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The articles published in SRDSJ Journal are in accordance with the approving dates by the anonymous reviewers.

Sustainable Regional Development Scientific Journal, Vol. I, (3), 2024 Editorial Note

In the second semester of 2024, the Sustainable Regional Development Scientific Journal (SRDSJ), published under the scientific aegis of the Albanian Association of Regional Scientists (A.A.R.S), launches the third (second regular) issue of its first volume (Vol. I) since the first day it was published. The SRDSJ is an international, open-access, and peer-reviewed journal that publishes research on various topics related to Regional Science and Sustainability. The journal aims to freely promote the academic dialogue in Regional Science worldwide, as well as to serve scientific research with solid quality standards in empirical, methodological, and theoretical contribution. It provides a platform for scholars, policymakers, and practitioners to share their research and insights on regional development, sustainability and its various dimensions.

Since July 2024, the SRDSJ has published 11 articles, on a wide range of topics (such as Regional Economics and Development; Spatial Analysis and Econometrics; Economic Geography and Transportation Economics; Urban Planning and Development; Tourism Economics and Development; Urban and Regional Sustainability; Regional Analysis and Policy; etc.). Serving its broad multidisciplinary scope, SRDSJ provides publication opportunities to researchers from various disciplines and an open-access platform for communicating regional science research and making it accessible to a wider audience. Also, SRDSJ supports a reasonably timely review process, promoting the academic dialogue by making scientific research accessible to the researchers' community in time.

The journal is indexed in various scientific databases (RePEc, EconPapers, RSAI, BnF) and its contribution to scientific research is accredited by scientific associations (such as Regional Science Association International, Albanian Association of Regional Scientists). Further, the SRDSJ has the merit to include in its editorial board reputable scholars from worldwide, who ensure that the published papers meet rigorous academic standards. Moreover, the SRDSJ systemically provides a forum for ideas exchange, news, and information, by covering topics of broader academic interest, such as events (conferences, workshops, and seminars), academic profiles (providing insights into the work and accomplishments of leading scholars in the field), and book reviews (offering a valuable service by summarizing and evaluating important publications). This broad academic framework enhances the value of SRDSJ as a resource for scholars and practitioners for readers interested in keeping up with the latest developments in Regional Science.

All these attributes and merits of SRDSJ have been so far fertile and promising for the journal's future path. Following this reputed heritage, the RSJ continues working hard toward providing a reputable and respected publication, along with a valuable platform for high-quality research for anyone interested in regional science, regional development, and related fields. In this semester, the current issue (SRDSJ, Vol. I, Issue 3, December, 2024) includes five (5) papers, which were carefully selected from a large pool of submissions so that to comply with the high journal's standards. These papers deal with modern and interesting topics of Regional Science research, such as regional economic resilience; labor market behavior and economic growth; public land transportation, air transport, and regional development; and business and entrepreneurship and economic growth.

In brief, the first paper, titled "*CLUSTERS AS ENGINES OF SUSTAINABLE EMPLOYMENT GROWTH IN ROMANIA*", authored by Cristina LINCARU, Gabriela TUDOSE, Daniel COSNITA, Speranța PIRCIOG, Adriana GRIGORESCU, and Vasilica CIUCA, examines the extent to which clusters act as accelerators of employment growth over time and space in Romania. Building on Linear Regression and time data from the Romanian Association of Clusters (CLUSTERO) and the National Institute of Statistics (Tempo INS), the paper assess whether the ratio of employment in clustered firms relative to total employment shows a positive trend over time, finding that clusters contribute significantly to employment growth, validating their function as a strategic asset in enhancing workforce specialization, economic development, and regional resilience. The study formulates recommendations toward the need for inclusive growth strategies incorporating sustainability to maximize cluster impact on social and economic objectives.

The second paper, titled "*USING QUANTITATIVE TOOLS TO UNDERSTAND POLITICAL ISSUES*", authored by Petraq PAPAJOJGI and Ardita TODRI, is motivated by recent thorny political issues and applies a Mind Genomics experiment designed to investigate the Americans' perceptions about the collaboration origins of insurrection. By considering four categories: Ordinary People; Leaders; The political world; and Personages, the study shows higher impact values of the answers for category "The Political World" that could solve complex social and political issues the USA is facing today, while the higher impact values for the vital performing elements in the teens provides insights into the existence of bias over the selection groups of respondents with similar points of view, with these strong points of view not being diluted.

The third paper, titled “*ANALYZING THE SPATIAL INTERACTIONS IN THE NATIONWIDE REGIONAL CAPITALS NETWORK OF GREECE*”, authored by Dimitrios TSIOTAS and Serafeim POLYZOS, studies the spatial interactions of the nationwide regional (NUTS III) capitals network in Greece, using complex network analysis and comparative methods. The study detects the topological characteristics of the nationwide spatial network composed of regional capitals and to examine how this network serves and promotes regional development. The analysis highlights the impact of spatial constraints on the network; provides information on the major infrastructure projects that have developed in the road transport sector and affected the country’s transport capacity; outlines the gravitational dimension of the nationwide spatial interconnectivity phenomenon; and, overall, highlights the effectiveness of complex network analysis in the modeling spatial networks and transport systems, and promotes the network paradigm in spatial and regional economics’ research.

The fourth paper, titled “*KOSOVO EMPLOYEE’S PERCEPTION OF ECONOMIC GROWTH AND DECENT WORK ACCORDING TO SUSTAINABILITY*”, authored by Petraq Filipos RUXHO, examines how employees of the public and private sector in Kosovo perceive the implementation of SDG 8 “Decent work and economic growth” deriving from the UN Sustainable Development Goals. Building on a primary data research consisting of 201 respondents, the analysis provides insights into considering no significant difference between perceptions of females and males about the economic growth in the country and impact on incomes; a moderate relation between economic growth related and the opportunity of being able to cover basic living expenses; a moderate accosiation between the perceptions of the integrity protection at workplace and the ability to cover basic living expenses; and a moderate relation between safety and physical security at workplace and economic growth.

Last but not least, the fifth paper, titled “*THE PREDICTIVE POWER OF TECHNICAL ANALYSIS: EVIDENCE FROM THE GBP/USD EXCHANGE RATE, Miguel LAMPREIA*”, authored by Fernando TEIXEIRA and Susana Soares Pinheiro Vieira PESCADA, examines the effectiveness of technical analysis in the foreign exchange market, focusing on the GBP/USD currency pair in 2019. By combining historical and granular analysis, the research leverages various technical tools, including trendlines, support and resistance levels, Fibonacci retracements, chart patterns, and candlestick formations. The study demonstrates the predictive power of these tools in identifying market trends, pinpointing potential reversals, and uncovering trading opportunities. This highlights the value of technical analysis for informed decision-making in the complex foreign exchange market.

All these interesting works are available on the next pages of the SRDSJ intending to promote the academic dialogue in Regional Science. Overall, the Editor in Chief, Professor Assistant Filipos A. Ruxho, the Editorial Board, and the signatory of this Editorial Note welcome the reader to the multidisciplinary journey of Sustainable Regional Development Scientific Journal that the current issue promises on its following pages.

On behalf of the Editorial Board
Assistant Professor **Dimitrios Tsiotas**

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Articles

CLUSTERS AS ENGINES OF SUSTAINABLE EMPLOYMENT GROWTH IN ROMANIA¹

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Abstract

The imperative for sustainable growth has elevated clusters as pivotal tools for economic and social inclusion, fostering job creation, equitable income distribution, and regional competitiveness. A cluster comprises interrelated companies and institutions in close geographical proximity, establishing expertise and a robust network of suppliers and skills. Clusters enhance productivity and catalyze development by concentrating enterprises and labor within a unified framework, surpassing isolated firms in regional impact. This study aims to examine whether clusters act as accelerators of employment growth over time and space. Using Simple Linear Regression (SLR) to analyze data from the Romanian Association of Clusters (CLUSTERO) and the National Institute of Statistics (Tempo INS) for 2013, 2015, 2019, and 2022, we investigate the research question: Do firms within clusters, as defined by European Policy criteria, contribute to accelerating employment creation? Specifically, we assess whether the ratio of employment in clustered firms relative to total employment shows a positive trend over time. Findings reveal that clusters contribute significantly to employment growth, validating their function as a strategic asset in enhancing workforce specialization, economic development, and regional resilience. Policy recommendations underscore the need for inclusive growth strategies that incorporate sustainability to maximize cluster impact on social and economic objectives.

Keywords: Clusters, Employment creation, Economic growth, Sustainability, Social inclusion

JEL Classification: L52, R11, O18, Q56, J23

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Terceira Island, Azores, Portugal & Virtual, Special Session Proposal Leave no one behind! The role of the EU Cohesion Policy in a changing world, Special Session: S47 Leave No One Behind! The Role of The EU Cohesion Policy in a Changing World ** Online/Onsite (Terceira) Daniela-Luminita Constantin, Erika Marin, Bucharest University of Economic Studies, Romania; Cristina Serbanica - "Constantin Brancoveanu" University of Pitesti, Romania, Onsite in Terceira Island, Azores, Portugal & Virtual, <https://az659834.vo.msecnd.net/eventsairwesteurop/production-ersa-public/3eb6afd2f7c94baa83d862dadd20b086>

Introduction

Clusters, defined as groups of geographically proximate companies, related economic actors, and institutions with specialized expertise, have been recognized as catalysts for both economic and social development. The formation of clusters leads to the multiplication and specialization of enterprises and the workforce, potentially accelerating employment creation (Porter 1990). This paper explores the theoretical and empirical evidence supporting the role of clusters in enhancing employment opportunities (Delgado, Porter, and Stern 2014).

1.1. Theoretical Background

The development of clusters over time and space provides empirical evidence supporting the theoretical assumption that clusters are effective in boosting employment and driving economic growth. Clusters foster increased efficiency and productivity through enterprise multiplication and specialization, highlighting the benefits of a concentrated network of companies and institutions in stimulating economic activity (Marshall 1890). The implications of cluster development extend beyond job creation to broader economic growth and social progress, supporting balanced regional development by reducing regional disparities and promoting inclusive growth strategies (European Commission 2021).

Support from entities such as the Romanian Ministry of Research and Innovation underscores the significance of advanced research, including GIS modelling, in understanding labour market trends and fostering innovation within clusters (Romanian Ministry of Research and Innovation 2023). Additionally, the **European Industrial Policy and Competitiveness approach** emphasizes the high importance of clusters. Beyond their geographical conceptualization, clusters are certified based on quality criteria:

- **By Activity Domain:** Membership in any of the industrial ecosystems.
- **International Networking and Connectivity:** Registration with the European Cluster Collaboration Platform (ECCP) or national association CLUSTERO.
- **Management and Administration:** Recognition by the Romanian Ministry of Economy, Entrepreneurship, and Tourism.

1.2. Goals of the Paper

This paper aims to investigate whether firms that are members of clusters, as defined by European policy criteria, contribute to accelerating employment creation. Specifically, it examines if there is a positive relationship over time between the ratio of employment in cluster-member firms and total employment in all firms.

To achieve this goal, the paper will:

Analyse the impact of cluster membership on employment growth within firms.

- Evaluate the sustainability of cluster development while achieving rapid economic growth.
- Propose strategies for policymakers to balance economic growth with long-term sustainability and social equity.

1.2.1. Research Question

Do firms that are members of clusters, defined by European policy criteria, contribute to accelerating employment creation? In relative terms, does the ratio between employment in cluster-member firms and total firm employment show a positive trend over time?

Literature Review

2.1 Theoretical Framework

Marshall's early 20th-century theories proposed that firms co-locate to reduce costs related to the transportation of goods, people, and ideas. This concept of agglomeration has since led to the emergence of high-tech clusters in cities like San Francisco and Boston, as well as industrial clusters, such as the automotive industry in Detroit (Marshall 1890). Cluster agglomeration plays a crucial role in job creation, driving both economic development and innovation. Forces such as reduced costs, increased productivity, and regulatory pressures that encourage innovation further underscore the benefits of clusters (Porter 1990; Porter and van der Linde 1995).

In the context of sustainability, clusters support regional resilience by concentrating resources, expertise, and infrastructure, which collectively promote efficiency and reduce environmental impact. According to Porter and van der Linde (1995), environmental regulations can also spur innovation within clusters, as firms seek competitive advantages by optimizing resources and minimizing waste. Consequently, clusters foster a more sustainable economic ecosystem where companies not only reduce costs but also contribute to broader environmental goals. The concentration of industries within clusters further amplifies knowledge sharing and collaboration on sustainable practices, reinforcing the alignment of economic growth with environmental and social objectives.

2.2 Previous Studies

Studies have further developed Marshall's theories by quantifying the factors contributing to cluster formation. O'Clery et al. (2019) used network-based methods to assess the roles of customer-supplier relationships, labour sharing, and idea exchange in cluster formation, finding that these factors significantly influence cluster dynamics. Gomez-Lievano and Fragkias (2024) expanded this research with insights from urban complexity theory and urban scaling, illustrating how city size and economic complexity impact cluster resilience. Additional research highlights that large cities tend to be more resilient to automation impacts on employment, largely due to their specialized labor markets (Frank et al. 2017). Ladas and Ruxho (2024) further emphasized the role of regional economic indicators in identifying economic disparities and shaping policies for balanced regional development. Their research underscores the importance of tailored strategies for mitigating economic disparities across regions, which is crucial for fostering cluster formation and supporting sustainable economic growth.

Clusters have been recognized as catalysts for economic growth, regional resilience, and employment creation, particularly in developing economies. Studies highlight the role of clusters in fostering specialization and collaboration, which enhance productivity and innovation. For instance, Lincaru et al. (2020) demonstrate the utility of GIS and multivariate clustering in analyzing employment patterns within tourism sectors at the local level, emphasizing the spatial dynamics of cluster-based employment growth. Furthermore, Stroe and Lincaru (2022) underscore the socioeconomic impact of clusters in mitigating rural poverty and breaking cycles of economic decline, showcasing their potential to address regional disparities. In exploring labor market challenges, Stroe and Cojanu (2018) provide insights into in-work poverty dynamics, highlighting how cluster strategies could amplify social inclusion efforts by integrating vulnerable workforce segments. Additionally, Stroe (2022) analyzes the effectiveness of guaranteed minimum income programs as tools for enhancing resilience and employment among disadvantaged groups, aligning these findings with the broader objectives of cluster policies to foster equitable growth.

The study of regional inequalities has garnered significant attention within both academic and policy-making circles. Ladas et al. (2009) present a comprehensive methodology for depicting and analyzing regional disparities in Greece, emphasizing the spatial dimensions of economic imbalances. This work aligns with broader efforts to understand and address disparities through sustainable development strategies. Further exploring the intersection of sustainability and regional development, Amoiradis et al. (2012) highlight Greece's potential as a sustainable tourism destination, offering insights into balancing economic growth with environmental preservation. Ladas's contributions extend to environmental attitudes, where Goula et al. (2016) investigate the influence of urban and rural origins on eco-conscious behaviors, underscoring the role of regional and cultural factors. Collectively, these studies provide a foundational framework for addressing regional inequalities through integrated, sustainability-driven approaches.

The role of government policies in promoting green industries has been extensively studied, with particular emphasis on their spatial distribution and economic impact. Park and Lee (2017) analyze

the development of green industries in South Korea, **applying a panel regression model** to identify spatial patterns and assess the effectiveness of policy interventions from 2006 to 2012. Their findings underscore the importance of strategic regional policies in fostering sustainable industrial growth, which is crucial for addressing disparities and achieving long-term economic and environmental goals.

2.3 Research Gaps

Although existing research supports the economic benefits of clusters, several gaps remain. One is the challenge of precisely measuring agglomeration economies due to factors such as self-selection, where more productive individuals are drawn to larger cities, creating an effect independent of clustering itself (Gomez-Lievano and Fragkias 2024). Additionally, while research acknowledges the potential for clusters to drive employment, there is limited empirical evidence on how cluster membership impacts job creation relative to non-cluster firms over time.

2.4 Concepts and Definitions

Clusters, according to the European Commission (**Appendix 1**), are defined as "geographically proximate groups of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standards agencies, trade associations) in particular fields that both compete and cooperate." This concept emphasizes that clusters encourage collaboration, innovation, and productivity by pooling resources, specialized labour, and knowledge-sharing networks (European Commission 2021). These elements contribute to enhanced economic growth and competitiveness, particularly when supported by EU initiatives like Smart Specialization Strategies (S3) and the Europe 2020 Strategy.

Methodology

3.1 Research Design

This study adopts a quantitative research design to investigate how company membership in clusters contributes to accelerated job creation. The primary goal is to test whether the ratio between employment in cluster-member firms and total firm employment has a positive relationship with time, suggesting a faster increase in employment within clusters compared to the national average (Lincaru et al. 2024). This research is based on regionally collected data (NUTS 2) and applies statistical methods to highlight trends over time.

3.2 Data Collection

We use data for the statistics of firms in clusters by the definition of Clusters in European Policy provided by CLUSTERO – Romania and statistics for all the firms provided by National Statistics Institute.

Clusters are described in complex manner, beyond the geographical proximity of the companies in the same domain are respond also to the criteria interconnection and association, according to the Definition of Clusters in European Policy.

Data was collected from national sources, including the Romanian Cluster Association (CLUSTERO) and the National Institute of Statistics (INS). CLUSTERO provides data on the number of firms and employees in Romanian clusters (Table 1), while INS offers national statistics on total firms and employees. (Table 2) The dataset spans the years 2013, 2015, 2019 and 2022 and includes variables such as the number of firms and employees in clusters compared to regional totals. Specifically, the analysis uses the INS indicator *TEMPO_INT102D_20_8_2024*, which includes data on active local unit personnel by national economic activities, CAEN Rev.2 section levels, company size classes, macro-regions, development regions, and counties (National Institute of Statistics 2024).

The Table 1 shows the evolution of employed persons in active enterprises from registered clusters across various regions in Romania from 2013 to 2022, highlighting a significant national increase in employment, with a 2022/2013 ratio of approximately 3.45 (from 71,169 in 2013 to 245,856 in 2022). Notable regional variations include substantial growth in Bucharest-Ilfov, which recorded the highest increase with a ratio of 4.42, followed closely by North-West with a ratio of 4.21. In contrast, the Center region shows a modest increase (ratio of 1.06), while regions like South and South-West present significant declines or incomplete values, reflecting disparate economic growth and employment patterns across the regions.

Table 1. Employed persons in active enterprises from registered Clusters (persons)

	Oc_CL 2013	Oc_CL 2015	Oc_CL 2019	Oc_CL 2022
Total	71169	103925	189193	245856
Bucuresti Ilfov	12200	17321	32903	53894
Centru	18301	27218	45242	19338
Nord Est	4067	7423	12339	6208
Nord Vest	12200	17321	32903	51388
Sud	2033	2474	8226	1800
Sud Est	10167	14846	28790	4928
Sud Vest	4067	4949	8226	?
Vest	8134	12372	20564	8780

Source: Sursa: Asociația Clusterelor din România –CLUSTERO

The Table 2 shows the change in employment in active enterprises across various regions in Romania from 2013 to 2022, with a national growth ratio of approximately 1.07 (from 3.98 million persons in 2013 to 4.26 million persons in 2022). Significant regional differences are evident, with Bucharest-Ilfov leading in growth with a ratio of 1.19, indicating a substantial increase in employment over this period. The North-East and North-West regions also show notable growth ratios of 1.10 and 1.10, respectively. In contrast, regions like the Center and South-East display more modest increases, with ratios close to 1.03 and 0.95, respectively, reflecting a slower employment growth rate in these areas. These variations highlight the uneven economic dynamics and employment opportunities across Romania's regions.

Table 2. Employed persons in active enterprises all firms (persons)

	Oc_ 2013	Oc_ 2015	Oc_ 2019	Oc_ 2022
Total	3979678	4054082	4284738	4255995
Bucuresti Ilfov	971631	1009465	1111698	1153753
Centru	520933	519189	555592	535600
Nord Est	385784	386098	419354	425474
Nord Vest	528051	556808	591359	580561
Sud	445488	450868	466989	458461
Sud Est	422828	420389	414179	403579
Sud Vest	292078	286418	299879	295257
Vest	412885	424847	425688	403310

Source: Tempo INS TEMPO_INT102D

3.2.1. Cluster Initiatives in Romania

As per the latest records by the Ministry of Economy, Directorate of Industrial Policies and Competitiveness, Romania has 78 cluster initiatives. Of these, 53 clusters are members of the Romanian Cluster Association (CLUSTERO), including two from the Republic of Moldova. CLUSTERO serves as a community for best practices and represents clusters nationally, across Europe, and internationally (CLUSTERO 2024).

a) European Certification of Romanian Clusters

The **European Secretariat for Cluster Analysis** (ESCA) conducted a rigorous certification process, categorizing the clusters as follows:

- Seven clusters with the Gold Label (the highest performance level in Eastern Europe),
- Twelve clusters with the Silver Label,
- Forty-one clusters with the Bronze Label.

b) Regional and Thematic Cluster Consortia

Romanian clusters are organized into regional and thematic consortia to enhance collaboration. These include:

- **Consortium of Clusters from Northern Transylvania** (North West Region),
- **Consortium of Clusters from Transylvania** (Central Region),
- **Consortium of Clusters from the North East Region**,
- **"Lower Danube" Cluster Consortium** (South East Region),
- **Wallachia Hub** (South Muntenia Region),
- **Consortium of Clusters from the Bucharest-Ilfov Region**.

Additionally, thematic consortia focus on specific industries:

- **"Noatex"** for the textile industry,
- **Wood and Furniture Industry Consortium**,
- **Agro-Food Sector Consortium**,
- **Medical Field Consortium "MEDRO"**,
- **ICT Field Consortium**,
- **Ecological Agriculture Consortium "Inter-Bio"** (CLUSTERO 2024).

c) Distribution and Industrial Ecosystem Coverage

Romanian clusters span 12 of the 14 European industrial ecosystems, excluding Commerce and Social Economy. The highest concentrations are in the Agri-Food and Digital sectors, with 12 clusters each, followed by Renewable Energy and Construction, with nine clusters each.

d) Regional Distribution:

- The **Bucharest-Ilfov** region hosts the most clusters (20),
- The **Center Region** follows with 14 clusters,
- The **South East Region** has 11 clusters.

A total of 62 Romanian clusters are registered on the **European Cluster Collaboration Platform (ECCP)**, demonstrating their integration into broader European cluster networks (ECCP 2023).

3.3 Analysis Methods

The primary analysis method is **Simple Linear Regression (SLR)**, applied to determine whether a significant relationship exists between the dependent variable Oc_cl/Oc and the independent variable t (year: 2013, 2015, 2019, 2022) at regional level NUTS 2 (8 regions). The analysis involves 8 steps.

3.3.1. Dependent Variable (Oc_cl/Oc)

The dependent variable in this analysis, Oc_cl/Oc , represents the employment ratio of cluster-member firms relative to total employment in firms within a given region. This ratio is calculated by dividing the number of employees in firms belonging to clusters (Oc_cl) by the total number of employees in all firms within the region (Oc). Mathematically, it is expressed as:

$$Oc_cl/Oc = \frac{Oc_cl}{Oc} | Ri_{tj} \quad (1)$$

Oc_cl - the number of employees in cluster-member firms.(Table 1)

Oc - the total number of employees in all firms within a region. (Table 2)

Oc_cl/Oc , represents the employment ratio of cluster-member firms relative to total employment in firms within a given region

Ri – region NUTS 2 level from 1 to i (8 regions)

tj – time for Surveys (from $j=1$ to 4)

This formula calculates the ratio of employment in cluster-member firms to total employment, providing a measure of the clusters' contribution to regional labour force employment.

The significance of this variable lies in its ability to illustrate the concentration and growth of employment within clusters as compared to the overall labour market. A higher Oc_cl/Oc ratio suggests that clusters contribute a substantial share to regional employment, indicating the role of clusters as potential accelerators of job creation. By tracking changes in this ratio over time, we can assess whether clusters are indeed fostering employment growth at a faster pace than the general economy.

Results are interpreted by evaluating regression coefficients, the R-squared value, and statistical significance (Montgomery, Peck, and Vining 2012).

3.3.2. Methodological Steps for Simple Linear Regression (SLR)

We run the (SLR) to understand if there is any relationship between two continuous variables: the time as independent variable (predictor) and **Oc_cl/Oc** as dependent variable (outcome). For this purpose we execute the following steps:

Step 1. Formulate the Hypotheses:

- **Null Hypothesis (H₀):** There is no relationship between the independent variable “t” and the dependent variable “**Oc_cl/Oc**”
- **Alternative Hypothesis (H₁):** There is a significant relationship between the independent variable “t” and the dependent variable “**Oc_cl/Oc**”

Step 2. Collect the Data from Clustero and Tempo INS (see 3.2)

Step 3. Pre-process the Data:

- **Calculate the ratio** for the Employment in firms’ members in Clusters to Employment in all firms by region (NUTS 2) in years 2013, 2015, 2019 and 2022 (see Table 3)
- **exclusion** as Outlier of the value of Oc_CL_2022

Step 4. Step-by-Step Check for Linear Regression Assumptions

Step 4.1. Linearity. To check if there is a linear relationship between the independent variable (t) and the dependent variable (Oc_cl/Oc):

- **Visual Inspection:** Create a scatter plot of Oc_cl/Oc against t.
- **Correlation Coefficient:** Calculate Pearson's correlation coefficient to see the strength and direction of the linear relationship.

Step 4.2. Independence of Residuals. To ensure the residuals are independent: **Durbin-Watson Test:** This test detects the presence of autocorrelation in the residuals from a regression analysis. A value close to 2 suggests that there is no autocorrelation, while a value closer to 0 or 4 indicates positive or negative autocorrelation, respectively. (Durbin and Watson 1950).

