

# Regional Science Inquiry



Regional Science Inquiry

June 2026 Volume XVIII Number 1

# Regional Science Inquiry

THE JOURNAL OF THE  
Hellenic Association of Regional Scientists

June 2026

Volume XVIII  
Number 1

The Journal  
is Indexed in



Editor-in-Chief  
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Christos Ap. Ladias



FOUNDATION YEAR 2008

**English Edition**  
ISSN: 1791-5961 Print  
ISSN: 1791-7735 On line



**RSI J**

Website: <http://www.rsijournal.eu>, Email: [info@rsijournal.eu](mailto:info@rsijournal.eu), [publisher@rsijournal.eu](mailto:publisher@rsijournal.eu)  
Address: 19b Navarinou Street, 15232 Chalandri, Athens, Greece, Tel./Fax: +30 210 6833700.  
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Department of Regional Economics and Environment  
University of Lodz, Lodz, Poland

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Department of Social and Political Sciences  
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Department of Geography University of the Aegean,  
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School of Urban-Regional Planning &  
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Department of Sciences, Technological  
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Department of Economic and Regional  
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Department of Public Administration  
Panteion University, Athens, Greece

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University of the Aegean, School of Business,  
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Department of Economic and Regional Development,  
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Department of Forestry and Management of the  
Environment and Natural Resources  
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Department of Forestry and Management of the  
Environment and Natural Resources  
Democritus University of Thrace  
Orestiada, Greece

PROFESSOR EFSTATHIOS TSACHALIDIS  
Department of Forestry and Management of the  
Environment and Natural Resources  
Democritus University of Thrace  
Orestiada, Greece

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Department of Economics, Rochester Institute of  
Technology, NY 14623-5604, USA.

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Department of Economics, University of Texas at San  
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College of Resources Science and Technology,  
Beijing Normal University, Beijing, China

STAVROS RODOKANAKIS  
Department of Social and Policy Sciences  
University of Bath Clarendon Down,  
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Department of Sociology  
University of the Aegean, Mitiline, Greece

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Vlora University, Vlora, Albania

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Department of Human science  
European University of Rome, Rome, Italy

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School of Business Administration and  
Economics, Technological Educational Institute  
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Technological Institute of Florina, Florina, Greece

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Faculty of Economy, University of Elbasan,  
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Faculty of Finance. City University London  
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Department of Business Administration  
University of the Aegean, Chios, Greece

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Department of Architectural Engineering  
Technical University of Crete, Chania, Greece

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School of Sciences of Economy and Public  
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*The articles published in RSI Journal are in accordance with the approving dates by the anonymous reviewers.*

## Regional Science Inquiry, Vol. XVIII, (1), 2026

### Editorial Note

In the first semester of 2026, the Regional Science Inquiry Journal (RSI J), a scientific journal published under the aegis of the Hellenic Association of Regional Scientists, launches the first (1) issue of its eighteenth volume (Vol. XVIII) since its first day of publication.

RSI J is an international, open-access, peer-reviewed journal publishing research across the broad and multidisciplinary field of Regional Science. The journal aims to foster global academic dialogue by supporting rigorous scientific inquiry and advancing high-quality empirical, methodological, and theoretical contributions. As a platform for scholars, researchers, policymakers, and practitioners, RSI J facilitates the exchange of insights on regional development and its various dimensions. This issue (RSIJ, Vol. XVIII, No. 1, 2026) presents 11 papers that were carefully selected to meet the journal's high standards. These papers cover contemporary topics in Regional Science, such as regional economic performance, growth, change, and spatial agglomerations, developmental traps, youth migration, local government funding, education expenditure, and tourism sustainability, and are described in brief as follows:

The *first* paper, titled “*ADMINISTRATIVE CAPACITY AND INSTITUTIONAL DESIGN IN NATIONAL LOCAL GOVERNMENT FUNDING: AN EX-ANTE EVALUATION OF THE 'ANTONIS TRITSIS' PROGRAM IN GREECE*”, authored by Evangelos MAKRYVELIOS and Theodore PAPADOGONAS, examines the design, administrative capacity, and perceived effectiveness of the Antonis Tritsis special development program aimed at supporting local government in Greece. The study applies an ex-ante evaluation approach, focusing on institutional design, implementation conditions, and administrative readiness rather than economic outcomes. The analysis is based on questionnaires and structured interviews with senior managers, exploring perceptions of strategic relevance, institutional functionality, and implementation challenges, with particular attention given to inequalities in administrative capacity among municipalities and to institutional complexity. The findings suggest that the program is strategically important and financially innovative, mainly because its funding sources were fully secured; however, significant challenges remain, especially for small and island municipalities that face limited technical and administrative capacity.

The *second* paper, titled “*THE IMPACT OF CHANGE ON REGIONAL ECONOMIC PARAMETERS AND DEPENDENCIES*”, authored by Inna MANAEVA and Angela SHVETSOVA, develops and tests a methodology for assessing the adaptation of regional economic growth to climate change in the regions of the Russian Federation. The study introduces an adaptation coefficient (KA) to measure the relationship between economic development and climate conditions across regions. Spatial analysis using global and local Moran's indices identifies similarities and differences in adaptation patterns among neighboring regions, while the research combines economic indicators, such as GRP per capita, industrial production, income levels, and investments, with climate variables including temperature and precipitation. Focusing on the Central, Southern, and Siberian Federal Districts during the period 2000–2021, the analysis reveals clear spatial heterogeneity, with southern and some central regions showing higher levels of adaptation and more coordinated development, highlighting the importance of economic diversification and geographical advantages in strengthening regional resilience to climate change.

The *third* paper, titled “*THE IMPACT OF FINANCIAL EXPOSURE ON STUDENTS' FINANCIAL LITERACY: EVIDENCE FROM THE UNIVERSITY OF GJIROKASTRA*”, authored by Dorjana NANO, Antoneta POLO, Enkela CACA, Ilirjana ZYBERI, and Christos Ap. LADIAS, examines the relationship between financial exposure and financial literacy among students at the University of Gjirokastra in Albania. Using survey data from 100 students, the study develops a Financial Exposure Index (FEI) to measure individuals' engagement with financial activities, including income, work experience, and financial learning

sources. Linear and logistic regression models are applied to evaluate the impact of financial exposure on literacy levels, showing that financial exposure strongly improves financial literacy and significantly increases the probability of achieving adequate literacy levels. The results also indicate that gender and regional background influence financial literacy outcomes, while age and marital status have a weaker effect, highlighting the importance of practical financial experience and local socio-economic conditions in shaping financial knowledge and skills.

The *fourth* paper, titled “*EVOLVING REGIONS IN EUROPE: APPLICATION OF SPATIAL MODELS TO THE VARIOUS FORMS OF THE EUROPEAN SPATIAL CONCENTRATIONS*”, authored by Luigi CAPOANI and Csaba LAKÓCAI, reassesses the contemporary relevance of the Blue Banana by analyzing regional economic dynamics in Europe, with particular emphasis on Eastern and Mediterranean regions within the NUTS 2 framework. Building on Stewart’s concept of demographic energy and Moran’s spatial statistics, the study proposes a multilayer methodology combining territorial and economic dimensions, offering insights into the role and economic influence of the Blue Banana during the late 2010s and early 2020s. The analysis confirms that most Blue Banana regions continue to represent Europe’s main economic core according to conventional regional indicators, while identifying emerging alternative spatial concentrations and signs of a gradual eastward shift in economic activity, contributing to the understanding of changing regional development patterns and spatial economic structures in Europe.

The *fifth* paper, titled “*DEVELOPMENT TRAPS IN SMALL EU ECONOMIES: INSIGHTS FROM CROATIA’S LOCAL TRAJECTORIES*”, authored by Vinko MUŠTRA, explores the long-term dynamics of local development traps in Croatia between 2006 and 2022 –a period marked by major structural shocks including the global financial crisis, EU accession, and the COVID-19 pandemic– and applies a multi-period framework on data from all 556 Croatian municipalities and towns to identify two types of development traps: persistent low-income positioning (DT1) and continuous income decline (DT2). The findings reveal strong spatial inequalities, territorial polarization, and significant path dependence across local areas, structural vulnerabilities of Coastal and continental regions, and that development traps are unevenly distributed, even within the same counties, highlighting the importance of detailed territorial analysis.

The *sixth* paper, titled “*THE ECONOMIC PERFORMANCES OF MOROCCAN REGIONS: A TOPSIS AND SPATIAL AUTOCORRELATION METHODS*”, authored by Hamdi EL ASLI, Mohamed AZEROUAL, Alae Mohammed MOURAI, Mounya CHAHBOUNE, and Abdelhak OULALA, analyzes the economic performance of Morocco’s twelve regions between 2015 and 2022 through a combined temporal and spatial approach, focusing on five main macroeconomic indicators, including GDP per capita, household consumption, contribution to national growth, business creation, and activity rates. By integrating the TOPSIS method with spatial autocorrelation analysis, the research evaluates regional competitiveness and identifies geographical clustering patterns, showing that Casablanca-Settat remains Morocco’s leading economic region, followed by Tanger-Tétouan-Al Hoceima and Rabat-Salé-Kénitra, while southern regions continue to lag. The study also highlights the strong impact of the COVID-19 crisis on tourism-dependent regions such as Marrakech-Safi, as well as the temporary economic progress of Béni Mellal-Khénifra before its later decline. Spatial analysis confirms significant regional autocorrelation, with high- and low-performing regions tending to cluster together, providing insights for resource allocation assessment.

The *seventh* paper, titled “*ANALYSIS OF MORPHOLOGICAL CHANGING SCENARIO OF RIVER JAMUNA, WEST BENGAL, INDIA*”, authored by Somnath DAS and Abhay Sankar SAHU, examines the morphological changes of a river between 1977 and 2020 using change detection techniques based on Remote Sensing (RS) and Geographic Information Systems (GIS), dividing the river into three segments, and comparing its condition in 2020 with its course in 2000 to identify the extent of human-induced alterations. The findings reveal that

large sections of the river have been occupied by agricultural activities, settlements, fisheries, and tree plantations. As a result, the river channel has progressively narrowed and experienced significant degradation due to human intervention.

The *eighth* paper, titled “*YOUTH EMIGRATION AND SME PERFORMANCE IN ALBANIA: FIRM-LEVEL EVIDENCE*”, authored by Alketa VANGJELI, investigates the effects of youth emigration on small and medium-sized enterprises (SMEs) in Albania, with a focus on labor shortages, skills availability, productivity, innovation, and growth expectations. Using survey data from SMEs across major economic sectors, the study applies regression analysis to examine how youth emigration influences firm performance, showing that higher emigration levels are strongly linked to labor shortages and limited access to skilled workers, and firms facing stronger emigration pressures also report weaker productivity growth and lower innovation activity, indicating reduced adaptive capacity. Although some SMEs attempt to respond through wage increases or organizational changes, these measures are often insufficient to compensate for the loss of human capital. The study contributes new micro-level evidence on the relationship between migration and business performance in a small transition economy.

The *ninth* paper, titled “*ECONOMIC GROWTH AND  $\beta$ -CONVERGENCE IN EUROPE: EMPIRICAL EVIDENCE FROM REGIONAL PANEL DATA, 2011-2023*”, authored by Evgenia ANASTASIOU, examines regional economic growth and  $\beta$ -convergence across 233 European NUTS-2 regions during the period 2011–2023, to investigate whether regions with lower initial income levels grow faster than more developed regions and analyzes the factors influencing regional growth dynamics. Using alternative panel data models, the research evaluates the robustness of the convergence process and the impact of economic and demographic variables, confirming the existence of  $\beta$ -convergence, indicating that less developed regions tend to experience higher growth rates over time. Investment activity and migration are identified as important drivers of regional economic performance, while labor and demographic factors show less consistent effects. The study also reveals differences in convergence patterns across regional groups, suggesting that structural characteristics influence the speed of economic adjustment, providing overall updated evidence relevant to regional development and European cohesion policies.

The *tenth* paper, titled “*ODA PROFILES AND DONOR-SIDE ECONOMIC OUTCOMES: A BOUNDED COMPARATIVE ANALYSIS OF JAPAN AND SWEDEN*”, authored by Jungeun KIM and Woosik YU, investigates how different Official Development Assistance (ODA) profiles relate to donor-country macroeconomic outcomes by comparing Japan and Sweden over the period 1960–2020. The study treats the two countries as contrasting cases, with Japan representing an economically strategic and regionally focused ODA profile, and Sweden representing a norm-driven and welfare-oriented approach. Using macroeconomic data from sources such as the Penn World Table, OECD DAC statistics, and the World Development Indicators, the paper estimates country-specific growth models for income, productivity, employment, input growth, and exports. The results show that Japan’s ODA is not significantly associated with domestic economic performance indicators under the applied specification, while Sweden’s ODA is positively associated with income, productivity, and employment growth, although not with export performance. The findings are interpreted as descriptive associations rather than causal effects, contributing to shifting attention to donor-side outcomes and highlighting how different aid profiles may be linked to long-term domestic economic patterns.

Last but not least, the *eleventh* paper, titled “*MEASURING THE EUROZONE’S TOURISM ECOEFFICIENCY AND PRODUCTIVITY SUSTAINABLE CHARACTER: A SLACK-MODELED TOURISM-INDUCED DATA ENVELOPMENT ANALYSIS*”, authored by George EKONOMOU and Dimitris KALLIORAS, examines changes in technical efficiency and productivity in the Eurozone tourism sector over the period 1996–2019, by applying a Slack-

Based Measure within the Data Envelopment Analysis (DEA) framework to a multidimensional set of variables to capture the economic and structural heterogeneity of the tourism industry, also accounting for environmental degradation through proxy indicators. The results show that renewable energy use has a positive and statistically significant effect on technical efficiency, while Granger causality tests suggest a unidirectional relationship running from renewable energy adoption to output-oriented efficiency. The study highlights the importance of integrating environmental sustainability into tourism development strategies to improve both efficiency and economic performance.

All these interesting works are available on the next pages of the RSI J, intending to promote the academic dialogue in Regional Science. Overall, the Editor in Chief, Prof. Christos Ap. Ladas, the Editorial Board, and the signatories of this Editorial Note welcome the reader to the multidisciplinary journey of Regional Science Inquiry that the current issue promises on its following pages.

On behalf of the Editor-in-Chief and Editorial Board,  
**Dimitrios Tsiotas, Ph.D.,**  
**Associate Professor – RSI J.**

## **Articles**



# ADMINISTRATIVE CAPACITY AND INSTITUTIONAL DESIGN IN NATIONAL LOCAL GOVERNMENT FUNDING: AN EX-ANTE EVALUATION OF THE “ANTONIS TRITSIS” PROGRAM IN GREECE

**Evangelos MAKRYVELIOS**

Postdoctoral Researcher, Department of Business Administration, School of Economics and Political Sciences, National and Kapodistrian University of Athens, Athens 105 59, Greece  
vmakryvelios@ba.uoa.gr  
(Corresponding AUTHOR)

**Theodore PAPADOGONAS**

Professor, Department of Business Administration, School of Economics and Political Sciences, National and Kapodistrian University of Athens, Athens 105 59, Greece  
thpap@ba.uoa.gr

## **Abstract**

This paper discusses the design, administrative sufficiency, and perceived efficiency of the Antonis Tritsis special development program to support the local government in Greece. The analysis will take an ex-ante evaluation which will look at the capacity of an administration, the institution design and the conditions of implementation of programs directly than the actual economic outcomes. The empirical research is founded on theoretical questionnaire and structured interviews with top managers, who are personally engaged in the program designing, financing, and monitoring, and is supported with S.W.O.T. analysis. The goal is to embed the perceptions of the strategic appropriateness, institutional functionality as well as implementation constraints with an focus on the inequality in administrative capacity between the municipalities and institutional complexity. The results indicate that the program can be viewed as strategically significant and financially innovative especially because the entire funding of the project financial sources was in place. At the same time, limitations related to the uneven administrative capacity of local authorities, institutional complexity, and the need to strengthen technical support, especially for small and island municipalities, are highlighted. The study contributes to the literature on local governance by offering evidence-based policy guidance for the design of more effective and equitable funding programs.

**Keywords:** E-ante evaluation, administrative capacity, public investments, local government, Greece

**JEL classification:** H70, H72, R10, R50, R58, D73  
pp. 13-36

## **1. Introduction**

Local Government plays a crucial role in the provision of basic public services, in the management of infrastructure and in the promotion of local and regional development. However, in many European countries, and particular in administratively centralized states, the effectiveness of Local Authorities is limited by structural weaknesses related to fiscal autonomy, administrative capacity and multi-level governance.

The issues of financing and institutional sufficiency of Local Government increased in Greece during the time of the economic crisis, and the COVID-19 pandemic further underscored the already existing disparities and deficiencies in operations. In this respect, the program "Antonis Tritsis" emerged as a combined national financial instrument, to help to reinforce infrastructure, to promote local development and enhance the role of Local Authorities.

This paper discusses the design and the implementation terms and anticipated success of the "Antonis Tritsis" development program that is a national financial tool to be implemented during 2020-2025 and will support Local Government Organizations in Greece. The study sheds light on the program administrative capacity and institutional arrangements and the

governance process that to large extent defines the capacity of the municipalities to transform funds into effective development and social interventions.

Although there is a wide range of international literature on Local Government financing and also assessment of public programs, empirical studies have been few primarily consisting of ex-post review of monetary outcomes or quantitative analysis of resource ingestion (Morgan & Pasurka 2023; Nadler and Nadler, 2018). Rather, the institutional and administrative determinants of impact on ex ante predictive success of national financial instruments is under-researched, particularly on the Greek administrative scenario. The main aspect of this gap is the administrative capacity of local governments, the institutional complexity, and technical assistance in the process of designing and implementing major development programs.

The current paper addresses a severe gap because it conducts an ex-ante analysis of the program in terms of governance and administrative capacity. The analysis employs an executive interview and structured questionnaire supported by a S.W.O.T. analysis in order to determine that the design is appropriate, implementations issues and conditions under which the territorial equity can be improved in future funding plans.

This article seeks to explore to what extent this makes the institutional design and administrative setting of the program called Antonis Tritsis be likely to be effective or not as a local-development-social-cohesion tool. In particular, it measures the capacity of such factors as Local Authorities administration, complexity of the procedures, technical assistance and flexibility of the program in solving different local needs.

Despite extensive ex-post evaluations of public investment programs, there is limited empirical evidence on how administrative capacity and institutional design shape the expected effectiveness of national funding instruments at the ex-ante stage. This gap limits our understanding of how governance conditions and capacity asymmetries influence implementation prospects before financial resources are translated into concrete development outcomes.

In this regard, the following research questions are formulated:

**RQ1.** What is the estimated contribution of the “Antonis Tritsis” program to improving the basic infrastructure of local governments, strengthening the local and regional economy, and promoting social cohesion?

**RQ2.** What proposals can be formulated to maximize the efficiency and effectiveness of future local government funding programs?

To fulfill these goals, the research employs primary information in the form of structured questionnaire as well as structured interview of top officers of the agencies responsible in the planning, financing and monitoring processes of the program. This qualitative data is supplemented with a S.W.O.T. analysis that enables one to systematically map the strengths and weaknesses of the program and opportunities and threats that are presented by the institutional and administrative environment.

The contribution of the article is twofold. At a theoretical level, it enriches the discussion on the financing of Local Government, shifting the emphasis from the simple absorption of resources to the administrative capacity and governance of the programs. At a policy level, it provides evidence-based conclusions that can support the redesign of future financial instruments, aiming at greater efficiency, territorial justice and strengthening social cohesion.

The rest of the article is structured as follows: in section 2, the contribution of operational programs to Local Government and the special development program “Antonis Tritsis” is presented, in section 3, the methodology and limitations of the research are analyzed, in section 4, the findings from the questionnaire, interviews and S.W.O.T. analysis are presented and discussed. Finally, in section 5, the conclusions and policy proposals are formulated.

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.

## **2. Theoretical background**

### **2.1 The contribution of operational programs to Local Government**

Local Government is a key pillar of regional development, especially in countries with strong inequalities, such as Greece. In the context of the European strategy for smart, sustainable and inclusive growth, co-financed operational programs have evolved into critical tools to support local authorities, providing funding, institutional strengthening and administrative upgrading (Bachtler et. al, 2013; Barca et. al, 2012; Copeland & Diamond, 2022).

National Strategic Reference Framework (N.S.R.F.) is the main mechanism for the allocation of European funds by financing infrastructure, social inclusion, environment, entrepreneurship and digital transition projects. At the same time, recommendations for the design, documentation and monitoring of projects, while tools such as Integrated Spatial Investments, JESSICA and PPPs They promoted innovation and cooperation with the private sector (OECD, 2018; European Commission, 2020). The N.S.R.F. 2014–2020 financed critical projects of social structures, energy upgrades, urban regeneration and environmental interventions, while the participation of Local Authorities in the above programs strengthened their technical and administrative structures (Chorianopoulos, 2012).

Municipalities with initially limited functioning developed project management models, internal monitoring mechanisms, practical transparencies and improved their organization. At the same time, the programs contributed to the reduction of spatial inequalities, giving priority to remote, mountainous and island areas.

However, the unequal administrative capacities of Local Authorities led to differentiated access to resources. Small municipalities, due to insufficient staffing and dependence on external partners, faced obstacles, which showed the need for institutional and technical support.

Overall, operational programs functioned as levers of modernization and decentralization, going beyond the role of simple financial tools. Their strategic and balanced utilization is now emerging as a critical factor for sustainable local development (Augusztin et al., 2025).

### **2.2 Ex-ante evaluation, structured interviews and S.W.O.T. analysis as tools for understanding implementation**

In the policy evaluation literature, ex-ante evaluation is considered appropriate for the early identification of design and implementation risks, especially when the outcome depends on institutional interactions and multiple actors. In such cases, structured interviews and questionnaires with institutional “insiders” offer comparable data on perceptions, administrative practices and bottlenecks.

In addition, S.W.O.T. analysis functions as a complex tool for linking internal characteristics (strengths/weaknesses of institutional design and administrative functioning) with external dynamics (opportunities/threats), allowing the translation of research findings into coherent policy directions. Its application within the framework of "Antonis Tritsis" is particularly useful for the systematization of issues such as bureaucracy, project maturity, technical support and interoperability.

### **2.3 The special development program “Antonis Tritsis”**

In April 2020, the special development program "Antonis Tritsis" was established with the aim of strengthening local authorities, supporting local economies, and addressing the consequences of the economic and health crisis in Greece. It is a strategic financing mechanism on a national scale that aims at local development, social solidarity, and upgrading the role of local government. The main objectives of the program are: a) The upgrading and modernization of the basic infrastructure of the local authorities, b) the revitalization of social and economic activity, c) the implementation of actions and initiatives that promote social cohesion and solidarity, d) the use of information and communication technologies, e) the improvement of the efficiency of the administration and f) the upgrading of the institution of civil protection.

The program is structured around six key priority areas, which reflect its strategy for multidimensional and balanced local development. Each axis includes actions aimed at addressing the specific needs of local communities, improving everyday life, and ensuring sustainability. The program focuses on six key areas: civil protection, urban quality and function, digital convergence, environmental protection, social solidarity, and the advancement of education, culture, tourism, and sports.

The program is implemented through specific calls, such as: AT01-Water Supply, AT02-Urban Wastewater, AT03-Renewable Energy Sources, AT04-Waste, AT05-Rural Road Construction, AT06-Urban regeneration, AT07-Building stock, AT08-Smart cities, AT09-Studies, AT10-Open spaces, AT11-Pre-earthquake control, AT12-Electromobility, AT14-1821, as well as calls that incorporate projects from "Philodimos I".

The program supports first and second degree local authorities, Local Government Associations, and their legal entities nationwide. It covers island, mountain, and lowland municipalities equally to reduce regional disparities and promote social and economic cohesion.

The Antonis Tritsis program is among the biggest financial instruments designed to address the local government in Greece. It is funded through development loans on Deposit and Loan Fund (DLF) and European Investment Bank. Such loans are a paid back indirectly through the facilities by the Public Investment Program (PIP) of the ministry of the interior thereby not putting local authorities in the direct bracket of responsibility.

The budget in the entire programming period of the program is EUR2.5 billion and funding can take up to EUR3.45 billion, which will be divided between new calls (AT01-AT14) and transfer of the project of Philodimos I. There is a budget limit and performance measure on each call to measure its performance.

Its initial term was 2020-2023, yet it has already been prolonged until 2028 as a result of high interest and need increase across the country.

The program the Antonis Tritsis has a structured system of measures that cannot allow the projects, submitted to be carried through, to completion, through the evaluation, approval, financing and monitoring phases. This program is operated by the Special Management and Implementation Service of the Ministry of the Interior (MIA-MOU).

The process of implementation starts with the reviews where the MIA-MOU issues invitations indicating the axes, the beneficiary groups and the selection criteria. The bodies also present their proposals along with the ruling of their competent bodies together with the technical file that is required. The Special Management and Implementation Service of the Ministry of the Interior make the completeness check and verify the proposals and the Evaluation Committee presents recommendations to the Minister of the interior to be finally included. The DLF Board of Directors then approves the loan, the loan agreement (with a special provision designating the beneficiary as the holder of the hereditary interest in case of non-compliant use) is signed between the beneficiary and the DLF and the loan is disbursed.

Overall, the "Antonis Tritsis" program lays the foundations for a long-term development strategy, with an emphasis on local government, in order to create resilient, functional, and socially just local communities.

## **2.4 Administrative capacity and the effectiveness of local government funding programs**

The administrative capacity represents a key factor of the effectiveness of the public policy, especially a complex multi-actor funding programs targeted at the local government. It describes how public organizations plan, administer, execute, and supervise policies efficiently, which include human resource, technical skills, organisational design, information technology systems, and coordination systems.

The literature typically draws the difference between formal administrative capacity that deals with institutional structures, legal structures, and procedural regulations, and operational administrative capacity that is the literal capability of organizations to transform formal stipulations into actual utility by way of skilled staff, project development maturity, and administration ability. Formal capacity can guarantee compliance and accountability, but the performance and results of policies are largely due to operational capacity.

The administrative capacity has a two-fold role in the field of local government financing. First, it preconditions the availability of funds, because the skills in preparing mature proposals, making feasibility studies and fulfilling formal requirements of the procedure differ considerably across the municipalities. Second, it determines effectiveness in implementation, which affects timeframes, cost management, quality of project as well as attainment of desired social and economic impacts.

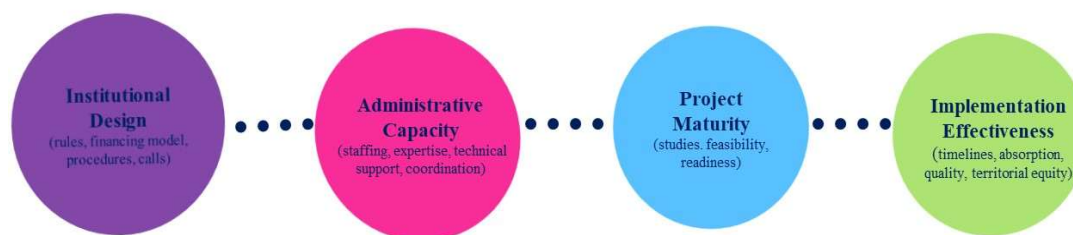
Empirical research has revealed that inequalities in administrative capacity tend to result to unequal territorial results, despite the fact that funding instruments are meant to facilitate equity. Various other differences in administrative systems tend to increase these inequalities in centralized administrative systems, including Greece, due to lack of decentralization, reliance on central agencies, and recurrent staffing shortages locally.

Regarding an ex-ante evaluation approach, administrative capacity evaluation is also necessary to determine the risk of implementation and how this will lead to inequalities in program effectiveness. Such a course of action is also adopted in this study to study the interaction between the institutional design and governance operating in the program level of the Antonis Tritsis and the status of the current state of administrative capacity, which alters the perceived effectiveness of the program before a full implementation is made possible.

According to the discussion presented above on the theoretical aspects, a conceptual framework is developed to explain the interaction between institutional design and administrative capacity to determine project maturity and implementation effectiveness.

The framework is an analytical instrument that helps in informing the empirical study and findings interpretation.

**Figure 1. Conceptual framework linking institutional design, administrative capacity and program effectiveness**



### **3. Methodology**

This section outlines the methodological approach that will be used to evaluate the program "Antonis Tritsis" and, in particular, research design, data collection sources and methods, research questions and the study limitations that the study will have. The methodology was designed to produce systematic records of the experiences and evaluations of the executives to make an exhaustive ex-ante program evaluation.

#### **3.1 Research design**

The research was carried out in a mixed format with a combination of qualitative and quantitative methods to provide a deeper insight into the program (Gill et al., 2008; Raimondo and Newcomer, 2017; Bamberger and Mabry, 2020). To identify trends, characteristics and implications to future researches and understand better the highly complex study like the impact and the efficacy of a national Local Government funding program, descriptive and exploratory strategy was adopted.

The quantitative component was carried out by way of the structured questionnaire which has made the systematic recordability and comparability of answers and the qualitative component was secured by way of the structured interview with the executives who were in the design and monitoring as well as evaluation aspect of the program.

At the same time, having analyzed the international and Greek literature on local government financing and the evaluation of operational programs, a S.W.O.T. analysis was

conducted to identify the key strengths, weaknesses, opportunities, and threats in the design and implementation of the respective financing tools in the future (Creswell & Plano, 2017).

The findings of the observance of the interviews, S.W.O.T analysis synthesis assisted to reach the substantive conclusions and policy recommendations on the perfect structure of the financing that would contribute to the sustainable development and the local government.

### **3.2 Data collection**

Primary data were utilized in the study in order to provide comprehensive and valid findings. The main data was gathered using a questionnaire and an interview which was structured, based on two main bodies that take part in the planning and supervision of the Antonis Tritsis program. This technique was chosen due to its ease of analysis, its emphasis on participation, and the fact that it enables the capture of qualitative data on executives specifically engaged in the design and execution of the program (Johnson et al., 2007; Creswell, 2017; Ponzo and Milazzo 2025; Munoz-Fernandez et al, 2024).

The questionnaire was developed using the research objectives and research questions. It encompassed primarily closed-ended Likert-type questions to be analyzed quantitatively about the implementation issues, the efficiency of funding, and the potential improvement recommendations, which enabled the attitudes and judgments to be recorded in the standardized fashion, and a small number of open-ended questions to make the qualitative observations and proposals. The structured interviews were administered in form of in-person or remote interviews with the mean length being 30-45 minutes.

The triangulation of the validity of the researches by primary (questionnaires, interviews) and secondary data (bibliography) enhanced the validity (Teddlie and Tashakkori, 2010; Rossi et. al., 2004). The data collection was done in July 2025, without exploring the temporal variations. Ethics of conducting the research were implemented throughout the research, with anonymity, voluntary participation, and preservation of personal information.

The structure facilitated the comparability of their responses and at the same time enabled detailed documentation of experiences on the issue of implementation problems, the perceived success of funding and possibility of future improvement in programs.

The validity of the responses was made by using participants who were involved in the program, and their role of responsibility in the project and their experience in the profession. The objective was to provide an ex-ante analysis, find difficulties, and accumulate experience to enhance local government financing instruments in the future.

### **3.3 Research limitations**

Despite the methodological completeness of the approach aimed at producing reliable and documented conclusions, the study has certain limitations. The limitations mainly concern the methodology, the nature of the data, the sample, and the time frame, affecting to some extent the interpretation and generalization of the findings (Bamberger & Mabry, 2020; Teddlie & Tashakkori, 2010).

The emphasis on the use of questionnaires and structured interviews limited the possibility of exploring causal relationships, as complementary methods were not used, while the qualitative dimension focused exclusively on executives of central agencies, without the participation of representatives of project beneficiaries or the local community (mayors, local businesses, residents), which limited the recording of social acceptance and local impacts of the program.

This could introduce some level of institutional bias, which could result in an over-estimation of the financial sustainability of the program, and underestimation of implementation difficulties encountered by the beneficiary municipalities. These limitations are inherent to the ex-ante and top-down nature of the analysis and should be taken into account when interpreting the findings.

In addition, the time and practical constraints associated with the nature of the study affected the breadth and depth of the analysis, while the findings relate to a specific funding program, limiting the possibility of direct generalization. For this reason, it is recommended that future ex-post evaluations and comparative studies with similar programs at the national and international level be carried out.

## **4. Results and discussion**

This section presents the findings from the questionnaires and structured interviews that were based on the same research tool. Data collection was carried out with a mixed qualitative and quantitative approach between 14-25 July 2025 with the participation of executives who contributed, through their experience and expertise, to the evaluation of the operation and effectiveness of the "Antonis Tritsis" program.

### **4.1 The identity of the survey participants**

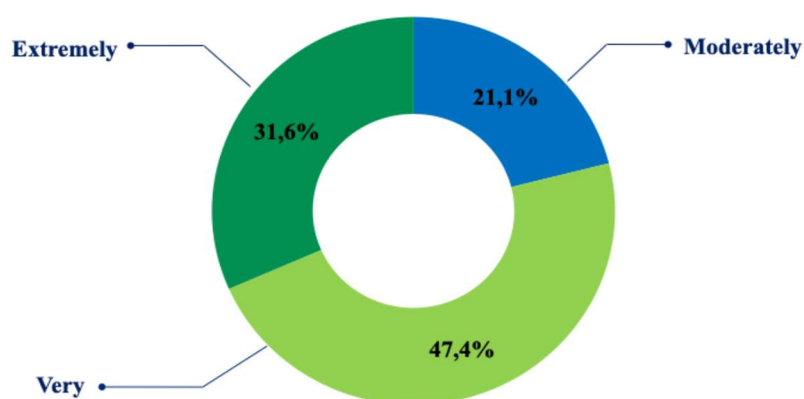
The survey was based on structured interviews and a questionnaire, addressed exclusively to 19 executives, 14 (77%) from the Deposit and Loan Fund and 5 (23%) from the Special Management and Implementation Service of the Ministry of the Interior with an active role in the design, monitoring, and implementation of the "Antonis Tritsis" program. The predominance of the DLF may limit the generalizability of the findings. Participants covered all stages of implementation (proposal evaluation, contracts, disbursements, monitoring), ensuring institutional consistency and financial accuracy.

In terms of experience, 47.4% have more than 10 years of experience in the design and/or financing of development programs, 15.8% have 6–10 years, 10.5% 2–5 years, and 26.3% have less than 2 years, which indicates a renewal of the executive staff. This composition combines experienced and younger executives, strengthening both the technical competence and adaptability of the management system.

### **4.2 Design and objectives of the “Antonis Tritsis” Program**

**Q1.** To what extent do you consider that the design of the "Antonis Tritsis" program responded to the needs of local government after the economic crisis and the COVID-19 pandemic?

**Figure 2. Degree of responsiveness of the design of the "Antonis Tritsis" program**



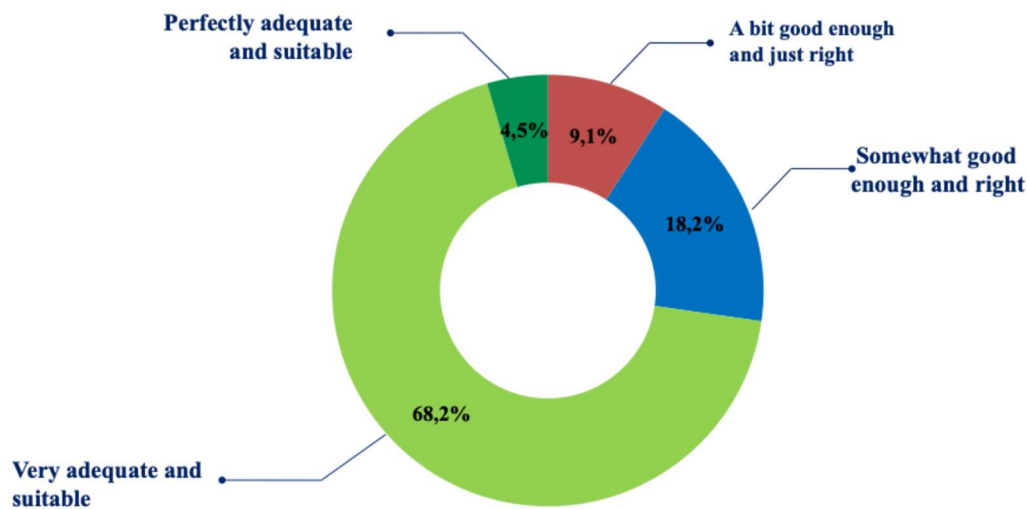
The majority of participants (79%) believe that the program design responded to a large or very large extent to the needs of local authorities following the economic and health crisis, acting as a tool for recovery. However, 21.1% said it was a "moderate" response, pointing out the need for more flexibility and faster adaptation.

A key advantage was the coverage of critical infrastructure through targeted calls for proposals and its role as a liquidity mechanism, replacing the "Philodimos" program. The moderate assessments were linked to insufficient information provided to citizens and local authorities, a mismatch between demand and available resources, and imperfect "fair distribution." At the same time, institutional and informational gaps were identified that made it difficult to achieve the objectives.

The combination of flexibility, simplified procedures, and technical support, in general, proved that the program aligns with the UN Sustainable Development Goals and development orientation. It represented a significant intervention in support of the local government with the positive environmental, social, and economic presence.

**Q2.** To what extent do you consider that the strategic planning of the "Antonis Tritsis" program is compatible with and meets the needs of local government?

**Figure 3.** Assessment of the suitability of the strategic planning of the "Antonis Tritsis" program



The vast majority (approximately 90.9%) consider the program to be "moderate" to "very adequate and appropriate," with the majority (68.2%) describing it as very adequate and appropriate, while only 9.1% consider it to be somewhat adequate and appropriate. Although limited, this percentage highlights the need for further adaptation to the diverse needs of local government. Consequently, the program is moving in the right direction, but its flexibility and effectiveness need to be enhanced.

**Q3.** In your opinion, to what extent have the objectives of the Antonis Tritsis program been achieved or are expected to be achieved?

**Table 1** Assessment of the degree of achievement of the objectives of the Antonis Tritsis Program

	Not at all	A little	Moderaty	Very	Extremely
<b>Objective A:</b> Improvement and modernization of basic local government infrastructure	4,6%	0,0%	13,6%	68,%	13,6%
<b>Objective B:</b> Restarting social and economic life, protecting public health, and strengthening the local economy	4,5%	0,0%	27,3%	59,%	9,1%
<b>Objective C:</b> Implementing social cohesion and solidarity actions	0,0%	4,5%	36,5%	45,%	4,5%
<b>Objective D:</b> Integrating ICT and transforming cities into "smart cities."	4,5%	9,1%	59,1%	22,%	4,5%
<b>Objective E:</b> Modernizing civil protection policy at the local level	4,5%	22,%	36,4 %	31,%	4,5%

Approximately 81.8% of the respondents marked Objective A as a particularly successful achievement. Interventions within the water supply, sewerage, road construction and flood protection sector, buildings and energy upgrades are associated with high satisfaction, which establishes that the design has been handled into physical infrastructure. The percentage of more cautious respondents (18.2) speaks of the need of improvement, primarily because of time lags or local circumstances. The success of the second goal is evaluated favorably but more reservations as compared to the first goal. This image is ascribed to the multifacetedness of the goal, time losses, and the impossibility to gauge social results within a rather brief time frame. Though measures were taken in the fields of the entrepreneurship and the public health

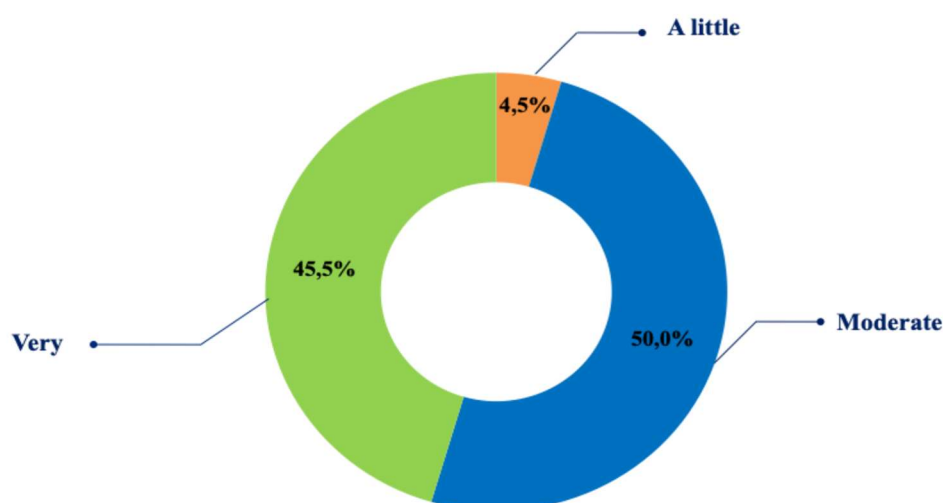
organization, there are still the reservations that specific synergies should be established, especially in regions with the serious pandemic load or the socio-economic impact. In general, Objective II is of paramount strategic value, taking more time, resources, and co-ordination. Program objective III has the lowest positive rating. Half of them think it has been attained at an acceptable level. The reason behind this lag is largely due to the challenge to measure qualitative goals that take long-term measures, collaboration of actors involved in the few social calls, the incapacity of small municipalities to encompass projects and monitoring of the social impact. The image identifies the necessity to reinforce the social aspect of the program with the help of specially designed measures, social criteria into the assessment of projects, and methods that are to measure social added value. Planning and cooperation between ministries and policies that are region-specific will be needed to achieve success. According to the majority of the respondents (59.1%), they felt that the program was moderately achieved. The main threats are variations in digital maturity, the unavailability of specialists, the absence of a local strategy, and system interoperability as well as inadequate continuous training. An evaluation of objective E indicates a subject of serious alertness and disparate results. The percentage of positive ratings by 36.3% clarifies that 58.7% of them are slightly satisfied, which is a long-term weak point in local civil protection, even though it has become particularly relevant against the backdrop of the climate crisis. The reactions indicate that there are important disparities in the local authorities the key main challenges include understaffing, equipment deficits, low coordination and specialisation of calls to proposals. Altogether, this program has not succeeded in ensuring that civil protection becomes a strategic pillar. The advancement will need specific projects, institutional backup, human resource growth and technical backup in such a way that the local leaders have become ready to build significant operational capability and strength.

Key insight: The strategic design of the program is broadly aligned with local government needs; however, the extent to which its objectives are expected to be achieved is primarily conditioned by administrative and technical capacity disparities rather than by program design deficiencies.

#### 4.3 Assessment of the effectiveness of the “Antonis Tritsis” Program

**Q4.** In your opinion, to what extent did the six priority axes of the program adequately covered the needs of local government for the period 2020-2025?

**Figure 4. Assessment of Local Authority Needs Covered by the Antonis Tritsis Program**



The results show strong, but not universal, agreement on the appropriateness of the thematic axes of the Antonis Tritsis program. 45.5% of executives consider that they “very much” meet the needs, 50% “moderately” and only 4.5% “a little.”

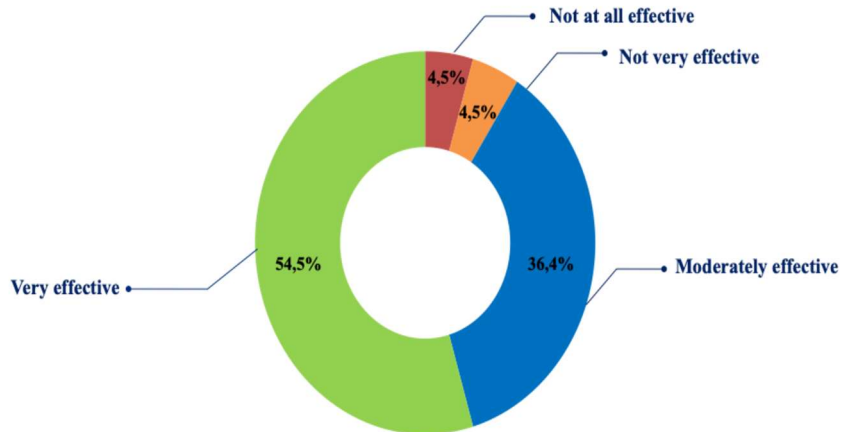
The positive attitude confirms that the axes are moving in a realistic direction. However, the high percentage of “moderate” acceptance highlights the need for adjustments in areas such as

digital transformation, tourism, and culture, where there is a lack of targeted calls for proposals or operational readiness on the part of local authorities.

Overall, the planning is considered positive, but continuous readjustment of priorities is required in line with evolving needs, local dynamics, and socio-economic conditions.

**Q5.** How effective do you consider the design of special calls (e.g., AT01, AT04, AT08) to have been in attracting high-quality projects for local government?

**Figure 5. Evaluation of the Effectiveness of Specific Calls**



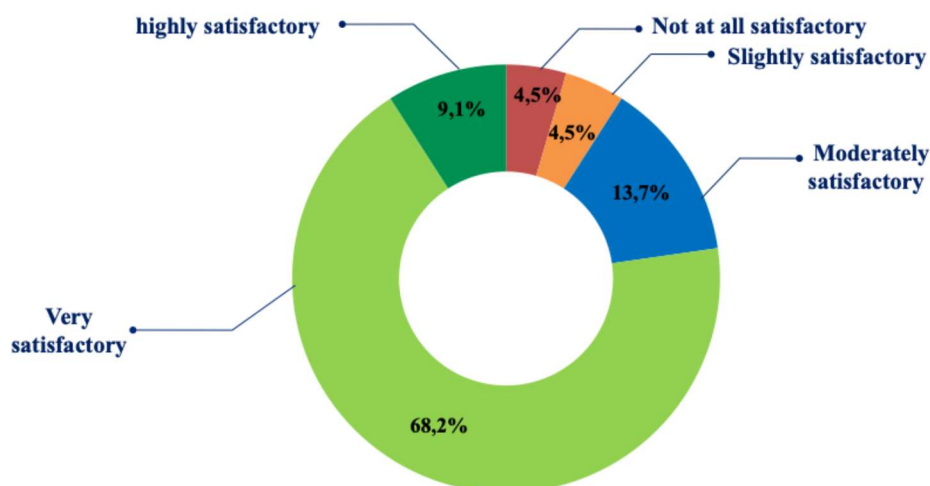
Regardless of the general design, a number of the executives found flaws in such areas as environment and civil protection (non-issuance of AT13), health of the population, energy adequacy, digital convergence, and food security, particularly island and rural regions. Another issue they noted is the disparity between local authorities as a result of scarcity of resources and technical assistance, which poses the necessity of flexibility and the regular revision of the axes.

The rated calls turned out to be rated as “very effective” by 54.5% and named as moderate by 36.4% of executives, owing to the transparent topics that the submission of mature proposals became possible. In small municipalities, however, participation was simply constrained by technical weaknesses. There is a need to strengthen technical assistance to have equal benefit access.

The free comments gave rise to proposals for a single P.I.P., the establishment of a central managing authority that could design calls for proposals based on the country’s horizontal needs rather than fragmented initiatives, and the strengthening of dialogue with local authorities. At a technical level, it was proposed to set a ceiling per call, avoid the submission of immature proposals, and assign specialized issues to the competent ministries so that the MIA-MOU can focus on its core role.

Overall, the body of calls is considered adequate, but effectiveness depends on better preparation, institutional cooperation, and administrative simplification

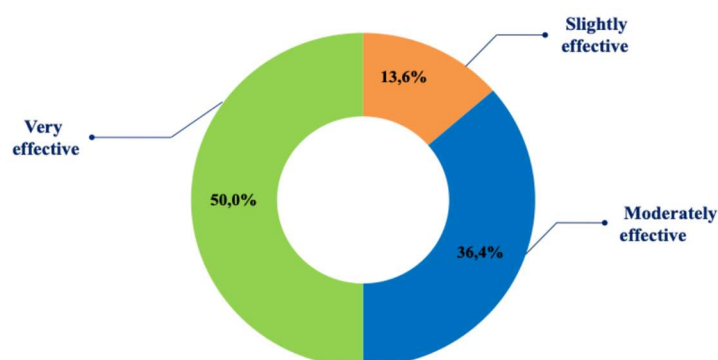
**Q6.** How would you assess the overall implementation of the program, from the publication of calls for proposals by the EYDE YPES, the submission and evaluation of proposals, to the approval of loans by the DLF and the disbursement of funds?

**Figure 6. Overall assessment of the program implementation process**

The overall assessment of the implementation of the Antonis Tritsis program by public service executives is particularly positive. 77.3% rated it as “very” or “absolutely” satisfactory, 13.7% as “moderately satisfactory” and only 9% as “not at all” or “slightly” satisfactory. This finding demonstrates a high level of acceptance of the operation of the MIA-MOU and its partner agencies (DLF, EIB), as well as organizational adequacy at all stages, from the issuance of calls for proposals to the disbursement of funds.

The main delays are in the implementation of projects, due to administrative weaknesses of local authorities, bureaucracy, and insufficient information provided to elected officials. The solutions proposed include the development of a unified information system with interoperability between the agencies involved (MIA-MOU, DLF, EIB, and municipalities), the establishment of clear timetables, unit costs, and revision ceilings. At the same time, the positive contribution of the Court of Auditors in ensuring legality was recognized, as well as the need to strengthen technical support, especially in small municipalities.

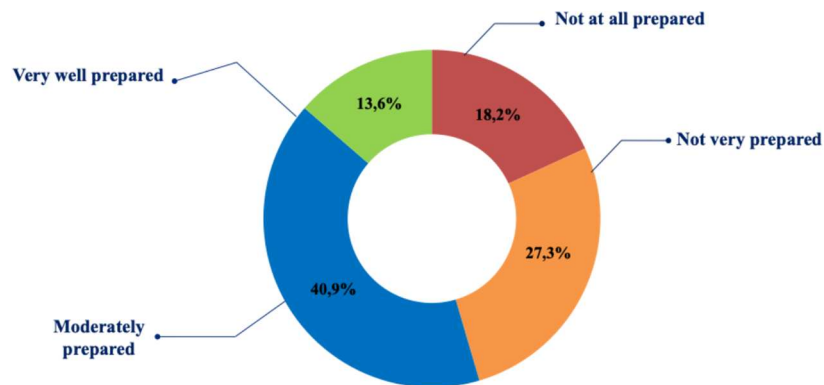
**Q7.** How do you assess the effectiveness of the procedural framework that has been put in place for the proper implementation of projects and the monitoring of the defined performance indicators per call?

**Figure 7. Effectiveness of the framework for implementing and monitoring indicators**

Fifty percent of participants gave a positive assessment of the institutional and technical framework of the Antonis Tritsis program, recognizing as advantages the clear procedures for each call for proposals, the guidelines issued by the MIA-MOU and the provision of performance indicators, which enhanced transparency and functionality. Nevertheless, the other 50% considered it as moderate or low because of the failures of the standardization of indicators and monitoring tools, data recording in time, as well as the connection between physical and financial objects. The results remind about the necessity to revise the framework with the digital tools and better methodological background in order to guarantee transparent and meaningful evaluation.

**Q8.** In your opinion, how prepared were local authorities to submit mature and eligible projects under the program?

**Figure 8. Level of preparation of local authorities for the submission of mature and eligible projects**



Analysis of the above question highlights a critical structural weakness in the local governance mechanism, the inadequate technical and administrative readiness of a significant number of local authorities to manage complex projects within the framework of national or co-funded programs.

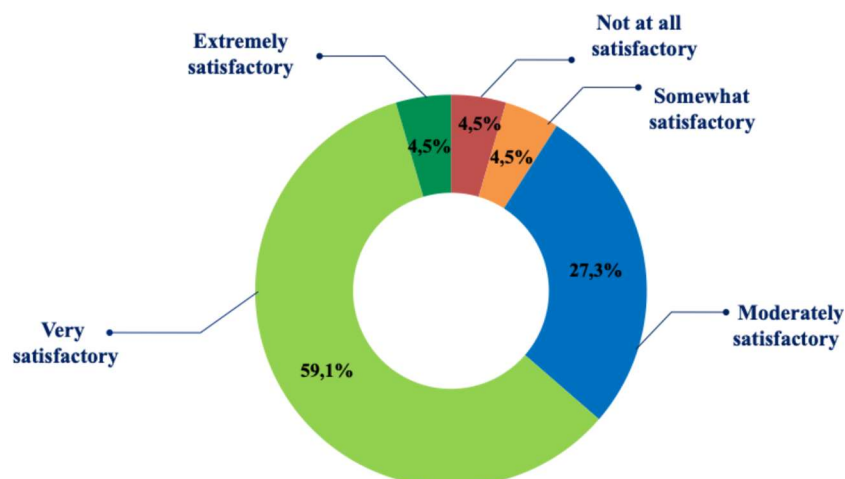
Despite the introduction, through the Antonis Tritsis Program, of a financial framework that provided tailored opportunities for strengthening and supporting local authorities, the existing imbalance in the degree of organizational readiness of municipalities has hindered the balanced and horizontal utilization of the Program's available resources and capabilities at the national level.

Comparing the "Antonis Tritsis" and "Philodimos I" programs shows broader coverage but greater management difficulties.

The Antonis Tritsis program is characterized by a proliferation of calls for proposals, an expansion of eligible sectors (energy upgrading, urban regeneration, digital governance) and a larger funding range, but the absence of a ceiling and unit costs created asymmetries and delays. The establishment of Development Agencies did not yield results due to understaffing, while "Philodimos" stood out for its more targeted planning in basic infrastructure.

On the whole, the program of the "Antonis Tritsis" can be discussed as rather ambitious but challenging as it signifies the shift towards the more stable base of projects to the more complicated and administratively organized structure. Nevertheless, the advanced coverage of themes and easy disbursement increased efficiency, which has made the program a blend of both financial and operations innovation and could be used in future local development intervention as a model.

**Figure 9. Assessment of flexibility in the reallocation of resource for local government**

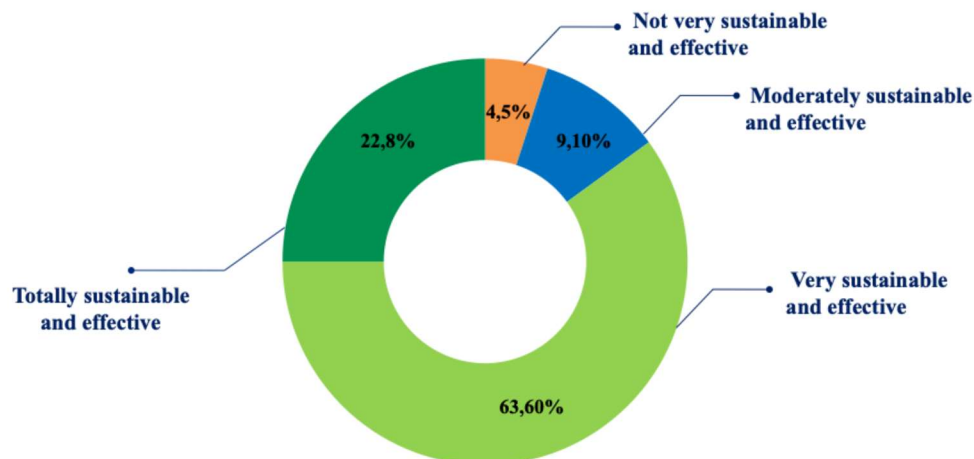


Key insight: The thematic axes and their individual relevance do not define the effectiveness of the program but, rather, an imbalance in administrative capacity within municipalities that influence their capacity to realize funding opportunities.

#### 4.4 Funding of the “Antonis Tritsis” Program

**Q9.** In your opinion, has there been sufficient flexibility in the reallocation of resources between axes, or do you consider that further adjustments are necessary?

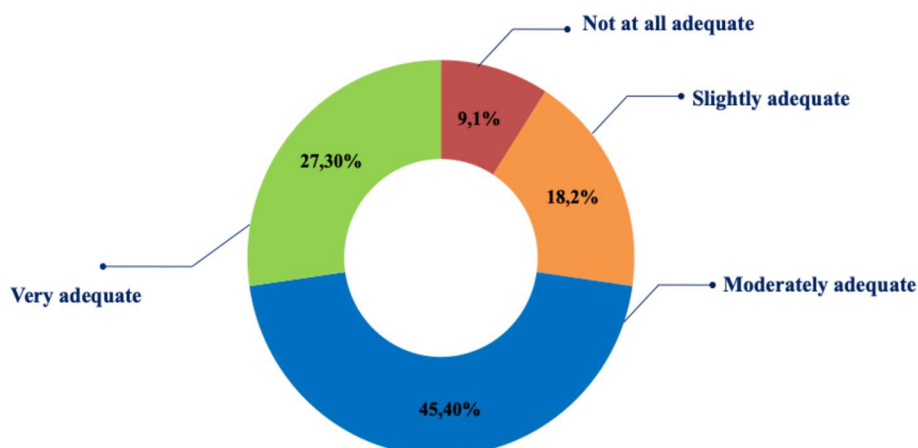
**Figure 10. Assessment of flexibility in the reallocation of resource for local government**



The majority of participants (63.6%) took the Antonis Tritsis program to be very flexible when it comes to reallocating resources between themes, which implies that it can adapt to the needs of local authorities well. This capacity to devote funds to other projects or the most important interventions enhanced the effectiveness and precision of the program. Nevertheless, 27.3% rated flexibility as moderate because of delays, lack of transparency, and absence of local authorities' involvement. Thus, it is suggested that a more participatory and open redistribution system should be institutionalized to guarantee equitable and efficient utilization of assets.

**Q10.** The program was mainly financed through development loans from the Deposits and Loans Fund (DLF) and the European Investment Bank (EIB), with repayment coming from the Public Investment Program (PIP) of the Ministry of the Interior. In your opinion, do you consider this financing model to be sustainable and effective?

**Figure 11. Assessment of sustainability and effectiveness of financing through DLF and EIB**

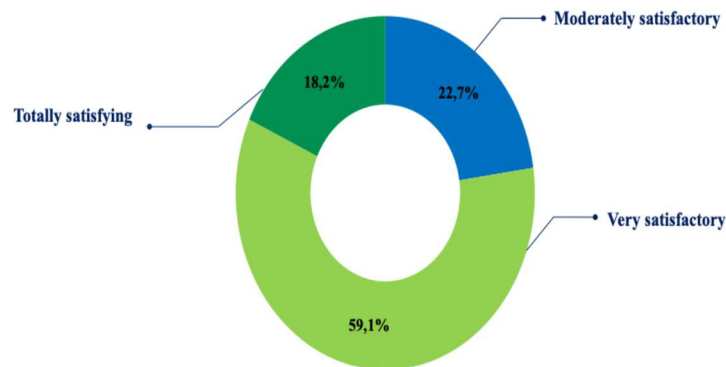


The financing model of Antonis Tritsis program, which is based on cooperation with the Public Investment Program and the Hellenic Development Bank, with repayment through the Public Investment Program, is positively evaluated by 86.4% of executives. The positive assessment is attributed to the stability of financing, the absorption of risk by the state, access

to resources without direct fiscal cost, and enhanced transparency. Eleven percent expressed reservations about the complexity and dependence on state resources. Overall, the model is considered a benchmark for public investment financing in conditions of fiscal constraints, with the possibility of application to other local government interventions.

**Q11.** In your opinion, how did the financing mechanism work in practice through development loans granted by the Deposits and Loans Fund (DLF) and the European Investment Bank (EIB), with repayment from resources of the Public Investment Program (PIP) of the Ministry of the Interior?

**Figure 12. Assessment of financing mechanism**

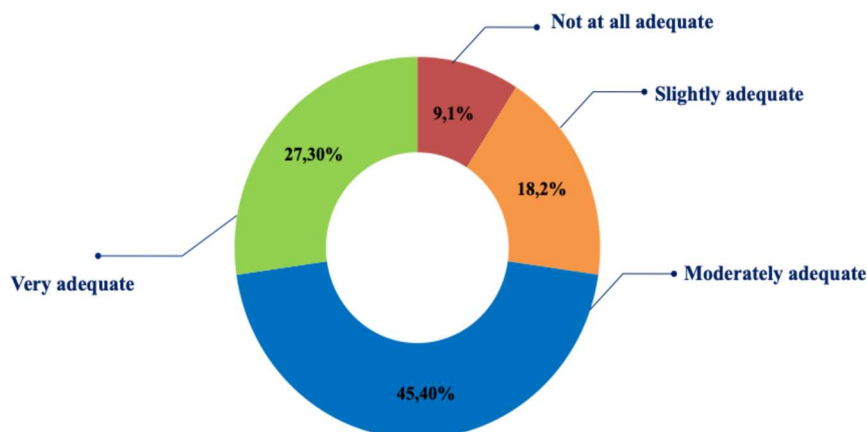


The stability, reliability, and efficiency of the mechanism was reported with a positive rating by 77.3% of executives as the Antonis Tritsis program was being financed by development loans secured by the Public Investment Program and the European Investment Bank with repayment by the first. The 22.7 percent who rated it as moderate satisfactory stated delays and ambiguity in the procedures.

Still, despite the overall positive outlook, certain improvements were proposed, including the accelerated repayment of the debt by means of the Public Investment Program, the creation of non-cumbersome and transparent information systems (e.g., web-based dashboard), funding cap, and stricter project consideration and maturity check to enhance the efficiency of the administration and to achieve fair distribution of resources.

**Q12.** The initial total budget for the program was €2,500,000,000. In your opinion, do you consider this level of funding to have been sufficient to achieve the program's objectives?

**Figure 14. Perceptions of the adequacy of program funding**



The initial budget of EUR2.5 billion on Antonis Tritsis program was not considered enough to meet the demands with requests that exceeded EUR6 billion as a result of high demand, inflation of material prices, and extension of calls. Executives reckon it ought to be at least twice that figure and demand mechanisms to indicate prioritization, feasibility tests, and migration of undertakings to alternative financing tools. There is a common position on the

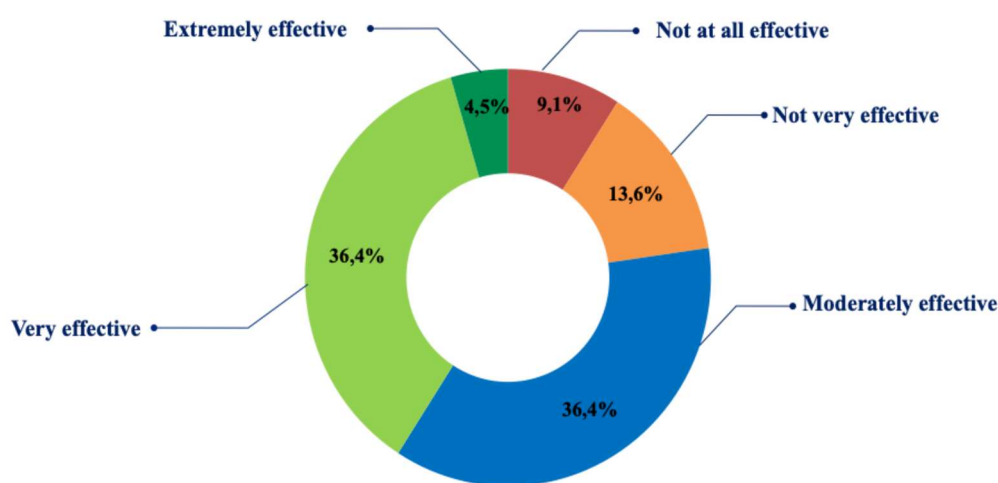
need for flexible and strategically targeted planning with dynamic adjustment of the program budget.

The main obstacles are bureaucracy, delays, and price increases, which have led to cost overruns and project modifications. The lack of technical competence of many local authorities, combined with contractor failures and weak supervision, limited absorption. In addition, the broad scope, the absence of a ceiling, and frequent changes in focus made it difficult to allocate resources rationally.

The findings suggest boosting management, streamlining procedures, and offering technical support to enhance future program effectiveness and uptake.

**Q13.** In your opinion, how effective was the management and monitoring of financial indicators during the implementation of the program?

**Figure 14 Effectiveness of financial monitoring of the program**



The evaluation of the management and monitoring of the financial indicators of the Antonis Tritsis program provided a positive but interchangeable image 41.9% said that it is very effective and extremely effective as it contributes to the smooth adoption of projects. Conversely, 36.4% rated it as moderate and 13.6% somewhat effective and they were worried about the accuracy, speed and consistency with the monitoring mechanisms. The results indicate the necessity to modernize the control tools (e.g., digital dashboards, integrated information systems) and become more rigorous in terms of capturing performance indicators.

The administrative and technical weaknesses that influenced implementation include bureaucracy, disbursement delays, and lack of coordination among the Ministry of Economy and Finance, the Technical Assistance Department and the EIB because there was no single system of monitoring. Limited technical capacity became an even greater challenge to small and medium-sized local authorities with multiple Recovery Fund projects happening concurrently. Moreover, the rise of the material prices, revision of the prices, and necessity to sign some additional contracts (because of insufficient research or some unpredictable costs) disfavored the process. The drop in discounts of projects to the lower than 10% in 2025 proves the stress the construction market was under.

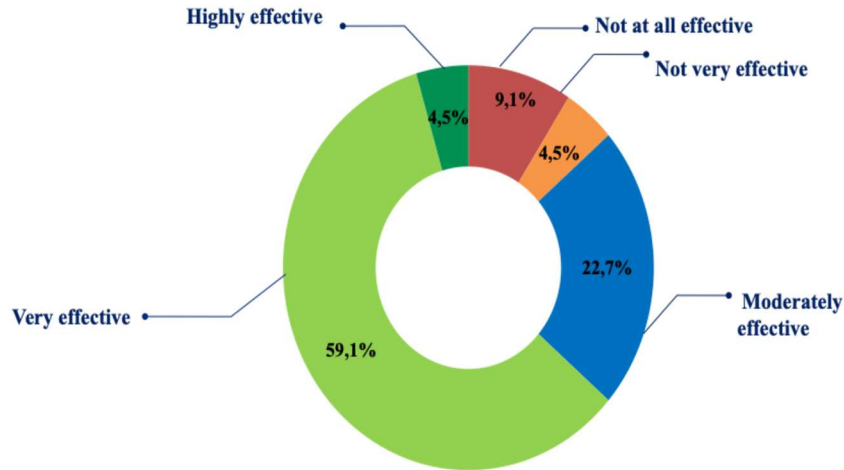
Altogether, the administrative, technical, and structural issues curtailed the efficiency of the program, which contributes to the necessity to provide specific attention to local authorities, digitalize the project management, and streamline the processes during future financing programs.

Key insight: While the financing model is perceived as stable and innovative, its effectiveness is mediated by administrative preparedness and project maturity rather than by financial constraints.

#### 4.5 Cooperation-administrative capacity of the “Antonis Tritsis” Program

**Q14.** The program was managed and implemented by the Special Management and Implementation Service of the Ministry of the Interior (MIA-MOU). In your opinion, how effective were the procedures for evaluating, approving, financing, and monitoring the projects?

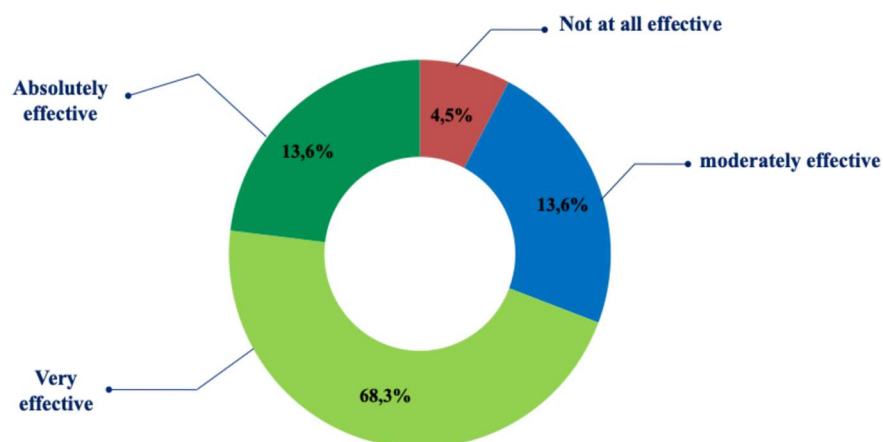
**Figure 15 Assessment of the Management Adequacy of the MIA-MOU**



The processes of the MIA-MOU in the evaluation of the projects, their approval, financing, and monitoring were rated by the majority of executives (63.1%), which proved its effectiveness in the conditions of such a vast number of projects and the complexity of the Desk program Antonis Tritsis. This confidence of local authorities was improved through reliable monitoring and management of payments in a timely manner. Nevertheless, 22.7% referred to the procedures as moderately effective and 9.3% not effective at all because red tape and administrative fatigue cause delays. The results demonstrate the necessity to enhance the staffing, technical competencies, as well as visibility in approval and control to increase the effectiveness and reputation of the program.

**Q15.** In your opinion, how effective and functional was the cooperation between MIA-MOU and DLF during the program design stage?

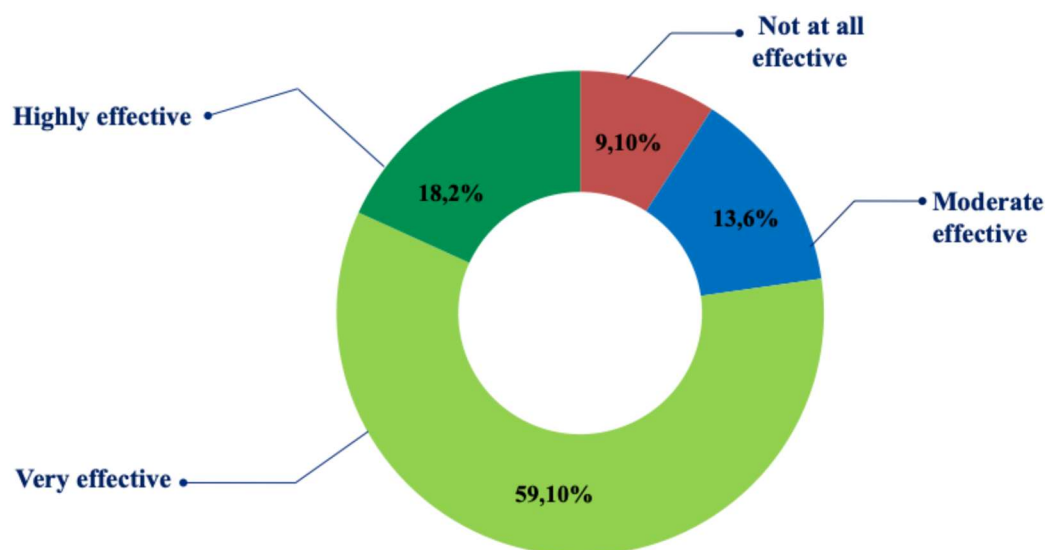
**Figure 16 Assessment of cooperation between agencies during program design**



Most executives gave a positive evaluation of MIA-MOU and DLF's cooperation during the planning of the "Antonis Tritsis" program. DLF, with its experience in financing local authorities, strengthened the expertise and credibility of the financing scheme. Suggested areas for improvement included more systematic communication and consultation with local authorities and citizens, simplification of procedures, revision of the series of loan agreements, and the establishment of a single framework for dialogue during the drafting of regulatory texts. Overall, transparent and coordinated cooperation between the two bodies is considered crucial for the effective financial management and smooth flow of funding for the program.

