1.6475905...
Sud-Muntenia - 18	-1.0175511...
Sud-Muntenia - 19	-0.2429476...
Sud-Muntenia - 20	-0.5681405...
Sud-Muntenia - 21	0.01519305...
Sud-Muntenia - 22	0.46339908...
Sud-Muntenia - 23	1.51281243...
Sud-Vest Oltenia - 15	-2.6968684...
Sud-Vest Oltenia - 16	-2.5801063...
Sud-Vest Oltenia - 17	-2.0241043...
Sud-Vest Oltenia - 18	-1.0269435...
Sud-Vest Oltenia - 19	-0.2952490...
Sud-Vest Oltenia - 20	-0.3187455...
Sud-Vest Oltenia - 21	-0.7024531...
Sud-Vest Oltenia - 22	-0.2698825...
Sud-Vest Oltenia - 23	0.67360780...
Vest - 15	-1.4804031...
Vest - 16	-1.6250665...
Vest - 17	-0.6837404...
Vest - 18	-0.0244514...
Vest - 19	0.24884206...
Vest - 20	-0.2555669...
Vest - 21	-0.3450009...
Vest - 22	0.33856024...
Vest - 23	1.75144740...

Source: Generated by the author.

Annex 3. Capabilities_Index1 Graphic



Source: Eviews output.