Step 4.3. Homoscedasticity. Homoscedasticity means that the residuals should have constant variance across all levels of the independent variable.

- **Visual Inspection:** Create a scatter plot of residuals against the predicted values. The spread of residuals should be roughly constant across all levels of the predicted values.
- **Breusch-Pagan Test:** This is a formal statistical test for homoscedasticity. A non-significant result (p-value > 0.05) indicates that the assumption is met. (Breusch and Pagan 1979).

Step 4.4. Normality of Residuals The residuals should be normally distributed if it happens:

- **the Histogram** follow a normal distribution
- **Q-Q Plot:** A quantile-quantile (Q-Q) plot can be used to check if the residuals are normally distributed. Points should lie approximately on the diagonal line if the residuals are normally distributed.
- **Shapiro-Wilk Test:** This statistical test formally checks the normality of residuals. A non-significant result (p-value > 0.05) suggests normality.

Step 5. Perform the Simple Linear Regression:

- Use SPSS statistical software to perform the regression.
- Fit the regression model using the formula:

$$\text{Oc_cl/Oc} | R_{i,t} = \beta_0 + \beta_1 t + \epsilon \quad (2)$$

Where:

Oc_cl/Oc | $R_{i,t}$: the dependent variable, representing the employment ratio of cluster-member firms relative to total employment within a specific region R_i over time t .

β_0 : the intercept, representing the baseline employment ratio across all regions and times.

β_1 : the slope (regression coefficient) for time t , indicating how the employment ratio changes over time.

t : the independent variable representing time (survey periods).

ϵ (epsilon): the error term, accounting for residual variation in the employment ratio not explained by region or time.

Step 7. Report the Findings:

Report the regression results, including the coefficients, R^2 value, and significance levels, and interpret the findings in the context of the research question. For instance, a positive and significant regression coefficient would indicate a growing trend in the employment ratio within clusters over time, relative to total employment. It's essential to discuss any model limitations, such as high

variability across regions, that may affect the interpretation of results (Montgomery, Peck, and Vining 2012).

Include visualizations, such as scatter plots with the regression line, to illustrate the relationship between the variables and help readers visualize trends in the data. Visual aids provide an intuitive grasp of the model fit and can highlight any deviations from the assumed linear relationship, making the findings more accessible and meaningful (Fox and Weisberg 2019).

Step 8. Draw Conclusions and Recommendations:

Based on the results, draw conclusions regarding the relationship between the variables and suggest potential implications or recommendations for further research. (Durbin and Watson 1950; Breusch and Pagan 1979).

Results/Analysis

4.1 Descriptive Analysis

The Table 3 illustrates the ratio of employed persons in firms from registered clusters to the total employed persons at the NUTS 2 level across Romanian regions from 2013 to 2022. At the national level, this ratio increased substantially from 1.79 in 2013 to 5.78 in 2022, indicating a significant rise in cluster employment's share within the overall workforce. Bucharest-Ilfov saw a notable increase in this ratio, reaching 4.67 in 2022, reflecting the region's dynamic cluster growth. The North-West region displayed the highest ratio by 2022, reaching 8.85, while regions like the South and South-East showed low ratios (0.39 and 1.22, respectively), highlighting less integration into cluster-based employment. These disparities underscore the varying regional roles of cluster employment within Romania's broader labor market dynamics.

Table 3. Ratio of employed persons from firms in registered clusters to total employed persons at NUTS 2 level

	Oc_cl/Oc 2013	Oc_cl/Oc 2015	Oc_cl/Oc 2019	Oc_cl/Oc 2022
Total	1,79	2,56	4,42	5,78
București Ilfov	1,26	1,72	2,96	4,67
Centru	3,51	5,24	8,14	3,61
Nord Est	1,05	1,92	2,94	1,46
Nord Vest	2,31	3,11	5,56	8,85
Sud	0,46	0,55	1,76	0,39
Sud Est	2,40	3,53	6,95	1,22
Sud Vest	1,39	1,73	2,74	
Vest	1,97	2,91	4,83	2,18

Source: calculated by authors

The increasing ratios of employed persons in registered clusters relative to total employment suggest a growing significance of cluster-based firms within Romania's economy, particularly in regions like North-West and Bucharest-Ilfov. This trend indicates a regional concentration of economic activity and employment opportunities within clusters, reflecting advancements in specialization, collaboration, and productivity. However, the much lower ratios in regions like South and South-East suggest an uneven distribution of cluster development, pointing to regional disparities in economic modernization and the benefits associated with cluster-based employment. Overall, this trend highlights a shift towards clustered economic structures, which may drive innovation and competitiveness, but also underscores the need for balanced regional development to ensure inclusive economic growth across all regions.

4.2 Key Findings

Step 4.1. Linearity.

- **Visual Inspection:** See in Figure 1 the scatter plot of Oc_cl/Oc against t. Points form a roughly straight line, this suggests a linear relationship by each NUTS 2 region.

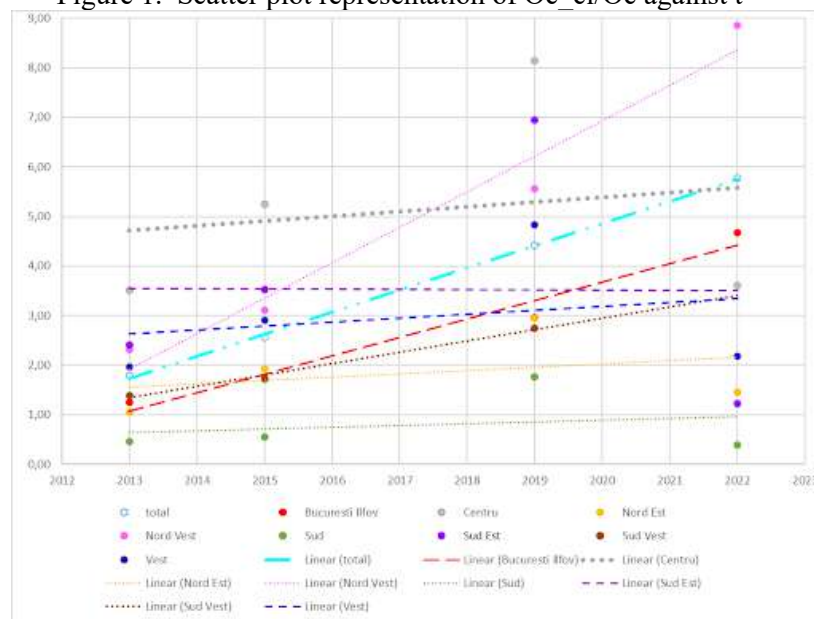
The scatter plot in Figure 1 illustrates the employment ratio **Oc_cl/Oc** for cluster-member firms relative to total employment in active firms across various regions in Romania over the years 2013,

2015, 2019, and 2022. Each region is represented with a different color and marker, with trend lines indicating the general direction of the employment ratio over time. We remark:

- **North-West** (pink dashed line) shows the steepest increase, suggesting a significant rise in the employment ratio for cluster-member firms in this region, indicating stronger cluster growth relative to total employment.
- **Bucharest-Ilfov** (dashed red line) and **Total** (light blue dashed line) also display upward trends, though at a more moderate rate than North-West. This suggests that cluster employment is growing steadily in these areas.
- **South-East** (purple dotted line) shows a declining trend, indicating a decrease in the employment ratio for cluster-member firms in this region over time.
- **South** (green dotted line) shows a relatively stable trend with minimal increases, indicating a slower rate of cluster employment growth compared to other regions.
- **South-West** (brown dotted line) and **Vest** (dark blue solid line) display less clear or fluctuating patterns, which may indicate variable cluster employment dynamics or regional differences in the impact of cluster development.

Overall, the plot demonstrates regional variability in the role of clusters in employment, with certain regions showing strong, consistent growth in cluster employment relative to the total workforce, while others exhibit less pronounced trends. The trends suggest that clusters contribute increasingly to employment in certain regions, underscoring the potential for regional policies to leverage cluster-based development as a strategy for economic growth.

Figure 1. Scatter plot representation of Oc_cl/Oc against t



Source: Graphic created by authors

○ **Correlation Coefficient:**

Table 4 displays the Pearson correlation coefficients between the variables OcCl_OC and t.

Table 4. Pearson Correlations between the variables OcCl_OC and t.

		OcCl_OC	t
Pearson Correlation	OcCl_OC	1.000	.395
	t	.395	1.000
Sig. (1-tailed)	OcCl_OC		.009
	t	.009	
N	OcCl_OC	35	35
	t	35	35

Source: calculated by authors

The results interpretation is:

1. Pearson Correlation

- **OcCl_OC with OcCl_OC:**

- The Pearson correlation of OcCl_OC with itself is 1.000, as any variable is perfectly correlated with itself.

- **OcCl_OC with t:**

- The Pearson correlation coefficient between OcCl_OC and t is **0.395**.
- This indicates a **moderate positive correlation**, meaning that as t increases, OcCl_OC tends to increase as well. However, the correlation is not very strong.

- **t with t:**

- The Pearson correlation of t with itself is also 1.000.

2. Significance (Sig. 1-tailed)

- **OcCl_OC with t:**

- The p-value (Sig.) for the correlation between OcCl_OC and t is **0.009** (one-tailed test).
- Since this p-value is less than 0.05, the correlation is **statistically significant**. This means there is a statistically significant positive relationship between OcCl_OC and t, and the likelihood that this correlation is due to chance is very low.

3. N (Sample Size)

- The sample size (N) for both OcCl_OC and t is **35**.

Step 4.2. Independence of Residuals. Durbin-Watson: The value is **1.506**.

- This statistic tests for autocorrelation in the residuals from a statistical regression analysis. The value ranges from 0 to 4, where:

- A value of 2 means no autocorrelation.
- A value less than 2 indicates positive autocorrelation.
- A value greater than 2 indicates negative autocorrelation.

A value of 1.506 suggests that there is some positive autocorrelation, but it's not too strong. Autocorrelation is generally a concern in time series data or when observations are not independent. (Montgomery, Peck, and Vining 2012, 206) Then, The Durbin-Watson statistic suggests some positive autocorrelation in the residuals, but it's not excessive.

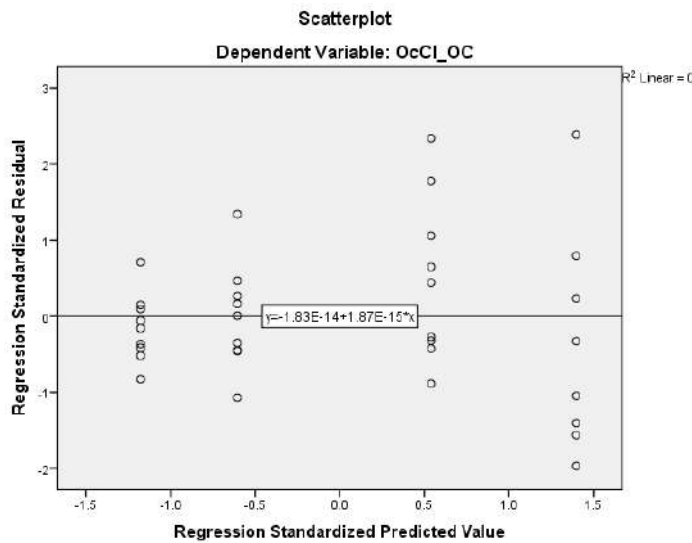
Step 4.3. Homoscedasticity.

In the Figure 2 which represents the Residuals vs. Predicted Values Scatterplot for Assessing Homoscedasticity in OcCl_OC Regression Model the scatterplot:

- The points appear fairly evenly distributed around the horizontal line, without any obvious pattern of increasing or decreasing spread.
- This suggests that the assumption of homoscedasticity is likely met, as there is no strong indication of a systematic change in the variance of residuals across different predicted values.

If further verification is needed, statistical tests such as the Breusch-Pagan test can also be used to formally test for homoscedasticity.

Figure 2. Residuals vs. Predicted Values Scatterplot for Assessing Homoscedasticity in OcCl_OC Regression Model



Source: Graphic created by authors

Breusch-Pagan Test: While p-value < 0.05 then the assumption of homoscedasticity is violated.

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	245.007	1	245.007	9.523	.004 ^b
	Residual	848.989	33	25.727		
	Total	1093.996	34			

a. Dependent Variable: Sqres

b. Predictors: (Constant), t

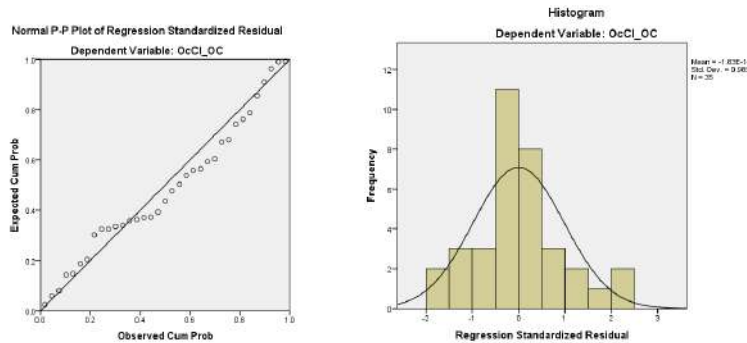
If the assumption of homoscedasticity is violated, it means that the residuals (the differences between the observed and predicted values) do not have constant variance across all levels of the independent variable. Instead, the residuals might display a pattern where the variance changes (e.g., increases or decreases) with the level of the predictor variable.

Violating the homoscedasticity assumption primarily affects the reliability and validity of our regression model's standard errors, confidence intervals, and hypothesis tests. **It does not bias the estimates of the coefficients themselves but makes them less efficient.** Taking steps to address this violation can lead to more accurate and reliable results.

Step 4.4. Normality of Residuals

The normality of residuals in the *OcCl_OC* regression model was assessed using a histogram and a Normal P-P Plot. (Figure 3) The histogram displays the distribution of standardized residuals and shows a roughly symmetric, bell-shaped pattern centered around zero, with a slight positive skew. This suggests that the residuals are approximately normally distributed, though with minor deviations. The P-P Plot further supports this observation, as most data points align closely with the 45-degree line, indicating that the residuals largely follow a normal distribution. Together, these plots confirm that the assumption of normality in the residuals is reasonably met, enhancing the reliability of the regression analysis results.

Figure 3. Normality Assessment of Regression Residuals for OcCl_OC: Histogram and P-P Plot



Source: Graphic created by authors

Step 5. Perform the Simple Linear Regression: and Step 7. Report the Findings

A simple linear regression was conducted to examine the relationship between time (t) and the employment ratio in cluster-member firms (OcCl_OC). The model explained 15.6% of the variance in OcCl_OC ($R^2=0.156$). (Table 5)

Table 5. Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Durbin-Watson	
						F Change	df1	Sig. F Change		
1	0.395 ^a	0.156	0.131	1.95186	0.156	6.111	1	33	0.019	1.506

a. Predictors: (Constant), t

b. Dependent Variable: OcCl_OC

The coefficient for time was 0.237 ($p = 0.019$), indicating a significant positive relationship. Each additional year is associated with an increase of 0.237 in the employment ratio. (Table 6a)

Table 6. Regression Coefficients

(a)	Unstandardized Coefficients		Standardized Coefficients		t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta				Lower Bound	Upper Bound
(Constant)	-474,356	193,140			-2,456	0,019	867,302	-81,410
t	0,237	0,096	0,395		2,472	0,019	0,042	0,432

Diagnostic tests indicated that residuals were approximately normally distributed, and no severe multicollinearity was observed ($VIF = 1.00$). (Table 6b)

Table 7. Regression Coefficients

(b)	Correlations			Collinearity Statistics	
	Zero-order	Partial	Part	Tolerance	VIF
(Constant)					
t	0,395	0,395	0,395	1,000	1,000

a. Dependent Variable: OcCl_OC

These findings suggest that clusters are increasingly contributing to employment growth over time.

- The model diagnostics provide insights into the performance and reliability of the regression analysis.
- Descriptive statistics** of the dependent variable $OcCl_OC$ (Appendix 2, Table 8) show a mean of 3.086 and a standard deviation of 2.093 across 35 observations, indicating variability in the employment ratio among cluster-member firms and emphasizes the heterogeneity within the dataset.
 - Collinearity diagnostics**, presented in Appendix 2, Table 9, reveal a high condition index of 1170.811. This value exceeds the commonly accepted threshold of 30, which suggests potential multicollinearity issues within the model. The high condition index is paired with variance proportions of 1.00 for both the constant and the predictor variable t , concentrated in the second dimension. Although there is only one predictor in this model, this condition index may be attributed to the scaling of the data or inherent characteristics of the dataset. Multicollinearity, when present, can lead to instability in coefficient estimates and should be considered when interpreting the model results.
 - Residual statistics**, as shown in Appendix 2, Table 10, provide further insight into model fit and residual behaviour. The residuals are centred around zero with a mean of 0 and a standard deviation of 1.92294, suggesting that the model's predictions are generally unbiased. The range of standardized residuals, from -1.968 to 2.386, indicates that no extreme outliers are present, which supports the model's reliability. However, the spread in residuals reflects some differences between observed and predicted values, highlighting potential areas for improvement in model accuracy. Together, these diagnostics confirm that while the model meets basic assumptions for linear regression, attention should be given to the multicollinearity warning indicated by the condition index.

Step 8. Formulate Insights and Recommendations:

The analysis reveals a statistically significant positive relationship between time (t) and the employment ratio ($OcCl_OC$) in cluster-member firms. This suggests that, over time, cluster employment is contributing increasingly to overall regional employment, indicating clusters' growing role in economic development.

Diagnostics indicate that while the model fits reasonably well, a high condition index signals potential multicollinearity concerns. Although multicollinearity does not invalidate the model, it may affect the precision of coefficient estimates, which should be considered in interpretation.

The residuals exhibit minimal signs of bias and no extreme outliers, confirming the model's reliability. However, some spread in residuals suggests that the model could benefit from additional predictors to improve accuracy.

Recommendations:

- **Policy Recommendations:** Given the positive association between time and cluster employment, regional policymakers should consider expanding support for cluster initiatives, particularly in regions where growth in cluster employment is pronounced. Such support might include funding, training, and infrastructure improvements aimed at fostering clusters in key sectors.
- **Model Improvement:** To address potential multicollinearity, future models could incorporate standardized variables or employ regularization techniques if multiple predictors are included. This would reduce multicollinearity's impact on coefficient stability, ensuring more precise estimates.
- **Further Research:** Additional predictors related to economic factors, regional investments, and sector-specific variables should be explored in future studies to improve the explanatory power of the model. This would provide a more nuanced understanding of the factors driving cluster employment growth across different regions.

Discussion

5.1 Interpretation of Results

The regression analysis demonstrates a statistically significant positive relationship between time (t) and the employment ratio in cluster-member firms ($OcCl_OC$). This finding suggests that over the observed period, employment within clusters has steadily increased relative to the total regional employment. Such a trend indicates that clusters are likely becoming more influential in the Romanian regional economic landscapes, contributing a growing share to local job markets.

The positive coefficient for time ($B = 0.237$, $p = 0.019$) suggests that for each additional unit of time (likely a year), the employment ratio $OcCl_OC$ increases by 0.237 units on average. This statistically significant relationship underscores the progressive strengthening of cluster employment, likely driven by the maturation and expansion of cluster initiatives over time. The model's explanatory power, with an R^2 of 0.156, implies that while time accounts for some variation in cluster employment,

other factors not included in the model also play a substantial role in explaining employment dynamics within clusters.

Diagnostic assessments, however, highlight some areas for caution. The high condition index in the collinearity diagnostics suggests potential multicollinearity concerns, which could affect the stability of coefficient estimates. This issue may not invalidate the model but indicates that additional predictors or adjustments (such as standardizing variables) might improve precision. Residuals analysis shows minimal bias and no extreme outliers, confirming the general reliability of the model's predictions despite a slight spread in residuals.

Overall, these results reinforce the notion that clusters play an increasingly significant role in employment growth over time.

5.2 Comparison with Literature

The findings of this study align with existing literature on the positive economic impact of cluster development in regional labour markets. Studies have shown that industrial clusters enhance employment by fostering networks, innovation, and economic resilience (Porter 1998; Delgado, Porter, and Stern 2014). Like the findings of this model, which reveal a positive relationship between time and cluster employment (OcCl_OC), prior research supports the notion that clusters can catalyse regional growth by concentrating resources and talent within specific industries (Audretsch and Feldman 2004).

However, the model's indication of multicollinearity, as suggested by the high condition index, prompts further discussion. Although multicollinearity is not uncommon in regional economic models due to overlapping economic factors, it can complicate the estimation of precise impacts (Wooldridge 2012). Some studies address this by introducing standardized or composite variables, an approach that could refine the stability of the model here, especially if additional predictors are introduced in future analyses.

The study's finding of a moderate but significant increase in cluster employment over time suggests that clusters are steadily strengthening their role within regional economies. This supports Delgado, Porter, and Stern's (2016) findings that cluster presence correlates with stronger employment and wage growth. The literature further suggests that policies fostering cluster formation, such as incentives for industry-specific training and infrastructure investment, can magnify these effects, highlighting an area where future regional policies could benefit from targeting clusters more strategically (Ketels 2013).

In this study, we leveraged a unique dataset provided by CLUSTERO, the Romanian Cluster Association, which offers valuable insights into the employment dynamics within clusters across Romania. While this dataset allows for an in-depth examination of cluster development over time, highlighting specific regional trends and industry concentrations, it also presents certain limitations due to its scope and granularity. Our research contributes original insights by analyzing this data through a comprehensive framework, offering a nuanced understanding of clusters not only as spatially proximate entities but as complex, interdependent ecosystems that drive regional economic growth. This approach underscores the significance of clusters as strategic assets for economic policy and regional development.

In sum, this study's results contribute to the growing body of evidence on cluster-driven regional development. While the positive relationship between time and cluster employment aligns with broader economic theories, addressing multicollinearity and expanding the model with additional predictors could enhance accuracy and insight in future research.

Conclusions

6.1 Summary of Findings

Clusters have been widely recognized as key drivers of sustainable regional economic development, offering a framework for collaboration and innovation across industries. Derlukiewicz et al. (2023) explore how EU policies support clusters as instruments for achieving sustainable development, emphasizing their role in fostering economic and social resilience while addressing environmental challenges. Complementing this perspective, Chen et al. (2023) examine the dynamics of an automotive cluster, highlighting how firm-level contributions within clusters drive regional growth and sustainability. Adding to these insights, Daniel et al. (2023) discuss strategies for selecting

and supporting clusters that maximize economic growth, emphasizing the importance of alignment between cluster capabilities and regional development goals. These studies collectively underscore the critical role of clusters in promoting inclusive and sustainable economic strategies.

This study provides a comprehensive analysis of employment trends within clusters in Romania, using a unique dataset from CLUSTERO. Our findings indicate a statistically significant positive relationship between time and the employment ratio in cluster-member firms, demonstrating that clusters play an increasingly prominent role in regional labor markets. The positive coefficient for time suggests steady growth in cluster employment over the observed period, emphasizing the value of clusters as economic drivers. Despite some indications of multicollinearity, diagnostics confirmed that the model reliably reflects employment trends without extreme outliers, supporting the robustness of the results.

6.2 Implications

The findings of this study carry important implications for regional economic policy and cluster development strategies. Based on the regression model's positive slope, we conclude that employment in cluster-member firms (Oc_cl) is growing at a faster rate than total employment (Oc) over the data period of 2013-2022. This trend reinforces the role of clusters as catalysts for economic growth, contributing significantly to employment dynamics within their regions. Targeted policies that bolster cluster ecosystems could therefore amplify these effects, particularly through strategic investments in infrastructure, training, and sector-specific support.

Furthermore, this study aligns with current efforts under the INTERREG DANUBE Project, "Plan-C-Moving Plastics and Machine Industry towards Circularity," where CLUSTERO is a project partner. Coordinated by Biz-Up Austria, the Plan-C project aims to transform the plastics value chain towards a circular economy by achieving three main objectives: designing plastics for circularity, creating circular life cycle phases in the machine industry, and developing a strategic transformation roadmap for the plastics value chain. The model developed in this study could be applied successfully to these industrial sectors, specifically the plastics industry, providing a benchmark for employment assessment in cluster-member firms. This approach also offers a best-practice framework that can be adapted by other national industries and Plan-C project partner regions to evaluate employment contributions within clusters, supporting broader efforts in the shift towards circular economies.

This expanded perspective on clusters—viewing them as complex, interconnected ecosystems—reinforces the European Commission's definition, which emphasizes clusters' role in driving innovation, economic resilience, and regional competitiveness. Recognizing clusters as multifaceted structures highlights their potential as strategic assets in policy frameworks aimed at sustainable and resilient economic growth.

6.3 Limitations and Future Research

The findings of this study carry important implications for regional economic policy and cluster development strategies. As clusters contribute to employment growth and economic resilience, targeted policies that foster cluster ecosystems can amplify these benefits. Policymakers might consider strategies that provide infrastructure, funding, and specialized training to reinforce cluster growth in high-impact sectors. This study also broadens the conceptualization of clusters, viewing them not merely as geographically concentrated entities but as complex ecosystems of interconnected organizations that collectively enhance regional competitiveness. This perspective aligns with the European Commission's multidimensional definition of clusters, which emphasizes their role in driving innovation and economic integration.

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Appendices

Appendice 1. Definition of Clusters in European Policy

[A1].1. European Cluster Definition:

The European Commission defines clusters as:

"Geographically proximate groups of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standard agencies, and trade associations) in particular fields that compete but also cooperate."