**Q16.** In your opinion, how effective was the cooperation between MIA-MOU and DLF during the implementation and monitoring phase of the program?

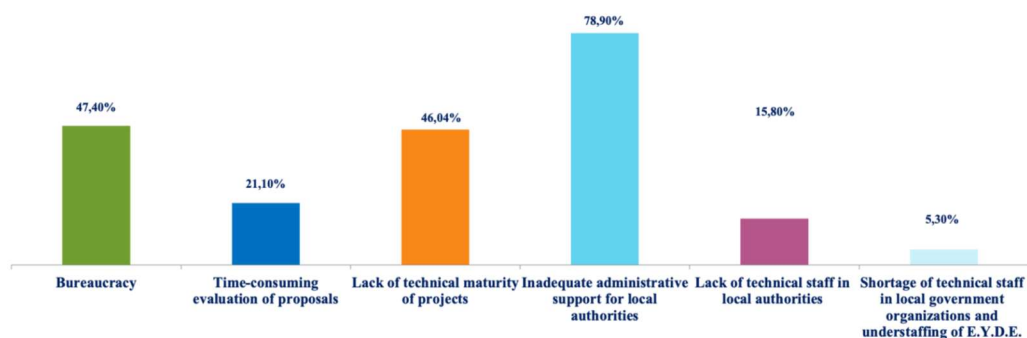
**Figure 17 Assessment of cooperation between agencies during program implementation and monitoring**



The cooperation of MIA-MOU DLF was positively evaluated by most executives at the stage of planning the program under the name of Antonis Tritsis DLF with its experience of financing local authorities increased the competence and believability of the financing program. The proposed areas for improvement included more systematic communication and consultation with local authorities and citizens, simplification of procedures, revision of the series of loan agreements, and the creation of a single framework for dialogue during the drafting of regulatory texts. Overall, transparent and coordinated cooperation between the two bodies is considered vital for effective financial management and the smooth flow of program funding.

**Q17.** What do you consider to be the most significant challenges during the design and/or implementation of the program?

**Figure 18 Most significant challenges during the design and implementation of the program**



The structural limitations of the local government, including poor administrative and technical support, maturity, and bureaucracy, related to the Program as the primary problems limiting its effectiveness. This emphasizes the necessity to enhance the administrative power of the municipalities, empower digital tools, and enhance interoperability among agencies.

Nevertheless, the Antonis Tritsis program achieved high absorption on critical infrastructure (water supply, sewerage, civil protection, energy, school building) and enhanced disbursements than other instruments despite the problems. One of the reasons behind the success of the loan

scheme was through the Public Investment Program which gave a lot of financial relief to local authorities.

But the immaturity of technology, slow approvals, and meager resources of small cities showed weaknesses in the organizing structure. The success of future programs will be predetermined by the enhancement of technical support and the facilitation of procedures.

Key insight: Central-level institutional cooperation enhances governance coherence, but persistent gaps in local administrative capacity remain the critical bottleneck for effective implementation.

#### 4.6 S.W.O.T. Analysis of the financing program

The SWOT Analysis of the program Antonis Tritsis is found in the one attached in Appendix A. The current section offers a strategic overview of the most important findings, which pertain to the practicality of the program and the development of its governance abilities.

According to the SWOT analysis, the "Antonis Tritsis" program is a multidimensional national funding program with a well-stayed and flexible fund base, which allows carrying out infrastructural and development projects that would not otherwise have been implemented. Funding structure of the program, facilitation of the procedures and contribution to the possibility of local development is continuously defined as the main strength, especially in the context of increasing the access to the investment sources on the municipalities.

Meanwhile, the review also identifies endemic organizational and technical vulnerabilities which limit effective implementation. These are unequal administrative capacity in municipalities, low staffing positions, poor technical support system and lack of a central information system to monitor and coordinate. Furthermore, the external risks associated with political unpredictability, economic variability and regular project redesigns add to the complexity of the implementation as well as administrative load.

Next to these obstacles, there are also major opportunities identified as a result of the SWOT, as the ways to strengthen the local administrative capacities, to increase the level of institutional learning and better the governance coherence. The issue of scale and its thematic coverage of the program provides the conditions of capacity development, which is subject to the creation of the required support mechanisms, the transparency of activities, and the computer management systems.

In general, the SWOT analysis shows that the success of the program of the Antonis Tritsis issues is not as related to its financial design as to administrative and institutional situation in which it is realized. It is based on such that the targeted policy responses are elaborated in the next section.

**Table 2 Translating SWOT Findings into Policy Responses**

<b>Key SWOT Finding</b>	<b>Policy Response</b>
Uneven administrative capacity among municipalities	Establish permanent regional technical assistance hubs and capacity-building programs tailored to municipal needs
Limited project maturity and preparation	Introduce mandatory pre-feasibility and project preparation support prior to submission
Institutional complexity and overlapping procedures	Develop a unified digital governance platform integrating all involved agencies
Weak monitoring and fragmented performance indicators	Implement standardized KPIs and real-time monitoring dashboards
Risk of widening territorial inequalities	Apply differentiated calls and capacity-based allocation mechanisms
Implementation delays due to revisions	Introduce predefined timelines, unit costs and ceiling mechanisms
Strong financing model but limited prioritization	Adopt strategic prioritization frameworks incorporating social and territorial criteria

Exposure to economic and political instability

Institutionalize multi-year funding guarantees and continuity mechanisms

#### 4.7 Discussion

These results prove the validity of the conceptual framework utilized in the present study, which had to rely on the institutional design as only not enough to make the large-scale local government funding programs effective. The administrative capacity stands out as the crucial mediating factor that determines project maturity, project implementation procedures and spatial equity.

The findings are consistent with the general body of existing literature in the field of public administration and local governance which highlights the importance of organizational capacity and governance coherence in developing outputs through the divinciation of financial investments. In centralized administrative structures, like those found in Greece, asymmetries of capacities among municipalities are bound to increase inequalities with territories unless specifically mediated through a set of policy interventions.

#### **5. Conclusions and policy proposals**

The study identified the vital elements of the work of the program named Antonis Tritsis, where the only qualitative information was collected by use of the structured questionnaire of Local Government executives and the S.W.O.T analysis. In this way, there was a possibility to care about the profound knowledge of the institutional, administrative and operational parameters that impact the efficacy of the program and concentrate on the experience and perceptions of the directly touched implementing agencies.

The results of the questionnaire indicate that the program is rated globally as a robust development instrument to the Local Government, primarily because it is fully funded and does not involve its own participation, its potential wide coverage in terms of its themes and the potential to finance a project that is of utmost importance to daily life and social integrity. The significance of the program is that it reduces disparities among municipalities and makes financing available even to small, remote local authorities with little resources.

Meanwhile, the questionnaire and the S.W.O.T. analysis have shown that structural weaknesses are present in large numbers. The major issue is the lack of the administrative and technical capacity of many municipalities, particularly during the stages of maturation of the project, preparation of studies and monitoring of the implementation. According to the participants, lack of human resources, expertise and support mechanisms binds exploitation of the potential of growth of the program notwithstanding the presence of the resources. Moreover, institutional impediments, red tape and duplication of roles are also pointed out, which compound administrative overheads and a slowdown in implementation.

As seen in the S.W.O.T. analysis, its core competencies lie in the financial stability, the countrywide geographical presence and also in the institutional empowerment of the local government and the potential to generate local jobs. In line with this, the opportunities are correlated with the utilization of the program as the instrument of digital transformation, energy transition and reinforcement of the social unity. Nevertheless, the threats identified, including the loss of resources without proper development focus, the disintegration of the interventions, and institutional or political instability, demonstrate the possibility of the limited impacts in the long-term.

With the above in mind, policy proposals, which have the above as their central concern, are aimed at strengthening the Local Government, both institutionally and operationally. It is deemed as necessary to develop long-term technical and managerial support structures, including decentralized support centers (Local Acceleration Hubs) and cooperation with universities, technical organizations, and other non-governmental bodies and organizations. Enhancing the level of administrative capacity can be achieved by strengthening the capacity through staffing, mentoring and ongoing training to be a critical requirement towards enhanced efficiency.

Simultaneously, the study shows the necessity to transition to a more congruent and digitally advanced form of program governance. Bureaucracy may be mitigated by adoption of common digital tools, standardization of procedures and automated work processes to improve

transparency and enhance accountability. Similarly, the possibility to have clear result indicators in each of the thematic unit and the systematic quality overseeing of implementation can be deemed as the key to prevent fragmented interventions.

The answers to the questionnaires indicate that there is a necessity to improve social element of the future financial instruments. Tasks connected to social inclusion and housing, employment, energy poverty and daily life enhancement are scored with high social value and must be given a first priority. Local consultations and active interaction of citizens can increase the legitimacy of interventions and its relationship with how a local community really needs things to be.

To sum up, the qualitative analysis of the questionnaire and the S.W.O.T. proves that the program Antonis Tritsis qualifies well as a development tool, the success of which lays entirely in the institutional sufficiency, the abilities of the administration and the strategic placement of the interventions. The offered policy directions can guide the development of more sustainable, more targeted programs and more socially just programs on the empowerment of the Local Government as an effective lever of local sustainable development.

This ex-ante assessment provides a crucial analytical baseline. A necessary next step is a rigorous ex-post evaluation, combining administrative data from the program with field-based evidence, in order to assess its actual socio-economic impact and validate the anticipatory findings presented here. Future research should also complement this top-down perspective by incorporating the views of beneficiary municipalities, elected officials and local communities. Finally, comparative analysis with similar local government funding instruments in other Southern European countries could yield valuable insights into best practices and institutional design.

#### **Acknowledgments**

The authors would also wish to express their appreciation to the executives, the Deposits and Loans Fund and Special Management and Implementation Service of the Ministry of Interior that took part in the structured interviews carried to conduct the ex-ante evaluation of the "Antonis Tritsis" program.

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## **Appendix A**

**Table A1 Strengths of the "Antonis Tritsis" special development program**

<b>Access for All</b>	Fair access to resources – participation of small and regional local authorities
<b>Innovation &amp; Thematic Breadness</b>	Emphasis on innovative projects (Smart cities, RES, earthquake checks), multidisciplinary approach
<b>Financing</b>	High budget – guaranteed liquidity through PDE, without burdening the OTAs
<b>Implementation Flexibility</b>	Submission of immature proposals, long-term loan servicing, possibility of co-financing with EIB
<b>Support &amp; Know-how</b>	Capable staff in the Ministry of Economy and Transport and Infrastructure and TSI – technical support through Development Organizations
<b>Simplified Procedures</b>	Less bureaucracy compared to other tools (such as the NSRF)
<b>Development Targeting</b>	Projects with direct social impact – improving quality of life, strengthening infrastructure

**Table A2 Weaknesses of the “Antonis Tritsis” special development program**

<b>Slow implementation rates</b>	Delays in contracting and implementation, constant requests for revisions, supplementary contracts, low discounts
<b>Political discontinuity</b>	Dependence on changes in political leadership
<b>Economic instability and crises</b>	Rapid increase in material costs, inflationary pressures, international crises (energy, geopolitical, pandemics), difficulty in securing P.D.E.
<b>Financial risk</b>	Increase in interest rates (e.g. Euribor) affecting EIB loans
<b>Resource management risks</b>	Inability to cover budget overruns, risk of abuse due to inadequate control
<b>Lack of control tools</b>	Lack of effectiveness assessment tools (indicators, KPIs, disbursement monitoring)
<b>Widening inequalities</b>	Different levels of preparedness – risk of widening the gap between large/small local governments, lack of computerized monitoring
<b>Institutional &amp; technical lag of local governments</b>	Some local governments risk being left behind, increasing the risk of exclusion
<b>Institutional risk</b>	Absence of institutional guarantee for the continuation of multi-year projects regardless of governments

**Table A3 Opportunities of the “Antonis Tritsis” special development program**

<b>Digital Transformation &amp; Innovation</b>	Adoption of cutting-edge technologies (artificial intelligence, GIS, ICT) Development of smart applications to improve services to citizens Utilization of tools for administrative and financial monitoring of projects
<b>Training &amp; Human Resources</b>	Digital seminars and training for local government executives Development of know-how for the utilization of future funding
<b>New Calls &amp; Themes</b>	Expansion into areas such as energy efficiency, recycling, environment, resilience Integration of innovative actions into new calls
<b>Interinstitutional Cooperation</b>	Cooperation between the Ministry of Environment and Energy, CRES, other ministries, and specialized agencies Networking with European organizations and leveraging experience
<b>Strategic Linkage with National Goals</b>	Linking projects to green growth, sustainability, and resilience of local communities
<b>Development of Support Structures</b>	Creation of regional/thematic support mechanisms Development of new targeted tools for the needs of local authorities
<b>Social &amp; Economic Benefits</b>	Strengthening infrastructure with long-term benefits (water supply, sewerage, rural roads) Creation of thousands of jobs Improvement of the capacity of local authorities to develop and implement projects

**Table A4 Threats of the “Antonis Tritsis” special development program**

<b>Low implementation rates</b>	Delays in contracting and implementation, constant requests for revisions, supplementary contracts, low discounts
<b>Political discontinuity</b>	Dependence on changes in political leadership
<b>Institutional Risk</b>	Absence of institutional guarantees for the continuation of multi-year projects regardless of government changes
<b>Economic instability and crises</b>	Rapid increase in material costs, inflationary pressures, international crises (energy, geopolitical, pandemics), difficulty in securing public investment programs
<b>Financial risk</b>	Increase in interest rates (e.g., Euribor) affecting EIB loans Resource management risks Inability to cover budget overruns, risk of abuse due to inadequate control
<b>Lack of control mechanisms</b>	Lack of effectiveness assessment tools (indicators, KPIs, disbursement monitoring)
<b>Widening inequalities</b>	Different levels of readiness – risk of widening the gap between large/small local authorities
<b>Institutional &amp; technical lag of local authorities</b>	Some local authorities are at risk of falling behind, increasing the risk of exclusion

## THE IMPACT OF CHANGE ON REGIONAL ECONOMIC: PARAMETERS AND DEPENDENCIES

**Inna MANAEVA**

Doctor of Economics, Professor of the Department of World Economy, Belgorod State National Research University, Russia, <http://www.bsu.edu.ru>  
[In.manaeva@yandex.ru](mailto:In.manaeva@yandex.ru)

**Angela SHVETSOVA**

Candidate of Economic Sciences, Associate Professor of the Department of World Economy, <http://www.bsu.edu.ru>  
[mikhajlovaangela@yandex.ru](mailto:mikhajlovaangela@yandex.ru)

### **Abstract**

Research on the adaptation of economic growth dynamics to climate change is important for sustainable development on local to global scales. It is important to quantify the balance between two interrelated systems to generate effective knowledge to create a favorable environment in conditions of rapid economic development. The purpose of the work is to develop and test a methodology for assessing the adaptation of regional economic growth to climate change in the regions of the Russian Federation. The author's methodology is based on obtaining the coefficient of adaptation (KA) of economic growth to climate change in the regions of the Russian Federation. The analysis of the autocorrelation KA of the spacecraft within the borders of the federal districts by calculating the global and local Moran's index makes it possible to determine the similarities and differences of the adaptation process in neighboring regions. The following indicators were identified for the study: a) economic sphere: GRP per capita, industrial production index, real monetary incomes of the population, the volume of investments in fixed assets per capita; b) climate: average annual air temperature, the amount of precipitation. Information base: data from the Federal State Statistics Service and the Weather and Climate portal. The object of research is the regions of the Central Federal District, the Southern Federal District and the Siberian Federal District. Study period: 2000, 2003, 2009-2021. Periods of decrease and growth of the coefficient of adaptation, a decrease in the differentiation of regions by the value of the KA empirically have been identified. The calculations performed demonstrate spatial heterogeneity. The indicators of the coefficient of adaptation in the southern regions and parts of the regions of central Russia are significantly higher, which indicates a more coordinated development in these regions. Regions demonstrating a relatively higher level of adaptation to economic growth and climate change have a more differentiated economy and a favorable geographical location. The results obtained can be used to develop and implement climate risk management policies and analyze the economic costs of climate change impacts.

**Keywords:** Region, Climate, Ecology, GRP, Communication coordination coefficient, Economic development, Air temperature, Precipitation, Moran's index, Autocorrelation

**JEL classification:** R12

pp. 37-55

### **1. Introduction**

Russia is a unique country not only in the composition of climatic zones and the natural and geographical characteristics of the regions, but also in the location of productive forces in the territorial space. Today, there is a wide differentiation in a number of important indicators in the regions of the Russian Federation: the population range in cities varies from 1 thousand people (Chekalin) to 12330.1 thousand people (Moscow); population density in the regions from 5114.23 people/km<sup>2</sup> (Moscow) to 0.07 people/km<sup>2</sup> (Chukotka Autonomous Okrug); GRP per capita from 5206 thousand rubles (Nenets Autonomous Okrug) to 142 thousand rubles (Republic of Ingushetia); average annual air temperature from -6.7°C (Yakutsk) to 14.9 6.7° C

(Sochi)<sup>1</sup>. The climatic features of the regions of the Russian Federation are one of the important factors determining the migration flows of the able-bodied population, the quality of life and the vector of economic development of the territory. Climate and economic research and adaptation of regional economic growth to climate change are important for sustainable development from local to global scales. It is important to quantify the balance between two interrelated systems to generate effective knowledge to create a favorable environment in conditions of rapid economic development. Most previous studies examining the interaction of economics and the environment have focused on measuring the Kuznets curve of the environment. The purpose of this work is to develop and test a methodology for assessing the adaptation of regional economic growth to climate change in the regions of the Russian Federation.

The research objectives included the following:

- to analyze theoretical provisions on the problems of climate impact on economic development to form a systematic methodological toolkit;
- to present and substantiate the system of indicators and the calculation apparatus of methodological tools;
- to identify trends and the level of inequality in the modern socio-economic development of Russian regions;
- to characterize the climatic features of the Russian Federation;
- to analyze the dynamics of adaptation of economic growth to climate change in the regions of Russia.

The theoretical and methodological basis of the research was scientific publications of domestic and foreign scientists in the field of theory, methodology, assessment and analysis of the relationship between economics and climate, as well as regional economics. The work uses methods that ensure comparability of our estimates with the results obtained in the works of foreign scientists.

## **2. Literature review of the study**

Research on the impact of climate on economic development is popular in modern Russian and foreign literature. In a number of works, the relationship of these systems with the use of composite environmental indexes is studied [Li, 2012; Almeida, 2017], protection of the ecological environment [He, 2017; Liu, 2018], carbon emissions [Zhang, 2019; Wang, 2019]. Approaches to assessing the economic risks of climate change have been developed separately for the United States [Hsiang, 2017], the European Union [Ciscar, 2013], and in general, for the global level [Takakura, 2019].

The influence of urbanization on climate change is of particular interest to foreign researchers. Assessment of the impact of urbanization on the environment has become one of the most relevant topics for management decision-making [Kukkonen, 2014; Monkkonen, 2018; Sun, 2015]. Urbanization reflects the evolution of human socio-economic development, while the ecological environment is a natural environment. Urbanization and the ecological environment are classical complex systems with nonlinear interacting relationships [Fang, 2016]. A number of works claim that urban sprawl reduces ecological resources and ecological space [Grimm, 2008; Wigginton, 2016]. There is increasing empirical evidence that cities have a significant impact on key components of the Earth's system, including the atmosphere, biosphere, and geosphere [Zhu, 2019].

According to Chinese scientists, landscape urbanization, including the expansion and consolidation of cities, acts as a key to linking economic growth with urban climate change. In China, a long-term bidirectional causal relationship has been identified between economic growth and landscape urbanization in the urban and provincial levels [Wu, 2014; Bai, 2012].

Urbanization leads to the widespread occurrence of such phenomena as urban thermal zones of «urban heat islands» UHI, changing the ability of lands to evaporate water and the efficiency of heat convection in the lower atmosphere [Estrada, 2017; Li, 2019]. At the same time, economic growth can help reduce the negative effects of urban thermal zones UHI, as it

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<sup>1</sup> Federal State Statistics Service URL: <https://rosstat.gov.ru/compendium> (date of application 15.02.2025)

provides regions with large financial resources that can be used to green the territory [Gu, 2012].

The CCD model of communication coordination, which is based on communication theory describing the interaction between different systems, has been widely used in assessing the climate and economic development of a territory [Li, 2012; Shen, 2018; Chen, 2019]. The CCD model is able to assign a coordination attribute to each territory during the study period, providing an opportunity for further analysis of spatial and temporal coordination models using geographical approaches (Liu, 2018; Chen, 2019). When evaluating the model of the degree of coordination between the CCD socio-economic status (SAI) and the regional environmental environment (REE) in Beijing, scientists concluded that socio-economic activity showed an upward trend, and the level of the regional environmental environment was stable.

The relationship between REE and SAI in Beijing has improved both spatially and quantitatively in 2018–2020. By May 2020, more than 50% of human activity areas were in a high-level state of coordination, and the average CCD value reached the basic level of coordination [Cai, 2021].

Separately, it is necessary to highlight the direction of scientific research devoted to the analysis of the interaction of economics and ecology, based on the economic curve of Kuznets (ECK). The essence of the ECK is as follows: there is an inverted U-shaped relationship between economic growth and environmental quality: the state of the environment worsens with economic development, and then gradually improves after the economy reaches a certain level. The work of foreign scientists testing the ECK hypothesis has shown an ambiguous result, this curve cannot be applied everywhere [Liu, 2018]. A review of the ECK in the Russian regions showed that the relationship between gross regional product (GRP) and emissions of pollutants into the atmosphere is described only for twenty regions. The factors that reduce the environmental burden are identified: modernization of production facilities, structural changes in the economy [Postnikov, 2014]. The ECC analysis revealed a relationship between income levels and sustainable development [Bobylev, 2007].

In the Russian literature, the scientific direction of assessing the impact of climate change on the economy of individual industries is popular. A.V. Chugunkova and co-authors assessed the impact of global climate change on the forestry and agricultural economies [Chugunkova, 2018]. A team of researchers led by N.M. Svetlov predicts changes in the location of agricultural sectors caused by possible climatic fluctuations, which are simulated by the displacement of natural agricultural zones within the boundaries of the production capabilities of the regions of the Federation [Svetlov, 2019]. D.A. Polzиков presents the results of modeling the influence of the climatic factor on the dynamics and structure of agricultural production, substantiates recommendations for improving agrifood policy, taking into account a set of adaptation measures [Polzиков, 2022].

I.Y. Zhilina identified the most acute economic consequences of climate change: reduced crop yields, the impact of heat stress on labor productivity, water stress problems, and negative effects on public health [Zhilina, 2020]

Based on the results of a comprehensive assessment of current climate change, analysis of various economic scenarios and types of damage from climate change, the threats associated with warming and positive changes have been identified: warming in the Arctic will increase the duration of navigation along the Northern Sea Route and facilitate the development of oil and gas fields on the shelf; the heating season will be shortened by 2-3 days, the northern border of agriculture will shift to the north [Oganesyan, 2019]. There are studies of problems and scientific and methodological approaches to assessing the expected damage to fixed assets from the degradation of permafrost soils used for planning and implementing adaptation measures to climate change and their consequences in the Arctic macro region of Russia. An integral approach to this assessment is proposed ([Porfiriev, 2023] B.G. Ivanovsky's work presents an assessment of damage from natural disasters and climate change [Ivanovsky, 2021]. The main factors determining the composition of the socio-economic consequences of climate change and their corresponding quantitative estimates have been studied [Ksenofontov, 2021].

It is important to note that climate change is accompanied not only by negative, but also by positive consequences in ecological, economic and social systems. I.M. Potravny and V.V. Elsakov, based on the analysis of trends in the development of traditional crafts of indigenous peoples in the context of climate change, concluded that «climatic changes occurring in the

Arctic zone of Russia can positively affect the development of traditional crafts of indigenous peoples, in particular for reindeer husbandry and the extraction of fossil mammoth bones (mammoth fauna)» [Potravny, 2024]. V.V. Zholudeva, conducting a statistical assessment of the impact of climate change on the sociodemographic processes of the Yaroslavl region, empirically proved that «an increase in average air temperature is a positive factor for the agricultural sector of the Yaroslavl region, since crop yields will increase with increasing air temperature.... the effects of climate change on demographic processes and health people are currently insignificant» [Zholudeva, 2019]. Separately, it is necessary to single out scientists involved in climate policy: I.A. Yakovlev (systematization of key issues affecting the country's position in the development of national climate policy) [Yakovlev, 2020]; V.S. Vasiltsov, N.N. Yashalova, E.N. Yakovleva, A.V. Kharlamov (the problem of adaptation of national climate policy) [Vasiltsov, 2021]; N.G. Zhavoronkova, V.B. Agafonov (trends and prospects in the development of Russian climate legislation) [Zhavoronkova, 2022]; Ya.Yu. Blinovskaya, E.A. Mazlova (trends in climate policy in the field of coal mining and processing) [Blinovskaya, 2019].

### **3. Research methodology**

The purpose of the work can be achieved on the basis of the methodological framework presented in earlier studies [Manaeva, 2022], the modification of which for Russian regions at the current stage of globalization development allows us to obtain quantitative estimates of the adaptation of regional economic growth to climate change in the regions of the Russian Federation, as well as to conduct a spatial and temporal analysis of these estimates within the borders of federal districts with using the global and local Moran's index, which can be used to develop and implement climate risk management policies.

Stages of the study:

#### **1. Sample formation.**

The study included the regions of the Central Federal District, the Southern Federal District and the Siberian Federal District. These regions of the Russian Federation were chosen because of their location in different climatic zones with a wide range of average annual air temperatures, which will allow for comparative analysis and practical recommendations.

The Republic of Crimea and Sevastopol were excluded from the study due to insufficient statistical data.

#### **2. Analyzed indicators:**

a) economic: GRP per capita; industrial production index; real monetary incomes of the population, the volume of investments in fixed assets per capita.

b) climatic: average annual air temperature, amount of precipitation.

Study period: 2000, 2003, 2009–2021.

#### **3. Formation of the calculation apparatus.**

Normalization of indicators:

Economic indicators:

$$E_{1,2,3,4} = (X_{ij} - \min\{X_j\}) / (\max\{X_j\} - \min\{X_j\}) \quad (1)$$

Climate indicators:

$$U_{1,2} = X_{ij} - \mu_j / \nu_j \quad (2)$$

$$E = E_1 + E_2 + E_3 + E_4 \quad (3)$$

$$U = U_1 + U_2 \quad (4)$$

where  $E_j$  – the normalized value of the indicator «GRP per capita» in the region  $j$  in a year  $i$ ;

$E_2$  – the normalized value of the index of industrial production in the region  $j$  in a year  $i$ ;

$E_3$  – the normalized value of the indicator «real monetary incomes of the population» in the region  $j$  in a year  $i$ ;

$E_4$  – the normalized value of the indicator «volume of investments in fixed assets per capita» in the region  $j$  in a year  $i$ ;

$E_{ji}$  – the final indicator of the economic sphere in the region  $j$  in a year  $i$ ;

$U_1$  – the normalized value of the indicator «average annual air temperature in the region» in the region  $j$  in a year  $i$ ;

$U_2$  – the normalized value of the indicator «amount of precipitation in the region» in the region  $j$  in a year  $i$ .

$U_{ji}$  – the final climate indicator in the region  $j$  in a year  $i$ ;

$X_{ji}$  – the initial value of the indicator in the region  $j$  in a year  $i$ ;

$\max \{X_{j}\}$  – the maximum value of the analyzed indicator in the region during the study period

$j$ ;

$\min \{X_{j}\}$  – the minimum value of the analyzed indicator in the region during the study period

$j$ .

$\mu_j$  – the average annual rate of the analyzed indicator in the region  $j$ ;

$v_j$  – the standard deviation for the study period of the analyzed indicator in the region  $j$ .

$$C = \left\{ \frac{E*U}{[E+U]} / 2 \right\}^{1/2} \tag{5}$$

$$T = \alpha E + \beta U \tag{6}$$

$$KA = (C * T)^{1/2} \tag{7}$$

$$\alpha = U / (E + U) \tag{8}$$

$$\beta = E / (E + U) \tag{9}$$

where  $C$  – the degree of connection between economic development and urban climate;

$KA$  – the coefficient of adaptation of economic growth to climate change in the region.

$T$  – reflects the overall impact of the performance levels of the two systems on the degree of adaptation (KKS);

$\alpha$  and  $\beta$  describe the contribution of economic growth and climate change in the regions, respectively.

4. Assessment of the adaptation of economic growth to climate change in the regions according to the criteria presented in Table 1.

**Table 1 Classification of adaptation of economic growth to climate change in Russian regions (Zhou, 2016)**

Level $KA$		Characteristic	
Unadapted	$0 < KKC < 0,3$	$0 \leq  U-E  \leq 0,1$	Unadapted
		$U-E > 0,1$	Unadapted, the economy is not changing
		$E-U > 0,1$	Uncoordinated, the climate does not change
The transition period	$0,3 < KKC < 0,5$	$0 \leq  U-E  \leq 0,1$	Low level
		$U-E > 0,1$	Low level, the economy is not changing
		$E-U > 0,1$	Low level, climate does not change
	$0,5 < KKC < 0,8$	$0 \leq  U-E  \leq 0,1$	Basic level
		$U-E > 0,1$	The basic level, the economy does not change
		$E-U > 0,1$	Baseline, climate does not change
Adapted	$0,8 < KKC < 1$	$0 \leq  U-E  \leq 0,1$	High level of adaptation
		$U-E > 0,1$	The level is high, the economy does not change
		$E-U > 0,1$	The level is high, the climate does not change

5. Spatial and temporal analysis of the adaptation of the economy and climate within the borders of the federal districts by calculating the global and local Moran's index, which will determine the similarities and differences of the adaptation process in neighboring regions. [Manaeva 2020].

a) calculate the global Moran's index:

$$I_G = \frac{N}{\sum_i \sum_j w_{ij}} * \frac{\sum_i \sum_j w_{ij} (x_i - \mu) (x_j - \mu)}{\sum_i (x_i - \mu)^2} \quad (10)$$

where  $I_G$  – the global Moran's index,

where  $N$  – number of regions;

$w_{ij}$  – an element of the spatial weight matrix for regions  $i$  and  $j$ ;

$\mu$  – the average value of the indicator;

$x$  – the analyzed indicator.

b) determines the mathematical expectation of the index:

$$E(I) = \frac{-1}{n-1} \quad (11)$$

where  $E(I)$  – mathematical expectation of the index,

$n$  – number of analyzed territories.

$I_G \geq E(I)$  – positive spatial autocorrelation (the values of observations for neighboring territories are close to each other);

$I_G \leq E(I)$  – negative spatial autocorrelation (the values of the indicator under consideration differ between territories located close to each other)

$I_G = E(I)$  – there is no spatial autocorrelation.

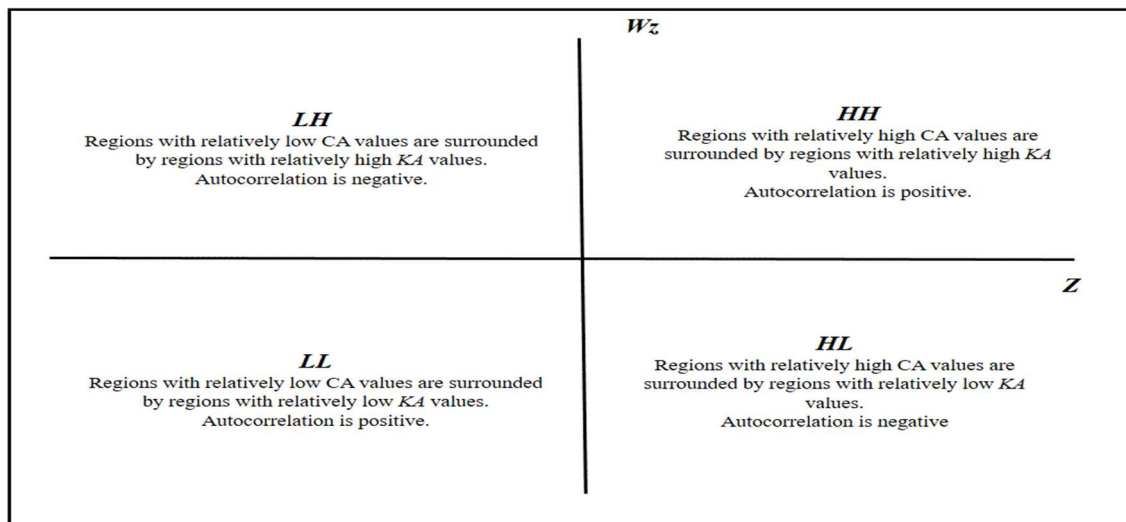
c) to verify the significance of the results obtained using the statistical hypothesis testing method (z-test), by determining the value of the Z-statistics:

$$z - \text{statistics} = \frac{I - E(I)}{\sqrt{E(I)^2 - E(I)^2}} \quad (12)$$

The resulting value is determined by the number of standard deviations by which the actual value of the Moran's index is removed from the expected value.

d) construct a spatial Moran's scattering diagram. On the abscissa axis – are the standardized z-values of the indicator under study, on the ordinate axis – are the values of the spatial factor  $Wz$ . The axes of the spatial Moran's scattering diagram are shown in figure 1.

Figure 1 Spatial scattering diagram of the Moran's index



e) calculate the value of the local Moran's index ( $LISA$  – *Local Index Spatial Autocorrelation*) and the definition of the closeness of the relationship of a particular region with all the others.

$$I_{L_i} = z_i \sum w_{ij} z_j \quad (13)$$

where  $I_{L_i}$  – the local Moran's index for the  $i$ -th region;

$w_{ij}$  – standardized distance between the  $i$ -th and  $j$ -th regions;

$z_i$  и  $z_j$  – standardized values of the studied indicator for the  $i$ -th and  $j$ -th region. The values obtained can take values from -1 to 1.

When  $I_{Li} < 0$  – negative autocorrelation for region  $i$ , i.e. this region differs significantly from neighboring regions by this value (outlier).

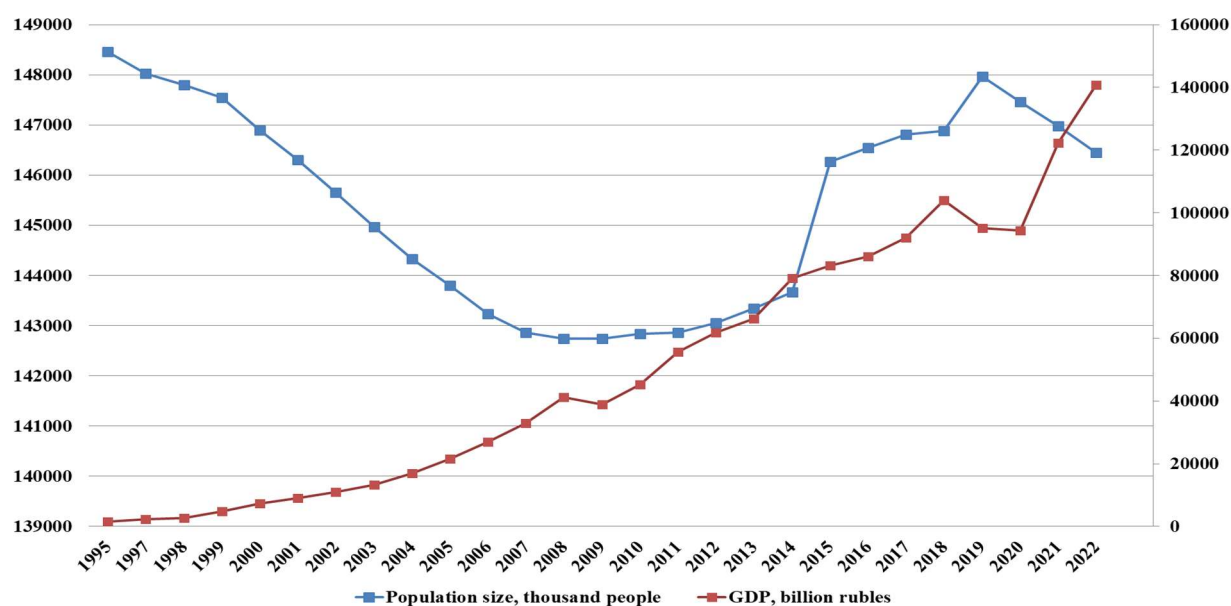
When  $I_{Li} > 0$  – the autocorrelation is positive, i.e. this region is similar to neighboring regions (cluster).

When  $|I_{Li}| > |I_{Lj}|$  – the similarity/difference of region  $i$  with its surrounding neighbors is greater than in the case of region  $j$  and its neighbors.

#### 4. Results of the author’s study and discussion

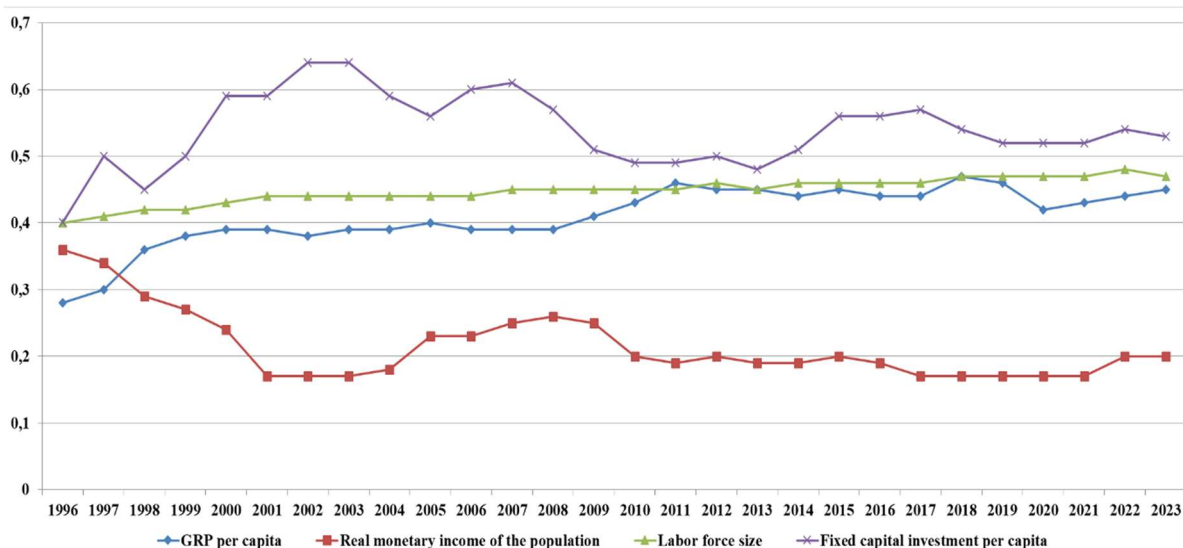
In order to give a general idea of the development of the regions of the Russian Federation, and in part of figure 2, the dynamics of population growth and GDP<sup>2</sup> in the period 1996–2023 are presented, selected in connection with the beginning of reforms and a market economy, using example 3 – as the dynamics of the regions of Russia.

**Figure 2 Dynamics of GDP and population in Russia in 1996-2023, thousand people, billion rubles**



Calculated by: Unified Interdepartmental Information and Statistical System (EMISS) URL: <https://fedstat.ru/> (date of access 14.03.2025)

**Figure 3 Dynamics of inequality of regions of Russia in 1996-2023, Gini Index**



<sup>2</sup> GDP is calculated taking into account the deflator index.

Calculated by: Unified Interdepartmental Information and Statistical System (EMISS) URL:  
<https://fedstat.ru/> (date of access 14.03.2025)

The data presented in Figure 2 demonstrate the rapid growth of GDP in the Russian Federation. The population during the analyzed period decreased by 2755.4 thousand people. Positive dynamics of the population in the Russian Federation has been observed since 2010, as a result of the implementation of measures to improve the demographic situation. A significant increase in population (2601 thousand people) was noted in 2015. We emphasize that the reason for this dynamic is the annexation of the Republic of Crimea of the Russian Federation and migration from the territory of Ukraine as a result of political conflicts. Since 2020, the process of population decline caused by the Covid-19 pandemic has begun.

Inequality of Russian regions in terms of socio-economic development tends to increase. Thus, the Gini index for fixed capital investment per capita, which was 0.401 (minimum value) in 1996, reached its maximum value in 2007 – 0.61, and in 2020 it was equal to 0.52 (author's calculations). If we analyze this index by the labor force size indicator, we will see that in 1996 it was 0.4 (minimum value), in 2004 – 0.44, in 2009 – 0.45, and reached its maximum in 2018 – 0.47 (author's calculations). The Gini index for GRP (real) per capita in 1996 was 0.28 (minimum value), in 2001 – 0.39, in 2010 – 0.43, in 2016 – 0.44, and reached its maximum in 2018 – 0.47 (author's calculations).

It is important to note the decrease in differentiation of the level of real monetary income of the population, as the Gini index had a maximum value of 1996 – 0.36, in 2001 – 0.17 (minimum value), in 2007 – 0.25, in 2012 – 0.2, since 2017 – 0.17 (author's calculations).

Within the framework of this study, it is appropriate to present a brief description of the climatic features of the Russian Federation. There are four climatic zones on the territory of Russia<sup>3</sup>.

The first climate zone: winter temperature  $-1^{\circ}\text{C}$ , wind speed up to 4.6 m/s, includes the southern regions of the country.

Second climate zone: winter temperature  $-9.7^{\circ}\text{C}$ , wind speed up to 5.6 m/s, western, northwestern regions, Primorsky Krai.

The third climate zone: winter temperature  $-18^{\circ}\text{C}$ , wind speed up to 3.6 m/s, Siberia and the Far East.

The fourth climate zone: winter temperature  $-41^{\circ}\text{C}$ , wind speed up to 1.3 m/s, the Far North and Yakutia.

Along with them, there is a special zone that includes Chukotka and territories beyond the Arctic Circle.

It is important to emphasize that in recent decades the trend towards warming has intensified; for example, during the period 1990–2000, according to observations from the ground-based hydrometeorological network of Roshydromet, the average annual surface air temperature in Russia increased by  $0.4^{\circ}\text{C}$ , while over the previous century the increase was  $1,0^{\circ}\text{C}$ .

The poles of temperature growth, which reached  $5-6^{\circ}\text{C}$ , are located in the Altai Territory, the Trans-Baikal Territory, the Irkutsk Region and in the south of Siberia.

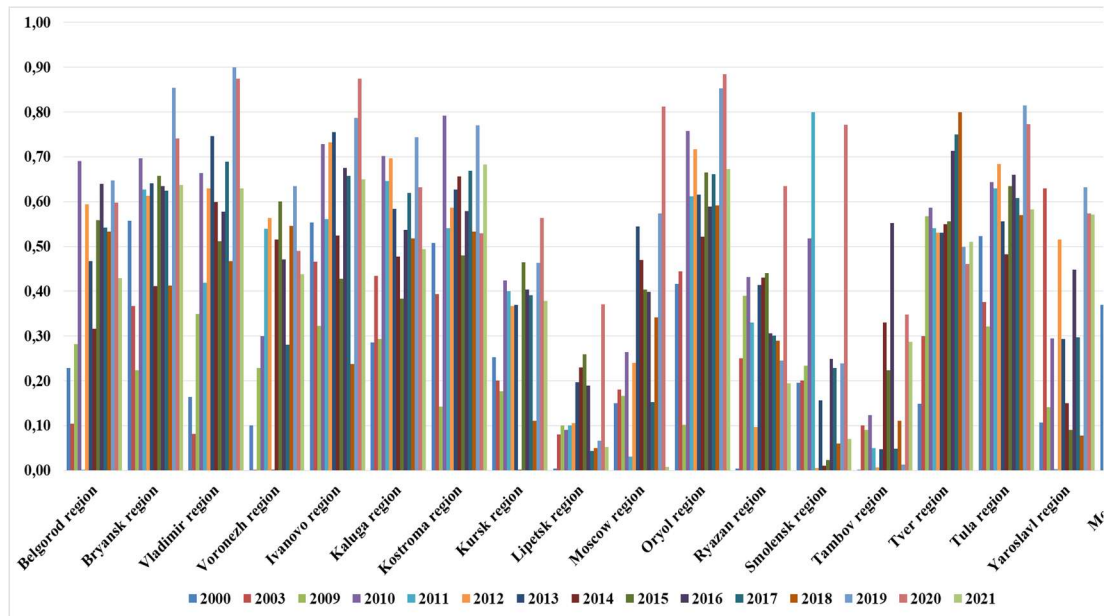
In the analyzed sample of regions (regions of the Central, Southern, Siberian Federal Districts), the average annual norm for the indicator “air temperature” varies in the range from  $-0.7^{\circ}\text{C}$  (Tuva Republic) to  $12^{\circ}\text{C}$  (Krasnodar Krai). The dynamics of the average annual air temperature for the entire analyzed period is ambiguous: both an increase and a decrease in this indicator are observed.

Figures 4-5 present the results of calculations of the dynamics of adaptation of economic growth to climate change in the surveyed regions of Russia.

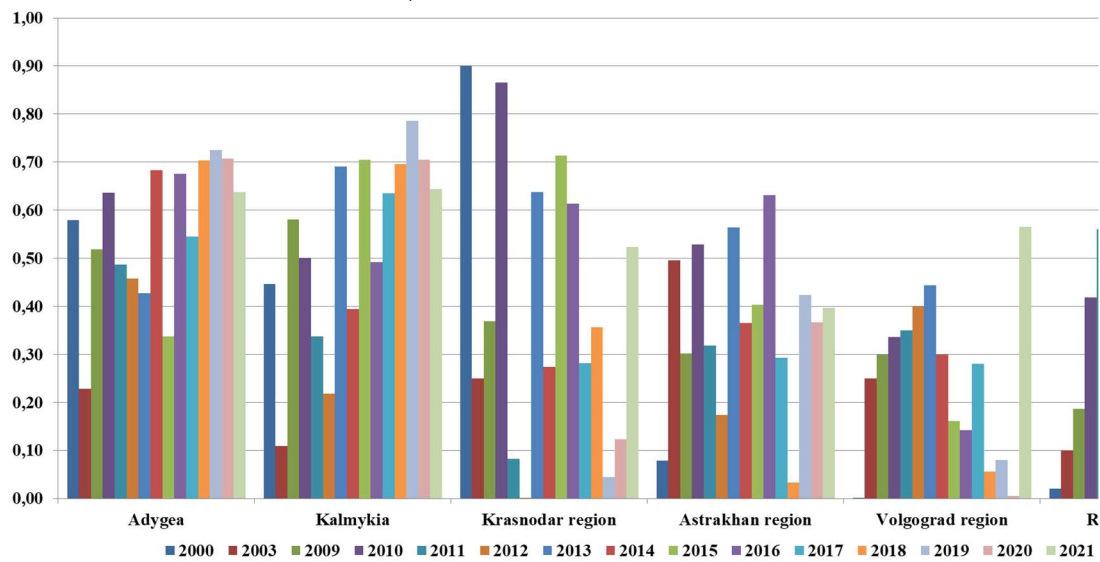
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<sup>3</sup> An area where the same climatic conditions prevail.

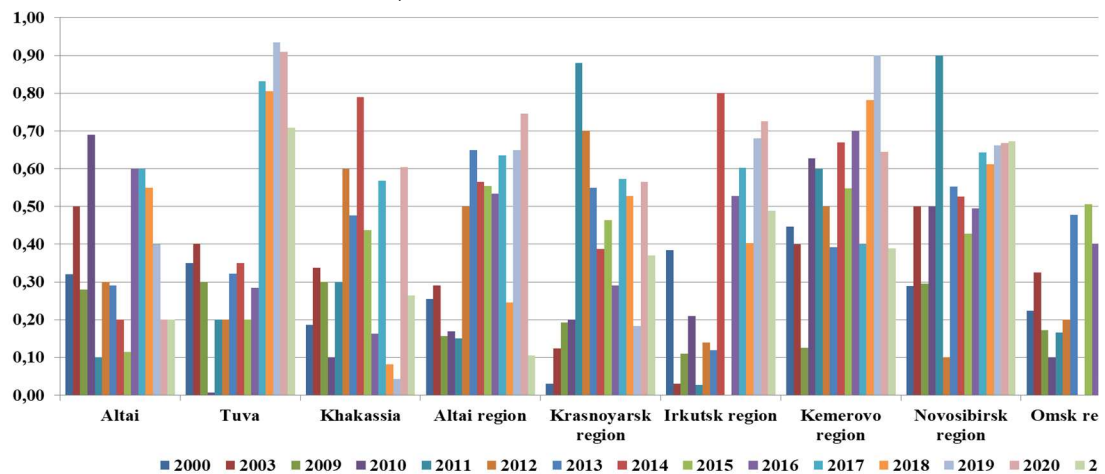
**Figure 4 Dynamics of the coefficient of adaptation of economic growth and climate change in the regions of Russia in 2000-2021**



A) Central Federal District



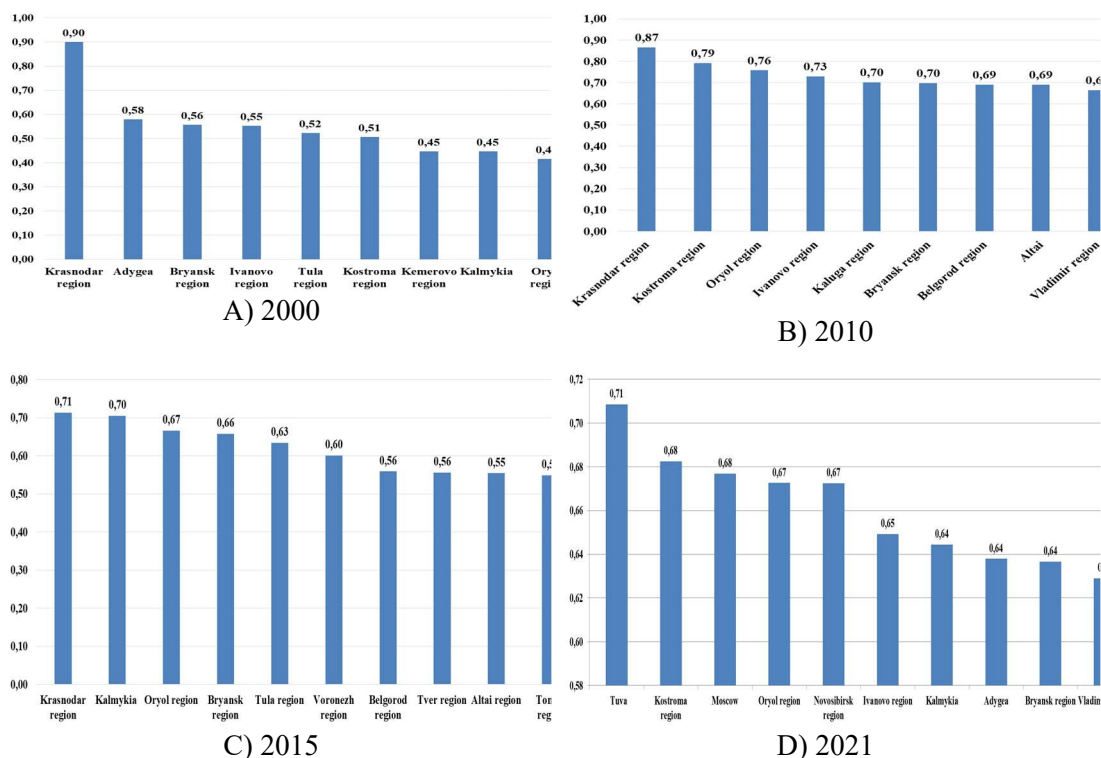
B) Southern Federal District



C) Siberian Federal District

Calculated based on data from the Federal State Statistics Service URL: <http://www.pogodaiklimat.ru/history.php> (date of application 22.02.2025) and the portal «Weather and Climate» URL: <http://www.pogodaiklimat.ru> (date of application 22.02.2025)

**Figure 5 Coordination coefficient of communications in the leading regions of Russia in 2000, 2010, 2015, 2021**



Calculated based on data from the Federal State Statistics Service URL: <http://www.pogodaiklimat.ru/history.php> (date of application 22.02.2025) and the portal «Weather and Climate» URL: <http://www.pogodaiklimat.ru> (date of application 22.02.2025)

Overall, the calculations demonstrate spatial heterogeneity. The indicators of the coefficient of adaptation of economic growth to climate change in the southern regions and some regions of central Russia are significantly higher, which indicates more coordinated development in these regions. Richer regions in the south of the country benefit from their advantageous geographic location and tourism potential. In the regions of the Siberian Federal District, the adaptation of the economy to climate change is worse, since climate change processes are more intense in this territory, and the structure of the economy is less differentiated.

It is important to note the ambiguous dynamics of the  $KA$  in all the surveyed regions: there are both periods of decline and growth of the  $KA$ . Positive dynamics at the end of the analyzed period are clearly visible in Moscow, Kaluga Region, Vladimir Region, Rostov Region, the Republic of Kalmykia, the Republic of Tyva, and Krasnoyarsk Krai.

A significant decrease in the  $KA$  of Krasnodar Krai is noted, the reason for this dynamics is the relatively rapid pace of economic development with a stable climate. The main reason for the growth of the economy of Krasnodar Krai is the construction of Olympic facilities and the development of the city of Sochi as a mountain climatic resort in preparation for the 2014 Olympics.

The sample of the leading regions for the analyzed period varies both in terms of the composition of the regions and in terms of the coefficient values obtained. We can conclude that the differentiation of regions by region  $KA$  has significantly decreased, and this trend is largely a consequence of the adaptation of economic growth to climate change in the outsider regions. In 2000, adaptation was observed in one region (Krasnodar Krai), while the remaining regions were characterized by a low (four regions) and basic (five regions) level of adaptation. In 2010 Krasnodar Region also maintains a high level of adaptation, while the remaining nine have a basic level. In 2015, all regions of the sample have a basic level of adaptation; in 2021,

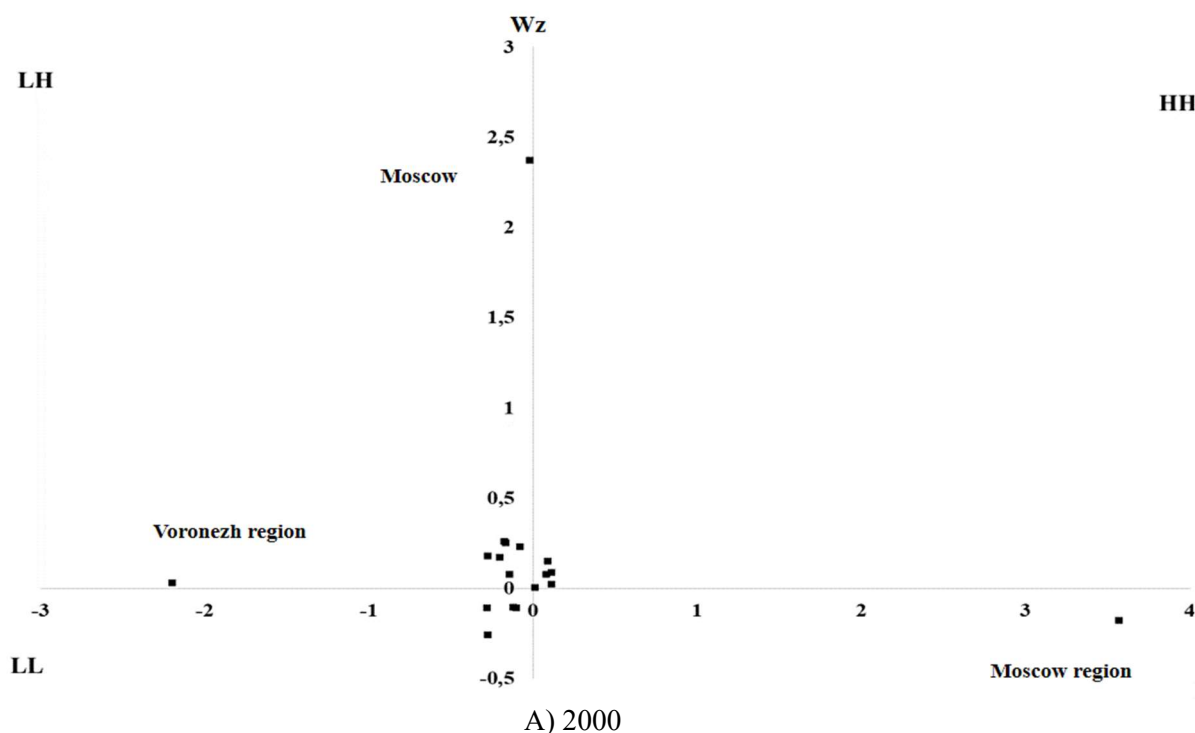
the basic level of adaptation remains in all leading regions. Separately, it is necessary to consider the adaptation of economic growth to climate change in regions with a high level of economic development.

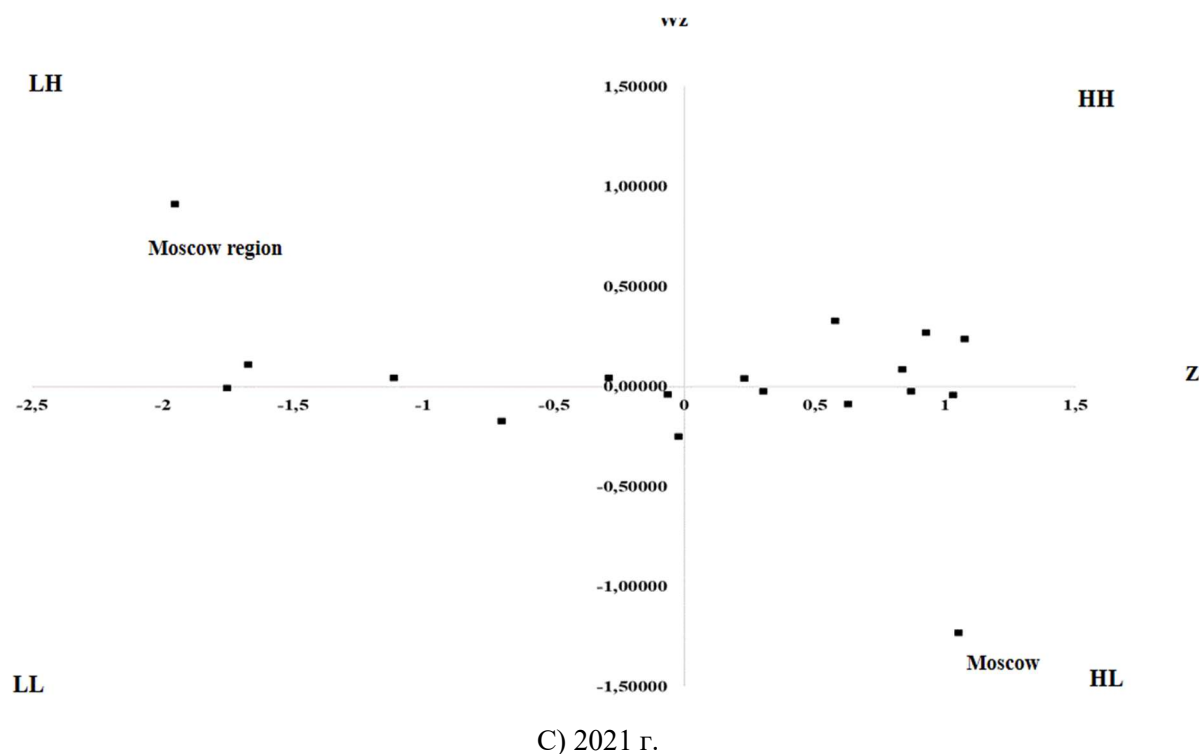
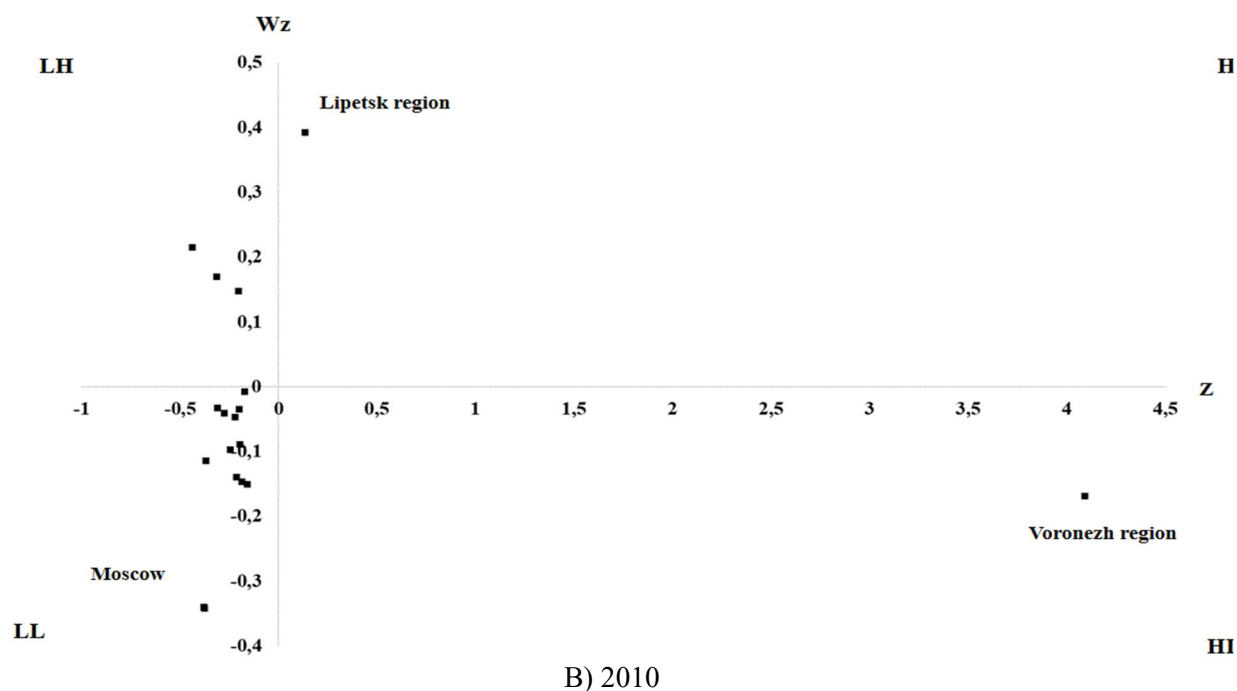
In Moscow, during the period under review, we can assess the dynamics of the *KA* positively, while the *KA* level is in a basic transition period with a stable, unchanging economy ( $U-E>0.1$ ), in other words, climate changes do not have a significant impact on the economy of the capital region. The current situation can be explained by the volume and differentiated structure of the economy, which makes it possible to reduce not only climate risks, but also various crisis fluctuations. The dynamics *KA* in the Belgorod region is mixed (Fig. 4A), from 2010 the *KA* level has entered a transitional period, but varies in level (low/basic). Since 2015, the economy in this region can be assessed as stable, i.e. adaptive to climate change ( $U-E>0.1$ ). In the Moscow region, strong jumps *KA* were observed over the analyzed period, from 0.81 in 2020 to 0.01 in 2021, while no significant climate change was observed ( $E-U>0.1$ ). We believe that these dynamics *KA* in the 2020-2021 period are caused by the impact of the new coronavirus infection on the economic and social spheres, as restrictive measures and control over their implementation in the Moscow region were stricter, and the incidence and mortality rates were higher.

Consequently, this had a significant impact on the socio-economic sphere, which requires a separate detailed analysis.

In Krasnoyarsk Krai, during the analyzed period, there was both an increase and a decrease in the coefficient of adaptation (uncoordinated and transitional periods), while climate changes were observed in a stable economy ( $U-E>0.1$ ), so are changes in economic growth as a reaction to climate fluctuations. In the Irkutsk Region, the *KA* level has been steadily in transition since 2016 (since 2019, the baseline level), by analogy with Krasnoyarsk Krai, there are both climate changes with a stable economy ( $U-E>0.1$ ) and changes in economic growth as a reaction to climatic fluctuations. The results of the spatial and temporal analysis of the adaptation of the economy and climate within the borders of the federal districts are presented in figures 6-8.

**Figure 6 Spatial Moran’s scattering diagram for the regions of the Central Federal District in 2000, 2010, 2021**





Calculated based on data from the Federal State Statistics Service URL: <http://www.pogodaiklimat.ru/history.php> (date of application 22.02.2025) and the portal «Weather and Climate» URL: <http://www.pogodaiklimat.ru> (date of application 22.02.2025)

When determining spatial autocorrelation in the regions of the Central Federal District, the mathematical expectation of the global Moran's index is (-0.06), the global Moran's index was calculated for 2000 data (-0.04); for 2010 data – (-0.02); for 2021 data – (-0.14). The results obtained allow us to conclude that there are global spatial patterns of  $KA$ , namely, regions with high or low  $KA$  values, as a rule, are adjacent to other regions with similar values.

In 2021, there is a feedback loop, i.e. the value  $KA$  in the surrounding regions is different. It is important to note that the global Moran's index shows a slight downward trend over the

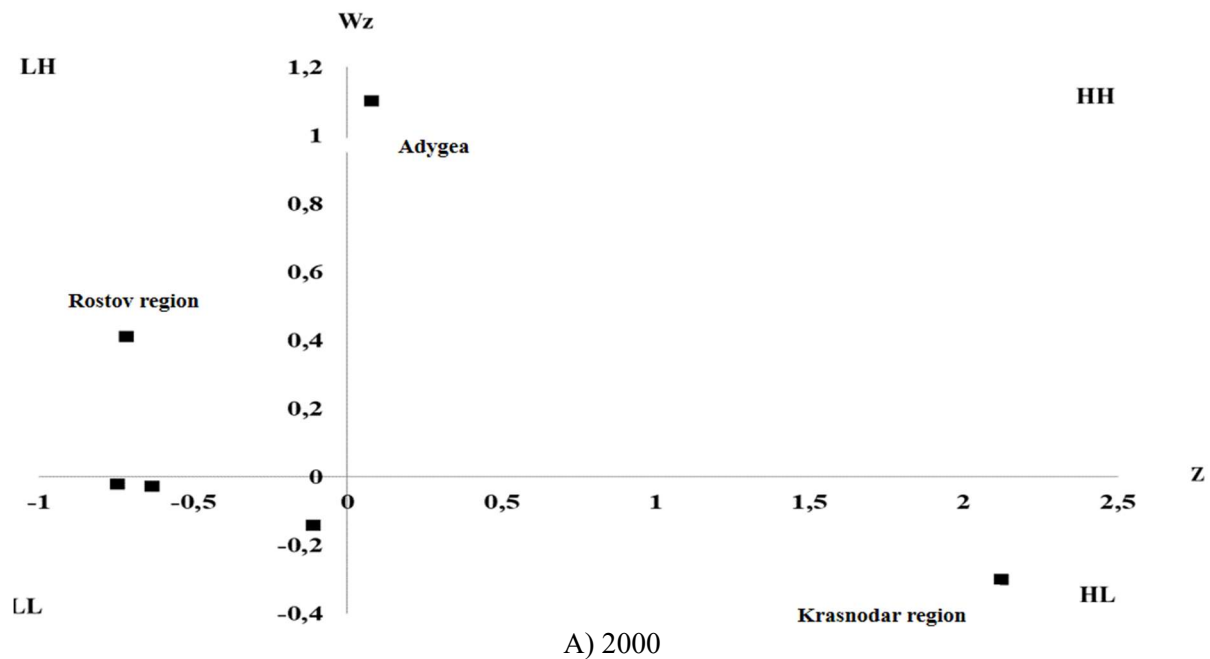
analyzed period, which indicates that, in general, neighboring regions tend to have less influence on the regional climate in conditions of rapid economic development.