Clusters are viewed as important for fostering economic growth because they:

- **Encourage collaboration and knowledge-sharing:** Clusters bring together diverse actors who can collaborate and innovate, leading to the exchange of ideas and technological advancements.
- **Improve productivity:** By clustering geographically, companies can benefit from a shared pool of specialized labor, suppliers, and services, leading to reduced costs and increased efficiency.
- **Promote innovation and competitiveness:** Clusters stimulate competition while promoting collaboration, resulting in a dynamic environment conducive to innovation.

[A1].2. Key Documents Defining and Supporting Clusters in European Policy:

- **European Cluster Memorandum (2007):** This document emphasized the importance of clusters for regional development and innovation. It provided guidelines on fostering clusters within Europe.
- **European Cluster Observatory Reports:** The European Cluster Observatory, an initiative launched by the European Commission, provides detailed reports and analyses on cluster dynamics across Europe, including statistical data and case studies of successful clusters.
- **Smart Specialization Strategies (S3):** Under the European Union's cohesion policy, regions are encouraged to develop Smart Specialization Strategies (S3) to identify niche areas of competitive strength, foster clusters, and drive innovation.
- **Europe 2020 Strategy:** The European Union's Europe 2020 strategy, particularly its flagship initiative "An Industrial Policy for the Globalisation Era," emphasizes the role of clusters in fostering innovation, sustainability, and competitiveness in Europe.

[A1].Significance of Clusters in European Industrial Policy

Clusters are integral to the EU's industrial policy because they:

- **Enhance regional innovation capacity:** Clusters are considered innovation hotbeds due to the close interaction between businesses, research institutions, and universities.
- **Support SMEs and entrepreneurship:** Clusters provide a supportive environment for small and medium-sized enterprises (SMEs), which are essential for job creation and economic dynamism.
- **Facilitate internationalization:** Clusters can help firms, especially SMEs, access international markets by pooling resources and leveraging shared branding and marketing efforts.

Clusters are a cornerstone of the EU's strategy to boost competitiveness, economic growth, and innovation by fostering collaboration and knowledge exchange among companies and institutions within a geographical area.

Appendice 2. **Diagnostics Tables****Table 8. Descriptive Statistics**

		Mean	Std. Deviation	N
OcCl	OC	3,0857	2,09343	35

Table 9. Collinearity Diagnostics^a

Model	Eigenvalue	Condition Index	Variance Proportions (Constant)	t
1	1	2,000	1,000	,00
	2	1,459E-06	1170,811	1,00

a. Dependent Variable: OcCl_OC

Table 10. Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,1119	4,2421	3,0857	,82748	35
Residual Std.	-3,84214	4,65786	,00000	1,92294	35
Predicted Value Std.	-1,177	1,398	,000	1,000	35
Residual	-1,968	2,386	,000	,985	35

a. Dependent Variable: OcCl_OC

USING QUANTITATIVE TOOLS TO UNDERSTAND POLITICAL ISSUES

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Abstract

This study focuses on understanding what the Americans think about the groups of people that collaborating among themselves would make it possible to solve the thorny political issues that brought the events of January 6th, 2021. A Mind Genomics experiment is designed to collect and analyze the collected data. A four X four experiment is used; for each pillar/category four potential answers are provided to cover the entire response spectrum. Thus, the four considered categories are Ordinary People, Leaders, The political world, and Personages. The main issue with this study is to analyze and understand the following question: What will happen when these people work together to solve this problem: Insurrection - People who want to overthrow the government. The study shows higher impact values of the answers for category "The Political World" that could solve complex social and political issues the USA is facing today. The higher impact values for the vital performing elements in the teens tell us that we have selected groups of respondents with similar points of view, with these strong points of view not being diluted.

Keywords: Leaders, Personages, Insurrection

JEL Classification Codes: P10, P20, R50

Citation

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Introduction

For quite some time, there has been a discussion in the scientific community about the best method to use in scientific studies. Generally, one discussion issue has been about using a quantitative versus a qualitative approach. The other discussion topic has been the hypothesis-based approach versus the hypothesis-free one. As for any other theoretical issue, different researchers would have different opinions. The research in the engineering and theoretical fields, due to their nature, is quantitative by default. The debate about the best research method is not unusual in the research community. Especially this debate can be of more relevance in the social and political sciences, which have a more narrative nature. There are different approaches to conducting research. Scholars, researchers, and students adopt one or more approaches that suit their backgrounds and orientation. There are valid arguments to support the fact that the choice of an approach(es) will affect the research outcome (PETER, 2018).

Thus, an intensive discussion has been ongoing among researchers regarding the best approach to embrace in social research. The disagreement had been between qualitative and quantitative methods of research. There are good reasons to believe that the heart of the discussion is the orientation and background of the researchers. Researchers using a qualitative approach are comfortable continuing with the same technique, whereas those researchers of a quantitative background are inclined to continue using the quantitative dimension to conduct social research.

The qualitative method deals with a “situated activity that locates the observer in the world,” where the researchers are “attempting to make sense of or interpret phenomena in terms of the meanings people bring to them” in natural settings (Gabrielian, Yang and Spice, 2008).

According to (Given, 2008), the quantitative method refers to “the systematic empirical investigation of observable phenomena via statistical, mathematical or computational techniques.”

In the 1960s, things started to change. A new approach emerged that called for the marriage of both existing orientations, the qualitative approach, and the empirical/statistical orientation. The new technique is referred to in the political jargon as the post-behavioral era.

Another battlefield among researchers has been the issue of the hypothesis-based versus the hypothesis-free approach. Hypothesis-based research and hypothesis-free research are two different approaches to scientific inquiry. Hypothesis-based research involves the development of a specific hypothesis or set of hypotheses to be tested through empirical research. The hypothesis is a proposed explanation for a phenomenon or observation that can be tested through systematic experimentation or observation. Researchers design experiments or studies to test the hypothesis and collect data to evaluate the hypothesis. On the other hand, hypothesis-free research is an approach that does not rely on a priori hypotheses to guide the research. Instead, researchers collect data without preconceived notions or expectations and use exploratory data analysis methods to identify patterns or relationships in the data. This approach is sometimes called data-driven research. Even on this topic, there are diametrically opposed views. Some authors like (Weinberg, 2010), strongly support hypothesis-based research. Others, such as (Goodman, 1999) and (Yanai and Lercher, 2020), will disagree and provide plenty of arguments for using a hypothesis-free type of research.

As the means for collecting massive amounts of data became affordable, researchers started questioning hypothesis-based studies. One of the first works to question the validity of the hypotheses-based approaches is presented in (Goodman, 1999). The provided argument is that data acquisition is so fast and cheap nowadays, and the time has come to let go of the hypothesis part and take in every possible bit of data one can. However, it is crucial to only catalog how the data were collected, and the results of every measure done (Goodman, 1999). One of the most solid criticisms of hypothesis-based research is that the focus on finding something predetermined could switch the attention of researchers from looking into other patterns the collected data may contain (Yanai & Lercher, 2020). There are several cases in the history of science where discoveries were not made due to trying to prove a predetermined hypothesis (Biesecker, 2013) but just by pure serendipity. When someone seeks, said Siddhartha, ‘then it easily happens that his eyes see only the thing that he seeks, and he can find nothing to take in nothing (Hesse, 1922). The research community continuously makes serious efforts to find the best way of collecting users' opinions using intelligent systems (Furlan, Nikolic and Milutinovic, 2013). Thus, there is a need for a discipline that allows for gathering data from consumers and structures the analysis of such data in a cogent manner to achieve successful management. This research uses Mind Genomics is an interdisciplinary field that aims to study the mental processes and individual differences in the perception and understanding of complex

information, including texts, images, and multimedia content (Moskowitz, Beckley and Ashman, 2006), (Gofman and Moskowitz, 2010). It involves using experimental methods and computational models to measure and explain differences in people's responses to stimuli (Moskowitz, Wren and Papajorgji, 2020). The goal is to develop a deeper understanding of how people process information and make decisions, with applications in marketing (Saulo *et al.*, 2019), (Papajorgji *et al.*, 2021) education (Todri *et al.*, 2020), (Attila Gere *et al.*, 2019) and psychology (A. Gere *et al.*, 2019), (Papajorgji and Moskowitz, 2022). Mind Genomics is a hypothesis-free approach.

This Mind Genomics-based study is designed to evaluate the social phenomenon currently occurring in the USA. The following section presents the experiment, the methodology, and the results obtained.

The Experiment

The experiment consists of creating a bookkeeping system comprising four silos or groups, each silo comprising, in turn, four related elements or answers. The silos represent the topics considered the study's pillars. The elements within a silo are not necessarily opposites of each other but somewhat different expressions of the general idea embodied in the silo. Table 1 gives the silos and elements for this study on Understanding January 6, 2021, Events.

Table 11. Understanding the events of January 6, 2021.

Question A: Ordinary People	
A1	My parents
A2	People like me
A3	Ordinary working people
A4	The mayor of my town or city
Question B: Leaders	
B1	A civil right leader - e.g., Martin Luther King
B2	A pastor of a very large church - e.g., Joel Osteen
B3	A high-ranking official from the military - e.g., Chief of Staff
B4	A well-known business leader - e.g., Bill Gates
Question C: The political world	
C1	President Joseph Biden
C2	Former President Donald Trump
C3	Speaker of the House Nancy Pelosi
C4	Senator Mitch McConnell
Question D: Personages	
D1	My favorite schoolteacher
D2	Senator Bernie Sanders
D3	Oprah Winfrey
D4	Mother Theresa

Thus, the four considered categories are Ordinary People, Leaders, The political world, and Personages. The main issue with this study is to analyze and understand the following question: What will happen when these people work together to solve this problem: Insurrection - People who want to overthrow the government.

Answers/elements presented in Table 1 are combined using an Experiment Design model to create vignettes presented to participants in the study for evaluation. The evaluation schema is as follows.

- 1=Cannot cooperate ... and ... No real solution will emerge
- 2=Cannot cooperate ... but ... Real solution will emerge

- 3=Honestly cannot tell
- 4=Can cooperate ... but ... No real solution will emerge
- 5=Can cooperate ... and ... Real solution will emerge

Mind Genomics uses two default classification criteria that are age, gender. Besides, three or four others could be defined by the researcher. In this study, the following are used as additional classification criteria.

- 1=Old time Republican
- 2=Trump Republican
- 3=Democrat
- 4=No political party

An online system (Mehta-Shah, Mehta and Zemel, 2021), (Biró and Gere, 2021) is used to collect and analyze the data. During the interview, each respondent provided 24 ratings for his perceptions of January 6 events and 24 ratings for his estimated perception by other Americans. The stimuli in the back of these 24 ratings are 16 elements, each appearing three times against different backgrounds. The 16 elements are statistically independent of each other by design. It is straight to relate the presence/absence of the elements to the ratings (the PER Model) or a transformation of the ratings (the INT Model, a binary transformation of the ratings).

Ordinary Least Squares (OLS) (Zdaniuk, 2014) regression is used to evaluate the statistical relevance of each of the answers provided by the respondents. The next step is combining the elements into concise vignettes or test concepts—each vignette comprising a maximum of four and a minimum of two elements. An underlying statistical plan creates the vignettes called an experiment design (Moskowitz, Kover and Papajorgji, 2022). During the vignette evaluation, it is critical to note that the entire context presented is the subject of evaluation. The Mind Genomics approach operates very differently from the yes/no surveys.

We write both models, the PER Model for the 1-9 ratings and the INT for the 0/100 transformation, by the same equation. Only the dependent variable changes:

$$\text{PER} = k_0 + k_1(\text{Element A1}) + k_2(\text{Element A2}) + \dots + k_{16}(\text{Element D4})$$

$$\text{INT} = k_0 + k_1(\text{Element A1}) + k_2(\text{Element A2}) + \dots + k_{16}(\text{Element D4})$$

The underlying experimental design used for each respondent allows us to estimate the parameters of the PER and INT models for each respondent, one respondent at a time. Then the average is calculated for the corresponding parameters across all respondents in the considering group. For example, as we see shortly, we estimate the additive constants for all 100 respondents who participate to general a consensus value. After averaging the results from 10-20 respondents, we converge to a stable estimate. Adding more respondents at random changes our average, but each additional respondent contributes less and less to the average.

Results and Conclusions

Relevance of silos/answers

Knowing the statistical relevance of elements of different silos in descending order is relevant. Table 2 shows the respondents' answers ordered by relevance. The additive constant of this experiment is 52, meaning that 52% of participants are relatively optimistic about the issue of the January 6 events without any additional information about the elements. Calculating the sum of elements' evaluation for each silo allows us to determine how participants evaluated the silos/questions.

Table 2 Statistical relevance of elements of the experiment.

	Group (Binary Ratings)	Total
	Base Size	100
	Additive Constant	52
D1	My favorite schoolteacher	4
B1	A civil right leader - e.g., Martin Luther King	3
C3	Speaker of the House Nancy Pelosi	3
D3	Oprah Winfrey	2
B2	A pastor of a very large church - e.g., Joel Osteen	1
C1	President Joseph Biden	1
C2	Former President Donald Trump	1
C4	Senator Mitch McConnell	1
D2	Senator Bernie Sanders	1
B4	A well-known business leader - e.g., Bill Gates	-1
D4	Mother Theresa	-1
A1	My parents	-2
B3	A high-ranking official from the military - e.g., Chief of Staff	-3
A2	People like me	-4
A4	The mayor of my town or city	-4
A3	Ordinary working people	-7

Table 3 presents the total evaluation per silo/question. As shown, the sum of all elements of silo A is -17. This result indicates that participants are not persuaded that "Ordinary people" involvement could solve the complex problems caused by the events of January 6, 2021. The sum of elements of silo B is 0, meaning participants are indifferent vis-a-vis the role "Leaders" (Martin Luther King, Bill Gates, etc.) could play in addressing the complex social and political issues causing the January 6, 2021, events.

Table 3 Total evaluation per silo.

Question A: Ordinary People	-17
Question B: Leaders	0
Question C: The Political world	6
Question D: Personages	6

The sum of elements of silo C is 6. This result shows that participants demonstrate certain confidence that political leaders (president Biden, ex-president Trump, speaker Pelosi and minority leaders, and McConnell) could play a positive role in helping to solve the social and political issues causing the January 6, 2021, events.

The Mindsets

It is essential for a study to demonstrate that the entire set of interviewed people could be divided into two or three subgroups, each subgroup representing people thinking similarly.

One of the most advanced features of the Mind Genomics approach is to reveal underlying groups in the population who think differently. We usually need to discover a simple relationship between a person's identity (the traditional way of dividing people) and how people think. The mindset segments may not necessarily realize who these individuals that form the group are. Furthermore, these mindset segments are not necessarily divided into easy-to-understand ways or divisions that suit sociologists, political pollsters, or consumer researchers. Instead, these mindset segments exist in the population, typically in the same proportions in subgroups, like gender or ethnicity, as they do in the total population.

Finding the mindsets means dividing the respondents by the pattern of ideas they seem to embrace. Usually, two or three groups are distinguished. In our study, two patterns or mindset segments are identified. These two patterns emerge from a simple analysis of the individual patterns of responses.

The following straightforward steps are performed:

1. Prepare the data at the individual respondent level.
2. For each respondent, relate the presence/absence of the 24 elements to the 5-point rating using OLS (ordinary least-squares) regression. The equation which emerges from the analysis is the aforementioned PER (persuasion) Model.
3. Each respondent generates a row of 25 numbers, one number for the additive constant and 24 numbers corresponding to the coefficients or impact values of the 24 elements.
4. Use a class of programs called cluster programs (or clustering) to identify groups of respondents with similar patterns of coefficients or impact values. For the Mind Genomics studies, one particularly favorite method computes the Pearson correlation between each pair of respondents (Pearson R) and then computes the number (1-R). The Pearson R varies from a high of +1 when two patterns follow identical paths, so increases in one pattern correspond to precise, predictable increases in the other. In such a case, the Pearson R of +1 becomes a 'distance' of 0 ($1-1 = 0$). A perfect inverse relation generates a Pearson R of -1 or a distance of 2 ($1-(-1) = 2$).
5. With these 'distances' between pairs of respondents, the clustering program creates solutions, such as a 2-cluster solution where each respondent is a member of exactly one of two segments (groups) or a 3-cluster solution where each respondent is a member of exactly one of three segments (groups), and so forth.
6. We select the best segmentation, i.e., the 2-cluster, 3-cluster, and 4-cluster solution, based on two simple criteria, parsimony, and interpretability, respectively.
7. Parsimony means as few segments or clusters as possible. Ideally, no clusters would be best; everybody will have the same opinion. Usually, this is not the case, but some situations come close, such as the response to serious crime, where people might share a common revulsion.
8. Interpretability is a subjective notion, left best to one's ability to see a bigger 'picture' within the data. Interpretability means that the segmentation should narrate a story. The segments or clusters should reveal each cluster's meaningful, unique pattern.

The well-known clustering algorithm (Mucherino, Papajorgji and Pardalos, 2009), considering the criteria of parsimony and interpretability, provides the two mindset segments, shown in Table 12.7. Notably, the dramatically higher impact values of the elements for Question C, describing "The Political World" could solve complex social and political issues the USA faces today. In this silo, we find high values such as 8, 10, and 11 that show a strong tendency that cannot be diluted. Dilution occurs when we have individuals of opposite views of the same element, with low impact values, often near 0, beliefs that cancel each other.

Table 4. Dividing participants into mindsets.

		Total	Segment 1 of 2	Segment 2 of 2
	Group (Binary Ratings)			
	Base Size	100	56	44
	Additive Constant	52	55	48
Question A: Ordinary People				
A1	My parents			
A2	People like me			
A3	Ordinary working people			
A4	The mayor of my town or city			
Question B: Leaders				
B1	A civil right leader - e.g., Martin Luther King	3		5
B2	A pastor of a very large church - e.g., Joel Osteen	1	1	2
B3	A high-ranking official from the military - e.g., Chief of Staff			
B4	A well-known business leader - e.g., Bill Gates			
Question C: The political world				
C1	President Joseph Biden	1	6	
C2	Former President Donald Trump	1	8	
C3	Speaker of the House Nancy Pelosi	3	10	
C4	Senator Mitch McConnell	1	11	
Question D: Personages				
D1	My favorite schoolteacher	4		10
D2	Senator Bernie Sanders	1		11
D3	Oprah Winfrey	2		9
D4	Mother Theresa			3

Analyzing the obtained results in table 4 allows summarizing as follows:

1. The additive constants for segments are relatively high, 55 and 48.
2. Segment 1 is characterized as *Believers in the political world*. Respondents have evaluated high elements C2, C3, and C4. The results show that members of segment or mindset 1 have put their faith in political leaders such as Trump, Pelosi, and McConnell to solve today's America's social and political issues.
3. Segment 2 or mindset 2, can be characterized as *Believers in personages* with strong personalities. One could notice that senator Bernie Sanders is leading, followed by the favorite teacher, and lastly comes Oprah Winfrey.

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ANALYZING THE SPATIAL INTERACTIONS IN THE NATIONWIDE REGIONAL CAPITALS NETWORK OF GREECE

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Abstract

This paper studies the spatial interactions of the nationwide regional (NUTS III) capitals network in Greece, using complex network analysis and comparative methods. The study detects the topological characteristics of the nationwide spatial network composed of regional capitals and to examine how this network serves and promotes regional development. The analysis highlights the impact of spatial constraints on the network, provides information on the major infrastructure projects that have developed in the road transport sector and affected the country's transport capacity, and outlines the gravitational dimension of the nationwide spatial interconnectivity phenomenon. Overall, the paper highlights the effectiveness of complex network analysis in the modeling spatial networks and transport systems, and promotes the network paradigm in spatial and regional economics' research.

Keywords: spatial networks; centrality; complex network analysis; transport development.

JEL Classification Codes: R4, R41, R42.

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1. Introduction

The study of spatial networks has engaged researchers for decades and has been particularly fruitful in many disciplines, including regional science, economic geography, spatial analysis, transport planning, spatial planning, and the social and natural sciences. The relevant literature (Barthelemy, 2011; Rodrigue et al., 2013; Tsiotas, 2017, 2021; Stavara and Tsiotas, 2024) suggests that spatial networks can be analyzed using complex network analysis methods and can provide insights regarding their centrality, connectivity, structural configuration, and functionality. The study of network topology, conceived as the structural organization and connectivity between spatial nodes (locations, cities, prefectures), can provide insights into the spatial coherence, the efficiency of movements, and the resilience of a network to different types of disturbances. Such an analysis can contribute to detect hub cities (Barthelemy, 2011; Tsiotas and Polyzos, 2024; Khan et al., 2024), identify areas with limited connectivity, and guide decisions on infrastructure improvements. This knowledge is particularly useful in areas related to urban and regional policy and planning (Polyzos, 2019; Ruxho and Ladas, 2022; Polyzos, 2023), sustainable development strategies (Ruxho et al., 2023; Pescada et al., 2024; Sequeira et al., 2024), and crisis management (Beha and Ruxho, 2024; Ruxho et al., 2024) in the event of economic crises and natural disasters.

One of the modern scientific fields that is becoming proficient in providing modeling methods towards this direction is complex network analysis (Brandes and Erlebach, 2005; Easley and Kleinberg, 2010; Barthelemy, 2011), which has evolved into the so-called Network Science (Brandes et al., 2013). The network paradigm drives into representing communication systems as graphs (Easley and Kleinberg, 2010; Borgatti and Halgin, 2011; Tsiotas, 2017, 2021), namely as bipartite sets consisting of a collection of interconnected units (the nodes) and their interconnections (the edges). The study of network topology using graph theory and complex network analysis contributes to the understanding of the architecture, structural characteristics, and functionality of spatial networks; and the detection of hierarchy patterns (Tsiotas and Tselios, 2024), nodes of privileged connectivity, and their overall growth dynamics. A topological analysis can also provide insights into the coherence and functionality of the network, as well as its resilience to failures.

According to the network perspective, a nationwide system of spatial interconnection between regional capitals can be represented as a network (graph), in which nodes express (at the interregional scale) the regions of origin and destination (Tsiotas and Polyzos, 2013), whereas edges express distance and flow information. The study of the topology of a network connecting the regional capitals nationwide is a critical and interesting subject for various disciplines, as such a network reflects the way in which the nationwide spatial, socio-economic and transport fabrics are structured (Polyzos, 2019, 2023; Tsiotas and Polyzos, 2024). Understanding the structure of a nationwide regional capitals network can reveal information about the spatial pattern of commercial connectivity (Ruxho et al., 2022; Teixeira et al., 2024), population interaction, and service interconnection across the country, suggesting directions for optimizing spatial connections.

The study of centrality in a nationwide prefecture capital network allows also identifying the most influential or connected cities. The term “centrality” (Crucitti et al., 2006; Estrada and Bodin, 2008; Wang et al., 2011; Tsiotas, 2021) is a general concept depending on geography and functionality, and is specialized according to its use by scientific fields (Algebra, Geometry, Statistics, Physics, Geography, Regional Science). For any given geographical area there is a unique geometric or spatial center, whereas several functional centers can be traced in functional (topological) spaces depending on the volume (intensity) of the activity being under study (Tsiotas and Polyzos, 2013; Tsiotas, 2021). The common feature in each definition of centrality concerns, however, the location resulting from the optimization of a topological property. Centrality is an essential concept in understanding the structural and topological properties of both physical and immaterial systems that interact with the social and economic environment (regions, regional capital cities, cities) and contribute to the shaping of human behavior and the evolution of socioeconomic life.

The concept of centrality was introduced in Regional Science along the lines of Crystaller and Losh (Capello, 2016; Polyzos, 2019, 2023), but it has become a fundamental concept for network analysis (O'Connor, 1992) and a popular research field, following the explosive utility that social networking induced in everyday life (Kalantzi and Tsiotas, 2011). Graph Theory is a key tool in network analysis because it predominantly studies topics involving the concept of location. Graph Theory can be seen as an algebra of ordered pairs $G(V,E)$, between a countable set of vertices (or nodes or points) V and a countable set of edges (or ties or lines) E , and is part of the broader discipline

of Discrete Mathematics. Essentially, Graph Theory is a calculus that focuses on the geometric position of an object, just as algebra focuses on its size (Diestel, 2005), which makes it particularly useful in the spatial and geographical disciplines.

Various studies to date have measured networks centrality by spatial (geographical) reference, using Graph Theory. Some initial approaches include the study of Irwin and Hughes (1992) on the structure of urban systems, the work of Fleming and Hayuth (1994) who examined spatial characteristics of transportation hubs, the research of Crucitti et al. (2006) who worked on the centrality of urban street networks, and the study of Estrada and Bodin (2008) who used measures of network centrality to study and manage landscape. Further, Wang et al. (2010) examined the structure and centrality of air transport network nodes and the relationship (2011) between street centrality and intensity in land use. More recently, the study of Tsiotas (2021) highlighted the potential of using network metrics as economic indicators of spatial interaction and spatial pattern detection, and Tsiotas and Tselios (2024) pointed out the direction of using network measures of interregional connectivity to assess spatial patterns and the degree of cohesion in the EU. Within the aforementioned conceptual framework, this paper studies the topology of the nationwide network of regional capitals in Greece (GRCN), i.e. the network configured between the capitals of the land NUTS III Greek regions. The characteristics of this network are examined both individually, in terms of the topology and functionality of the network being constructed, and comparatively to detect time changes in centrality.

The remainder of the paper is structured as follows: section 2 presents the methodological framework, and in particular the modeling assumptions, the graph modeling, and the network analysis methods that are used. Section 3 presents the results of the analysis and discusses them in the light of regional science, focusing on the transport sector. Finally, section 4 presents the conclusions of the research.

2. Methodological Framework

2.1. Network modeling

The GRCN (Figure 1) is a network with a more economic and less physical interpretation. This spatial model represents an aspect of the nationwide road network expressed at an interregional scale (NUTS III). The construction of the GRCN essentially attempts to represent the functions and spatial land communication relationships that develop between the Greek NUTS III regions, to study the topology and economic dynamics shaped by this system of spatial and economic interactions. More specifically, the GRCN is represented in L-space (Barthelemy, 2011; Tsiotas and Polyzos, 2013; Tsiotas, 2021) as an undirected graph $G(V,E)$ with spatial weights (spatial network), whose set of nodes V represents the capitals of the Greek NUTS III regions, while the set of edges E expresses the existence of the possibility of direct land connections between the NUTS III regions of Greece. The nodes positions of the GRCN on the map (Figure 1) correspond to the geographical coordinates of the capitals of the Greek NUTS III regions, while the edges lengths represent the Euclidean kilometric distances between nodes. The choice of this particular type of nodes is made due to the economic importance of regional capitals in Regional Economics, as places of significant population concentrations (Capello, 2016; Polyzos and Tsiotas, 2020, 2023; Tsiotas and Polyzos, 2024). Due to its configuration, the resulting GRCN is a model with significant economic impact.

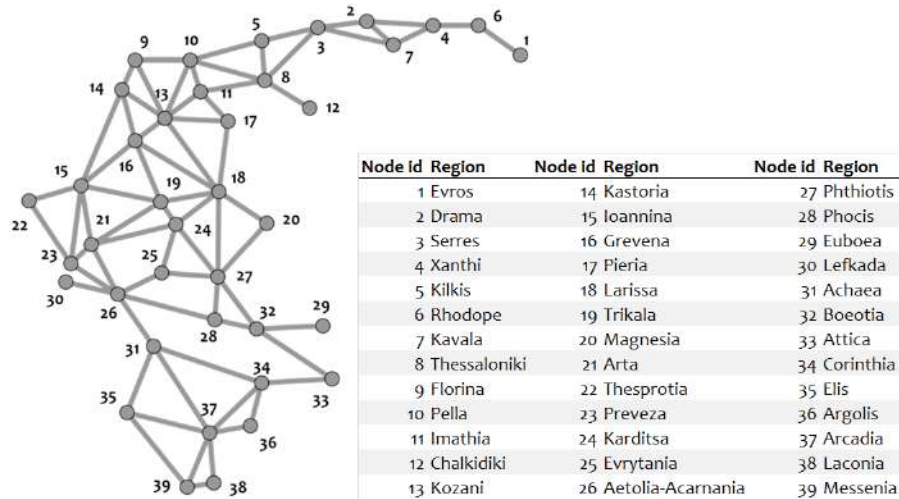


Figure 1. Topological layout of the nationwide Greek Regional Capitals Network (GRCN), represented in *L-space* as an undirected graph with $n=39$ nodes and $m=71$ edges (the nodes in the graph represent the capitals of the NUTS III regions).

The GRCN is a *connective* network (one component), consisting of $n=39$ regional (NUTS III) capital cities (nodes) of the mainland and $m=71$ spatial links (edges) between them (Figure 1). The term *connectedness* represents the existence in the graph of at least one path between any two nodes (Diestel, 2005; Bathelémy, 2011; Tsiotas, 2021). The spatial weights $w_{s,ij} = d(e_{ij})$ of the GRCN edges express the actual kilometric distances of the shortest paths (km) connecting the regional capitals. Each edge corresponds to bi-directional segments, resulting in a symmetric adjacency matrix. Further weights in the GRCN are spacetime distances between nodes, which express the required time (min) to cover a given kilometric distance between two network locations. These values can provide an indirect indicator of the efficiency of this interregional network, since the average transit time of a route represents the quality of the road infrastructure of the network (Barthelemy, 2011; Tsiotas, 2021). From a technical viewpoint, the distances between any pair of nodes in the graph are collected in two weight matrices of the form $D^{39 \times 39}$, where each element d_{ij} represents the spatial costs (Diestel, 2005; Crucitti et al, 2006) from node v_i to v_j . The first matrix includes time distances (time required to cover a given link) $D_t = [d_{ij}^T]$ (min) and the second of kilometric (road) distances $D_s = [d_{ij}^E]$ (km), between regional capital cities P_i and P_j (or nodes v_i and v_j) with $i, j = 1, \dots, 39$.

The spatial data (geographic coordinates) used for the construction of the GRCN were obtained from Google's digital mapping services (2024), while the data of kilometric distances and time distances were obtained from the works of Tsiotas (2021) and Tsiotas and Polyzos (2013). The available data of time distances correspond to two time states (snapshots) of the inter-prefecture Greek network. The first one includes data from the year 1988, which describes the state of the national road network in its most recent past, namely in the initial stage of its modern form. The second includes data from 2010, which represents a more modern picture of the network, following the integration into the country's road infrastructure of the key upgrading projects of the *Rio-Antirrio Bridge* (set in operation in 2004) and the *Egnatia Motorway* (set in operation in 2009).

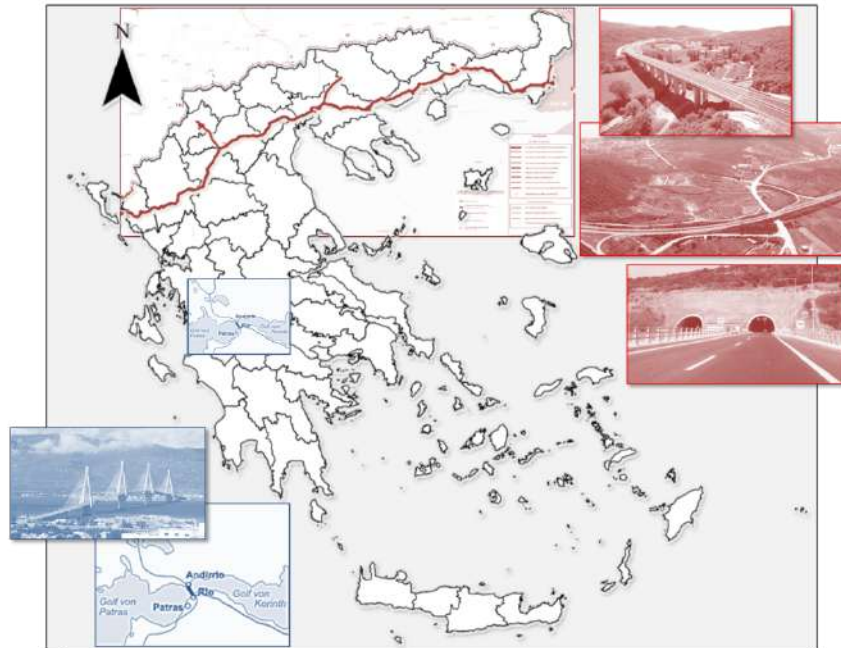


Figure 2. Map layout of Greece highlighting the location of the Rio-Antirrio Bridge and the Egnatia Motorway's path (indicative photos are included).

2.2 Network analysis

The measures of network topology used in the GRCN analysis are shown in brief in Table 1.

Table 1
Network Measures used in the GRCN's analysis

Measure	Description	Math Formula
<i>Graph</i>	A pair set consisting of a node-set V and an edge-set E . In graph $G(V,E)$, n is the number of nodes, and m is the number of links.	$G(V,E)$
<i>Graph density (ρ)</i>	The fraction of the existing (m) to the number of possible graph connections. It expresses the probability of meeting a link between two randomly chosen nodes in the network.	$\rho = m / \binom{n}{2} = \frac{2m}{n \cdot (n-1)}$
<i>Network diameter (dG)</i>	The longest shortest path $p(i,j)$ in a network.	$d(G) = \max \{ p(i, j) \mid i, j \in V \}$
<i>Node Degree (k)</i>	The number of graph edges being adjacent to a given node i . It expresses the communication potential of a node.	$k_i = m(i) = m_i = \sum_{j \in V(G)} \delta_{ij} = \sum_{j \in V(G)} \delta_{ji}$, where $\delta_{ij} = \begin{cases} 1, & \text{if } e_{ij} \in E(G) \\ 0, & \text{otherwise} \end{cases}$
<i>Node strength or weighted degree (s)</i>	The sum of weights (w_{ij}) of the links (e_{ij}) being adjacent to a given node i . The δ_{ij} operator is the Kronecker delta function yielding one for links belonging to a graph G .	$s_i = s(i) = \sum_{j \in V(G)} \delta_{ij} \cdot d_{ij}$, where $d_{ij} = w(e_{ij})$ in km
<i>Closeness Centrality (CC)</i>	Is computed on the average path-lengths $d(i,j)$ originating from a given node i to all other nodes j in the network. It measures accessibility.	$CC(i) = \frac{1}{n-1} \cdot \sum_{j=1, i \neq j}^n d_{ij} = \bar{d}_i$
<i>Betweenness Centrality (CB)</i>	The proportion that is defined by $\sigma(i)$ shortest-paths that pass through a given node i to the total shortest-paths σ in the network. It expresses intermediacy.	$CB(i) = \sigma(i) / \sigma$

Measure	Description	Math Formula
<i>Local Clustering Coefficient</i> (C)	The probability of a node i to have $E(i)$ connected neighbors. It is computed on the number of triangles configured by node i to the number of the total triplets $k_i(k_i-1)$ shaped by this node.	$C(i) = \frac{E(i)}{k_i \cdot (k_i - 1)}$
<i>Modularity</i> (Q)	The objective function expresses the potential of a network to be divided into communities. In its mathematical formula, g_i is the community of node i , $[A_{ij} - P_{ij}]$ is the difference of the actual minus the expected number of edges falling between a particular pair of nodes i, j , and $\delta(g_i, g_j)$ is an indicator function returning 1 when $g_i = g_j$.	$Q = \frac{\sum_{i,j} [A_{ij} - P_{ij}] \cdot \delta(g_i, g_j)}{2m}$
<i>Average path length</i> ($\langle l \rangle$)	The average of the path lengths $d[p(i, j)]$ computed for all accessible pairs (i, j) of network nodes.	$\langle l \rangle = \frac{\sum_{v \in V} d(p(i, j))}{n \cdot (n - 1)}$

Sources: Koschutzki et al. (2005); Barthelemy (2011); Tsiotas (2021)

In addition to these basic measures, the *omega* (ω) index of Telesford et al. (2011) is computed in the GRCN analysis to detect the small-world $S-W$ property (Watts and Strogatz, 1998) and the presence of lattice-like characteristics or random-like characteristics. The measure compares the empirical network's average clustering coefficient $\langle c \rangle$ with that of an equivalent lattice $\langle c \rangle_{latt}$ and the average path length of the empirical network $\langle l \rangle$ with that of an equivalent random graph $\langle l \rangle_{rand}$, according to the relationship (Tsoulias and Tsiotas, 2024):

$$\omega = \left(\frac{\langle l \rangle_{rand}}{\langle l \rangle} \right) - \left(\frac{\langle c \rangle}{\langle c \rangle_{latt}} \right) \quad (1)$$

Values of the ω -index close to zero indicate the small-world property, positive values indicate the existence of random-like characteristics in the network, while negative values indicate the existence of lattice-like characteristics (Tsiotas, 2021; Tsoulias and Tsiotas, 2024). The null models used to compute the above relationship are generated using the randomization algorithm of Maslov and Sneppen (2002), and the latticization algorithm of Sporns and Kotter (2004). Both are *iterative* algorithms and preserve the degree distribution of the empirical network. The randomization algorithm is applied in two steps: first, four nodes are randomly selected whose edges are bisected, assigning half an edge to each node, and then half the edges are randomly connected (Rubinov and Sporns, 2010). Sporns and Kotter's (2004) *latticization algorithm* applies the same procedure, imposing the constraint that half-edge rewiring only occurs when the resulting adjacency matrix has its non-zero entries closer to the main diagonal compared to its initial state. This condition approximates the topology of a lattice network, since in lattices it is unlikely that connections of distant nodes can be made (Sporns and Kotter 2004; Rubinov and Sporns, 2010). In general, the $S-W$ property is rigorously tested on an available graph family when it is detected that $\langle l \rangle$ does not grow faster than logarithmically as the number of nodes tends to infinity (Porter, 2012), that is when $\langle l \rangle_{bin} = O(\log n)$ as $n \rightarrow \infty$. Since collecting a family of different longitudinal versions of the GRCN to test the $S-W$ property based on this definition is not usually available, in this paper we choose to test the small-world property using the approximation based on the ω -index (Tsoulias and Tsiotas, 2024). This approach provides further insights into whether the typology of the considered network is governed by random network or lattice network characteristics.

2.3. Centrality analysis

Three different measures of centrality (Koschutzki et al., 2005; Barthelemy, 2011; Tsiotas, 2021) are used to study the GRCN's centrality: degree, closeness and straightness centrality. These measures are calculated in the 39 land NUTS III regions of Greece, as they were defined by the *Kapodestrian* administrative division (Act.2539/1997). The overall approach aims to highlight the geographical transformation of the Greek transport network during the last twenty years (1988-2010) and to evaluate the policies related with the Greek transport infrastructure sector.

Degree centrality (C^D) follows the general principle that the most valuable nodes in a graph or network $G(V,E)$ have the largest number of adjacent edges relative to the other nodes in a graph. Degree centrality is an enumeration of the edges that are adjacent to a given node, expressed by the relation (Koschutzki et al., 2005):

$$C^D = \sum_{i=1}^n a_{ij} / (n-1) = \sum_{j=1}^n a_{ij} / (n-1) = k_i / (n-1) \quad (2)$$

where k_i is the degree of node i , a_{ij} expresses the element of the adjacency matrix at location ij , and n the number of nodes in the set V .

Closeness centrality (C^C) is defined as the total geodesic distance of a given node to all others, according to the expression (Koschutzki et al., 2005):

$$C_i^c = (n-1) / \sum_{j=1, i \neq j}^n d_{ij} = \left(\sum_{j=1, i \neq j}^n d_{ij} / (n-1) \right)^{-1} = (\bar{d}_i)^{-1} = 1/\bar{d}_i \quad (3)$$

where d_{ij} is the distance between nodes i and j and $\sum_{j=1, i \neq j}^n d_{ij}$ is the sum operator of the minimum length of the possible edges interposed between nodes i and j . The concept of closeness centrality describes the degree to which a node i is close to all others along a geodesic path and practically illustrates the transport cost required to overcome spatial constraints between different regions and activities. Essentially, closeness centrality expresses the *inverse average distance* of a vertex i to all others.

Last, *straightness centrality* (C^S) generally measures the *efficiency* between nodes i and j in a communication system. This measure computes network distances and Euclidean distances according to the mathematical expression (Koschutzki et al., 2005):

$$C_i^c = \frac{1}{n-1} \sum_{j=1, i \neq j}^n \frac{d_{ij}^E}{d_{ij}} \quad (4)$$

where d_{ij}^E represents the Euclidean distance between nodes i and j and d_{ij} the original network distances. Straightness centrality captures the degree to which a path between nodes i and j deviates from the straight-line distance. To the extent that Euclidean distance is the minimum route between any pair of nodes, straightness centrality provides a measure of spatial efficiency. In this study, C^S is used slightly modified. On the one hand, instead of the Euclidean distances, we use kilometric (km) distances between nodes i and j . On the other hand, we consider as network distance the available time distances (min) of the GRCN. This modification serves as an indicator of the “*quality of road transport infrastructure*”, because it calculates the accessibility speed of the GRCN’s network edges. The higher the straightness centrality of a node i is, the higher its accessibility is. Within this context, a comparative view of the differences in straightness centrality between different periods can to provide insights into which nodes have benefited most from structural changes to the network in the meanwhile period. In the case of the GRCN, the map of the differences in straightness centrality for the available periods 1988 and 2010 can to provide insights into the nodes that benefited most from the Greek transport infrastructure works conducted in the meanwhile period.

3. Results and Discussion

3.1 Network Measures Analysis

In the first part of the analysis, the network measures of the GRCN are calculated and the results of are shown in Table 2.

Table 2

Comparative table with the results of the calculation of the network measures for GRCN and GRCN

Measure	Symbol	Unit	Value
			GRCN
Number of nodes	n	# ^(a)	39
Number of edges	m	#	71
Nodes with self-connections	$n(e_{ii} \in E)$	#	0
Number of isolated nodes	$n_{k=0}$	#	0
Linking components	α	#	1
Maximum node degree	k_{\max}	#	7
Minimum node degree	k_{\min}	#	1
Average degree of nodes	$\langle k \rangle$	#	3.641
Average (spatially) weighted node rank	$\langle k_w \rangle$	km	322.264
Average degree of nearest neighbours	$\langle k_{N(v)} \rangle$	#	3.641
Weighted average nearest neighbours grade	$\langle k_{N(v,w)} \rangle$	km	322.26
Average edge length	$\langle d(e_{ij}) \rangle$	km	85.497
Total edge length	$\sum_{ij} d(e_{ij})$	km	3,334.4
Average path length	$\langle l \rangle$	#	4.58
Average path length	$d(\langle l \rangle)$	km	389.045
Network diameter (binary)	$d_{bin}(G)$	#	14
Length of network diameter	$d_w(G)$	km	1,124.4
Graph (planar) density	ρ	net ^(b)	0.640
Graph density (non-planar)	ρ	net	0.097
Clustering Coefficient	C	net	0.47
Average Clustering Coefficient	$\langle C \rangle$	net	0.422
Compatibility	Q	net	0.566

a. Cardinality

b. Dimensionless number

By definition, the GRCN has no self-connections ($n(e_{ii} \in E)=0$), no isolated nodes ($n_{k=0}=0$), and no more than one component ($a_{GRCN}=1$). The maximum GRCN node degree is $k_{GRCN,\max}=7$, while the minimum degree is $k_{GRCN,\min}=1$, due to its connectedness. Further, the average degree of GRCN is equal to $\langle k \rangle_{GRCN}=3.641$ and is numerically close to the range where the highest frequency of degrees in urban road systems occurs, as described in the study of Courtat et al. (2010). The average path length generally expresses the spatial cost (in steps of separation) required to transport in a network (Tsiotas and Polyzos, 2013; Tsiotas, 2021). For the GRCN, this cost implies that the path between two random network nodes is $\langle l \rangle_{GRCN}=4.58$ spatial units (steps of separation). This value of is close to the order of magnitude $\mathbf{O}(\sqrt{n})=\sqrt{39} \approx 6.245$, expressing the average path length $\langle l \rangle_{lat}$ of an equivalent lattice, providing insights into the relevance of the GRCN to this theoretical model. In addition, the kilometric-weighted average path length of the GRCN equals $d(\langle l \rangle)_{GRCN}=389.045\text{km}$ and expresses the average kilometric distance required to randomly travel two nodes in the network. Subsequently, the binary (topological) diameter expresses that the longest binary path that can be traversed inter-regionally in the GRCN consists of 14 edges, while the distance-weighted diameter is $d(GRCN)=1,124.40\text{km}$. The GRCN density ρ , considered as a planar graph equals $\rho_{1,GRCN}=0.64$, while for the non-planar case it equals $\rho_{2,GRCN}=0.097$. Both these values are extremely small compared to the corresponding empirical values for urban road networks (Barthelemy, 2011). The GRCN clustering coefficient equals to $C_{GRCN}=0.47$ and indicates a satisfactory clustering in the network structure. Further, the average clustering coefficient equals $\langle C \rangle_{GRCN}=0.422$, which is remarkably

larger than the corresponding value of a random network $ER \sim 1/n = 1/39 = 0.026$, expressing that the network is far from being the result of random processes. Finally, the GRCN modularity score is equal to $Q_{GRCN} = 0.566$, expressing the ability of the GRCN to separate into communities. This value describes a satisfactory divisibility into communities, better at least than the cases of road network partitioning, which in practice usually appear of the order of $Q_{bipart} < 0.4$.

3.2. Network Topology Analysis

To study the degree distribution of the GRCN nodes, we construct and examine the scatter plots $(k, n(k))$ in Figure 3. These diagrams display a peaked distribution pattern, whose typology is different from a power-law curve corresponding to a hub-and-spoke connection pattern. Also, the mode observed in the value $\langle k \rangle_{GRCN} \sim 3$ suggests the presence of strong spatial constraints (Barthelemy, 2011) in the GRCN structure.

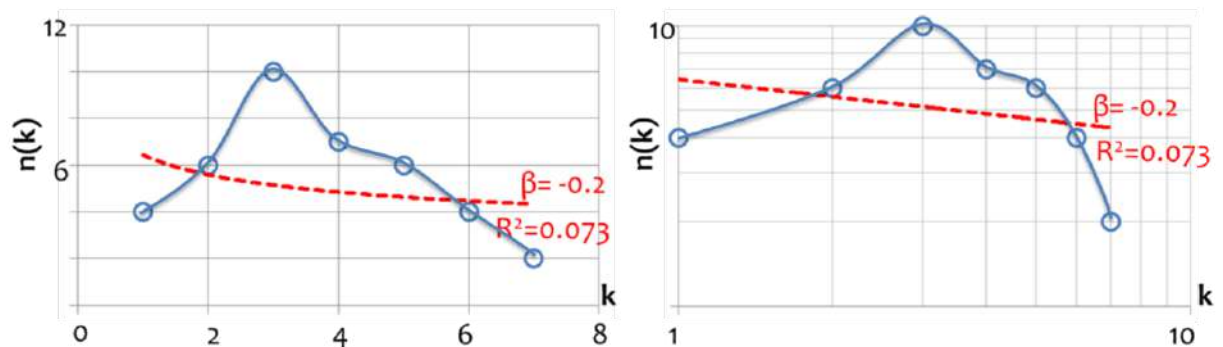


Figure 3. Scatter plots $(k, n(k))$ of the GRCN degree distribution at metric (ar.) and logarithmic (right) scales.

In the next part of the analysis, we construct (Figure 4) the spy plots (Tsiotas, 2019) of (a) the GRCN connection matrix and four node-equivalent ($n_i = 39$) (b) scale-free, (c) lattice-like, (d) small-world and (e) random-like null models, respectively. From the comparison of the plots, it is evident that the typology of the GRCN sparsity pattern is similar to that of the (c) lattice network, but the values of the GRCN connection matrix appear slightly more distant from the main diagonal, compared to the standard case.

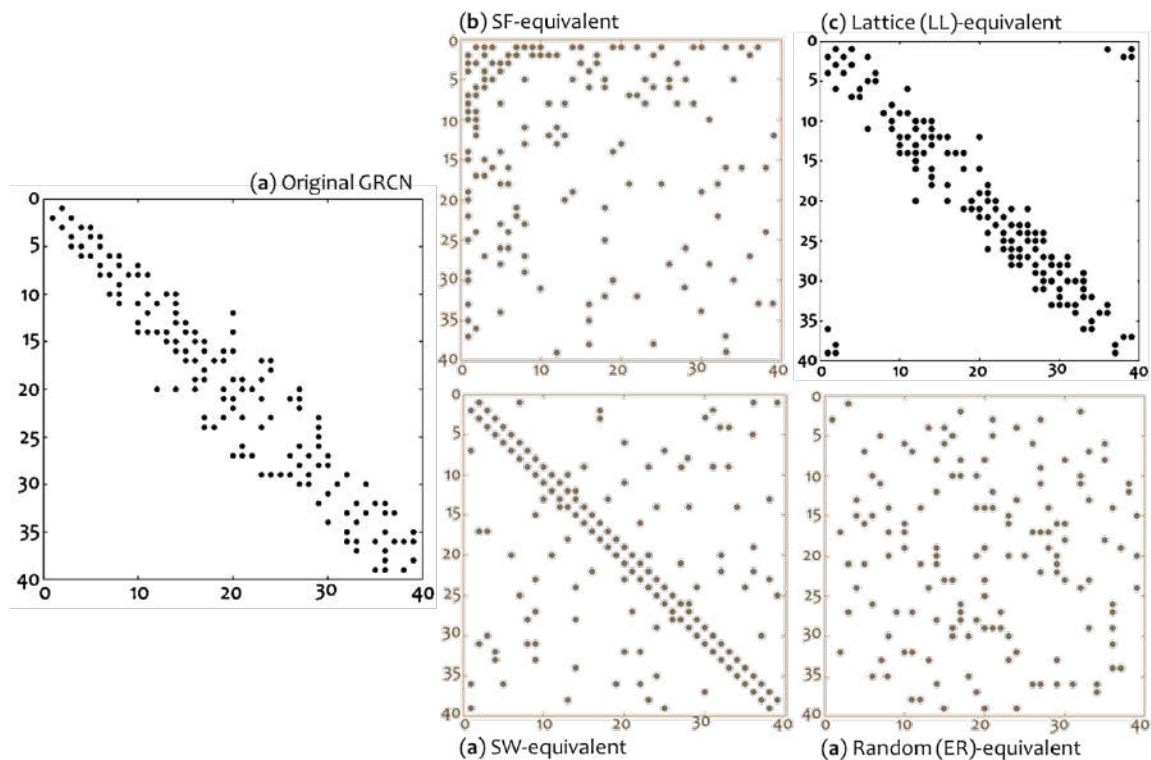


Figure 4. Spy plots of adjacency matrices (a) of the Greek road network (GRCN) and its node-equivalent ($n_i=39$) (b) scale-free, (c) lattice-like, (d) small-world and (e) random-like null models.

The analysis of the sparsity (spy) plots seems to be further verified by the results of the *omega* (ω) index calculation (Telesford et al., 2011), which are shown in Table 3. As can be seen, the GRCN is more relevant to lattice-like characteristics, which is expected for cases of (spatial) networks subject to strong spatial constraints.