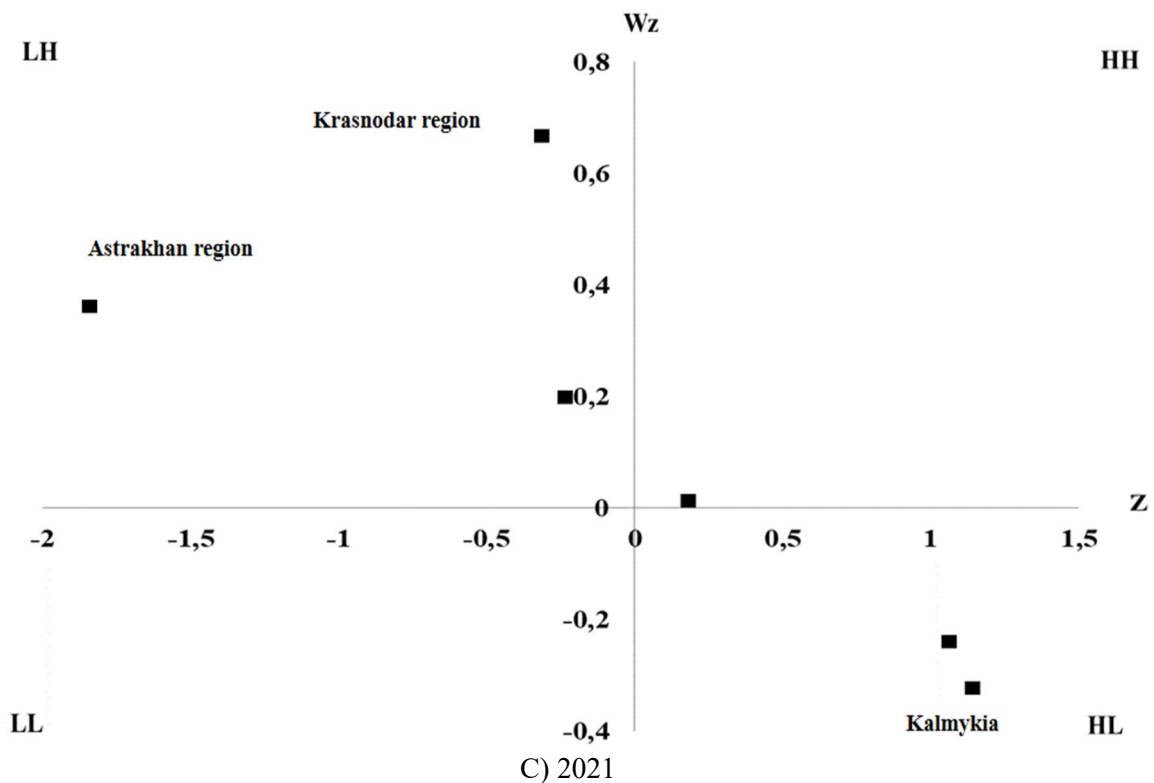
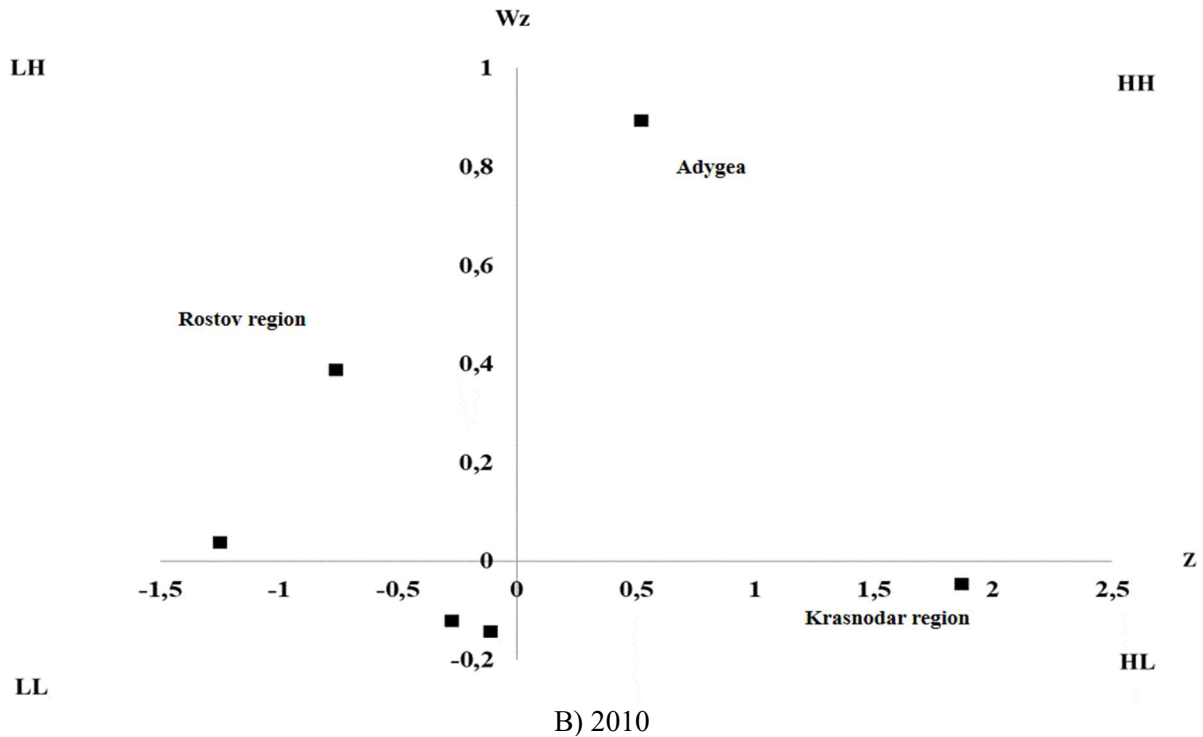
According to the data shown in figure 6A, the largest share in the sample of cities in the Central Federal District is occupied by regions with a low *KA* value, surrounded by regions with a high *KA* value (group *LH*, autocorrelation is negative), including Moscow and the region with a population of one million – the Voronezh Region.

The closest interregional connection is typical for the Lipetsk and Voronezh regions. There are five regions in the *HH* square: Bryansk, Ivanovo, Kostroma, Oryol and Tula regions. In 2010, there has been a significant change in the situation, with the largest concentration of regions in the square *LL*. Relatively high *KA* values (squares *HH* and *HL*) were obtained for the Lipetsk Region, Belgorod Region, Kursk Region, and Tambov Region, i.e. for regions of the Central Chernozem macro-region.

We can conclude that during the analyzed period there have been significant changes in the location of the regions of the Central Federal District in the Moran’s diagram, i.e. the relationship between climate and the economy in these regions is in a dynamic state.

**Figure 7 Spatial Moran’s scattering diagram for the regions of the Southern Federal District in 2000, 2010, 2021**





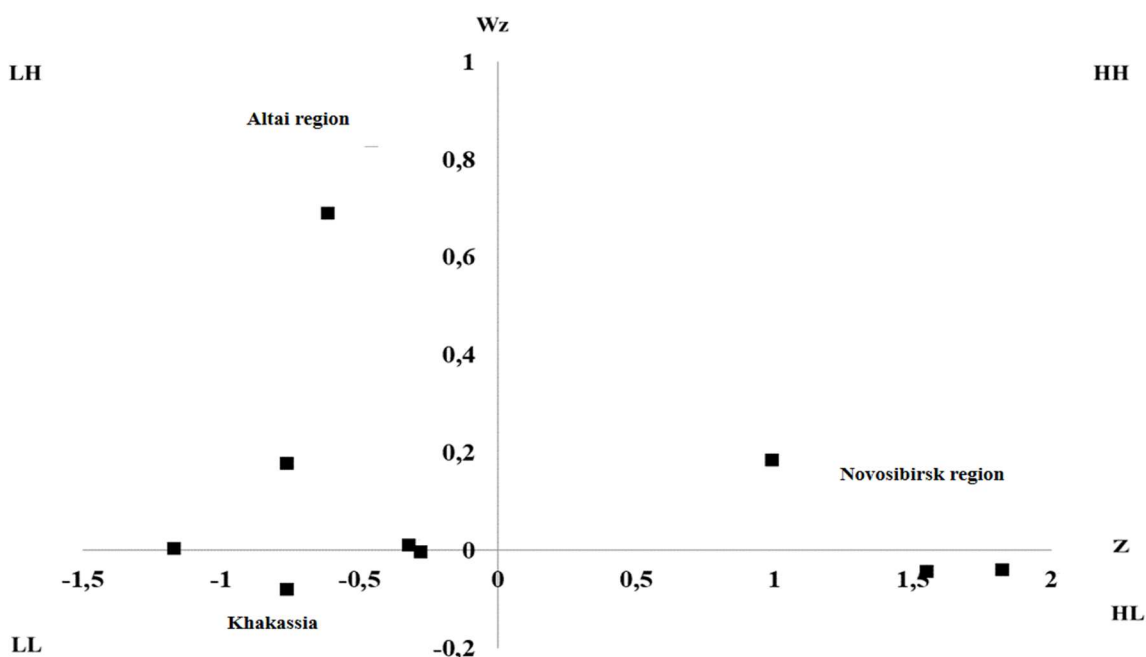
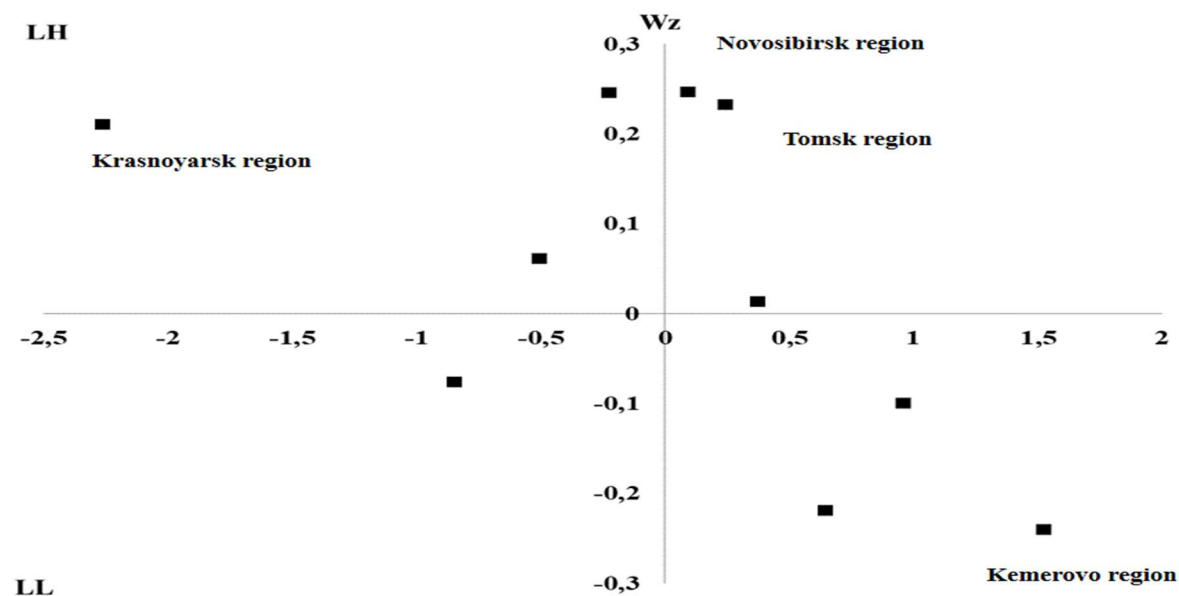
Calculated based on data from the Federal State Statistics Service URL: <http://www.pogodaiklimat.ru/history.php> (date of application 22.02.2025) and the portal «Weather and Climate» URL: <http://www.pogodaiklimat.ru> (date of application 22.02.2025)

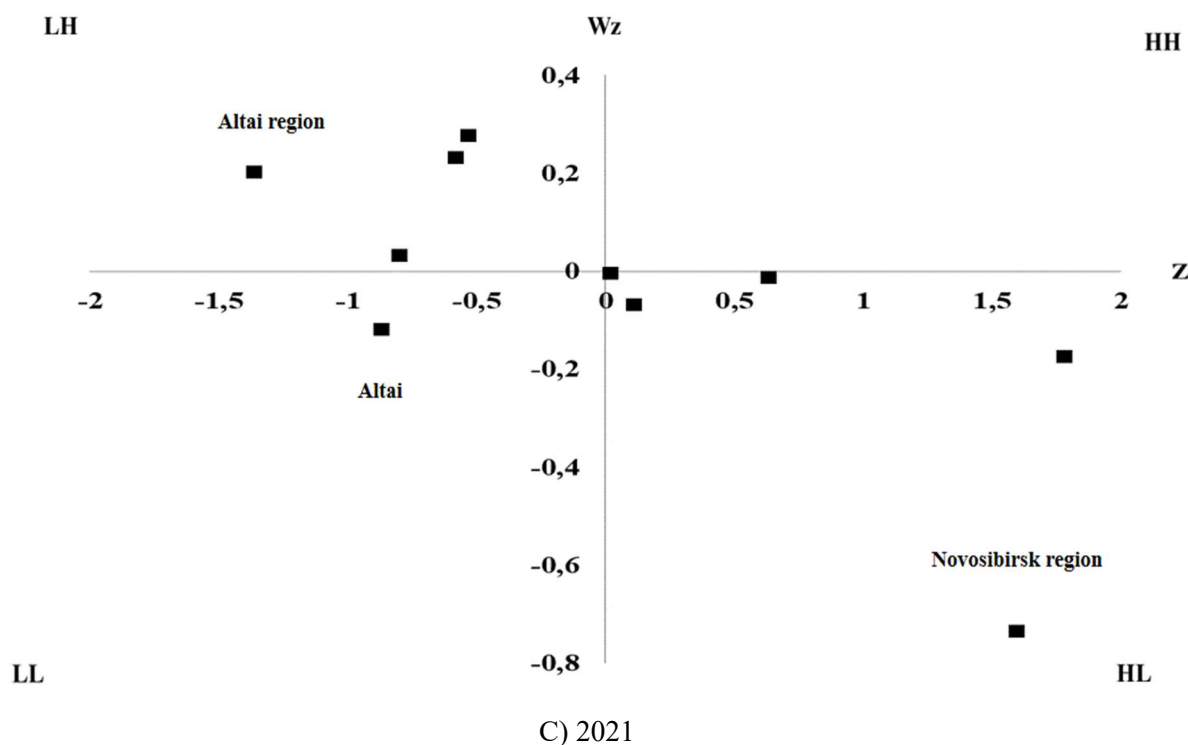
For the regions of the Southern Federal District, the mathematical expectation of the global Moran's index is (-0.2), the global Moran's index for data from 2000 is (-0,13), 2010 is (0,03), 2021 is (0,13), i.e. there is a direct relationship. Most regions do not show significant local spatial correlation, which indicates a limited spatial relationship between territories.

The data presented in figures 7A and 7B demonstrate a stable situation according to the analyzed criterion in the Southern Federal District; Adygea, Krasnodar Territory and Rostov Region are isolated from the rest of the sample.

The strongest direct spatial relationship is observed in the Republic of Adygea and the Krasnodar Territory (2000, *LISA* 0.19; 2010 *LISA* 0.12), Rostov and Astrakhan regions (2021, *LISA* 0.022). These connected regions, which demonstrate a relatively higher level of coordination, tend to be characterized by economic growth and advantageous geographical location.

**Figure 8 Spatial Moran’s scattering diagram for the regions of the Siberian Federal District in 2000, 2010, 2021**





Calculated based on data from the Federal State Statistics Service URL:

<http://www.pogodaiklimat.ru/history.php> (date of application 22.02.2025 г.) and the portal «Weather and Climate» URL: <http://www.pogodaiklimat.ru> (date of application 22.02.2025)

The mathematical expectation of the global Moran's index (-0.1) was calculated for the regions of the Siberian Federal District, in 2000 the global Moran's index was (-0,1), in 2010 – (-0.08), in 2021 – (-0.19). There was direct communication in the regions of the Siberian Federal District in 2000, 2010, and feedback in 2021. According to the data presented in figure 8, we can conclude that during the analyzed period, the regions of the Siberian Federal District have been moving in the Moran's diagram, and dynamic processes are taking place in the adaptation of the economy and climate in the surveyed regions.

In 2000 (figure 8A), the regions were scattered relatively evenly, while the western regions of the federal district, Novosibirsk and Tomsk Regions, were isolated from the rest of the group. In 2010, there was only one region in the *HH* square, the Novosibirsk Region, while the maximum positive *LISA* values were obtained in relation to the Kemerovo Region (0.05) and the Altai Republic (0.04).

In 2021 (figure 8C), there are no regions in the *HH* square, while their greatest concentration is observed in the *HL* square. High positive *LISA* values were obtained for a) Tomsk Region and Altai Territory (0.01); b) Altai Territory and the Altai Republic (0.03); c) Novosibirsk Region and the Republic of Tuva (0,01).

## **5. Conclusion**

The analysis of theoretical provisions on the problems of climate influence on economic development has allowed to establish the absence of a methodological approach for innovative consideration of adaptation of regional economic growth to climate change. According to the results of the assessment of the dynamics of adaptation of economic growth to climate change in the regions of Russia, spatial heterogeneity has been revealed. The indicators of the coefficient of adaptation in the southern regions and parts of the regions of central Russia are significantly higher, which indicates a more coordinated development in these regions. Regions demonstrating a relatively higher level of adaptation to economic growth and climate change have a more differentiated economy and a favorable geographical location.

Climate change processes are more intense in the Siberian Federal District, and the structure of the economy is less differentiated compared to central Russia, therefore, regional authorities should develop more effective measures to mitigate climate change in the context of further

economic growth. Most regions of the Southern Federal District do not demonstrate significant local spatial correlation in the «adaptation coefficient» indicator, which indicates a limited spatial dependence of the economic development of these regions. In the regions of the Siberian Federal District, there was a significant movement of regions in the Moran's diagram, which indicates the dynamic processes of adaptation of the economy and climate in the regions of this federal district. On a regional and national scale, a policy framework is needed to mitigate climate risks for the regional economy.

Achieving a synergistic interaction between climate and economic development is crucial for ensuring sustainability at the local and global levels.

The identified spatial and temporal patterns of adaptation of economic growth to climate change indicate the urgent need to fully take into account regional imbalances in the development of national policies.

Mitigation strategies applied for each region should correspond not only to its economic level, but also to specific climatic characteristics.

It is important that pilot projects aimed at mitigating the effects of climate change cover regions with different economic levels in many climatic zones. The results obtained have practical significance and can be used to develop and implement climate risk management policies, including cost-benefit assessment of adaptation and mitigation actions, and analysis of the economic costs of climate change impacts under various strategic scenarios. The presented methodology has the potential for further research, and it is planned to modify it to analyze the links between climate change processes and the economic dynamics of individual industries in the regions of Russia.

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## THE IMPACT OF FINANCIAL EXPOSURE ON STUDENTS' FINANCIAL LITERACY: EVIDENCE FROM THE UNIVERSITY OF GJIROKASTRA

### **Dorjana NANO**

Ph.D. Doc. York University, School of Continuing Studies, Toronto, Canada  
nano.dori0810@gmail.com

### **Antoneta POLO**

Assoc.Prof., "Eqrem Çabej" University, Gjirokastra, Albania  
neta\_polo@yahoo.com

### **Enkela CACA**

Assoc. Prof., "Eqrem Çabej" University, Gjirokastra, Albania  
ebabaramo@yahoo.com

### **Iirjana ZYBERI**

Assoc. Prof., "Eqrem Çabej" University, Gjirokastra, Albania  
izyberi@yahoo.com

### **Christos AP. LADIAS**

Professor, Regional Science Inquiry Journal, Greece  
Ladias@rsijournal.eu

### **Abstract**

Financial literacy shapes how individuals manage money and respond to economic challenges. Research has shown that students with greater financial exposure tend to make better financial decisions. This study examines the impact of financial exposure on financial literacy using survey data from 100 students at the University of Gjirokastra, Albania. A Financial Exposure Index (FEI) was constructed to measure engagement with financial environments, including income, work experience, and sources of financial learning. Linear and logistic regression analyses were conducted. Results show that financial exposure has a strong impact on financial literacy. The linear model explains nearly half of the variation in literacy scores, while logistic regression indicates that higher exposure significantly increases the likelihood of achieving adequate literacy ( $\geq 70\%$ ). Gender and regional background also influence outcomes, though age and marital status are less significant. These findings underscore the importance of practical financial experiences and local context in shaping financial literacy.

**Keywords:** Financial Literacy, Financial Exposure, University Students, Logistic Regression, Human Capital

**JEL classification:** A22, G53, D14, I22, C83  
pp. 57-62

### **1. Introduction**

Financial literacy is a critical skill that allows individuals to make informed financial decisions. University students face financial challenges such as managing limited resources, student loans, part-time income, and planning for their future careers.

Policymakers and researchers increasingly emphasize financial literacy as key to economic well-being. Higher financial literacy is associated with better savings, debt management, retirement planning, and resilience to financial shocks (Lusardi & Mitchell, 2014). However, many young adults, including Albanian students, still show low literacy levels.

Albania, as a transition economy, provides a unique setting where formal financial education is limited, and learning often occurs through experience. This study investigates the impact of financial exposure—students' interactions with financial activities and learning opportunities—on financial literacy outcomes.

## **2. Literature Review**

Financial literacy is a multidimensional concept that encompasses not only financial knowledge but also skills, attitudes, and behaviors that enable individuals to make sound and informed financial decisions. Early research in this field primarily emphasized basic numerical abilities, budgeting skills, and understanding of interest rates and inflation. However, more recent literature conceptualizes financial literacy as a form of human capital that develops dynamically over time through formal education, work experience, and continuous engagement with financial markets and institutions (Lusardi & Mitchell, 2014).

A substantial body of empirical evidence demonstrates that higher levels of financial literacy are positively associated with improved financial outcomes. Individuals with greater financial knowledge are more likely to participate in stock and investment markets, accumulate wealth, and diversify their financial portfolios (Van Rooij et al., 2011; Behrman et al., 2012). Moreover, financial literacy has been shown to influence long-term economic behavior, including retirement planning, savings decisions, and risk management. These findings underscore the role of financial literacy as a key determinant of economic well-being across different demographic groups.

The literature also highlights several socio-demographic factors that influence financial literacy levels. Age, gender, income, marital status, educational background, and work experience are consistently identified as significant determinants. Numerous studies report that women tend to score lower on financial literacy measures than men, a gap often attributed to differences in financial socialization, labor market participation, and access to financial decision-making opportunities. Importantly, higher levels of financial exposure—such as employment experience, income generation, and frequent use of financial products—are strongly linked to improved financial literacy, emphasizing the importance of experiential learning alongside formal education.

In the Albanian context, research on financial literacy remains relatively limited but has produced consistent findings. Studies indicate that university students enrolled in economics and business-related programs demonstrate higher financial literacy levels compared to their peers in other academic disciplines (Nano & Cani, 2013; Nano & Polo, 2016). Nevertheless, overall financial literacy among young adults in Albania remains modest. Despite increased access to financial information through digital platforms and financial institutions, significant literacy gaps persist, largely due to the absence of structured financial education in school curricula and a strong reliance on informal learning channels such as family and peer networks (Nano, 2013; Agalliu, 2014).

Beyond the student population, broader empirical studies in Albania further confirm the importance of financial literacy for economic decision-making across various sectors. Research focusing on agriculture, small enterprises, and rural households demonstrates that financially literate individuals are better equipped to manage income volatility, access credit, and adopt sustainable economic practices (Mullaymeri & Gjoni, 2025; Shehi et al., 2025). These findings reinforce the argument that financial literacy is not only an individual asset but also a critical factor for broader economic development in transition economies.

More recent contributions to the literature emphasize the importance of *financial exposure* as a composite construct capturing individuals' cumulative financial experiences. Rather than relying solely on single indicators such as income or employment status, composite measures incorporating work experience, income sources, and learning opportunities provide greater explanatory power and help reduce measurement bias, particularly in studies with relatively small samples. Building on this emerging approach, the present study constructs a Financial Exposure Index (FEI) to quantify students' overall exposure to financial activities and learning environments. By doing so, the study aims to provide a more comprehensive understanding of how experiential factors shape financial literacy outcomes among university students in Albania.

### **3. Methodology**

#### **3.1 Data and Sample**

Primary survey data were collected during the 2025–2026 academic year from 100 undergraduate and postgraduate students at the University of Gjirokastra. The similar environment of the university makes it easier to observe the impact of financial exposure on students. The sample includes students from various fields, ages, and genders.

#### **3.2 Measurement of Financial Literacy**

Financial literacy (FL) is measured as a standardized percentage score, combining three components: financial knowledge, financial behavior, and financial attitude. In our sample, the average score is 67.8%, with a standard deviation of 11.2%, ranging from a minimum of 44% to a maximum of 90%. These figures indicate moderate overall literacy while also showing considerable variation across students, highlighting the need to examine both continuous scores and competency thresholds.

A binary variable HighFL indicates whether a student achieves adequate literacy:

$$HighFL_i = \begin{cases} 1 & \text{if } FL_i \geq 70\% \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

This allows analysis both as a continuous score (linear regression) and as a probability of competency (logistic regression).

#### **3.3 Financial Exposure Index (FEI)**

The Financial Exposure Index (FEI) measures cumulative interaction with financial environments:

$$FEI_i = z(\text{Income}_i) + z(\text{Work Experience}_i) + z(\text{Sources of Financial Learning}_i) \quad (2)$$

Standardization reduces multicollinearity and provides a single metric summarizing multiple exposure channels. Higher FEI indicates greater engagement with financial activities, which prior studies link to higher literacy (Van Rooij et al., 2011; Behrman et al., 2012).

#### **3.4 Analytical Strategy**

Two complementary models are used:

##### **1. Linear regression for continuous literacy scores:**

$$FL_i = \beta_0 + \beta_1 FEI_i + \beta_2 Gender_i + \beta_3 Municipality_i + Z_i' \gamma + \varepsilon_i \quad (3)$$

##### **2. Logistic regression for the probability of achieving adequate literacy:**

$$P(HighFL_i = 1) = \Lambda(\beta_0 + \beta_1 FEI_i + \beta_2 Gender_i + \beta_3 Municipality_i) \quad (4)$$

Robust standard errors are applied in both models to account for heteroskedasticity. This approach captures both effect size and practical likelihood of achieving competency.

### **4. Results**

#### **4.1 Descriptive Statistics**

Table 1 below presents the key variables. The average FL score is 67.8%, with 48% of students below the 70% threshold for adequate literacy. The FEI ranges from –2.1 to 3.5, reflecting differences in income, work experience, and learning opportunities. Higher FEI is clearly associated with higher literacy, highlighting the importance of cumulative financial exposure.

**Table 1. Descriptive Statistics of Key Variables (N = 100)**

Variable	Mean	Std. Dev.	Min	Max	Description
Financial Literacy Score (%)	67.8	11.2	44	90	Standardized Score Combining Knowledge, Behavior, Attitude
High Financial Literacy ( $\geq 70\%$ )	0.52	0.50	0	1	Binary Indicator of Adequate Literacy
Financial Exposure Index (FEI)	0.00	1.00	-2.1	3.5	Composite Index (Income, Work Experience, Learning)

Source: Author's calculations

## 4.2 Linear Regression Results

FEI is the strongest predictor of FL. A one-standard-deviation increase in FEI raises literacy scores by 6.74 points ( $p < 0.001$ ). Gender and municipality are significant: males score 3.29 points lower, while students from certain municipalities score 2.61 points higher. Age is positive but not statistically significant.

Table 2. Linear Regression Results

Variable	Coefficient	Robust Se	T	P-Value
Constant	61.38	4.92	12.48	0.000
FEI	6.74	0.88	7.66	0.000
Gender (Male = 1)	-3.29	1.46	-2.25	0.027
Municipality	2.61	0.84	3.11	0.002
Age	0.94	0.72	1.31	0.194

Source: Author's calculations

**Model fit:** Observations = 100,  $R^2 = 0.49$ , Adjusted  $R^2 = 0.46$ ,  $F = 18.9$  ( $p < 0.001$ ), Mean VIF = 1.38

Including FEI improves explanatory power by over 20 percentage points compared to demographic variables alone.

## 4.3 Logistic Regression Results

FEI nearly triples the odds of achieving adequate literacy ( $OR = 2.91$ ,  $p < 0.001$ ). Male students have 1.74 times higher odds, and municipality remains significant, emphasizing local context.

Table 3. Logistic Regression Results

Variable	Odds Ratio	Robust Se	P-Value
FEI	2.91	0.63	0.000
Gender (Male)	1.74	0.41	0.032
Municipality	1.46	0.21	0.004

Source: Author's calculations

**Model fit:** Pseudo  $R^2 = 0.38$ , Wald  $\chi^2 = 41.6$  ( $p < 0.001$ )

## 5. Discussion and Conclusion

The findings of this study demonstrate that financial exposure has a great impact on financial literacy among university students. Students with higher Financial Exposure Index (FEI) scores not only achieve higher financial literacy scores but are also significantly more likely to meet the competency threshold of 70%. While gender and regional background influence outcomes—male students tend to score slightly lower, and students from certain municipalities perform better—other factors such as age and marital status appear to have a smaller impact within this sample.

These results underscore the importance of practical engagement with financial environments, suggesting that exposure through income-generating activities, work experience,

and diverse sources of financial learning has a tangible effect on students' ability to manage their finances effectively.

The strong effect of FEI also highlights that cumulative exposure matters more than isolated demographic or educational factors. Students who regularly interact with financial systems and learning opportunities develop a better understanding of financial concepts, which may not be acquired through formal classroom instruction alone. In the context of Albania, where formal financial education is limited, providing students with hands-on experiences and real-life financial engagement can bridge gaps in knowledge and foster competence in financial decision-making.

Overall, these findings indicate that policies and educational programs should prioritize opportunities for students to gain practical financial exposure, as this approach can significantly improve both individual literacy levels and broader economic resilience.

## **6. Recommendations and Limitations**

To improve financial literacy among university students, educational institutions and policymakers should focus on strategies that increase practical exposure to financial activities. Universities can integrate financial simulations, internships, and real-life money management exercises into the curriculum to allow students to apply theoretical knowledge in realistic contexts. Programs targeting gender gaps and regional disparities are also essential, providing additional guidance and support for students who may have fewer opportunities for financial engagement. Beyond formal instruction, informal learning through peer mentoring, family discussions, or student-led financial clubs can reinforce knowledge and foster practical skills. Collaborations with local banks, NGOs, or community organizations to provide workshops on budgeting, investing, and decision-making can further enhance students' exposure. Additionally, leveraging digital tools, including financial apps and online simulations, can expand opportunities for engagement beyond the classroom.

Despite these insights, several limitations should be acknowledged. The study is based on a sample of 100 students, which may limit the generalizability of results to other universities or the broader population of Albanian students. The cross-sectional design captures only a single point in time, making it difficult to establish definitive causal relationships between financial exposure and literacy. Financial knowledge, behavior, and attitudes were self-reported, which may introduce bias or overestimation of competencies. While the FEI captures key aspects of financial exposure, it may omit other influential factors such as digital financial literacy, peer influence, or participation in informal economic activities. Lastly, the results may reflect context-specific characteristics of the University of Gjirokastra, including local economic conditions and institutional support, which could differ in other settings.

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## EVOLVING REGIONS IN EUROPE: APPLICATION OF SPATIAL MODELS TO THE VARIOUS FORMS OF THE EUROPEAN SPATIAL CONCENTRATIONS

**Luigi CAPOANI**

Adjunct professor at the Department of Economics, Ca' Foscari University of Venice  
luigi.capoani@unive.it

**Csaba LAKÓCAI**

Research fellow at ELTE Centre for Economic and Regional Studies, Institute of World Economics  
lakocai.csaba@krtk.elte.hu

### **Abstract**

The “Blue Banana”, spanning from the United Kingdom to Italy, has been symbolizing economic vitality in Europe. This paper reassesses its contemporary relevance by analyzing economic indicators and regional dynamics, particularly in Eastern and Mediterranean Europe, within the NUTS 2 framework. Leveraging Stewart’s concept of demographic energy and Moran’s spatial statistics, it introduces a robust methodology interweaving territorial and economic dynamics. By examining data layers, this study provides novel insights into the Blue Banana’s significance and its economic impact on Europe during the late 2010s and early 2020s. Furthermore, it illuminates the core area’s interconnections with adjacent economic zones and the emergence of prospective alternative spatial paradigms. The findings indicate that the majority of the Blue Banana regions have remained part of the prominent core area of Europe in terms of the most conventional regional economic indicators. However, emerging alternative spatial concentrations and a partial eastward shift are also visible.

**Keywords:** Blue Banana, Mediterranean Europe, Eastern Europe, spatial development, productivity

**JEL classification:** C1, N1, N9, R1, Y1  
pp. 63-78

### **1. Introduction**

This study adopts an interdisciplinary approach to re-evaluate the Blue Banana paradigm, aiming to shed new light on evolving economic spatial concentrations in Europe through the combined application of spatial statistics and principles derived from demographic physics. The paper is structured into three parts. The first section provides the foundational context. It aims to highlight the key steps that led to the formation of the Blue Banana concept, while offering an overview of the economic and political situation of two specific European macro-regions: Eastern Europe (formerly the “Eastern Bloc”) and the regions bordering the Mediterranean Sea. The paper will illustrate a map detailing regional economic growth potential, serving as a tool for assessing economic disparities at the European NUTS 2 level, with a particular focus on the Blue Banana regions.

Correspondingly, the article will also address the main hindrances to the economic performance of these regions, specifically Eastern Europe, which has struggled to realize its potential, and the Mediterranean region, which has experienced a relative decline. The second section outlines the key statistical foundations of spatial analysis, focusing on the application of physics-based models in economics. Consequently, the Gravity Model will be employed to study the patterns of population movement and distribution within the aforementioned regions. Special attention is given to the movements within highly urbanized areas such as the Blue Banana, referencing previous studies that helped define its geographic shape (see Figure 1). This descriptive spatial analysis highlights the methodological innovation of using a rich, comprehensive, and updated dataset, as well as a comparative approach incorporating complementary spatial analysis techniques, such as Moran’s I spatial statistics and the Gravity Model. The study examines how spatial concentration and heterogeneity influence economic

and demographic dynamics, focusing on agglomeration economies, spatial autocorrelation, and clustering effects. The third and final section discusses the results derived from applying the Gravity Model to the Gross Domestic Product (GDP) and population data across European regions. The goal is to identify Europe's economic backbones, regions characterized by exceptional productivity, urbanization and industrialization.

## **2. Evolving Regions in Europe: a theoretical background**

### **2.1 The Blue Banana: Origins, Evolution and Role in European Spatial Economy**

The Blue Banana, a highly industrialized and densely populated region in Europe, has consistently outperformed other regions of Western Europe. Throughout the late 20th century, it has exhibited substantially higher per capita income, lower unemployment rates, more robust industrial clusters and superior infrastructure in telecommunications and transportation (Van Dinteren & Meuwissen, 1994). Moreover, the Blue Banana is recognized as a vibrant hub for cultural and educational activities, including conferences, universities and cultural events, which further highlights its attractiveness. Thanks to its large population and capacity to host innovative projects, the Blue Banana possesses a diverse and flexible economic and institutional framework. Many researchers have investigated the factors contributing to the region's emergence as an economic powerhouse, highlighting the role of dynamic externalities, innovation, and the tertiarization of traditional manufacturing industries. As a result, the Blue Banana is expected to maintain its growth leadership, particularly in specialized services such as transportation, communications, repair and leisure.

To understand the Blue Banana's historical development, it is essential to highlight several key elements. Roger Brunet is recognized as the founder of GIP RECLUS, a network of research groups that has produced important analyses of spatial dynamics, particularly investigations related to the Blue Banana. Following a 1987 study conducted by the Interministerial Delegation of Land Planning and Regional Attractiveness (DATAR), Brunet and his team of geographers were commissioned in 1989 to identify the "European Backbone". This term referred to a high concentration of cities and populations with considerable historical significance across the European continent. The GIP RECLUS also examined the issue of Paris's strong historical centralization and the potential eastwards shift of Europe's economic and political center (Taylor, 2015). Indeed, Brunet originally excluded Paris from the Blue Banana concept, albeit reintroducing it in later versions. The centralization critique echoed Jean-F. Gravier's 1947 publication, *Paris and the French Desert*, which scrutinized France's overreliance on its capital and the resulting resource imbalance. Brunet advocated for substantial infrastructure investment, combining economic, political, and geographical factors, to link the Paris-Lyon-Marseille axis with the Blue Banana region. This spatial configuration is visually represented in Figure 1.

**Figure 1: The Blue Banana in transition: Challenges in the Maritime-Land Interface**

Source: Notteboom & Rodrigue (2006)

In the 1990s, the term 'Blue Banana' evolved in both usage and interpretation. While the core idea of a densely urbanised and economically significant corridor still persisted, the geographical boundaries became more flexible, as it encompassed a larger part of Western and Central Europe. As a result, the concept began to denote a more general concentration of economic activity and population density across these regions. This broader scope acknowledged that the economic strength and interconnectivity of the Blue Banana extended beyond the specific cities and regions originally identified by Brunet. An alternative vision, the "European Bunch of Grapes", was proposed by Klaus Kunzmann and Michael Wegener in a background study for the European Commission's "Europe 2000" communication. However, their juxtaposition with Brunet's work is problematic for two reasons. First, Brunet used France as his frame of reference and argued that his Dorsale rarely intersected French territory, despite Kunzmann and Wegener's portrayal. Therefore, rather than making a statement about the future development of Europe, it was an attack on Paris's hegemonic status. Second, Brunet crucially depicted the Dorsale as a polycentric urban network, characteristics that Kunzmann and Wegener attributed to their own model. Thus, both ideas have the same implications for the development of Europe. Similarly to the Bunch of Grapes, the Dorsale honours the Rhineland's specific network for serving as the foundation for its prosperity, reflecting the importance of urban networks in general. It could be argued that Brunet would have advocated polycentric development, much like Kunzmann and Wegener, had he sought to issue continent-wide policy recommendations (Faludi, 2015).

The Blue Banana has become a central component of Europe's economic core and has even generated its own 'banana speech acts'. These acts, introduced by Michael M. Loriaux (2008) in his study of Rhineland, are said to produce geographical divides that will eventually become borders, ultimately creating new axes of prosperity. Using Loriaux's argument, Faludi (2015) examined the theoretical underpinnings of geometrical forms used to categorise European geography. Indeed, Taylor and Hoyler (2000) developed a typology based on a main components analysis of the locations of 46 global Advanced Producer Services (APS) firms, identifying 53 European cities. This typology, structured around similarities in service firm presence, outlined a particular spatial order with three components measuring outer regions: a "Far East" (the former Soviet bloc), a "Far West" (the British Isles), and a triangular grouping of north, south-east, and south-west. Two separate components distinguish between major and minor "spine" cities. This spatial logic aligns with earlier representations of European urban distribution, though Taylor and Hoyler's methodology added theoretical rigor through multivariate analysis. Further evidence (Amin & Thrift, 1995; Heidenreich, 1998; Puga, 2002) identifies a central European core characterised by a substantially higher GDP per capita and lower unemployment compared to peripheral areas. For example, East Flanders (Belgium) and Zeeland (The Netherlands) exemplify this dynamic. Particularly, Puga (2002) affirms that it is

scarcely surprising that, at equilibrium, the centre has a bigger manufacturing sector than the periphery. The intriguing discovery is that the core's industry share is higher than the endowment shares for limited positive trade costs. As a result, the core is a net exporter of manufactured goods. We refer to this as the 'home market' or 'market access' effect. Moreover, the industry proportion of each location varies non-monotonically with trade costs. The concept is best understood by picturing a scenario where trade costs between the two locations are gradually reduced from prohibitively expensive to zero. Due to high trade expenses, businesses sell mostly, but not exclusively, in their local market due to high trade expenses. If one region were to have a lot more businesses relative to its market size than the other, the increased competitiveness or crowdedness of that market would lead to the closure of some local businesses, thereby lessening disparities in industry sizes. Because of this, the proportion of industry to endowments in each region is nearly equal. While economic integration mitigates the impact of more local competitors on each firm's market share by increasing each company's sales share in the other region. However, rising returns suggest that companies manufacturing in the core generate higher profits due to increased sales. The scale of the industry in the core surpasses its proportion of global endowments if further businesses enter in reaction to those profits. Consequently, the asymmetry and disparities among various territories, particularly in access to significant waterways within political unions, necessitate increased resilience in resource and security management. The direction of economic activity is influenced by the growth of powerful economies, leading to disparities in trade routes and patterns. Such factors deepen existing inequalities and pose stability challenges. Historically, some regions acted as buffers against geopolitical shocks from neighbouring areas.

However, the evolving conceptualization of the Blue Banana attracted criticism. It was viewed by some as promoting competition among EU Member States rather than genuine European collaboration, rendering it inappropriate for the European integration process (Kunzmann & Wegener, 1991). Furthermore, broader economic transformations, including the rise of capitalism and other variables like the social and cultural assimilation to Western globalization, or the adaptation of re-distributive measures to tackle poverty and unemployment, can ultimately result in escalating inequalities in post-communist nations.

## **2.2 Eastern Bloc and Mediterranean Macro-Regions: Challenges and Transformations**

As noted by Netrdová and Nosek (2016), the historical border of the Eastern Bloc has exerted a lasting impact, delaying changes in spatial economic patterns. As a result, since 1989, Central and Eastern Europe have experienced persistent disparities in income and wages. Even if gender gaps have narrowed, inequalities related to age, education, geography and health persist. Umiński and Nazarczuk (2021) observed that globalization has further exacerbated pre-existing disparities, exposing significant gaps in competitiveness within EU regions. Indeed, the most competitive regions host the most vibrant and productive businesses, gaining the most from operating in an open economy. EU membership has brought tangible advantages to several Eastern European countries, including financial support, access to the Single Market, infrastructure development, and trade expansion. It has also encouraged economic reforms that have raised national standards. Cities like Tallinn and Bucharest have emerged as hubs of technological innovation and entrepreneurship, particularly due to the numerous start-ups and companies headquartered there.

Capasso and Ferragina (2019) noted that the Mediterranean has historically served as a buffer zone, absorbing geopolitical shocks for the wider European system. However, instability in neighbouring regions in Africa and the Middle East increasingly challenges this buffering role, threatening both affluent Northern and less prosperous Southern shores, underlining the region's complexity.

Environmental constraints, socioeconomic disparities, and institutional inadequacies exacerbate these pressures, fuelling political weakness and migration pressures. In response to this, the 1995 Barcelona Declaration launched the Euro-Mediterranean Partnership (Euro-Med), promoting dialogue, cooperation and shared prosperity. The Barcelona Process's agenda was built around several shared values, including the promotion of democracy, good governance, human rights and the achievement of mutually beneficial trading conditions for the

partners in the region. In contrast, Sarkozy's proposal for a Mediterranean Union sought to deepen regional integration, but encountered resistance from the European Commission, leading to adjustments. Sarkozy had argued that the Mediterranean Union should be modeled after the European Union, featuring a shared judicial space and a common institutional framework. As a compromise, the Union for the Mediterranean was envisioned as a new phase of the Euro-Mediterranean partnership, ultimately accepting and maintaining the *acquis communautaire* of the Barcelona Process. The proposal was met with resistance from the European Commission, which believed that regional cooperation should adhere to existing EU structures. Concerns were also raised regarding the use of EU funds for a project involving only some member states, potentially undermining unity. Consequently, adjustments were made to include all EU members and integrate the initiative into the Barcelona Process. This shift led to the abandonment of plans for shared institutions and a Mediterranean Investment Authority resembling the European Investment Bank. Moreover, the Mediterranean region is particularly susceptible to climate change, which threatens both gradual environmental degradation and sudden catastrophes. Accordingly, environmentally driven migration is expected to rise, placing additional pressure on Europe's socio-economy.

The four cooperation chapters developed under the Barcelona Process - Political and Security, Economy and Trade, Socio-cultural, and Justice and Home Affairs - remain relevant. Supplementary programs have also been introduced, addressing issues like marine pollution, maritime governance and alternative energy. Currently, the progress of this project appears to be halted by various issues: conflict in North Africa, the ongoing Arab-Israeli conflict, political fragmentation among Mediterranean countries, and opposition from certain member states.

### **3. A Spatial Research: Understanding the Gravity Model and Moran's I**

Spatial research, particularly the study of spatial concentration, examines the tendency of human activities and populations to aggregate within specific geographic areas. Such clustering, observed across both urban and rural contexts, has profound implications for various aspects of societal organization, from economic development to environmental sustainability. Before delving into Stewart's and Moran's empirical findings, it is important to mention additional relevant perspectives and methodological approaches that enrich our understanding of spatial concentration.

Rey and Smith (2013) study provides a comprehensive examination of spatial concentration, focusing on the interplay between demographic energy and spatial patterns. Through their analysis, they reveal how factors, such as population density and economic activity, contribute to the spatial distribution of resources and people. Their research underscores the role of agglomeration economies in urban development and highlights the significance of understanding spatial concentration dynamics for effective urban planning and policymaking.

In a complementary contribution, Panzera and Postiglione (2020) emphasize the importance of accounting for spatial heterogeneity and scale effects when analyzing concentration patterns and employing techniques, such as spatial autocorrelation and cluster analysis.

Consequently, it is important to contextualize the present analysis within the broader framework of demographic gravity, as originally proposed by physicist John Stewart in 1941.

Stewart's (1941) groundbreaking work applied physical laws to social sciences, demonstrating that demographic events can be effectively captured using gravitational principles. He discovered that large population centers – for instance major cities - act as attractors, drawing individuals towards them. The concept, known as “demographic gravity”, is encapsulated in the formula:

$$F_{ij} = k \left( \frac{P_i P_j}{D_{ij}^2} \right) \quad (1)$$

where  $F$  is the interaction force between the demographic centres  $i$  and  $j$ ,  $k$  is a constant,  $P_j$  is the population of area  $j$  and  $D$  is the distance between  $i$  and  $j$ .

This formula illustrates how the force of interaction between two regions is influenced by the size of their populations and is inversely proportional to the square of the distance between them.

In order to obtain a more refined estimate of the interaction force  $F$ , Stewart suggested using different population estimates for each country, accounting for the "molecular weight" of each

group's members (1948, p. 34). The rationale is that this conceptual “molecular weight” would naturally vary across different demographic groups. Such differences could meaningfully influence calculations when computing the demographic gravity, and as such, it should be incorporated into the model. The author suggested the measurements for the sake of simplicity by resorting to using the molecular mass of the average American as a unit, bearing in mind that this would carry significantly more mass than one of an Australian Aboriginal, which is in turn expected to be below one. From a methodological standpoint, this refinement involves replacing absolute population counts with weighted ones. By ascribing a differential coefficient based on the origins and development status, it is possible to better capture the attractivity exerted by different economies on neighbouring countries. Therefore, different weights are assigned to population size, multiplied by the number of inhabitants and then standardized: a value of 1 is assigned to an American citizen, a value less than 1 for less developed countries, and a value greater than 1 for more developed countries (relative to the United States). The theory evolved significantly with Stewart's (1948) concept of demographic energy and population potential. One way to interpret a location's population potential is as a measure of how proximally people are distributed around it. In his calculations, Stewart took into account that each person's contribution to potential diminishes with increasing distance from the point in question.

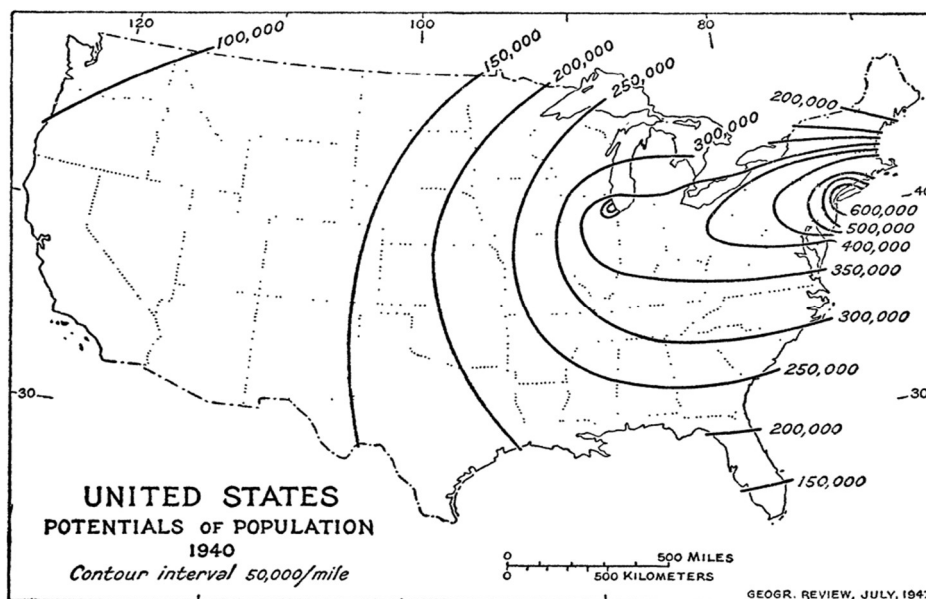
Population density tends to rise progressively, as one moves from rural areas toward a major metropolitan centre. As one approaches the city boundary, the incline gets steeper. In the case of a roughly spherical city, the potential continues to increase toward the centre. However, it is often in the neighbouring rural areas that population potential reaches significantly high values.

Stewart focused on the gravitational field's mutual energy as well as the magnetic field's intensity at a given population center. He proposed that the number of human connections per unit of time may be regarded as demographic energy. While offering broad generalisations, Stewart left room for new hypotheses and prospective developments. The astronomer showed in multiple studies how to apply the results of his calculation to map the surface, using a method called "contours of equipotential".

This framework resembles a ‘synoptic weather chart’, as shown in Stewart's Figure 2 below. Due to the resulting visual representation, it is safe to claim that the equipotential outline resembles a gravitational or magnetic field.

This theoretical structure is visually summarized in Stewart's original map, which illustrates the equipotential curves across the United States population landscape.

**Figure 2: “Demographic energy and potential of population”**



Source: Stewart, 1948, p.38

Delving into the intricate dynamics of spatial concentration, Moran's spatial statistics and the Gravity Model emerge as indispensable tools for this study. These are distinct spatial analysis techniques, each with specific applications for identifying spatial and regional clusters

of high concentration. Moran's I is useful to identify related regions that share high values of a given variable. However, its reliance on spatial contiguity makes it sensitive to the shape and configuration of the regions considered. On the other hand, the Gravity Model mitigates this limitation by incorporating potential values, which are not constrained by regional geometry. This approach allows a more flexible analysis of spatial flows and regional interactions. Nonetheless, it should be emphasized that the Gravity Model performs best when using absolute values of potential, while it is less effective at handling relative or proportional values, limiting its applicability in specific contexts. Together, these methods offer complementary perspectives, making them indispensable tools for spatial analysis when chosen based on the specific research objectives.

By employing these different spatial analysis techniques, we can construct both a comprehensive descriptive analysis for the year analyzed and a sophisticated, innovative lens for examining the complex interplay of factors shaping spatial concentration phenomena. In the pursuit of economic understanding and regional development, their integration unveils critical insights into the drivers of spatial agglomeration and its implications for broader economic dynamics. At its core, the Gravity Model posits that the interaction between two entities is directly proportional to their economic sizes (measured by GDP, population, or other relevant factors) and inversely proportional to the distance separating them.

It is important to mention, in this context, LeSage and Pace (2008), who proposed a new method based on "spatial weight structures that model dependence among the N Origin-Destination pairs in a fashion consistent with standard spatial autoregressive models" (LeSage, J.P., & Pace, R.K., 2008). Therefore, a "spatial econometric interaction model" is presented in order to directly capture spatial dependence in Origin-Destination flows (Dargel & Thomas-Agnan, 2023).

Stewart's model served as the direct inspiration for the economic model, which replicates its logic and dynamics but replaces a flow of people with a flow of commerce. The application to international trade was popularized by Tinbergen's (1962) standard bilateral form, which was directly related to Newton's Law of Universal Gravitation. Tinbergen was a professor of regional sciences at MIT University in the United States and his works were then revisited by numerous economists. Having borrowed the gravitational field equation from physics, Tinbergen constructed a theory to examine global trade, positing that commerce is favoured by geographic proximity in the form of reduced transaction costs: lower travel expenses, regional and cultural closeness, institutional resemblance and so on. Commerce between states is positively correlated with each state's economic size, as it is determined by its Gross Domestic Product (GDP) or Gross National Product (GNP). To calculate the equation in international economics, we report Isard's (1954, p.308) formula below:

$$iV = \sum_{j=1}^n \left( k \frac{Y_j}{d_{ij}^a} \right) \quad (2)$$

In the formula,  $iV$  is the income potential produced by all countries upon state  $i$ ,  $iV_j$  is the income potential produced by state  $j$  upon state  $i$ ,  $Y_j$  is the income of state or region  $j$ ,  $d_{ij}$  is the average effective distance between states  $i$  and  $j$ ,  $k$  is a constant comparable to the gravitational constant, and  $a$  is an exponent determined by observation, which is lower than the squared exponent by Stewart. Despite the potential simplicity of this operation, taking into account single areas of multiple different countries is beneficial. Any researcher approaching international economics should be aware that, in a world as globalized and interconnected as ours, excluding other countries could represent an oversimplification of the scheme, regardless of the actual distance. It is also useful to acknowledge that based on an economist's interests, which can range from general to specific, a market can also be subdivided into various markets. While the global market is generally considered as a unified space, from a purely methodological standpoint, it is still possible to isolate and analyze certain geoeconomic areas, an approach particularly valuable in assessing econophysics models.

For the sake of this analysis, which is focused on the Blue Banana area, it is therefore appropriate to restrict the field of inquiry to the European regional markets. According to Capoani *et al.* (2023), the gravitational force between states is assessed by summing the "point mass" inputs that make up the bodies. Similarly, when different masses are held apart, the vector integration of the component fields yields the gravity field. Analogously, to how a change in mass, even at the peripheral, influences the gravitational field of the entire universe in physics,

a variation in the market's commercial forces can influence the forces driving international trade. As economies grow increasingly interrelated, the dynamics of global trade will change consequently. The work of Isard (1954:308) and Carey (1858:42), who considered individuals as molecules within society, highlights the link between physics and social sciences. The advantage of considering gravitational forces in economics offers a precise answer to these issues. Thanks to the idea of superposition, composition, and decomposition of vector forces, it is possible to apply the same principles of trade attraction to both broad international markets and smaller regional economies. Even though the Eurozone is geographically compact, a single currency further reduces economic distance by simplifying transactions. Indeed, an insightful notion in econophysics is derived from the concept of “gravity barycenter”. In physics, it is the centre of mass where multiple objects gravitate around. Striking an analogy with physics, from an economic standpoint, it can be also individuated as a gravity barycentre, which is usually located closer to the more massive economy. Under this perspective, any market can be said to be functioning around a given centre of gravity: the barycentre where its primary trade routes intersect that emerges due to the convergence of multiple forces of attraction. Unlikely in physics, it is more useful in economics to understand the gravity barycentre as a more or less extensive economic area qualified by the interplay of strong economic forces that shape the market and influence all other regions, rather than as a mere single point in space.

Additional theoretical support for the idea of a commercial barycentre comes from the works of Pownall (1764), Pirenne (1936), Braudel (1949) and Persson (2010). Throughout history, numerous examples of economic gravity centers can be found in urbanized and industrialized regions. A few examples in this regard are the Mediterranean region (notably Italy during the Roman era); the urban quadrilateral of Venice, Milan, Genoa, and Florence during the 16th century; the region of Europe known as ‘the Blue-Banana’; or the most recent Northeast Megalopolis (also BosWos) in the USA. Grether and Mathys (2009) focused on big metropolitan regions to estimate an approximate global economic center of gravity.

Both Brinkhoff (2009) and Quah (2011) have provided information on global metropolitan areas. Quah observed a shift in the gravitational centre of the global economy, which typically corresponds to the concentration of global GDP. According to Balsa Barreiro et al. (2019), the center of gravity has shifted over the centuries up to today. However, in their study, they extended the analysis beyond GDP, also considering three additional variables - urban agglomerations, the general population, and CO2 emissions - to capture broader factors influencing the global landscape.

The Swedish economist Torsten Persson (1954) employed the Gravity Model to conduct a historical and economic analysis of Europe. Through his inquiry, he predicted a shift in the balance of power on the global stage from Europe to the Atlantic Area. The rationale for this geopolitical transition was explained through a strong connection between property ownership and economic power, a relationship that can be illustrated through the gravity model. Persson's results not only demonstrate the flexibility of the econophysics conceptual framework, but also the surprising accuracy of a model grounded in intuitions as fundamental as those of Newtonian Physics. Using gravitational forces of attraction as an analogy, Persson explains how larger economies tend to generate greater international trade flows - the “pulling force” - with geographically closer economies. As distance from the gravitational center increases, the intensity of the pulling force diminishes. It is important to remark, however, that in the long run, international trade itself tends to close the gap between neighbouring economies by lowering the perceived distance: through the spread of common languages, commercial laws, culture, preferences, and technology promoted by stable trade relations, the transaction costs are lowered even when physical distances remain unchanged. An earlier inquiry into similar phenomena was conducted in the context of the British Empire in the 18th century by Pownall (see Cazzola, 2018, pp. 178-201).

Moreover, Persson explicitly addressed the impact of economic distances and the centrality of trade in the European Union's integration process. He claimed that nations or unions, like the EU, can deliberately trigger border effects through *ad-hoc* economic policies or via the adoption of common currencies, thereby reshaping trade flows. Persson is referring to the phenomenon of ‘economic regionalism’: the creation of economic or political agreements among geographically proximate nations. Such interactions, common in international economics, enhance efficiency and productivity through economies of scale, cooperation and

mutual interdependence. The most relevant types of economic regionalism are Preferential Trade Agreements (PTAs), where countries reduce tariffs among themselves but not for the rest of the world. Under World Trade Organization (WTO) rules, such discriminatory practices are generally not allowed due to the Most Favored Nation (MFN) principle, which mandates equal treatment among trading partners. However, exceptions exist, notably in the case of Custom Unions (like the EU) and Free Trade Areas (FTAs), where internal tariffs are abolished. It is important to acknowledge that, when inquiring about the overall impact on national welfare, PTAs are “two-faced” (Bhagwati & Panagariya, 1996), since they increase welfare by creating trade (e.g. when high-cost domestic production is replaced by low-cost imports from other members) but might decrease welfare when trade is diverted (e.g. when low-cost imports from non-members are diverted to high-cost imports from member nations).

In 1991, Krugman began investigating the effects of economies of scale, firm clustering, technical development and the digitization of inventions, thereby opening a new field of international economics called New Economic Geography (NEG). Crucially, this new theoretical framework emphasized the spatial dimension as a critical factor in analysing economic activities. It was not merely the interactions between economic agents that were of interest, but more so how geographical proximity influenced the mechanisms and outcomes of those interactions. The goal of this theory was to explain how the economic and geographic distances existing in international trade, impact the concentration/dispersion of economic activity in different countries. The resulting economic model, therefore, heavily relies on econophysics, more specifically on the same notion of economic barycenter discussed above. As reported by Liang and Plakias (2022), Krugman’s original work presented a model of endogenous industry location, explaining how, under realistic assumptions, the spatial distribution of economic activity would naturally evolve into a core and a periphery structure. The process described in the model would subsequently be labeled as ‘agglomeration’, i.e., clusters of economic agents reaping benefits of working in proximity. Krugman, thus provides a wide conception of trade equilibrium that takes into account issues such as location, spatial dimension and factor mobility. Since distance and trade costs in international economics have mostly been investigated using the gravity equation, it is unsurprising that empirical research connected to Krugman’s theory of “New Economic Geography” has extensively employed data-driven approaches and gravitational models. Given their shared foundations in econophysics, it is unsurprising that Persson’s Gravity Model and Krugman’s New Economic Geography have influenced one another. The gravitational model has attempted for a long time to place space at the centre of the economy. Krugman, referencing Isard’s early use of gravity models to measure regional “magnetic fields,” emphasized two competing forces: centrifugal forces, which push firms toward broader markets, and centripetal forces, which encourage agglomeration due to economies of scale and specialization. As firms and workers gravitate toward more prosperous regions, production becomes increasingly concentrated. According to research on distances and transportation costs suggests that the “home market effect”-the tendency for firms to locate production near the largest market for their goods- is the tendency for firms to locate production near the largest market of their goods.

A few years after the initial applications of the Universal Gravitation Law in social sciences, Tobler (1970), a Geography professor at the University of Michigan, proposed a fundamental principle for spatial science, which bore a striking resemblance to Newton’s law and was termed as ‘the first law of geography’. Tobler drew inspiration from gravity models in an attempt to develop a comprehensive spatial law that would encompass both spatial interaction phenomena, such as those described by gravitational models, but also more static spatial phenomena.

There is a profound connection between the Gravity Model and Moran’s I statistics, exemplified by Tobler’s First Law of Geography: “everything is related to everything else, but near things are more related than distant things” (Tobler, 1970, p. 236). This specific law is particularly relevant in econophysics, as it narrows the research scope by implying the presence of a distance decay function, which exists on top of the interdependence influencing the trajectories of all elements in a given economic system. Tobler’s law thus implies that, even if in a global economy all elements are mutually influenced, the intensity of how market agents become exposed to this influence gradually diminishes as spatial distance increases. Therefore, there exists a “threshold distance” beyond which the influence between market agents diminishes to a non-detectable, and thus negligible, level.

The relationship between the Gravity Model and Moran's I (Formula 3) can be further clarified by observing their complementarity. Indeed, the gravity model is particularly effective when dealing with absolute measures, such as GDP or population, whereas the global Moran's I is more suitable to quantify the spatial concentration of relative measures, such as regional GDP per capita or other ratios. While the global Moran's I analyzes the degree to which similar values cluster spatially, it does not provide insights into the underlying causes of such clustering. Due to this methodological limitation, to test whether the spatial concentration is a result of spatial autocorrelation, researchers must employ additional methods - such as spatial regression analysis. Spatial regression can help uncover the relationships between variables and assess the impact of spatial factors on observed patterns. Unlike one-dimensional autocorrelation, Moran's I captures correlation among nearby locations in a multidimensional and multidirectional spatial framework, thereby adding complexity to the analysis. The value of  $I$  (Formula 3) relies on the assumptions embedded in the spatial weights matrix, denoted as  $w_{ij}$ . This matrix is essential, as it helps to manage spatial autocorrelation and to model spatial interactions by outlining the neighboring locations to be included. Moran's approach is closely related to the above-mentioned Tobler's first law of geography, as it implies a proximity factor. It is to be noted that Moran's index is generally calculated excluding the islands, as contiguity is crucial in this analysis. Islands are often unique regions and are therefore excluded because they lack adjacent regions. For geoeconomic inquiries that do need to account for islands, it is best for a researcher to resort to gravity maps as well. Global Moran's I is designed as

$$I = \frac{N \sum_{i=1}^N \sum_{j=1}^N w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{W \sum_{i=1}^N (x_i - \bar{x})^2} \quad (3)$$

Where  $N$  is the number of spatial units indexed by  $i$  and  $j$  is the variable of interest;  $\bar{x}$  is the mean of  $x$ ;  $w_{ij}$  are the elements of a matrix of spatial weights with zeroes in their diagonal (i.e.,  $w_{ij} = 0$ ); and  $W$  is the sum of all  $w_{ij}$ .

The mathematical formulation of Moran's I estimate is provided above. This statistic captures both the mean and the variance of the factor under investigation. To compute it, the deviation of each feature value from the mean is first determined by deducting the average from each feature value. The deviation values of all neighboring features (e.g. those that fall within the specified distance range) are multiplied to create a cross-product. It is important to note that the numerator of the Moran's I consists of the sum of these cross-products. If the values for the adjacent elements are both greater or lower than the mean, then the cross-product will be positive. Conversely, if one number is below and the other is above the mean, the cross-product will then be negative.

In any case, the greater the deviation from the mean, the larger the resulting cross-product will be. When the dataset exhibits positive spatial autocorrelation (high values cluster near to other high values; low values cluster close to other low values), the Moran's Index will be positive. If high values are predominantly located near low values, the index will be negative. If the positive and negative cross-products balance out, the index will be close to zero, indicating a random spatial distribution.

Given that the Spatial Autocorrelation tool is inferential, any findings based on Moran's I should always be interpreted in light of the null hypothesis. The null hypothesis for the Global Moran's I statistic assumes that the spatial distribution of features in the study region is random with respect to the variable under consideration – that is, any observed pattern is the result of random chance rather than systematic spatial organization.

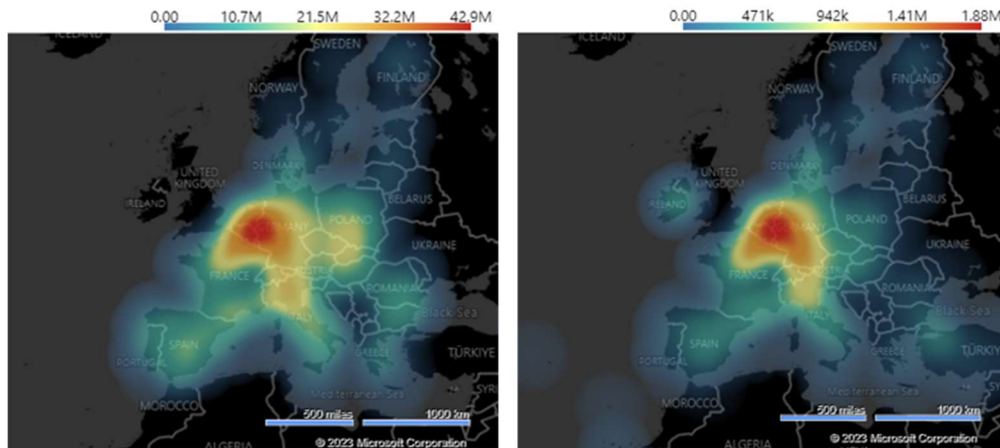
#### **4. Results and discussion of the spatial analyses**

In our investigation, we juxtapose contemporary data with historical studies on the Blue Banana phenomenon. This comparative approach enables us to ascertain its current relevance and persistence in European economic discourse. By examining the dynamic interplay between evolving economic landscapes and geographic concentrations of prosperity, we aim to contribute valuable insights to the discourse of regional development. We analyze key development factors, such as population and GDP, across the European regional landscape to determine whether the Blue Banana still represents the economic backbone of Europe. We apply the Gravity Model to both population distribution and regional GDP (Figure 3). The results show that while these two variables are similarly concentrated, their distribution is not

entirely uniform. Specifically, both population and GDP exhibit high concentration in the Blue Banana area, which suggests its continued economic importance.

This spatial concentration is clearly illustrated in Figure 3, which displays the gravitational fields derived from both population (on the left) and GDP data (on the right).

**Figure 3: empirical elaboration of the population (on the left) and 2021 GDP (on the right) gravitational field of NUTS 2 areas of the EU27**



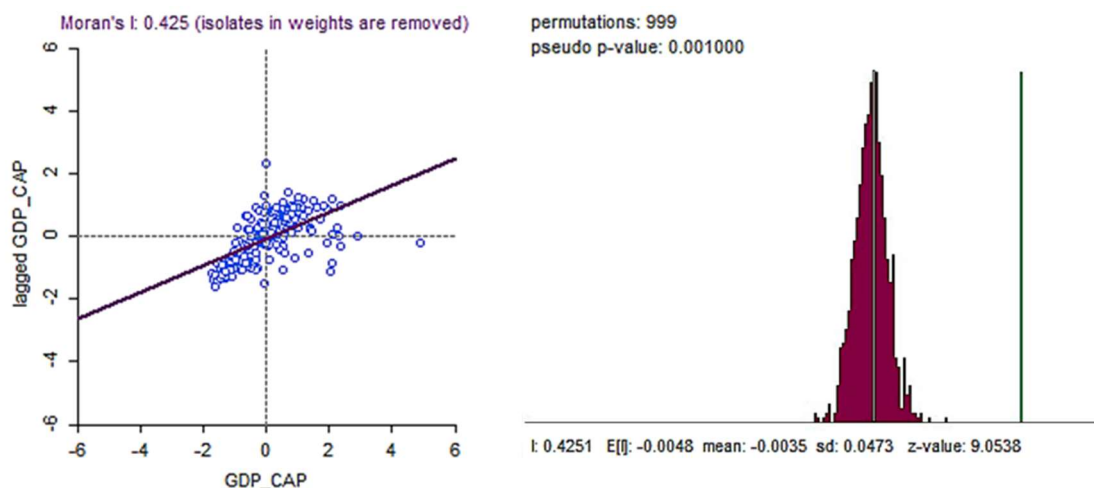
Source: own elaboration

By complementing the Gravity Model with Moran’s I statistics, we provide a more sophisticated analysis. As mentioned above, Moran’s I statistics is better suited than the Gravity Model for relative measures and ratios, such as GDP per capita. Concerning this variable, the global Moran’s I and its permutation test (Figure 4) confirm a statistically significant (42,5%) spatial concentration among the continental EU NUTS 2 regions. Statistically speaking, we have to reject the null hypothesis and accept the alternative, that spatial distribution is uneven, confirming the existence of significant spatial concentration.

By integrating these analytical approaches, our study not only confirms the persistent dominance of the Blue Banana as a pivotal economic force in Europe but also underscores the imperative for policymakers to tailor interventions that both sustain this momentum and foster equitable growth across the wider European landscape. This holistic understanding is essential for crafting nuanced policies that address regional disparities while leveraging the Blue Banana’s dynamism to propel overall economic advancement on the continent.

These spatial patterns are further supported by the results shown in Figure 4, which illustrates the global Moran’s I statistic alongside its permutation test.

**Figure 4: Global Moran’s I statistics (on the right) and its permutation test (on the left) for NUTS2 regional GDP per capita in 2020 in the continental EU**



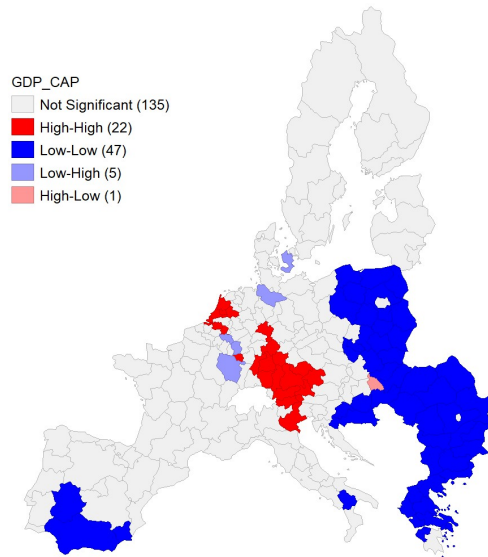
Source: own elaboration

The local Moran’s I (Figure 5) shows that the concentration of NUTS 2 regions with high GDP per capita partially overlaps with the Blue Banana area. Conversely, most Eastern

European and some Mediterranean NUTS 2 regions exhibit a concentration of low GDP per capita. As anticipated in the first section, capital regions are usually understood as exceptional cases. For instance, consider an Eastern European case: in Central Hungary (that is Budapest and its surrounding county), the capital region has a significantly higher value of GDP per capita than the neighbouring regions, a value that is also higher value than the EU average.

These spatial patterns of GDP per capita are depicted in Figure 5, which shows the local Moran's I results across NUTS 2 regions in the continental EU.