Table 3
Results of the approximate small-world detection analysis for GRCN

Measure	$\langle c \rangle$	$\langle c \rangle_{latt}$	$\langle l \rangle$	$\langle l \rangle_{rand}$	ω^*
GRCN	0.422	0.312	4.580	2.889	-0.7218
Indication	Lattice-like characteristics				

*. According to relation (1)

In the next step of the analysis, the major node measures of topology and centrality (degree, betweenness, closeness, clustering, modularity, and spatial strength) of GRCN are calculated. Their spatial distributions are shown in the layouts of Figure 5. First, we consider the spatial distribution of degree (k) (Fig.5a), which forms a distinct pattern, with a cluster of strongly connected nodes located in the central core of the GRCN, but also a single hub located in the Peloponnese sub-network. The cluster of the central structure is formed with the hubs of the NUTS III regions of Larissa, Phthiotis, Kozani, Aetolia-Acarmania, and Ioannina, while the Peloponnese hub is located in the prefecture of Arcadia.

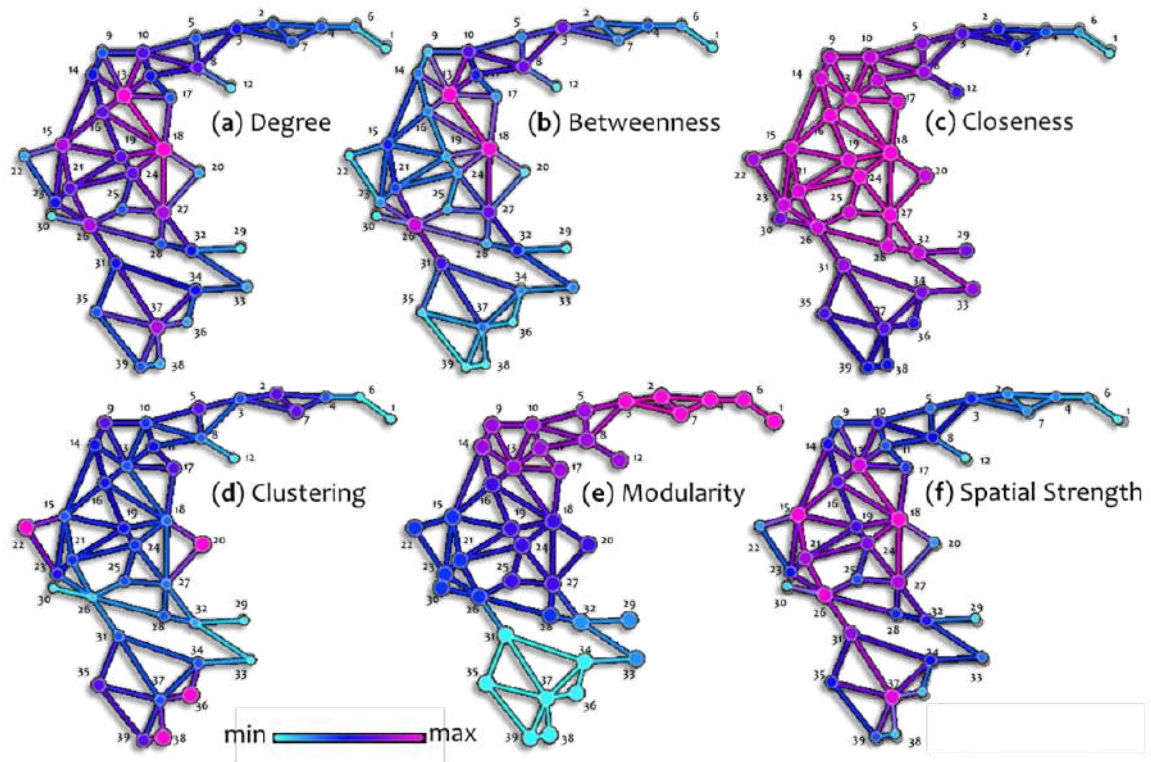


Figure 5. Layouts with the spatial distribution of node measures for GRCN: (a) Degree (b) Betweenness (c) Closeness (d) Clustering (e) Modularity classification and (f) Spatial strength (node labeling as in Figure 1).

Secondly, the regional capital cities of Pella and Thessaloniki in Northern Greece, as well as the regional capital cities that form the Grevena-Trikala-Karditsa-Arta arc in Central Greece, show remarkable connectivity. Considering that the level of degree expresses the connectivity (and therefore the ability of the network nodes to communicate), it follows that the spatial distribution of the degree (Figure 5a) highlights the privileged GRCN nodes in terms of connectivity. This advantage highlights

the dynamics of central than regional configurations in geographical space, as described in the location theories and new economic geography theories in regional economics (Krugman, 1991; Fujita and Krugman, 2004; Capello, 2016; Polyzos, 2019; 2023; Tsiotas and Polyzos, 2024). Next, the spatial distribution of betweenness centrality C^b (Figure 5b) shows a greater intensity of the maximum values in the eastern part of the GRCN, where more upgraded infrastructure prevails (Polyzos, 2019; Tsiotas and Polyzos, 2024). In contrast, the distribution of closeness centrality values C^c (Figure 5c) shows small values in the borderline regions (Eastern Macedonia, Thrace, Western Peloponnese), while large values are concentrated in the central (continental) part of the country, highlighting the accessibility advantage that central regions have in spatial networks.

Next, the spatial distribution of the clustering coefficient C (Figure 5d) shows the central nodes to be located at the periphery of the GRCN, and particularly in the regions of Elis, Messenia, Laconia, and Argolis in the Peloponnese; in the regions of Thesprotia and Magnesia in the central part of the country; and in the regions of Pieria, Florina, Kilkis, Drama and Kavala in the northern part of Greece. This situation generally expresses that the regional capital cities of Greece have a higher probability of being related to interconnected neighbors, describing their privilege to enjoy network interactions of greater relevance in their content. However, this privilege can also be seen in the long run as a disadvantage, because it indicates a polar co-existence (Polyzos, 2019; Tsiotas and Tselios, 2024) implying the dependence of these nodes on their neighbors. In terms of economic geography (Krugman, 1991; Fujita and Krugman, 2004; Capello, 2015) this spatial distribution outlines a center-periphery pattern providing guidelines for the use of the clustering coefficient as an indicator that can contribute to the detection of this pattern (Tsiotas, 2021). For the GRCN, this context allows interpreting that the network accessibility of nodes with a high clustering coefficient depends on the transport infrastructure of their neighbors, which, due to the high degree of neighbor interdependence, may exhibit similar quality characteristics.

Next, the spatial distribution of modularity classification (referring to the community membership of the GRCN nodes) in Figure 5e appears to be consistent with the spatial networks theory (Guimera et al., 2005; Kaluza et al., 2010; Barthelemy, 2011). In particular, this distribution follows a distinct partitioning into zones ($g_1=\{1-4,6,7\}$, $g_2=\{5,8-10,12-14,17\}$, $g_3=\{15,21-23,26,30\}$, $g_4=\{19-20,24,25,27\}$, $g_5=\{29,32,33\}$, and $g_6=\{31,34-39\}$) of geographical relevance, which verifies the contingency forces ruling the GRCN characteristics. Finally, the spatial strength distribution (Figure 5f) appears more intensive in the center, forming a “horseshoe” (U-shaped) arrangement consisting of the regions of Phthiotis, Larissa, Kozani, Ioannina, Arta, Aetolia-Acarmania, and Arcadia. This arrangement resembles with this of node degree (Figure 5a) and implies that, at the interregional scale, spatial strength is more a matter of connectivity (degree k) than of geographical distance.

In the last part of the analysis, we examine the correlations between *node degree* k and *betweenness centrality* C^b ; *spatial strength* (s); and *clustering coefficient* C . The results of the analysis are shown in Figure 6.

The fitting curves applies to the pairs $(k, \langle C^b|_{k=k_i} \rangle)$ and $(k, \langle s|_{k=k_i} \rangle)$ show the existence of remarkable linearity for both cases, having determination coefficients =0.96 and =0.906 respectively.

The relationship $\langle C^b|_{k=k_i} \rangle = f(k)$, between degree k and average betweenness centrality per degree $\langle C^b|_{k=k_i} \rangle$, with $i=2,3,\dots,7$, has power-law exponent $\beta_{\text{GRCN}}=1.94$ and expresses that the network hubs undertake the largest load of the network traffic. In contrast, the exponent $\beta_{\text{GRCN}}=1.156$ of the relationship $\langle s|_{k=k_i} \rangle = f(k)$, between degree k and average spatial strength $\langle s|_{k=k_i} \rangle$, is close to unity (~ 1) and indicates a smooth hyperbolic decline in the distance connectivity undertaken by hubs, which is approximately described by the pattern $y = f(x) = \frac{a}{x}$.

Finally, the relationship $C=f(k)$ indicates the existence of an exponential decline in the GRCN's clustering by degree k , which is consistent with common research practice (Sen et al., 2003; Barthelemy, 2011). This relationship expresses that as the connectivity of a node increases in the network, the probability that this node is associated with interconnected neighbors is reduced, thus highlighting a more centralized connectivity pattern.

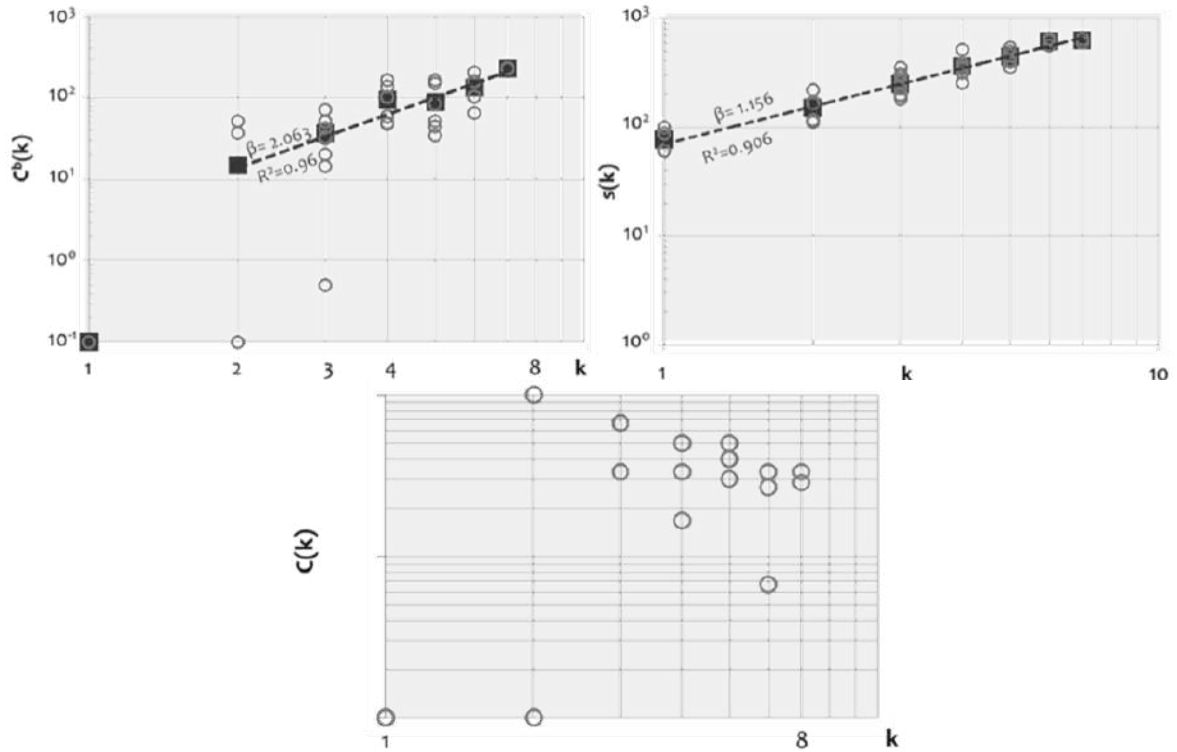


Figure 6. Scatter plots of degree-betweenness centrality (k, C^b); degree-spatial strength (k, s); and degree-clustering coefficient (k, C); for the GRCN. Where applicable, the red squares correspond to the mean values for each degree category.

3.3. Network Centrality Analysis

This section studies GRCN’s centrality. Having available for the GRCN spatial and time-distance data, we examine the changes in the spatial distribution of the network centrality for the years 1988 and 2010. Starting with the simplest measure of degree centrality, we first examine changes due to geographical and structural advantages in connectivity of a region during the examined period. In Figure 7 we can observe that the regions Larissa and Kozani are the most central in terms of degree. This fact is attributed to their proximity to the Athens-Thessaloniki major road axis (highway). Further, the Ioannina region appears to be central in western Greece, as is Thessaloniki and to a lesser extent Kozani in northern Greece, and Arcadia in Peloponnese.

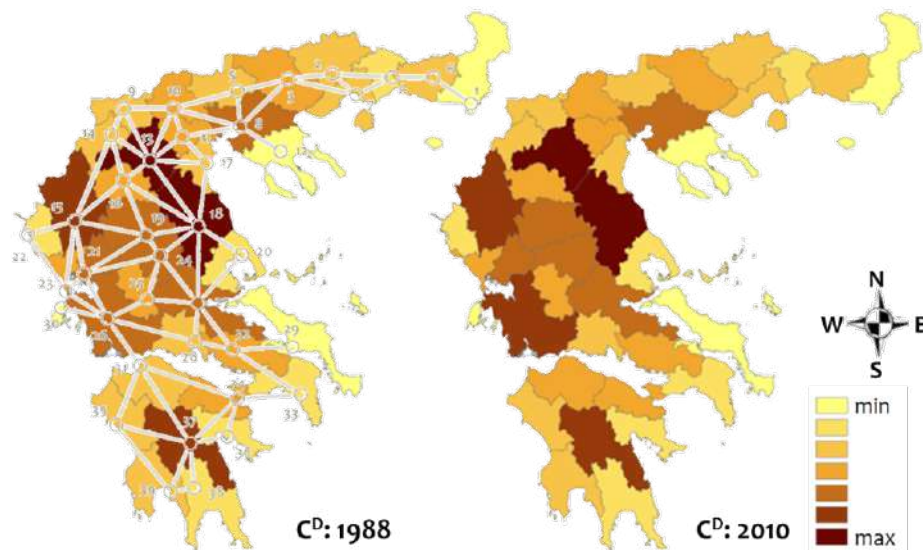


Figure 7. Degree centralities of the Greek interregional transport system (left) in 1988 and (right) in 2010.

The differences observed in degree centrality for the period 1988-2010 can be attributed to the construction of the Rio-Antirrio Bridge (Figure 2), which provided direct road access to the regions of Achaia and Aetolia-Acarmania. As can be seen from the comparison of the two maps, the only difference in network connectivity is for the regions of Aetolia-Acarmania and Achaia, which increased their rank by one connection. This change can be attributed to the construction of the Rio-Antirrio Bridge, which provided direct road access to these NUTS III regions.

The distribution of closeness centrality in 1988 (Figure 8) describes the accessibility of the transport network at that time. The most privileged regional capital cities in 1988 in terms of geographical accessibility were Pieria, Larissa, Magnesia, and Phthiotis, presumably due to their proximity to the Athens-Thessaloniki (highway) road axis. The prefecture of Thessaloniki enjoyed a more central role at that time (1988) compared to the metropolitan region of Attica. The changes in closeness centrality from 1988 to 2010 reveal the relative transformation that transport infrastructures underwent the meanwhile period. As it can be observed, the secondary central Greece regional cluster in 1988 was demoted in terms of closeness in 2010, implying that transport infrastructures upgrade occurred in the meanwhile favored the core connectivity axis of Attica-Thessaloniki. Although this change may be attributed to the construction of the Egnatia Motorway and the Rio-Antirrio Bridge (Figure 2), which enhanced accessibility between Central and Northern Greece, this observation provides insights into the existence of an underlying mechanism of economies of scale in transportation development in Greece, following the “rich-gets-richer” growth model. This interpretation brings into the light the Sisyphus analogy in transportation (Rodrigue et al., 2013; Polyzos and Tsiotas, 2020), according to which large scale transportation infrastructures attract more users and therefore induce derived demand requiring their subsequent upgrade. Overall, the upgrade of the road network that took place in the period 1988-2010 illustrates a major developmental pattern that benefited the wider Central Greece region, where the most accessible areas are clustered. The results of the closeness centrality analysis interprets that accessibility in the current form of the GRCN appears mainly a matter of geographical location rather than infrastructure. The decline in the relative position of the prefecture of Boeotia appears of particular interest, and is probably related to another gravitational effect attributed to the metropolitan prefecture of Attica.

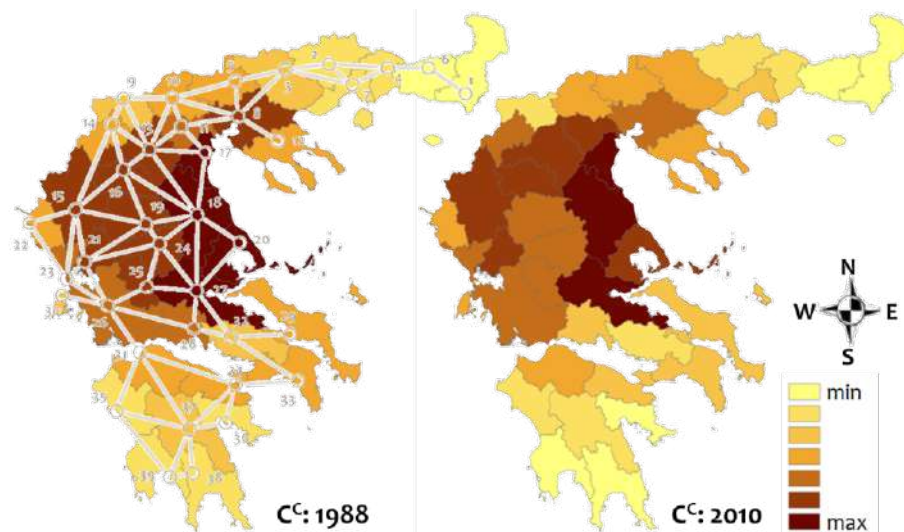


Figure 8. Closeness centrality of the Greek interregional road transport system in 1988 (left) and 2010 (right) (source: own processing)

Finally, the spatial distribution of straightness centrality provides insights into the quality of the country's road infrastructure. Straightness centrality expresses the deviation from spatial directedness between the GRCN regions. Figure 9 depicts the most benefited regional capital cities in transport infrastructure policy, which are Ioannina and Thesprotia. The geographical location of these two regions indicates that they have benefited from both the Rio-Antirrio Bridge and the Egnatia Motorway road projects (Figure 2). The next lowest centrality is shown by the regions Kastoria, Preveza, and Arta, which also have easy access to the Rio-Antirrio and Egnatia Motorway projects. Next in the ranking are the regions Evros and Kavala, in northern Greece; Pieria, Evritania, and Attica, in central Greece; and Arcadia and Laconia and Messenia, in the Peloponnese.

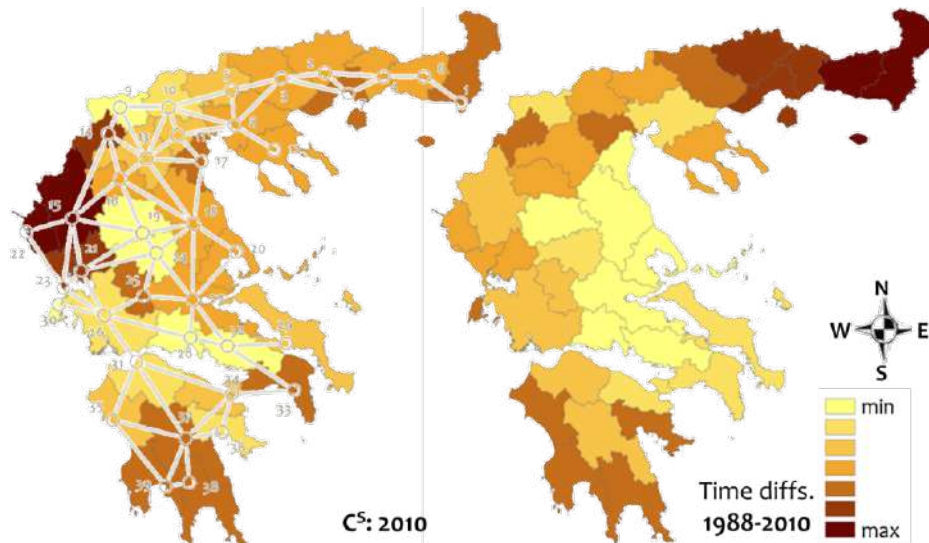


Figure 9. Spatial distribution of (left) centrality of the Greek interregional road transport system in 2010 and (right) differences of average time distances per prefecture for the periods 1988 and 2010 (source: own processing)

The geographical grouping of these NUTS III regions shows the projects that contributed most to their centrality, namely the construction of the Egnatia Motorway (which connects the prefecture of *Thesprotia* with *Evros*) for the northern Greek departments, the Rio-Antirrio Bridge (which connects the prefecture of *Achaia* and *Aetolia-Acarmania*, providing access to and from the Peloponnese from Western Greece) for the Peloponnese and the Athens-Thessaloniki axis for the regions Pieria, Evritania, and Attica in central Greece. The geographical dispersion of the regions Pieria, Evritania, and Attica suggests that there are also secondary apparent causes of increased centrality, such as the Egnatia Motorway for Pieria and the Rio-Antirrio Bridge for Evritania. Next, the geographical distribution of the travel time differences (Figure 9 right) shows the regions that benefited most in terms of travel time from the Greek transport policy of 1988-2010. As shown in the map, the travel time differences distribution shows a clear spatial clustering with the largest values in the periphery and the smallest in the center. In particular, the regional capital cities that showed larger time gains in their interregional travel are mainly the borderline regions Evros and Rhodope, and secondarily the regions Xanthi, Kavala, and Drama. The next most important (in terms of straightness) regions are Serres, Imathia, and Florina, in Northern Greece; Preveza and Lefkada, in Western Greece; and the cluster of the regions Elis, Messenia, Laconia, and Argolis, in the Peloponnese. The positions of the regions included in the aforementioned cases can facilitate correspondences for the infrastructure projects that impacted their reduction of inter-regional travel times.

4. Conclusions

The study of the topology of the Nationwide Network of (NUTS III) Regional Capitals of Greece (GRCN) highlighted the decisive influence of spatial constraints in the network's configuration, revealing particular characteristics that contribute to the understanding of its spatial cohesion and functionality. The topological pattern detected by the pattern recognition distribution analysis (with a peaked distribution and a high concentration of nodes around the main diagonal of the adjacency) revealed that GRCN does not exhibit scale-free characteristics but more resembles to a lattice network. However, the geographical relevance and spatial ordering of the network are enhanced through the small-world property indicated by the ω -index, assigning to the GRCN spatial characteristics found in densely interconnected networks with high local coherence. The centrality analysis identified nodes with high betweenness centrality, implying a geographical structure of GRCN as a heavy center, highlighting areas that play a central role in inter-regional connections. At the same time, the grouping of the network into geographical communities (modularity optimization) highlighted the spatial relevance and the tendency of the network to form regional sets with increased connectivity within them. A finding illuminated by the study is that lattice-like topology is associated with the existence of long-range connections, which are identified by the high value of the power-law exponent ($\beta > 1$). This finding can provide insights into spatial planning to the extent that intercity administrative

connections are submitted to latticization spatial dynamics. Moreover, the comparison of the centrality measures of the NUTS III regions between the available years 1988 and 2010 demonstrates the improvement of the country's transport capacities as a result of major infrastructure projects. The changes in centrality highlight the role of national and regional policy, which over the period 1988-2010 sought to strengthen border and remote areas, reducing geographical disparities and promoting development prospects across the country. This targeted direction underlines the importance of public investment in reshaping spatial dynamics and improving accessibility at regional level.

Overall, the study demonstrates the added value of complex network analysis in understanding and improving spatial interactions and provides an important research framework for developing strategies based on evidence-based spatial connectivity models. The GRCN paradigm represents a fruitful application in economic geography and transport sciences, offering insights that can be used in regional and development planning.

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KOSOVO EMPLOYEE'S PERCEPTION OF ECONOMIC GROWTH AND DECENT WORK ACCORDING TO SUSTAINABILITY

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Abstract

This research paper aims to identify how implementation of Goal 8 “Decent work and economic growth” deriving from the UN Sustainable Development Goals is being perceived by employees of the public sector and private sector in Kosovo. This paper aims to investigate perceptions of the employees on decent work and explore the path how employees, employers, social partners and public policymakers contribute to a united response to the implementation of sustainability dimensions to foster community cohesion and promote common vision. In a discovery seeking environment, as a research method was used survey. The sample consists of 201 respondents that targeted employees of either private or public sector in different regions of the country. Data collected were analyzed using Independent T-Test and Spearman's rank order correlations. The study reveals that there is no mean difference between perceptions of females and males about the economic growth in the country and impact on incomes. Economic growth is moderately related with the opportunity of being able to cover basic living expenses. Moreover, the perceptions of the integrity protection at workplace and being able to cover basic living expenses is moderately intertwined with the equal pay for equal value. Safety and physical security at workplace is also moderately related to protection of integrity in the workplace. Perceptions of respondents on economic growth are moderately associated with working sector.