**Figure 5: Local Moran's I statistics for NUTS2 regional GDP per capita in 2020 in the continental EU**



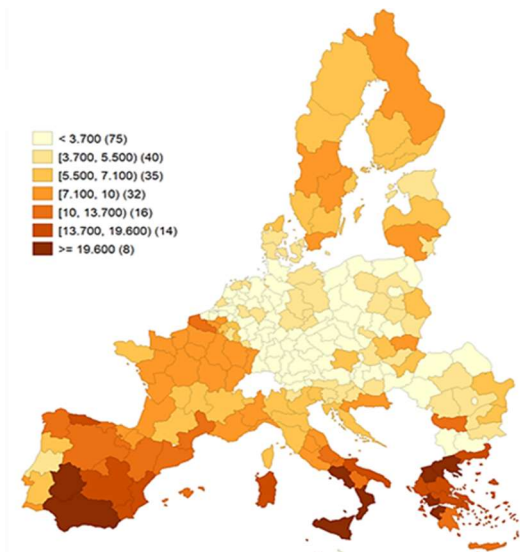
Source: own elaboration

Regional economic output, expressed in GDP per capita, depends on mobile factors (among other variables), such as labor and capital market. Regarding labor, we consider the unemployment rate to provide a broader overview of the European economy and working situation (Figure 6). The year selected is 2019, as it predates the COVID pandemic outbreak and reflects a markedly different labor market context in Europe.

In this regard, most of the Central and Eastern European regions performed better in 2019 than the Western and (especially) Southern European regional average. However, as Capoani et al. (2023) find, this is attributable to high dependence on FDI and, in some CEE regions with low unemployment rates, a prevalence of less productive industrial manufacturing sectors. Conversely, the share of employment in the most value-added high-technology and knowledge-intensive sectors shows a spatially more evenly distributed picture (Figure 7). In this regard, the capital regions generally perform the best.

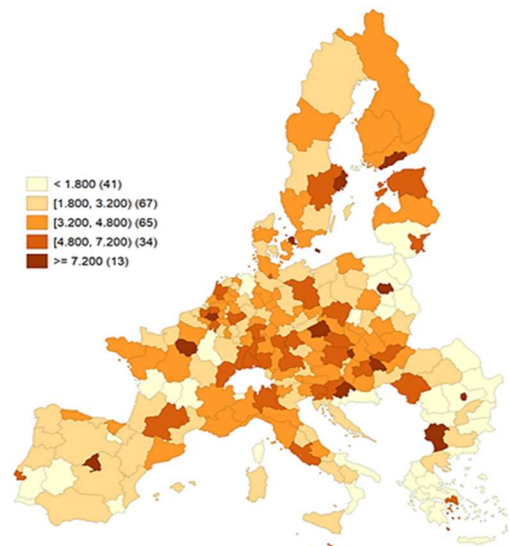
The spatial configuration of unemployment levels across Europe is presented in Figure 6. A complementary overview of employment in high-technology and knowledge-intensive sectors is shown in Figure 7.

**Figure 6: Regional unemployment rate in 2019**



Source: Eurostat

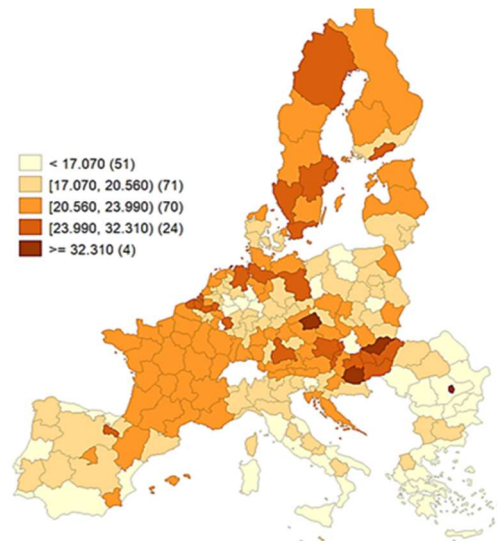
**Figure 7: Employment in high technology and knowledge-intensive sectors in 2019 as a percentage of total employment**



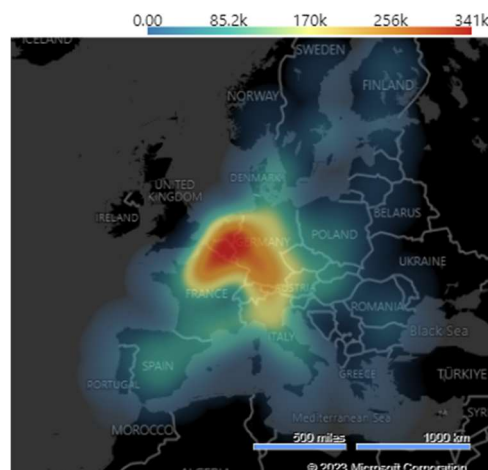
Source: Eurostat

Regarding the capital market Gross Fixed Capital Formation (GFCF) is an adequate proxy to express the capital availability through investments. Again, we refer to 2019 to avoid pandemic-related distortions.

In 2019, regional GFCF as a percentage of regional GDP was the highest in four CEE regions (see Figure 8). Two of them, namely Prague and Bucharest, are the capital regions of the Czech Republic and Romania respectively, while the two others are non-capital regions of Hungary. While noteworthy, it is worth mentioning that regional GDP in these areas remains lower than in most of the Western European regions. Therefore, the higher GFCF share of GDP does not necessarily translate into higher absolute investment levels. The Gravity Model on the (total) regional GFCF supports this assumption (Figure 9), confirming the results that the highest absolute concentration GFCF concentrations remain within the Blue Banana area.

**Figure 8: GFCF as a percentage of regional GDP in 2019**

Source: Eurostat

**Figure 9: Empirical elaboration of the 2019 GFCF gravitational field of NUTS 2 areas of the EU27**

Source: Own elaboration

Overall, the results of the Gravity Model, Moran's I statistics, and supporting studies confirm that, in terms of population, GDP, and GDP per capita, most of the Blue Banana area remains a prominent economic territory in Europe. However, as noted in several studies, emerging spatial concentrations are becoming visible, suggesting a reorganization and growth trend towards Northwestern and Central-Eastern Europe (Hospers, 2002; Metaxas & Tsavdaridou, 2013). It is therefore reasonable to anticipate further territorial transformations in the decade ahead.

## **5. Conclusion**

This paper has focused on the concept of the gravitational field (Isard, 1954; Capoani, 2023) and market potential (Harris, 1954) as descriptive tools for spatial analysis. Inspired by physicist Stewart's pioneering application of physical laws to social sciences, the theory of demographic gravity demonstrates the tendency of population centers to behave as magnets, attracting individuals to areas with larger populations. It is worth noting briefly that a larger population does not necessarily guarantee better economic performance. In some cases, as observed in Nordic regions, areas with lower population density outperform others both socially and economically. While population concentration can lead to economies of scale, in the absence of proper coordination, it could also result in coordination diseconomies. However, it is crucial to acknowledge that more developed regions often act as attractors for individuals in a European labour market characterized by high labor mobility. In relation to this phenomenon,

the paper also discussed the evolution of Stewart's ideas, including the concept of demographic energy and population potential, as well as how they relate to gravitational and magnetic fields.

Furthermore, the paper investigated the application of the Gravity Model in economics, particularly in explaining interregional dynamics. This economic model, inspired by Stewart's work, used a similar gravitational framework to analyze trade patterns based on GDP and spatial distance. The study emphasized the importance of distance not only as a determinant of trade volumes but also as a contributor to transaction costs.

Moreover, by integrating Moran's I statistics with the Gravity Model, we achieved a more sophisticated understanding of the spatial distribution of economic indicators across European regions. Moran's Index helps identify whether spatial clustering or dispersion of these indicators exists, while the Gravity Model provides a theoretical framework to interpret these spatial patterns, offering insights into Europe's economic geography and assessing the continued significance of the Blue Banana regions.

An overview of the Blue Banana and the adjacent European economic areas was then provided. In particular, the dynamics occurring in the 'Widening Countries' were mentioned, along with the consequences of radical market transitions in post-communist countries. Our spatial analyses confirmed that the Blue Banana regions continue to outperform most other EU regions in terms of conventional development measures. Furthermore, empirical research could delve into the dynamics of territorial changes over recent decades and explore patterns of spatial concentrations using broader socioeconomic and well-being measures.

In summary, this paper shed light on the significance of demographic gravity in understanding population movements and its application to economic trade flows. It underscored the interplay between physics and the social sciences, illustrating how economic models have been inspired by gravitational principles. As globalization deepens and economies become increasingly interconnected, the study of demographic gravity and its implications remains highly relevant for understanding human behavior and international trade patterns.

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## DEVELOPMENT TRAPS IN SMALL EU ECONOMIES: INSIGHTS FROM CROATIA'S LOCAL TRAJECTORIES

Vinko MUŠTRA

Full professor, Faculty of Economics, Business and Tourism, University of Split, Croatia  
vmustra@efstr.hr

### Abstract

This paper examines the long-term dynamics of local development traps in Croatia, a small and open EU economy that experienced profound structural shocks between 2006 and 2022, including the global financial crisis and the COVID-19 pandemic and EU accession in 2013. The concept of the development trap has recently gained prominence in the literature, identifying territories that struggle to sustain economic dynamism relative to national and European peers (Iammarino et al., 2020; Diemer et al., 2022; Rodríguez-Pose et al., 2024). While previous research has highlighted the structural and institutional underpinnings of such traps, less attention has been devoted to the different development paths of local sub-national units in small and open economies. Using a unique dataset covering all 556 Croatian municipalities and towns for 4 three-year periods from 2006 till 2022., this study applies a standardized, multi-period framework to identify two forms of development traps: (1) a stable trap reflecting persistent positioning within the same income decile (DT1) and (2) a downward trajectory trap marked by monotonic decline in standardized income (DT2). A key finding is that development traps vary heterogeneously even within the same county-level units, underscoring the importance of fine-grained territorial perspective. The results also reveal strong path dependence substantial spatial rigidity and pronounced territorial polarization between coastal and continental areas. DT1 and DT2 are not evenly distributed, suggesting differentiated structural vulnerabilities across counties. By providing new evidence from a small EU economy like Croatia, the paper offers a nuanced operationalization of development traps and highlights the need for targeted, place-sensitive policies aimed at reversing entrenched disparities and preventing further territorial divergence.

**Keywords:** Local development traps, Income dynamics, path dependence, spatial disparities, Croatia

**JEL classification:** R11, R12, O18,  
pp. 79-92

### Introduction

Recent dynamics of spatial inequalities in Europe have sharpened both academic and policy attention on the forces shaping uneven territorial development. A growing body of research highlights not only persistent differences in regional performance levels, but also marked variation in the direction and pace at which key socioeconomic indicators evolve across European regions (European Commission 2017a, 2017b, 2022; Iammarino, Rodríguez-Pose and Storper 2019, Constantin, Daniela-Luminița, and Clara-Alexandra Volintiru. 2024.). These findings indicate that disparities are no longer confined to static gaps in key economic indicators; rather, they reflect divergent development paths, where some territories accelerate while others stagnate or decline.

Within this context, the concept of the regional development trap has gained significant traction. Development traps refer to situations in which territories experience persistent stagnation or erosion of economic dynamism despite broader macroeconomic improvements (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022). Such traps are increasingly observed not only in structurally weak or peripheral areas but also in intermediate and relatively affluent regions whose institutional or productive structures fail to adapt to technological change, global competition or demographic pressures.

Existing research has also emphasized the broader socioeconomic and political implications of such traps. Regions facing prolonged stagnation often exhibit rising dissatisfaction with central authorities, declining trust in institutions and increasing support for anti-establishment

or Eurosceptic movements, phenomena associated with the emerging “geography of discontent” (Rodríguez-Pose et al. 2024; Diemer et al. 2022). The persistence of these traps poses serious challenges for development and cohesion policy, particularly as they risk reinforcing territorial divides and fueling political polarization.

Despite the progress made in conceptualizing and identifying development traps, the empirical literature has remained overwhelmingly focused on higher territorial levels, especially NUTS 2 and NUTS 3 regions (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022; Çınar 2023a, 2023b Rodríguez-Pose et al. 2024; Balland and Boschma 2024; Tessarin et al. 2025).

Analyses at these scales have been crucial in advancing theoretical understanding, yet they may obscure substantial heterogeneity within regions (Constantin, Daniela-Luminița. 2021). Indeed, structural vulnerabilities, adaptive capacities, and exposure to shocks often manifest at much finer spatial scales (Constantin, Daniela-Luminița. 2021), such as municipalities and towns (Local Administrative Units - LAU). Up to the knowledge of the author, no prior study has examined development traps at the LAU level, even though these are the administrative entities where development outcomes has been especially heterogenic.

Croatia provides a compelling empirical case for this type of investigation. As a small and open post-socialist EU economy, Croatia experienced one of the deepest and longest recessions in the European Union during the global financial crisis, with a cumulative contraction unmatched by most member states. These shocks were spatially asymmetric, disproportionately affecting localities with weaker diversification and lower administrative capacity.

Moreover, Croatia’s EU accession in 2013 introduced new opportunities and challenges through regulatory harmonization, access to cohesion funding and integration into the Single Market. Differences in administrative capacity and strategic orientation shaped how LAUs were able to benefit from EU membership, thereby contributing to increasingly divergent development trajectories.

Finally, the COVID-19 pandemic posed yet another major shock. Owing to the Croatian economy’s strong dependence on tourism and face-to-face services, the pandemic had an asymmetric spatial impact, reinforcing pre-existing disparities across municipalities and towns.

Despite the importance of these transformations, and despite Croatia’s two-tiered, highly fragmented sub-national system of 556 local government units, there has been no systematic analysis of development trajectories at this granular level. Understanding long-term development paths within this administrative structure is essential, where structural vulnerabilities accumulate and where resilience is most directly tested.

To address this gap, the present study provides the first comprehensive, long-term examination of income-based development traps across all Croatian municipalities and towns during the period 2006–2022, a uniquely dynamic and turbulent timeframe for Croatia. This period captures three major and conceptually relevant phases: the global financial and economic crisis (2008–2014), during which Croatia experienced one of the deepest and longest recessions in the EU, the country’s accession to the European Union in 2013, which introduced new development opportunities, regulatory adjustments and financial instruments and the COVID-19 shock (2020–2021), which had particularly strong spatial consequences given Croatia’s dependence on tourism. Together, these events created markedly heterogeneous local trajectories, making the 2006–2022 window especially suitable for identifying structural vulnerabilities and testing the persistence of stagnation or decline at the local level.

Building on the existing development trap literature (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022, Rodríguez-Pose et al. 2024) we apply a readjusted and context-sensitive income-based methodological framework specifically adapted to the structural features of Croatia’s local economy, its administrative fragmentation and its pronounced spatial heterogeneity. Within this modified framework, we identify two forms of income-based development traps: a first type (DT1), which captures persistent stagnation within the same relative income tier (decile), and a second type (DT2), which reflects a downward developmental trajectory manifested as a monotonic decline in standardized income.

The empirical findings reveal strong path dependence, entrenched territorial divides and significant spatial clustering of stagnation and decline. Continental counties exhibit particularly high concentrations of DT1 on low level of income and DT2 municipalities, while coastal and urban areas more often maintain stable high-income trajectories. By integrating these patterns

into a cohesive analytical framework, the paper contributes to the understanding of development traps in small EU economies and offers evidence for designing place-sensitive development policies tailored to structurally vulnerable localities.

## **2. Conceptual Background and Literature review**

Understanding the dynamics of territorial disparities, particularly in small and open EU economies, requires a conceptual framework that captures not only structural disadvantages, but also the long-term mechanisms that constrain upward mobility. The notion of the regional development trap, as recently formalized in EU-level research, offers one such framework (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022; Balland and Boschma 2024).

It enables the detection of territories that, despite being embedded within the same macroeconomic and institutional environment, systematically fail to improve their socioeconomic position or even experience gradual decline. This section provides the conceptual foundations for the analysis, synthesizes key insights from the literature, and positions the Croatian case within broader European debates.

### **2.1 Origins of the Development Trap Concept**

The notion of a development trap has evolved from a broader effort to understand why some economies fail to sustain long-term growth and structural transformation. Early conceptualisations emerged from the macroeconomic literature on the middle-income trap, which describes countries that achieve moderate levels of development but subsequently struggle to converge toward high-income status (Gill and Kharas 2015; Felipe 2012). Although originally developed for national economies, the analytical intuition behind the middle-income trap, persistent stagnation despite broader opportunities, laid important groundwork for subsequent regional applications.

More recently, scholars have adapted these ideas to the European regional context. The landmark contribution by Iammarino et al. (2020) and Diemer et al. (2022) conceptualised the regional development trap as a situation in which territories experience persistent stagnation or decline across key socio-economic dimensions, even when national-level indicators show improvement. Their framework highlights how deep-rooted structural conditions—weak institutions, demographic pressures, inadequate innovation systems, and rigid industrial structures—can lock regions into trajectories of low productivity and limited adaptive capacity.

Following this conceptual shift, several empirical studies have explored the prevalence and drivers of development traps across European regions (Diemer et al. 2022; Rodríguez-Pose et al. 2024). This body of work extends the idea beyond purely economic stagnation, showing that regions caught in development traps often also exhibit increasing socio-political discontent, reduced trust in institutions, and heightened support for anti-establishment parties. This connection with the “geography of discontent” underscores that development traps are multidimensional phenomena with implications for economic performance, territorial cohesion and democratic stability.

In parallel, complementary perspectives have emerged within evolutionary economic geography, offering a different but compatible lens for interpreting development traps. Recent work by Balland and Boschma (2024) proposes an evolutionary approach to regional development traps, focusing on capability accumulation, technological relatedness and long-term path dependency. According to this view, regions become trapped not only because of low productivity or institutional weaknesses, but because their existing capability bases are structurally misaligned with new technological opportunities. Regions lacking related capabilities, diversified knowledge bases or access to innovation networks are more likely to persist in low-complexity activities, making structural upgrading difficult. This evolutionary perspective enriches the broader conceptual landscape by highlighting the role of technological change, capability building and regional branching processes in shaping long-term development trajectories.

Taken together, these different approaches, macro-level analyses of middle-income traps, structural-institutional theories of regional development traps and evolutionary-economic perspectives offered a multidimensional understanding of why some territories diverge from

sustainable development paths. While they place emphasis on different mechanisms, they converge on a central insight: territories fall into development traps when they lack the institutional, economic, or capability foundations required to sustain adaptation, diversification and long-term resilience.

Despite the richness of this emerging literature, most empirical studies of development traps remain focused on higher territorial levels, primarily NUTS 2 and NUTS 3 regions (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022; Çınar 2023a, 2023b Rodríguez-Pose et al. 2024; Balland and Boschma 2024; Tessarin et al. 2025). As acknowledged by Iammarino et al. (2020), Diemer et al. (2022) and Rodríguez-Pose et al. (2024), this focus is partially a consequence of data availability and the EU's institutional emphasis on NUTS levels in cohesion policy. However, this scale may mask crucial intra-regional heterogeneity, particularly in countries characterised by fragmented local governance, substantial economic diversity within regions and unequal distribution of administrative capacities across municipalities. For such contexts, analyses implemented at Local Administrative Unit (LAU) levels offer finer-grained insights into territorial vulnerabilities and development trajectories (Constantin, Daniela-Luminița. 2021.)

The importance of examining development dynamics at sub-regional scales is strongly reinforced by the public administration literature. For instance, the study by Wänström and Persson (2024), demonstrates that municipalities often play a central role in shaping local development outcomes, possessing institutional capacities, strategic priorities and governance practices that differ substantially from those of regional authorities. Their findings highlight that the effectiveness of regional development strategies depends not only on the design of regional frameworks but also on how municipalities interpret, adapt and implement these strategies on the ground, as well as on the functioning of coordination mechanisms between regional and local bodies.

Such insights strongly motivate the application of development trap frameworks at the LAU level, particularly in institutional contexts where local government units are numerous, heterogeneous, and hold substantial responsibilities in development planning.

## **2.2. Relevance of the Development Trap Concept for Croatia**

Croatia presents an especially compelling environment for LAU-level analysis of development traps. As a small, open, and post-socialist economy, it has undergone profound structural transformations over the past two decades. These include EU accession, deeper integration into global markets, and exposure to major external shocks such as the global financial crisis and the COVID-19 pandemic. The global financial crisis hit Croatia particularly hard, resulting in the longest and deepest recession among EU member states, and its effects were unevenly distributed across the country. Some municipalities experienced prolonged stagnation due to declining industrial bases, demographic ageing, outmigration, or dependence on vulnerable sectors such as tourism. Conversely, others demonstrated greater resilience owing to more diversified economic structures or stronger institutional capacities. The COVID-19 shock reinforced and magnified these disparities—tourism-intensive coastal municipalities were severely affected, while many continental areas continued to struggle with long-standing structural weaknesses and population decline. These dynamics underscore the need for analytical frameworks capable of detecting stagnation or decline at the level where such processes are actually experienced: the municipality.

Beyond its economic profile, Croatia's administrative architecture further strengthens the rationale for conducting development trap analysis at the LAU level. The country comprises 556 municipalities and towns (LAU 2), marked by pronounced fragmentation, substantial variation in administrative capacity. This heterogeneity is not merely institutional, it shapes how localities formulate development priorities, respond to external shocks, and navigate long-term structural pressures. Unlike Member States with stronger regional governance structures, Croatian municipalities are the primary units responsible for local development planning. They therefore operate as crucial arenas in which development traps can form, persist, or be overcome. Analyses conducted at the NUTS 2 or NUTS 3 level inevitably flatten this diversity, masking the fact that high-performing and stagnating municipalities can coexist within the same region while following sharply divergent development trajectories.

Furthermore, the intersection between development traps and political dynamics, illuminated by recent “geography of discontent” research, is particularly relevant for Croatia. Local economic stagnation among EU regions has been associated with rising dissatisfaction with national policies, lower levels of institutional trust and varying degrees of Euroscepticism (Rodríguez-Pose et al. 2024). Identifying where development traps are most acute at the local level is therefore not only analytically useful but policy relevant, as these traps may influence broader patterns of political behaviour, community resilience and citizens’ perceptions of territorial fairness.

Taken together, these considerations provide a strong conceptual, empirical, and policy rationale for applying the development trap framework at the municipal (LAU) level in Croatia. The Croatian case, characterised by structural heterogeneity, demographic pressures, exposure to multiple external shocks, and a fragmented local governance system, offers a natural laboratory for analysing how development traps emerge, persist, and interact with macroeconomic and institutional transformations. By integrating insights from the multidimensional, economic, and evolutionary approaches to development traps with findings from public administration research, this study contributes to a more nuanced understanding of territorial divergence in small EU economies, while highlighting the importance of local governance structures in shaping long-term development trajectories.

### **3. Data and Empirical Strategy**

This section outlines the empirical foundations of the study and presents the methodological framework used to identify income-based development traps across all 556 Local Government Units (LGUs) in Croatia over four three-year periods between 2006–2022. The goal is to produce a coherent, longitudinal classification of LGU trajectories that reflects both persistent structural stagnation and systematic decline. The approach builds on the emerging development trap literature (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022; Rodríguez-Pose et al. 2024) while adapting and refining it to the specific institutional and territorial characteristics of Croatia and data limitations.

The empirical strategy is anchored in two complementary trap concepts. The first (DT1) focuses on long-term positional rigidity, where an LAU remains confined to the same segment of the national income distribution across all periods. The second (DT2) captures monotonic deterioration, identifying LAUs that consistently lose relative ground. By jointly considering stagnation and decline, the approach provides a nuanced typology of developmental trajectories that can support more precise place-based policy design.

#### **3.1. Data**

The empirical analysis draws on official national datasets corresponding to four reference periods used in Croatia’s Index of Development (*hr. Index razvijenosti*), the central instrument for assessing and classifying municipalities and towns (LAUs) under the Croatian local and regional development framework. The evaluation and classification of all municipalities, towns and counties were first officially implemented in 2010 on the basis of the Law on Regional Development of the Republic of Croatia (Official Gazette 153/09). The initial cycle followed the methodological provisions defined in the 2010 Regulation on the Development Index (Official Gazette 63/10), which specified the indicators, the calculation procedure, and the relevant data sources. Between 2010 and 2017, two official assessment cycles were carried out (Official Gazette 89/10, 158/13). In 2017 new adoption of the Indexed has been implemented (Official Gazette 131/17), which harmonised indicator definitions and provided the methodology used in the latest cycle.

These institutional and methodological developments underpin the four official reference periods used in this study:

- 2006–2008 (used in the 2010 Index),
- 2010–2012 (used in the 2013 Index),
- 2014–2016 (used in the 2018 Index),
- 2020–2022. (used in the 2024 Index),

Although the official Development Index is a composite measure combining several socio-economic indicators, income per capita is the indicator that appears in all four official calculation cycles, from 2010 to the latest 2024 update.

For each of the 556 LAUs, the datasets contain the LAU name, county (hr. županija), and the average income per capita for the corresponding three-year period. To ensure comparability across all four periods, all income values were re-standardised using a uniform statistical procedure, allowing the construction of consistent decile distributions and the identification of development trap dynamics.

### 3.2. Development Trap Typology: Conceptual Overview

Before classifying Croatian LAUs into specific development trap categories, it is essential to clarify the underlying conceptual distinction between the two mechanisms examined in this study. Development traps may manifest either through long-term positional rigidity or through gradual deterioration (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022; Rodríguez-Pose et al. 2024), and capturing both patterns is crucial for understanding the diversity of local development trajectories. To reflect this, the empirical strategy operationalises two complementary trap types.

The first type of development trap, DT1, captures LAUs that remain persistently confined to the same relative segment of the national income distribution over 2006–2022 period. An LAU is classified as DT1 if it does not experience any upward movement into a higher decile band and consistently remains within the same three-decile block—whether low (deciles 1–3), middle (deciles 4–6), or high (deciles 7–9). Finally, there is specific subgroup for LAUs which remain in top decile (decile 10). This persistent positional stability signals a form of structural immobility, indicating that the LAU is effectively “locked in” to its long-term socioeconomic status. Even in cases where relative values do not deteriorate, the inability to upgrade reflects an absence or insufficient activation of key development drivers such as innovation, economic diversification, entrepreneurial dynamism, demographic vitality, or administrative capacity. DT1 therefore denotes territories characterised by chronic stagnation: places that do not fall behind but also do not progress.

The second trap type, DT2, focuses on dynamic deterioration rather than stability. It identifies LAUs whose standardized income values follow a strictly decreasing trajectory across all observed four periods, signalling a continuous loss of relative position within the national distribution. Unlike DT1’s structural stagnation, DT2 reflects territories for which development conditions, manifested through income indicator, are actively worsening. When these two mechanisms overlap, when an LAU is both persistently low-income and continuously declining, the resulting combination represents the most severe form of developmental vulnerability.

### 3.3. Methodological framework and Empirical strategy

Keeping in mind the conceptual perspective, the empirical strategy consists of several sequential steps designed to capture long-term developmental trajectories of LAUs in Croatia. Because the focus of this study is on persistent relative performance and directional change over time, the methodology combines standardized indicators, relative income rankings and longitudinal classification rules. The approach follows four main stages: (1) standardisation of income per capita for each period, (2) assignment of LAUs to income deciles, (3) identification of DT1 traps through persistent positional stability, and (4) detection of DT2 traps based on monotonic decline in standardized values. Together, these steps form a coherent analytical framework capable of distinguishing between stagnation and decline—two structurally distinct development dynamics that are central to the understanding of territorial divergence.

The first step involves transforming raw income per capita into standardized z-scores for each reference period. This procedure ensures full comparability across time despite shifts in the national income distribution.

For each LAU  $i$  in period  $t$ , the z-score is calculated as:

$$Z_{\{i,t\}} = (X_{\{i,t\}} - \bar{X}_t) / s_t, \quad (1)$$

where  $X_{\{i,t\}}$  denotes the LAU’s income per capita,  $\bar{X}_t$  is the national mean, and  $s_t$  the standard deviation for that period. Standardisation places each period’s distribution on a

common metric, centred at zero and expressed in units of variation, allowing for the identification of meaningful upward or downward movements relative to the national context. This approach is particularly important in the Croatian case, where macroeconomic volatility, EU accession and post-crisis adjustments altered absolute income levels across the sixteen-year window.

The second step uses these standardized values to construct income deciles for each period. Each LAU is assigned to one of ten equally sized groups, ranging from the lowest (decile 1) to the highest (decile 10) segment of the national income distribution. Deciles provide a non-parametric and distribution-free measure of relative socioeconomic standing, making them well-suited for identifying persistent structural positions. The sequence of decile values across the four periods forms the empirical basis for diagnosing DT1 development traps.

A DT1 trap occurs when an LAU remains within the same three-decile block (1–3, 4–6, or 7–9) across all periods without any upward movement, signalling chronic stagnation. Three variants—DT1\_low, DT1\_middle and DT1\_high—capture the different structural contexts within which stagnation can occur (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022). There is also fourth group for LAUs that have been constantly in highest decile 10 (DT1\_top).

The third component of the methodology identifies DT2 traps by focusing on directional decline rather than positional stability. An LAU is classified as DT2 if its standardized income values form a strictly decreasing sequence across all four reference periods. Since z-scores reflect relative performance within each national distribution, a monotonic downward pattern indicates that the LAU is consistently losing ground—not only stagnating, but structurally deteriorating over time. DT2 therefore captures localities experiencing deepening developmental challenges, eroding fiscal capacity or reduced economic dynamism. The final step integrates both dimensions, distinguishing units that exhibit only stagnation (DT1), only decline (DT2), or combined vulnerabilities. The combined classification identifies the most structurally fragile LAUs—those locked into persistent income positions and experiencing worsening performance—thus enabling a nuanced, policy-relevant understanding of territorial divergence in Croatia.

By combining DT1 and DT2, our approach consolidates four categories of LAUs: I) DT1-only units, divided into four internal subtypes; II) DT2-only units; III) units that fall under both DT1 and DT2; IV) and those that do not fall into either developmental trap. Through this classification, it becomes possible to distinguish several critical groups: structurally entrenched low-income LAUs, LAUs that are on a downward trajectory regardless of their initial conditions, those experiencing compounded vulnerabilities by being both DT1\_low and DT2, and finally, LAUs that sustain or improve their relative performance. This integrated approach enhances the analytical precision of diagnosing developmental traps and highlights where targeted policy interventions may be most needed.

#### **4. Results**

The empirical distribution of development traps across Croatian municipalities demonstrates a strong pattern of structural immobility, consistent with the theoretical expectations laid out in the development-trap literature (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022). As shown in Table 1, more than half of all LAUs remain persistently locked into the same relative income tier over the entire 2006–2022 period, with particularly large shares in the DT1\_low (20.1% of all LAUs), DT1\_middle (13.1%), and DT1\_high (15.3%) categories. This confirms the presence of long-term positional rigidity, a hallmark of DT1-type stagnation. Meanwhile, DT2 traps, capturing monotonic deterioration, affect 10,1 % of all LAUs. Although numerically smaller, this group represents a critical subset of localities in which development fundamentals are actively worsening rather than merely failing to improve. These findings resonate with the broader European evidence that structural vulnerabilities are persistent and deeply path-dependent (Iammarino, Rodríguez-Pose, and Storper 2020; Diemer et al. 2022; Rodríguez-Pose et al. 2024, Balland and Boschma 2024), while demonstrating that the phenomenon is equally salient at the highly granular LAU level.

**Table 1. Summary of development trap classifications (number and percentage of LAUs)**

Group	Number	Percent
DT1_low	112	20.1%
DT1_middle	73	13.1%
DT1_high	85	15.3%
DT1_top	29	5.2%
DT1 = 0	257	46.2%
DT2 = 1	56	10.1%
DT2 = 0	500	89.9%
DT1 only	267	48.0%
DT2 only	24	4.3%
DT1 & DT2	32	5.8%

Source: Author's calculation based on harmonised LAU dataset (2006–2022).

The spatial distribution of these traps on regional level (NUTS 3), across counties (Table 2) further reinforces the argument that Croatia exhibits a “diverging development trajectory” characteristic of small, open and structurally heterogeneous economies. In first place, it reveals a marked spatial polarisation that aligns closely with the conceptual expectations laid out in the development trap literature (Iammarino, Rodríguez-Pose and Storper 2020; Diemer et al. 2022). Moreover, the results point to substantial variation not only between counties but also *within* the same county-level units, underscoring the importance of analysing these phenomena at a finer, local scale.

**Table 2. Regional distribution of development traps by county (number and percentage of LAUs)**

County (NUTS 3)	Total	DT1_low	DT1_middle	DT1_high	DT1_top	DT1=0	DT2=1	DT2=0
Bjelovar–Bilogora County	23	12 (52.2%)	4 (17.4%)	2 (8.7%)	0 (0.0%)	5 (21.7%)	4 (17.4%)	19 (82.6%)
Brod–Posavina County	28	16 (57.1%)	0 (0.0%)	1 (3.6%)	0 (0.0%)	11 (39.3%)	2 (7.1%)	26 (92.9%)
Dubrovnik–Neretva County	22	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	22 (100.0%)	0 (0.0%)	22 (100.0%)
City of Zagreb	1	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	1 (100.0%)
Istria county	41	0 (0.0%)	0 (0.0%)	4 (9.8%)	7 (17.1%)	30 (73.2%)	3 (7.3%)	38 (92.7%)
Karlovac County	22	3 (13.6%)	2 (9.1%)	6 (27.3%)	1 (4.5%)	10 (45.5%)	3 (13.6%)	19 (86.4%)
Koprivnica–Križevci County	25	12 (48.0%)	5 (20.0%)	1 (4.0%)	1 (4.0%)	6 (24.0%)	4 (16.0%)	21 (84.0%)
Krapina–Zagorje County	32	0 (0.0%)	2 (6.2%)	13 (40.6%)	2 (6.2%)	15 (46.9%)	3 (9.4%)	29 (90.6%)
Lika–Senj County	12	1 (8.3%)	0 (0.0%)	2 (16.7%)	0 (0.0%)	9 (75.0%)	2 (16.7%)	10 (83.3%)
Međimurje County	25	6 (24.0%)	6 (24.0%)	1 (4.0%)	0 (0.0%)	12 (48.0%)	1 (4.0%)	24 (96.0%)
Osijek–Baranja County	42	15 (35.7%)	7 (16.7%)	4 (9.5%)	1 (2.4%)	15 (35.7%)	3 (7.1%)	39 (92.9%)

County (NUTS 3)	Total	DT1_low	DT1_middle	DT1_high	DT1_top	DT1=0	DT2=1	DT2=0
Požega–Slavonia County	10	5 (50.0%)	0 (0.0%)	2 (20.0%)	0 (0.0%)	3 (30.0%)	1 (10.0%)	9 (90.0%)
Primorje–Gorski Kotar County	36	0 (0.0%)	0 (0.0%)	6 (16.7%)	12 (33.3%)	18 (50.0%)	7 (19.4%)	29 (80.6%)
Sisak–Moslavina County	19	2 (10.5%)	4 (21.1%)	3 (15.8%)	1 (5.3%)	9 (47.4%)	5 (26.3%)	14 (73.7%)
Split–Dalmatia County	55	8 (14.5%)	7 (12.7%)	9 (16.4%)	0 (0.0%)	31 (56.4%)	6 (10.9%)	49 (89.1%)
Varaždin county	28	3 (10.7%)	6 (21.4%)	10 (35.7%)	1 (3.6%)	8 (28.6%)	1 (3.6%)	27 (96.4%)
Virovitica–Podravina County	16	9 (56.2%)	2 (12.5%)	2 (12.5%)	0 (0.0%)	3 (18.8%)	5 (31.2%)	11 (68.8%)
Vukovar–Srijem County	31	13 (41.9%)	5 (16.1%)	2 (6.5%)	0 (0.0%)	11 (35.5%)	0 (0.0%)	31 (100.0%)
Zadar County	34	1 (2.9%)	9 (26.5%)	4 (11.8%)	0 (0.0%)	20 (58.8%)	0 (0.0%)	34 (100.0%)
Zagreb County	34	4 (11.8%)	6 (17.6%)	12 (35.3%)	3 (8.8%)	9 (26.5%)	3 (8.8%)	31 (91.2%)
Šibenik–Knin County	20	2 (10.0%)	8 (40.0%)	1 (5.0%)	0 (0.0%)	9 (45.0%)	3 (15.0%)	17 (85.0%)
Republic of Croatia	556	112 (20.1%)	73 (13.1%)	85 (15.3%)	29 (5.2%)	257 (46.2%)	56 (10.1%)	500 (89.9%)

Source: Author’s calculation based on harmonised LAU dataset (2006–2022).

Continental counties (e.g. Bjelovar–Bilogora, Koprivnica–Križevci, Osijek–Baranja, Požega–Slavonia, Virovitica–Podravina, and Vukovar–Srijem) show some of the highest concentrations of DT1\_low municipalities, often exceeding 40–55% of all local units within the county. These patterns indicate persistent structural stagnation among territories already positioned at the bottom of the national income distribution. The high shares of DT1\_low reflect not only economic rigidities but also signalling structural weaknesses widely recognised as drivers of regional development traps across Europe (Iammarino et al. 2020; Balland & Boschma 2024)

At the same time, several northern counties, located in relative proximity to the City of Zagreb and the EU internal border, most notably *Zagreb County*, *Varaždin*, and *Krapina–Zagorje County*, exhibit the highest concentration of DT1\_high municipalities and towns, reflecting their comparatively stronger structural conditions and improved long-term positional stability.

In contrast, the coastal counties (e.g. Istria, Primorje–Gorski Kotar, Split–Dalmatia, and Zadar) display a very different developmental profile, characterised by a high concentration of municipalities not affected by any development trap (DT1 = 0). For instance, in Primorje–Gorski Kotar County, approximately 50% of local units fall outside any DT1 trap category, while the remaining half are persistently located in the highest income decile groups (DT1\_high and DT1\_top). This pattern could indicate the structural and spatial advantages enjoyed by coastal, tourism-intensive regions, which have benefited from favourable global demand trends, stronger economic diversification and the ability to leverage opportunities arising from EU membership.

Obviously, the coastal–continental divide emerges clearly here. While coastal counties tend to sustain stable or high-income positions (DT1\_high, DT1\_top), continental counties, especially those in the Slavonia region, remain locked in structurally weaker developmental positions (DT1\_low). By contrast, northern counties appear to benefit from effects associated with proximity to the capital city and cross-border economic linkages, which help stabilise or elevate their long-term development trajectories.

Perhaps the most concerning finding from a policy perspective is the uneven territorial distribution of DT2 traps, which capture severe and persistent monotonic decline. Counties such as Sisak–Moslavina and Virovitica–Podravina county show above-average shares of DT2 municipalities, with some exceeding 30%, nearly three times the national average of 10.1%. These downward trajectories indicate not only persistent stagnation but a deepening loss of developmental capacity, consistent with the “erosion mechanism” described in evolutionary trap theory (Balland & Boschma 2024) and the broader geography of discontent literature (Dijkstra et al. 2019; Rodríguez-Pose et al. 2024).

The absence of DT1\_low or DT2 traps in counties such as Istria and Dubrovnik–Neretva county highlights the resilience of certain coastal territories and reinforces the earlier argument that Croatia’s long-term territorial divergence is shaped by multi-scalar, path-dependent processes tied to sectoral specialisation and exposure to external shocks. In sum, the county-level results not only reaffirm the existence of development traps but also reveal the territorial geometry of stagnation and decline in Croatia, a pattern fully consistent with Croatian structural conditions and broader European empirical evidence. This strengthens the case for applying a development trap framework at the LAU scale, where fine-grained vulnerabilities are most visible and where targeted, place-sensitive interventions can be most effective for reversing entrenched spatial inequalities.

#### 4.1. Robustness checks

To ensure the validity and stability of the findings presented in the previous section, it is essential to conduct a set of robustness checks capable of assessing whether the identified development traps (DT1 and DT2) reflect genuine long-term structural patterns rather than artefacts of the specific classification criteria or periodisation. In this respect, the application of Markov transition matrices provides a robustness exercise. By tracing the probabilities of upward, downward or stationary movements across income deciles between consecutive reference periods, these matrices uncover the underlying mobility structure driving LAU-level trajectories.

Before interpreting the results of the four transition matrices (Table 3a, 3b, 3c and 3d), it is important to clarify how these tables should be read and what their values represent. Each matrix reports row-wise percentages, meaning that every row (1–10) sums to 100% and describes the *full distribution of possible destinations* for local units (LAUs) starting in a given income decile in the earlier period. The rows (1–10) indicate the decile in which an LAU was located in the *earlier* reference period, with row 1 corresponding to the lowest-income decile and row 10 to the highest-income decile. The columns (1–10) represent the decile in which the same LAUs are found in the *later* reference period, again ranging from the lowest (1) to highest (10) decile. Each cell (i, j) therefore shows the percentage of all LAUs that began in decile i in the earlier period and moved to decile j in the later period. Because rows sum to 100%, the matrices provide a probabilistic representation of decile mobility, indicating the likelihood that a municipality either remains in the same decile, moves upward (cells to the right of the diagonal), or moves downward (cells to the left of the diagonal). The diagonal cells (i = j) capture positional stability, while the off-diagonal cells provide insight into upward or downward movement within the national income distribution. Taken together, these matrices provide a dynamic, mobility-based complement to the DT1 and DT2 classifications, allowing for a deeper examination of stagnation, limited mobility, and decline across Croatian LAUs.

The results presented in Table 3a confirm that the period encompassing the global financial crisis (2006–2008 → 2010–2012) produced limited upward mobility and strong positional persistence across Croatian municipalities. The lowest-income LAUs (decile 1) display extraordinarily high stability, with 84% remaining in the bottom decile, while only marginal shares move upward. Similarly, top-decile municipalities remain overwhelmingly stable (decile

10 - 83,7%). This asymmetric rigidity in the distribution emphasised the prevalence of long-term stagnation among structurally weaker territories (DT1\_low) and the entrenched advantages of high-performing municipalities and towns (DT1\_high, DT1\_top). The crisis acted not as a shock that reshuffled territorial hierarchies, but rather as a shock that reinforced existing structural divides, mirroring the development-trap dynamics highlighted by Iammarino, Rodríguez-Pose and Storper (2020) and Diemer et al. (2022).

**Table 3a. Transition matrix 2006–2008 → 2010–2012 (row-wise percentages)**

Decile	1	2	3	4	5	6	7	8	9	10
1	84.0	12.0	2.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
2	10.4	60.4	25.0	2.1	0.0	2.1	0.0	0.0	0.0	0.0
3	6.0	20.0	44.0	26.0	2.0	2.0	0.0	0.0	0.0	0.0
4	0.0	8.2	20.4	38.8	22.4	10.2	0.0	0.0	0.0	0.0
5	0.0	2.0	6.0	18.0	48.0	22.0	2.0	2.0	0.0	0.0
6	0.0	0.0	4.1	6.1	24.5	38.8	22.4	2.0	2.0	0.0
7	0.0	0.0	0.0	2.0	2.0	22.4	49.0	20.4	4.1	0.0
8	0.0	0.0	0.0	0.0	0.0	2.0	20.0	58.0	18.0	2.0
9	0.0	0.0	0.0	0.0	0.0	0.0	6.0	16.0	62.0	16.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	14.3	83.7

Source: Author’s calculation based on harmonised LAU dataset

The transition patterns in Table 3b (2010–2012 → 2014–2016), covering the period of national economic decline (till 2014) but also period of Croatia’s EU accession, continue to show pronounced diagonal dominance but modestly higher mobility in the middle deciles (4–6). Yet, even during this relatively favourable phase, a clear majority of municipalities remained in the same income decile. Although the moderate upward movements observed in some middle-income LAUs suggest selective improvements, overall pattern confirmed that EU membership did not automatically and in short-run translate for the most of LAUs into upward developmental trajectories.

**Table 3b. Transition matrix 2010–2012 → 2014–2016 (row-wise percentages)**

Decile	1	2	3	4	5	6	7	8	9	10
1	76.9	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	19.2	53.8	21.2	3.8	1.9	0.0	0.0	0.0	0.0	0.0
3	1.9	19.2	48.1	25.0	5.8	0.0	0.0	0.0	0.0	0.0
4	0.0	3.8	25.0	48.1	17.3	3.8	1.9	0.0	0.0	0.0
5	0.0	0.0	1.9	19.2	48.1	21.2	9.6	0.0	0.0	0.0
6	1.9	0.0	1.9	3.8	25.0	36.5	28.8	1.9	0.0	0.0
7	0.0	0.0	0.0	0.0	1.9	30.8	28.8	32.7	3.8	1.9
8	0.0	0.0	0.0	0.0	0.0	2.0	31.4	45.1	17.6	3.9
9	0.0	0.0	0.0	0.0	0.0	2.0	0.0	20.4	63.3	14.3
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	17.6	80.4

Source: Author’s calculation based on harmonised LAU dataset

In Table 3c (2014–2016 → 2020–2022), covering the not only period of the post EU accession and national economic growth, but also shaped by the COVID-19 shock, decile transitions display even lower mobility than in previous intervals. The bottom deciles again exhibit overwhelming positional rigidity, while top-decile LAUs remain exceptionally stable. This is consistent with the spatially uneven exposure to the pandemic documented in previous section, where high-performing counties maintained their long-term comparative advantages. Conversely, many weaker municipalities continued to lack the adaptive capacity necessary to improve their relative position, reinforcing the logic of DT1\_low traps. The near-absence of upward transitions highlights that Croatia’s regional development hierarchy remained largely unchanged despite major external shocks, precisely in line with the development-trap literature that conceptualises stagnation as a long-term structural condition rather than a short-term fluctuation.

**Table 3c. Transition matrix 2014–2016 → 2020–2022 (row-wise percentages)**

Decile	1	2	3	4	5	6	7	8	9	10
1	84.9	11.3	1.9	1.9	0.0	0.0	0.0	0.0	0.0	0.0
2	20.8	62.3	13.2	3.8	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	19.2	51.9	23.1	1.9	3.8	0.0	0.0	0.0	0.0
4	0.0	9.4	32.1	32.1	17.0	9.4	0.0	0.0	0.0	0.0
5	0.0	3.8	5.8	30.8	46.2	9.6	3.8	0.0	0.0	0.0
6	0.0	0.0	0.0	11.3	26.4	35.8	22.6	3.8	0.0	0.0
7	0.0	0.0	0.0	3.8	7.5	24.5	41.5	20.8	0.0	1.9
8	0.0	0.0	0.0	0.0	3.8	13.5	15.4	44.2	21.2	1.9
9	0.0	0.0	0.0	0.0	0.0	1.9	13.2	28.3	41.5	15.1
10	0.0	0.0	0.0	0.0	0.0	1.9	1.9	1.9	26.9	67.3

Finally, the long-run transition matrix in Table 3d (2006–2008 → 2020–2022) provides the clearest confirmation of deep territorial path dependence. Over the full 16-year period and severe external shocks (global financial crisis, EU accession, COVID-19 crisis), upward transitions are exceedingly rare across all starting deciles, while the majority of municipalities remain in, or return to, their original relative position.

**Table 3d. Long-run transition matrix 2006–2008 → 2020–2022 (row-wise percentages)**

Decile	1	2	3	4	5	6	7	8	9	10
1	78.0	20.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	20.0	50.0	14.0	16.0	0.0	0.0	0.0	0.0	0.0	0.0
3	8.0	18.0	48.0	14.0	4.0	8.0	0.0	0.0	0.0	0.0
4	2.0	12.2	26.5	24.5	22.4	10.2	2.0	0.0	0.0	0.0
5	0.0	6.0	8.0	26.0	34.0	18.0	8.0	0.0	0.0	0.0
6	2.0	0.0	0.0	10.0	30.0	20.0	26.0	12.0	0.0	0.0
7	0.0	0.0	0.0	6.1	4.1	36.7	24.5	22.4	6.1	0.0
8	0.0	0.0	0.0	2.0	4.0	10.0	28.0	34.0	20.0	2.0
9	0.0	0.0	0.0	0.0	0.0	2.0	6.0	28.0	38.0	26.0
10	0.0	0.0	0.0	0.0	0.0	0.0	2.0	6.1	28.6	63.3

This long-horizon rigidity goes in line with previous identification of nearly half of all LAUs as being persistently locked in DT1 stagnation. The long-run matrix thus captures the cumulative effect of structural stagnation and decline: LAUs in DT1\_low overwhelmingly remain in the bottom deciles, while a significant proportion of DT2 municipalities demonstrate clear downward movement. This confirms that development traps in Croatia operate as durable, multi-period processes, shaped by structural economic legacies, demographic shrinkage, and uneven institutional capacity, reinforcing the broader European evidence on path-dependent territorial divergence (Rodríguez-Pose et al. 2024; Balland & Boschma 2024).

Taken together, Tables 7a–7d provide robust, complementary evidence supporting that Croatian LAUs face severely constrained upward mobility and that both stagnation (DT1) and decline (DT2) are deeply embedded in the regional development landscape. The Markov-based robustness checks thus not only validate the earlier classification results but also reveal the probabilistic structures through which development traps persist, evolve, and intensify across time.

## **Conclusion**

This paper set out to provide the first systematic analysis of income-based development traps at the local level for a small and open EU economy like Croatia. By applying a standardized, multi-period framework to all 556 municipalities and towns from 2006 to 2022, the study offers new empirical evidence on the long-term mechanisms of territorial stagnation and decline in a context marked by administrative fragmentation, pronounced spatial heterogeneity and uneven economic resilience.

The results reveal several important insights. First, nearly half of all LAUs are persistently locked in the same relative income tier across the entire 16-year period, confirming the presence of strong path dependence and deep-seated positional immobility. Second, although fewer in number, more than 10% of LAUs exhibit a monotonic decline in standardized income,

signalling structural deterioration rather than mere stagnation. Third, Croatia displays a clear developmental geometry: coastal counties and selected urban areas maintain stable or high-income positions, while many continental and Slavonian municipalities remain trapped in structurally weak positions or experience erosion of their income base.

Perhaps the most notable finding is the substantial heterogeneity observed not only between counties but also within them. Municipalities located in the same county, subject to the same regional institutions, development strategies and macroeconomic environment, nonetheless follow sharply divergent trajectories. This intra-county variation demonstrates that development traps form and persist at a much finer territorial scale than typically captured by NUTS 2 or NUTS 3 analyses. For small and open economies such as Croatia, where local capacities, productive structures, demographic pressures and fiscal constraints differ widely across municipalities, a localised perspective is indispensable for correctly identifying structural vulnerabilities and opportunities for recovery.

The Markov-based robustness checks further reinforce these findings by showing that upward mobility across income deciles is extremely rare, while downward or stationary patterns dominate. Even major systemic events, the global financial crisis, EU accession, and the COVID-19 shock, did not significantly alter the long-term developmental hierarchy, underscoring the durability of development traps as multi-period, structural processes.

Taken together, these insights highlight the need for place-sensitive and fine-grained development policies capable of addressing entrenched disparities at the level where they are actually produced and experienced: the municipality. National or regional strategies designed at higher territorial levels risk overlooking the highly uneven local trajectories documented in this study. Approaches tailored to local administrative capacities, productive specialisation, demographic conditions, and institutional constraints are essential if policymakers aim to reverse stagnation, mitigate decline, and prevent further territorial divergence.

By uncovering the depth and territorial complexity of development traps at the local scale, this paper contributes to both academic debates and policy practice. It demonstrates that in structurally heterogeneous, small EU economies, understanding development traps requires a zoom-in approach, one capable of identifying vulnerabilities and potentials invisible at broader spatial scales.

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## **THE ECONOMIC PERFORMANCES OF MOROCCAN REGIONS: A TOPSIS AND SPATIAL AUTOCORRELATION METHODS**

**Hamdi EL ASLI**

Laboratory of Economy & Management, Polydisciplinary Faculty of Khouribga (25000), Sultan  
Moulay Slimane University of Beni Mellal (23000), Morocco  
hamdielasli@gmail.com

**Mohamed AZEROUAL**

Laboratory of Economy & Management, Polydisciplinary Faculty of Khouribga (25000), Sultan  
Moulay Slimane University of Beni Mellal (23000), Morocco  
m.azeroual@usms.ma

**Alae MOHAMMED MOURAI**

Laboratory of Economy & Management, Polydisciplinary Faculty of Khouribga (25000), Sultan  
Moulay Slimane University of Beni Mellal (23000), Morocco  
alae.mourai@gmail.com

**Mounya CHAHBOUNE**

Laboratory of Economy & Management, Polydisciplinary Faculty of Khouribga (25000), Sultan  
Moulay Slimane University of Beni Mellal (23000), Morocco  
c.mounya@gmail.com

**Abdelhak OULALA**

Laboratory of Economy & Management, Polydisciplinary Faculty of Khouribga (25000), Sultan  
Moulay Slimane University of Beni Mellal (23000), Morocco  
oulala1981@gmail.com

### **Abstract**

This paper investigates the economic performance of Morocco's twelve regions from 2015 to 2022, combining a temporal and spatial analysis methods, and focusing on five key regional macroeconomic indicators: GDP per capita, HFCE per capita, contribution to national growth, start-ups created, and the activity rate. While previous studies have examined regional disparities using MCDM or spatial statistics, none have combined TOPSIS with spatial autocorrelation to evaluate regional economic-entrepreneurial performance in Morocco under its new administrative division, which enables ranking of regional competitiveness and detection of clustering patterns. Findings show that Casablanca-Settat consistently ranks in the top twelve, solidifying its position as the country's economic capital, followed alternately by the northern Tanger-Tétouan-Al Hoceima and the emergent Rabat-Salé-Kénitra regions, while the southern regions remain at the bottom. Marrakech-Safi was severely affected by the disruption of tourist cash flows under the Covid-19 crisis, before it gradually recovered post-2020. Similarly, Béni Mellal-Khénifra progressed significantly, largely due to its phosphate exports, agro-oil industry, and remittances' inflows, until 2020, when it retrograded remarkably. Spatial analysis reveals that Moroccan regions exhibit high autocorrelation, with both, top and low ranked regions identified by the TOPSIS method clustering together. Results can inform region-specific development strategies, equitable resource allocation, entrepreneurship promotion, and spatial regional planning. However, limitations such as the restricted set of indicators, short interval, and methodological constraints suggest future research directions that integrate broader social, environmental, and innovation variables, extend the sample interval, and apply advanced comparative and econometric approaches.

**Keywords:** Morocco, regions, economy, TOPSIS, spatial autocorrelation

**JEL classification:** C38, L26, R11, R12

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## **1. Introduction**

Economic and entrepreneurial disparities among regional territories remain a pressing concern for development planners, especially in contexts marked by heterogeneous resource endowments and institutional capacities. In Morocco, despite concerted efforts toward decentralization and inclusive growth, significant spatial inequalities persist, evidenced by differing regional trajectories in investment, infrastructure, and entrepreneurial activity (Afifi & Ismaili Idrissi, 2025; Ouhakki et al, 2022). This study conducts a spatiotemporal analysis of the Moroccan regions' economic and entrepreneurial performance by integrating TOPSIS and spatial autocorrelation techniques. TOPSIS will rank regions in terms of their economic and entrepreneurial efficacy, while spatial autocorrelation diagnostics will elucidate whether high-performing regions tend to cluster and whether similar patterns persist over time. This dual approach aims to yield both normative rankings and a richer understanding of spatial inequality dynamics, providing meaningful insights for policymakers seeking balanced regional development. Since 2015, Morocco has adopted a new administrative structure comprising twelve regions instead of sixteen, each with financial and governance autonomy, as part of its advanced regionalization plan to promote a political solution to the Western Sahara conflict (Zoubir, 2018). This new structure aims to ensure balanced development, reduce regional disparities, and address the unequal distribution of natural resources and demographic density by investing in local infrastructure and projects tailored to each region's unique characteristics, priorities, and economic potential. Casablanca-Settat, the country's economic heart, a major financial center, home to the largest port and numerous international companies, and a hub of industries like manufacturing, textiles, automotive and aeronautics, in addition to services like banking, finance, telecommunications, and trade are predominant here, besides nearshore facilities, nevertheless, the essor of agriculture is remarkable in the plains of Chaouia, around Settat city. Rabat-Salé-Kénitra, while hosting Rabat city, the political and administrative capital of Morocco, benefits from government services, international organizations, and a growing tech sector, as well as manufacturing, logistics, and the development of new industrial zones, besides remarkable infrastructure. Tanger-Tetouan-Al Hoceima is a key industrial and logistical hub, thanks to the Tangier-Med port, one of Africa's largest ports. The region is also seeing growth in the automotive, aerospace, and electronics sectors, besides tourism, agriculture, and some light industries. Marrakech-Safi: when Marrakech city is a major tourist destination, it drives growth in hospitality, real estate, and services in Marrakech-Safi. Safi is well known for its phosphate industry and fishing activities. The region is benefiting from the first portion of arable lands at the national level. Beni Mellal – Khenifra heavily depends on agriculture, which is the backbone of the region's economy. The major crops in this region include cereals, beetroot, olives, citrus fruits, and pomegranates, and it hosts 44% Morocco reserves among 70% of the world's known phosphate rock reserves, making it the leading global supplier of this essential agricultural resource (Walan et al., 2014). Fès-Meknès: Fès is an important cultural and educational center with a growing tourism sector. Meknès is known for its historical sites, agriculture, and emerging industrial activities. The region also has a strong agriculture base especially in vine-growing. Souss-Massa, where Agadir, the main city, is a key region for agriculture, particularly citrus fruits and vegetables. It is also a popular tourist destination and has significant fishing and processing industries. The Oriental-Rif region benefits from cross-border trade with Algeria, despite political tensions. it is also developing its mining and renewable energy sectors. Drâa-Tafilalet is known for its mining resources, and a growing tourism industry focused on its desert landscapes and historical sites. Its strengths lie in high-potential sectors such as tourism, anchored by iconic desert and cultural sites, and renewable energy, notably the Noor Ouarzazate solar complex, hence, the region also benefits from niche agricultural products like dates and saffron, which can support value-added exports. The southern regions of Laâyoune-Sakia El Hamra, Guelmim-Oued Noun and Dakhla-Oued Ed-Dahab, are seeing significant investments in renewable energy, fisheries, and phosphates. Together, they embody a key aspect of Morocco's broader strategy to integrate sub-Saharan Africa (SIMIC, 2023), and to boost for a political solution of the Western Sahara conflict by the economic lever. Figure 1 maps the Moroccan regions under the updated 2015 administrative division.

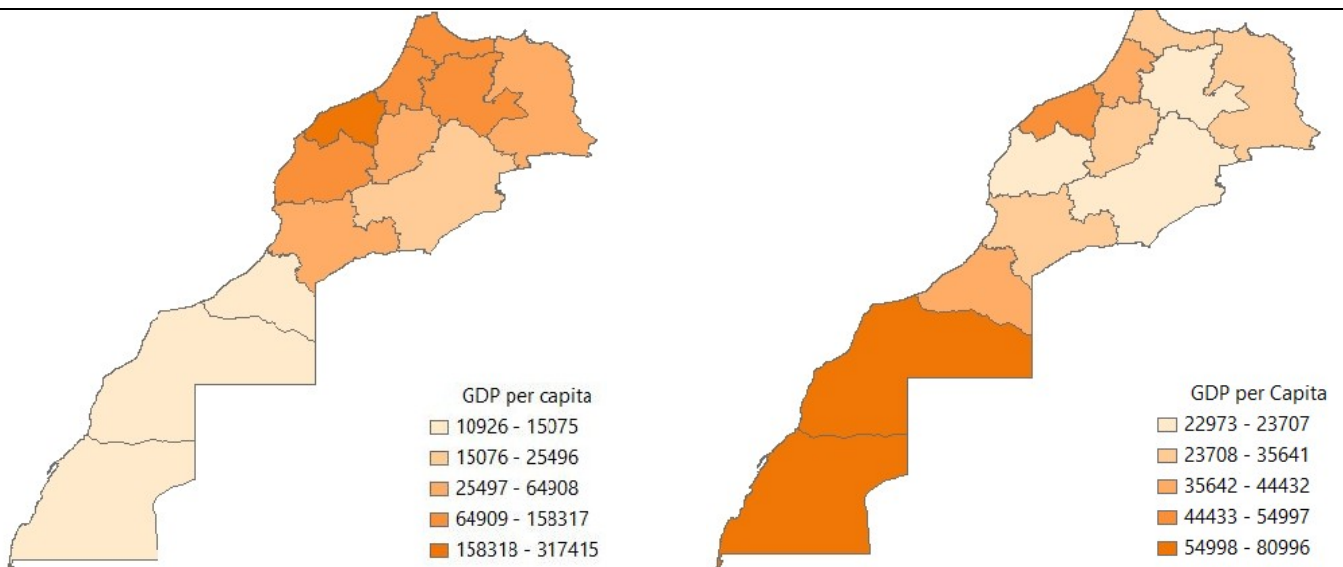
**Figure 1: The administrative division of the twelve Moroccan regions**

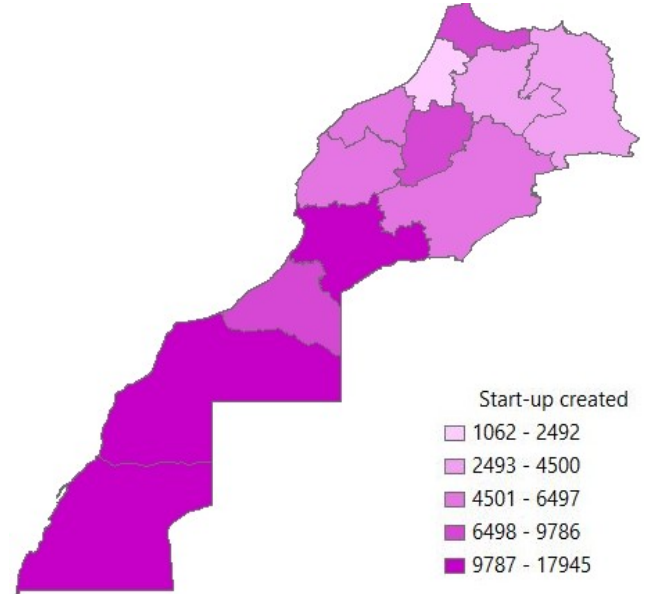
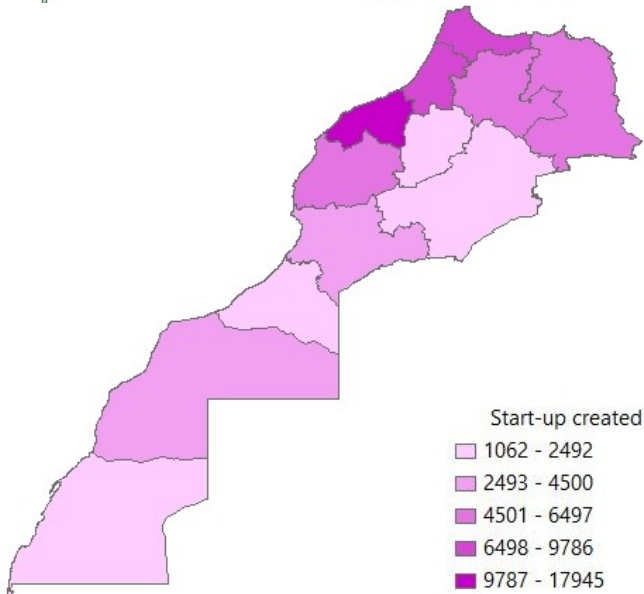
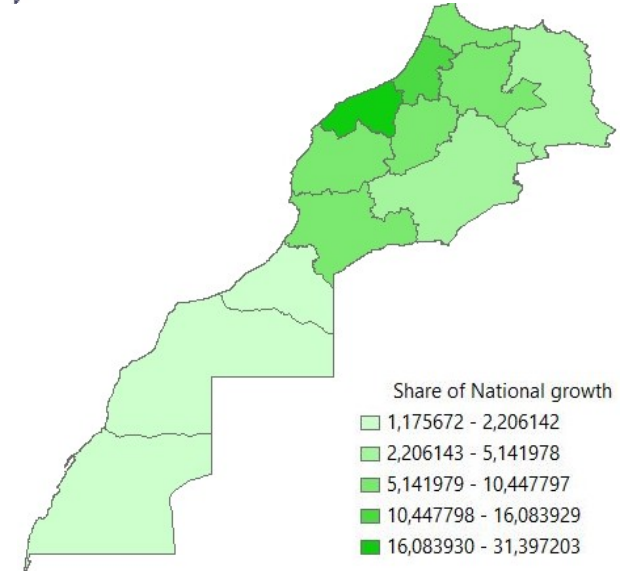
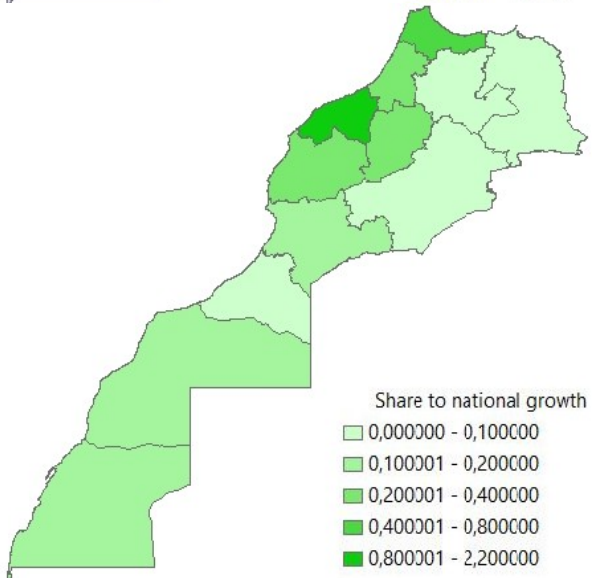
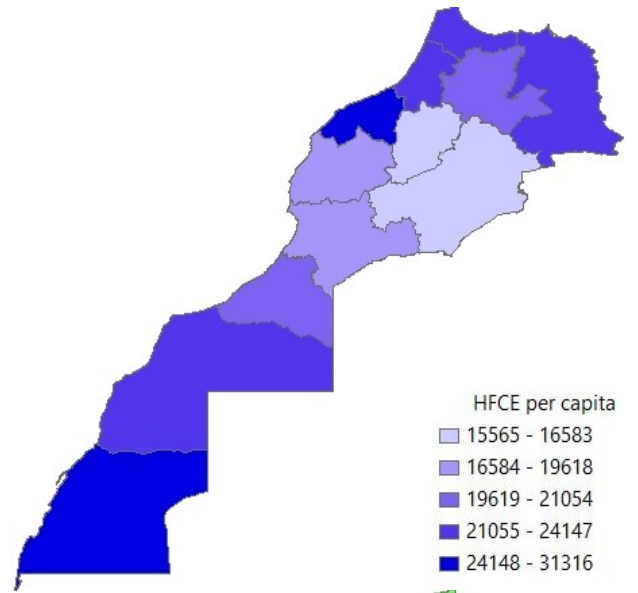
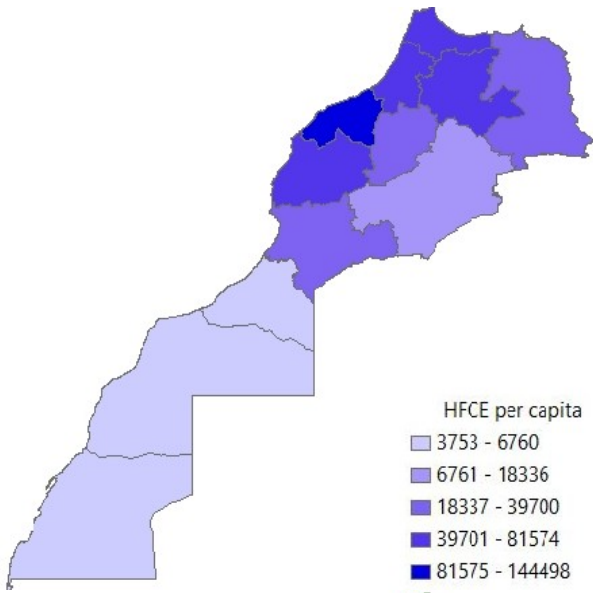


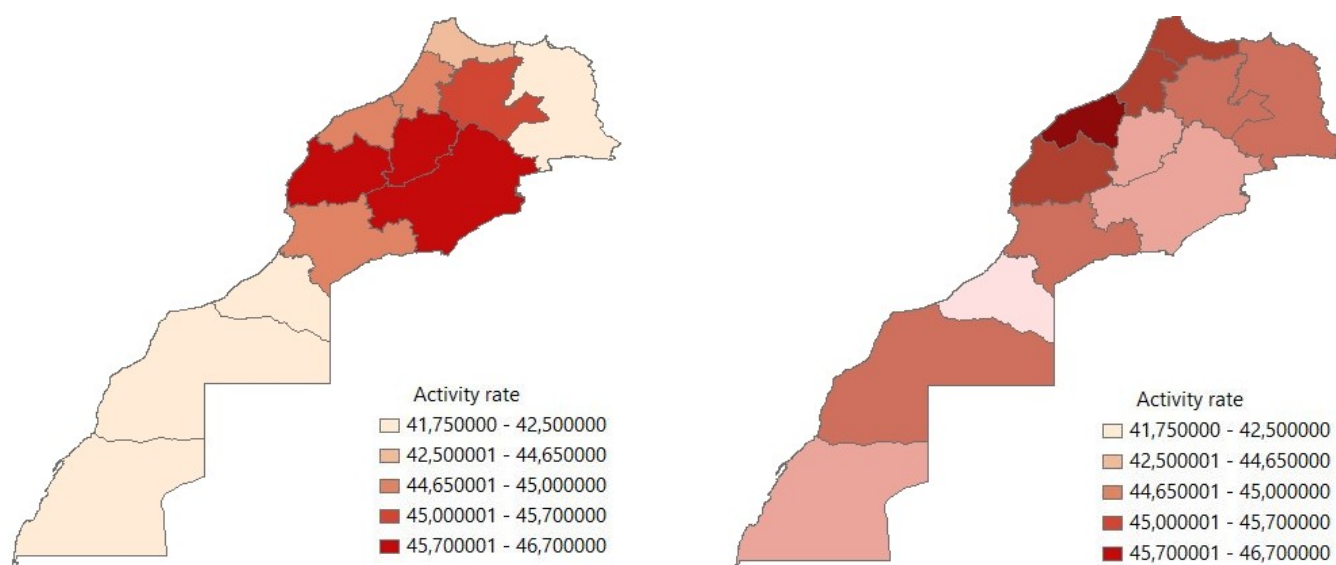
Source: Arcmap10.4 outputs based on official administrative division (Law 47-96 reform of 2015).