Keywords: SDG8, decent work, economic growth, perception

JEL Classification: J 10, J 13, J40, O10, O40

Citation

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1. Introduction

The Sustainable Development Goals (SDGs) are an outcome of the United Nations Conference on Sustainable Development, followed by the 2030 Agenda for Sustainable Development, adopted by all United Nations Member States (193 states) in 2015. Kosovo is not a member state of the United Nations and subsequently is not a signatory to the 2030 Agenda for Sustainable Development. In the same vein, Kosovo aims to join European Union (EU). A contractual relationship between Kosovo and EU has been established through The Stabilization and Association Agreement (SSA) that entered into force in April 1, 2016. However, the Assembly of Kosovo in January of 2018 exhibited a proclivity for commitment to develop voluntarily national sustainable development indicators to enhance global monitoring of the SDG's progress through adoption of the Resolution for Sustainable Development and establishment of the Council for Sustainable Development. The United Nations Kosovo Team is the key supporter of the Government of Kosovo to provide 'a shared blueprint for peace and prosperity for people and the planet, now and into the future' (The 2030 Agenda for Sustainable Development, 2015). Activities of the United Nations development system agencies in Kosovo are guided by the United Nations Sustainable Development Cooperation Framework. Of particular interest is the extent to which these agencies will manage to give rise to implementation of SDGs at local and central level of government through apparatus of guiding, funding and programs. At the heart of this framework is a series of joint outcomes expected to be achieved by 2025 for helping people of Kosovo "live healthier, longer and more dignified, and have prosperous and secure lives" (United Nations Kosovo Team, 2021).

2. Literature Review

2.1 Conceptual Frameworks: Economic Growth and Sustainability

Economic Growth as a Pillar of Sustainability: Economic growth is often seen as a driver of improved living standards, increased employment opportunities, and poverty reduction. However, studies emphasize the need for "inclusive and sustainable growth," which balances economic expansion with environmental and social considerations.

Decoupling Growth from Environmental Degradation: Research highlights the challenge of achieving growth while reducing ecological harm. Sustainable growth strategies aim to minimize the environmental footprint, a factor employees increasingly value when assessing their workplace.

2.2 Decent Work and Employee Well-Being

Definition of Decent Work: The International Labour Organization (ILO) defines decent work as "productive work that delivers fair income, security, and dignity for all." Employees perceive decent work as crucial for their economic stability and social well-being.

Impact on Employee Engagement: Empirical studies show that employees who experience decent work conditions, such as fair wages and safe workplaces, report higher job satisfaction and loyalty. Sustainability-focused policies further enhance this effect, demonstrating a strong link between corporate social responsibility (CSR) and employee morale.

2.3 Employee Perception of Sustainability Practices

Awareness and Acceptance: Employees are more likely to support sustainability initiatives when they understand how these practices benefit them and their communities. Studies show that transparent communication about sustainability goals positively influences employee perceptions.

Perception Gaps: Research often identifies a discrepancy between organizational sustainability rhetoric and actual practices. Employees may become disengaged when they perceive greenwashing or insufficient commitment to sustainable development goals.

2.4 Actions, Organizations and Definition of Terms

Recognizing the urgency of understanding and correctly interpreting the variety of terms and fostering the knowledge on sustainable development goals, since sustainable development has a different meaning to different people and different countries, because some countries are very rich and others are poor, a holistic approach of describing appropriately a range of terms for all SDG's is addressed

within 17 volumes, each one considering one of the 17 SDGs within the Encyclopedia of the UN Sustainable Development (2020). Volume 8 of the above-mentioned Encyclopedia provides fundamental explanations towards “attainment of more just and empowering economic models, and putting at the forefront the well-being of workers by striving to provide employment and better working conditions that respect the dignity of workers”.

The International Labour Organization (ILO) is mandated to set up international labour standards and to provide support and guiding to all countries. This organization defines decent work as “productive work under conditions of freedom, equity, security and dignity, in which rights are protected, adequate remuneration and social coverage are provided” (ILO, 1999). Kees van der Ree (2020) believes that the major challenge for ILO is to “ensure social justice in the evolving transition and chartering the course towards a sustainable future that is decent and green for all”. In moving toward implementation of SDG 8, European Commission in cooperation with various partners, including International Labour Organization (ILO) is committed to implement the best social standards through implementation of the Pillar of Social Rights between all its member state, region of Balkan, candidate countries and potential candidate countries. The European Pillar of Social Rights Action plan is built upon three pillars and a summary of each is provided in the following:

- Equal opportunities and access to the labor market: education, training and life-long learning, gender equality, equal opportunities and active support to employment,
- Fair working conditions: secure and adaptable employment, wages, information about the employment conditioned and protection in case of dismissals, social dialogue and involvement of workers, work-life balance, healthy, safe and well adopted work environment and data
- Social protection and inclusion: child care and support to children, social protection unemployment benefits, minimum income, old-age income and pensions, healthcare, inclusion of people with disabilities, long-term care, housing and assistance for homeless, and an access to essential services (European Commission, 2021).

Economic growth as a compelling topic in research and as an independent discipline is defined as an increase in the quantity and quality of the economic goods and services that a country produces and consumes. The World Bank and OECD (2022) defines annual percentage growth rate of GDP per capita as in the following:

“... based on constant local currency. GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources”.

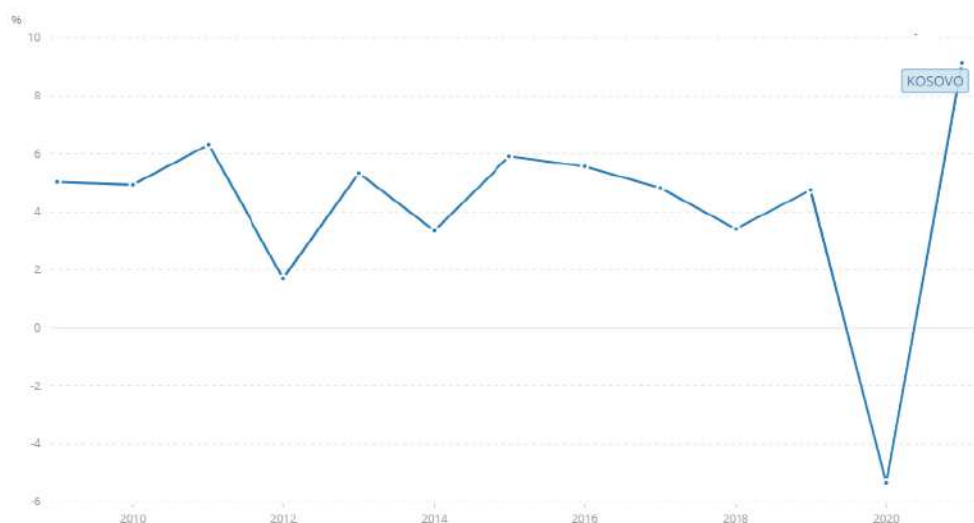


Figure 1: GDP growth (annual %) – Kosovo

Source: World Bank national accounts data, and OECD National Account data files, 2022

Based on the Sustainable Development Goal 8, Target One, the least developed countries shall achieve at least 7% gross domestic product in managing to sustain. Trends of annual growth in Kosovo vary significantly among years and data is provided within Figure 1. During the 2021, GDP growth for Kosovo marked 9.1% (World Bank & OECD 2022). In 2020, the world's annual growth marked a decrease from -4.29%, whereas Kosovo was doing badly -5.41% compared to the Albania with -3.40%. (World Bank & OECD 2022). In 2019, the world's annual growth was 1.52%, whereas Kosovo marked 5.24% (World Bank & OECD 2022). In 2018, the world's annual growth was 2.14%, whereas Kosovo marked 3.06% (World Bank & OECD 2022). In 2017, the world's annual growth was 2.22%, whereas Kosovo 4.04% (World Bank & OECD 2022). In 2016, the world's annual growth was 1.64%, whereas Kosovo marked 6.20% (World Bank & OECD 2022).

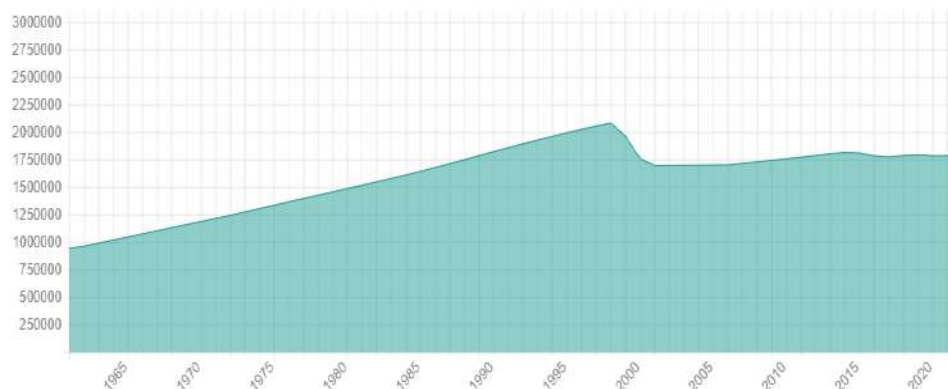


Figure 2: Population growth since 1960

Source World data, 2022

Kosovo has a high population growth and based on the World Data (2022) from 1960 until 2021 the population numbers increased from 947, 000.00 to 1.81 million as given in Figure 2. During the war year 1999, Kosovo had its biggest decrease on population with -10.38%. The current average age is 30 years old. In countries with high population growth and low-income, there is most likely the possibility of having a slow development (Peterson, 2017).

3. Methodology

3.1 Inconsistencies and Contradictions

By emphasizing sustainable dimensions in academic research and literature, during last three decades, various aspects of the economic growth and decent work are treated in many disciplines. On the other hand, due research on the implementation of the SDGs is still at its early phase at developing countries and it requires in-depth scientific analysis, covering fully the decent work concept, monitoring and undertaking political action. (Bilek-Steindl et al. 2022, Pereira et al 2019). Rahman (1970) supports the fact that there is a need for public sector in less developed countries to develop adequate planning for initiating, directing and leading the process of economic growth. Hence, measuring economic growth and decent work in Kosovo it's not without problems because many aspects that make countries' well-being are not part of gross domestic product (GDP).

Research shows that proposals that highlight the private sector vis-à-vis the public sector rest largely on theoretical considerations. Moreover, negative relationship are found between government size and economic growth and adverse effects are reported on marginal factor productivities in the public and private sector Dalamagas (2000).

Approaching the problem of decent work and dignity from the concept of management perspective has taken a new turn and dimensions such is emotional labour that is deeply explored (Grandey et al , 2015; Humphrey et al 2015), emphasizing the importance of the wages. The issue of "minimum wages" in Kosovo is regulated by national Law on Labour No.03/L-212. In addition to national laws, some countries apply collective bargaining (International Labour Organization, 2013). Yao et al (2017) found that "respondents adjudged the effectiveness and legitimacy ("fairness") of pay in multi-

dimensional terms, relating to perceptions of personal inputs (skills and attributes), treatment at work, and pay relative to others and according to their own contingent household needs. All of these factors provide the context for the impact of pay on well-being". Finally, the literature reviewed here indicates that economic growth is the main driver of the impact on decent work and sustainability. There are, however, important caveats to the impact magnitude on incomes and based on this foundation, the following hypothesis is raised:

H₀ There is no mean difference on economic growth perceptions and its impact on income increase among females and males.

H₁ There is a mean difference on economic growth perceptions and its impact on income increase among females and males.

In fact, a growing body of literature on SDGs with a pedigree suggests that continued economic growth and decent work is perhaps the most deeply entrenched human rights obligations of all governments. Frey (2017) concludes that "the ambiguity in SDG 8 presents both opportunities for human rights monitoring and accountability but also enhanced legitimacy for the business approach". Bali and Yang-Wallentin (2020) suggest that sustainable development in developing countries requires a strategic policy focus. This approach shall serve as an equalizer in fulfilling targets of SDG8 in private and public sector. Despite the different views, deficit on the work agenda and the quality of employment is evident in many countries (Tadjoeddin, 2014) and in ensuring work engagement, the focus shall be directed towards sustainability, growth, and success of workers (Navajas-Romero, 2019). In this research, differences on economic growth perceptions, equal pay, safety and physical protection, integrity and wellbeing and respect of employee rights towards impact for employees working in private and public sector are addressed through the following hypothesis:

H₀: Perception of respondents on integrity protection at workplace and perception of respondents on equal pay are not related.

H₂: Perception of respondents on integrity protection at workplace and perception of respondents on equal pay are related.

H₀: Perceptions of respondents on being able to cover basic living expenses and perceptions of respondents on equal pay distribution are not related.

H₃: Perceptions of respondents on being able to cover basic living expenses and perceptions of respondents on equal pay distribution are related.

H₀: Perceptions of respondents on safety at workplace and perceptions of respondents on integrity protection are not related.

H₄: Perceptions of respondents on safety at workplace and perceptions of respondents on integrity protection are not related.

H₀: Perceptions of respondents on economic growth are not related with the respondents working sector.

H₅: Perceptions of respondents on economic growth are related with the respondents working sector.

H₀: Perceptions of respondents on economic growth are not related with being able to cover basic living expenses.

H₆: Perceptions of respondents on economic growth are not related with being able to cover basic living expenses.

In what follows, criticism about inconsistencies and contradictions of SDG's (Ponte & Rodríguez-Enríquez, 2016), provides convincing reasons why some developing countries with low incomes such as Kosovo does not have enough "national capabilities for participation and implementation of Decent Work Country Programmes" (Rantanen, 2020) including decent work research. Yet, it is unclear in Kosovo if its current economic growth trend is sustained and what is the right action or research method to address any of the SDG's, especially when considering "several overlaps and trade-offs between the different goals" (Barbier and Burgess 2019), and considerations of the business as a consisting part of the solutions of all SDG's (Aerni, 2021). Kreinin and Aigner (2021) raise the need to revise and reformulate SDG 8 framework, so that other new sub goals could possibly take place.

Historically, the increase in efforts to conceptualize economic empowerment of women; to set up research priorities in trying to respond to the question of the female representation in different

industries; and, in identifying key impediments of females in decent employment especially during the rapid employment changes, has helped predominantly in modelling projection series of employment in many countries (Grantham et al, 2021; Granada et al, 2019; Evans, 2017; Floro & Mieke, 2009; Sarfraz, 2021; Kabeer, 2012).

3.2 Structure of the survey

The aim of this study is to identify how few dimensions of Goal 8 “Decent work and economic growth” deriving from the UN Sustainable Development Goals are being perceived by employees of the public sector and private sector in county. According to the United Nations General Assembly (2015) this global goal aims to “promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all”.

To find out what are the perceptions of employees in Kosova concerning the above-mentioned dimensions, the present study is conducted by applying quantitative method. The survey was administered by bachelor students of the Department of Business and Management at “Universum” College in Municipality of Lipjan and Municipality of Ferizaj in Kosova. The field distribution of the questionnaire and data collection of questionnaire took place during the month of February and March 2022. The sample consists of 201 respondent’s that are working either in private or public sector and represent different regions within the country.

In developing a survey questionnaire, the most helpful approach was collection of the opinions from the academic staff within the College in compiling question. The first part of the questionnaire includes demographic information such as gender, age and sector of employment that served as independent variables in this research. The second part of the questionnaire is composed of close-ended questions that contain six questions using Likert scale ranging from very satisfied (4), to a great extent (3), somewhat (2), very little (1) not at all. The questionnaire is structured around the perceptions that respondent’s hold toward economic growth, income increase, equal pay, safety and security in the workplace, integrity and wellbeing, and having employee rights respected.

The six questions of the questionnaire, recognized as part of this survey, intend to identify how employees of public sector and private sector perceive trends of economic growth and how they feel about the impact on monthly incomes, standard and quality of well-being, equal treatment at work, security, integrity and mutual respect at workplace. Questions of the survey are stated as in the following: (Q1) Do you believe that country’s economic growth influenced the increase on your incomes? (Q2) Are you earning enough monthly incomes to cover basic living expenses? (Q3) Do you believe that your organization is distributing equal pay between genders, employees with same occupations and employees with disability? (Q4) Do you feel safe and physically secured at your working place? (Q5) Is your integrity and wellbeing protected at your workplace? And, (Q6) Are your rights protected at workplace?

After the collection of the data from the survey, inputs are recorded on Statistical Package for the Social Science (SPSS) software (version 20) for analysis and further synthesizes of the results are conducted. Two hypotheses in this paper are tested by using Independent t-Test.

This study has limitations that require to be addressed in any future research conducted in country. First, the data derives from the survey targeting population that was employed during administration of the questionnaire. More data from random sampling might advance the knowledge on the subject being studied. Second, this study focused only on SDG 8 and future research design including all SDGs can tell details that coalesce into an implementation framework

4. Results and Discussion

4.1 Demographic Profile of Respondent’s

The statistical analysis of this survey are coded on SPSS in nine items and the first step of analysis involved measuring of internal consistency to figure out the scale reliability of data using Cronbach’s alpha in trying to measure the degree to which scales are free from error. From our case, the

Cronbach's alpha is 0.443 which indicates an acceptable reliability coefficient level of internal consistency between scales.

The sample consists of 55% females and 46% males. Respondent's that work in in public sector make up 45% of this sample, and 55% work in private sector. The age of employed respondent's is categorized in three groups: the first category includes respondent's that ranges from 25 to 34 years old; the second category includes respondent's that range from 35 to 54 years old; and the third category includes respondent's that range from 55 to 65 years old. Respondent's aged 25 to 34 years old are the majority group making up 60% of the sample, and it is followed by 31% of respondents who are aged from 35 to 55 years old and the third group of respondent's are aged from 55 to 65 years old and count 9 % of this sample. Most respondent's (69%) aged 25 to 34 years old of all surveyed respondent's work in private sector, compared to 25 % respondent's aged 35 to 54 years old and 6 % of respondent's aged 55 to 65 years old.

Respondents were asked about their perceptions on different work-related and well-being dimensions. First question: Do you believe that country's economic growth influenced the increase on your incomes?, using Liker's likelihood four scale measure indicates that 20% are satisfied to a great extent, 40% are somewhat satisfied, 30 % are very little and 10% not at all. Second question: Are you earning enough monthly incomes to cover basic living expenses?, respondent's indicated the only 17% earn money to cover expenses to a great extent, 41% somewhat, 34% very little and 8% not at all. Third question of the survey: Do you believe that your organization is distributing equal pay between genders, employees with same occupations and employees with disability?, indicates that 62% believe on equal pay to a great extent, 32% somewhat, 5% very little and 1% not at all. Forth question: Do you feel safe and physically secured at your working place?, indicates that 51% of employees feel safe and physically secured at their working places, 40 % somewhat, 7% very little and 2% not at all. Fifth question: Is your integrity and wellbeing protected at your workplace?, indicates that 63% of respondent's feel that their integrity and wellbeing is protect at the workplace to a great extent, 25 % somewhat, 8% very little and 4% not at all.

The first part of the survey is consisted of three variables: gender, age and working sector. In general, there are more females than males who work in private sector (64%). In contrast, 58% of males work in public sector, and only 36% of male work in private sector.

4.2 Cross tabulation Analysis of Respondent's Perception

In this part is presented a summary of respondent's distribution based on gender, workplace and age and what are their perceptions on economic growth and its impact on incomes; perceptions on the amount of money earned and its sufficiency to cover basic living expenses; perceptions on equal pay based on occupation, gender and people with disability; perception on integrity and wellbeing in the workplace; perception on safety and physical security in the workplace; and, perception on respect of employees rights in the workplace.

Table 1. Descriptive statistics

Variables	N	Mean	Std. Deviation
Gender	187	1.4492	.49875
Institution	184	1.5000	.66939
Age	198	1.5505	.49870
Q1	200	2.3300	.91942
Q2	200	2.3250	.85618
Q3	197	1.4365	.61635
Q4	198	2.0707	.98982
Q5	198	1.5909	.70482
Q6	200	1.5100	.78292

Source: Author's data

Descriptive statistics are provided for all variables within Table 1. Summary of all means and SD for every single variable is as follows: gender (M=1.4492, SD=.49875); institution (M=1.5000, SD=.66939), age (M=1.5505, SD=.49870); Q1 economic growth (M=2.3300, SD=.91942), Q2 basic living expenses (M=2.3250, SD=.85618), Q3 equal pay (M=1.4365, SD=.61635), Q4 integrity (M=2.0707, SD=.98982), Q5 safety (M=1.5909, SD=.70482), and Q6 rights (M=1.5100, SD=.78292). Table 2 presents results based on cross tabulation of variable perception on economic growth and the influence income increase and other independent variables gender, institution and age. Females (9%) perceive that the economic growth didn't had an impact on the increase of their incomes and respondent's representing the private sector (10%) indicated the same. Approximately 20% of all respondent's working in public or private sector and belonging to any of the three age groups perceive that economic growth influenced incomes to a great extent.

Table 2: Perception of employees on economic growth and influence on incomes

Q 1: Perceptions on economic growth influence on an income increase				
	To a great extent	Somewhat	Very little	Not at all
Gender				
Female	10%	19%	17%	9%
Male	10%	20%	12%	3%
Sector				
Public Sector	11%	20%	13%	1%
Private Sector	8%	21%	16%	10%
Age				
Age 25-34	10%	20%	20%	10%
Age 35-54	5%	14%	9%	2%
Age 55-65	3%	4%	2%	1%

Source: Author's data

Table 3 presents results based on cross tabulation of variable perception on the amount of money earned to cover basic living expenses and other independent variables gender, institution and age. Respondent's working in private sector seem to be able to cover their living expenses (12%) to a great extent compared to those working in public sector (6%). On the other hand, 7% of the respondent's working in private sector are not able or very little (20%) to cover all basic living expenses. No significant variation is found between females and males concerning all measuring scales. Respondent's aged 25 to 34 (28%) indicate that they are very little or not at all able to cover their basic living expenses, which is more than half of the respondent's belonging to this group age.

Table 3: Perceptions of employees on sufficiency of earned money to cover basic living expenses

Q 2: Perceptions on the amount of money earned to cover basic living expenses				
	To a great extent	Somewhat	Very little	Not at all
Gender				
Female	8%	20%	23%	4%
Male	9%	20%	11%	5%
Sector				
Public Sector	6%	24%	13%	2%
Private Sector	12%	16%	20%	7%
Age				
Age 25-34	11%	20%	22%	6%
Age 35-54	6%	15%	9%	1%
Age 55-65	2%	5%	2%	1%

Source: Author's data

Table 4 indicates that equal pay is more a concern for respondent's working in private sector compared to those in public sector (10% very little and 9% not at all), whereas there is no highlighted difference in terms of age and gender in this regard.

Table 4: Data from survey on perceptions of employees on equal pay

Q 3: Perceptions on equal pay				
	To a great extent	Somewhat	Very little	Not at all
Gender				
Female	17%	20%	11%	7%
Male	16%	16%	8%	5%
Sector				
Public Sector	19%	15%	8%	3%
Private Sector	15%	21%	10%	9%
Age				
Age 25-34	17%	24%	10%	8%
Age 35-54	14%	10%	4%	3%
Age 55-65	4%	2%	3%	1%

Source: Author's data

Table 5 perceptions of respondent's towards the integrity protection and wellbeing at workplace. In general, the results reveal that only 4% of all respondent's being females or males, in any of the group ages and working either in public or private sector feel that integrity and wellbeing is not protected in the workplace. On the other hand 62% of respondent's feel that integrity and wellbeing is being protected in the workplace to a great extent.

Table 5: Data from survey on perception of employees on integrity and wellbeing

Q 4: Perceptions on integrity and wellbeing on workplace				
	To a great extent	Somewhat	Very little	Not at all
Gender				
Female	37%	13%	4%	1%
Male	28%	10%	4%	3%
Sector				
Public Sector	26%	12%	5%	2%
Private Sector	36%	14%	3%	2%
Age				
Age 25-34	42%	12%	4%	2%
Age 35-54	16%	11%	2%	1%
Age 55-65	5%	3%	1%	1%

Source: Author's data

Table 6 presents results on perception of employees on safety and physical security. Based on the outputs, it is evident that still a small percentage (2%) of employees do not feel safe at work even in terms of physical security. The majority of the respondent's feel safe at workplace to a great extent and private sector is perceived more safe (30%).

Table 6: Data from survey on perception of employees on safety and physical security

Q 5: Perceptions on workplace safety and physical security				
	To a great extent	Somewhat	Very little	Not at all
Gender				
Female	30%	22%	3%	1%
Male	23%	17%	3%	1%
Sector				
Public Sector	21%	20%	2%	1%
Private Sector	30%	19%	4%	1%
Age				
Age 25-34	31%	24%	3%	1%
Age 35-54	17%	11%	2%	0%
Age 55-65	5%	4%	1%	1%

Source: Author's data

Table 7 presents data of respondent's' perceptions on their rights being respected at the workplace. As shown below, in general respondent's feel that their rights are respected regardless the gender, age or type of sector. Approximately 64% of respondent's declare that to a great extent their rights are respected and only 1% at group age 55-65 from private sector declare that rights are not being respected at all.

Table 7: Data from survey on perception of respect of rights to employees

Q 6: Perceptions on respecting of employee rights				
	To a great extent	Somewhat	Very little	Not at all
Gender				
Female	34%	19%	2%	0%
Male	30%	11%	3%	1%
Sector				
Public Sector	29%	14%	1%	0%
Private Sector	33%	18%	4%	1%
Age				
Age 25-34	40%	16%	3%	0%
Age 35-54	17%	13%	1%	0%
Age 55-65	6%	3%	0%	1%

Source: Author's data

4.3 Hypothesis Test

To test our first hypotheses in this paper is used independent t-test. The hypothesis questions the mean difference on economic growth perceptions of respondent's and its impact on income increase among females and males. The aim is to determine and understand whether the mean (perceptions of respondent's toward economic growth and its impact on income increase) is different based on gender (Table 8). Here, the dependent variable is "mean perception on economic growth", and the independent variable is "gender", which has two groups: "females" and "male". The level at which it is considered that the independent t-test result is statistically significant is given as alpha level which is set at $\alpha = .05$, with 95 % confidence interval percentage. Based on the independent t-test, the p-value is 0.41, the mean difference in the dependent variable (perceptions of respondent's on economic development) between the two groups of the independent variable (females and males) is statistically significant based on the sample data.