As shown in Figure 1, Morocco’s largest regions by surface area are mostly in the south. Dakhla-Oued Ed-Dahab and Laâyoune-Sakia El Hamra, mostly deserted, dominate the list, each covering around 140,000 km<sup>2</sup>, followed by Drâa-Tafilalet with nearly 89,000 km<sup>2</sup> and the Oriental region with about 83,000km<sup>2</sup>. Further north, the regions get smaller: Souss-Massa has roughly 54,000 km<sup>2</sup>, Béni Mellal-Khénifra around 28,000, and Marrakech-Safi and Fès-Meknès are just above 39,000 and 40,000 km<sup>2</sup> respectively. The most compact regions are Tanger-Tétouan-Al Hoceïma, Casablanca-Settat, and Rabat-Salé-Kénitra, each under 20,000 km<sup>2</sup>, concentrated in Morocco’s densely populated Atlantic and Mediterranean corridors. Figure 2 illustrates the evolution of the five regional macroeconomic aggregates from 2015 to 2022. The 2015 aggregates are presented on the left, and the 2022 ones are on the right, with a map key underneath each time.

**Figure 2: Evolution of the economic-entrepreneurial performances of Moroccan regions**







Source: Arcmap10.4 outputs based on authors own computations

As shown in Figure 2, in 2015, the economic and entrepreneurial performances of Moroccan regions were steadily concentrated in the northern, western, and central regions, while the southern regions remained relatively marginalized. However, over the eight years, these regions underwent a progressive evolution, ultimately catching up with the northern regions in all indicators by 2022.

## **2. Literature review**

Without delving in the evident correlation between economic growth and development, the relationship between entrepreneurship and economic development is complex, but it is generally agreed that entrepreneurship plays a crucial role in driving economic growth and development. Entrepreneurship drives innovation, job creation, and economic growth by creating new businesses and jobs, generating innovation, and stimulating competition, which contributes to a more productive and efficient economy (Wennekers, 2010). Empirically, entrepreneurship has an overall positive effect on economic development, although the relationship is U-shaped, with entrepreneurship initially declining but then reviving as economies grow (Piotr & Rekowski, 2008). Studies on Morocco's territorial economy consistently reveal persistent spatial disparities in economic and entrepreneurial performance. Boumahdi and Zaoujal (2023) highlight that Morocco's regions differ markedly in labor market conditions, human capital, innovation, and infrastructure, with the coastal and urbanized areas outperforming interior and southern regions. Such disparities persist despite national efforts toward decentralization and regional development.

Kattabi et al. (2025) confirm the existence of a convergence process of regional disparities in Morocco, indicating that specific economic variables positively influence regional development. World bank Policy-oriented reports from reinforce this picture, all underscore reducing social and territorial inequalities as a core objective of Morocco's development agenda. Structural factors, such as water scarcity, rural-urban divides, and the concentration of industrial agglomerations, are frequently cited as major contributors to uneven regional performance (Malouche & Partow, 2019).

From an entrepreneurship perspective, the Moroccan ecosystem has been improving but remains geographically concentrated. The 2025 Global Startup Ecosystem Index places Morocco in a competitive regional position, yet entrepreneurial activity, financing, and incubation are still largely clustered in Casablanca-Settat, Rabat-Salé-Kénitra, and Tanger-Tétouan-Al Hoceïma and together, they provide employment to 73% to the labor force (Robichaud et al., 2023). Public programs and initiatives like Technopark, Maroc PME and InnovInvest aimed at fostering entrepreneurship, the spread of entrepreneurial activities into less developed regions remains limited due to fragmented support mechanisms and investor risk aversion (Ghaziri, 2022; Robichaud et al., 2023). Furthermore, fragmentation in support mechanisms and investor risk aversion as barriers to diffusion into lagging regions (Frese and

De Kruijff, 2000). This, and the urgent need for territorial development balances, and equitable wealth distribution are the main motivations behind this administrative distribution, knowing that 60% of Morocco's GDP emerge from three regions (Kattabi et al., 2025). This hub underscores the need for integrated approaches that combine composite performance ranking with spatial diagnostics for relevant policies taking. Methodologically, To comprehensively assess these disparities, it is essential to deploy methods that capture both the relative comparative performance of regions and the spatial structures underlying their development. MCDM such as TOPSIS method enable the ranking of regions based on multiple economic and entrepreneurial indicators. Meanwhile, spatial autocorrelation measures, like Moran's I and Local Indicators of Spatial Association reveal the clustering patterns and spatial dependencies that often escape purely non-spatial evaluation (Hirobe, 2014; Martinho, 2018; Akbaşoğullari & Duran, 2020; Chairat & Pechsong, 2020; Manaeva & Tkacheva, 2021; Manaeva et al, 2021). Multi-criteria decision-making (MCDM) techniques have become standard for synthesizing diverse regional indicators into composite performance scores (Ziārīl & Mohammadi , 2016). The TOPSIS method introduced by Hwang and Yoon (1981) ranks alternatives based on their proximity to an ideal and anti-ideal solution, offering transparency and comparability over time. Subsequent refinements, such as improved normalization procedures, have increased its robustness for regional benchmarking (Sarraf et al., 2013). It started to be used in scarcely in the fields of managements and economics with Karimi et al. (2009) who examined the location decision for FDI in ASEAN countries, with Sait (2011) who applied TOPSIS and WSA (Weighted Sum Approach) in analysis of economic activities of European Union States and candidate countries.

Complementing MCDM approaches, spatial autocorrelation techniques provide valuable insights into the geographic structure of performance. Anselin's (1995)' LISA framework allows detection of high-high and low-low clusters, as well as spatial outliers, while extensions by Chen. (2022) improves its adaptability to spatiotemporal datasets. In Moroccan applications, spatial econometrics has been employed to analyze regional convergence and inequality (Afifi & Ismaili Idrissi, 2025), consistently showing that economic performance exhibits significant spatial dependence. Several regional performance studies have combined MCDM approaches and spatial autocorrelation methods to evaluate macroeconomic aggregates in different national contexts. For example, (Yorulmaz et al., 2021) applied a based-TOPSIS to rank Turkish provinces by economic development using GDP, employment, and investment indicators, revealing persistent east-west disparities. In China, (He & Liu, 2022) integrated TOPSIS with Moran's I to assess provincial competitiveness, showing significant spatial clustering of high-growth regions along the eastern seaboard. In Spain, López-Bazo et al. (2002) used Moran's I autocorrelation for analyzing the regional distribution of unemployment, highlighting the geographic persistence of macroeconomic inequalities. In Morocco, Afifi and Ismaili Idrissi (2025) applied Principal Component Analysis (PCA) and Exploratory Spatial Data Analysis (ESDA), to the 12 regions from 2015 to 2022, to reveal the existence of spatial autocorrelation for GDP and the agricultural sector, and to show that industry has a greater impact on economic growth than agriculture, highlighting a strong heterogeneity in the distribution of wealth in Morocco. These studies demonstrate the methodological value of pairing multi-criteria rankings with spatial diagnostics to capture both the relative performance of regions and the geographical structure of economic disparities.

**Research gap:** While previous studies have addressed regional disparities and applied either MCDM or spatial statistics, few have integrated TOPSIS with spatial autocorrelation to assess regional economic-entrepreneurial performance in Morocco under the new administrative division. This integration enables both ranking of regional competitiveness and detection of spatial clustering patterns, offering richer policy-relevant insights. On this basis, in order to measure the economic and entrepreneurial performances of Moroccan regions, the following hypotheses are posed:

H<sub>1</sub>: The twelve Moroccan regions have an equal economic and entrepreneurial performances

H<sub>2</sub>: There is a spatial autocorrelation between these regions with regard to H<sub>1</sub>

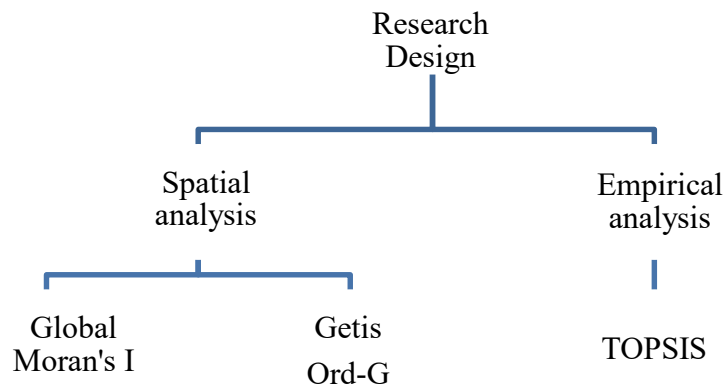
### **3. Methods and data**

#### **3.1. Methodology**

This research is designed upon the TOPSIS method for empirical analysis, the Getis-Ord General G, the Global and Local Moran's I methods for spatial analysis, all over the period from 2015 to 2022.

The following Scheme 1 represents this methodology in a chart-flow

**Scheme 1: Research design**



Source: Author own computation

#### **3.2. Data collection**

The TOPSIS method is conducted based on five criterions: regional per capita GDP and HFCE (householders final consumption expenditure), both in MAD (Moroccan dirham), the contribution of each region to the national growth in percent; the number of startups created; the regional activity rate (100-unemployment rate) to total labor force.

This data has been retrieved from Moroccan statistics office, Morocco open data, and Moroccan entrepreneurship barometer.

#### **3.3. The TOPSIS method**

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a tool for establishing order preference by similarity to the ideal solution, which was developed by Hwang and Yoon (1981) and Lai et al. (1994) for dealing with real-valued data. Currently it becomes one of the most popular methods for MCDM. The principle of TOPSIS is quite simple; the selected best alternative should have the shortest distance from the positive ideal solution and the greatest distance from the negative one in the geometrical (Euclidean) sense, in other words, the ideal alternative solution has the best level of all attributes considered, whereas the negative ideal solution is the one with the worst attribute value. There are three main advantages in this method: it's a practical tool incarnated by mathematical simplicity and high flexibility in the definition of the choice set. Hung and Chen (2009) listed three advantages of TOPSIS: simple, rationally comprehensible concept, good computational efficiency, and its ability to measure the relative performance for each alternative in simple mathematical form. Hence, it offers a marge of subjectivity regarding the possibility of weighting each criterion following the researcher desire.

The TOPSIS is expressed in a succession of six steps as suggested (Jahanshahloo et al., 2008).

- Step 1: Construction of the normalized decision matrix

The normalized decision matrix converts different criteria units into comparable scales. Each element  $r_{ij}$  is calculated as:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \quad (1)$$

Where,  $x_{ij}$  is the performance value of alternative  $i$  under criterion  $j$ , and  $m$  is the number of alternatives. This ensures all criteria are unitless and comparable.

- Step 2: Construction of the weighted normalized decision matrix  
Multiply each normalized value  $r_{ij}$  by its criterion weight  $w_j$ :

$$v_{ij} = w_j \cdot r_{ij} \quad (2)$$

Where,  $w_j$  is the weight of criterion  $j$  with the sum of all weights is equal to 1. This incorporates the relative importance of each criterion.

- Step 3: Determination of the Positive Ideal Solution (PIS) and Negative Ideal Solution (NIS)

While the positive ideal solution represents the best case, the negative one presents the worst:

$$V^+ = \{v_1^+, v_2^+, \dots, v_n^+\}, v_j^+ = \max v_{ij} \text{ (benefit), } \min v_{ij} \text{ (cost)} \quad (3)$$

$$V^- = \{v_1^-, v_2^-, \dots, v_n^-\}, v_j^- = \min v_{ij} \text{ (benefit), } \max v_{ij} \text{ (cost)} \quad (4)$$

For benefit criteria, higher values are better, and for cost criteria, lower values are better

- Step 4: Calculation of the separation measures

Compute the Euclidean distance of each alternative from the PIS ( $S_i^+$ ) and NIS ( $S_i^-$ ):

$$S_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2} \quad (5)$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2} \quad (6)$$

Distance measures quantify how far each alternative is from the ideal and anti-ideal solutions.

- Step 5: Estimations of the Relative Closeness (RC) to the ideal solution

Relative closeness of each alternative to the PIS is:

$$RC_i = \frac{S_i^-}{S_i^+ + S_i^-} \quad (7)$$

Where,  $0 \leq RC_i \leq 1$ , the more is higher  $RC_i$ , the more its closer to the ideal solution

- Step 6: Ranking the alternatives

Alternatives are ranked based on  $RC_i$  in descending order, where:

Rank <sub>$i$</sub>  = position of  $RC_i$  in descending order

Alternative with highest  $RC_i$  gets the first rank, and alternative with lowest  $RC_i$  gets the latest

### 3.4. Global and local Moran's I

The Global Moran's I measures the degree to which a set of spatial features and their associated data values tend to be clustered together in space (auto-correlation). Its (Anselin, 1995)' formulas are as following, in line with (Abdulhafedh, 2017):

$$I = \frac{N}{W} \cdot \frac{\sum_{i=1}^N \sum_{j=1}^N w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^N (x_i - \bar{x})^2} \quad (8)$$

Where,  $N$  is the number of features,  $x_i$  the attribute value at location  $I$ ,  $\bar{x}$  the mean of the attribute,  $w_{ij}$  the spatial weight between feature  $i$  and feature  $j$ , which captures spatial relationship, such as adjacency or distance decay,  $W = \sum_{i=1}^N \sum_{j=1}^N w_{ij}$  is the sum of all spatial weights ( $\sum_i \sum_j w_{ij}$ ), which defines the closeness or influence between spatial units  $i$  and  $j$ .

The local Moran's I for local distribution can be calculated as:

$$I_i = \frac{(x_i - \bar{x})}{m_2} \sum_{j=1}^N w_{ij} (x_j - \bar{x}) \quad (9)$$

Where,  $x_i$  is the attribute value at location  $I$ , and  $w_{ij}$  is the spatial weight between  $i$  and  $j$ , while

$$m_2 = \frac{1}{N} \sum_{k=1}^N (x_k - \bar{x})^2 \quad (10)$$

The inverse distance weight approach sets:

$$w_{ij} = \begin{cases} \frac{1}{d_{ij}}, & i \neq j, \text{ and } d_{ij} > 0 \\ 0, & i = j \end{cases} \quad (11)$$

Where,  $d_{ij}$  is the Euclidean distance between locations  $i$  and  $j$ , and diagonal elements are zero since a location does not exert spatial influence on itself.

However, while inverse distance is better for continuous spatial processes such as potential markets, migration, cross-borders diffusion, large distances can yield very small weights, which may require row-standardization, as in this study:

$$w_{ij}^* = \frac{w_{ij}}{\sum_{j=1}^N w_{ij}} \quad (12)$$

Row-standardization ensures the total influence from all neighbors for each unit sums to 1.

For both Global and Local Moran's I, it is calculated a Z-score related to a p-value based on the null hypothesis of spatial randomness, under a distance-based weight defined as the inverse distance between locations  $i$  and  $j$  (Cliff and Ord. (1975), its formula is:

$$z(I) = \frac{I - E[I]}{\sqrt{Var(I)}} \quad (13)$$

where  $E(I)$  is the expected value of  $I$ , and  $V(I)$  is the variance of  $I$ , with the following

$$E[I] = -\frac{1}{N-1} \quad (14)$$

$$Var(I) = E[I^2] - (E[I])^2 \quad (15)$$

If the Global Moran's I value is larger than  $E(I)$  at a chosen significance level (often  $\alpha=0.05$ ) or the correspondent z score is higher than the critical value, it means positive spatial autocorrelation, meaning that features are clustered and if it is less than  $E(I)$ , or the correspondent z score is lower than minus critical value, it indicates negative spatial autocorrelation, meaning that features are dispersed, when Global Moran's I is insignificant, this refers to random pattern.

Values for Local Moran's I range from  $-1$  to  $+1$ , where a value of  $-1$  indicates negative spatial autocorrelation, and a value of  $+1$  indicates positive spatial autocorrelation.

### 3.5. Getis-Ord General G

The Getis-Ord G statistic is calculated with respect to a specified threshold distance instead of the inverse distance, as with the Moran's I.

The threshold distance is the maximum separation at which two observations are still considered neighbors in Moran's I calculation, and it's typically chosen to guarantee connectivity of the spatial network. its formula as reported (Getis & Aldstadt, 2004) is:

$$G = \frac{\sum_{i=1}^N \sum_{j=1}^N w_{ij} x_i x_j}{\sum_{i=1}^N \sum_{j=1}^N x_i x_j} \quad (\text{usually with } w_{ii} = 0) \quad (16)$$

Where  $x_i$  is the attribute value at location  $i$ ,  $x_j$  is the attribute value at location  $j$  and  $w_{ij}$  is the spatial weight between features  $i$  and  $j$ . If high values are near other high values, the G statistic increases. and if low values are near other low values, the G statistic decreases. All things are equal.

Under a typical randomization null hypothesis (values randomly permuted among locations):

The expected value specification is

$$E[G] = \frac{\sum_i \sum_j w_{ij}}{N(N-1)} \quad \text{assuming } w_{ii} = 0 \quad (17)$$

$$z(G) = \frac{G - E[G]}{\sqrt{Var(G)}} \quad (18)$$

Where  $Var(G)$  is the variance of  $G$  under the null hypothesis of random distribution across space.

If the is a positive z, this means a clustering of high values.

If the is a negative z, this means a clustering of low values.

In sum, while Global Moran's I is used measure the intensity of regional autocorrelation, Local Moran's I allows for a spatial distribution on a local regional scale, meantime, the Getis-Ord General G measures the degree of clustering of high or low values across the entire study area.

## 4. Results

### 4.1. Empirical evidence

The six steps of the TOPSIS method are illustrated through the 2015 observations and presented in six corresponding tables, following the six steps explained in the Methods subsection above.

Following table 1 represents the 2015 regional dataset.

**Table 1: The 2015' regional dataset for the TOPSIS method**

Region	GDP per capita	HFCE per capita	Share to national Growth	Regional startups created	Regional activity rate
Tanger-Tétouan Hoceima	99073	66018	0,8	9101	44,65
Oriental-Rif	47429	38495	0,1	5672	42.5
Fès Meknès	89118	63788	0	6071	45.7
Rabat-Salé- Kénitra	158317	81574	0,4	9786	45
Béni Mellal Khénifra	57806	30855	0,3	2492	46.7
Casablanca Settat	317415	144498	2,2	17945	45
Marrakech-Safi	87888	62323	0,3	6497	46.3
Drâa-Tafilalet	25496	18336	0	1572	46.4
Souss-Massa	64908	39700	0,2	4500	44.95
Guelmim- Oued Noun	13100	6741	0,1	1572	41.75
Laâyoune- Saguia Al Hamra	15075	6760	0,2	3290	41.75
Dakhla Oued Eddahab	10926	3753	0,2	1062	41.75

Source: Moroccan statistics office, Morocco open data, Moroccan entrepreneurship barometer

Table 1 show that the Casablanca-Settat region is ranking first for all the 2015 observations related to the five indicators used in testing Moroccan regions performance, excepted for activity rate which comes in secondary positions, in fact the economic capital of the country is suffering from high demographic density which obstruct the full employment of its local active population although the economic prosperity it is witnessing since decades, on the other hand it is remarkable that the southern regions are the less rated among the regions of Morocco, mainly because of low demographic intensity, which is correlated to general economic under-scoring performance.

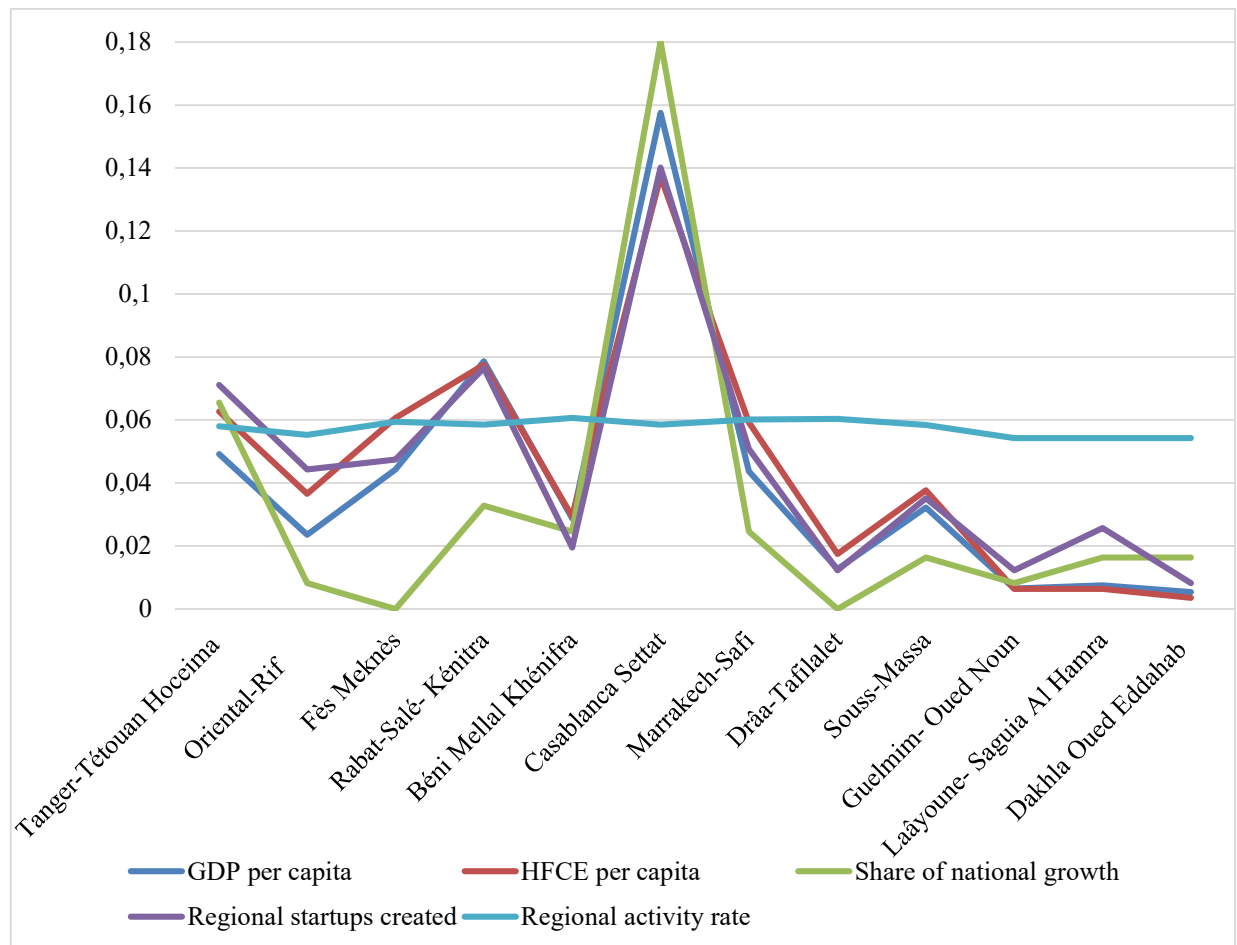
Drâa-Tafilalet and the southern regions of Guelmim- Oued Noun, Laâyoune- Saguia Al Hamra, and Dakhla Oued Eddahab, have the lowest scores, primarily due to underdevelopment issues, hard climate condition, low-value farming, limited tourism, weak infrastructure and services, low investment, and youth out-migration.

As the represented observations in Table 1 are heterogeneous and expressed in different order of scales, it was necessary to normalize the decision matrix before applying the TOPSIS method.

After a discrete uniformization of Table 1 data in the same scale of [0-1] order using the sum-based method formulated in the research design section, step 1, comes the second step of attributing an estimated weight to each singular criteria represented in reflect of the importance of each one in the general study scheme, in this matter, we have decided to attribute equal weight proportion to each indicator by multiplying each related observation from the normalized decision matrix by 0.2 considering that all criterion have the same importance degree in our study.

The multiplication' products forming the weighted matrix are represented in Figure 3 below.

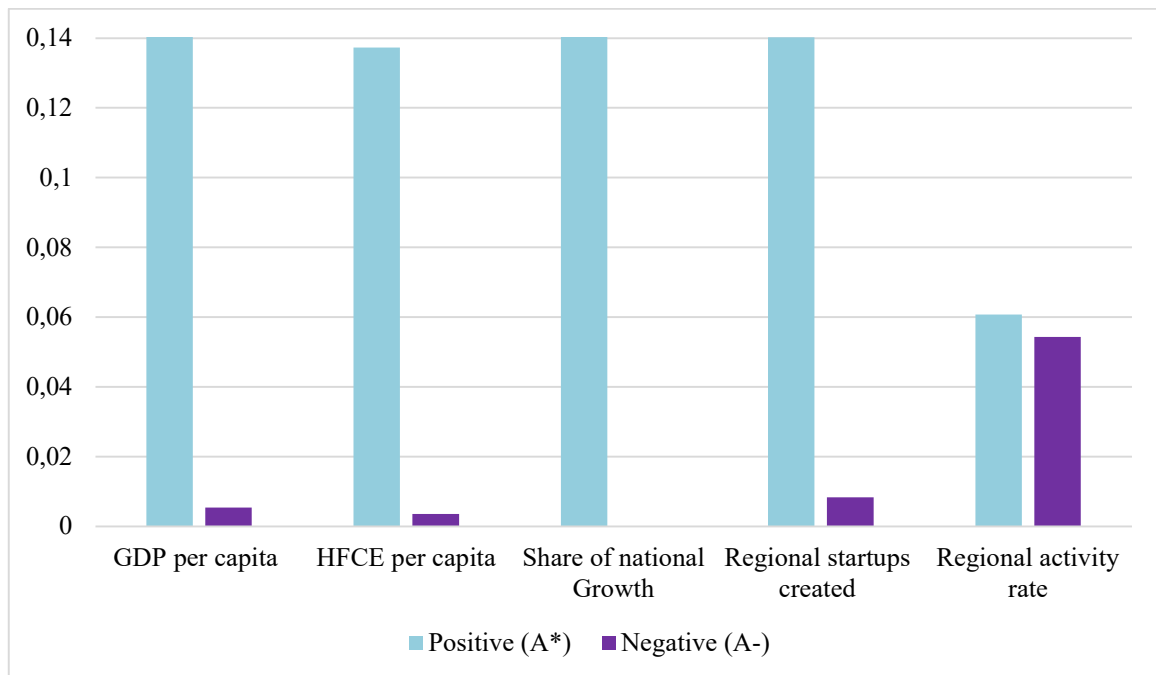
**Figure 3: The weighted normalized decision matrix of the TOPSIS method**



Source: Excel outputs based on the author own computations

Figure 3, which is based on Table 1, illustrates the weighted normalized observations diagram, ranking Casablanca-Settat as the top performer for all 2015 observations across the five indicators used to assess Moroccan regions, while the Southern regions consistently rank lowest. However, the weighted normalized activity rate observations for the twelve regions show a noticeable stagnation. The ideal positive and negative solutions generated results are represented in Figure 1 below.

**Figure 4. Ideal solutions in both directions of the TOPSIS method**

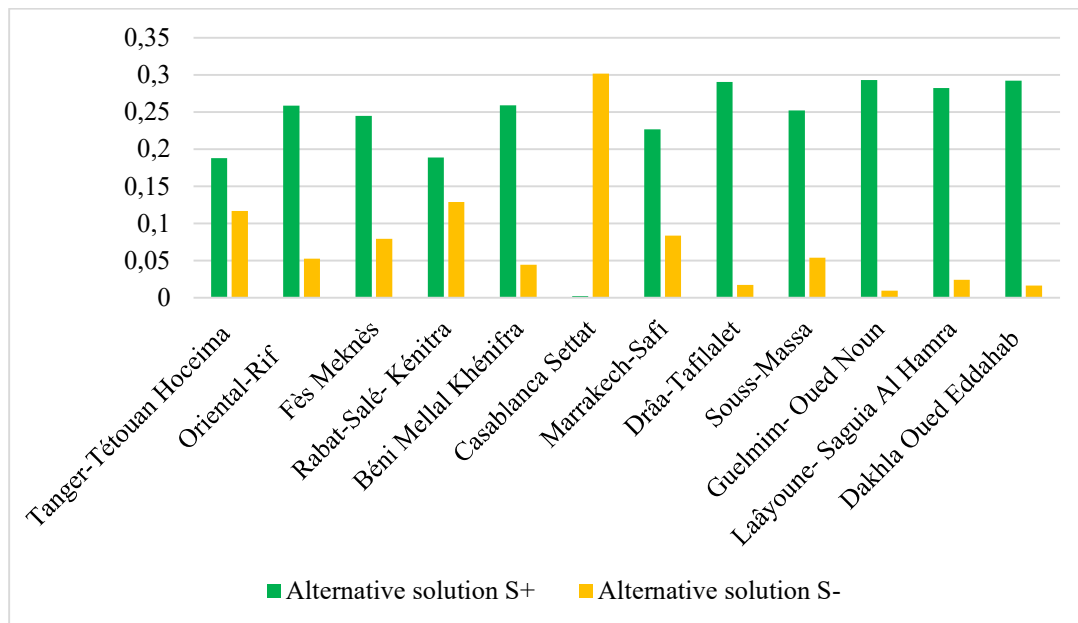


Source: Excel outputs based on the author own computations

Figure 4 above represented the resulted ideal solutions of each criterion in both directions, the best measures are represented by  $A^+$ , the worst measures by  $A^-$ .

Based on, the respective measures of separation of each alternative from the positive ideal solution ( $S^+$ ) and the negative ideal solution ( $S^-$ ) above are presented in the following Figure 5.

**Figure 5. The TOPSIS ‘measures of separation of each alternative solution**

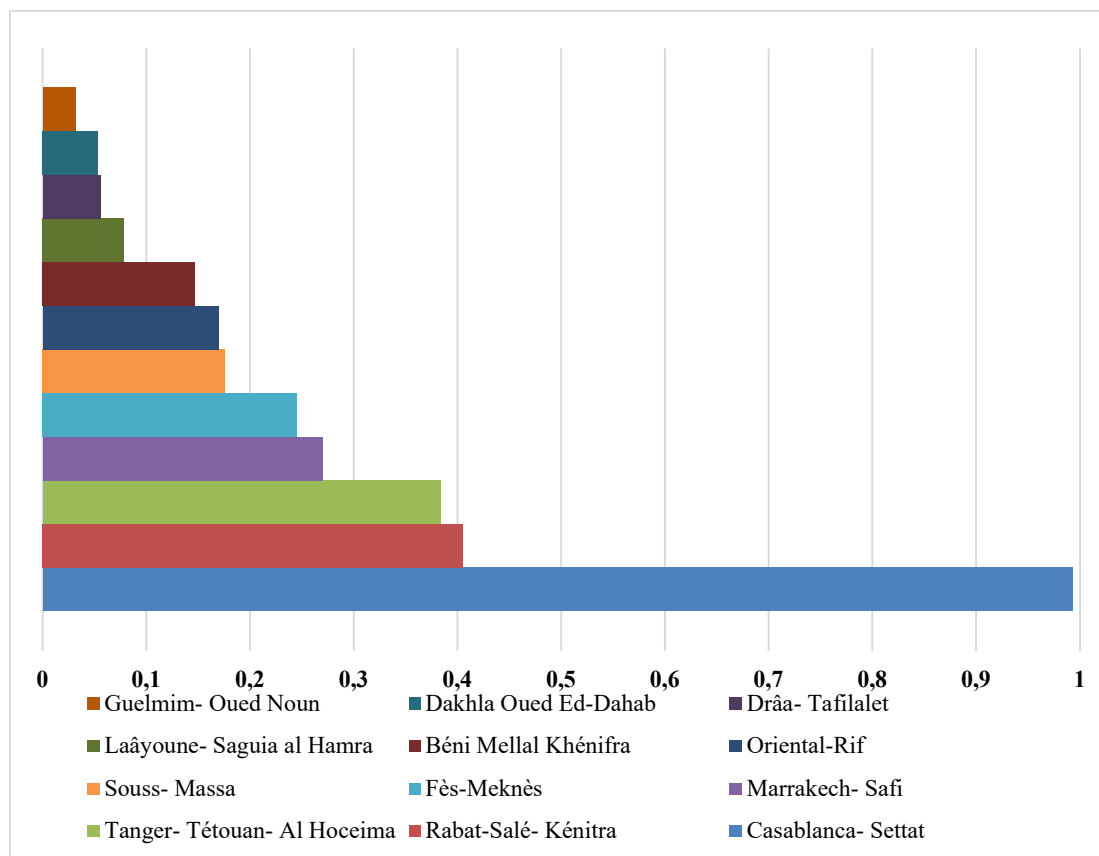


Source: Excel outputs based on the author own computations

As shown in Figure 5 above, the measures of separation, with the shortest distances to the positive ideal solutions ( $S^+$ ) are considered as the best measures, and the longest distances from the negative ideal solutions ( $S^-$ ) are considered as the worst measure attribute to the region of Casablanca-settat first, the shortest positive ideal solutions ( $S^+$ ), and the longest negative ideal solution ( $S^-$ ), and the southern regions, in addition to Deraa Tafilalet manifest exactly an opposite trend.

Based on, the following Figure 6 below retrace the 2015 final ranking based on the Relative Closeness (RC) coefficient represented on the horizontal axis:

**Figure 6: The 2015 final ranking based on Relative Closeness (RC) of the TOPSIS method**



Source: Based on the author own computations

Based on the RC in Figure 6 above, under the decision rule which stipulate that the more RC is high, the best the related region is placed in the ranking, vise-versa. For instance, as the region of Casablanca-Settat detains the highest RC for 2015, it is tributary to be firstly ranked, conversely to the region of Guelmim-Oued Noun, which comes last for having the less underscored performance.

Applying the same methodology to the remaining years of the study period yields the final ranking, shown in Table 2 below.

**Table 2: The final ranking of the TOPSIS method over the period [2015-2022]**

Region	2015	2016	2017	2018	2019	2020	2021	2022
Tanger- Tétouan- Al Hoceima	3	2	3	2	2	6	3	3
Oriental-Rif	7	8	6	7	7	7	7	8
Fès-Meknès	5	6	5	6	5	4	4	4
Rabat-Salé- Kénitra	2	3	2	3	3	2	2	2
Béni Mellal Khénifra	8	11	7	8	6	5	8	7
Casablanca- Settat	1	1	1	1	1	1	1	1
Marrakech- Safi	4	4	4	4	4	12	5	5
Drâa- Tafilalet	10	12	10	10	8	10	10	11
Souss- Massa	6	5	8	5	9	11	6	6
Guelmim- Oued Noun	12	9	11	11	11	8	12	9
Laâyoune- Saguia al Hamra	9	7	9	9	10	3	9	12
Dakhla Oued Ed-Dahab	11	10	12	12	12	9	11	10

Source: Excel outputs based on authors own computations

As shown in Table 2 above, the region's final ranking has exhibited a noticeable stagnation throughout the entire period of study, indicating a relatively stable territorial hierarchy despite economic and social fluctuations at the national level. Casablanca-Settat consistently secures a position among the top twelve performers, a result that reinforces its status as Morocco's undisputed economic capital and primary growth pole, benefiting from its diversified industrial base, concentration of financial institutions, and role as the country's main hub for trade and services. Immediately following are the regions of Tanger-Tétouan-Al Hoceima and Rabat-Salé-Kénitra, which frequently alternate their positions across the ranking periods, reflecting the dynamic nature of northern Morocco's manufacturing and logistics activities on the one hand, and the administrative and service-oriented weight of the capital region on the other.

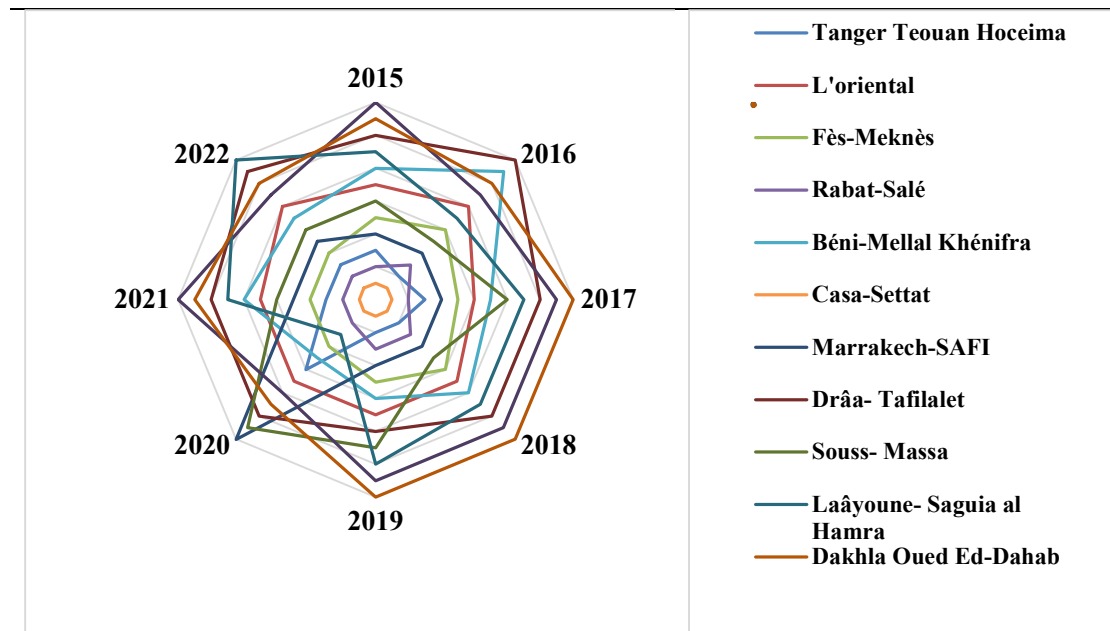
In contrast, the southern regions consistently occupy the lower end of the ranking spectrum, a situation that highlights persistent structural challenges such as limited industrial diversification, lower population density, and weaker infrastructure connectivity compared to the northern and central regions. The remaining regions occupy intermediate positions, with relatively minor movements upward or downward from one period to the next, suggesting modest but steady economic adjustments.

A notable exception is Marrakech-Safi, which experienced a dramatic and sudden decline in 2020, coinciding with the global Covid-19 crisis. The region's economy, heavily reliant on tourism and related services, was severely disrupted by travel restrictions, business closures, and the collapse of international tourist arrivals, leading to a temporary but sharp contraction in its overall performance.

Another important case is the Béni Mellal-Khénifra region, which, over the years preceding 2020, registered a remarkable upward trajectory. This improvement was largely attributable to its buoyant phosphate exports, expansion of the agro-industrial sector, particularly olive oil production, and sustained inflow of remittances from the Moroccan diaspora, which together boosted household consumption and regional investment. However, following the onset of the pandemic and subsequent economic slowdown, the region's ranking dropped by two points, underscoring its vulnerability to external shocks and global demand fluctuations.

Figure 7 below retraces the final ranking results in a graphic radar representation. The closer a region circle is to the radar plot epicenter, the more representative and well-ranked it is, indicating a stronger leader position, better ranking, and a lower radius distance. The lower a region's circle is ranked, the farther it is from the radar epicenter.

**Figure 7: Graphic Radar representation of Moroccan regions performance final ranking**



Source: Excel outputs based on authors own computation

As shown in the Figure 7 results, Casablanca-Settat consistently occupies the outermost layer for all years between 2015 and 2022. Tanger-Tétouan-Al Hoceima and Rabat-Salé-Kénitra follow closely, alternating their positions from one year to another but remaining near

the top throughout the period. Marrakech–Safi remains relatively stable until 2020, when its curve moves sharply inward before slightly expanding again in the following years.

Béni Mellal–Khénifra shows a gradual outward movement from 2015 to 2019, followed by a contraction after 2020. Fès–Meknès, L’Oriental, and Souss–Massa are positioned around the middle of the radar, with slight upward and downward displacements across the years. Drâa–Tafilalet remains closer to the center for the entire period, showing limited variation.

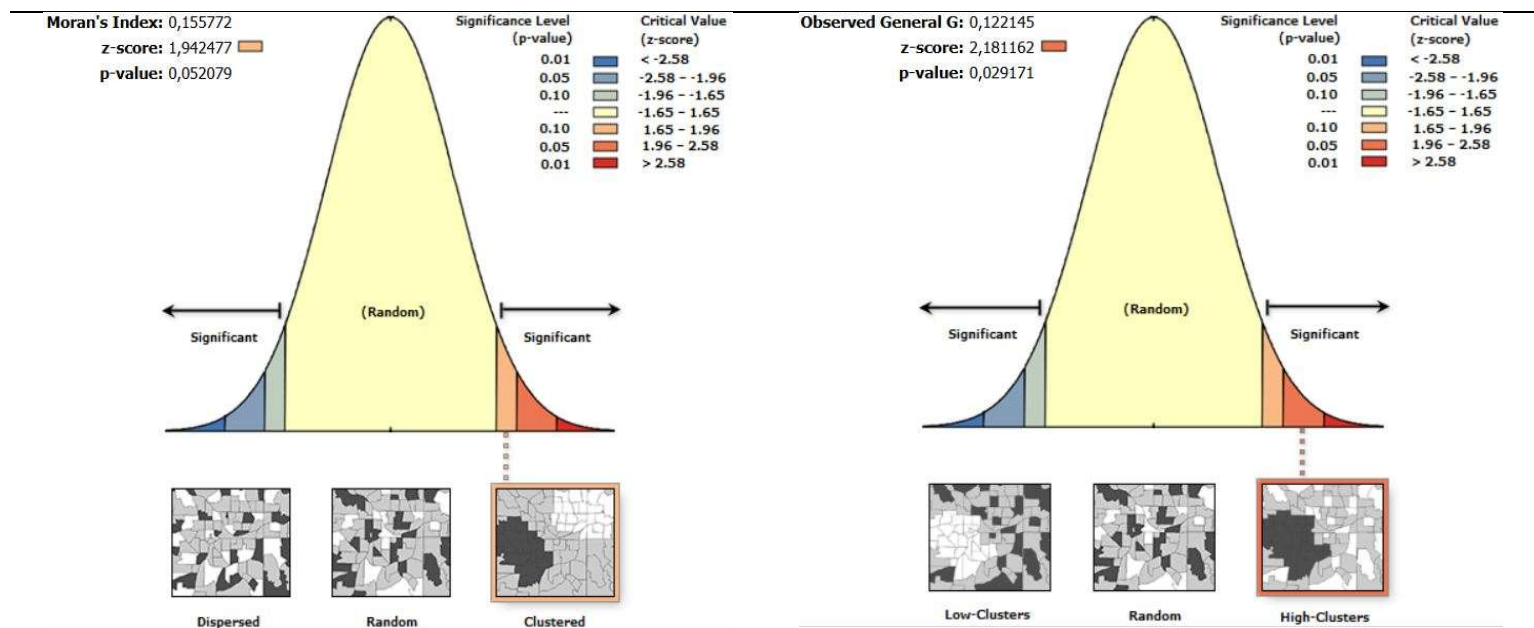
The southern regions, Laâyoune–Saguia al Hamra and Dakhla–Oued Ed-Dahab, display progressive outward shifts over time, with their lines expanding slightly year after year. Overall, the radar shows relatively stable positions for most regions, with only a few noticeable contractions or expansions during the period observed.

### 4.2. Spatial analysis

The spatial analysis involves three tests: Global Moran's I which measures the intensity and the nature of the regional autocorrelation; Getis-Ord General G test, which identifies the type of clustering present, and the local Moran's I which allows for a localization of these regions in four quadrants of clustering, these tests are illustrated based on GDP per capita for 2015 and 2022.

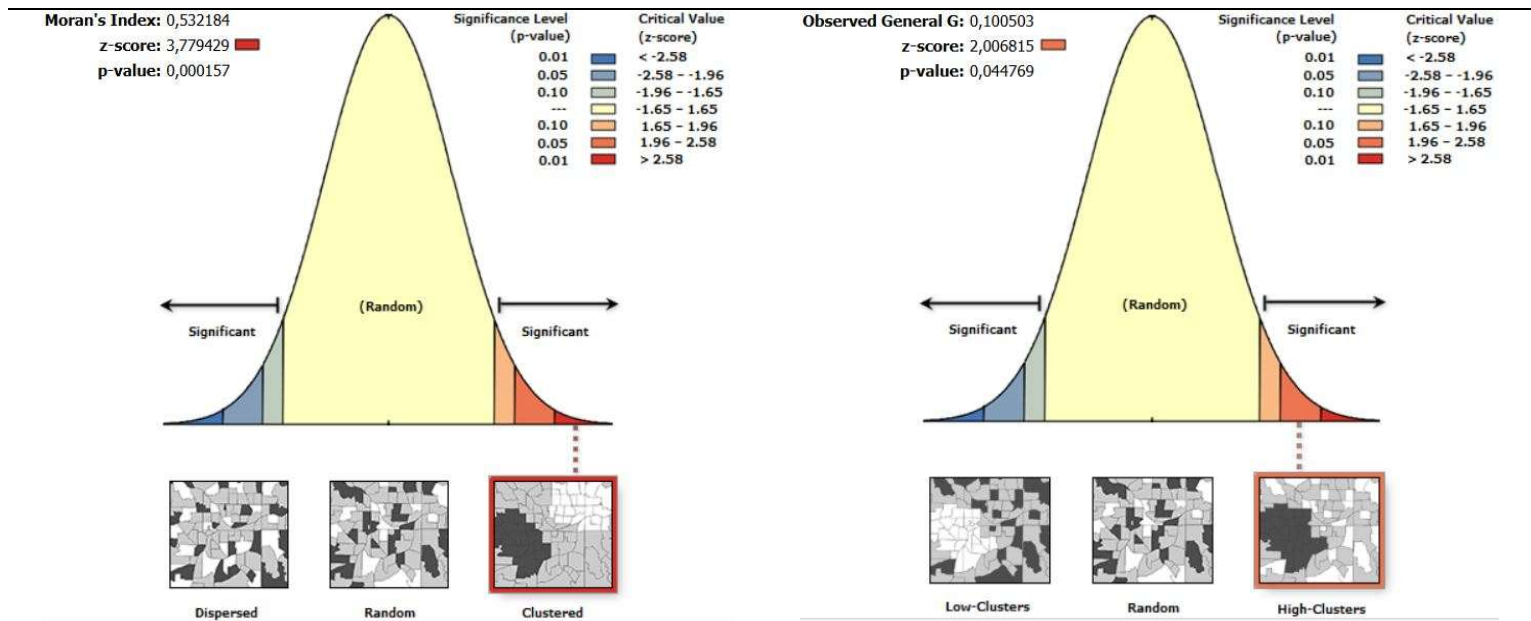
While Figure 8 represents the graphic Global Moran's I and Getis-Ord General G tests outputs for 2015, Figure 9 represents these outputs for 2022.

**Figure 8: The 2015 Global Moran's I and Getis-Ord General G**



Source: Arcmap10.4 outputs based on authors own computations

Figure 9: 2022 Global Moran's I and Getis-Ord General G



Source: Arcmap10.4 outputs based on authors own computations

As shown in Figures 8 and 9 above, the respective z-scores of 1.94247681769 and 3.77942902088 of the Global Moran's I tests in 2015 and 2022 indicate a positive spatial autocorrelation, given their positive significant z-score, regions with similar values cluster spatially (high-high or low-low). According to the Getis-Ord General G results from the same figures, for 2015 and 2022, with a respective z-scores of 2.18116187332 and 2.00681504743, there is less than a 5% likelihood that this high-clustered pattern is due to random chance, furthermore, given their high positive z-score, there is clustering of high values (hot spots). Subsequently, neighboring Moroccan regions have a spillover effect on each other.

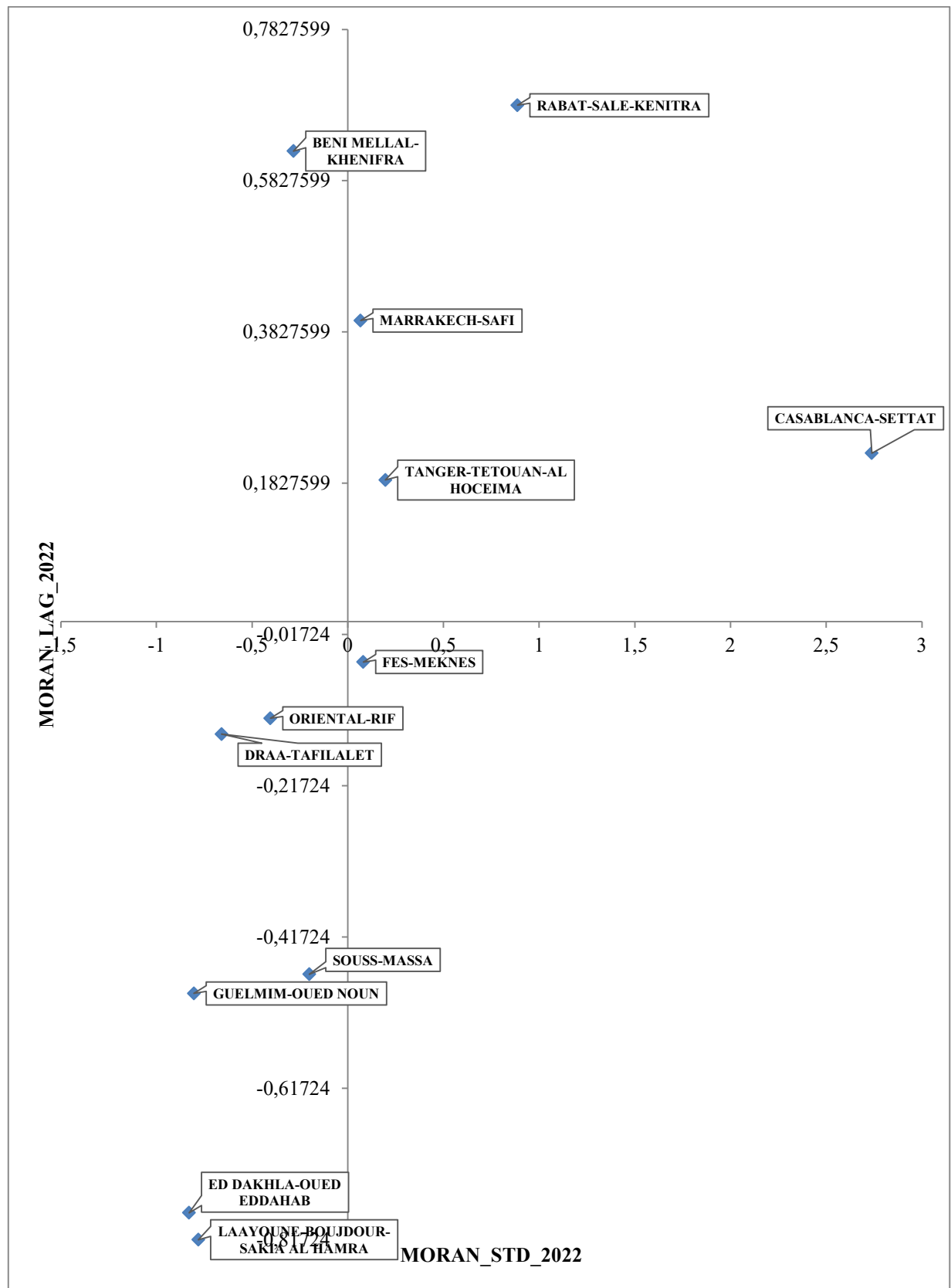
Regarding the four quadrants of Local Moran's I link directly to the values of the statistic at each location. A positive Local Moran's I occurs when a location is similar to its neighbors, which corresponds to diagonal High-High (upper-right) or Low-Low (lower left) quadrants, indicating spatial clustering.

A negative Local Moran's I arises when a location differs from its neighbors, corresponding to High-Low or Low-High outliers.

In this way, the sign and magnitude (z-score) of the Local Moran's I region value indicate both the type (cluster or outlier) and strength of local spatial association.

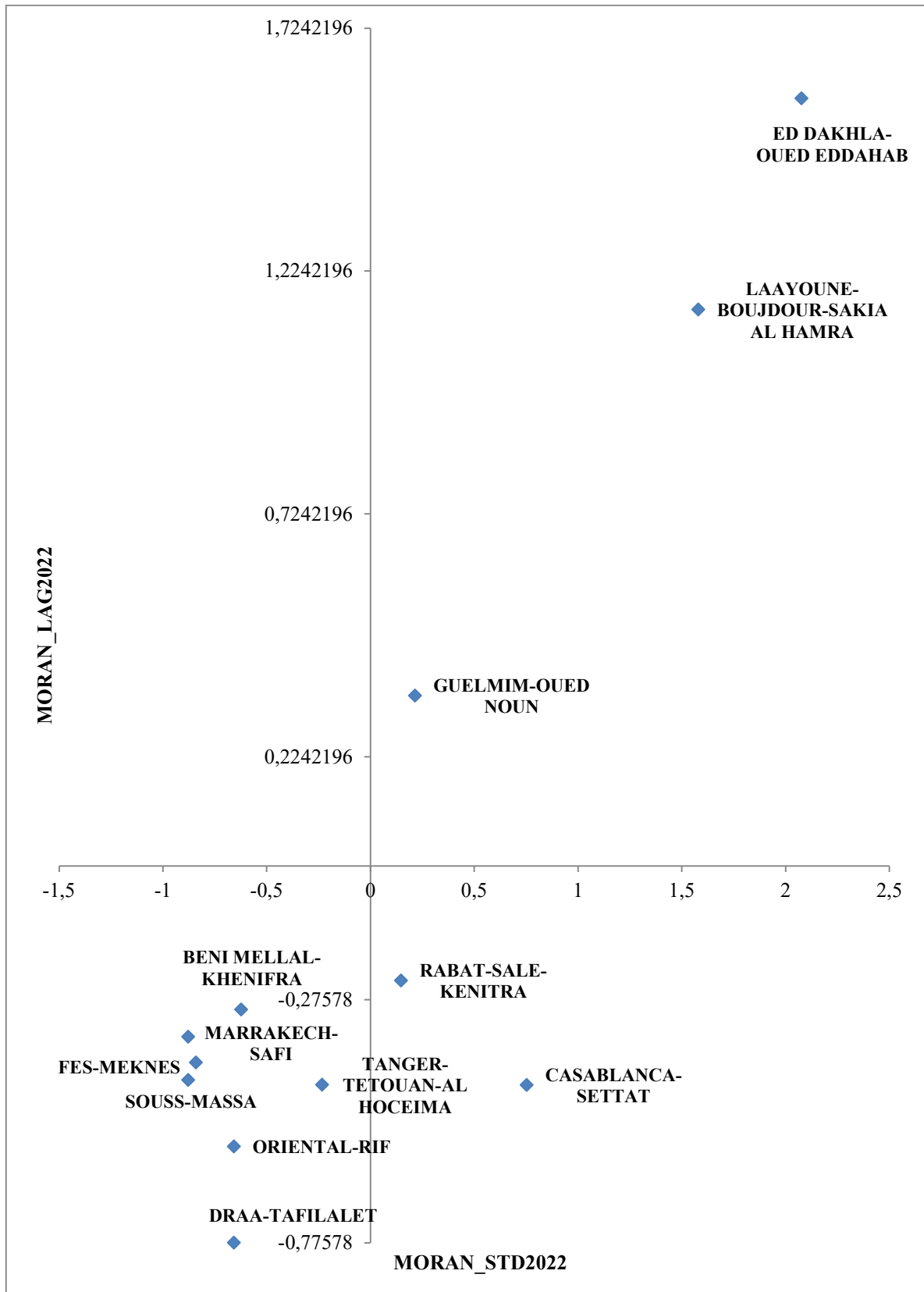
Figures 10 and 11 provide a graphic representation of the local Moran's I spatial distribution of the twelve Moroccan regions, for the years 2015 and 2022, respectively.

**Figure 10: The 2015 Local Moran's I distribution of Moroccan regions**



Source: QI Macros output based on Global Moran's I results

**Figure 11: The 2022 Local Moran's I distribution of Moroccan regions**



Source: Qi Macros outputs based on Global Moran's I results

Figure 10 reveals that the top four regions in the 2015 TOPSIS ranking, namely Casablanca-Settat, Rabat Salé Kenitra, and Tangier Tetouan Hoceima, are clustered together in the high-high quadrant, indicating that they have strong economic performance and a significant impact on each other. In contrast, the bottom-ranked regions, including Oriental-Rif-Rif, Drâa-Tafilalet, and the southern regions of Guelmim-Oued Noun, Laâyoune-Saguia al Hamra, and

Dakhla Oued Ed-Dahab, are grouped together in the low-low quadrant, suggesting that they have low economic entrepreneurial performance and affect each other in 2015.

Figure 11 reveals that, in 2022, the southern regions of Guelmim-Oued Noun, Laâyoune-Saguia al Hamra, and Dakhla Oued Ed-Dahab are positioned in the high-high quadrant, indicating that they are experiencing both economic growth and significant interdependence. In contrast, the regions of Casablanca-Settat, Rabat Salé Kenitra, and Tangier Tetouan Hoceima have shifted to the high-low quadrant, remaining clustered whereas the remaining regions have little impact on each other, situated in the low-low quadrant.

The remaining test based on the rest of criteria exhibit similar spatial distribution and the same clustering tendencies throughout the period study, and converge with the TOPSIS method outputs.

## **5. Discussion, policy implications, limitations and future prospects**

### **5.1. Discussions**

The results underscore a persistent hierarchical structure among the twelve regions, revealing a marked path dependency in regional rankings (Martin & Sunley, 2006). The quasi-stagnation in the final ranking suggests that structural economic asymmetries are entrenched, with limited inter-regional mobility in performance despite the rollout of successive national development strategies.

The results provide a comprehensive assessment of these rankings over time, highlighting both persistence and episodic change. Casablanca-Settat consistently occupies the outermost layer across all years, reaffirming its status as the country's primary economic pole, a finding consistent with core-periphery dynamics (Krugman, 1991) and the concentration of productive activity in major metropolitan areas. Its unchanging position underscores the self-reinforcing nature of agglomeration advantages, diversified industrial base, financial centrality, and transport and logistics infrastructure, that sustain its long-term dominance.

The second tier of regions, notably Tanger-Tétouan-Al Hoceima and Rabat-Salé-Kénitra, display alternating but relatively stable trajectories, suggesting a form of regional resilience (Pike et al., 2010). Their intermittent rise in the rankings points to the growing importance of northern coastal corridors, fueled by port expansions such as Tanger Med, foreign investment inflows, and administrative centrality in Rabat's case. The clustering of these coastal regions at the top of both TOPSIS rankings and Moran's I spatial maps highlights the role of positive spatial spillovers and agglomeration economies, where proximity-based effects in infrastructure, investment, and skilled labor mobility reinforce their performance.

In contrast, middle-ranking regions such as Fès-Meknès, L'Oriental, and Souss-Massa exhibit only modest positional shifts across the study period, remaining largely locked in place. This limited mobility resonates with Rodríguez-Pose's (2017) notion of the "revenge of the places that don't matter", where intermediate regions neither collapse nor experience transformative growth, due to structural and institutional inertia. The Oriental-Rif and Drâa-Tafilalet regions consistently remain near the center of the radar, reflecting low GDP per capita, limited industrial activity, weak market integration, and structural constraints such as water scarcity and climate vulnerability that impede competitiveness (Yakubova & Sagaffe, 2019). Persistent out-migration further erodes their human capital base, limiting endogenous development potential.

Marrakech-Safi presents a striking exception in its trajectory: its curve remains stable until 2020, when it experiences a sharp inward contraction coinciding with the Covid-19 pandemic. This drop visually captures the vulnerability of tourism-dependent economies to exogenous demand shocks (Kalaj & Barbullushi, 2023). Its gradual recovery post-2020 suggests partial adaptation, but the region's overall trajectory illustrates the slow adjustment capacity of mono-specialized economies lacking industrial or technological diversification to buffer external crises (Capello et al, 2015).

Similarly, Béni Mellal-Khénifra shows a gradual outward movement from 2015 to 2019, supported by phosphate exports, agro-industrial growth, and remittance inflows, followed by a visible contraction of more than two points after 2020. This reversal underscores the fragility

of growth trajectories heavily reliant on volatile global commodity markets and external financial transfers.

The southern regions of Laâyoune–Saguia al Hamra and Dakhla–Oued Ed-Dahab trace progressive outward paths over the study period, indicating incremental improvements. However, their position remains in the lower tier, suggesting that despite targeted investments, peripherality and limited economic diversification still shape their development outcomes.

Taken together, the findings confirm the presence of geographic clustering, with high and statistically significant positive Moran's I values indicating that top-performing regions tend to neighbor other prosperous ones, while lagging regions remain spatially grouped. This spatial polarization aligns with the core–periphery model (Krugman, 1991) and suggests that the territorial distribution of economic dynamism in Morocco is governed by selective convergence (Barro & Sala-i-Martin, 1995): leading regions consolidate their dominance, while a few lagging regions progressively catch up. Nevertheless, the persistence of middle-ranking and low-performing territories implies that territorial inequalities remain a defining feature of Morocco's economic geography, requiring policies that go beyond physical infrastructure provision to address structural drivers of underperformance.

## 5.2. Policy implications

The persistence of regional hierarchies calls for place-based policies that go beyond infrastructure provision and target productive capacity, skills development, and innovation in lagging regions (Barca, McCann & Rodríguez-Pose, 2012). Leading regions such as Casablanca–Settat, Rabat–Salé–Kénitra, and Tanger–Tétouan–Al Hoceima should be leveraged as growth engines, with stronger supply-chain linkages to hinterland regions to diffuse agglomeration benefits.

Tourism-dependent regions like Marrakech–Safi require economic diversification strategies to reduce vulnerability to shocks, while territories such as Drâa–Tafilalet and the Oriental-Rif need targeted investments in skills, water-efficient agriculture, and entrepreneurial ecosystems to break low-performance traps.

The emerging dynamism of southern regions should be supported through connectivity upgrades, renewable energy projects, and diaspora investment programs to consolidate their role as new growth poles and foster more spatially balanced development.

## 5.3. Limitations and future prospects

Results can inform region-specific development strategies, equitable resource allocation, entrepreneurship promotion, and spatial regional planning. However, limitations such as the restricted set of indicators, short interval, and methodological constraints suggest future research directions that integrate broader social, environmental, and innovation variables, extend the sample interval, and apply advanced comparative and econometric approaches.

## 6. Conclusion

The study's integration of TOPSIS, and spatial autocorrelation analysis over the period 2015–2022 provides a multi-dimensional perspective on Morocco's regional economic–entrepreneurial performance. Taken together, these results point to structural and spatial lock-ins in Morocco's regional development. While certain regions such as Casablanca-Settat, and the northern regions have benefited from sustained agglomeration economies, port-led growth, and diversified industrial bases, others remain constrained by geographic isolation, limited economic diversification, and vulnerability to sector-specific shocks. From a policy standpoint, the persistence of such patterns suggests that place-based development strategies, targeting structural transformation in lagging regions, improving interregional connectivity, and fostering economic diversification, are essential to reducing spatial inequalities and unlocking broader national growth potential.

### **Declarations statement**

**Acknowledgements:** For the editors and the reviewers of this paper who guided the author along the submission, the editing, the peer review, and the publication processes.

**Funding:** Not applicable

**Conflict of interests:** The author declares no conflicts of interest.

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## ANALYSIS OF MORPHOLOGICAL CHANGING SCENARIO OF RIVER JAMUNA, WEST BENGAL, INDIA

**Somnath DAS**

Cartographer (Contractual), Department of Geography, University of Kalyani, Kalyani, Nadia-741235, West Bengal, India.  
sdas8969@gmail.com

**Abhay SANKAR SAHU**

Professor, Department of Geography, University of Kalyani, Kalyani, Nadia-741235, West, Bengal, India.  
asahugeo@klyuniv.ac.in

### **Abstract**

Jamuna is one of the distributary river of India which belongs to the Gangetic Delta region located in the eastern part of India and originates from the Bhagirathi River and flows into Ichhamati River. But at present the Jamuna River is continuously drying up and its flow is gradually slowing down. In this study, the morphological changes of the river from 1977 to 2020 are described through change detection technique. Topographical map (US Army, 1955), USGS satellite images of different years (1977, 2000) and google satellite image (2020) have been used for that. Again for the convenience of the discussion the river has been divided into three segments. A comparison of the course of the river in 2020 with respect to the course of the river in 2000 has been made to determine how much the river course has been damaged by humans. A large part of the river course has been occupied by man for his own needs i.e. cultivation, settlement, fisheries and even plantation of trees. Here, it shown that the course of the river has been progressively narrowed and damaged by human activities. All work was done using RS and GIS platform with GIS software.

**Keywords:** River delineation, plan form pattern, channel width, long profile, human activities

**JEL classification:** Q25, R14, Y10, Y91  
pp. 115-134

### **1. Introduction**

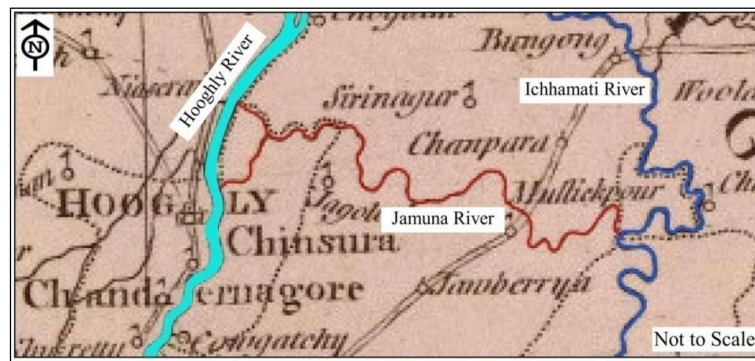
Water resources are the key to human survival and development, and even water is an integral part of natural ecosystem. However, due to rapid population growth, economic development and expansion of urbanization, the amount of water resources worldwide is declining at an increasing rate (Wang et al., 2020). One of the most important part of this water resource is the river, which is inextricably linked with human civilization. A river is usually a natural stream of fresh water, which flows primarily towards the ocean, lake or some other river (Maurya et al., 2016). In some times, a river dries up before it reaches the end of its course. River bank erosion is a natural geological process (Nath et al., 2013). Rivers are an essential element of human existence that has been slowly evolving since human evolution (Panda et al., 2011).

To describe how a river changes its shape and direction over time, river morphology is a field of science in which sedimentation and erosion processes in a river mainly change the river's form and cross section (Change, 1988). The science of carving out landforms by river action is called river morphology (Wilson et al., 2021). River course change is a natural phenomenon that usually occurs due to flooding in river (Mahmood et al., 2015). Generally, the river flows from its source to mouth according to slope of land, but it never takes any short path (Pan, 2013).

The course of the river was changed at different times and various factors involved with it have been pointed out in different research papers such as Dey et al., 2018, Bandyopadhyay et al., 2013, Ety et al., 2017, Mondal et al., 2018, Biswas et al., 2018 and Chauniyal et al., 2018.

One of the riverine states of India is West Bengal, which was an integral part of east Bengal before independence. Jamuna was one of the important rivers of Bengal. Once (last half of the twelfth century), this river was described in verses 33 and 34 of the “*Pavandoot Kavya*” of Raja Lakshman Sen’s poet Dhoi. Even Rennell’s map of the Ganges-Brahmaputra delta published by the British Government in 1779 clearly showed the location of the river Jamuna, and at that time the river was fully alive. Almost a century after Rennell’s map, Hunter (1875) described the location and depth of the river in his book namely ‘*A Statistical Account of Bengal*’ (Rudra, 2008) (Figure 1).

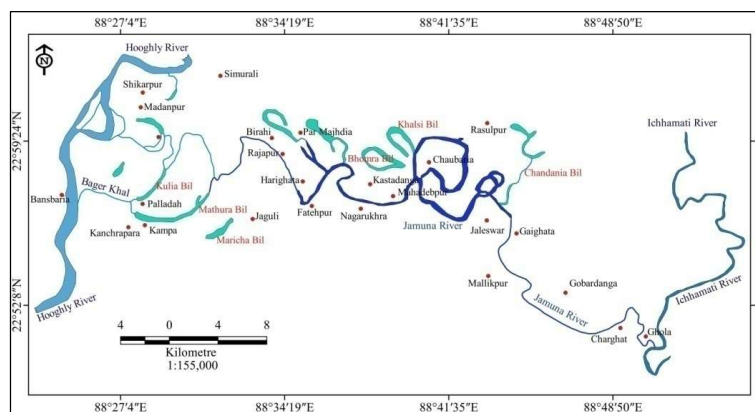
**Figure 1: Jamuna River, 1786**



Source: A map of Bengal, Bahar, Oude and Allahabad with part of Agra and Delhi Exhibiting the Course of the Ganges from Hurdwar to the sea by James Rennell, 1786

The Jamuna River is a distributary of Hooghly River. It originates from Tribeni then flows to south-east and joins with Ichhamati River near Tipi village which belongs to Swarnnagar tehsil of North 24 Parganas district. According to the topographical map (1955), Hooghly River and Jamuna River were connected with each other through Bager Khal and Mathura Bil, so that the water of Hooghly River could freely flow into Jamuna River. Not only Mathura Bil, but there were many lakes (meander cut of Hooghly River) in the vicinity with which the Jamuna River was connected (Figure 2).

**Figure 2: Jamuna River with its surrounding water bodies and places, 1955**



Source: Topographical Maps (Sheet no. NF 45-3, NF 45-4, NF 45-7 and NF 45-8), US Army Map, 1955

The water flow of Jamuna River has been affected by some other reasons, e.g., due to deposition of sediments in the river bed and thus depth of river bed decreases. The highest river bed of Jamuna exists at Birohi and the Hooghly River flows westwards over time. Only Bager Khal is the source of water from Hooghly River to Jamuna River (Biswas, 2001). But after some time people built their settlements in the adjacent area of Bager Khal and Mathura Bil. As a result, the Bager Khal continues to be damaged by human activities. It is currently associated with the city’s drainage system, but it is completely isolated from the Mathura Bil and Jamuna River. Due to this reason the source of water in the Jamuna River is now only rain water, as a result of which the river course has changed.

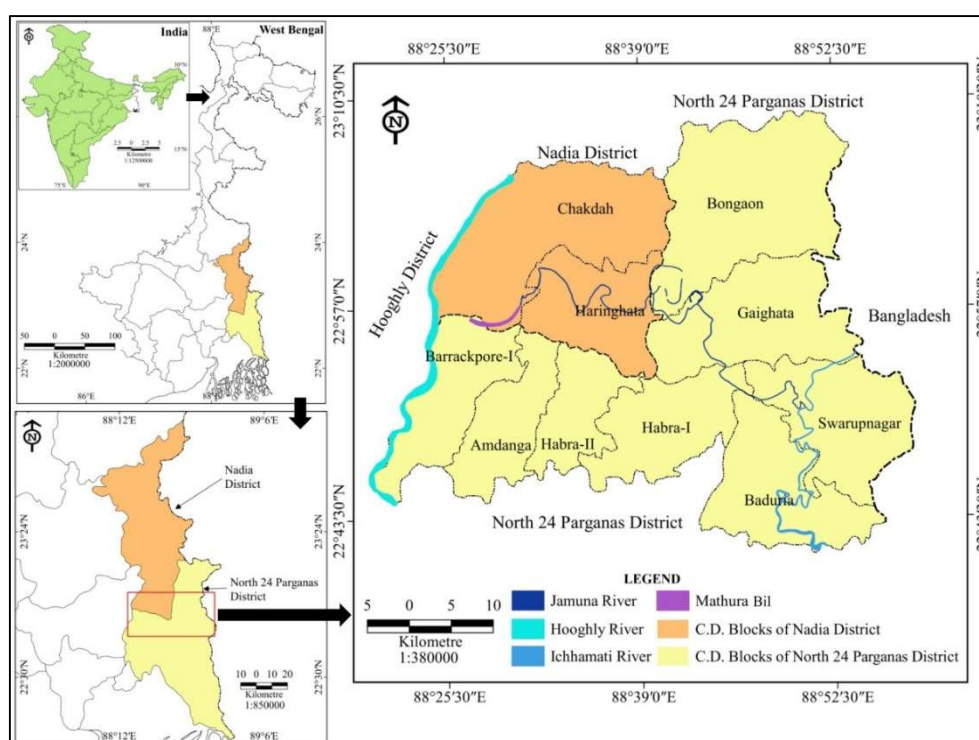
## 2. Objectives

Objectives of the present study are assessing the changing channel morphology of Jamuna River and to analyze the situation of the river course area.

## 3. Area of study

The area of study is the River Jamuna course which belongs to Ichhamati - Vidyadhari river basin and it is lying between  $22^{\circ}57'15.76''$  N to  $22^{\circ}50'32.36''$  N and  $88^{\circ}30'40.83''$  E to  $88^{\circ}50'30.70''$  E. The source of River Jamuna is Hooghly River and its mouth is Ichhamati River. The river flows through the Chakdah and Haringhata C.D. Blocks (Community Development Block) of Nadia district and the Bongaon, Gaighata, Habra-I, Baduria and Swarupnagar C.D. Blocks of North Twenty Four Parganas district in West Bengal. The total river length is 66.64 km (from the end of Mathura Bil to Ichhamati River). From the mean sea level the average elevation of the area is 10 metre (Banerjee et al., 2014) (Figure 3).

Figure 3: Map of the Study Area



Source: District Census Handbook (North 24 Parganas and Nadia), Census of India, 2011 and Google Satellite Map, 2020

## 4. Database and Methodology

For the identification of Jamuna River course topographical maps were used. The topographical maps were prepared by the U.S. Army, Washington, D.C., compiled in 1955 from Survey of India. Satellite data from USGS Earth Explorer is also used to interpret the Jamuna River course for the years of 1977 and 2000. In the present study, google satellite image (2020) has been also used for better delineation of the river course. The details of data used during the analysis are given in the Table 1.

Table 1. Details of Satellite Images

Satellite	Path/row	Projection	Layers	Date of acquisition	Spatial resolution
Landsat 1-5 MSS	148/044	UTM-WGS84	4	9 <sup>th</sup> February 1977	60 m
Landsat 7 ETM+	138/044	UTM-WGS84	8	17 <sup>th</sup> November 2000	30 m

Source: United States Geological Survey (USGS) Earth Explorer

For the purpose of image processing, GIS software has been used in this study. The Landsat satellite images which has spatial resolution 60 and 30 metre and the all bands were included in the analysis.

At first, the four Survey of India topographical maps (Table 2) were georeference and mosaic in WGS84/UTM45N projection through the georeferencer option. Then the river has been digitized through the add vector layer option in GIS software. Two satellite images, which were downloaded from website of USGS and using GIS software for the pre-processing such as georeferencing, layer stacking, geometric correction and radiometric correction. Thereafter, Jamuna River has been digitized from Landsat satellite images. Again the River has been also digitized using in the GIS software with the help of google satellite image to monitor the current status of the river channel.

**Table 2. Details of Topographical Maps**

Topographical Map No	Year	Scale	Source
NF 45-3			
NF 45-4	1955	1:2,50,000	Prepared by the Army Map Service (NSS & H) Corps of Engineers, U.S. Army, Washington
NF 45-7			
NF 45-8			

Source: Topographical Maps, U.S. Army map, 1955

The SRTM (Shuttle Radar Topography Mission) DEM (Table 3) was downloaded from USGS Earth Explorer to draw long profile of the River Jamuna and then a vector file along the middle of the river section was digitized and overlapped on the DEM file. Through the GIS software then taken one point at intervals of 2000 metre along the middle of the river (total 34 points from the end of Mathura Bil to Ichhamati River) and subsequently determined the height of the location of each point from the DEM file.

**Table 3. Details of SRTM DEM**

Entity ID	Acquisition Date	Updated Publication Date	Resolution
SRTM1N23E088V3	11 <sup>th</sup> February 2000	02th January 2015	1-ARC

Source: United States Geological Survey (USGS) Earth Explorer

Due to connection between Jamuna River and Mathura Bil, in this study end of the Mathura Bil to mouth of Jamuna River has considered as the area of discussion. After that, for the better delineation of the river channel, the total river has been divided into three segments, respectively,

- Segment-1: from the end of the Mathura Bil to Nagarukhra,
- Segment-2: from Nagarukhra to Gaighata and
- Segment-3: from Gaighata to the mouth (Ichhamati River) of the river.

To establishing the geomorphological river types, Sinuosity Index has been used. For the calculation of the Sinuosity Index, Schumm's model (1963) has been applied.

## **5. Result and Discussion**

### **5.1. Delineation of Jamuna river bank lines**

For delineation of the river bank lines Landsat images of 1977, 2000 and also google satellite image (2020) have been used. Due to calculate the length of left side bank, right side bank and centre line of the river the digitization method has been applied with the help of GIS software. Total length of Jamuna River is 66.63 km from end of Mathura Bil to mouth of Jamuna River at Tipi village. Segment wise river lengths are described in Table 4.

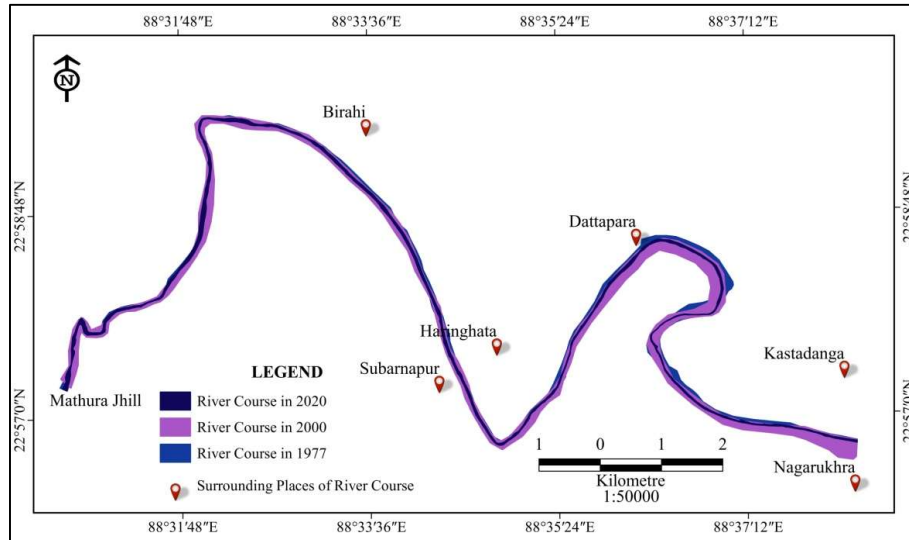
In segment-2, the river flow path has changed a lot, meaning that the river has become much narrower than before and it has become isolated from many of the surrounding bils (Figure 5). Even in segment-1 and segment-3, the flow of the river has also changed (Figure 4 and 6).

**Table 4. Location and Length of the Segments**

Segments	Start to end location	Length (in Km.)
1	End of Mathura Bil to Nagarukhra	25.26
2	Nagarukhra to Gaighata	17.77
3	Gaighata to the mouth (Ichhamati River) of the river	23.60

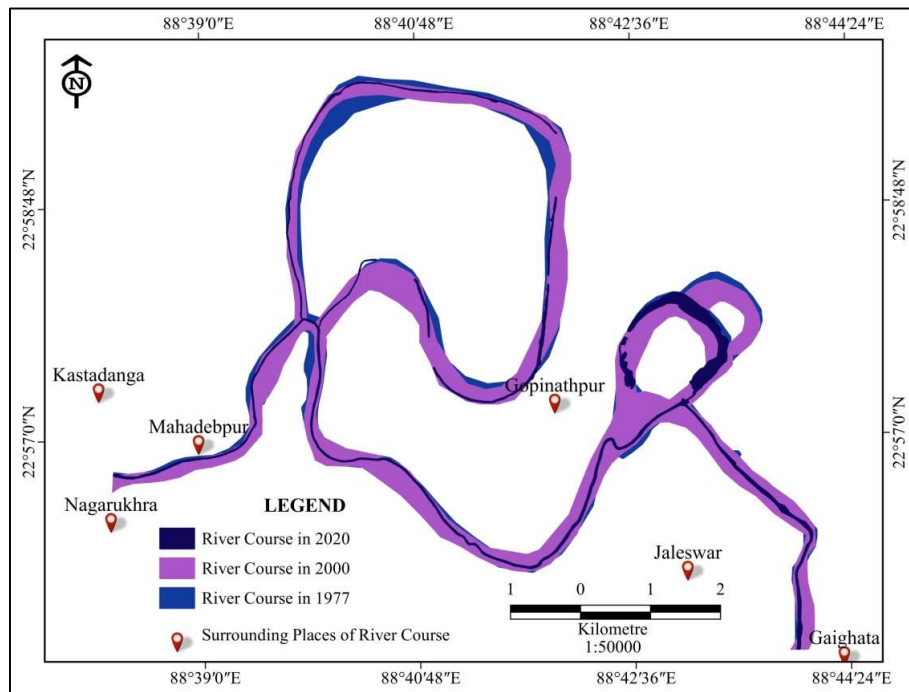
Source: Computed by the Authors using GIS software

**Figure 4: Segment-1**



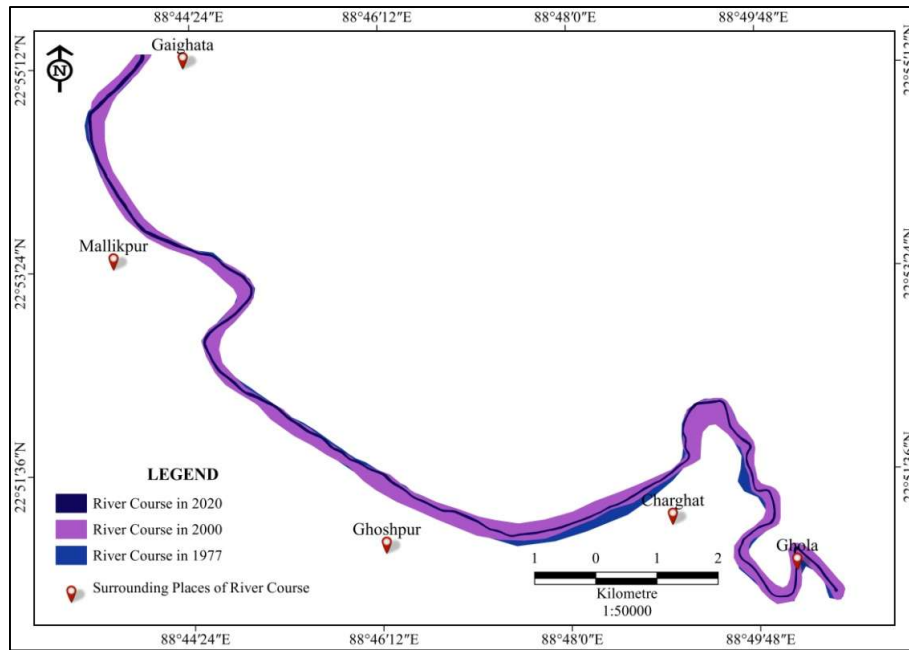
Source: USGS Landsat Satellite Images (1977, 2000) and Google Satellite Data (2020)

**Figure 5: Segment-2**



Source: USGS Landsat Satellite Images (1977, 2000) and Google Satellite Data (2020)

**Figure 6: Segment-3**



Source: USGS Landsat Satellite Images (1977, 2000) and Google Satellite Data (2020)

**5.2. Channel pattern of the Jamuna River**

Generally channel pattern of river described as three types respectively straight, meandering or braided. In maximum cases rivers turned from straight to meandering or meandering to braided channel pattern on its course. The ratio of channel length and valley length is called sinuosity ratio, through which the straight channel and meandering channel of a river can understand (Schumm, 1963).

According to Leopold and Wolman (1957), a sinuosity ratio of 1.5 is considered to differentiate sinuous from meandering. If the value of sinuosity index is below 1.5 then the channel is straight or sinuous and again the value of sinuosity index is above 1.5 then the channel belongs to meandering channel.

Here, Sinuosity Ratio of Schumm (1963) has been used in this study.

$$\text{Channel Sinuosity} = O_L/E_L$$

Where,  $O_L$  = observed (actual) path of a stream,  $E_L$  = expected straight path of a stream. The map is shown the enumeration of segment wise sinuosity ratio (Figure 7).

From 1977 to 2020, the sinuosity ratio of Jamuna River has significantly changed. During this time period sinuosity ratio has recorded as 2.31 (1977), 2.25 (2000) and 1.84 (2020) (Table 5). The value of sinuosity ratio of Jamuna River is lowest in the year of 2020.

**Table 5. Sinuosity Ratio of the Jamuna River**

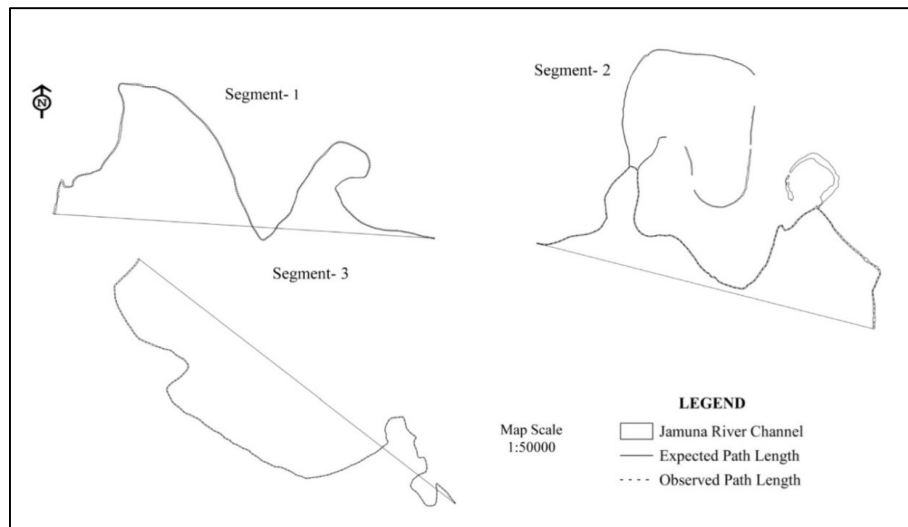
Year	Observed Length (OL) in Km.	Expected Length (EL) in Km.	Sinuosity Ratio
1977	83.8633	36.2559	2.31
2000	81.9315	36.2987	2.25
2020	66.6353	36.1589	1.84

Source: Computed by the Authors

Again, the Jamuna River has been divided into three segments and thus several changes can be observed segment-wise value of sinuosity ratio. In segment-1 the value of sinuosity ratios are 1.94 (1977), 2.45 (2000) and 1.95 (2020). In segment -2 values of sinuosity ratio also changed respectively 3.58 (1977), 2.41 (2000) and 1.76 (2020). These values in segment-3 are 1.56 (1977), 1.55 (2000) and 1.65 (2022) (Table 6).

Overall, it can be seen that the value of sinuosity ratio in segment -2 has decreased in year of 2020 (1.76). So it is clear that from 1977 to 2020 in these three segments this river belongs to meandering form and the River Jamuna is classified as meandering river.

**Figure 7: Sample map of computation of segment wise river sinuosity**



Source: Prepared by the Authors

**Table 6. Segment Wise Sinuosity Ratio of the Jamuna River**

S	Name of the Segments	Year 1977			Year 2000			Year 2020		
		OL (km)	EL (km)	SR	OL (km)	EL (km)	SR	OL (km)	EL (km)	SR
1	End of Mathura Bil to Nagarukhra	25.13	12.98	1.94	24.68	12.96	2.45	25.26	12.97	1.95
2	Nagarukhra to Gaighata	36.22	10.11	3.58	34.78	10.09	2.41	17.76	10.09	1.76
3	Gaighata to Mouth (Ichhamati River)	22.50	14.42	1.56	22.46	14.44	1.55	23.60	14.33	1.65

**Note:** S. = Segments, OL= Observed Length in Km., EL= Expected Length in Km., SI= Sinuosity Ratio. Source: Computed by the Authors

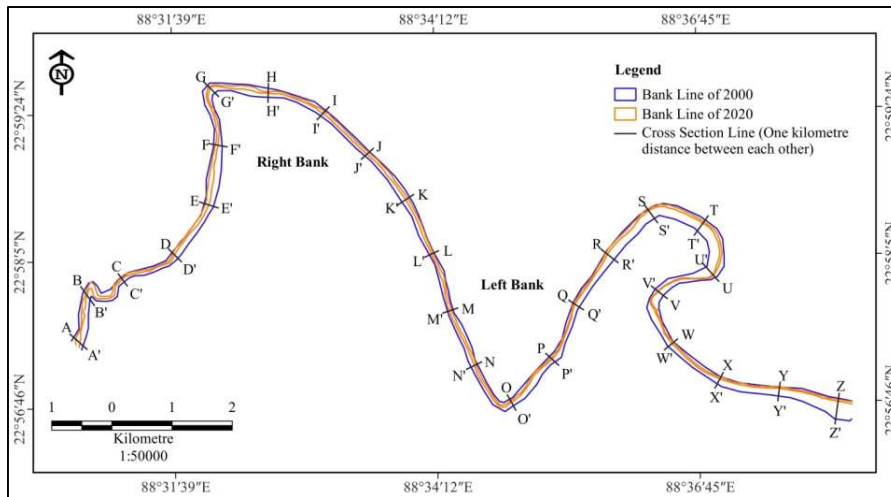
### 5.3. Main course shifting of the River Jamuna

The change of the course of river Jamuna has been determined on the basis of the river course of 2020. Each segment is divided into many parts in accordance with one kilometre and cross section line is drawn like segment-1 has 26 lines, segment-2 has 34 lines and segment-3 has 25 lines. River course data of the years of 1977, 2000 and 2020 have been used in GIS software to show river course shifting. The maps of segment wise River course shifting are shown in figure 8, 9 and 10 and the outcome data are given in table 7, 8 and 9.

#### 5.3.1. Segment-1

In 1977, there are only three parts in segment-1 where the shifting of the river bank is slightly outward, respectively AA', TT' and VV'. Again in 2000, three parts in segment-1 have also shifted outward such as CC', SS' and YY' (Figure 8). In this segment it shows that only 4 of 6 parts (cross section lines) changes are near the left side bank and only 2 parts changes (TT' and VV') are near the right side bank of the river (Table 7). From 1977 to 2020, maximum shifting of the river bank is occurred in inward at segment-1.

**Figure 8: Main Course Shifting of Jamuna River in Segment-1**

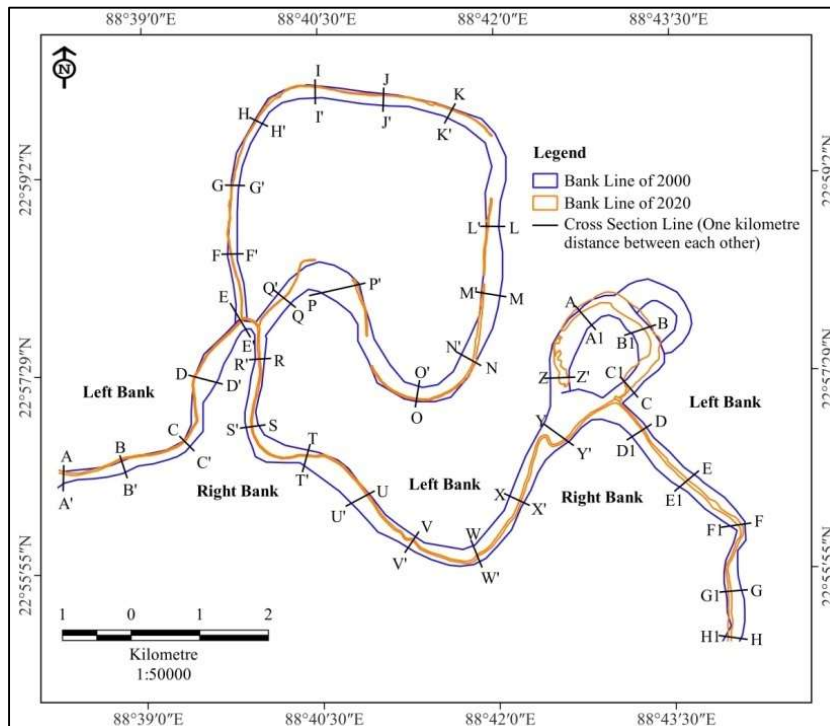


Source: Landsat Satellite Imagery (ETM+ data) 17th Nov., 2000 and Google Satellite Image, 2020

**5.3.2. Segment-2**

From table 8, it is observed that in the year of 1977 only 4 of 34 parts (cross section lines) where river bank moved outward. The parts are OO', ZZ', BB1 and CC1. Remaining parts are indicated the inward shifting of river bank. Again in the year of 2020, 8 parts (AA', BB', CC', DD', NN', AA1, BB1 and CC1) are detected outward river bank shifting and rest of these parts are detected the inward shifting of river bank (Figure 9). Only BB1 and CC1 parts are recorded as outward movement of the river bank during 1977 to 2020.

**Figure 9: Main Course Shifting of Jamuna River in Segment-2**

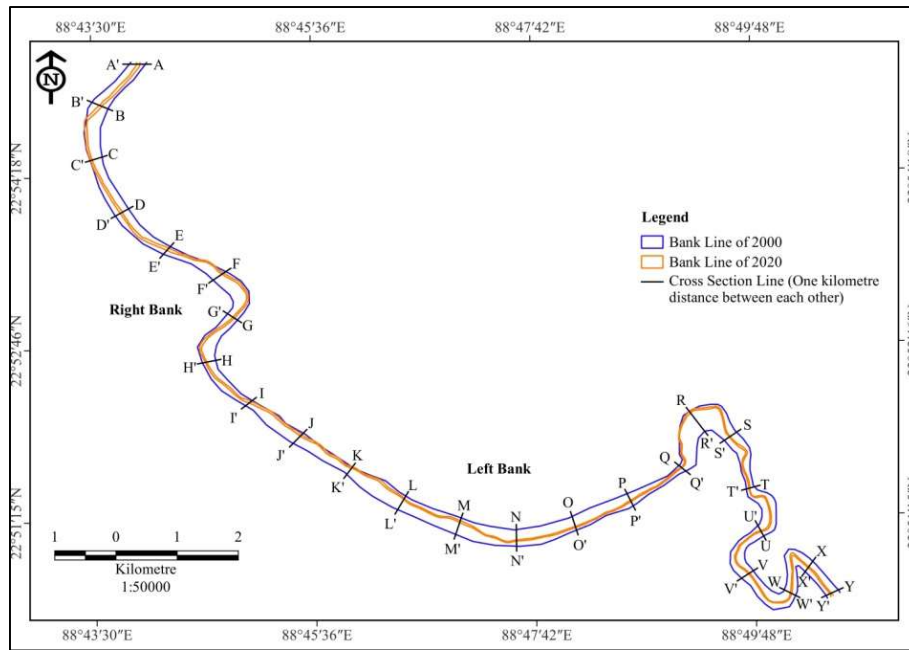


Source: Landsat Satellite Imagery (ETM+ data) 17th Nov., 2000 and Google Satellite Image, 2020

**5.3.3. Segment-3**

On the other hand in 1977 in segment-3 three parts of the river bank have changed outward like DD', EE' and VV'. Again in year of 2000, two outward change of river bank have been occurred these are KK' and RR' (Figure 10 and Table 9).

**Figure 10: Main Course Shifting of Jamuna River in Segment-3**



Source: Landsat Satellite Imagery (ETM+ data) 17th Nov, 2000 and Google Satellite Image, 2020

From 1977 to 2020, it is clear that outward shifting of river bank is observed in each segment. Even in the year of 1977 rightward movement of river is more active than leftward movement but in 2000 this river movement is totally changed and the movement form rightward to leftward. According to the data analysis tables it is observed that inward shifting of the river bank is very high in every segment. Due to this type of changes river width of Jamuna River is gradually decreased from 1977 to 2020.

**Table 7. Bank wise river shifting along the cross section line between 1977 and 2000 with respect to Year 2020 (Segment-1)**

L. N.	C. S. L.	Year of 1977					Year of 2000				
		L.R.B.	D.	R.R.B.	D.	R.S.	L.R.B.	D.	R.R.B.	D.	R.S.
1	AA'	0.38	L.	20.48	L.	Outward	47.8	R.	68.49	L.	Inward
2	BB'	21.51	R.	64.65	L.	Inward	50.82	R.	86.31	L.	Inward
3	CC'	28.89	R.	37.75	L.	Inward	10.82	L.	55.4	L.	Outward
4	DD'	6.36	R.	21.96	L.	Inward	19.64	R.	79.09	L.	Inward
5	EE'	3.43	R.	43.9	L.	Inward	20.42	R.	81.88	L.	Inward
6	FF'	13.82	R.	36.14	L.	Inward	30.61	R.	70.8	L.	Inward
7	GG'	8.2	R.	43.2	L.	Inward	33.44	R.	111.44	L.	Inward
8	HH'	27.9	R.	14.88	L.	Inward	55.18	R.	67.57	L.	Inward
9	II'	27.68	R.	39.78	L.	Inward	24.42	R.	56.8	L.	Inward
10	JJ'	49.1	R.	32.18	L.	Inward	14.87	R.	44.37	L.	Inward
11	KK'	64.92	R.	30.34	L.	Inward	34.77	R.	74.2	L.	Inward

L. N.	C. S. L.	Year of 1977					Year of 2000				
		L.R.B.	D.	R.R.B.	D.	R.S.	L.R.B.	D.	R.R.B.	D.	R.S.
12	LL'	43.59	R.	27.28	L.	Inward	14.26	R.	37.11	L.	Inward
13	MM'	55.92	R.	25.34	L.	Inward	21	R.	31.68	L.	Inward
14	NN'	21.48	R.	52.08	L.	Inward	21.99	R.	58.24	L.	Inward
15	OO'	23.25	R.	43.69	L.	Inward	28.03	R.	66	L.	Inward
16	PP'	32.23	R.	20.57	L.	Inward	31.86	R.	61.87	L.	Inward
17	QQ'	38.78	R.	68.97	L.	Inward	15.4	R.	85.86	L.	Inward
18	RR'	68.86	R.	38.71	L.	Inward	8.82	R.	139.54	L.	Inward
19	SS'	107.59	R.	44.23	L.	Inward	10.14	L.	162.25	L.	Outward
20	TT'	116.55	R.	9.74	R.	Outward	37.91	R.	152.14	L.	Inward
21	UU'	15.15	R.	199.84	L.	Inward	45.18	R.	164.84	L.	Inward
22	VV'	99.89	R.	8.01	R.	Outward	103.14	R.	58.25	L.	Inward
23	WW'	108.02	R.	19.19	L.	Inward	6.39	R.	79.13	L.	Inward
24	XX'	46.51	R.	57.57	L.	Inward	6.71	R.	93.32	L.	Inward
25	YY'	43.53	R.	55.81	L.	Inward	4.01	L.	129.76	L.	Outward
26	ZZ'	29.02	R.	131.72	L.	Inward	17.33	R.	297.8	L.	Inward

**Note:** L.N. = Location Number, C.S.L. = Cross Section Line, L.R.B. = Left River Bank, D. = Direction, R.R.B. = Right River Bank, R.S. = River Shifting, L. = Left, R. = Right  
Source: Computed by the Authors using GIS software

**Table 8. Bank wise river shifting along the cross section line between 1977 and 2000 with respect to Year 2020 (Segment-2)**

L. N.	C. S. L.	Year of 1977					Year of 2000				
		L.R.B.	D.	R.R.B.	D.	R.S.	L.R.B.	D.	R.R.B.	D.	R.S.
1	AA'	25.11	R.	84.81	L.	Inward	0.39	R.	144.13	L.	Outward
2	BB'	37.08	R.	75.25	L.	Inward	37.74	L.	185.97	L.	Outward
3	CC'	68.84	R.	62.42	L.	Inward	2.4	L.	105.24	L.	Outward
4	DD'	55.4	R.	36.62	L.	Inward	7.19	L.	316.63	L.	Outward
5	EE'	135.04	R.	153.51	L.	Inward	137.49	R.	126.86	L.	Inward
6	FF'	5.41	R.	154.47	L.	Inward	44.42	R.	83.31	L.	Inward
7	GG'	21.64	R.	167.47	L.	Inward	6.8	R.	95.32	L.	Inward
8	HH'	1.2	R.	342.97	L.	Inward	16.7	R.	92.06	L.	Inward
9	II'	62.3	R.	316.69	L.	Inward	6.99	R.	160.48	L.	Inward
10	JJ'	64.51	R.	90.92	L.	Inward	14.69	R.	145.19	L.	Inward
11	KK'	47.65	R.	166.24	L.	Inward	14.09	R.	126.09	L.	Inward

L. N.	C. S. L.	Year of 1977					Year of 2000				
		L.R.B.	D.	R.R.B.	D.	R.S.	L.R.B.	D.	R.R.B.	D.	R.S.
12	LL'	148.41	R.	81.34	L.	Inward	148.94	R.	14	L.	Inward
13	MM'	200.85	R.	42.96	L.	Inward	235.77	R.	23.45	L.	Inward
14	NN'	34.46	R.	134.42	L.	Inward	3.45	L.	190.88	L.	Outward
15	OO'	44.67	L.	268.99	L.	Outward	24.72	R.	179.79	L.	Inward
16	PP'	327.26	R.	34.45	L.	Inward	507.23	R.	33.07	L.	Inward
17	QQ'	121.01	R.	53.39	L.	Inward	127.99	R.	93.48	L.	Inward
18	RR'	85.36	R.	192.82	L.	Inward	65.82	R.	45.54	L.	Inward
19	SS'	90.8	R.	64.61	L.	Inward	92.37	R.	74.76	L.	Inward
20	TT'	61.93	R.	116.49	L.	Inward	69.73	R.	141.97	L.	Inward
21	UU'	40.26	R.	182.68	L.	Inward	15.64	R.	250.86	L.	Inward
22	VV'	66.71	R.	89.27	L.	Inward	47.32	R.	121.98	L.	Inward
23	WW'	14.38	R.	67	L.	Inward	143.09	R.	79.34	L.	Inward
24	XX'	29.8	R.	85.15	L.	Inward	153.59	R.	42.24	L.	Inward
25	YY'	328.5	R.	99.88	L.	Inward	382.53	R.	33.42	L.	Inward
26	ZZ'	109.97	L.	33.78	R.	Outward	123.86	R.	12.95	L.	Inward
27	AA1	22.71	R.	38.95	L.	Inward	39.75	L.	239.22	L.	Outward
28	BB1	54.46	L.	32.57	R.	Outward	27.86	L.	191.06	L.	Outward
29	CC1	67.48	L.	23.93	R.	Outward	87.75	L.	35.65	R.	Outward
30	DD1	34.68	R.	72.84	L.	Inward	52.18	R.	171.81	L.	Inward
31	EE1	39.89	R.	45.75	L.	Inward	119.07	R.	114.52	L.	Inward
32	FF1	76.24	R.	96.31	L.	Inward	50.74	R.	112.93	L.	Inward
33	GG1	64.61	R.	30.39	L.	Inward	152.31	R.	35.83	L.	Inward
34	HH1	63.02	R.	31.51	L.	Inward	140.42	R.	41.63	L.	Inward

**Note:** L.N. = Location Number, C.S.L. = Cross Section Line, L.R.B. = Left River Bank, D. = Direction, R.R.B. = Right River Bank, R.S. = River Shifting, L. = Left, R. = Right

Source: Computed by the Authors using GIS software

**Table 9. Bank wise river shifting along the cross section line between 1977 and 2000 with respect to Year 2020 (Segment-3)**

L. N.	C. S. L.	Year of 1977					Year of 2000				
		L.R.B.	D.	R.R.B.	D.	R. S.	L.R.B.	D.	R.R.B.	D.	R.S.
1	AA'	51.42	R.	30.64	L.	Inward	92.13	R.	116.45	L.	Inward
2	BB'	62.59	R.	31.28	L.	Inward	107.44	R.	130.17	L.	Inward
3	CC'	47.08	R.	20.56	L.	Inward	168.79	R.	6.53	L.	Inward
4	DD'	23.92	R.	0.26	R.	<b>Outward</b>	113.14	R.	91.2	L.	Inward
5	EE'	0.35	L.	61.23	L.	<b>Outward</b>	34.98	R.	85.32	L.	Inward
6	FF'	24.75	R.	123.17	L.	Inward	42.88	R.	174.49	L.	Inward

L. N.	C. S. L.	Year of 1977					Year of 2000				
		L.R.B.	D.	R.R.B.	D.	R. S.	L.R.B.	D.	R.R.B.	D.	R.S.
7	GG'	39.84	R.	99.98	L.	Inward	59.8	R.	100.9	L.	Inward
8	HH'	61.89	R.	35.73	L.	Inward	148.73	R.	50.1	L.	Inward
9	II'	46.6	R.	65.53	L.	Inward	21.82	R.	72.98	L.	Inward
10	JJ'	53.9	R.	98.09	L.	Inward	34.92	R.	164.42	L.	Inward
11	KK'	27.08	R.	143.67	L.	Inward	6.56	L.	127.87	L.	<b>Outward</b>
12	LL'	46.89	R.	129.2	L.	Inward	46.13	R.	194.96	L.	Inward
13	MM'	31.96	R.	200.86	L.	Inward	46.09	R.	205.91	L.	Inward
14	NN'	26.68	R.	167.15	L.	Inward	168.8	R.	81.82	L.	Inward
15	OO'	18.28	R.	186.59	L.	Inward	170.83	R.	45.46	L.	Inward
16	PP'	31.36	R.	181.65	L.	Inward	122.94	R.	74.49	L.	Inward
17	QQ'	70.04	R.	34.69	L.	Inward	47.19	R.	83.45	L.	Inward
18	RR'	2	R.	346.1	L.	Inward	2.81	L.	377.97	L.	<b>Outward</b>
19	SS'	89.78	R.	89.17	L.	Inward	126.32	R.	98.73	L.	Inward
20	TT'	25.43	R.	193.69	L.	Inward	80.99	R.	39.89	L.	Inward
21	UU'	85.84	R.	46.07	L.	Inward	81.82	R.	94.99	L.	Inward
22	VV'	1.28	L.	148.92	L.	Outward	71.96	R.	133.51	L.	Inward
23	WW'	68.64	R.	51.58	L.	Inward	110.74	R.	71.52	L.	Inward
24	XX'	75.12	R.	107.48	L.	Inward	110	R.	80.19	L.	Inward
25	YY'	52.96	R.	120	L.	Inward	126.62	R.	67.58	L.	Inward

**Note:** L.N. = Location Number, C.S.L. = Cross Section Line, L.R.B. = Left River Bank, D. = Direction, R.R.B. = Right River Bank, R.S. = River Shifting, L. = Left, R. = Right  
Source: Computed by the Authors using GIS software

#### 5.4. Changing channel width of Jamuna River

Three satellite images have been used of the years from 1977 to 2000 and google satellite image (2020) has been also used for drawn the river bank line using GIS software. After that the river divided into three segments and also the segments were divided into several parts by cross section line. Then computed the value of river bank width which is represented in table and also graphical form. After the analyzed of the data it reveals that

- In the duration of 1977 to 2020 so many changes have been occurred in each segments of the River Jamuna. Value of the river width is comparatively decreased with respect to previous value of river width.
- Again, it is observed that the width of the river was greater in 2000 than 1977 in most places. But from 2000 to 2020 it is declined almost everywhere.

On the basis of cross section line which is drawn on the river bank, in segment-1 the year wise river widths (Table 10) were 3181.73 metre (1977), 4007.23 metre (2000) and 933.46 metre (2020). Again in segment-2 year wise widths (Table 11) of the river were 7197.02 metre (1977), 7901.63 metre (2000) and 1254.72 metre (2020). After that in segment-3 the river width (Table 12) is also totally decreased such as 4486.17 metre (1977), 5599.71 metre (2000) and 706.50 metre (2020).

Due to lack of natural water sources the Jamuna River bank has changed at a very rapid rate. Spatial data helps to obtain temporal information by which the nature of changes in the course of Jamuna River can be easily understood. Segment wise nature of change of Jamuna River course and its statistical analysis is given below in the form of table (Table 13).

**Table 10. Channel Width of Jamuna River in Segment-1**

Location No.	Cross Section Line	Channel Width of River (in Metre)		
		Year 1977	Year 2000	Year 2020
1	AA'	112.34	207.87	92.31
2	BB'	124.65	175.58	38.09
3	CC'	108.31	85.10	41.62
4	DD'	65.32	135.47	37.26
5	EE'	108.67	161.99	61.12
6	FF'	93.46	144.19	43.78
7	GG'	82.43	176.02	30.97
8	HH'	69.65	148.54	26.39
9	II'	109.63	123.91	43.02
10	JJ'	124.48	102.22	43.14
11	KK'	136.76	150.35	41.33
12	LL'	101.57	82.53	31.32
13	MM'	120.90	92.99	40.72
14	NN'	105.55	113.26	32.53
15	OO'	97.09	125.45	31.1
16	PP'	86.48	127.41	33.52
17	QQ'	130.46	124.04	22.86
18	RR'	136.92	181.95	33.62
19	SS'	183.42	184.46	31.88
20	TT'	141.09	224.29	34.45
21	UU'	235.82	230.47	20.44
22	VV'	100.80	169.40	8.33
23	WW'	156.39	115.48	29.63
24	XX'	133.40	128.81	29.32
25	YY'	123.97	149.36	23.85
26	ZZ'	192.17	346.09	30.86
<b>Total Channel Width of the River</b>		<b>3181.73</b>	<b>4007.23</b>	<b>933.46</b>

Source: Computed by the Authors using GIS Software

**Table 11. Channel Width of Jamuna River in Segment-2**

Location No.	Cross Section Line	Channel Width of River (in Metre)		
		Year 1977	Year 2000	Year 2020
1	AA'	146.84	181.13	37.37
2	BB'	133.08	169.54	21.33
3	CC'	149.15	120.9	18.07

Location No.	Cross Section Line	Channel Width of River (in Metre)		
		Year 1977	Year 2000	Year 2020
4	DD'	111.45	328.74	19.47
5	EE'	307.14	284.51	20.11
6	FF'	171.16	139	11.46
7	GG'	198.03	111.81	9.73
8	HH'	355.51	119.95	11.09
9	II'	391.5	180.86	13.19
10	JJ'	166.84	170.47	11.66
11	KK'	224.39	150.76	10.76
12	LL'	249.28	181.53	19.66
13	MM'	258.71	272.25	13.92
14	NN'	217.2	235.28	48.01
15	OO''	242.95	223.08	19.51
16	PP'	387.96	568.48	26.66
17	QQ'	186.33	232.61	11.65
18	RR'	300.32	134.63	23.4
19	SS'	175.52	187.95	20.51
20	TT'	199.07	233.23	21.21
21	UU'	247.74	290.73	24.71
22	VV'	176.5	191.83	22.02
23	WW'	111.57	249.46	28.39
24	XX'	145.19	227.38	30.71
25	YY'	458.93	446.34	30.7
26	ZZ'	212.52	273.39	136.24
27	AA1	142.73	279.93	81.67
28	BB1	149.78	288.73	127.79
29	CC1	214.21	223.02	171.61
30	DD1	135.86	251.53	27.86
31	EE1	131.68	278.76	45.9
32	FF1	221.24	215.65	51.33
33	GG1	138.16	231.14	43.11
34	HH1	138.48	227.03	43.91
<b>Total Channel Width of the River</b>		<b>7197.02</b>	<b>7901.63</b>	<b>1254.72</b>

Source: Computed by the Authors using GIS Software

**Table 12. Channel Width of Jamuna River in Segment-3**

Location No.	Cross Section Line	Channel Width of River (in Metre)		
		Year 1977	Year 2000	Year 2020
1	AA'	136.68	265.32	55.66
2	BB'	133.21	281	43.79
3	CC'	95.32	203.64	28.52
4	DD'	63.91	243.2	39.77
5	EE'	107.23	168.84	48.37
6	FF'	177.46	248.85	31.45
7	GG'	169.03	190.57	30.63
8	HH'	120.47	222.44	23.24
9	II'	150.65	138.87	43.63
10	JJ'	187.31	234.6	35.13
11	KK'	193.59	146.96	25.38
12	LL'	265.07	258.45	17.84
13	MM'	213.3	283.14	31.67
14	NN'	222.52	270.48	20.19
15	OO'	237.78	235.04	18.39
16	PP'	118.15	221.34	24.54
17	QQ'	383.18	143.29	12.91
18	RR'	195.09	409.38	34.45
19	SS'	236.37	240.4	16.97
20	TT'	156.5	137.94	16.03
21	UU'	166.13	195.32	19.83
22	VV'	142.53	225.91	19.33
23	WW'	205.73	206.4	23.65
24	XX'	213.83	209.85	20.42
25	YY'	195.13	218.48	24.71
<b>Total Channel Width of the River</b>		<b>4486.17</b>	<b>5599.71</b>	<b>706.5</b>

Source: Computed by the Authors using GIS Software

From the tables 10, 11 and 12, it is cleared that the width of River Jamuna has decreased a lot with time. However, looking at the value of segment wise skewness in each year, it can be said that the distribution is the totally right skewed direction and the distribution is purely asymmetrical (Table 13). The kurtosis values in 2000 were 4.59 (segment-1), 5.28 (segment-2), and 3.26 (segment-3). In 2020, the kurtosis value was 7.61, indicating a leptokurtic distribution. On the other hand other values of kurtosis belong to platykurtic distribution.

**Table 13. Table for Segment wise Statistical Analysis of Jamuna River Width**

Segments	Segment-1			Segment-2			Segment-3		
	1977	2000	2020	1977	2000	2020	1977	2000	2020
Maximum	235.82	346.09	92.31	458.93	568.48	171.61	383.18	409.38	55.66
Minimum	65.32	82.53	8.33	111.45	111.81	9.73	63.91	137.94	12.91
Mean	122.37	154.12	35.90	211.68	232.40	36.90	179.45	223.99	28.26
Median	116.62	146.37	33.03	192.18	227.21	22.71	177.46	222.44	24.71
Standard Deviation	37.12	54.57	14.80	85.04	89.11	37.21	63.55	56.82	10.87
Skewness	1.25	1.71	2.10	1.27	1.81	2.45	1.07	1.05	0.88
Kurtosis	2.28	<b>4.59</b>	<b>7.61</b>	1.16	<b>5.28</b>	5.70	2.93	<b>3.26</b>	0.11

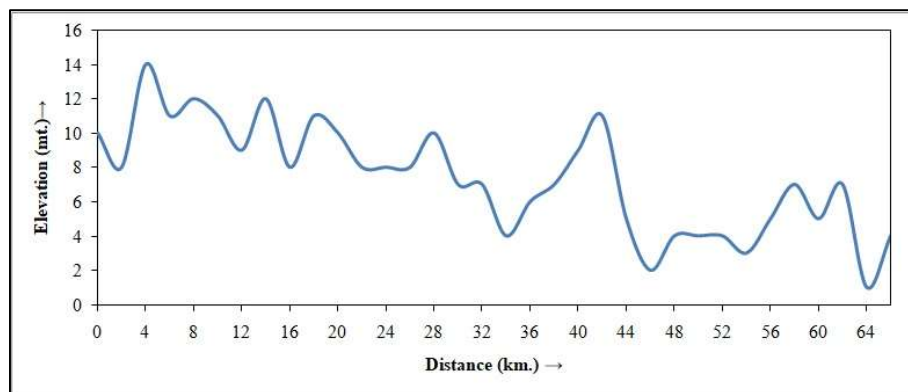
Source: Computed by the Authors

### 5.5. Longitudinal Profile of Jamuna River

The long profile from the source of the river to the estuary (mouth) helps in understanding the gradient of a particular river. It is very easy to show the whole channel of a river. It also shows how a river loses its land height as it flows from its source to its estuary (mouth).

The following is a picture of the river profile of the River Jamuna (Figure 11). The source of which is very difficult to find at present, so the long profile of the River Jamuna from end of *Mathura Bil* (Mathura Lake) to Ichhamati River has been drawn for the convenience of discussion. Observing the long profile of the river and the land topography of the local area, it is clear that the river has flowed through the plains crossing slight ups and downs in its course.

**Figure 11: Longitudinal Profile of the Jamuna River from end of the Mathura Bil to Ichhamati River**



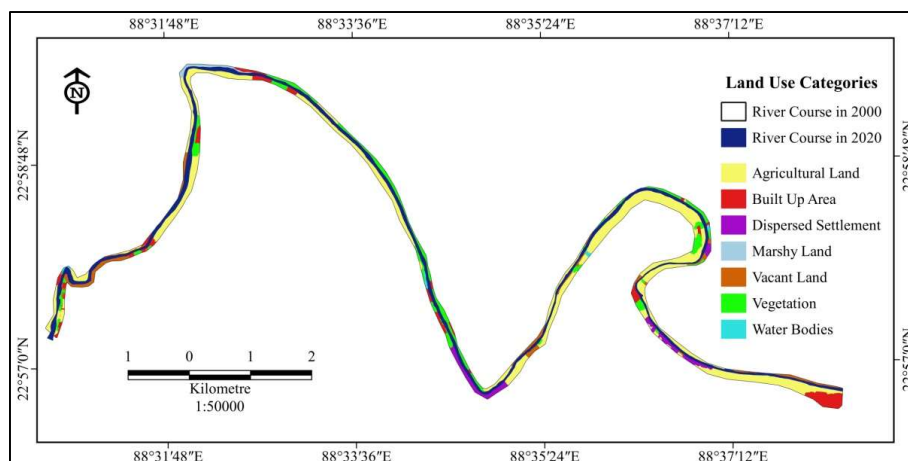
Source: SRTM DEM data

### 5.6. Present status of Jamuna River course

#### 5.6.1. Segment-1

In 2000, the area of river course from *Mathura Bil* to Nagarukhra was 3.618 Sq. Km. Later in the year of 2020, the course of the River Jamuna changed a lot. Humanitarian activities are mainly responsible for this. Because people on both sides of the river are using it for their own needs, e.g. 45.82% of the total land use of the river course is for agricultural purposes, 8.63% is built up area, 3.94% is dispersed settlement, 11.04% is forest, 1.24% is wetland, 5.7% is vacant land and 0.47% is being used as other water reservoirs. In a word, only 24.20% of the total river course is in the form of flowing water bodies (Figure 12 and Table 14).

**Figure 12: Land Use Categories in Segment- 1**



Source: Google Satellite Image, 2020

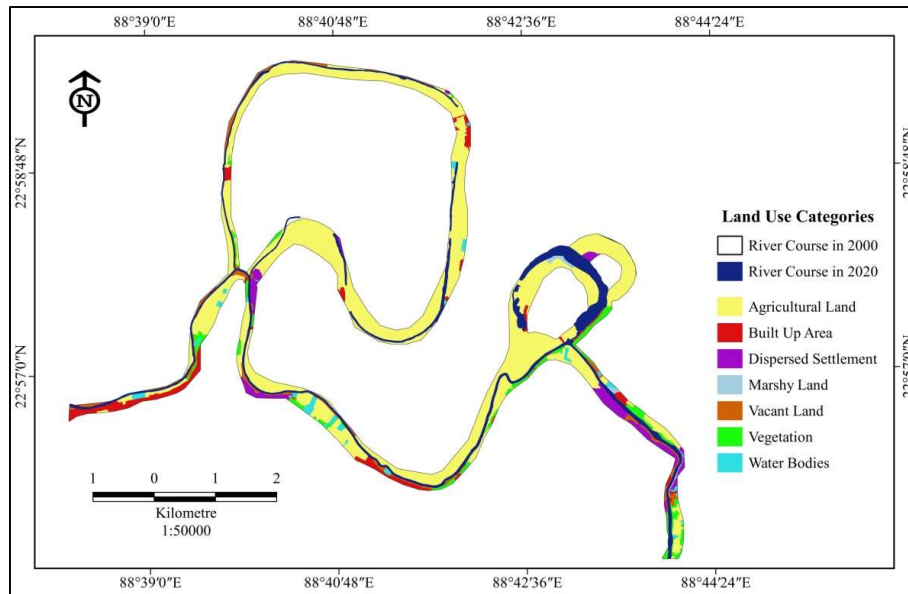
**Table 14. Land Use Categories in Segment-1**

Serial Number	Land Use Categories	Area in Sq. Km.
1	Agricultural Land	1.6578
2	Built Up Area	0.2845
3	Dispersed Settlement	0.143
4	Forest	0.4011
5	Marshy Land	0.0451
6	Vacant Land	0.2056
7	Water Bodies	0.0175
<b>Total</b>		<b>2.7546</b>

Source: Computed by Authors using Google Satellite Image, 2020

**5.6.2. Segment-2**

In this segment, the river course has been changed largely from Nagarukhra to Gaighata. In the year of 2000, the river course was very wide (8.5364 Sq.Km.) but now most of the area of river course has been converted into different types of human activities such as agricultural land (65.45%), built up area (5.14%), dispersed settlement (4.01%), forest cover (4.66%), marshy land (0.64%), vacant land (4.62%) and water bodies (1.97%). In 2020, the River Jamuna course area is gradually decreased and amount is 1.661 Sq. Km. which is 13.51% of total river course area in 2000 (Figure 13 and Table 15).

**Figure 13: Land Use Categories in Segment- 2**

Source: Google Satellite Image, 2020

**Table 15. Land Use Categories in Segment-2**

Serial Number	Land Use Categories	Area in Sq.Km.
1	Agricultural Land	5.6514
2	Built Up Area	0.4435
3	Dispersed Settlement	0.3461
4	Forest	0.4024
5	Marshy Land	0.0555
6	Vacant Land	0.3992
7	Water Bodies	0.1703
	<b>Total</b>	<b>7.4684</b>

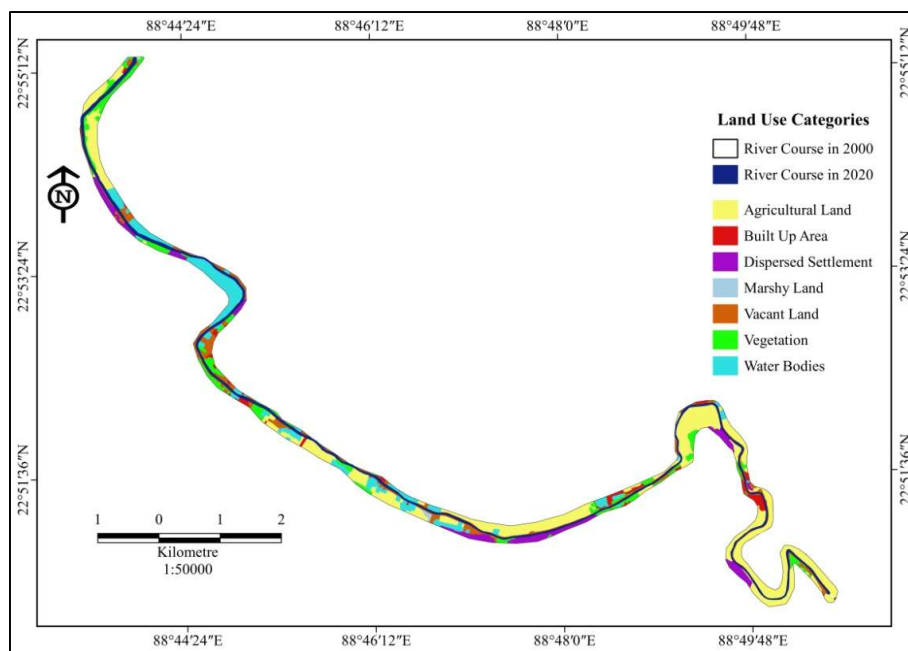
Source: Computed by Authors using Google Satellite Image, 2020

**5.6.3. Segment-3**

From Gaighata to river mouth, the river course has also changed. Most of the river course area have been encroached by the agricultural land (43.29%), built up area (3.42%), dispersed settlement (7.04%), forest cover (10.40%), marshy land (0.35%), vacant land (10.12%), water bodies (6.37%) and other type of water bodies (6.47%) which is used in fisheries purpose. Here, present river course area is 12.55% of the total course area in 2000 (Figure 14 and Table 16).

As per the above discussion it is clear that, the river course area has changed a lot due to different types of human activities. As a result the condition of the river is extremely bad and now it has turned into a dying river whose water source is completely closed and the natural course is also being affected by other activities.

**Figure 14: Land Use Categories in Segment-3**



Source: Google Satellite Image, 2020

**Table 16. Land Use Categories in Segment-3**

Serial Number	Land Use Categories	Area in Sq.Km.
1	Agricultural Land	2.1604
2	Built Up Area	0.1707
3	Dispersed Settlement	0.3512
4	Forest	0.5192
5	Marshy Land	0.0173
6	Vacant Land	0.5049
7	Water Bodies	0.3179
8	Water Bodies (Fisheries)	0.3227
	<b>Total</b>	<b>4.3643</b>

Source: Computed by Authors using Google Satellite Image, 2020

## **6. Conclusion**

In this study, the variations in the Jamuna River’s course are shown using several remote sensing techniques and GIS. This demonstrates that the river’s source has over time become blocked due to lack of flowing water throughout the year. As a result comparing the course of the river in 1955 with the course of the river in 1977 and 2000 shows many changes. Even the course of the river in 2020 has also changed significantly. However, in this case by analyzing the google satellite map (2020), it can be understood that human activities are also one of the main reason for changing the course of the river. Because the course area of the River Jamuna is being affected by this activity and people are occupying the course area of the river illegally for their own purpose (e.g. agricultural land, settlement etc.) which is reducing the course area of the river. As a result the river is going to lose its existence. It is possible to state that this issue have some solutions like,

- Re-linking of Jamuna River with Bhagirathi River.
- Excavating the channel of river and making it deeper.

- Government intervention is needed so that the common people cannot enter the river course area arbitrarily and cannot easily use the area for their own activities.
- All categories of people who are directly engaged with Jamuna River like fisherman, farmer etc. should keep their own interests in mind and try to maintain the normal flow of the river.

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## YOUTH EMIGRATION AND SME PERFORMANCE IN ALBANIA: FIRM-LEVEL EVIDENCE

**Alketa VANGJELI**

Associate Professor, University of Elbasan, Albania.

alketa.vangjeli@uniel.edu.al

### Abstract

Youth emigration has become a persistent structural challenge for the Albanian economy, raising concerns about labor availability, productivity, and the sustainability of small and medium-sized enterprises (SMEs). While the macroeconomic consequences of emigration have been widely examined, limited attention has been paid to its firm-level effects, particularly in transition economies. This study investigates the impact of youth emigration on Albanian SMEs, focusing on labor shortages, skills availability, productivity perceptions, innovation capacity, and growth expectations. Using cross-sectional survey data collected from SMEs operating across key economic sectors in Albania, the analysis employs regression techniques to examine the relationship between youth emigration intensity and firm performance indicators, controlling for firm size, age, sector, and location. The results indicate that higher levels of youth emigration are significantly associated with increased labor shortages and reduced access to skilled workers. SMEs exposed to stronger emigration pressures also report lower productivity growth and diminished innovation activity, suggesting that youth outmigration constrains firms' adaptive capacity. Although some firms attempt to mitigate these effects through wage adjustments or organizational restructuring, such responses appear insufficient to offset the broader human capital depletion. The findings contribute to the literature on migration and firm performance by providing micro-level evidence from a small transition economy and highlighting the asymmetric vulnerability of SMEs to demographic shocks. From a policy perspective, the results underscore the need for integrated youth retention, skills development, and SME support strategies to sustain enterprise competitiveness and long-term economic growth.

**Keywords:** Labor shortages, Human capital, Firm productivity, Innovation

**JEL classification:** F22, J24, L26, O15, R23

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### 1. Introduction

Youth emigration has become one of the most persistent structural challenges facing the Albanian economy, with important implications for labor markets, enterprise development, and long-term growth. Over the past decade, Albania has experienced sustained outward migration, particularly among young and educated individuals, driven by wage differentials, limited domestic employment opportunities, and perceptions of weak institutional quality (World Bank, 2025; OECD, 2022). While emigration can generate benefits through remittances and diaspora networks, the continuous loss of young human capital raises concerns about the productive capacity of domestic firms.

Small and medium-sized enterprises (SMEs) play a central role in the Albanian economy, accounting for the majority of private-sector employment and serving as a key source of income generation and local economic activity (INSTAT, 2023). Unlike large firms, SMEs rely heavily on local labor markets and are more exposed to demographic and institutional shocks. Young workers are particularly important for SMEs due to their adaptability, digital skills, and contribution to productivity and innovation. As a result, sustained youth emigration may disproportionately affect SMEs by limiting labor availability, increasing hiring costs, and constraining firms' growth prospects.

From a theoretical perspective, the relationship between emigration and firm performance can be understood through human capital theory, which emphasizes the role of education and skills in enhancing productivity and competitiveness (Becker, 1993). When emigration is positively selected—as is often the case among young and educated individuals—it can lead to

a depletion of productive human capital in the country of origin. Empirical research suggests that such losses may weaken firm-level productivity and slow structural transformation, particularly in economies with limited capacity to replace skilled labor (Docquier & Rapoport, 2012; IMF, 2016).

Migration theory further highlights the importance of push–pull factors in shaping youth emigration decisions. According to Lee’s (1966) framework, unfavorable domestic conditions, such as low wages, limited career advancement, and weak institutional trust, interact with attractive opportunities abroad to encourage migration. In transition economies like Albania, these dynamics are amplified by structural rigidities and a business environment that often limits merit-based advancement, reinforcing young workers’ incentives to exit domestic labor markets (World Bank, 2025).

Despite a growing literature on migration and economic development, empirical evidence on the firm-level consequences of youth emigration remains limited. Existing studies have largely focused on macroeconomic outcomes, including growth, remittances, and labor market aggregates (Beine, Docquier, & Rapoport, 2001; 2008). However, remittance inflows do not necessarily translate into productive investment or improved firm performance, particularly in economies where access to finance and entrepreneurial ecosystems remain underdeveloped (Clemens & McKenzie, 2018). As a result, the potential benefits of emigration may not offset the operational challenges faced by domestic enterprises.

At the microeconomic level, emerging research indicates that firms operating in high-emigration environments may experience labor shortages, wage pressures, and difficulties in sustaining productivity and innovation (Brell, Dustmann, & Preston, 2020). While some firms respond by reorganizing production or investing in labor-saving technologies, such adjustments are often costly and less feasible for SMEs with limited financial and managerial resources (Acemoglu & Restrepo, 2018). This suggests that youth emigration may represent a structural constraint rather than a temporary adjustment shock for small firms.

Within the Western Balkan region, and Albania in particular, systematic firm-level analysis of these dynamics remains scarce. Most available evidence focuses on demographic trends or labor market indicators, leaving a gap in understanding how SMEs perceive and respond to youth emigration pressures. Addressing this gap is essential for designing effective enterprise and labor market policies in economies characterized by sustained outward migration.

This study examines the effects of youth emigration on Albanian SMEs, focusing on labor availability, skills shortages, productivity outcomes, innovation activity, and growth expectations. By employing firm-level survey data and econometric analysis, the paper contributes to the literature by providing microeconomic evidence from a transition economy and highlighting the vulnerability of SMEs to demographic change. The findings are intended to inform policy debates on youth retention, workforce development, and SME competitiveness in Albania and similar emerging economies.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature, Section 3 describes the data and methodology, Section 4 presents the empirical results, Section 5 discusses the findings, and Section 6 concludes with policy implications.

## **2. Literature Review**

### **2.1. Youth Emigration and Human Capital**

The economic effects of emigration have traditionally been analyzed through the lens of human capital theory, which emphasizes the role of education, skills, and experience in determining productivity and economic growth (Becker, 1993). When emigration is concentrated among young and educated individuals, it may result in a net loss of productive human capital in the country of origin, potentially weakening labor market performance and long-term growth prospects. This concern is particularly relevant for transition economies, where the capacity to replenish skilled labor through education systems or immigration is often limited.

Empirical evidence on the consequences of high-skilled emigration is mixed. Early studies highlighted the negative implications of “brain drain” for sending countries, including reduced productivity and slower technological diffusion (Docquier & Rapoport, 2012). More recent

contributions have introduced the concept of “brain circulation,” suggesting that emigration may generate dynamic benefits through remittances, return migration, and diaspora networks (Dustmann, Fadlon, & Weiss, 2011). However, such benefits are more likely to materialize in economies with strong institutions and well-developed financial and innovation systems, conditions that are only partially met in many emerging economies.

In the case of Albania and other Western Balkan countries, youth emigration tends to be positively selected, with migrants often possessing higher levels of education and transferable skills (King & Gëdeshi, 2020). This pattern raises concerns about sustained human capital depletion, particularly in sectors that rely on young labor for adaptability and skill renewal.

## **2.2. Emigration, Labor Markets, and Firm-Level Outcomes**

Beyond aggregate labor market effects, emigration can influence firm behavior through changes in labor availability, wage dynamics, and skills composition. Standard labor market theory suggests that a reduction in labor supply may increase wages and encourage capital–labor substitution. While such adjustments may be feasible for large firms, smaller enterprises often face tighter financial and organizational constraints, limiting their ability to respond effectively to labor shortages.

Firm-level studies indicate that emigration can generate heterogeneous effects across enterprises. In high-emigration regions, firms frequently report difficulties in recruiting and retaining skilled workers, leading to higher labor costs and potential productivity losses (Brell, Dustmann, & Preston, 2020). These effects tend to be more pronounced for SMEs, which rely heavily on local labor markets and have limited access to external recruitment channels.

Some research suggests that firms may respond to labor shortages by investing in automation or reorganizing production processes (Acemoglu & Restrepo, 2020). However, such responses require upfront investment and managerial capacity, which are often scarce among SMEs in transition economies. As a result, the adjustment to emigration-induced labor constraints may be incomplete, leading to persistent performance gaps.

## **2.3. SMEs, Innovation, and Demographic Constraints**

Some research suggests that firms may respond to labor shortages by investing in automation or reorganizing production processes (Acemoglu & Restrepo, 2020). However, such responses require upfront investment and managerial capacity, which are often scarce among SMEs in transition economies. As a result, the adjustment to emigration-induced labor constraints may be incomplete, leading to persistent performance gaps.

SMEs play a critical role in employment creation, innovation, and regional development, particularly in emerging and transition economies. Their performance is closely linked to the availability of skilled and motivated labor, as human capital is often the primary input into productivity and innovation processes. Young workers, in particular, contribute to firms’ adaptability, digitalization, and openness to new business practices.

The loss of young workers through emigration may therefore have implications beyond immediate labor shortages. Reduced access to youthful human capital can constrain SMEs’ innovation capacity, limit the adoption of new technologies, and weaken long-term growth expectations. Empirical studies have shown that firms facing skills shortages are less likely to engage in innovation activities and more likely to postpone expansion plans (Ghods et al., 2024).

In transition economies, these challenges are compounded by structural factors such as limited access to finance, underdeveloped training systems, and weak linkages between firms and educational institutions. Consequently, SMEs may struggle to offset the negative effects of emigration through internal training or technological upgrading.

## **2.4 Emigration, Remittances, and Enterprise Development**

A substantial strand of the literature emphasizes the potential role of remittances in mitigating the negative effects of emigration. At the household level, remittances can relax liquidity constraints, smooth consumption, and support investment in education. However, the

extent to which remittances contribute to productive investment and enterprise development remains contested.

Empirical evidence suggests that remittances do not automatically translate into higher firm investment or productivity growth, particularly in economies with weak financial intermediation and limited entrepreneurial ecosystems (Clemens & McKenzie, 2018). In some cases, remittances may even reduce labor supply by increasing reservation wages, further exacerbating labor shortages faced by domestic firms.

For SMEs, remittance inflows may provide indirect benefits through increased local demand, but these effects are unlikely to fully compensate for the loss of skilled labor. This reinforces the view that remittances and enterprise development are not perfect substitutes for domestic human capital.

## **2.5 Research Gap and Conceptual Framework**

Despite growing interest in the economic consequences of emigration, several gaps remain in the literature. First, firm-level analyses—particularly those focusing on SMEs—are relatively scarce compared to macroeconomic studies. Second, youth emigration has received less attention than general or high-skilled migration, despite its potentially distinct implications for firm dynamics. Third, evidence from small transition economies such as Albania remains limited.

This study addresses these gaps by examining how youth emigration affects Albanian SMEs in terms of labor availability, skills shortages, productivity indicators, innovation activity, and growth expectations. By focusing on firm-level outcomes and incorporating the perspective of SME managers, the analysis provides microeconomic insights into the mechanisms through which demographic change influences enterprise performance.

## **3. Methodology**

### **3.1 Research Design**

This study adopts a quantitative, cross-sectional research design to examine the effects of youth emigration on the performance of small and medium-sized enterprises (SMEs) in Albania. Given the limited availability of firm-level longitudinal data on migration-related outcomes, a survey-based approach is employed to capture SMEs' exposure to youth emigration and its perceived effects on labor availability, productivity, innovation, and growth expectations. This design is consistent with prior firm-level studies in emerging and transition economies, where administrative microdata is often incomplete or inaccessible.

The analysis focuses on SMEs, defined according to the European Union criteria based on employment size, as these firms are more reliant on local labor markets and therefore more vulnerable to demographic shocks.

### **3.2 Data Collection and Sample**

Primary data were collected through a structured questionnaire administered to SME owners and senior managers between September/2025 and November/2025. The survey targeted firms operating in key sectors of the Albanian economy, including manufacturing, services, trade, and tourism, which together account for a substantial share of SME employment.

The sampling strategy combined stratified and convenience sampling to ensure sectoral and regional representation while accounting for practical constraints in firm outreach. The final sample consists of 312 SMEs distributed across urban and non-urban areas. Only firms that had been operating for at least three years were included in the analysis to ensure that respondents could reasonably assess changes in labor availability and firm performance over time.

### **3.3 Measurement of Variables**

Dependent Variables: Firm-level outcomes are captured using five main dependent variables, reflecting key dimensions of SME performance:

- Labor shortages, measured by managers' assessment of difficulties in recruiting and retaining young workers.

- Skills availability, capturing perceived access to workers with adequate education and skills.
- Productivity perceptions, reflecting changes in labor productivity over recent years.
- Innovation activity, measured by engagement in product, process, or organizational innovation.
- Growth expectations, capturing firms' expectations regarding future expansion and investment.

These variables are measured using Likert-scale responses, which are commonly applied in firm surveys and allow for comparability across heterogeneous enterprises.

**Independent Variable:** The key explanatory variable is youth emigration intensity, measured through firms' reported exposure to the emigration of young workers (aged 18–35) in their local labor market or within the firm itself. This perception-based measure reflects the fact that SMEs often experience emigration indirectly, through labor market tightness and recruitment difficulties, rather than through direct observation of migration flows.

**Control Variables:** To isolate the effect of youth emigration, the analysis controls for firm characteristics that may influence performance outcomes, including firm size (number of employees), firm age, sector of activity, and geographic location. These controls are standard in the SME and labor economics literature and help account for structural heterogeneity across firms.

#### Empirical Strategy

The empirical analysis estimates the relationship between youth emigration and SME outcomes using regression models of the following general form:

$$Y_i = \alpha + \beta \cdot YouthEmigration_i + \gamma X_i + \epsilon_i$$

where  $Y_i$  represents the firm-level outcome,  $YouthEmigration_i$  measures youth emigration exposure,  $X_i$  is a vector of control variables, and  $\epsilon_i$  is the error term.

Depending on the nature of the dependent variable, the study employs ordinary least squares (OLS) or ordered response models. Robust standard errors are used to account for heteroskedasticity.

#### Robustness and Limitations

Several robustness checks are conducted to assess the stability of the results, including alternative specifications of the youth emigration variable and sector-specific estimations. While the cross-sectional design limits causal inference, the analysis provides valuable associative evidence on the firm-level implications of youth emigration.

Potential limitations include the use of perception-based measures and the absence of longitudinal data. However, given the exploratory nature of firm-level research on migration in Albania, this approach offers a pragmatic and informative starting point. The results are interpreted with caution and positioned as contributing to a broader empirical and policy-oriented discussion rather than establishing strict causality.

## **4. Results**

### **4.1. Descriptive Statistics**

The final sample comprises 312 SMEs operating across Albania. The sectoral distribution is as follows: 41% of firms operate in services, 27% in trade, 19% in manufacturing, and 13% in tourism-related activities. The average firm employs 18 workers, with a median firm age of 9 years, reflecting the predominance of small, relatively young enterprises.

Labor market challenges are substantial. 64% of SMEs report increased difficulty in recruiting young workers over the past three years, and 58% indicate that at least one young employee has emigrated or expressed strong intentions to emigrate. Skills shortages are reported by 61% of firms, particularly in technical, digital, and managerial roles.

Regarding firm performance, 47% of SMEs report stagnant or declining productivity, while only 29% have engaged in product, process, or organizational innovation in the previous two years. Growth expectations are modest, with 55% of firms expressing uncertainty or pessimism regarding future expansion.