Table 8: Independent T test for first hypothesis

Independent T test	Mean	Std. Deviation	Sig. (2-tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
Perception on economic growth by female respondent's	2.45	.957	0.041	.011	.543
Perception on economic growth by male respondent's	2.17	.866			

Source: Author's data

Therefore, we reject the null hypothesis that there is no mean difference between the two groups in the population and accept the alternative hypothesis that there is a mean difference between the two groups in the population. A 95% Confidence interval of the difference suggests that the mean difference in perceptions toward economic growth between the first group (females) and second group (males) in the population might be somewhere between 0.01 and 0.54 where 0.11 reflects the lower bound of the 95%CI and 0.54 reflects the upper bound. Therefore, between the two gender groups, it appears that perceptions on economic growth are more negative among females compared to perceptions on economic growth among males.

Hence, the remaining hypothesis presented below are being tested by applying Spearman's rank order correlations (see Table 9).

Table 9: Correlations Hypothesis Test

Hypotheses	Correlation Coefficient	Sig. (2-tailed)	Number of respondents	Test
H ₂ :	.347**	.000	197	Accepted
H ₃ :	.289**	.000	198	Accepted
H ₄ :	.350**	.000	198	Accepted
H ₅ :	.215**	.002	197	Accepted
H ₆ :	.310**	.000	200	Accepted

Source: Author's data

When handling results of testing the remaining hypotheses from H₂ to H₆, the Spearman's rank-order correlation was run to determine the relationship between different variables. The correlation tests outputs indicate that all null hypotheses are rejected (see Table 9).

The second hypothesis questioning the relationship of respondent's perception on integrity protection and perceptions on equal pay reveals that relationship is moderate ($r_s=.347$, $n=197$), and it is statistically significant ($p=.000$). The third hypothesis questioning the fact of being able to cover basic living expenses and receiving the same pay as all others for the same job/profession has a weak positive relationship ($r_s=.289$, $n=198$), but it is statistically significant ($p=.000$). The fourth hypothesis on feeling safe at the workplace and having the integrity protected at workplace has a moderate positive association ($r_s=.350$, $n=198$), and it is statistically significant ($p=.000$). The fifth hypothesis on perceptions of respondents on economic growth and representing working sector has a weak positive relationship ($r_s=.215$, $n=197$), but still it is statistically significant ($p=.002$). The sixth hypothesis on respondent's perceptions on economic growth and being able to cover basic living expenses indicates a moderate positive association ($r_s=.310$, $n=200$) and is statistically significant ($p=.000$). In sum, following the above-mentioned outputs, it is concluded that there is a moderate positive relationship among all variables within.

5. Conclusions

One simple way to implement Sustainable Development Agenda in Kosovo is a holistic institutional approach and a clear understanding of the importance that SDG - related initiatives hold. A first approach to consider is that "global problems are too big and the public sector is too weak to solve them alone" (Martens, 2020). In this regard, the paper examined how respondent's who are working do perceive the domestic trends of economic growth, impact on an increase of their incomes, protection of the integrity, rights, safety and wellbeing based on gender and employment sector.

Importantly, the mean difference between perceptions of males and females about the economic growth in the country and impact on incomes was statistically significant which is in harmony with other studies on SDG8 revealing that there are gendered gaps constraining the parameters of SDG 8 (Shirin et al, 2019). Economic growth is moderately related with the opportunity of being able to cover basic living expenses. Moreover, the perceptions of the integrity protection at workplace and being able to cover basic living expenses is moderately intertwined with the equal pay for equal value. Safety and physical security at workplace is also moderately related to protection of integrity in the workplace. Some perceptions of respondents on economic growth are moderately associated with working sector as follows:

- Employees increasingly recognize the importance of aligning workplace practices with sustainability principles. However, their perceptions often vary depending on organizational transparency and communication about these goals.
- Perceptions of economic growth are linked to job stability, fair wages, and opportunities for career advancement. Employees view sustainable economic growth positively when it leads to tangible benefits such as improved workplace conditions and equitable pay structures.
- Decent work (fair income, job security, and a safe working environment) is central to employee satisfaction and engagement. Workers value ethical practices, respect for labor rights, and inclusivity in their workplace.
- Employees feel more motivated and loyal when organizations adopt sustainable practices, such as reducing environmental impacts, promoting ethical labor, and contributing to community well-being.
- Many employees report gaps between organizational claims and actions regarding sustainability and decent work. For example, while policies may exist, they are not always effectively implemented or monitored.
- In transitional economies, such as Kosovo, economic and institutional challenges significantly impact employee perceptions. Workers may prioritize basic job security and wages over broader sustainability goals due to economic constraints.
- Leadership commitment to sustainability and decent work strongly influences employee perceptions. Clear strategies, regular communication, and participatory decision-making are essential for aligning organizational goals with employee expectations.
- Employees value organizations that integrate economic, social, and environmental dimensions into their operations. These companies are often perceived as better employers, fostering long-term commitment and productivity.
- Employees in Kosovo emphasize the need for stability in job markets, especially in industries like agribusiness and tourism. They see potential in sustainable tourism initiatives but express concerns about inadequate enforcement of labor rights and fair wages.

Government of Kosovo and all its partners shall clearly put forward directions on how SDGs shall be addressed at this stage and decide on a united response to the implementation of all SDGs to foster community cohesion and common vision through enhanced mechanisms of sustainable economic growth, employment, and decent work for all.

In sum, the Kosovo institutions, the national private business sector, and the local community, has crucial moment to clearly put forward directions on how SDGs shall be addressed at this early stage and decide on a united response to the implementation of all SDGs to foster community cohesion and common vision through enhanced mechanisms of sustainable economic growth, employment, and decent work for all.

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THE PREDICTIVE POWER OF TECHNICAL ANALYSIS: EVIDENCE FROM THE GBP/USD EXCHANGE RATE

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Abstract

This study examines the effectiveness of technical analysis in the foreign exchange market, focusing on the GBP/USD currency pair in 2019. By combining historical and granular analysis, the research leverages various technical tools, including trendlines, support and resistance levels, Fibonacci retracements, chart patterns, and candlestick formations. The study demonstrates the predictive power of these tools in identifying market trends, pinpointing potential reversals, and uncovering trading opportunities. This highlights the value of technical analysis for informed decision-making in the complex foreign exchange market.

Keywords: Financial markets, Forex market, Technical analysis, GBP/USD, Volatility.

JEL Classification: D50, D53

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1. Introduction

Individuals can make informed investment decisions by anticipating future market trends, capitalizing on opportunities, and mitigating risks, requiring a deep understanding of economics, industry dynamics, and geopolitical events, and often combining technical and fundamental analysis (Fronzetti Colladon et al., 2023). Technical analysis is a widely used methodology for predicting the future price movements of financial assets such as stocks, indices, currencies, and commodities (Ghanem et al., 2024). Instead of focusing on economic fundamentals, it assumes that all relevant information is reflected in asset prices and that historical price patterns can indicate future trends (Han et al., 2024). Key techniques include charts, trend lines, support and resistance levels, chart patterns, and technical indicators (Hassanniakalager et al., 2021). Charts, like line, bar, and candlestick types, visualise price history, while trend lines and support/resistance levels highlight market direction and psychological barriers. Indicators such as moving averages, RSI, and MACD confirm trends and generate trading signals (Oktaba & Grzywińska-Rapca, 2024). Although valuable for identifying trends, entry/exit points, and managing risk, technical analysis relies on historical data and may be less effective in volatile or rapidly changing markets (Cohen, 2021). Its subjective nature can also lead to varying interpretations among analysts (Lakshmi & Adithya, 2024).

This study employs a comprehensive technical analysis approach to evaluate the effectiveness of analytical tools in the foreign exchange market, focusing specifically on the GBP/USD currency pair during the calendar year 2019. The research methodology integrates a sophisticated blend of quantitative and graphical analysis techniques, meticulously designed to provide nuanced insights into market dynamics. Secondary data was systematically extracted from the Tradingview platform, with the GBP/USD exchange rate pair selected based on scholarly recommendations from Hassanniakalager et al. (2021), who underscored the pair's significant economic importance and pronounced volatility characteristics. The research adopted a multi-tiered temporal approach to ensure comprehensive market analysis. A broad historical context was established using an extensive weekly timeframe spanning from 3 May 1993 to 31 December 2018, enabling the identification of long-term market trends and structural patterns. This was followed by a granular daily timeframe analysis to conduct an in-depth examination of the pair's behaviour throughout 2019. Multiple sophisticated technical analysis tools were integrated into the study, including trend identification and analysis, support and resistance level mapping, Fibonacci retracement techniques, graphical pattern recognition, candlestick pattern evaluation, and price breakout analysis. The analytical procedure followed a systematic five-stage protocol. Firstly, the GBP/USD currency pair was selected due to its demonstrated market volatility and economic significance. The second stage involved a comprehensive analysis of historical price movements to establish foundational support and resistance levels and identify prevailing market trends. In the third stage, an in-depth evaluation of 2019 price movements was conducted to assess the predictive and interpretative potential of the previously identified technical levels. The fourth stage entailed a rigorous examination of various technical indicators, including chart patterns, candlestick formations, and price breakout configurations. Finally, the research concentrated on the analysis of reversal candlestick patterns, traditionally used as critical indicators for market entry points. This study offers several methodological contributions. It develops a robust multi-timeframe analytical framework and demonstrates the comprehensive integration of diverse technical analysis tools. Additionally, it provides a systematic approach to pattern recognition and market trend interpretation. The study empirically validates the effectiveness of technical analysis in navigating the complexities of currency markets, highlighting its utility for informed decision-making in trading strategies.

2. Literature Review

The Forex market is renowned for its accessibility and popularity, as highlighted by Juszczuk and Kruś (2017). It stands as the world's largest financial market, with daily transactions exceeding \$6.6 trillion in 2019, according to the Bank for International Settlements (BIS) (Schrimpf & Sushko, 2019). Pongsena et al. (2021) further underscore its economic significance and unparalleled scale. Within this market, technical and fundamental analysis play pivotal roles as core components of rule-based

trading systems, enabling traders to generate buy and sell signals by analysing historical price data and economic indicators (Juszczuk & Kruś, 2017). Technical analysis has been widely explored as a tool for predicting price movements. Zheng (2023) highlights its reliance on historical data and technical indicators to identify potential buying and selling opportunities, acknowledging its limitations and the need for a comprehensive investment strategy. Chart patterns, such as triangles, flags, head and shoulders, and double tops or bottoms, are particularly valuable for identifying trend continuations or reversals, as noted by Akbarzadeh and Soleimani (2023). Reversal patterns, including head and shoulders and double tops/bottoms, provide further insights into potential trend shifts (Zheng, 2023). Specific tools such as Fibonacci retracement are crucial for identifying support and resistance levels, aiding traders in making informed decisions (Tsinaslanidis et al., 2022; Sethi et al., 2020). Japanese candlesticks, which visually represent price movements, are also emphasised for their role in identifying trend reversals, continuations, and key price levels (Cohen, 2021; Heinz et al., 2021). Meanwhile, breakouts are highlighted by Yu and Li (2021) for their potential to signal significant price shifts and trading opportunities. Advanced methodologies have further enhanced technical analysis. Neural networks, as Rundo et al. (2019) argue, capture complex price patterns, enabling more accurate predictions and investment decisions. Similarly, machine learning techniques, introduced by Jiang et al. (2023), have demonstrated superior predictive capabilities compared to traditional approaches. AI-driven tools are increasingly central to market prediction and decision-making, benefiting both traders and policymakers by improving market stability (Bartram et al., 2020; Pongsena et al., 2021). Research has also explored the optimisation of trading strategies. Vezeris et al. (2018) demonstrated that refining Take Profit and Stop Loss parameters in a MACD-based trading system significantly enhances performance. Moreover, the challenges of measuring investor sentiment and the need for advanced techniques are addressed by Cookson and Niessner (2020).

3. Methodology

The study conducted an in-depth technical analysis to evaluate the effectiveness of analytical tools in the foreign exchange market, focusing specifically on the GBP/USD currency pair during the year 2019. Employing a sophisticated integration of quantitative and graphical analysis techniques, the research was meticulously designed to provide nuanced insights into market dynamics. Data was systematically sourced from the Tradingview platform, with the GBP/USD pair strategically chosen based on recommendations from Roy Trivedi (2022) and Darvas & Schepp (2024), who emphasised the pair's economic significance and notable volatility. To ensure a comprehensive market analysis, the study adopted a multi-tiered temporal approach. A broad historical perspective was established using an extended weekly timeframe spanning from 3 May 1993 to 31 December 2018, enabling the identification of long-term market trends and structural patterns. This was complemented by a detailed daily timeframe analysis, which examined the pair's behaviour throughout 2019 in greater depth. The research integrated a range of sophisticated technical analysis tools to enhance its analytical scope. These included trend identification and analysis, mapping of support and resistance levels, Fibonacci retracement techniques, graphical pattern recognition, candlestick pattern evaluation, and price breakout analysis. The analytical procedure followed a structured five-stage protocol. In the first stage, the GBP/USD pair was deliberately selected due to its economic importance and market volatility. The second stage involved a comprehensive analysis of historical price movements, establishing foundational support and resistance levels while identifying prevailing trends. The third stage focused on a detailed evaluation of the pair's price movements during 2019, assessing the predictive and interpretative relevance of previously identified technical levels. In the fourth stage, the research undertook a rigorous examination of technical indicators, including chart patterns, candlestick formations, and breakout configurations. Finally, the study concentrated on the analysis of reversal candlestick patterns, recognised as critical indicators for identifying market entry points. By combining a robust methodology with diverse technical tools, the study offered valuable insights into the utility of technical analysis in navigating the complexities of the GBP/USD currency market.

4. Results

This currency pair has exhibited a persistent downward trend since 2008. Figure 1 highlights this long-term descending trendline (red line). However, for the specific context of 2019, this trendline is not directly relevant as it remains well above the fluctuation range observed during the analysed period. Examining recent years reveals a historical low point reached in 2016, followed by a partial recovery that extended until 2018. After this period, the pair resumed its decline. In the year under study, the pair fluctuated within the range of 1.35160 to 1.19600. As illustrated in Figure 1, the currency pair initially followed an upward trajectory early in the year, maintaining this ascent until mid-March. During this period, the price approached a key resistance level at 1.33683 but failed to break through. This inability to surpass the resistance marked the start of a downward movement, which extended through to September, culminating in the lowest price recorded for the year. At this point, the price found support at the 1.20152 level, where it rebounded, initiating an upward movement that continued until the year's peak in December. Throughout this period, former resistance and support zones maintained their influence on price movements, continuing to act as critical points of resistance and support. A more detailed trend analysis reveals that, from the beginning of the year until late April, the price adhered to an ascending trendline identified as LTA1. However, upon breaking this trendline, the price retraced to retest it, in line with the observation by Pring (2014) that an ascending trendline, once broken, tends to act as resistance. Following this retest, the price entered a downward phase characterised by two observable descending trendlines. The first descending trendline, LTD1, was less steep and acted as resistance from March until October, at which point it was breached. The second, LTD2, was steeper and confined the price movement more tightly, restraining it between May and September. In both cases, these trendlines were respected by the price and played a role as resistance throughout the downward trajectory. Towards the year's end, a new ascending trendline (LTA2) emerged, providing support for the price during the final two months of 2019. This trendline helped stabilise the price as it began a moderate upward movement. In summary, 2019 was marked by dynamic price fluctuations within a defined range, influenced by key resistance and support levels as well as identifiable trendlines. Each of these elements played a significant role in guiding price behaviour, underscoring the continued relevance of technical analysis tools in understanding market movements.

Figure 1 – GBP/USD Trends



Source: Own elaboration on the Tradingview platform

Following the break of LTD2, Figure 2 illustrates the formation of a Head and Shoulders (HS) pattern, which does not fully adhere to the established criteria for such patterns. According to the principles outlined by Pring (2014) and Eugster Uhl (2023), an HS pattern typically requires a noticeable increase in trading volume during the development of the first shoulder and the head, reflecting heightened market activity. However, in this instance, the volume remains stable throughout the formation of the pattern, failing to meet this essential condition. Additionally, the price does not break below the neckline, which is a critical requirement for confirming the validity of an HS pattern. Without this downward movement, the expected bearish signal associated with this formation cannot be considered reliable. Consequently, while the visual resemblance to an HS pattern is present, its failure to meet these fundamental criteria renders it invalid for practical analysis or decision-making.

Figure 2 - Head & Shoulders GBP/USD



Source: Own elaboration on the Tradingview platform

In addition to the incomplete Head and Shoulders (HS) pattern, a double top formation is observed during the year under analysis. This pattern occurs during a correction within a downward movement, as the price is not ready to initiate an upward trend. The double top is characterised by two peaks at approximately the same level, separated by a trough in between (Fernández & Crespo, 2022). Following some indecision around the trough, which aligns with the resistance level of 1.25226, the price ultimately breaks downward in an impulsive movement, as shown in Figure 3. This behaviour confirms the bearish implications of the double top pattern, reinforcing its reliability in identifying potential reversals within a broader downtrend. The occurrence of this pattern highlights the importance of recognising key resistance levels and the subsequent price action for effective trend analysis and forecasting.

Figura 3 – Double Top GBP/USD



Source: Own elaboration on the Tradingview platform

During the year under analysis, three continuation patterns were identified, as illustrated in Figure 4. The first occurred during an upward movement, where a flag pattern formed. According to Ghanem et al. (2024), this pattern creates a parallelogram that points in the opposite direction of the trend. After completing its formation, the price broke through the structure and resumed its initial upward trajectory. At the end of July and the beginning of August, during a downward movement, the price consolidated within a symmetrical triangle. As noted by Singh (2021), this is the most prevalent continuation pattern in charts. Formed by two converging lines, the price oscillated between them until breaking the structure and continuing the downward movement. Towards the end of the year, during another upward movement, a rectangle pattern emerged. The price consolidated for several weeks within this structure before breaking out and resuming the initial upward trend. Similarly to the analysis of the previous pair, Figure 4 highlights bearish reversal patterns in red and bullish reversal patterns in green. In this pair, fewer patterns were observed overall. Following bearish reversal patterns, the price typically decreased as anticipated. However, bullish reversal patterns showed a less

consistent outcome. As previously discussed, Ghanem et al. (2024) emphasises that reversal patterns should only be considered if they occur in key areas of reversal, such as trendlines, channels, support/resistance zones, pattern boundaries, or Fibonacci retracement levels. This analysis reinforces the importance of recognising chart patterns within the context of significant technical areas, as they provide better reliability and predictive value. The observed continuation patterns aligned well with their theoretical behaviours, supporting their utility in trend analysis. Conversely, the fewer reversal patterns and their occasional inconsistency underscore the necessity of incorporating broader contextual elements for accurate interpretation (Sin, 2023).

Figure 4 – Continuation Patterns GBP/USD



Source: Own elaboration on the Tradingview platform

Upon the breakdown of the Long-Term Ascending (LTA) trend and disruption of its upward momentum, the Fibonacci retracement method is systematically applied to identify potential price retracement zones. In this specific market scenario, illustrated in Figure 5, the most significant Retracement Bands (RB) demonstrate critical influence on price dynamics, functioning simultaneously as resistance and support levels. The analysis reveals that at the 23.6% Fibonacci retracement level, a significant resistance zone emerges, precipitating a subsequent bearish price movement. This precise interaction between Fibonacci levels and price action underscores the method's analytical potency in technical market analysis. The strategic identification of these retracement zones enables traders to anticipate potential price reversals, manage risk more effectively, and develop more informed trading strategies by leveraging the mathematical precision of Fibonacci retracement techniques.

Figure 5 - Fibonacci Retracement I GBP/USD



Source: Own elaboration on the Tradingview platform

Upon the breakdown of the Long-Term Descending (LTD) trend, the Retracement Band (RB) method is systematically reapplied, as illustrated in Figure 6 and substantiated by Cohen (2023) research. This analytical approach critically examines the most significant retracement zones, which simultaneously function as resistance and support levels in market dynamics. In this specific scenario, the price encounters robust support at the 23.6% retracement zone. Despite the initial trend breakdown, the market demonstrates resilience, initiating an unexpected bullish movement that progressively develops momentum. This ascendant trajectory ultimately culminates at the 100% retracement level, exemplifying the complex and nuanced nature of market behaviour. The observed price action underscores the sophisticated predictive potential of Fibonacci retracement techniques, offering traders a mathematically grounded methodology for anticipating potential market reversals and understanding intricate trend mechanisms (Dumiter & Turcaş, 2023).

Figure 6 - Fibonacci Retracement II GBP/USD



Source: Own elaboration on the Tradingview platform

5. Conclusions

The analysis of this currency pair throughout 2019 reveals a complex and dynamic market environment, demonstrating the sophisticated interplay of technical analysis methodologies (Ni, 2024). This study makes several significant contributions to understanding market behaviour and technical analysis. The research developed a robust methodological approach that integrates multiple technical analysis techniques, including trendline identification and analysis, pattern recognition, Fibonacci retracement methods, and support and resistance zone mapping (Cohen, 2023 and Ghanem et al., 2024). The study introduced a rigorous framework for validating technical patterns, particularly highlighting the limitations of traditional pattern recognition. For instance, the Head and Shoulders pattern analysis demonstrated the critical importance of volume and structural integrity in pattern confirmation (Zheng, 2023). The research substantiated the predictive potential of Fibonacci retracement techniques, revealing their capacity to identify critical price reversal zones, provide mathematically grounded risk management strategies, and offer nuanced insights into market momentum and potential trend reversals (Tsinaslanidis et al., 2022). The currency pair exhibited a persistent downward trend with notable fluctuations, with price movements consistently influenced by established resistance and support levels (Tripathi et al., 2021). Multiple trendlines and continuation patterns were identified and analysed. continuation patterns demonstrated high predictability, while reversal patterns showed less consistent outcomes, emphasizing the need for contextual analysis and the importance of examining patterns within broader technical areas (Charles, 2018). The study reinforces existing technical analysis theories, particularly Pring's (2014) and principles of pattern recognition, Chen's (2010) research on market behaviour and pattern formation, and the critical role of mathematical and geometric approaches in market analysis (Karatas & Unal, 2021). For traders, it generates strategic insights through enhanced understanding of market trend mechanisms, improved risk management through precise zone identification, and more informed trading strategy development (Dumiter & Turcaş, 2023). The analytical methodology demonstrated the value of multi-dimensional technical analysis, highlighted the importance of contextual interpretation, and emphasized the need for comprehensive pattern validation (Khattak et al., 2023). This research provides a comprehensive exploration of technical analysis methodologies, offering

valuable insights into currency pair market dynamics by integrating multiple analytical approaches. The sophisticated analytical framework developed herein contributes to academic understanding and provides practical tools for traders and financial analysts. The findings underscore the importance of a holistic, mathematically grounded approach to market analysis. Future research should expand the analytical timeframe, incorporate advanced statistical and machine learning techniques, refine pattern recognition algorithms, and conduct cross-market comparisons to enhance our understanding of market dynamics and predictive modeling.

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Announcements, Conferences, News

**64th ERSA Congress “Regional Science in Turbulent Times. In search of a resilient, sustainable and inclusive future”
26 to 29 August 2025 (onsite participation only).**

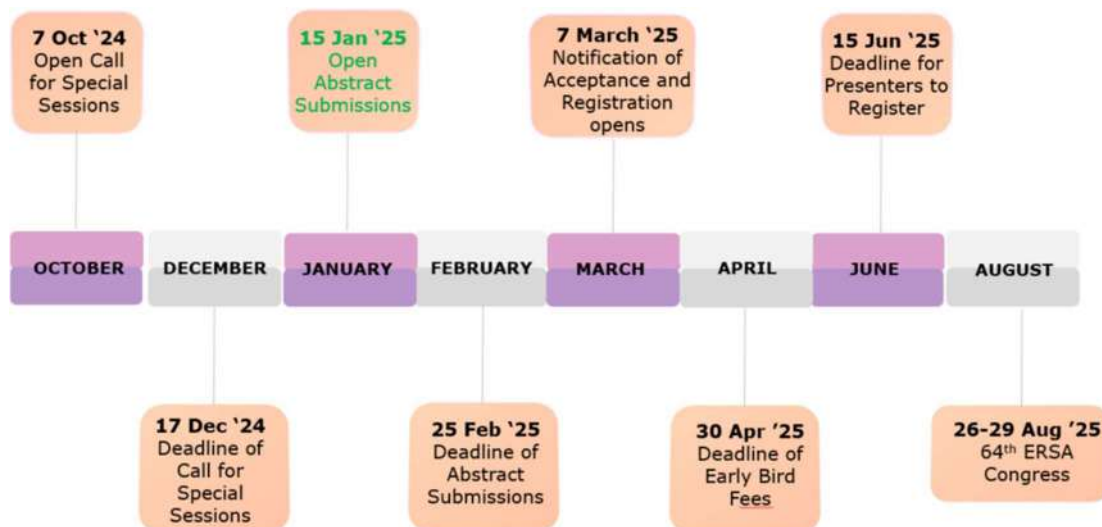


Event Overview

The 64th ERSA Congress will be held from 26 to 29 August 2025 with onsite participation only. The ERSA2025's edition will focus on “Regional Science in Turbulent Times. In search of a resilient, sustainable and inclusive future”. This theme is explicitly related to the contemporary challenges that people and places are facing today and to how Regional Science can reflect and interact with these challenges. The economic crisis, the refugee crisis and the pandemic are some representative examples of the unprecedented intensity and prolonged duration of the sequential crises that have been experienced. The field of Regional Science is made up of a dynamic association of scientists and policy makers who are engaged in understanding, analyzing, and promoting policy proposals that will lead to a more resilient and inclusive future for people and places across the globe.

With approximately 800 participants every year from all continents, the ERSA Congress has become the largest academic conference in regional science worldwide, providing a place to present your research results, get precious feedback and network as well as find out about new developments in the field, and also meet colleagues and friends.