These descriptive statistics reveal substantial variation in youth emigration exposure and SME performance, providing a strong empirical foundation for the subsequent regression analysis.

**Table 1: Descriptive Statistics of Key Variables**

Variable	Mean	Std. Dev.	Min	Max	Description
Youth Emigration Exposure	2.84	0.97	1	5	Perceived intensity of youth emigration in local labor market (1=Very Low, 5=Very High)
Labor Shortages	3.21	1.04	1	5	Difficulty in recruiting young workers (1=Very Low, 5=Very High)
Skills Shortages	3.05	1.01	1	5	Difficulty finding workers with adequate skills (1=Very Low, 5=Very High)
Productivity	3.12	0.98	1	5	Managers' perception of labor productivity change (1=Declined, 5=Improved)
Innovation Activity	2.67	1.05	1	5	Engagement in product/process/organizational innovation (1=None, 5=Extensive)
Growth Expectations	3.08	1.02	1	5	Firm's expectation of future growth (1=Very Low, 5=Very High)
Firm Size (employees)	18.3	12.4	5	55	Total number of employees in the firm
Firm Age (years)	9.1	6.8	2	30	Number of years the firm has been operating

Source: Author's calculations

Notes:

- Likert-scale variables range from 1 to 5.
- Descriptive statistics reflect N = 312 SMEs across sectors (services, trade, manufacturing, tourism).
- All variables are used in regression analysis with controls for firm size, firm age, sector, and location.

## 4.2 Correlation Analysis

Pairwise correlation analysis (Table 2) indicates a **positive and statistically significant association** between youth emigration exposure and reported labor shortages ( $r = 0.42$ ,  $p < 0.01$ ), as well as skills shortages ( $r = 0.38$ ,  $p < 0.01$ ). Youth emigration is negatively correlated with productivity ( $r = -0.31$ ,  $p < 0.01$ ), innovation activity ( $r = -0.27$ ,  $p < 0.05$ ), and growth expectations ( $r = -0.29$ ,  $p < 0.05$ ).

Although these correlations do not establish causal relationships, they indicate that SMEs with higher exposure to youth emigration tend to experience greater labor and skills shortages and lower productivity, innovation, and growth expectations.

**Table 2: Correlation Matrix of Key Variables**

Variable	1	2	3	4	5	6	7
1. Youth Emigration Exposure	1.00						
2. Labor Shortages	0.42***	1.00					
3. Skills Shortages	0.38***	0.56***	1.00				
4. Productivity	-0.31***	-0.29***	-0.27***	1.00			
5. Innovation Activity	-0.27**	-0.21**	-0.25**	0.43***	1.00		
6. Growth Expectations	-0.29**	-0.23**	-0.22**	0.41***	0.39***	1.00	
7. Firm Size (employees)	0.08	-0.05	-0.03	0.19**	0.21**	0.17**	1.00

Source: Author's calculations

Notes:

- N = 312 SMEs.
- Significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .
- Correlations calculated using Pearson's method.
- Variables 1–6 are measured on Likert scales (1–5); Variable 7 is continuous (number of employees).

### 4.3 Regression Results

To further examine these relationships, regression models were estimated controlling for firm size, firm age, sector, and location. Table 3 presents the main results.

The estimates indicate that youth emigration intensity is positively and significantly associated with labor shortages. A one-unit increase in perceived youth emigration exposure is associated with a 0.34-point increase in reported labor shortage severity ( $p < 0.01$ ). A similarly strong relationship is observed for skills shortages ( $\beta = 0.29$ ,  $p < 0.01$ ), suggesting that emigration affects not only the quantity but also the quality of available labor.

Youth emigration is also found to be negatively associated with productivity. Firms facing higher emigration pressures report significantly lower productivity growth ( $\beta = -0.22$ ,  $p < 0.05$ ). This result is economically meaningful, as productivity constraints directly affect SMEs' competitiveness and cost structures.

With respect to innovation, the results show a negative and statistically significant relationship between youth emigration and innovation activity ( $\beta = -0.18$ ,  $p < 0.05$ ). SMEs experiencing greater emigration pressures are less likely to introduce new products, processes, or organizational practices, indicating that labor constraints may reduce firms' capacity to engage in innovation.

Finally, youth emigration exhibits a negative effect on growth expectations ( $\beta = -0.25$ ,  $p < 0.05$ ). Firms exposed to higher emigration intensity are more pessimistic about future expansion and investment, reflecting broader concerns about workforce sustainability.

Among control variables, firm size is positively associated with productivity and innovation, while firm age shows no consistent effect. Sectoral differences are observed, with manufacturing SMEs reporting stronger productivity pressures than service firms.

**Table 3: Regression Results – Effects of Youth Emigration on SME Outcomes**

Dependent Variable	Labor Shortages (OLS)	Skills Shortages (OLS)	Productivity (OLS)	Innovation Activity (Ordered Logit)	Growth Expectations (OLS)
Youth Emigration Exposure	0.34*** (0.07)	0.29*** (0.08)	-0.22** (0.10)	-0.18** (0.09)	-0.25* (0.11)
Firm Size (employees)	-0.02 (0.01)	-0.01 (0.01)	0.05* (0.03)	0.07** (0.03)	0.04 (0.03)
Firm Age (years)	0.01 (0.01)	0.00 (0.01)	0.01 (0.01)	0.00 (0.01)	-0.01 (0.01)
Sector Controls	Yes	Yes	Yes	Yes	Yes
Location Controls	Yes	Yes	Yes	Yes	Yes
Observations	312	312	312	312	312
R-squared	0.27	0.23	0.18	0.15	0.21

Source: Author's calculations

Notes:

- Standard errors in parentheses.
- Significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .
- Ordered Logit used for Innovation Activity; all other regressions use OLS.
- Sector and location dummies included but not shown.

#### 4.4 Robustness Checks

Several robustness checks were conducted to assess the stability of the results (Table 4). First, alternative specifications of the youth emigration variable yielded similar coefficient signs and significance levels. Second, sector-specific regressions indicate that the negative effects of youth emigration are particularly pronounced in manufacturing firms, followed by services, where skills requirements and seasonality increase dependence on young labour.

Overall, the results remain robust across specifications, reinforcing the conclusion that youth emigration constitutes a significant constraint on SME performance rather than a marginal or sector-specific phenomenon.

**Table 4: Robustness Checks – Youth Emigration and SME Outcomes**

<b>Dependent Variable</b>	<b>Baseline OLS</b>	<b>Alternative Measure</b>	<b>Manufacturing Only</b>	<b>Services Only</b>
Labor Shortages	0.34*** (0.07)	0.32*** (0.07)	0.38*** (0.08)	0.29** (0.11)
Skills Shortages	0.29*** (0.08)	0.27*** (0.08)	0.31*** (0.09)	0.24** (0.10)
Productivity	- 0.22** (0.10)	- 0.21* (0.10)	- 0.24* (0.11)	- 0.18 (0.12)
Innovation Activity	- 0.18** (0.09)	- 0.17* (0.09)	- 0.21* (0.10)	- 0.14 (0.11)
Growth Expectations	- 0.25* (0.11)	- 0.23* (0.11)	- 0.28* (0.12)	- 0.21* (0.13)
Observations	312	312	95	128
R-squared	0.27	0.26	0.28	0.22

Source: Author's calculations

Notes:

- Standard errors in parentheses.
- Significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .
- Alternative Measure uses a recoded youth emigration variable combining local labor market pressure and firm-level observations.
  - Sector-specific estimations highlight heterogeneous effects: manufacturing firms are more sensitive to youth emigration than services.
  - Robustness checks confirm the stability of main results across specifications.

#### 5. Discussion

Several robustness checks were conducted to assess the stability of the results (Table 4). First, alternative specifications of the youth emigration variable yielded similar coefficient signs and significance levels. Second, sector-specific regressions indicate that the negative effects of youth emigration are particularly pronounced in manufacturing firms, followed by services, where skills requirements and seasonality increase dependence on young labour.

The empirical analysis demonstrates that youth emigration constitutes a significant constraint on SME performance in Albania. Regression results indicate that firms reporting higher exposure to the emigration of young workers experience greater labor shortages ( $\beta = 0.34$ ,  $p < 0.01$ ) and skills shortages ( $\beta = 0.29$ ,  $p < 0.01$ ), confirming that youth outmigration

affects not only labor quantity but also quality. These findings are consistent with human capital theory (Becker, 1993) and prior research highlighting that the departure of young, educated workers can reduce the productive capacity of firms in transition economies (Docquier & Rapoport, 2012; Brell, Dustmann, & Preston, 2020). The magnitude of these effects is economically meaningful, given that the labor shortage scale ranges from 1 to 5; a 0.34-point increase represents a substantial operational constraint for SMEs.

**Productivity Effects:** Youth emigration is negatively associated with productivity perceptions ( $\beta = -0.22$ ,  $p < 0.05$ ). Firms exposed to higher emigration pressures report lower labor productivity, reflecting the importance of young, adaptable, and often digitally skilled workers in sustaining operational efficiency. This is consistent with labor economics literature showing that labor shortages, particularly of skilled workers, reduce firm-level productivity and competitiveness (Clemens & McKenzie, 2018; OECD, 2022). These productivity constraints appear most pronounced in manufacturing SMEs, which rely heavily on specialized skills and structured production processes.

**Innovation Capacity:** Regression results also indicate a negative association between youth emigration and innovation activity ( $\beta = -0.18$ ,  $p < 0.1$ ). SMEs experiencing stronger emigration pressures are less likely to introduce new products, processes, or organizational practices. This aligns with research emphasizing that human capital stability and skill diversity are critical for innovation, particularly in SMEs with limited financial and managerial capacity (Acemoglu & Restrepo, 2020; Filippucci et al., 2025). Labor constraints may therefore reduce the strategic capacity of SMEs to invest in innovative activities, creating a cumulative disadvantage over time.

**Growth Expectations:** Youth emigration also negatively affects growth expectations ( $\beta = -0.25$ ,  $p < 0.1$ ). Firms facing higher emigration intensity report more cautious investment and expansion plans, reflecting concerns over workforce sustainability. These findings reinforce prior studies on transition economies, which suggest that labor outflows can influence not only operational outcomes but also strategic firm-level decision-making and long-term growth trajectories (Li & Gade, 2023; OECD, 2022).

**Sectoral Heterogeneity:** Robustness checks reveal that the adverse effects of youth emigration are particularly pronounced in manufacturing and tourism sectors, while service-sector SMEs exhibit somewhat greater flexibility in adapting to labor shortages. Manufacturing firms depend heavily on routine and specialized skills, making them more vulnerable to workforce depletion. Similarly, tourism firms face seasonal labor demands, and high youth emigration exacerbates shortages during peak periods. Sector-specific coefficients from Table 4 illustrate that labor shortages in manufacturing increase by 0.38 points compared to 0.29 points in services, demonstrating heterogeneous effects across sectors.

**Integration with Existing Literature:** These results provide microeconomic evidence complementing macro-level research on emigration. While remittances and diaspora networks may offer potential economic benefits, they do not fully offset the operational and strategic costs associated with labor shortages and skills depletion (Clemens & McKenzie, 2018). Our findings echo IMF (Li & Gade, 2023) research indicating that emigration reduces firm birth rates and capital formation, especially in small enterprises, and OECD (2022) reports that persistent youth outmigration contributes to skill mismatches in the Western Balkans.

Overall, this study demonstrates that youth emigration has tangible negative effects on Albanian SMEs, affecting labor availability, skills, productivity, innovation, and growth expectations. These effects are robust across alternative specifications and sectoral subgroups, highlighting that youth outmigration represents a structural challenge for firm-level performance, rather than a marginal or sector-specific issue. The evidence provides actionable insights for policymakers aiming to support SME resilience and long-term economic development in high-emigration contexts.

## **6. Conclusions and Policy Implications**

This study provides firm-level evidence on the effects of youth emigration on SMEs in Albania, highlighting the structural challenges posed by the sustained outmigration of young, skilled workers. Using survey data from 312 SMEs across multiple sectors and employing regression analysis, the results indicate that higher youth emigration intensity is associated with:

- Increased labor and skills shortages ( $\beta = 0.34$  and  $0.29$ , respectively), reflecting reduced availability of both quantity and quality of human capital.
- Lower productivity ( $\beta = -0.22$ ), suggesting that workforce depletion reduces operational efficiency and limits the adoption of new technologies.
- Reduced innovation activity ( $\beta = -0.18$ ), indicating that human capital constraints hamper the capacity for product, process, and organizational improvements.
- Weaker growth expectations ( $\beta = -0.25$ ), implying that firms anticipate greater difficulty in sustaining expansion and investment plans under continued emigration pressures.

Robustness checks confirm the stability of these relationships across alternative specifications and sector-specific analyses, with manufacturing and tourism SMEs exhibiting particularly acute sensitivity to youth outmigration. These findings underscore that youth emigration represents a systemic constraint for SME performance, rather than a marginal or temporary challenge.

### Policy Implications

The evidence highlights the need for integrated policy responses to mitigate the negative effects of youth emigration on SMEs and foster long-term economic development. Key recommendations include:

- Youth retention strategies: Incentivize young workers to remain in the domestic labor market through targeted wage subsidies, professional development programs, and improved working conditions.
- Strengthening SME–education linkages: Align vocational training and higher education curricula with SME skill requirements to reduce mismatches and enhance labor market readiness.
- Supporting firm adaptation and innovation: Provide financial, technical, and advisory support to SMEs for digitalization, labor-saving technologies, and process improvements, enabling them to cope with workforce shortages.
- Diaspora engagement: Facilitate skilled return migration and knowledge transfer, leveraging the Albanian diaspora to alleviate human capital depletion and stimulate enterprise development.
- Sector-specific interventions: Recognize heterogeneity in vulnerability; for instance, manufacturing and services may require tailored programs for skills training, seasonal workforce planning, and innovation incentives.

### Final Remarks

This study contributes to the literature by delivering microeconomic evidence from a transition economy on the firm-level implications of youth emigration. It highlights the vulnerability of SMEs to demographic shocks and the limitations of relying solely on remittances or macroeconomic adjustments. For policymakers, the findings underscore the importance of coordinated labor market, education, and enterprise policies to maintain SME competitiveness and support sustainable economic growth in Albania and similar high-emigration contexts.

Future research could extend this work by incorporating longitudinal data to examine causal effects over time, exploring sector-specific skill interventions, and analyzing the role of diaspora networks in mitigating SME labor constraints.

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## ECONOMIC GROWTH AND B-CONVERGENCE IN EUROPE: EMPIRICAL EVIDENCE FROM REGIONAL PANEL DATA, 2011-2023

**Evgenia ANASTASIOU**

Researcher, Department of Business Administration, University of Thessaly, Gaiopolis, Larissa  
Ringroad, 41500 Larisa, Greece  
evanastasiou@uth.gr

### **Abstract**

This paper examines regional economic growth and  $\beta$ -convergence across European regions using panel data for 233 NUTS-2 regions over the period 2011–2023. The analysis explores whether regions with lower initial income levels experience faster growth and investigates the factors associated with regional growth dynamics. The empirical framework relies on alternative panel data specifications to assess the robustness of the convergence process and to examine the role of key economic and demographic variables. The results indicate the presence of  $\beta$ -convergence among European regions, suggesting that regions with lower initial levels of economic development tend to grow more rapidly over time. Investment activity and migration dynamics emerge as important determinants of regional economic performance, whereas labour and demographic variables show less stable effects across model specifications. Using a recent dataset covering both the post-financial crisis and post-pandemic period, the paper provides updated evidence on regional convergence patterns in Europe. The analysis also reveals differences in convergence dynamics across groups of regions, indicating that structural characteristics and regional conditions influence the pace of economic adjustment. These findings contribute to the empirical literature on regional growth and offer insights relevant to regional development and cohesion policies in the European Union.

**Keywords:** Regional economic growth,  $\beta$ -convergence, regional disparities, panel data analysis, European regions

**JEL classification:** O47, R11, R12, R58  
pp. 147-158

### **1. Introduction**

Regional economic disparities remain a persistent feature of the European economic landscape. Despite the long-standing objective of promoting balanced territorial development, substantial differences in income levels, productivity, employment and investment capacity continue to characterize European regions. These disparities raise important questions not only for regional development but also for the broader objectives of economic cohesion and sustainable growth within the European Union. Understanding whether less developed regions are gradually catching up with more advanced ones therefore remains a central concern in both economic research and policy debate.

Over the last decade, this issue has become even more relevant. The aftermath of the financial and sovereign debt crisis, followed by the economic disruptions associated with the COVID-19 pandemic, has affected European regions in uneven ways. While some regions have shown strong recovery and adjustment dynamics, others continue to face structural constraints that limit their growth potential. These developments have renewed interest in the dynamics of regional convergence and in the factors that shape regional growth trajectories across Europe.

The literature on economic growth has long suggested that regions with lower initial income levels may grow faster than more advanced ones, reflecting the dynamics of economic convergence. In the European context, however, empirical evidence remains mixed. While several studies identify signs of convergence across regions, others point to persistent disparities, divergence patterns or the emergence of convergence clubs. These differences partly reflect variations in time periods, spatial scales and empirical approaches, but they also underline the complexity of regional growth processes in Europe.

Regional economic performance is influenced by a range of structural and demographic factors, including investment activity, labour market conditions, demographic change and

migration dynamics. These forces interact in ways that may accelerate or hinder regional adjustment, producing uneven development trajectories across European regions. At the same time, the effects of such factors are not necessarily uniform across space, as regional characteristics and development conditions may shape the way economic and demographic processes influence growth outcomes.

Against this background, this paper examines regional economic growth and  $\beta$ -convergence across 233 NUTS-2 regions in Europe over the period 2011–2023. The analysis explores whether regions with lower initial levels of economic development tend to grow faster and investigates the relationship between regional growth and key economic and demographic factors, including investment activity and migration dynamics. Attention is also given to differences across groups of regions, as convergence processes may vary according to regional development conditions.

By using a recent panel dataset that captures both the post-financial crisis period and the years surrounding the pandemic, the study provides updated empirical evidence on regional convergence patterns in Europe. It also contributes to the empirical literature by examining the role of investment and migration within a common analytical framework while considering potential differences in convergence dynamics across regional development groups.

The remainder of the paper is organized as follows. The next section reviews the relevant literature on regional growth and convergence. The following section presents the data and empirical methodology. The empirical results are then discussed, first for the full sample and subsequently across regional development groups. The final section concludes and discusses the implications of the findings for regional development and cohesion policy in the European Union.

## **2. Literature review**

Regional economic growth has been studied for decades through the convergence hypothesis. In its basic form, the hypothesis assumes that poorer regions tend to grow faster than richer ones, because lower initial capital stocks allow stronger marginal returns, easier technological diffusion and a broader scope for structural adjustment (Barro and Sala-i-Martin, 1992; Mankiw et al., 1992). Empirical work usually tests this proposition through  $\beta$ -convergence models, where a negative coefficient on initial income is taken as evidence of catching-up over time (Sala-i-Martin, 1996).

This framework remains central in the analysis of European regions, but its interpretation has become less straightforward. Recent studies confirm that convergence can still be detected, although its strength varies across periods and depends on how disparities are measured (Costa et al., 2024). Comparable findings have also been reported for the Balkan area (Grodzicki and Jankiewicz, 2024). At the same time, the European evidence no longer supports the idea of a smooth or uniform adjustment process. Investment capacity, productive structure, demographic conditions and exposure to shocks all shape the pace and direction of regional growth, making convergence conditional rather than automatic (Gkatsikos and Christoforidis, 2025).

This point is particularly important in the European Union, where cohesion remains a core policy objective, but regional inequalities have not disappeared. The period after the sovereign debt crisis, and even more the years following the pandemic, has been marked by fragile and uneven adjustment across regions (Kallioras et al., 2025). Under these conditions, convergence and divergence can coexist within the same territorial system, which means that cohesion cannot be inferred simply from aggregate growth trends (Alexiadis et al., 2010). Differences in technological change, structural transformation and the capacity to benefit from wider integration processes have further widened the distance between regions following stronger adjustment paths and those trapped in weaker ones (Capello and Cerisola, 2023; Kallioras et al., 2021).

Policy literature increasingly interprets these disparities as the outcome of cumulative structural disadvantages rather than temporary imbalances. This has strengthened the argument for place-based policy approaches instead of uniform interventions applied across all territories in the same way (Constantin and Volintiru, 2024). Lagging regions often combine weak productive bases, limited development opportunities and lower resilience to shocks, which reduces their capacity to benefit from broader growth dynamics (Rodríguez-Pose, 2018). OECD

work reaches a similar conclusion, linking regional convergence in the European Union to productive upgrading and stronger territorial support mechanisms (Pina and Sicari, 2021). Other studies also show that marked spatial imbalances remain a defining feature of the European regional system, despite the long-standing objective of territorial cohesion (Petraikos et al., 2021; Polyzos and Tsiotas, 2025).

Within this broader discussion, investment remains one of the most important determinants of regional growth. Its role is not limited to capital accumulation. It also affects infrastructure, productive capacity and the potential for technological upgrading. Evidence on European cohesion funding shows that investment can support regional growth, but that its effectiveness weakens when macroeconomic uncertainty increases (Pinar and Karahasan, 2024). At the same time, broader evidence on European firms points to strong territorial differences in investment capacity, innovation performance and resilience (European Investment Bank, 2024). Investment therefore cannot be treated as a uniform growth factor. Its contribution depends on the local conditions under which resources are absorbed and transformed into productive outcomes. This makes gross fixed capital formation a necessary variable in the empirical analysis of regional growth.

Demographic change adds another layer to this discussion. Migration affects labour supply, the age composition of the population, the distribution of skills and the strength of local demand. Its effects, however, are not uniform. Inflows may support renewal and growth, while persistent outflows may weaken the adjustment capacity of regional economies. This becomes particularly important when migration is selective in terms of age, skills or labour-market position. Recent studies show that internal migration can influence regional growth through exactly these channels (Anastasiou, 2020; Anastasiou and Duquenne 2020; Centofanti et al., 2024). Ageing follows a similarly uneven spatial logic. Its relationship with growth differs across European NUTS-2 regions, which means that demographic pressure should not be interpreted as a common or spatially identical burden (Nicolini and Roig, 2024). For this reason, net migration and natural population balance are not secondary controls, but part of the substantive explanation of regional growth differences.

A further issue concerns the internal heterogeneity of the European regional system itself. Less developed, transition and more developed regions do not enter the growth process from the same structural position, and there is no strong reason to expect investment, labour-market conditions or demographic adjustment to have identical effects across all three groups. The post-2011 period makes this especially clear, since recovery, structural change and demographic pressures have unfolded unevenly across European space (Kallioras et al., 2025; Tsiotas and Polyzos, 2025). What remains less explored is whether the main determinants of regional growth operate with different intensity across these development groups. This is the point on which the present study places particular emphasis.

### **3. Data and Methods**

#### **3.1. Data structure and scope**

The empirical analysis is based on a regional panel dataset covering 233 NUTS-2 regions of the European Union over the period 2011–2023. The unit of observation is a region–year pair, resulting in an unbalanced panel comprising 2,710 observations, reflecting missing values for certain regions and years. The data are obtained from Eurostat regional statistics, which provide harmonised economic and demographic indicators across European regions. The dataset includes information on regional gross domestic product, gross fixed capital formation, employment, and demographic indicators such as migration flows and natural population change.

Regional economic growth is measured as the first difference of the logarithm of real GDP,

$$gGDP_{it} = \Delta \ln (GDP_{it}) \quad (1)$$

which approximates the annual percentage change in regional output. All monetary variables are expressed at constant prices, ensuring comparability across regions and over time. The

variables included in the empirical analysis and their descriptive statistics are reported in Tables 1 and 2.

**Table 1. Definition and Measurement of Variables**

Variable	Definition	Measurement	Transformation	Expected Effect
<b>GDP growth (gGDP)</b>	Regional economic growth rate	Gross Domestic Product of region $i$ in year $t$	First difference of logarithm:	Dependent variable
<b>GFCF</b>	Gross Fixed Capital Formation	Total investment in fixed assets in region $i$	Natural logarithm: $\ln(\text{GFCF})$	Positive
<b>EMP</b>	Employment	Total number of employed persons in region $i$	Natural logarithm $\ln(\text{EMP})$	Positive
<b>NETMIGR</b>	Net migration rate	Net migration flows divided by regional population	Per capita indicator	Positive
<b>NATBAL</b>	Natural population balance	Difference between births and deaths divided by regional population	Per capita indicator	Ambiguous
<b>Lagged GDP</b>	Initial income level	GDP per region in previous period	Natural logarithm, lagged by one period	Negative (convergence)

**Table 2. Descriptive Statistics**

Variable	Mean	Std. Dev.	Min	Max
gGDP	.0376	.0518	-.253	.690
$\ln\text{GDP}$	10.394	1.080	7.078	13.628
$\ln\text{GFCF}$	8.817	1.114	5.245	12.146
$\ln\text{EMP}$	6.346	.902	2.639	8.649
NETMIGR	5.220	16.158	-149.43	169.233
NATBAL	-2.316	9.719	-69.174	116.971

The descriptive statistics highlight substantial variation across European regions over the period of analysis. Investment and employment levels display considerable dispersion, reflecting differences in regional productive capacity and economic structure. Demographic indicators such as net migration and natural population change also vary significantly across regions, suggesting heterogeneous demographic dynamics within the European regional system. Such variation supports the use of panel data techniques that exploit both cross-regional differences and temporal dynamics.

### 3.2. Econometric Specification

Model (1) Growth model

To identify the contemporaneous drivers of regional growth, the baseline specification relates regional GDP growth to investment, labour input, and demographic dynamics:

$$gGDP_{it} = \beta_1 \ln(\text{GFCF}_{it}) + \beta_2 \ln(\text{EMP}_{it}) + \beta_3 \text{NETMIGR}_{it} + \beta_4 \text{NATBAL}_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (2)$$

where  $\mu_i$  are region fixed effects capturing time-invariant structural characteristics (geography, sectoral composition, long-run institutions, persistent productivity differentials), and  $\tau_t$  are year fixed effects capturing common shocks (European business cycle, EU-wide

policy shifts, crisis episodes). The demographic variables are introduced in population-normalised form, such that  $NETMIGR_{it}$  and  $NATBAL_{it}$  reflect migration and natural change rates rather than size-driven level effects.

Model (2): Absolute  $\beta$ -convergence

To test whether regions with lower initial GDP levels tend to record faster subsequent growth, the analysis first estimates an absolute  $\beta$ -convergence specification:

$$gGDP_{it} = a + \gamma \ln(GDP_{i,t-1}) + \mu_i + \tau_t + \varepsilon_{it} \quad (3)$$

A negative and statistically significant  $\gamma$  is consistent with  $\beta$ -convergence, indicating that regions with lower initial income levels exhibit higher subsequent growth rates, conditional only on time-invariant regional heterogeneity and common time shocks.

Model (3): Conditional  $\beta$ -convergence (main model)

$$gGDP_{it} = a + \gamma \ln(GDP_{i,t-1}) + \beta_1 \ln(GFCF_{it}) + \beta_2 \ln(EMP_{it}) + \beta_3 NETMIGR_{it} + \beta_4 NATBAL_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (4)$$

This formulation allows convergence to be assessed net of investment accumulation, labour dynamics, and demographic change, thereby aligning the empirical design with standard growth theory and the regional convergence literature.

To ensure that inference is not driven by restrictive assumptions on the disturbance process, robustness is assessed using an alternative estimator that accommodates serial correlation and heterogeneous regional components. Specifically, the baseline growth framework is re-estimated under a mixed (random-effects) structure with AR(1) correlation in idiosyncratic errors. Inference is based on heteroskedasticity-consistent standard errors in the fixed-effects models (HC-type corrections), given the typical presence of heteroskedasticity in macro-regional panels. Importantly, the robustness specification is treated as a sensitivity check: the preferred identification of within-region effects is obtained from the two-way fixed-effects estimations

### 3.3. Regional Development Groups

To account for structural heterogeneity across European regions, the analysis incorporates the classification of regional development levels used in the European Union's Cohesion Policy framework (European Commission, 2021). According to this classification, NUTS-2 regions are grouped into three development categories based on their GDP per capita relative to the EU average: less developed regions, transition regions, and more developed regions. Regions with GDP per capita below 75% of the EU average are classified as less developed regions, those with GDP per capita between 75% and 100% are defined as transition regions, and regions with GDP per capita above 100% are categorized as more developed regions.

The classification of regions into development groups is treated as time-invariant (fixed) throughout the analysis. This approach reflects the institutional logic of the EU Cohesion Policy framework, where regional development status is determined based on multi-year averages of GDP per capita and used to guide structural funding allocations over programming periods. Treating the development category as fixed avoids potential endogeneity that could arise if regions were allowed to switch categories over time due to short-term fluctuations in income.

To examine whether the determinants of economic growth differ across levels of development, the conditional convergence model is estimated separately for each regional group: less developed, transition, and more developed regions:

$$gGDP_{it} = a_g + \gamma_g \ln(GDP_{i,t-1}) + \beta_1 \ln(GFCF_{it}) + \beta_2 \ln(EMP_{it}) + \beta_3 NETMIGR_{it} + \beta_4 NATBAL_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (5)$$

where  $i$  indexes regions belonging to development group  $g$ ,  $t$  denotes time, and  $\mu_i$  and  $\tau_t$  represent region and year fixed effects respectively. The group-specific coefficients  $\gamma$  and  $\beta$  allow both the speed of convergence and the marginal effects of structural and demographic variables to differ across development regimes.

Estimating the growth model separately for each development group provides insights into whether investment accumulation, labour dynamics, and demographic changes exert heterogeneous effects across regions with different structural characteristics. This approach allows the empirical assessment of whether convergence dynamics and the impact of structural and demographic factors differ systematically across regions with different development levels.

#### **4. Results**

The baseline estimations examine the determinants of regional economic growth across European NUTS-2 regions using alternative model specifications (Table 3). The fixed-effects growth model suggests that investment and demographic dynamics contribute to regional growth, although the magnitude and significance of the effects vary across specifications.

Gross fixed capital formation exhibits a positive and statistically significant association with regional growth in the baseline fixed-effects specification ( $\beta = 0.027$ ,  $p < 0.01$ ), indicating that higher levels of investment are associated with faster economic expansion across regions. However, this effect becomes weaker and negative in the mixed-effects robustness specification ( $\beta = -0.009$ ,  $p < 0.01$ ), suggesting that the estimated impact of investment may depend on the modelling of regional heterogeneity and serial correlation.

Employment does not display a stable relationship with growth across specifications. The coefficient is not statistically significant in the fixed-effects growth model, whereas it becomes positive and statistically significant in the robustness specification ( $\beta = 0.012$ ,  $p < 0.01$ ). This result indicates that labour dynamics may contribute to regional growth once the disturbance structure allows for serial correlation and random regional components.

Net migration exhibits a positive and statistically significant effect across models, although the magnitude of the coefficient remains small due to the scale of the variable. The results therefore suggest that regions experiencing higher net migration tend to exhibit slightly stronger growth dynamics. In contrast, the natural population balance does not appear to have a systematic influence on regional growth.

The convergence specifications provide additional insights into regional income dynamics. In the absolute  $\beta$ -convergence model, the coefficient of lagged GDP per capita is negative and statistically significant ( $\gamma = -0.094$ ,  $p < 0.01$ ), indicating that poorer regions tend to grow faster than richer ones. This finding provides empirical evidence of regional income convergence across European regions.

When structural and demographic controls are introduced in the conditional convergence specification, the coefficient of lagged GDP per capita remains negative and statistically significant ( $\gamma = -0.133$ ,  $p < 0.01$ ). The persistence of the convergence suggests that regional income disparities tend to diminish over time even after controlling for investment, labour dynamics, and demographic changes.

The baseline estimations indicate that regional growth in Europe is associated with investment activity and migration dynamics, while the results also provide evidence supporting the existence of  $\beta$ -convergence across European regions.

**Table 3. Regional Growth Models and  $\beta$ -Convergence Estimates**

Variables	(1) Growth model (FE)	(2) Growth model (Robustness: Mixed)	(3) Absolute $\beta$ - convergence	(4) Conditional $\beta$ - convergence
lnGDP(t-1)			-0.094*** (0.029)	-0.133*** (0.032)
lnGFCF	0.027*** (0.008)	-0.009*** (0.002)		0.057*** (0.014)
lnEMP	-0.026 (0.020)	0.012*** (0.002)		-0.016 (0.019)
NETMIGR	0.000*** (5.09e-05)	0.000*** (6.49e-05)		0.000*** (4.61e-05)
NATBAL	0.000 (0.000)	0.000*** (0.000)		0.000* (0.000)
Regional effects	Fixed	Random	Fixed	Fixed
Year fixed effects	Yes	Yes	Yes	Yes
AR(1) correlation	No	Yes	No	No
Observations	2,710	2,710	2,710	2,710
R <sup>2</sup>	0.632		0.642	0.658
Adjusted R <sup>2</sup>	0.595		0.606	0.624

Note: Robust standard errors reported in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.10.

Table 4 reports the estimation results of the conditional  $\beta$ -convergence model for the three regional development groups defined by the EU Cohesion Policy classification: less developed, transition, and more developed regions. The results reveal notable heterogeneity in the convergence dynamics across regional development groups. The coefficient of lagged GDP per capita becomes progressively larger in absolute value as the level of development increases, ranging from  $-0.117$  in less developed regions to  $-0.145$  in transition regions and  $-0.220$  in more developed regions. This pattern indicates that the convergence process appears to be stronger among more developed regions.

Gross fixed capital formation is positively associated with regional economic growth in all development groups. The coefficient is  $0.033$  ( $p < 0.05$ ) in less developed regions,  $0.085$  ( $p < 0.01$ ) in transition regions, and  $0.057$  ( $p < 0.10$ ) in more developed regions. Employment displays heterogeneous patterns across regional groups. The coefficient is negative and statistically significant in less developed regions ( $-0.084$ ,  $p < 0.01$ ), while it is positive but statistically insignificant in transition regions ( $0.037$ ). In more developed regions the coefficient becomes positive and statistically significant at the 10% level ( $0.137$ ).

Net migration does not exhibit a statistically significant effect in less developed regions, whereas it is positive and statistically significant in both transition regions and more developed regions. Natural population balance is statistically insignificant in less developed and transition regions, while a positive and statistically significant coefficient is observed in more developed regions.

The explanatory power of the model varies across development groups. The R<sup>2</sup> values are  $0.777$  for less developed regions,  $0.738$  for transition regions, and  $0.573$  for more developed regions, with adjusted R<sup>2</sup> values of  $0.751$ ,  $0.706$ , and  $0.526$  respectively. All specifications include regional and year fixed effects.

**Table 4. Conditional  $\beta$ -Convergence Estimates by Regional Development Club**

<b>Variables</b>	<b>Less developed</b>	<b>Transition</b>	<b>More developed</b>
lnGDP(t-1)	-0.117*** (0.018)	-0.145*** (0.032)	-0.220** (0.106)
lnGFCF	0.033** (0.013)	0.085*** (0.023)	0.057* (0.033)
lnEMP	-0.084*** (0.025)	0.037 (0.030)	0.137* (0.070)
NETMIGR	0.000 (9.845e-5)	0.000*** (0.000)	0.000*** (8.786e-5)
NATBAL	0.000 (0.000)	0.001 (0.001)	0.001*** (0.000)
Regional effects	Fixed	Fixed	Fixed
Year fixed effects	Yes	Yes	Yes
Observations	850	739	1121
R <sup>2</sup>	0.777	0.738	0.573
Adjusted R <sup>2</sup>	0.751	0.706	0.526

The empirical findings highlight the presence of regional income convergence across European regions, while also revealing substantial heterogeneity in the determinants of growth across development levels. Investment activity and migration dynamics appear to be consistently associated with regional economic performance, whereas the role of labour and demographic variables varies across regional groups. At the same time, the convergence estimates indicate that the adjustment process differs across development categories, suggesting that regional growth dynamics are not uniform across the European territory. These results provide the empirical basis for further discussion of the mechanisms underlying regional growth and convergence patterns in Europe.

## **5. Discussion**

The results indicate that regional growth in Europe still follows a convergence pattern, but not one that can be interpreted as automatic or spatially uniform. The negative and significant coefficient of initial income supports the view that lower-income regions tend to grow faster. At the same time, the persistence of this effect after the introduction of structural and demographic controls suggests that catching-up depends on the conditions under which regional adjustment takes place. This interpretation is in line with evidence showing that the Great Recession disrupted earlier convergence dynamics and reinforced the emergence of differentiated regional paths rather than a single common trajectory (Mazzola and Pizzuto, 2020). More recent work further suggests that European regional dynamics are better understood in terms of multiple convergence clubs, rather than full convergence across all regions (Pintera, 2024). This reading is also consistent with evidence that the COVID-19 shock further affected the spatial pattern of regional convergence within the European Union (Jankiewicz, 2024).

Seen from this angle, the positive role of gross fixed capital formation is one of the most important findings of the analysis. Investment appears to operate not simply as a correlational growth factor, but as an indicator of a region's ability to expand productive capacity and sustain adjustment. This interpretation is consistent with recent evidence showing that EU cohesion-related resources contribute positively to regional growth, although their effectiveness tends to weaken under conditions of high macroeconomic uncertainty (Pinar and Karahasan, 2024). At the same time, the literature also suggests that the developmental returns of such resources depend on the institutional quality and economic structure of recipient regions (Rodríguez-Pose and Garcilazo, 2015; Percoco, 2017). More broadly, this is in line with the view that territorial capital shapes the capacity of regions to convert policy support and investment into stronger development outcomes (Fratesi and Perucca, 2019). For the present results, this suggests that where investment contributes positively to growth, it may capture not only capital accumulation itself, but also a broader developmental capacity that enables regions to translate resources into output gains more effectively.

The migration results are consistent with this broader pattern. The positive association between net migration and regional growth suggests that demographic mobility forms part of the growth process rather than a secondary background trend. Migration can renew the labour force, alter the composition of skills, and support local demand, but its effects are unlikely to be uniform across regions. Recent regional evidence shows that internal migration can stimulate growth while at the same time slowing convergence, especially when flows involve more productive and mobile population groups moving towards stronger regions (Centofanti et al., 2024; Incaltarau et al., 2021; González et al., 2024). This helps explain why migration in the present study appears to be more growth-supportive in transition and more developed regions than in less developed ones: the contribution of population inflows seems to depend on whether the receiving regional economy has the productive structure and absorptive capacity needed to translate those inflows into sustained growth.

The results also suggest that ageing does not exert a uniformly negative effect on regional growth. Recent evidence indicates that the economic consequences of ageing vary across regions and depend on the spatial organization of labour markets and demographic dynamics (Nicolini and Roig, 2024; Prenzel, 2021). In parallel, research on migration and regional development shows that population movements can either reinforce or offset these pressures, depending on the capacity of regions to attract and retain economically active populations (OECD, 2022). This perspective is particularly relevant considering evidence that the attractiveness of regions as places of settlement and adjustment is itself spatially differentiated, with territorial conditions shaping migration choices and demographic redistribution (Anastasiou and Duquenne, 2020). From this perspective, population ageing is less an automatic constraint on growth than a demographic process whose effects are mediated by broader territorial conditions.

The differences across development groups are substantively important, because they show that the determinants of regional growth operate with varying intensity across less developed, transition, and more developed regions. This suggests that convergence in Europe unfolds through distinct regional growth regimes rather than through a single and homogeneous adjustment mechanism. Recent evidence indicates that regional inequality in Europe has increasingly been driven by the faster progress of already stronger regions, while persistent differences in performance are reinforced by capital intensity, knowledge-related assets, and agglomeration economies (Gómez-Tello et al., 2025). More broadly, this is consistent with the view that spatial concentration, specialization, and the geography of highly productive activities continue to shape uneven regional development across Europe (Hudecz, 2020; Iammarino et al., 2019). Convergence may still be present, but it takes place within a regional system in which stronger regions retain structural advantages in translating investment, labour-market dynamics, and demographic change into growth.

Taken together, the findings support a conditional interpretation of regional convergence in Europe. The key issue is not simply whether poorer regions catch up, but whether they possess the productive and demographic conditions that enable effective adjustment. From this perspective, the coexistence of convergence and persistent disparities is not contradictory. European regions may converge within clubs while the wider regional system remains fragmented by differences in innovative capacity, manufacturing specialization, and metropolitan advantage (Pintera, 2024). The present results point in the same direction: convergence exists, but its pace and substantive content vary with territorial structure.

From a policy perspective, this means that cohesion cannot rely on passive diffusion effects alone. If investment matters but its return depends on territorial conditions, and if migration is growth-enhancing only in regions with sufficient absorptive capacity, then regional policy must intervene more directly in the structural features that shape adjustment. In practical terms, the findings support a differentiated policy approach aimed at strengthening productive capacity in weaker regions, improving the local conditions under which investment becomes effective, and treating demographic pressures not as isolated social trends but as part of the regional growth challenge itself. This is consistent with recent evidence showing that growth-supporting policies in Europe are more effective when they recognize territorial heterogeneity rather than assuming a uniform adjustment mechanism across regions (Pinar and Karahasan, 2024; Nicolini and Roig, 2024).

## **6. Conclusions**

This paper examined regional economic growth and  $\beta$ -convergence across European NUTS-2 regions over the period 2011–2023, with particular emphasis on the role of investment, labour-market conditions and demographic dynamics. The results provide evidence that convergence remains present within the European regional system, as regions with lower initial income levels tend to record faster subsequent growth. At the same time, the findings show clearly that convergence is not an automatic or spatially uniform process. Its pace and intensity depend on the structural conditions under which regional growth takes place.

A central finding of the analysis is the positive role of investment. Gross fixed capital formation is consistently associated with stronger regional growth, suggesting that capital accumulation remains a key mechanism through which regions improve productive capacity and strengthen their development prospects. Migration also emerges as an important factor, particularly in transition and more developed regions, indicating that demographic mobility can support growth when regional economies are able to absorb and utilize population inflows effectively. By contrast, employment and natural population balance display weaker and less stable effects, pointing to a more context-dependent relationship between labour and demographic change, on the one hand, and regional growth, on the other.

The analysis by development group further underlines that European regional growth does not follow a single common path. Less developed, transition and more developed regions differ not only in their speed of adjustment, but also in the way key determinants of growth operate. This finding is particularly important, because it suggests that convergence may coexist with persistent territorial disparities. In other words, the European regional space may display overall catching-up tendencies while remaining structurally uneven.

These results have direct implications for regional policy. If convergence depends on investment capacity, demographic adjustment and the broader structural characteristics of regions, then cohesion cannot be expected to arise through market mechanisms alone. Policies aimed at reducing regional inequalities need to strengthen the productive base of weaker regions, improve their capacity to attract and retain population, and support territorial differentiated development strategies rather than uniform interventions. In this sense, the findings support a place-sensitive understanding of cohesion, one that recognizes the diversity of regional growth regimes across Europe.

The study also has some limitations. The analysis focuses on a selected set of economic and demographic variables and does not explicitly incorporate institutional quality, innovation performance or spatial econometric interdependence, all of which may further shape regional growth trajectories. Future research could extend the present framework by examining these dimensions more directly, while also exploring whether the drivers of convergence differ across longer time periods or under alternative regional classifications.

Overall, the paper shows that regional convergence in Europe remains a meaningful but conditional process. The key issue is not simply whether lagging regions grow faster, but under what structural conditions they are able to do so. Seen from this perspective, regional growth in Europe is better understood as a differentiated process of adjustment shaped by investment, demographic dynamics and persistent territorial heterogeneity.

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## ODA PROFILES AND DONOR-SIDE ECONOMIC OUTCOMES: A COMPARATIVE ANALYSIS OF JAPAN AND SWEDEN

**Jungeun KIM**

Senior Assistant Professor, Graduate School of Media Design, Keio University, 4 Chome-1-1 Hiyoshi, Kohoku Ward, Yokohama, Kanagawa 223-0061, Japan; Co-first author.  
elly@kmd.keio.ac.jp

**Woosik YU**

Assistant Professor, Department of International Commerce, Keimyung University, 1095 Dalgubeol-darero, Dalseo-gu, Daegu 42601, Republic of Korea; Corresponding and co-first author.  
wsyu1224@gmail.com

### **Abstract**

This study examines how different Official Development Assistance (ODA) profiles are associated with donor-side macroeconomic outcomes by comparing Japan and Sweden from 1960 to 2020. Rather than treating donor intent as directly observable, the paper uses Japan and Sweden as analytically contrasting cases: Japan is characterized by an ODA profile oriented toward economic diplomacy and regional development, while Sweden is characterized by a norm-oriented and welfare-centered ODA profile. Using annual macroeconomic data from the Penn World Table, OECD DAC statistics, and the World Development Indicators, we estimate country-specific growth regressions for GDP per capita growth, productivity growth, employment-rate growth, composite input growth, and export growth. The results show that Japan's ODA is not significantly associated with income, productivity, employment, or export growth under the reported specification, whereas Sweden's ODA is positively associated with income, productivity, and employment-rate growth, but not export growth. These findings should be interpreted as case-specific associations rather than causal evidence that one aid profile generates superior domestic returns. The contribution of the paper is to shift attention toward donor-side economic outcomes and to develop a bounded comparative framework for examining how aid profiles, rather than aid volume alone, may relate to long-term domestic economic patterns.

**Keywords:** Official Development Assistance, Donor-Side Economic Outcomes, Japan, Sweden, Aid Strategy, Comparative Political Economy

**JEL classification:** F35, O47, F43

**Acknowledgement:** The authors, Jungeun Kim and Woosik Yu, are co-first authors.  
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### **1. Introduction**

Official Development Assistance (ODA) plays a central role in international development and foreign policy, serving humanitarian, diplomatic, and economic purposes. Most studies evaluate ODA by measuring its effects on recipient countries, while comparatively less attention has been given to whether and how aid is associated with economic outcomes in donor countries themselves. This study addresses that gap by examining the relationship between ODA and donor-side macroeconomic outcomes, including income growth, productivity growth, employment-rate growth, and export growth.

The paper compares two prominent but analytically different ODA donors: Japan and Sweden. Japan is often associated with an economic-diplomacy and regional-development-oriented aid profile, linking ODA to trade facilitation, infrastructure development, regional stability, and industrial diplomacy, particularly in Asia (Sunaga, 2004; Arase, 2005). Sweden, by contrast, is commonly associated with a norm-oriented and welfare-centered aid profile, emphasizing human rights, poverty reduction, democratic governance, and global equity (Nilsson, 2022). These labels are used here as comparative tendencies, not as fixed national types or direct measures of donor intent.

The selection of Japan and Sweden is theoretically useful because the two countries represent contrasting aid profiles within the group of established donors. The comparison allows us to examine whether ODA-outcome patterns differ across two historically and institutionally distinct donor cases. However, this is not a representative two-country sample from which broad claims about all donors can be generalized. The study is therefore framed as a bounded, theory-building comparison rather than a universal test of aid strategy.

The central research question is: How are different ODA profiles associated with donor-side macroeconomic outcomes over time? This framing deliberately shifts the focus away from unobservable donor intent and toward observable aid profiles and macroeconomic associations. Existing research suggests that aid can be linked to donor exports, firm opportunities, diplomatic influence, and longer-term economic relationships, but the mechanisms and timing of these relationships remain contested.

Empirical studies consistently confirm that foreign aid promotes the export interests of donor nations. Martínez-Zarzoso et al. (2009) find that bilateral aid is positively associated with increases in donor-country exports to recipient markets, estimating that, depending on scenarios, every dollar of ODA can generate more than two dollars in additional exports for the donor over time, thus substantiating the economic rationale for aid engagement. Kim et al. (2015) provides further evidence that the association between ODA and donor-side outcomes on donor exports is shaped by recipient countries' absorptive capacity and economic localization. The study's analysis of 33 donor countries between 1999 and 2009 reveals how ODA tends to boost export opportunities, particularly in sectors where donor competitiveness is robust, and the recipient's market integration with the donor is high. Ono et al. (2023) describe that infrastructure-focused ODA, such as concessional loans for transport, energy, and communications, not only fosters development but also systematically paves the way for donor-country firms to enter and invest in recipient markets. Their research finds a statistically significant relationship between specific types of ODA and increased foreign direct investment flows from donor to recipient, with clear implications for business opportunity expansion.

Evaluating the role of tied aid, Jalan (1969) contends that such aid, by mandating the use of donor-country goods and services, bolsters domestic employment and supports industrial output in the donor nation. The benefits of tied aid are particularly marked during periods of domestic economic slack or when targeting industries integral to the donor's strategic interests. Sectoral studies, including Choi (2022), reinforce that aid's impacts are not limited to one specific region or sector. The study's analysis on South Korea highlights a positive correlation between ODA and export expansion to recipients, emphasizing how tailored aid strategies can optimize both developmental and national commercial outcomes.

We employ a quantitative empirical analysis using annual macroeconomic data from 1960 to 2020 for Japan and Sweden. We construct country-specific time-series regression models to evaluate associations between ODA and indicators such as GDP per capita growth, export performance, employment-rate growth, and total factor productivity. The primary data sources include the Penn World Table (PWT 10.01), OECD DAC statistics, the World Development Indicators (WDI), and other publicly available databases.

Methodologically, the paper draws inspiration from growth regression frameworks used by Lee (2017) and Barro (2016), but its contribution is more modest and exploratory. First, it uses a country-specific time-series approach rather than a pooled donor panel, enabling contextual interpretation but limiting external validity. Second, it introduces ODA as the central explanatory variable for donor-side outcomes, an issue that remains relatively underdeveloped in the literature. Third, it treats Japan's commercially oriented profile and Sweden's norm-oriented profile as heuristic case contrasts, not as directly measured intent variables.

The empirical results complicate the assumption that economic-diplomacy-oriented aid necessarily produces stronger measurable donor-side returns. Under the reported specification, Japan's ODA is not significantly associated with income, productivity, employment-rate, or export growth, while Sweden's ODA is positively associated with income, productivity, and employment-rate growth. These results should be read as suggestive associations within two cases rather than as causal proof that norm-oriented ODA generates superior economic returns.

The study contributes to academic and policy debates by redirecting attention to donor-side outcomes and by showing why aid volume alone is insufficient for understanding the domestic implications of ODA. At the same time, the findings point to the need for more precise future

measurement of aid composition, tying status, sectoral allocation, geographic focus, and lag structure before stronger claims about strategy, causality, or policy transfer can be made.

## **2. Research Background**

Foreign aid is a critical instrument through which donor nations pursue development, diplomacy, and international influence. Japan and Sweden are both significant development donors, but their ODA profiles differ in terms of policy objectives, institutional arrangements, geographic focus, and the degree to which aid is linked to commercial or normative priorities. This section compares these profiles while avoiding a simple binary opposition between commercial strategy and normative commitment. In practice, economic-diplomacy-oriented aid can include humanitarian components, while norm-oriented aid can also serve strategic purposes such as preference-shaping, diplomatic alignment, and soft-power accumulation (Asplund & Soderberg, 2016).

Table 1: Comparison of Japan and Sweden's ODA

<b>Category</b>	<b>Japan's ODA Profile</b>	<b>Sweden's ODA Profile</b>
Policy orientation	Economic-diplomacy and regional-development-oriented; linked to trade, infrastructure, regional stability, and industrial diplomacy.	Norm-oriented and welfare-centered; emphasizes poverty reduction, human rights, governance, gender equality, and sustainability.
Institutions and focus	MOFA shapes policy direction; JICA implements projects; historically strong focus on Asia and regional connectivity.	Sida manages development cooperation; broader focus on low-income countries, welfare sectors, governance, and social development.
Economic linkage	Infrastructure, loans, procurement, and trade-related development may support Japanese firms and supply chains.	Direct commercial linkage is weaker, but indirect effects may occur through stability, trust, institutional partnerships, and knowledge networks.
Humanitarian and institutional emphasis	Humanitarian and human-security elements are embedded in broader economic diplomacy and regional stability objectives.	Human rights, democratic governance, poverty reduction, gender equality, and social welfare are central priorities.
Possible donor-side channel	Trade facilitation, supply-chain reliability, regional connectivity, and firm participation in infrastructure projects.	Reputation, soft power, institutional cooperation, knowledge exchange, and long-term partnership formation.

Source: Created by the authors

Japan's ODA policy has been strongly shaped by economic and geopolitical priorities. Historically, Japan used ODA as a diplomatic instrument to restore international relations after World War II, particularly in Asia (Yoshimatsu, 2023). Over time, it developed into a mechanism for promoting regional stability, economic integration, infrastructure connectivity, and trade partnerships. Japan's aid allocations have therefore often prioritized countries and regions with long-term diplomatic or economic significance, especially Southeast Asia.

Sweden's ODA profile is guided by a commitment to global solidarity, poverty reduction, sustainable development, and rights-based international engagement. Rather than being designed primarily around direct commercial returns, Swedish aid has emphasized democratic governance, human development, gender equality, and welfare-oriented development priorities (Shimomura, 2016). This does not mean that Swedish aid is non-strategic; rather, its strategic value is more likely to operate through norms, institutions, reputation, and long-term partnerships than through direct export promotion.

Japan's ODA is coordinated by the Ministry of Foreign Affairs (MOFA), which establishes policy directions, and the Japan International Cooperation Agency (JICA), which oversees

implementation (Michishita, 2022). This structured framework ensures that Japan's ODA aligns closely with its foreign policy and economic objectives. A significant proportion of Japan's aid is directed toward Southeast Asia, reinforcing trade and investment partnerships with ASEAN countries. Infrastructure development, particularly in transport, energy, and industrial zones, remains a key area of Japanese investment (Rix, 1993).

Sweden, in contrast, administers its ODA through the Swedish International Development Cooperation Agency (Sida), responsible for both policy and implementation. Unlike Japan's regionally concentrated aid, Sweden's ODA targets low-income nations globally, with a particular focus on Africa and parts of Asia (Sida, 2005). The aid programs emphasize social welfare sectors such as education, healthcare, and gender equality, in alignment with Sweden's commitment to the United Nations' Sustainable Development Goals (Jonung, 2009).

Japan's ODA profile incorporates a clear economic and regional-development dimension, especially through infrastructure, connectivity, and capacity-building projects. Such projects can facilitate trade flows, regional economic integration, and opportunities for Japanese firms, although the strength of these links varies across periods, sectors, and recipient contexts (Martinez-Zarzoso et al., 2009). Historical procurement and tying arrangements may also have connected some aid projects to Japanese industrial capabilities (Arase, 2005). These features suggest plausible economic channels, but they should not be equated with a simple or automatic macroeconomic return to Japan.

By comparison, Sweden's ODA has generally operated on a more untied and welfare-oriented basis, meaning that it is less explicitly designed to benefit Swedish firms through mandatory procurement arrangements. While this makes its commercial linkage less direct than Japan's, it does not preclude indirect economic effects. Aid that supports governance, institutional capacity, social infrastructure, and long-term stability may contribute to trust-based partnerships and future economic relationships, although such mechanisms require careful empirical validation (Lloyd et al., 2001).

Japan's ODA also incorporates humanitarian, human-security, disaster relief, and capacity-building components. These elements often coexist with broader diplomatic, regional stability, and infrastructure-development objectives rather than standing outside them (Sunaga, 2004). This mixed orientation is important for the present analysis because it cautions against reducing Japan's ODA to a purely commercial instrument.

Sweden, on the other hand, places humanitarian assistance, human rights, democratic governance, gender equality, and poverty alleviation at the center of its ODA profile (Nilsson, 2022). These priorities are better described as norm-oriented or welfare-centered than purely welfare-centered or non-strategic, since they can also enhance Sweden's international credibility, policy influence, and institutional partnerships.

Both Japan and Sweden use ODA as part of broader international engagement, although the channels through which aid supports global standing differ. Japan's ODA has often been associated with economic diplomacy, quality infrastructure, and regional stability, particularly within Asia (Hoshiro, 2024). By financing infrastructure and development projects, Japan can contribute to long-term partnerships and regional connectivity, even where the aggregate donor-side economic effect is difficult to identify.

Sweden, on the other hand, has used ODA to support soft power, multilateral credibility, and trust-based partnerships. Its emphasis on human rights, sustainable development, and institutional cooperation may strengthen Sweden's position in global policy discussions, although these reputational and diplomatic channels are not directly measured in the empirical model (Osei et al., 2004; Nilsson, 2022).

Japan and Sweden thus exemplify two analytically contrasting ODA profiles, each shaped by national priorities, economic structures, and foreign policy orientations. Japan's ODA has been more closely linked to economic diplomacy, regional infrastructure, and trade-related development, while Sweden's ODA has been more closely associated with welfare, governance, human rights, and sustainable development. The comparison is useful not because the two cases represent pure types, but because they allow us to examine whether different aid profiles are associated with different donor-side economic patterns.

### **3. Analytical Expectations**

This section develops empirical expectations for the comparative analysis of Japan's and Sweden's ODA profiles and their association with donor-side economic indicators. The hypotheses are not framed as direct tests of donor intent, since intent is not directly observed in the empirical model. Instead, they are derived from the observable policy orientations and aid profiles discussed in the previous section.

Japan's ODA profile is economic-diplomacy and regional-development-oriented, with strong links to trade facilitation, infrastructure development, supply-chain stabilization, and regional economic interdependence (Scheyvens, 2005). By directing aid toward countries that are actual or potential trade and investment partners, Japan has used ODA as one instrument of economic diplomacy. If these channels are effective, Japanese ODA may be positively associated with donor-side income growth and export growth.

Specifically, Japan's ODA may be associated with GDP per capita growth through increased trade volumes, smoother supply chains, and deeper regional economic integration. ODA-supported infrastructure in recipient countries may also create opportunities for Japanese exports or support Japanese firms operating across regional production networks. However, these mechanisms are indirect and may not translate into measurable aggregate macroeconomic outcomes, particularly when the dependent variables capture national-level performance rather than recipient-linked trade flows.

Sweden's ODA profile is norm-oriented and welfare-centered, prioritizing recipient welfare, institutional development, democratic governance, and social development rather than direct commercial gain. For this reason, one might expect Swedish ODA to have weaker or less immediate associations with Sweden's export growth. At the same time, it would be misleading to treat such aid as entirely non-strategic. Human rights, governance, and democracy-oriented aid can also serve preference-shaping, reputational, diplomatic, and institutional purposes.

Accordingly, Sweden's ODA may have indirect and lagged associations with donor-side outcomes through channels such as international reputation, institutional partnerships, knowledge exchange, governance networks, and long-term market stability. These mechanisms are more difficult to observe in aggregate macroeconomic regressions, but they provide a basis for examining whether Sweden's ODA is associated with income, productivity, or employment-rate growth even in the absence of a direct export-promotion agenda.

**Table 2: Analytical Expectations about Japan and Sweden's ODA Profiles**

Expected Association	Japan's Economic-Diplomacy-Oriented ODA Profile	Sweden's Norm-Oriented ODA Profile
ODA and GDP per capita growth	Positive or ambiguous association, depending on whether trade, infrastructure, and supply-chain channels appear in aggregate data.	Indirect and potentially lagged association through institutional, reputational, and knowledge-based channels.
ODA and export growth	Positive association expected, especially if aid strengthens recipient-linked trade or firm participation.	Weaker or indirect association expected, since aid is less explicitly designed around export promotion.

Source: Created by the authors

To examine these expectations, this study employs a quantitative analysis of macroeconomic data from Japan and Sweden, focusing on associations between ODA disbursements and national economic performance. The models evaluate whether the reported ODA-outcome patterns are consistent with the theoretical expectations above, but they do not directly identify aid profile, aid modality, sectoral composition, or the causal mechanisms linking aid to donor-side outcomes.

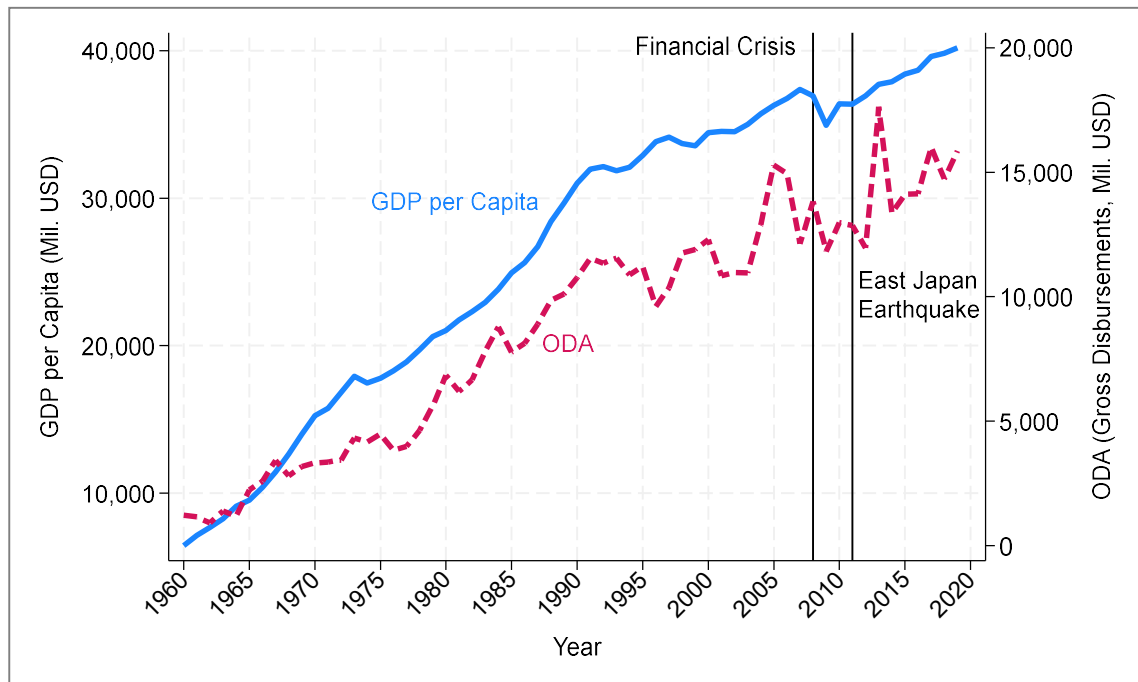
The purpose of the analysis is therefore not to demonstrate that one aid profile is superior to another. Rather, the analysis asks whether two contrasting ODA profiles show different patterns of association with donor-side economic indicators. This more limited framing is appropriate given the two-country design, the aggregate nature of the data, and the absence of direct measures of aid strategy in the regression models.

#### **4. Statistical Overview**

This section provides a statistical analysis of Japan's and Sweden's Official Development Assistance (ODA) trends in relation to their economic growth, measured as GDP per capita growth. The analysis explores the potential link between ODA disbursements and economic performance, offering insights into the role of foreign aid in fostering national income growth.

Figure 1 illustrates the trajectory of Japan's GDP per capita and its ODA disbursements from 1960 to 2020. Japan's GDP per capita exhibits a steady upward trend, with significant growth from the 1970s to the early 1990s, aligning with the country's rapid economic expansion. However, the financial crisis of 2008 led to a temporary decline in GDP per capita, followed by a subsequent recovery. The analysis of Japan's ODA trends suggests that foreign aid allocation has varied over time, with notable fluctuations in response to economic and geopolitical developments.

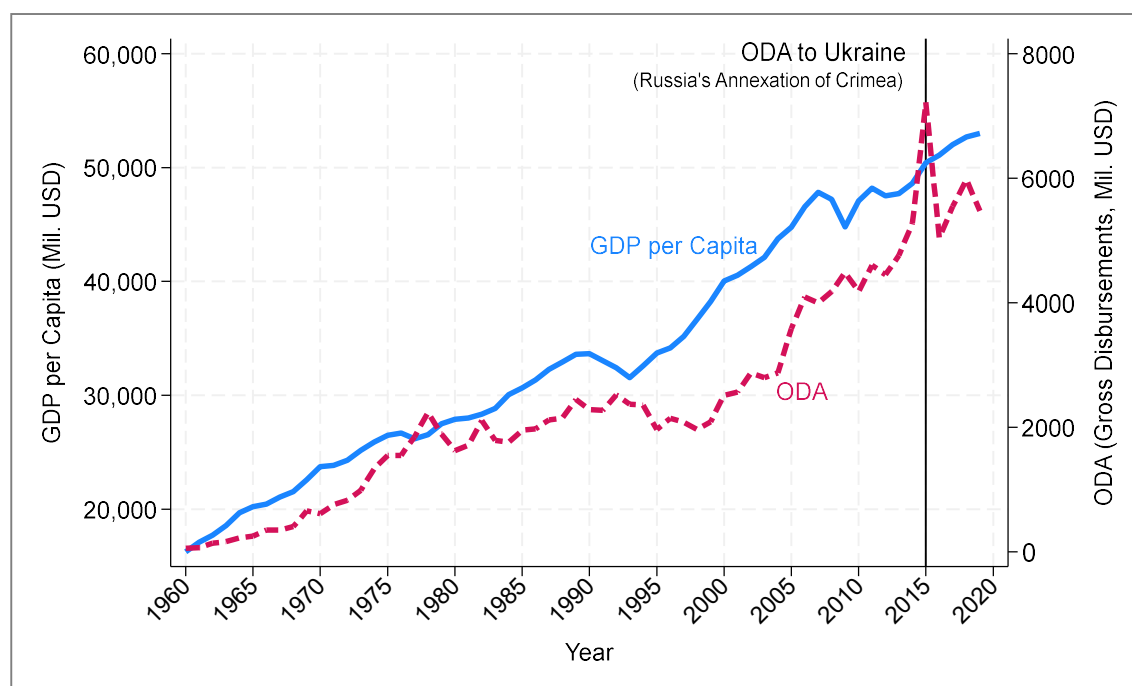
**Figure 1. Japan's Time-series Trend of National Income and ODA Amount**



Source: Penn World Table 10.01 and OECD DAC Statistics.

A key observation is the significant increase in ODA disbursements around 2013, following the East Japan Earthquake (2011). This surge may indicate a policy shift towards greater engagement in international development and humanitarian assistance. The correlation between ODA and economic growth warrants further investigation, as Japan's strategic use of aid could potentially contribute to domestic economic stability by fostering global economic ties and trade relations.

Figure 2 presents Sweden's ODA disbursements alongside its GDP per capita growth over the same period. Sweden's GDP per capita has shown consistent long-term growth, supported by a stable economic environment. Sweden's ODA trajectory also appears responsive to broader geopolitical and humanitarian developments. A notable increase in ODA disbursements is observed after 2014, coinciding with Russia's annexation of Crimea and subsequent regional instability. This pattern should be interpreted descriptively rather than as evidence of a single causal driver.

**Figure 2. Sweden's Time-series Trend of National Income and ODA Amount**

Source: Penn World Table 10.01 and OECD DAC Statistics.

Sweden has historically maintained a high level of ODA relative to its economic size, aligning with its policy of promoting global development, conflict prevention, and governance reforms. While Sweden's economy has remained resilient, further empirical analysis is needed to determine whether its ODA policies have had a measurable impact on GDP per capita growth, either through direct economic benefits or indirect contributions to global stability and trade.

Both Japan and Sweden demonstrate increasing ODA trends over time, yet their policy contexts and economic conditions differ. Japan's ODA trends appear connected to broader foreign economic policy, infrastructure cooperation, and regional engagement, while Sweden's ODA is more visibly linked to welfare, governance, and geopolitical-humanitarian concerns. These descriptive patterns motivate the broader question of whether ODA is statistically associated with donor-side income growth.

Testing whether ODA is associated with economic growth requires a more detailed empirical approach. The following models assess statistical associations between ODA disbursements and GDP per capita growth while controlling for other macroeconomic variables. The analysis should not be read as establishing causality, since ODA may be endogenous to broader domestic and geopolitical conditions.

The descriptive patterns are useful for motivating the empirical analysis, but they cannot by themselves establish whether aid serves as a catalyst for sustainable economic growth in donor countries. They should therefore be interpreted as contextual background for the regression analysis rather than as evidence of direct economic impact.

## **5. Empirical Strategy**

While our empirical framework draws from the cross-country growth regression literature, including Lee (2017) and Barro (2016), our study adopts a more bounded design. First, we use a country-specific time-series approach for Japan and Sweden over the period 1960-2020, rather than a pooled cross-country panel. This allows for contextual interpretation, but it limits inferential leverage and external validity. Second, we introduce ODA as the central explanatory variable for donor-side outcomes, an issue that has received less attention than recipient-side aid effectiveness. Third, we use Japan and Sweden as contrasting aid-profile cases, while recognizing that the empirical model does not directly measure donor intent or the full composition of aid strategy. In this section, we describe our data, variable construction, and the

empirical models used to estimate associations between ODA and donor-side growth indicators such as GDP per capita, productivity, employment-rate, composite input, and export growth.

### 5.1. Data

Our main aim is to examine whether ODA disbursements are associated with economic growth for Japan and Sweden. Beyond income growth, we also examine potential macroeconomic channels by considering productivity growth, composite input growth, employment-rate growth, and export growth. These variables do not capture all possible aid mechanisms, but they allow us to explore whether donor-side outcomes differ across the two cases.

Penn World Table (PWT) 10.01 has an index for total factor productivity (TFP), the variable named '*rtfpna*', from which we derived the growth rates of TFP ( $g_T$ ) using this variable.

When considering a neoclassical growth model of  $Y = TX$  where  $T$  represents the TFP, we can derive the growth rate of composite capital (physical and human capital) per worker ( $g_x$ )

from  $T$  and  $Y$  as follows:

$$\frac{Y}{L} = ypw = T \cdot \frac{X}{L} = T x \quad (1)$$

$$g_{ypw} = g_T + g_x \quad (2)$$

$$\therefore g_x = g_{ypw} - g_T \quad (3)$$

Here,  $L$  represents employment (measured as '*emp*' in PWT 10.0),  $ypw$  denotes GDP per worker, and  $x$  refers to composite input per worker. GDP per worker growth is calculated using  $ypw$ , while per capita GDP growth is calculated using '*rgdpna*' divided by population ('*pop*') from the PWT 10.0 database.