Currently, the Congress is accepting proposals for Special Sessions, with a submission deadline of December 17, 2024. Key dates for subsequent phases of the Congress are outlined in the timetable below:



The Congress Chair, Professor Yannis Psycharis, and the Organizing Committee cordially invite members of the Regional Science community to participate in the 64th ERSA Congress in Athens. This event will bring together diverse perspectives to foster creative and innovative solutions to regional challenges. Attendees will benefit from a dynamic environment, gaining insights from keynote speakers and colleagues alike, while building connections, sharing experiences, and exchanging ideas.

For more information, please visit: <https://ersa.eventsair.com/ersa2025/>

Assistant Professor, SRDS J.

Event overview edited by Dimitrios Tsiotas,

Academic Profiles



Prof. Dr. Luljeta MINXHOZI - First Deputy Governor of the Bank of Albania

First Deputy Governor of the Bank of Albania on 9 January 2019. She joined the Bank as a member of the Supervisory Council in December 2018.

Prof. Dr. Minxhozi graduated in Economics from the University of Tirana, in 1982 and holds the title Professor since 2011. Between 1982 and 2017, she attended a series of academic programmes in renowned European universities.

Her teaching career started in 1982, at the Faculty of Economics, University of Tirana, to be later enriched by other teaching experiences in a number of universities. Notably, she served as the Dean of the Faculty of Economics at the European University of Tirana over the period 2008 - 2018, and as the Vice Rector of Luarasi University in 2018.

Throughout her extensive academic experience, Prof. Dr. Minxhozi has been engaged as a lead professor in various subjects of economics and finance in a number of universities in Albania and abroad. Her rich bibliography of works includes numerous economic studies, scientific articles, academic publications, university textbooks and monographs.

She has also delivered a series of lectures in many national and international conferences, contributing to academic and economic debate.

*Academic Profile by:
Ass. Professor Dr. Filipos Ruxho
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Prof.Dr. Petraq Papajorgji

Prof.Dr. Petraq Papajorgji is a consultant at Moore Albania shpk, Tirana, Albania, independent member of Moore Global Network Limited. His area of expertise is modeling complex information systems. Prof. Papajorgji was for 10 years, editor-in-chief of International Journal of Agricultural and Environmental Information Systems (IAEIS) indexed in 14 indexes in the web of Science, Associate Editor of Journal of Biomedical Data Mining, Iberoamerican Journal of Applied Computing, Member of Center for Applied Optimization University of Florida, Gainesville, Florida, USA, Honorary Citizen of Berat, Albania. Prof. Papajorgji is member of the group that were awarded the Prize of the Republic, the highest prize in the country, for the study “The Conditions of the Olive Tree in Albania”, 1986. He is author and coauthor of a number of books published by Springer and IGI publishing houses. He has won a number of international awards such Best Paper Award, IGI Publishing, Pennsylvania (USA) in 2012, Certificate for Outstanding Contribution in Reviewing, Journal of Computers and Electronics in Agriculture 2018 and Best Paper Award, 15th International Strategic Management Conference, Poznan, Poland. Prof. Papajorgji has taught a number of courses at several universities around the world. Professor Papajorgji has published more than 100 research papers. Currently, prof. Papajorgji is listed in top 3% of Albanian scientists in Google Scholar.

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Prof. Ass. Dr. Alma SHEHU

Alma Shehu Lokaj is a distinguished scholar and assistant professor at the University “Haxhi Zeka” in Peja Kosovo, where she also serves as the Vice Rector for Teaching, Students’ Affairs, and Scientific Research. Her academic expertise and leadership position underscore her significant contributions to advancing education and research at the university, shaping its academic policies and fostering an environment conducive to innovative research.

Professor Shehu holds a PhD in Management with a specialization in Human Resources Management, a field central to understanding organizational dynamics and workforce optimization. Her scholarly work focuses on HRM, leadership, organizational culture, and the interplay between these factors in private and public organizations. In her administrative role, she is instrumental in enhancing the quality of education and research initiatives at Higher Education Institutions. Her leadership involves developing academic programs, supporting faculty and students, and promoting international collaboration.

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Assistant Professor Dimitrios TSIOTAS

Dimitrios Tsiotas, PhD, is an early-career Greek scholar specializing in Regional Science. He earned his Ph.D. in Regional Science and Network Science from the University of Thessaly (Volos, Greece) in 2016. Since 2021, he has been serving as an Assistant Professor in Regional Economics and Development at the Department of Regional and Economic Development, Agricultural University of Athens (Amfissa, Phocis, Greece). Dr. Dimitrios Tsiotas holds a multidisciplinary academic background, including two bachelor's (B.Sc.) degrees: one in Aircraft Infrastructure Engineering, from the Hellenic Air Force Academy, and another in Mathematics from the National and Kapodestrian University of Athens; and two postgraduate (M.Sc.) degrees: one in Spatial Planning, Urban Planning, and Development, from the University of Thessaly, and another in Statistics and Modelling from Aristotle University of Thessaloniki. Dr. Dimitrios Tsiotas is a member of the Regional Science Association International (RSAI) and serves as a Co-Editor of the esteemed journal Spatial Economic Analysis (SEA, Taylor & Francis, <https://www.tandfonline.com/journals/rsea20>). He is also a member of the Editorial Board in Regional Science Inquiry (RSIJ, <https://rsijournal.eu>), Sustainable Regional Development Scientific Journal (SRDSJ, <https://srdsjournal.eu>), Theoretical and Empirical Researches in Urban Management (TERUM, <http://www.um.ase.ro>), Management Research and Practice (MRP, <http://mrp.ase.ro>), and the Greek scientific journal Aeihoros (Αειχώρος, <https://journals.lib.uth.gr/index.php/aeihoros/index>). He has also contributed to special issues and has an extensive reviewer record for almost 40 academic journals. Dr. Dimitrios Tsiotas has published more than 120 scientific documents, including articles in scientific journals, conference proceedings, and book chapters. His research spans topics such as Regional Science and Economics; Transport Economics, Transportation, and Spatial Networks; Urban Economics and Planning; Network Science and Complex Network Analysis; and Quantitative Methods in Regional and Urban Development; and enjoys so far over 1,560 citations in the Google Scholar database (and over 820 citations in the Scopus database). Notable publications appear indicatively in Proceedings of the National Academy of Sciences (PNAS); Journal of Transport Geography; Regional Science Policy and Practice; Progress in Economic Geography; Networks and Spatial Economics; Planning Practice and Research; Environment and Planning A; Environment, Development, and Sustainability; Journal of International Development; and Scientific Reports.

In December 2021, Dr. Dimitrios Tsiotas had the honor of being invited to the Hellenic Parliament, alongside the Rector of the Agricultural University of Athens, Prof. Spiridon Kintzios, to present a study on regional inequalities in Greece and the development of the Phocis Region. This presentation was delivered at the Special Standing Committee of the Regions with the topic: "Restrictions imposed in the public interest and hindering the development of geographical areas and regions: Establishing incentives and providing compensatory benefits to redress injustices - The case of Phocis as the most typical."

Dr. Dimitrios Tsiotas' teaching portfolio encompasses undergraduate and postgraduate courses across Greek universities, including the Agricultural University of Athens, University of Thessaly, Hellenic Open University, and International Hellenic University. He has also contributed teaching to the European University for Smart Urban Coastal Sustainability (EU-CONEXUS) initiative. His teaching inventory includes (amongst others) courses such as Regional Economics I & II; Urban Economics I & II, Introduction to Regional Science; Economic Analysis and Policy; Spatial Planning and Transportation; Regional Development and Inequalities; Economics of Natural Resources; Local and Regional Development; Innovation in Technology and Engineering Management; Campaign Planning and Management; Econometrics; Research Methodology' Quantitative Methods; and Mathematics.

For more information on Dr. Dimitrios Tsiotas' research and academic activities, you can visit:

Dept. of Regional and Economic Development's Web Page:

<https://w1.aua.gr/poa/en/faculty/dimitrios-tsiotas>

Google Scholar:

<https://scholar.google.com/citations?user=a5d4awMAAAAJ&hl=el>

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Researchgate:

<https://www.researchgate.net/profile/Dimitrios-Tsiotas>

Academic Profile by:

Ass. Professor Dr. Filipos Ruxho

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Associate Professor Enkela CACA - BABARAMO

Enkela Caca is Doctor in Economics and Associate Professor at the Department of Economics and Tourism, Faculty of Economy at the University “Eqrem Çabej”, Gjirokastra-Albania.

Enkela obtained her MSc degree in Economics (2005) and the PhD degree (2009) at University of Tirana, Faculty of Economy, in “The role of small and medium-sized enterprises (SME) in economic growth and economic policies affecting their development”. She has completed Post-Doctoral studies at the Faculty of Economics and Management Science, Department of Economics, University of Ioannina, Greece, (2015-2016) with main field of study “Development of Regional Economies in Micro and Macro Aspects”. She became "Associate Professor" in 2012. Since 1997 she is a full time lecturer at “Eqrem Çabej” University, Faculty of Economy. 2012-2018, she was Head of Economics Scientific Research Teaching Group, in Faculty of Economy “Eqrem Çabej” University. She is a member of: Association of Accountants and Financiers of Albania; Economic Consultative Council of the Municipality of Gjirokastra; Editorial Board of "International Journal of Management and Business Economics" (IJMBE), ISSN 2304-0207; Scientific Committee of "1st International Scientific Conference: European Integration of SEE Countries – Challenges Or Reality”, Education and Social Science Faculty, “Eqrem Çabej” University; Scientific Committee of "2nd International Conference Regional Challenges for the Sustainable Development", "Aleksandër Xhuvani University", Elbasan. Enkela was part of the team survey project: “Competing for Remittances” organized by International Organization for Migration (IOM), CARDS, and European Union Program. She has experience in participating in international EU projects and programs, including Erasmus+ Program, as well as bilateral joint research projects with various European Institutions.

Enkela has over 55 publications, including journal articles and symposium proceedings, with main research background in economics, focusing on areas such as innovation, technology, and the development of SMEs in transition economies like Albania. Her work often explores the factors affecting enterprise growth and the impact of technological and organizational innovations. She has also co-authored studies addressing challenges in the informal sector, particularly within Albania's tourism industry, and the financial dynamics of small businesses in developing economies.

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Associate Professor Antoneta ARSENI - POLO

Senior Lecturer in Management Accounting and Financial Analysis, “Eqrem Çabej” University, Faculty of Economy, Department of Accounting & Finance.

Research areas: Management Accounting, Financial Analysis, Management of Sustainable Tourism, Human Resource Management, Regional Economics, among others.

She obtained her MSc degree in Accounting (2009) and her PhD in Economic Sciences, with a focus on Accounting (2015) from the Faculty of Economy, University of Tirana. The title of her doctoral dissertation was: “Methods and Models of Valuation of Economic Units Based on Economic and Financial Indicators.” She completed Post-Doctoral studies (2015–2016) at the Faculty of Economics and Management Science, Department of Economics, University of Ioannina, Greece, with main field of study “Development of Regional Economies in Micro and Macro Aspects.” She became Associate Professor in 2023. Between 1992 and 1998, she worked in the private sector as Head of Finance. Since 1998, she has been a senior lecturer at “Eqrem Çabej” University. Since 2006, she has been a member of the Association of Accountants and Financiers of Albania. In May 2010, she was Associate Editor for the American journal *The International Journal of Interdisciplinary Social Sciences* (Volume 5, ISSN: 1833-1882). Since June 2010, she has been a member of the Editorial Board of the scientific journal *Regional Science Inquiry* (ISSN: 1791-5961), which is indexed in Scopus and EconLit. She is also a full member of the American Economic Association (A.E.A.). In September 2011, she was a member of the Scientific Committee for the 1st International Scientific Conference: European Integration of SEE Countries – Challenges or Reality (23–24 June 2011), organized by the Faculty of Education and Social Sciences, “Eqrem Çabej” University, Gjirokastra, Albania. Since 2015, she has been a scientific collaborator on the blog proklisinews.wordpress.com, a member of the Economic Consultative Council of the Municipality of Gjirokastra, Albania. In March 2016, she was Associate Editor for the journal *The International Journal of Social Sustainability in Economic, Social, and Cultural Context* (Volume 12). In 2017, she was a member of the Editorial Advisory Board for the publication *Technological Integration as a Catalyst for Industrial Development and Economic Growth* by B. Christiansen and U. Yuksel, published by IGI Global in the book series *Advances in Finance, Accounting, and Economics (AFAE)* (ISSN: 2327-5677; eISSN: 2327-5685). Starting in July 2024, she serves as Advisor, Secretariat Member, Critical Surveys Editor, and Editor-Author for the *Sustainable Regional Development Scientific Journal (SRDSJ)*, available at www.srdsjournal.eu. The SRDS Journal is registered with La Bibliothèque Nationale de France (BnF), Paris, ISSN: 3006-3876 (Print), ISSN: 3006-3884 (Online). As an RSI Journal editor, she has written book reviews and conference overviews.

She has extensive experience participating in international EU projects, Erasmus+ programs, and bilateral research projects with various European institutions. She has authored over 70 publications, including journal articles, symposium proceedings, and monographs.

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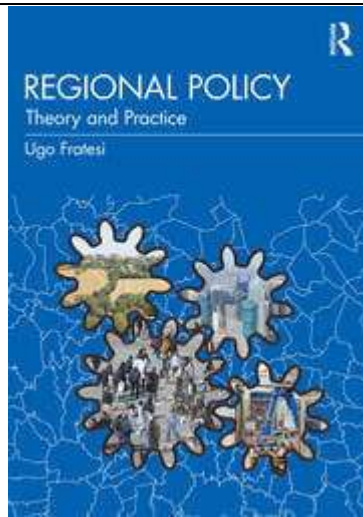
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Book Reviews



REGIONAL POLICY – Theory and Practice, Edited by Ugo Fratesi, Routledge. 2024

Regional policy is an essential in any government's toolkit for promoting socioeconomic prosperity. It comes in many forms and can be used to target the development of weak and stronger regions. This textbook provides comprehensive and systematic coverage of regional policy, dealing with core theories and looking at contemporary challenges in practice, addressing regional policy across the world.

Structured in four parts, the book opens with an exploration of regional policy's characterisation, aims and rationale. The second part is devoted to issues of implementation and the instruments available to policymakers for intervention. The third part addresses regional policy evaluation, as well as statistics and modelling in policymaking. Finally, the book discusses how regional policy is applied in different contexts. Each chapter contains real-life examples of a regional policy topic in action and highlights supplementary topics for advanced readers.

With its broad coverage of the subject, *Regional Policy: Theory and Practice* will prove a valuable resource for advanced students, researchers and practitioners in regional policy, regional economics, economic geography, planning and public policy.

Book Review by:
Ass. Professor Dr. Filipos Ruxho
Sustainable Regional Development Scientific Journal – SRDSJ

Guidelines

For the writers & a format model for the articles submitted
to be reviewed & published in the journal

Sustainable Regional Development Scientific Journal

(Bibliothèque Nationale de France, BnF) – www.srdsjournal.eu

Guidelines for the Writers & a format model for the Articles submitted to be reviewed & published in the journal

The Title of the paper must be centered, and the font must be Times New Roman, size 12, in Uppercase, in Bold

For the writers' personal information use the Times New Roman font, size 11, in bold, and centered. Use lowercase for the first name and uppercase for the last name. The line below the name includes the professional title and workplace; use the Times New Roman font, size 10, centered. In the third line write only the contact e-mail address in Times New Roman 10, centered.

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Abstract

The abstract consists of a single paragraph, no longer than 250 words. The font must be Times New Roman, size 11. The text must be justified. The title "Abstract" must be aligned left, in Times New Roman, size 11, in bold. A space of one line must be left between the title and the text of the abstract. The abstract must contain sufficient information, be factual, and include the basic data of the paper.

Keywords: Use 3 to 5 keywords, separated by commas

JEL classification: We kindly request that you classify your paper according to the JEL system, which is used to classify articles, dissertations, books, book reviews, and a variety of other applications. The use of the JEL classification is necessary so that your paper be properly indexed in databases such as EconLit. Select the codes that represent your article and separate them by commas. You can find information on the JEL system here: <https://www.aeaweb.org/jel/guide/jel.php>

1. Introduction

All articles must begin with an introduction, a section which demarcates the theoretical background and the goals of the paper.

The present document provides the necessary information and formatting guidelines for you to write your article. We recommend that you copy this file to your computer and insert your own text in it, keeping the format that has already been set. All the different parts of the article (title, main text, headers, titles, etc.) have already been set, as in the present document- model. The main text must be written in regular Times New Roman font, size 11, justified, with a 0.5 cm indent for the first line of each paragraph.

We recommend that you save this document to your computer as a Word document model. Therefore, it will be easy for you to have your article in the correct format and ready to be submitted. **The only form in which the file will be accepted is MS Word 2003**. If you have a later version of Microsoft Office / Word, you can edit it as follows:

- Once you have finished formatting your text, create a pdf file, and then save your file as a Word "97-2003" (.doc) file.
 - Compare the two files – the pdf one and the Word "97-2003" (.doc) one.
 - If you do not note any significant differences between the two, then – and only then – you can submit your article to us, **sending both the pdf and the Word "97-2003" (.doc) files** to our e-mail address.
- If you use a word processor other than Microsoft Word, we recommend that you follow the same

procedure as above, creating a pdf file and using the appropriate add-on in order to save your document in MS Word “97-2003” (.doc) form. Once you compare the two files (and find no significant differences), send us both.

2. General Guidelines on Paper Formatting

2.1. Body

The body of the text consists of different sections which describe the content of the article (for example: Method, Findings, Analysis, Discussion, etc.). You can use up to three levels of sections – sub-sections. For the Body of the text, use the default format style in Word, selecting the Times New Roman font, size 11, justified, with a 0.5 cm indent for the first line of each paragraph (this is further detailed in the section “Paragraphs”).

2.2. References

The references included in the paper must be cited at the end of the text. All references used in the body of the paper must be listed alphabetically (this is further detailed in the section “References”).

2.3. Appendices

The section “Appendices” follows the section “References”.

3. Page formatting

3.1. Page size

The page size must be A4 (21 x 29,7 cm), and its orientation must be “portrait”. This stands for all the pages of the paper. “Landscape” orientation is inadmissible.

3.2. Margins

Top margin: 2,54cm Bottom margin: 1,5cm
Left and right margins: 3,17cm Gutter margin: 0cm

3.3. Headers and Footers

Go to “Format” → “Page”, and select a 1,25cm margin for the header and a 1,25cm margin for the footer. Do not write inside the headers and footers, and do not insert page numbers.

3.4. Footnotes

The use of footnotes or endnotes is expressly prohibited. In case further explanation is deemed necessary, you must integrate it in the body of the paper.

3.5. Abbreviations and Acronyms

Abbreviations and acronyms must be defined in the abstract, as well as the first time each one is used in the body of the text.

3.6. Section headers

We recommend that you use up to three sections – sub-sections. Select a simple numbering for the sections – sub-sections according to the present model.

3.7. First level header format

For the headers of the main sections use the Times New Roman font, size 11, in bold and underlined, and leave a size 12 spacing before the paragraph and a size 6 spacing after the paragraph. The header must be aligned left. Use a capital letter only for the first letter of the header.

3.8. Second level header format

For second level headers, follow this model. Use the Times New Roman font, size 11, in bold, and leave a size 12 spacing before the paragraph and a size 3 spacing after the paragraph. Select a 0.5 cm indent. The header must be aligned left. Use a capital letter only for the first letter of the header.

3.8.1. **Third level header**

For third level headers, follow this model. Use the Times New Roman font, size 11, in bold and italics, and leave a size 6 spacing before the paragraph and a size 0 spacing after the paragraph. The header must be aligned left, with a left indent of 1 cm. Use a capital letter only for the first letter of the header.

4. **Paragraphs**

In every paragraph, use the Times New Roman font, size 11, with single line spacing. We recommend you modify the default (normal) format style in Word and use that in your text. For all paragraphs, the spacings before and after the paragraph must be size 0, and the line spacing single. Use a 0,5cm indent only for the first line of each paragraph. Leave no spacings nor lines between paragraphs.

4.1. **Lists**

In case you need to present data in the form of a list, use the following format:

- Bullet indent: 1,14cm
 - Text:
 - Following tab at: 1,5 cm
 - Indent at: 1,5cm
- Use the same format (the above values) if you use numbering for your list.
1. Example of numbered list 1
 2. Example of numbered list 1

5. **Figures, images, and tables**

5.1. **Figures and images**

Insert your figures and images directly after the part where they are mentioned in the body of text. They must be centered, numbered, and have a short descriptive title.

Figures put together “as they are”, using Office tools, are absolutely inadmissible. The figures used must have been exclusively inserted as images in Word, in gif, jpg, or png form (with an analysis of at least 200dpi), and in line with the text. The width of an image must not exceed 14,5cm so that it does not exceed the margins set above.

The images, figures, and tables must be inserted “as they are” in the text, in line with it.

Figures and images which have been inserted in a text box are absolutely inadmissible.

5.1.1. **Reference inside the text**

Avoid phrases such as “the table above” or the “figure below” when citing figures and images. Use instead “in Table 1”, “in Figure 2”, etc.

5.1.2. **Examples**

A model of how to format figures/images follows. For the title, use the Times New Roman font, size 10, in bold. Write the title above the figure, and set a size 6 spacing before the title and a size 0 spacing after it. The line spacing of the title must be 1.5 line. Both the image and its title must be centered.

Image 1: Title



Source: cite the source

Directly below the figure you must cite the source from which you took the image, or any note regarding the figure, written in Times New Roman, size 10. Write it below the figure, leaving a size 0 spacing before and after it, use a line spacing of 1.5 line, and make it centered.

5.2. Tables

For the title, use the Times New Roman font, size 10, in bold. Write the title above the table, and set a size 6 spacing before the title and a size 0 spacing after it. The line spacing of the title must be 1.5 line. Both the table and its title must be centered. The width of the table must not exceed 14,5cm so that it does not exceed the page margins set.

Table 1. Example of how a table must be formatted

Age	Frequency	Percentage %
Under 40	44	32.1
40 - 49	68	49.6
Over 50	25	18.2
Total	137	100.0

Source: cite the source

If the table needs to continue on the next page, select in the “Table properties” that the first line be repeated as a header in every page, as in the above example of Table 1. **Tables (or figures or images) which are included in pages with a “Landscape” orientation are absolutely inadmissible.**

Every table must have horizontal lines 1 pt. wide at the top and bottom, as shown in the example. The use of vertical lines and color fill at the background of the cells is strictly prohibited.

Directly below the table you must cite the source or any note regarding the table, written in Times New Roman, size 10. Write it below the table, leaving a size 0 spacing before and a size 6spacing after it, and make it centered.

6. Mathematical formulas

There is a variety of tools in order to insert and process mathematical formulas, such as the “Mathematics”, found in the most recent editions of Word, “Math Type”, “Fast Math Formula Editor”, “MathCast Equation Editor”, “Math Editor”. Since it is impossible for us to provide youwith compatibility with all these tools in all their editions, **we can only admit your paper if it contains mathematical formulas solely in the form of images.**

Keep a continuous numbering for the mathematical formulas and center them in the page, as shown in the following example:

$$y = ax^2 + bx + c \quad (1)$$

The same stands for formulas or particular mathematical symbols you may have integrated in your text. For instance, if you want to use the term in your text, you must insert it as an image, in line with the text. The images containing the mathematical formulas must be legible (at least 300dpi).

In the exceptional case of a text which may contain a great number of mathematical formulas, the writer may send it to us in TeX form if they so wish.

7. References

We recommend that you use the Chicago Manual of Style Author-Date system, as it is recommended by the AEA (American Economic Association) for the journals included in the EconLit database, and it is the dominant style of bibliography in the field of Economics. For more information, you can go to the following links:

- <https://www.aeaweb.org/journals/policies/sample-references>
- http://www.chicagomanualofstyle.org/tools_citationguide.html
- <http://libguides.williams.edu/citing/chicago-author-date#s-lg-box-12037253>

7.1. Online references (internet citations)

Check your links again before sending your file, to confirm that they are active.

Avoid long internet links. Where possible, also cite the title of the website operator-owner. Return the font color to black, and remove the hyperlink. Links such as the following are impractical and distasteful, therefore should be avoided.

Example of an inadmissible hyperlink

<https://el.wikipedia.org/wiki/%CE%9F%CE%B9%CE%BA%CE%BF%CE%BD%CE%BF%CE%BC%CE%B9%CE%BA%CE%AC>

7.2. References Formatting

For your list of references, use the Times New Roman font, size 10, with single line spacing. The paragraph format must include a size 0 spacing before the paragraph and a size 0 spacing after it, aligned left. Use a 0,5 cm indent only for the first line of each paragraph. Leave no spacings or lines between paragraphs.

7.3. Example of how References must be formatted

Bureau of Labor Statistics. 2000–2010. “Current Employment Statistics: Colorado, Total Nonfarm, Seasonally adjusted - SMS080000000000000001.” United States Department of Labor.
<http://data.bls.gov/cgi-bin/surveymost?sm+08> (accessed February 9, 2011).

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Romer, Christina D., and David H. Romer. 2010. “The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks: Dataset.” American Economic Review.
<http://www.aeaweb.org/articles.php?doi=10.1257/aer.100.3.763> (accessed August 22, 2012).

Ausubel, Lawrence M. 1997. “An Efficient Ascending-Bid Auction for Multiple Objects.” University of Maryland Faculty Working Paper 97–06.

Heidhues, Paul, and Botond Köszegi. 2005. “The Impact of Consumer Loss Aversion on Pricing.” Centre for Economic Policy Research Discussion Paper 4849.