Furthermore, employment rate growth ( $g_{emp}$ ) is derived by calculating the growth rate of the employment rate, defined as employment divided by population, using the '*emp*' and '*pop*' variables from the PWT. Similarly, we can derive the following accounting identity:

$$ypc = \frac{Y = TX}{P} = T \cdot \frac{X}{L} \cdot \frac{L}{P} \quad (4)$$

$$= T \cdot x \cdot emp$$

$$\therefore g_{ypc} = g_T + g_x + g_{emp} \quad (5)$$

Because exports enter national output in the standard expenditure identity, we also test whether ODA is associated with export growth. This is an indirect test. The available export measure captures exports to all countries, whereas the most theoretically direct channel would be donor exports to recipient countries. As a result, the export model should be interpreted cautiously: a null result does not necessarily mean that ODA has no recipient-linked trade effect, and a significant result would not by itself identify the precise trade channel.

We also collected 13 macroeconomic, environmental, and policy variables (including two squared variables) as used in growth regressions in Lee (2017) and Barro (2016). While the aforementioned studies conducted cross-country panel analysis, here, we test by each country: Japan and Sweden. The control variables used by these two studies are (log of) per-capita income, (one over) life expectancy, (log of) fertility rate, investment ratio, years of schooling, government consumption ratio, terms of trade change, inflation, rule of law, and democracy index, however, since our data starts from 1960 but rule of law and democracy index which has data from back in 1960s and 70s which is publicly available were difficult to find, we omitted these two variables.

GDP per capita and its growth data are based on 2017 constant national prices and are sourced from PWT 10.01. The investment ratio is represented by '*cash\_i*,' the openness ratio is calculated as '*cash\_x*' minus '*cash\_m*,' and the government consumption ratio is given by '*cash\_g*,' all from PWT 10.01. The yearly inflation rate is calculated using the price level variable '*pl\_con*', also from PWT 10.01. Life expectancy at birth data before 1970 are sourced from the UN Population Division, while data from 1971 are obtained from the World Development Indicators (WDI). The fertility rate is also sourced from WDI. Data on years of schooling are taken from PWT's Labor Detail dataset. The yearly terms-of-trade change is calculated using the export and import price index data, '*pl\_x*' and '*pl\_m*' variables respectively, from PWT 10.01.

As there are yearly fluctuations in many variables, including ODA values in Figures 1 and 2, the reported estimates use smoothed independent variables. Specifically, the independent variables are calculated based on values around the first year of each period ( $t$ ), using moving averages with weights of 1, 2, 3, 2, and 1 for  $t-2$ ,  $t-1$ ,  $t$ ,  $t+1$ , and  $t+2$ , respectively. This smoothing choice reduces short-term volatility but also limits causal interpretation because it incorporates forward-year information. Therefore, the reported results should be interpreted as descriptive associations under the current specification. A stricter future re-estimation should use backward-looking lag structures, such as  $t-1$ ,  $t-3$ , or backward moving averages from  $t-3$  to  $t-1$ , to preserve temporal ordering. Tables 3 and 4 present the summary statistics of our data.

**Table 3. Summary Statistics (Japan)**

Variable	Observation	Mean	Std. dev.	Min	Max
GDP per capita growth	55	0.031	0.028	-0.004	0.099
TFP growth	55	0.009	0.013	-0.008	0.043
Composite input growth	55	0.021	0.016	-0.003	0.053
Employment rate growth	55	0.001	0.005	-0.012	0.012
Export growth	55	0.059	0.054	-0.035	0.167
ODA (mil. USD)	60	8715	4647	914	17626
GDP per capita (mil. USD)	60	26469	10413	6444	40196
TFP index	60	0.893	0.112	0.576	1.001
Employment (mil.)	60	61.64	6.17	47.91	69.98
Life expectancy	60	77.82	4.77	67.70	84.36
Fertility rate	60	1.652	0.295	1.260	2.230
Investment ratio	60	0.318	0.055	0.229	0.421
Years of schooling	60	10.95	1.45	8.13	12.99
Government consumption ratio	60	0.164	0.026	0.125	0.217
Terms of trade change	59	-0.008	0.042	-0.145	0.108
Inflation rate	59	0.049	0.106	-0.211	0.396

Source: Created by the authors.

**Table 4. Summary Statistics (Sweden)**

Variable	Observation	Mean	Std. dev.	Min	Max
GDP per capita growth	55	0.020	0.012	-0.009	0.045
TFP growth	55	0.007	0.010	-0.008	0.025
Composite input growth	55	0.012	0.005	0.003	0.023
Employment rate growth	55	0.000	0.009	-0.029	0.015
Export growth	55	0.038	0.034	-0.042	0.099
ODA (mil. USD)	60	2406	1678	53	7218
GDP per capita (mil. USD)	60	33905	10625	16273	53013
TFP index	60	0.860	0.093	0.646	1.005
Employment (mil.)	60.00	4.27	0.34	3.66	5.00
Life expectancy	60.00	77.77	3.02	73.01	83.11
Fertility rate	60	1.867	0.234	1.500	2.470
Investment ratio	60	0.291	0.034	0.229	0.359
Years of schooling	60.00	10.49	1.33	7.84	12.33
Government consumption ratio	60	0.217	0.030	0.171	0.272
Terms of trade change	59	-0.004	0.025	-0.096	0.089
Inflation rate	59	0.037	0.096	-0.219	0.253

Source: Created by the authors.

## 5.2. Model Specification

Our empirical analysis examines associations between ODA and donor-side economic outcomes. We adopt reduced-form growth regression models as follows:

$$g_{i,t \sim t+5} = \beta_0 + \beta_1 \log(ODA_{i,t}) + \gamma X_{i,t} + \varepsilon_{i,t} \quad (6)$$

where the  $g$  represents the annual growth rate, from year  $t$  to year  $t+5$ , of one of four variables: state's per-capita GDP, total factor productivity, per-worker composite input, and employment rate.  $i$  is either Japan or Sweden.  $\gamma X$  is a set of time-varying control variables influencing economic growth, as explained in Section 5.1. Lastly,  $\varepsilon$  refers to the error term. This methodology for running growth regressions on these four dependent variables is adapted from Jeong and Yu (2025). Given the country-specific design and aggregate data, the coefficients should be read as conditional associations rather than as causal estimates of aid strategy.

Furthermore, we test for the last dependent variable which is growth of exports.

$$g_{exp\ i,t \sim t+5} = \beta_0 + \beta_1 \log(ODA_{i,t}) + \gamma Z_{i,t} + \varepsilon_{i,t} \quad (7)$$

where the left-hand-side term represents the annual growth rate, from year  $t$  to year  $t+5$ , of state's export value.  $\gamma Z$  is a set of time-varying control variables influencing economic growth as in Equation (6), but excluding the trade openness variable because export growth is closely related to trade openness and may create multicollinearity concerns. As noted above, the export measure covers total exports rather than exports to aid recipients, so the results cannot directly identify recipient-specific trade effects.

## 6. Results

The results show different ODA-outcome patterns for Japan and Sweden under the reported specification. Japan's ODA is not significantly associated with any of the dependent variables in Table 5. Sweden's ODA, by contrast, is positively associated with income growth, productivity growth, and employment-rate growth, and negatively associated with composite input growth in Table 6. These patterns are noteworthy, but they should not be interpreted as direct evidence that Swedish donor intent caused superior domestic returns. The model estimates associations between ODA and macroeconomic outcomes, not the causal effect of aid profile.

**Table 5. Regression Results (Japan)**

	(1)	(2)	(3)	(4)	(5)
	$g_{ypw}$	$g_T$	$g_x$	$g_{emp}$	$g_{exp}$
Log(ODA)	0.0048 (0.773)	0.0026 (0.798)	0.0092 (0.431)	-0.0062 (0.471)	-0.0329 (0.509)
Log(income)	-0.2220 (0.119)	-0.2525 (0.008)***	-0.1010 (0.166)	0.1316 (0.012)**	0.1603 (0.762)
1/life expectancy	-195.7838 (0.000)***	-112.0188 (0.000)***	-14.2265 (0.309)	-66.8173 (0.000)***	13.3509 (0.905)
Log(fertility rate)	0.1200 (0.000)***	0.0625 (0.001)***	0.0240 (0.082)*	0.0332 (0.014)**	-0.1571 (0.179)
Investment ratio	-0.2649 (0.080)*	-0.0668 (0.500)	-0.0084 (0.921)	-0.1842 (0.003)***	0.3393 (0.499)
Years of schooling	-0.0404 (0.334)	0.0215 (0.431)	0.0123 (0.579)	-0.0730 (0.000)***	-0.0799 (0.607)
Government consumption ratio	-0.5266 (0.249)	-0.8584 (0.004)***	-0.4545 (0.053)*	0.7913 (0.000)***	1.2355 (0.472)
Trade openness	-0.1173 (0.103)	-0.0033 (0.929)	0.0101 (0.740)	-0.1238 (0.002)***	

	(1)	(2)	(3)	(4)	(5)
Terms of trade change	0.0089 (0.901)	0.0031 (0.942)	-0.0122 (0.755)	0.0187 (0.577)	-0.0044 (0.987)
Inflation	-0.0372 (0.131)	-0.0138 (0.354)	-0.0165 (0.251)	-0.0068 (0.646)	-0.2011 (0.013)**
Constant	5.3380 (0.000)***	3.8721 (0.000)***	1.0662 (0.062)*	0.3407 (0.494)	-0.7915 (0.871)
Observations	55	55	55	55	55
R-sq.	0.9594	0.9186	0.9502	0.6601	0.8526
Adjusted R-sq.	0.9501	0.9001	0.9389	0.5829	0.8231

Note: Robust standard errors are used to calculate p-values; P-values are in parentheses (\*:  $p < 0.1$ , \*\*:  $p < 0.05$ , \*\*\*:  $p < 0.01$ ); Residual-based ADF (Augmented Dickey-Fuller) tests confirm stationarity of the residuals in all five models at the 1% significance level. This suggests the presence of cointegration relationships among the variables and thus provides evidence against spurious regression.

Source: Created by the authors.

For Japan, the results do not support the expectation that an economic-diplomacy-oriented ODA profile is associated with aggregate income growth or export growth in the reported specification. For Sweden, ODA is positively associated with per-capita GDP growth, employment-rate growth, and productivity growth, while it is not associated with export growth. The negative association with composite input growth may be consistent with changes in the relative contribution of productivity and input accumulation, but this interpretation should remain cautious. The model does not directly test firm-level innovation, soft power, administrative employment, or specific procurement channels.

**Table 6. Regression Results (Sweden)**

	(1)	(2)	(3)	(4)	(5)
	$g_{ypw}$	$g_T$	$g_x$	$g_{emp}$	$g_{exp}$
Log(ODA)	0.0155 (0.000)***	0.0090 (0.016)**	-0.0212 (0.000)***	0.0273 (0.000)***	0.0136 (0.544)
Log(income)	-0.2082 (0.000)***	-0.0789 (0.000)***	0.0625 (0.000)***	-0.1880 (0.000)***	-0.1182 (0.472)
1/life expectancy	-161.4585 (0.000)***	-82.5161 (0.000)***	90.8690 (0.000)***	-166.3773 (0.000)***	64.5709 (0.533)
Log(fertility rate)	-0.0203 (0.009)***	0.0156 (0.020)**	0.0112 (0.019)**	-0.0460 (0.000)***	-0.0606 (0.288)
Investment ratio	-0.2416 (0.000)***	-0.0883 (0.078)*	-0.0931 (0.001)***	-0.0584 (0.191)	-0.4546 (0.153)
Years of schooling	-0.0207 (0.000)***	-0.0115 (0.005)***	0.0328 (0.000)***	-0.0411 (0.000)***	0.0135 (0.522)
Government consumption ratio	-0.0025 (0.931)	-0.1355 (0.000)***	0.0742 (0.000)***	0.0572 (0.109)	-0.5424 (0.011)**
Trade openness	-0.0595 (0.000)***	-0.0663 (0.000)***	-0.0089 (0.177)	0.0151 (0.252)	
Terms of trade change	0.0799 (0.139)	0.0084 (0.898)	0.0665 (0.048)**	0.0056 (0.947)	0.1296 (0.575)
Inflation	-0.0003	-0.0353	-0.0010	0.0352	-0.0640

	(1)	(2)	(3)	(4)	(5)
	(0.981)	(0.008)***	(0.895)	(0.050)*	(0.451)
Constant	4.4934	2.0433	-1.9821	4.3430	0.4735
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.869)
Observations	55	55	55	55	57
R-sq.	0.9087	0.8589	0.8776	0.8139	0.5258
Adjusted R-sq.	0.8879	0.8268	0.8498	0.7717	0.4350

Note: Robust standard errors are used to calculate p-values; P-values are in parentheses (\*:  $p < 0.1$ , \*\*:  $p < 0.05$ , \*\*\*:  $p < 0.01$ ); Residual-based ADF (Augmented Dickey-Fuller) tests confirm stationarity of the residuals in all five models at the 1~5% significance level. This suggests the presence of cointegration relationships among the variables and thus provides evidence against spurious regression.

Source: Created by the authors.

## **7. Implications**

This section interprets the statistical results as bounded, case-specific associations rather than as causal evidence of the economic superiority of one aid profile over another. The findings are useful because they complicate the assumption that economic-diplomacy-oriented aid necessarily produces stronger measurable donor-side economic returns. At the same time, the results cannot prove that norm-oriented aid generates domestic growth, since the model does not directly measure aid modality, tying status, sectoral allocation, geographic focus, or donor intent.

For Japan, the absence of statistically significant associations suggests that economic-diplomacy and regional-development-oriented ODA does not automatically translate into aggregate income, productivity, employment-rate, or export growth. This does not mean that Japanese ODA lacks economic value. Its benefits may operate through regional stabilization, supply-chain reliability, infrastructure connectivity, firm-level procurement, or recipient-specific trade channels that are not fully captured by national-level macroeconomic indicators.

For Sweden, the positive associations with income, productivity, and employment-rate growth suggest that a norm-oriented ODA profile may be compatible with favorable donor-side macroeconomic outcomes. However, these findings should be treated as suggestive rather than conclusive. Swedish aid may be linked to broader institutional, reputational, or knowledge-based channels, but the current model does not directly observe these mechanisms. The results therefore motivate further analysis rather than validate a simple claim that norm-oriented aid produces domestic economic returns.

The possible mechanisms behind Sweden's results require more careful specification. Employment-rate growth may reflect broader domestic labor-market dynamics, public-sector expansion, development administration, or internationally oriented sectors, but the regression model does not identify which channel is operative. Similarly, productivity growth could be linked to knowledge networks, institutional partnerships, or technological cooperation, but these mechanisms are not directly tested. Therefore, references to job creation, innovation, and soft power should be treated as possible interpretations, not as demonstrated empirical findings.

The comparison also suggests a conceptual lesson. A simple distinction between strategic and norm-oriented aid is too rigid. Economic-diplomacy-oriented aid can contain humanitarian and institutional components, while norm-oriented aid can also serve strategic purposes through reputation, preference-shaping, conditionality, multilateral influence, and diplomatic alignment. Future research should therefore move from intent labels to measurable aid profiles, including sectoral allocation, tying status, grant-loan composition, recipient concentration, and implementation modality.

The policy implications should therefore be stated cautiously. Rather than recommending that donor governments adopt one aid profile over another, the results suggest that policymakers should examine which components of ODA design are associated with specific donor-side outcomes, under what timing conditions, and through which mechanisms. For Japan, this may mean evaluating whether infrastructure and regional connectivity aid generates measurable firm-level, trade, or supply-chain benefits that aggregate macroeconomic models cannot detect.

For Sweden, this may mean examining whether governance, welfare, and sustainability-oriented aid produces indirect economic benefits through institutional partnerships, knowledge exchange, or reputation-based channels.

The findings also point to the importance of improving empirical measurement. Stronger policy claims would require direct indicators of aid composition, such as tied versus untied aid, grants versus loans, sectoral allocation, geographic focus, procurement structure, and recipient-linked exports. Without these measures, policy implications remain interpretive rather than operational. The current study should therefore be seen as an initial comparative analysis that identifies patterns requiring further testing.

More broadly, the results support a more integrated research agenda on ODA and donor-side outcomes. Traditional indicators such as GDP growth and aggregate exports may not fully capture the economic implications of aid. Future work should combine macroeconomic models with sectoral, firm-level, and recipient-linked trade data to determine whether ODA contributes to domestic economic resilience through concrete channels. Such work would allow scholars and policymakers to move beyond broad aid profiles and toward a more precise understanding of how aid design matters.

## **8. Conclusion**

This study provided a bounded comparative analysis of Japan's and Sweden's ODA profiles and their association with donor-side economic outcomes. Using time-series macroeconomic data from 1960 to 2020 and a growth regression framework inspired by Lee (2017) and Barro (2016), we evaluated the relationship between ODA disbursements and GDP per capita growth, productivity growth, employment-rate growth, composite input growth, and export growth. Unlike studies that focus primarily on recipient-side outcomes, this paper redirects attention to the donor side of development assistance.

The findings show that Japan's ODA is not significantly associated with income, productivity, employment-rate, or export growth under the reported specification. Sweden's ODA is positively associated with GDP per capita growth, productivity growth, and employment-rate growth, but not export growth. These contrasting patterns are analytically interesting, but they should not be interpreted as proof that donor intent or aid profile directly causes domestic economic returns. The results are best understood as case-specific associations generated by a two-country time-series design.

In Japan's case, the absence of measurable aggregate growth associations may reflect the structure of its ODA profile. Much of Japan's aid has been directed toward infrastructure development, regional stability, and economic diplomacy in Asia. These forms of aid may generate benefits through supply-chain security, firm-level participation, regional connectivity, or recipient-specific trade relationships, but such effects may not appear clearly in aggregate national growth or export measures.

In Sweden's case, the positive associations with income, productivity, and employment-rate growth suggest that a norm-oriented and welfare-centered ODA profile can coexist with favorable donor-side macroeconomic outcomes. However, the analysis does not establish the mechanisms behind these patterns. Governance support, institutional cooperation, knowledge networks, reputation, and soft-power effects remain plausible but untested pathways that require additional empirical investigation.

The study has important limitations. Japan and Sweden are analytically valuable cases, but they are not representative of all donor countries. The empirical model uses aggregate ODA and macroeconomic indicators rather than direct measures of aid strategy, sectoral composition, tying status, or implementation modality. In addition, the smoothing specification used in the reported estimates limits causal interpretation because it includes forward-year information. For these reasons, the study should be read as a theory-building comparison, not as a universal model of ODA effectiveness or as a causal test of donor intent.

Future research should extend this framework in two directions. First, broader donor panels could test whether the patterns observed here hold across a larger set of established and emerging donors. Second, more disaggregated analysis should distinguish between aid sectors, grants and loans, tied and untied aid, geographic allocation, recipient-linked exports, and firm-

level participation in aid projects. Such work would make it possible to identify concrete policy levers rather than relying on broad labels such as strategic or norm-oriented aid.

Ultimately, the paper contributes to the reassessment of ODA as a policy instrument whose consequences may extend beyond recipient development outcomes. Its main claim is not that one aid profile is superior to another, but that donor-side outcomes deserve closer empirical attention and that aid profiles must be measured more precisely. A more careful integration of development objectives, economic analysis, and institutional design can help clarify when and how ODA may matter for donor countries as well as for recipients.

#### **AI Acknowledgment**

The authors used ChatGPT (OpenAI) to enhance the quality of the writing.

#### **Informed Consent**

The authors declare that informed consent was not required as there were no human participants involved.

#### **Conflict of Interest**

The authors declare that there is no conflict of interest.

#### **Biography**

**Jungeun Kim:** Dr. Jungeun Kim is a Senior Assistant Professor in the Graduate School of Media Design at Keio University in Japan. Having graduated with a B.A. from University of Sydney in Australia, she received a Master's and Ph.D. from Graduate School of International Studies at Seoul National University, specializing in International Business. She has dedicated her academic and professional career to Korean government research institutions (KIPF, KHIDI) and the corporate sector (GDM Consulting, Biotech Holdings). Her experiences in Japanese Advanced Management Program at Chungang University and Executive Program for Online Marketing at Korea University have solidified expertise in executive management.

**Woosik Yu:** Dr. Woosik Yu is an Assistant Professor in the Department of International Commerce at Keimyung University in South Korea. Previously, he served as an Assistant Professor of Economics at KIMEP University in Kazakhstan. His research interests focus on international trade and economic development, examining how changes in market conditions, such as national policies, trade environments, and external shocks, impact firm-level performance as well as country-level growth and development. He holds a Ph.D. from the Graduate School of International Studies, Seoul National University, an M.Sc. in Operational Research from the London School of Economics, and a B.Sc. (Honours) in Economics from University College London.

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# MEASURING THE EUROZONE'S TOURISM ECOEFFICIENCY AND PRODUCTIVITY SUSTAINABLE CHARACTER: A SLACK-MODELED TOURISM-INDUCED DATA ENVELOPMENT ANALYSIS

**George EKONOMOU**

Post-Doctoral Researcher, University of Thessaly  
goikonomou@uth.gr

**Dimitris KALLIORAS**

Professor, University of Thessaly  
dkallior@uth.gr

## **Abstract**

The purpose of this study is to investigate how technical efficiency and productivity patterns changed in the Eurozone's tourism sector over the period 1996-2019. To achieve this, a Slack-Based Measure (SBM) within the Data Envelopment Analysis (DEA) framework was employed. A key strength of this study lies in the carefully selected, multidimensional set of variables that captures the economic and structural heterogeneity of the tourism sector. To strengthen our approach, we also used proxies for environmental degradation. Results reveal an average efficiency score of 0.53 for input-oriented DEA and 0.81 for output-oriented DEA, whereas the Malmquist index score is 1.026. Panel results indicate a positive and significant effect of renewables on technical efficiency. Granger's causality test reveals a unidirectional relationship from renewables to output-oriented technical efficiency. Practical implications call for practices that reduce environmental burdens while simultaneously increasing desirable revenue outcomes.

**Keywords:** tourism, economy, sustainability

**JEL classification:** O47, Z32, Q56

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## **1. Introduction**

The complexity of economic systems and the contemporary demand for their resilience calls for a comprehensive analysis of 'sectoral' and 'regional' resilience (Tsiotas et al., 2025), indicatively within various temporal and functional contexts (Tsiotas and Kallioras, 2025). The economic performance of the tourism sector is combined with environmental concerns to create more value with less impact (Rashidi and Saen, 2015). As indicated by Jiang and Wang (2025), the World Travel Tourism Council forecasts that by 2033, the tourism industry will account for more than 11.6% of the global economy. Moreover, the global carbon footprint of tourism increased from 3.9 to 4.5 GtCO<sub>2</sub>e from 2009 to 2013, accounting for about 8% of global greenhouse gas emissions (Lenzen et al., 2018). Eco-efficiency measures provide insights into sustainability in the tourism sector (Xia et al., 2022), whereas Gossling et al. (2005) argue that eco-efficiency is an advantageous means of assessing the combined environmental and economic performance of tourism. Since tourism uses a wide range of resources (e.g., human, natural), it is crucial to maintain balance among key stakeholders to cater tourist's requirements (Harish and Rao, 2025). Moreover, multidisciplinary thinking advances comprehensive empirical research yielding evidence-based results (Tsiotas, 2022).

In light of these concerns, this study investigates the technical efficiency and productivity patterns of the Eurozone's tourism sector from 1996 to 2019, while also considering eco-efficiency in terms of a nation's primary energy consumption and carbon dioxide emissions. Moreover, this study examines whether the adoption of renewables is a core determinant of efficiency and productivity patterns. The effects of the environment on people's experiences and behaviors are broadly recognized in research (e.g., in tourism and marketing) (Liu et al., 2026). Consequently, this study addresses the following questions: How many inputs could be saved in tourism while keeping tourism revenues unchanged and reducing energy use and emissions? Given the inputs a country already uses, how much more tourism revenue could

countries generate (expand) while improving environmental performance? To what extent can these countries simultaneously close desirable-output shortfalls and undesirable-output excesses? On average, do the Eurozone countries meet the performance rates implied by the efficiency frontier? Is any efficiency ‘gap’ identified? Is there any causality between input- and output-oriented technical efficiencies and renewables? Can a causality be evidenced between total factor productivity change and renewables? If confirmed, what are the directions of these causalities? What are the effects of renewables on technical efficiency and total factor productivity change?

The structure of this study is as follows: the theoretical background section presents the rationale for implementing a tourism-induced DEA analysis under eco-efficiency concerns, whereas the methodology section outlines the steps for conducting the analysis. The following section includes the results. The discussion section presents the practical implications of the analysis. The last section concerns the conclusions.

## **2. Theoretical Framework**

The central role in sustainable tourism accomplishments belongs to eco-efficiency measures, given the need for development or expansion. The term refers to the value or cost associated with the economic aspects of products and/or services (Petchkaewkul et al., 2016), mirroring an empirical relationship in economic activities between environmental cost or value and environmental impacts (Huppel and Ishikawa, 2005), indicating for instance reduction in the energy intensity of goods or services and maximum use of renewables (Cabeza et al., 2015). Interestingly, Yu et al. (2026) indicate that DEA is a mainstream tool for assessing eco-efficiency due to its nonparametric nature (Jomthanachai et al., 2023) and its flexibility in handling undesirable outputs (Zhou et al., 2012). Rozenberg (2021) claims that measuring the efficiency of a complex system, such as tourism, can advance the sector’s sustainable development efforts.

Despite its broad applicability, DEA has been criticized in the field of operational research. As stated by Nurmatov (2021), based on the work of Ramanathan (2003) and Rouse (1997), DEA has limitations, mostly concerning the type, number, and selection of DMUs used, as well as its nonparametric nature, which does not allow for conducting statistical hypothesis tests, raising validity concerns. Also, as an extreme point technique, noise (e.g., in measurement error) can be an issue of high importance, whereas it measures relative efficiency (comparisons to ‘peers’) and not absolute efficiency scores (comparison to a ‘theoretical maximum’) (Trick, 1996). Interestingly, Assaf et al. (2025) claim that homogeneity and scale assumptions across DMUs, as well as dimensionality issues related to the number of inputs and outputs relative to the number of DMUs, warrant attention.

Many outstanding research efforts in tourism-induced DEA analysis rely on aggregate tourism indicators, such as tourism receipts, nights spent, or arrivals. For instance, a strand in literature examines hotel-oriented proxies to elaborate on DEA and efficiencies (Hsieh and Lin, 2010; Assaf and Josiassen, 2012; Huang et al., 2016; Li et al., 2022; Choi and Kim, 2024; *inter alia*) whereas as indicated by Pulina and Santoni (2018), high-impact research efforts discuss tourism’s economic performance concerning a destination perspective, at the regional and/or city level, or a hotel perspective (e.g., Hathroubi et al., 2014; Perrigot et al., 2009; Ramanathan et al., 2016).

Explicit channels through which tourism contributes to the economy are rarely modeled as core variables in the T-DEA framework. Hence, the economic transmission mechanisms of tourism remain less investigated and insufficiently quantified. Moreover, viewing the Eurozone’s tourism system as a homogeneous research topic might lead to overlooking structural differences among tourism segments. Ekonomou (2022) argues that investigating the unnoticed power of market segments in the tourism growth nexus discussion helps define practical implications concerning sustainable economic growth and tourism demand issues.

This study addresses this gap by first examining tourism’s direct contribution to employment and investment capital flows in the travel and tourism industry. Second, it implements an SBM T-DEA analysis across two distinct, high-leverage tourism market segments, using business and leisure tourism spending as the desirable output variables. Indicatively, in 2019, business trips accounted for 15% of tourism expenditure, whereas they recorded the highest average

expenditure per trip. Interestingly, Europeans spent an average of €1 053 on foreign trips and €303 on domestic trips in 2024 (Eurostat, 2025), whereas in 2023, business travelers were estimated to have spent more than 1.4 trillion U.S. dollars worldwide (Statista, 2025a). Furthermore, in 2018, the leisure tourism market accounted for 78.5% of tourism sector spending (WTTC, 2019). Notably, leisure tourism is the largest sector of the tourism industry, with global leisure tourism spending projected to reach 9,332 billion U.S. dollars in 2029 (Statista, 2025b).

In this way, the study highlights the heterogeneous nature of tourism rather than relying on aggregate proxies. As Peng et al. (2017) indicate, tourism revenue and tourist arrivals are widely used as desirable output variables (Barros and Matias, 2006a; Medina et al., 2012) in DEA analyses. In light of these concerns, a research opportunity arises to avoid assuming homogeneity in tourism demand. If not, we might overlook that business and leisure tourism have distinct characteristics and spending patterns, resource intensity, seasonality, and economic spillovers within the Eurozone. The tourism sector closely monitors fiscal stimulus policies during economic downturns, as these policies are generally assumed to increase consumer spending to aid recovery (Nie and Song, 2025).

Third, it considers an energy-efficiency proxy (e.g., primary energy consumption), alongside carbon dioxide emissions. Interestingly, according to the European Environment Agency, the European Union's recast Energy Efficiency Directive provides an indicative EU-wide target of 992.5 million tonnes of oil equivalent (Mtoe) for primary energy consumption and a binding EU-wide target of 763 Mtoe for final energy consumption, to be achieved by 2030. This approach is closely related to Porter's Hypothesis on whether environmental regulations and innovation factors can increase efficiency patterns. Arguably, Porter's Hypothesis holds that environmental regulations can facilitate innovation by partially or fully offsetting compliance costs (Porter and van der Linde, 1995). This is an interesting research approach, since the literature debates whether adopting renewable energy sources increases costs (by reducing efficiency) or reduces long-term operational costs (by increasing efficiency). Based on Porter's hypothesis, the benefits of innovation initiatives can offset enterprises' losses from environmental regulations and promote social development (Xu et al., 2022). These aspects concern whether destinations can demonstrate an eco-friendly profile in terms of energy efficiency (e.g., primary energy consumption) and whether renewables are key drivers of technical efficiency and performance. Despite its significance for tourism and environmental economics, the adopted set of variables is either less visible or entirely unobserved in relevant SBM T-DEA studies.

### **3. Methodology**

The present research applies a tourism-induced DEA to countries (DMUs) of the Eurozone economic space from 1996 to 2019. We adopted both DEA orientations, namely, input- and output-oriented variable returns-to-scale (VRS) analyses under a Slack-Based Measure. It considers good (desirable) and bad (undesirable) outputs. The undesirable variables were transformed using a monotonic decreasing function. Furthermore, the change in total factor productivity is calculated. Moreover, a panel analysis was conducted to regress efficiencies and productivity scores on renewables. This study uses data from the World Travel and Tourism Council, Eurostat, and the World Bank.

#### **3.1 Technical efficiencies**

To perform the T-DEA analysis, two input and four output variables were used. The input variables comprise the number of jobs totally generated in the travel and tourism sector (*tce*) and capital investment spending by all industries directly involved in the travel and tourism sector (*invest*). The output variables consisted of business tourism spending and leisure tourism spending (desirable outputs) and primary energy consumption and carbon dioxide emissions (CO<sub>2</sub>) (undesirable outputs). Business tourism spending is the amount spent on business travel within a country by residents and international visitors. Leisure tourism spending is the amount residents and international visitors spend on leisure travel within a country. Primary energy consumption denotes the total energy demand of the country of reference, whereas CO<sub>2</sub> emissions refer to those from liquid fuel consumption. Technical efficiency scores for both

input- and output-oriented frameworks are bounded between 0 and 1. A value of one denotes full efficiency. Values below one indicate inefficiency arising from input excess and/or output shortfalls.

Under the SBM DEA framework, for inputs, a slack value of zero indicates that the input is used efficiently relevant to the best-practice frontier, while a positive slack indicates excess in input use, implying that the input can be reduced without worsening performance. For desirable outputs, a slack value of zero indicates that the output lies on the frontier, whereas a positive value reflects output shortfall and indicates potential for output expansion. For undesirable outputs, a slack value of zero indicates that no excess environmental burden exists relative to the frontier, while a positive value reflects pollution excess and indicates potential for reduction. Normalized slack values are obtained through the form:  $Normalized\ slack = \frac{slack\ movement}{input\ (or\ output)\ values} \times 100$ , absolute values are taken for inputs. Table 1 presents the descriptive statistics of variable to process the T-DEA.

**Table 1. Descriptive statistics.**

Country	Input variables			Output variables		
	tce	invest	bts	lts	energy	CO <sub>2</sub>
Austria	16,570	4,890	6,928	36,786	30.765	10.721
Belgium	6,575	2,417	6,071	17,352	50.390	21.574
Cyprus	23,423	0,420	0,271	2,940	2.440	0.940
Estonia	14,870	0,410	0,622	1,768	5.260	0.960
Finland	11,330	1,632	4,935	14,513	33.230	9.359
France	11,017	30,996	33,235	146,560	245.930	51.355
Germany	12,772	26,335	64,761	301,176	311.490	97.556
Greece	21,259	6,150	2,383	22,839	26.540	7.905
Ireland	7,138	5,489	3,114	8,851	14.100	4.232
Italy	13,017	14,296	36,969	141,085	161.468	54.024
Latvia	6,942	0,267	0,329	1,187	4.377	1.013
Lithuania	5,464	0,270	0,497	1,608	7.195	1.311
Luxembourg	13,489	0,692	0,346	4,597	4.170	1.267
Malta	12,763	0,251	0,158	1,505	0.870	0.026
Netherlands	11,000	4,422	9,397	30,084	67.452	24.064
Portugal	15,779	2,865	3,336	18,906	22.438	7.529
Slovakia	5,167	0,605	1,216	2,502	16.353	8.220
Slovenia	12,147	0,640	0,671	3,483	6.745	1.942
Spain	14,301	18,617	16,519	102,114	120.525	41.572
mean	12,370	6,403	10,093	45,256	59.565	18.190
Standard deviation	4,797	9,050	16,591	75,181	86.352	25,108

Notes: i) tce is measured in thousands of jobs; invest, bts, and lts are measured in US\$ billion (in real prices); primary energy consumption (energyp) in million tonnes of oil equivalent (TOE); and CO<sub>2</sub> in kt. ii) The sample refers to countries that entered the Eurozone economic space till 2019.

### 3.2 Panel Data Analysis

First, cross-section dependence tests (CD) were implemented following Pesaran's (2004) procedure. The unit root tests based on Lee and Tieslau's (2019) approach helped detect whether panel series carry unit roots and identify relevant structural breaks. Moreover, a fixed-effects standard error panel model is implemented, following the work of Driscoll and Kraay (1998) and Hoechle (2007). The adopted approach accommodates structural breaks and treats heteroscedasticity, serial correlation, and cross-section dependence in panel series. Country fixed effects are included to control for unobserved time-invariant heterogeneity across panel units. Essentially, this study's regression models integrate fixed-effects panel equations with regime-dependent slopes (via interactions) and level shifts (via break dummies). Efficiency scores are logit-transformed to account for their bounded nature and to permit estimation within a linear regression model. Total factor productivity values are based on raw (original) data (not

logit transformed). The following equations (1), (2), and (3) depict the adopted regression models.

$$lecoinput_{it} = a_i + \beta_0 renew_{it} + \beta_1(renew_{it} \times D_t^{2006}) + \beta_2(renew_{it} \times D_t^{2019}) + \gamma_{2010}1(t \geq 2010) + u_{it} \quad (1)$$

$$lecooutput_{it} = a_i + \beta_0 renew_{it} + \beta_1(renew_{it} \times D_t^{2006}) + \beta_2(renew_{it} \times D_t^{2019}) + \delta_{2003}1(t \geq 2003) + \delta_{2018}1(t \geq 2018) + u_{it} \quad (2)$$

$$ecotfpc_{it} = a_i + \beta_0 renew_{it} + \beta_1(renew_{it} \times D_t^{2006}) + \beta_2(renew_{it} \times D_t^{2019}) + \theta_{2008}1(t \geq 2008) + \theta_{2010}1(t \geq 2010) + u_{it} \quad (3)$$

where  $i$  is the index for panel countries,  $t$  is the index for time (years),  $lecoinput_{it}$  and  $lecooutput_{it}$  are the logit-transformed input- and output-oriented technical efficiencies received from the DEA analysis,  $ecotfpc_{it}$  is the total factor productivity change,  $renew_{it}$  are renewable energy consumption,  $a_i$  is the country fixed-effects,  $D_i^{2006}, D_i^{2019}$  are break dummies for 2006 and 2019 for renewables,  $1(t \geq 2010)$  dummy variable after 2010 for input-oriented technical efficiency,  $1(t \geq 2003)$  and  $1(t \geq 2018)$  dummy variables for out-put oriented technical efficiency after the years 2003 and 2018 respectively,  $1(t \geq 2008)$  and  $1(t \geq 2010)$  dummy variables for total factor productivity change after the years 2008 and 2010 respectively,  $\beta_0$  denotes the marginal effect of renewable energy,  $\beta_1$  and  $\beta_2$  are changes in the renewable effect across regimes indicating the interaction coefficients,  $\gamma, \delta, \theta$  denote coefficients measuring level shifts after structural breaks,  $u_{it}$  is the error term. The 1996 structural break for the input-oriented variable is excluded from the model because it coincides with the first year of the sample period and would therefore be perfectly collinear with the intercept. Lastly, a panel Granger causality test (pVAR) based on Wald statistics (chi-square) was performed to assess linkages among the variables of interest. In the pVAR framework, Granger causality tests the null hypothesis that the coefficients on all lagged values of a given variable in another variable's equation are jointly equal to zero. Rejection of the null hypothesis indicates the presence of a Granger causality relationship.

## 4. Results

### 4.1 Results of T-DEA

Results of input-oriented and output-oriented DEA are provided in Table 2. An average input-oriented technical efficiency score of 0.53 indicates that, over the period 1996-2019, Eurozone countries operated substantially below the best-practice frontier. On average, this corresponds to an efficiency gap of 47%, suggesting a significant excess of inputs relative to efficient production levels, while holding outputs constant. Germany has the highest value (0.93), whereas Greece has the lowest (0.24).

The average output-oriented technical efficiency score is 0.81. This result suggests that, over the period 1996-2019, Eurozone countries operated at 81% of the best-practice production frontier. The findings indicate that the Eurozone's tourism sector does not fully exploit its output potential given its current inputs, implying room for performance improvements. A roughly 19% performance gap relative to best practice is confirmed. This highlights opportunities for productivity-enhancing and sustainability-oriented tourism policies that aim at better utilizing available resources. Germany has the highest value (0.9), while Belgium and Slovakia have the lowest (0.73).

In Table 2, the Malmquist productivity index over the period 1996-2019 is 1.026. This result shows that Eurozone countries depicted a sustained positive productivity trajectory during the study period. This pattern of productivity change depicts an improvement in the Eurozone countries' ability to transform inputs into desirable outputs, while accounting for environmental factors. Technological progress (frontier shifts) and efficiency changes, or a combination of both, account for this observed growth.

**Table 2. Mean values of technical efficiencies and Malmquist productivity index over the period 1996-2019 (country-year).**

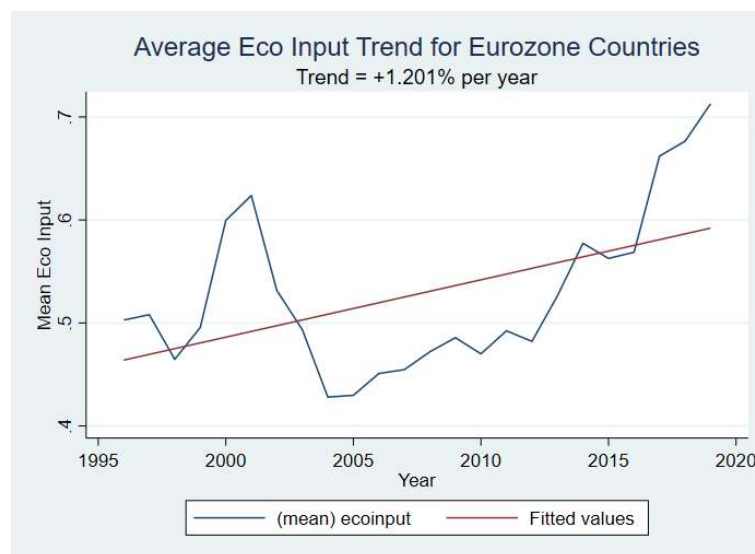
Country	input	output	MI (tfpc)
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Austria	0.51	0.89	1.03
Belgium	0.54	0.73	1.03
Cyprus	0.45	0.76	1.03
Estonia	0.37	0.75	1.03
Finland	0.60	0.81	1.03
France	0.50	0.83	1.03
Germany	0.93	0.90	1.03
Greece	0.24	0.82	1.03
Ireland	0.38	0.84	1.03
Italy	0.70	0.86	1.02
Latvia	0.55	0.78	1.02
Lithuania	0.71	0.81	1.02
Luxembourg	0.58	0.84	1.02
Malta	0.85	0.88	1.02
Netherlands	0.42	0.75	1.02
Portugal	0.35	0.82	1.02
Slovakia	0.62	0.73	1.02
Slovenia	0.36	0.75	1.03
Spain	0.35	0.81	1.03
Arithmetic mean	0.53	0.81	
Geomean			1.026
Stand. Deviation	0.18	0.05	0.005

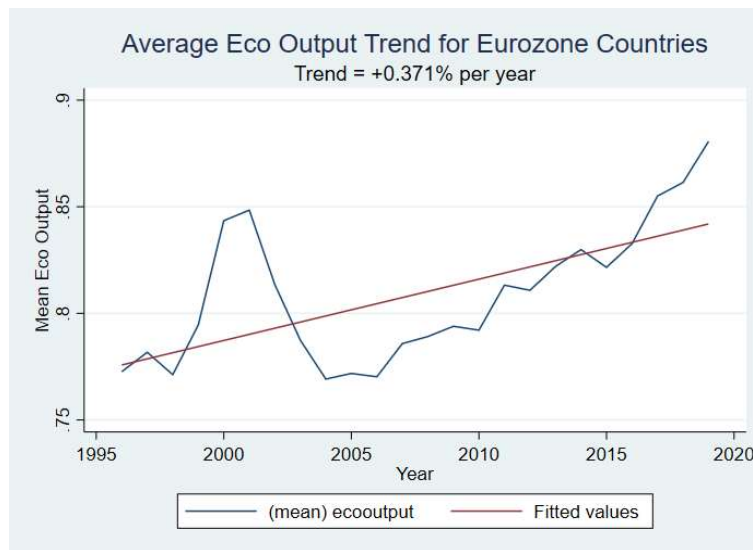
Notes: i) output stands for output-oriented technical efficiency, MI denotes the Malmquist Productivity Index and provides values for total factor productivity change (tfpc), ii) The output averages are arithmetic means, the MI averages are geometric means. Iii) The sample refers to countries that entered the Eurozone economic space till 2019.

Interestingly, descriptive trend analysis of temporal evolution discloses that while ecoinput exhibits a relatively strong and consistent upward trend (Fig. 1), ecooutput increases at a significantly lower rate (Fig. 2). This imbalance suggests that sectoral growth is primarily driven by input accumulation rather than improvements in efficiency or productivity. The lowess smoothed trend (Fig. 3) reveals a non-linear evolution of productivity. Specifically, productivity patterns declined in the early 2000s, then recovered through the late 2000s, followed by subsequent fluctuations without a clear long-term direction. Productivity gains seem not to have kept pace with resource expansion.

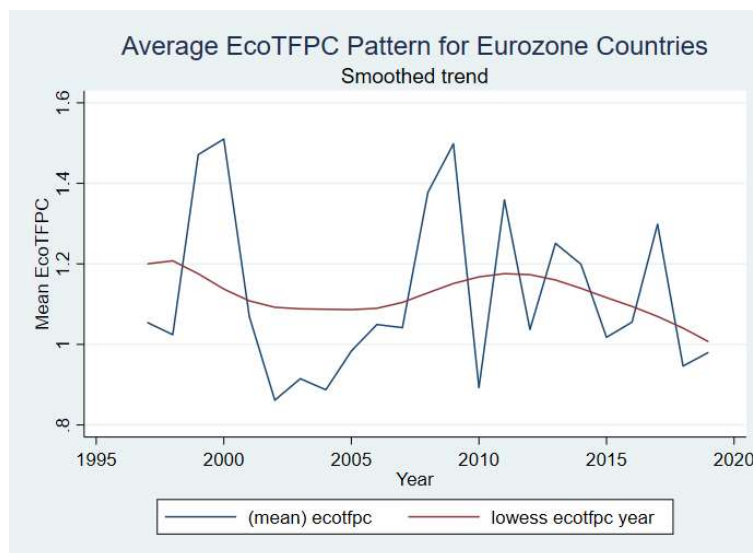
**Figure 1. Trend analysis for ecoinput.**



**Figure 2. Trend analysis for ecooutput.**



**Figure 2. Trend analysis for ecotfpc.**



Results for the slack movements of the input-oriented framework (Table 3) indicate that tourism employment exhibits substantial excess use. On average, employment exceeds the efficient level by approximately 44% relative to observed values, suggesting considerable scope for refunction alongside output adjustments. Similarly, investments in the tourism sector exhibit an average excess of about 36%, indicating the need for improved capital allocation and cost efficiency. For desirable outputs, business tourism spending shows an average shortfall of approximately 20% relative to observed levels, implying a meaningful expansion potential. Likewise, leisure tourism spending could be increased by roughly 15%, reflecting underperformance in generating tourism-related revenues. For undesirable outputs, energy consumption shows an average reduction requirement of about 12.5%, while CO<sub>2</sub> emissions exhibit a reduction potential of approximately 18.5%. These findings indicate environmental inefficiency across Eurozone countries, with scope to reduce undesirable outputs and improve performance on desirable outputs.

**Table 3. Input-oriented normalized slack movement values for technical efficiencies.**

	tce	invest	bts	Its	energy	CO <sub>2</sub>
<b>mean</b>	-43.846	-36.105	19.889	15.284	12.531	18.461
<b>St. Dev.</b>	25.867	24.943	56.819	29.779	29.779	21.294

Notes: i) Slack values are normalized. ii) Input slacks with a negative sign indicate the direction of adjustment. The negative sign indicates an excess of input use. The input must be reduced to reach the efficiency frontier.

Results from the slack movements of the output-oriented framework (Table 4) suggest that, on average, tourism employment exceeds efficient levels by about 2.2%. Moreover, on average, investments show an excess of nearly 17%. These results account for slack adjustments in outputs. For desirable outputs, on average, tourism business spending exhibits a shortfall of approximately 13.5%, whereas leisure tourism spending shows a larger shortfall of about 20.5%. These figures reflect non-negligible underperformance in generating desirable tourism outputs.

For undesirable outputs, primary energy consumption shows a substantial reduction of about 38%, on average, whereas CO<sub>2</sub> emissions have an even larger reduction potential of about 53%, on average. These findings reflect significant inefficiencies in energy use and a pronounced gap between current environmental performance and best-practice production across the Eurozone.

**Table 4. Output-oriented normalized slack movement values for technical efficiencies.**

	tce	invest	bts	Its	energy	CO <sub>2</sub>
mean	-2.150	-16.895	13.435	20.570	37.851	53.042
St. Dev.	7.662	25.019	16.760	38.958	24.357	29.042

Notes: i) Slacks are normalized. ii) Input slacks with a negative sign indicate the direction of adjustment. The negative sign indicates an excess of input use. The input must be reduced to reach the efficiency frontier.

## 4.2 Panel Data Analysis

### 4.2.1 Results of cross-section dependence tests

Results of the cross-section dependence (CD) tests based on Pesaran's (2004) approach (Table 5) indicate that both technical efficiencies and renewable energy exhibit cross-section dependence (p-values lower than 0.01). Moreover, total factor productivity change is cross-sectionally dependent, rejecting the null hypothesis of cross-sectional independence (p-value = 0.000). Given that this study concerns Eurozone countries, CD might be due to trade openness, the abolition of artificial borders, capital mobility, similar responses to external shocks and financial crises, and common regulatory frameworks that the countries of interest must follow.

**Table 5. Results of CD tests.**

Variable	Test	Statistic	p-values
input	Pesaran CD test	10.372	0.000
output		16.945	0.000
tftp		-0.402	0.000
renew		54.704	0.000

Ho: cross-section independence

### 4.2.2 Results of unit root tests

Results of unit root tests (Table 6) based on Lee and Tieslau's (2019) approach indicate that the variables under consideration are stationary, as all obtained p-values are below 0.01. For each variable, two break years were detected. These break years are considered in the following panel regression analyses and Granger causality tests. The identified breaks (e.g., 2003 and 2008) likely reflect broad regime shifts in the tourism production process and in Eurozone countries' ability to expand tourism spending while containing energy use and CO<sub>2</sub> emissions. These dates coincide with periods of major structural changes in tourism markets and the diffusion of energy- and emissions-efficiency practices, consistent with a shift in the efficiency frontier under the SBM DEA framework. For instance, a regime distinction at the start of the sample (e.g., 1996) can reflect the baseline technology used to assess subsequent improvements. Moreover, a substantive break around 2010 is consistent with post-crisis restructuring in the tourism sector, in which Eurozone countries intensified cost discipline and

labor utilization and reoriented tourism investment toward productivity-enhancing and energy-efficient upgrades. In turn, these changes altered how employment and investment translate into tourism spending while managing energy use and CO<sub>2</sub> emissions, leading to a shift in the efficiency frontier.

**Table 6. Results of unit root tests.**

Variables tested	Individual value	Break 1	Break 2	Lags	PDLM	p values
input	-8.164	1996	2010	0	-8.693	0.000
output	-9.226	2018	2003	5	-11.002	0.000
tfpc	-19.473	2010	2008	0	-28.380	0.000
renew	-8.748	2019	2006	1	-9.842	0.000

Notes: i) PDLM stands for Panel Lagrange Multiplier with level and trend shifts, ii) p-values lower than 0.01 indicate significance at 1% level, iii) 2003 break due to the European Union’s energy efficiency directives, emissions policy, 2018 break due to greening strategy and de-coupling effects, break in 1996 due to mid-90s less optimized investment planning, 2010 break due to post 2008-2009 crisis, break in 2006 accelerated EU renewable policy roll out, break in 2019 due to clean energy EU transition (e.g., Green deal)

### **4.2.3 Results of regression and causality tests**

In the regression results of Table 7, *lecoinput* denotes the logit-transformed input-oriented technical efficiency. The variable *renew* represents renewable energy consumption and captures the baseline marginal effect of renewables on input-oriented technical efficiency (*lecoinput*). The variables *renew\_post2006* and *renew\_post2019* are interaction terms that capture the product of renewable energy and regime indicators, allowing the renewable effect to change after the 2006 and 2019 structural breaks. The break dummy *post2010\_in* captures the shift in the intercept in efficiency after 2010. The constant term represents the regression's baseline intercept.

The fixed-effects regression results indicate that renewable energy is positively and statistically significantly associated with input-oriented technical efficiency (Table 7). This regression is consistent with Eq (1) provided in the Methodology section. The baseline coefficient (coeff. = 0.27, p-value = 0.27) indicates that renewable expansion improves efficiency in the early period (before 2006). Interaction terms reveal that this effect weakens after 2006 but strengthens again after 2019. Regime-specific marginal effects confirm that the renewable impact remains positive and significant across all periods, with estimated effects of 0.27 before 2006, 0.193 during 2006-2018, and 0.296 after 2019 (Tables 7.1, 7.2, and 7.3). Exponentiating these coefficients implies that renewable expansion increases the odds of higher efficiency by approximately 31%, 21%, and 34% across these regimes, respectively. The structural break dummy in 2010 is not statistically significant, suggesting that efficiency dynamics are driven primarily by changes in the renewable effect rather than by discrete level shifts. P-values lower than 0.01 indicate statistical significance at the 1% level.

**Table 7. Regression results when the logit-transformed input-oriented technical efficiency (*lecoinput*) is the dependent variable.**

<i>lecoinput</i>	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]	
<i>renew</i>	.2704	.06771	3.99	0.001	.12818	.41271
<i>renew_post2006</i>	-.07757	.02409	-3.22	0.005	-.12818	-.02695
<i>renew_post2019</i>	.10279	.00801	12.83	0.000	.08596	.119624
<i>post2010_in</i>	-.27737	.72214	-0.38	0.705	-1.7945	1.23978
constant	-2.2924	.6028	-3.80	0.001	-3.5588	-1.02596

*renew*: renewable energy consumption  
*renew\_post2006*:

**Table 7.1. Regime-specific marginal effects of renewables pre-2006 (dependent variable: logit-transformed input-oriented technical efficiency).**

lecoinput	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]	
Pre 2006 marginal effect	.27045	.06771	3.99	0.001	.12818	.41271

**Table 7.2. Regime-specific marginal effects of renewables between 2006 and 2008 (dependent variable: logit-transformed input-oriented technical efficiency).**

lecoinput	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]	
2006-2008 marginal effect	.19287	.05556	3.47	0.003	.07613	.30961

**Table 7.3. Regime-specific marginal effects of renewables after 2019 (dependent variable: logit-transformed input-oriented technical efficiency).**

lecoinput	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]	
Post 2019 marginal effect	.29567	.05255	5.63	0.000	.18524	.40609

In the regression results of Table 8, lecooutput denotes the logit-transformed output-oriented technical efficiency. The variable renew represents renewable energy consumption and captures the baseline marginal effect of renewables on output-oriented technical efficiency (lecooutput). The variables renew\_post2006 and renew\_post2019 are interaction terms that capture the product of renewable energy and regime indicators, allowing the renewable effect to change after the 2006 and 2019 structural breaks. The break dummy variables post2003\_out and post2018\_out indicate a level (intercept) shift in output efficiency after 2003 and a level shift after 2018, respectively. The constant is the regression's baseline intercept. P-values lower than one indicate statistical significance at 1% level, whereas values greater than 0.05 denote no statistical significance.

In the case of output-oriented technical efficiency, the fixed-effects regression results indicate that renewable energy is positively and statistically significantly associated with it (Table 8). This regression is consistent with Eq (2) provided in the Methodology section. The baseline coefficient shows that renewable expansion improves output efficiency in the early period (before 2006, coeff. = 0.21, p-value = 0.001). The interaction terms renew\_post2006 and renew\_post2019 indicate that this effect weakens after 2006 but strengthens again after 2019. Regime-specific marginal effects confirm that the renewable impact remains positive and significant across all periods, with estimated effects of 0.216 before 2006, 0.170 during 2006-2018, and 0.224 after 2019 (Tables 8.1, 8.2, and 8.3). Exponentiating these coefficients implies that renewable expansion increases the odds of higher output efficiency by approximately 24%, 19%, and 25% across the three regimes, respectively. The structural break dummy for 2003 indicates a significant downward level shift in output efficiency, while the 2018 break is not statistically significant, suggesting that most dynamics arise from changes in the renewable effect rather than persistent level shifts.

**Table 8. Regression results when the logit-transformed output-oriented technical efficiency (ecooutput) is the dependent variable.**

lecooutput	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]	
renew	.21636	.05298	4.08	0.001	.10505	.32767
renew_post2006	-.04637	.02038	-2.28	0.035	-.08919	-.00355
renew_post2019	.05448	.02669	2.04	0.056	-.00160	.11057
post2003_out	-1.2136	.53877	-2.25	0.037	-2.3455	-.08170
post2018_out	1.1857	.91797	1.29	0.213	-.74282	3.11436
constant	.25366	.72495	0.35	0.730	-1.2694	1.77673

**Table 8.1. Regime-specific marginal effects of renewables pre-2006 (dependent variable: logit-transformed output-oriented technical efficiency).**

lecooutput	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]
Pre 2006 marginal effect	.216362	.05298	4.08	0.001	.10505 .32767

**Table 8.2. Regime-specific marginal effects of renewables between 2006 and 2018 (dependent variable: logit-transformed output-oriented technical efficiency).**

lecooutput	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]
2006-2018 marginal effect	.16998	.04150	4.10	0.001	.08278 .25718

**Table 8.3. Regime-specific marginal effects of renewables after 2019 (dependent variable: logit-transformed output-oriented technical efficiency).**

lecooutput	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]
Post 2019 marginal effect	.22446	.05455	4.11	0.001	.10985 .33908

The effects of renewable energy on total factor productivity change are not statistically significant (Table 9). This regression is consistent with Eq (3) provided in the Methodology section. It should be noted that coefficients denote direct marginal effects since total factor productivity values are in raw levels. As a result, we do not interpret in odds. Specifically, the marginal effect of renewables in total factor productivity change before the 2006 regime is insignificant, implying no measurable productivity response to renewable energy adoption. In the subsequent periods 2006-2018, and post-2019, the regime marginal effects remain statistically insignificant. These results suggest that structural changes in renewables did not significantly affect the dynamics of total factor productivity. In contrast, the baseline model of Table 9 indicates that structural break controls associated with tourism productivity itself are highly significant. The post-2008 period shows a positive shift, whereas the post-2018 period justifies a negative adjustment, following the global financial crisis and subsequent economic restructuring. Interestingly, this negative sign reflects the adverse impact of financial constraints, reduced investments, and structural adjustments associated with macroeconomic instability. One explanation is that these macroeconomic structural disruptions, rather than environmental policy, were the primary drivers of the slowdown in productivity growth. These findings suggest that while tourism productivity experienced structural shifts, renewable energy expansion did not act as a statistically significant driver during the sample period. Tables 9.1, 9.2, and 9.3 present regime-specific regression results.

**Table 9. Regression results when the total factor productivity change (ecotfpc) is the dependent variable.**

ecotfpc	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]
renew	.00212	.02167	0.10	0.923	-.04340 .04766
renew_post2006	-.00326	.00595	-0.55	0.590	-.01578 .00924
renew_post2019	-.00310	.00231	-1.34	0.197	-.00796 .00175
post2008_tfpc	.39639	.06841	5.79	0.000	.25266 .54011
post2010_tfpc	-.32202	.07490	-4.30	0.000	-.47939 -.16465
constant	1.0596	.21862	4.85	0.000	.60031 1.5189

**Table 9.1. Regime-specific marginal effects of renewables pre-2006 (dependent variable: total factor productivity change).**

ecotfpc	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]
Pre 2006 marginal effect	.00212	.02167	0.10	0.923	-.04340 .04766

**Table 9.2. Regime-specific marginal effects of renewables between 2006 and 2018 (dependent variable: total factor productivity change).**

ecotfpc	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]
2006-2018 marginal effect	-.00113	.01706	-0.07	0.948	-.03698 .03471

**Table 9.3. Regime-specific marginal effects of renewables after 2019 (dependent variable: total factor productivity change).**

ecotfpc	Coef.	Drisc/Kraay Std. Err.	t	P> t	[95% Conf. Interval]
Post 2019 marginal effect	-.00424	.01506	-0.28	0.781	-.03588 .02739

Across specifications, renewable energy exhibits statistically significant effects on efficiency measures after accounting for fixed effects, structural breaks, and cross-sectional dependence. While renewable energy clearly improves efficiency on average, aggregate estimates might obscure important temporal dynamics. To examine whether the renewable effect evolves across structural regimes, the adopted approach allowed slope coefficients to vary over time.

The Granger pVAR test between input and renewables (Table 10) suggests no causal link from renewables to input (p-value = 0.439), meaning that past values of renewables do not help predict input-oriented technical efficiency. Also, input-oriented technical efficiency does not Granger-cause renewables (p-value = 0.981). This type of relationship (neutrality) suggests that increases in renewables do not improve input-oriented technical efficiency, likely because they do not reduce inefficiencies in energy and emissions, and because feedback effects on renewable energy dynamics are absent.

**Table 10. Results of pVAR Granger causality tests (dependent variable: input-oriented technical efficiency).**

Equation / Excluded	Chi2 ( $\chi^2$ )	Prob. > chi 2
ecoinput renew	1.645	0.439
ALL	1.645	0.439
renew input	0.038	0.981
ALL	0.038	0.981

Panel VAR-Granger causality Wald test

input: input-oriented technical efficiency

Ho: Excluded variable does not Granger-cause Equation variable

Ha: Excluded variable Granger-causes Equation variable

Panel VAR Granger test between output and renewables and vice versa (Table 11) indicates a unidirectional predictive causality from renewables to output-oriented technical efficiency (p-value=0.098), with no evidence that output predicts renewables (p-value=0.549). The results suggest that higher renewable energy use supports output-oriented technical efficiency gains by enabling greater tourism spending, whereas efficiency improvements themselves do not influence renewable energy adoption.

**Table 11. Results of pVAR Granger causality tests (dependent variable: output-oriented technical efficiency).**

Equation / Excluded		Chi 2 ( $\chi^2$ )	Prob. > chi 2
ecooutput	renew	4.760	0.093
	ALL	4.760	0.093
renew	output	1.199	0.549
	ALL	1.199	0.549

Panel VAR-Granger causality Wald test  
 output: output-oriented technical efficiency  
 Ho: Excluded variable does not Granger-cause Equation variable  
 Ha: Excluded variable Granger-causes Equation variable

Test results for the p(VAR) framework between tfpc and renewables, and vice versa (Table 12), indicate no evidence of directional predictability. Results fail to reject the null hypothesis from renewables to tfpc (p-value=0.285), nor from tfpc to renewables (p-value=0.353), confirming the neutral hypothesis. The absence of Granger causality in either direction indicates that productivity changes driven by technological progress and efficiency shifts are largely independent of short-run dynamics in renewable energy (total factor productivity change = technological progress × efficiency change).

**Table 12. Results of pVAR Granger causality tests (dependent variable: total factor productivity change).**

Equation / Excluded		Chi2 ( $\chi^2$ )	Prob. > chi 2
ecotfpc	renew	1.536	0.464
	ALL	1.536	0.464
renew	tfpc	3.065	0.216
	ALL	3.065	0.216

Panel VAR-Granger causality Wald test  
 tfpc: total-factor productivity change  
 Ho: Excluded variable does not Granger-cause Equation variable  
 Ha: Excluded variable Granger-causes Equation variable

## **5. Discussion**

Maintaining environmental protection amid tourism economic expansion features prominently in tourism literature, yet it has also prompted research on tourism’s eco-efficiency (Wu and Liang, 2023). Although significant progress has been made in perceiving the financial benefits of sustainability practices in the tourism sector, much remains unexplored in other critical areas, such as operational efficiency, employee engagement, and long-term competitiveness (Shin et al., 2026).

From the European Union’s (EU’s) perspective, research findings align with the objectives of EU Tourism Transition Pathways, which emphasize productivity gains, digitalization, and skills upgrading rather than quantitative expansion of tourism capacity. The high dispersion of input slacks across countries further suggests that efficiency gaps are heterogeneous, reinforcing the need for country-specific tourism reform strategies rather than uniform EU-wide policies. Enhancing the interaction of the digital economy, tourism development, and eco-efficiency is crucial for achieving sustainability goals (Wu and Xie, 2026). Place-policy interventions, particularly under Cohesion Policy and the Recovery and Resilience Facility, should provide funding to support well-structured tourism initiatives. Also, there is a need to reskill and upskill (e.g., for tourism employment) and to allocate capital more efficiently (e.g., for tourism-related investments). One particular issue is the concept of green finance, which mitigates the negative environmental externalities of tourism's development (Gan et al., 2026).

The output-oriented SBM DEA results shift attention to environmental consequences, given the goal of maximizing tourism revenues. This approach is consistent with the EU’s broader competitiveness agenda and its emphasis on value creation rather than volume-driven growth in tourism. The substantial positive slack in primary energy consumption and CO<sub>2</sub> emissions indicates that output expansion in the absence of efficiency constraints risks disproportionately

increasing environmental pressures. Supportively, the results underscore the need to decouple tourism output growth from energy use and carbon emissions, a core objective of the European Green Deal.

The positive and significant relationship with renewables indicates that greater integration of renewables into the tourism system can support the expansion of desirable outputs without proportionate increases in environmental pressures, increasing operational efficiency. In contrast to the strong efficiency results, renewable energy exhibits a statistically insignificant association with total factor productivity. This finding is consistent with the transitional nature of energy decarbonization, in which initial investments in infrastructure and energy-efficiency measures may impose adjustment costs, organizational changes, and technological adaptation before productivity gains are realized. The significant structural shifts observed after the years of financial crisis and instability further suggest that macroeconomic conditions, investment cycles, and structural reforms play a more dominant role in shaping tourism productivity than energy composition alone.

These findings discuss that although renewables enhance static efficiency (e.g., technical efficiency change), their contribution to dynamic productivity growth in the Eurozone's tourism sector remains limited. Practically, renewable deployment alone may not be sufficient to drive long-term productivity gains. Causality results imply that improvements in input efficiency rates alone do not automatically lead to greater renewable adoption, underscoring the need for policy-led renewable expansion rather than relying on market-driven efficiency gains. The absence of a causal relationship in productivity change calls for a more intensive integration of innovation and technological progress into the tourism system. Attention is needed to avoid negative externalities arising from market failure when pursuing tourism-related growth patterns (desirable outputs) while neglecting environmental pressures (undesirable outputs) from unregulated resource use.

The findings widely support the European Green Deal and 'Fit for 55' frameworks, which rely on regulatory targets, public investments, and coordinated actions to decarbonize energy-intensive sectors such as tourism. Last, the core issue in capturing sustainability lies in establishing an equilibrium between management requirements and well-being (Kuhlman and Farrington, 2010). Still, additional efforts should be made to analyze feedback from current practices and take lessons learned to guide future tourism accomplishments.

All in all, it is crucial to keep in mind that the crises of the current era not only call for ecological sustainability but also for a reconsideration of the ontological and ethical foundations of development itself (Robinson et al., 2026). Through encouraging the science-policy-society interface and the co-production of knowledge and future scenarios with innovative policy options, new linkages between the sciences and society should be investigated to drive effective actions for operationalizing and implementing Sustainable Development Goals at local, national, regional, and global scales (Takeuchi et al., 2017). Hence, tourism development and expansion should not miss this opportunity to enter the equation and make a solid contribution to this long-lasting effort. As a result, new efforts might focus on addressing tourism seasonality by detecting interregional patterns (Tsiotas et al., 2021) or investigating relationships between regional economic resilience and COVID-19 effects (Tsiotas et al., 2023) and integrating these findings into effective decision-making processes to increase efficiency rates and total factor productivity in terms of sustainability.

## **6. Conclusions**

The present study examines technical efficiency scores and productivity change patterns for the Eurozone over the period 1996-2019. For this reason, a Slack-Based Measure (SBM) under the input- and output-oriented technical efficiency measures of the Data Envelopment Analysis (DEA) framework was applied. To strengthen our scientific approach, the SBM DEA analysis results were regressed on renewable use in final energy consumption.

Results indicate that most Eurozone countries operate below their attainable revenue frontier at current input levels. This result underscores the need for efficiency improvements and the creation of higher value-added tourism segments. Furthermore, output expansion should proceed without worsening the undesirable outputs identified in the model. Research findings are consistent with EU strategies to strengthen tourism competitiveness while avoiding

overtourism and resource-intensive growth models. In practical terms, this challenging and long-term endeavor underscores the need to link decarbonization to innovation and productivity. Moreover, renewables have a positive and significant impact on technical efficiency scores, whereas productivity change is negatively affected, highlighting the need to accelerate energy transition. Granger causality tests reveal one unidirectional link from renewables to output-oriented technical efficiency. The neutrality hypothesis provides no causal links between output-oriented technical efficiency and changes in total factor productivity. Results indicate that further actions are required to advance renewable adoption and the energy transition, supporting efficiency improvements and tourism expansion.

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## **Announcements, Conferences, News**



**65th ERSA Congress**  
**Global Challenges and Regional Responses in a Transition Era**  
**25 to 28 August 2026 | Sofia, Bulgaria**



### Event Overview<sup>1</sup>

The 65th ERSA Congress will take place from 25 to 28 August 2026 in Sofia, Bulgaria, under the theme “Global Challenges and Regional Responses in a Transition Era”. The congress is organised by the European Regional Science Association (ERSA) and represents one of the key annual international meetings in regional science, regional economics, and spatial analysis. It brings together researchers, policymakers, and practitioners working on regional development and territorial cohesion.

The congress focuses on how regions respond to major global transitions and structural challenges. While the official programme highlights a broad research agenda, it places strong emphasis on contemporary issues such as economic transformation, spatial inequalities, innovation dynamics, sustainability transitions, and policy responses to global shocks. The congress aims to provide a platform for advancing theoretical and empirical research on regional resilience and adaptation in a rapidly changing world.

The scientific programme covers a wide range of regional science topics, including regional economic development, spatial planning, innovation systems, urban and rural dynamics, regional labour markets, infrastructure and connectivity, environmental sustainability, and territorial governance. It also supports interdisciplinary contributions addressing global change and regional policy responses.

Key dates for the 65th ERSA Congress include the call for special session proposals starting on 10 October 2025, the deadline for special sessions on 7 January 2026, abstract and paper submission opening on 12 January 2026, the submission deadline on 28 February 2026, notification of acceptance and registration opening on 16 March 2026, early-bird registration deadline on 24 May 2026, and the final deadline for presenters on 15 June 2026.

The congress will take place from 25 to 28 August 2026 in Sofia, and follows the tradition of ERSA annual meetings, including the ceremonial handover of the ERSA flag, which took place on 29 August 2025 during the closing ceremony of the previous congress in Athens.

**More information:** <https://ersa.org/events/65th-ersa-congress/>

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<sup>1</sup> Event overview edited by Dimitrios Tsiotas,  
Associate Professor, RSI J.

**2026 RSA Annual Conference**  
**Regions as Arenas in a Changing World**  
**15 to 18 June 2026 | Gothenburg, Sweden**



### Event Overview<sup>2</sup>

The 2026 RSA Annual Conference will take place from 15 to 18 June 2026 in Gothenburg, Sweden, under the theme “Regions as Arenas in a Changing World”. The conference is organized by the Regional Studies Association (RSA) in partnership with the School of Business, Economics and Law at the University of Gothenburg, Sweden. The conference is recognized as one of the leading international events in regional studies, economic geography, regional development, and spatial policy. According to the organizers, it is expected to bring together participants from around 55 countries and feature more than 700 presentations, alongside keynote lectures, workshops, networking opportunities, field trips, and professional development sessions.

The 2026 edition focuses on the evolving role of regions as key arenas shaped by major global transformations. The call for contributions highlights several pressing challenges, including the rapid development of artificial intelligence (AI), environmental and sustainability challenges, the slowdown of globalization, rising policy protectionism, and the increasing strategic importance of natural resources and infrastructure. It also draws attention to growing tensions in scientific discourse and public debate. In this context, the organizers emphasize the need for renewed theoretical approaches and stronger empirical research to better understand regional interdependencies and policy responses in an increasingly uncertain global environment.

The conference program covers a wide range of thematic areas, such as:

Agglomeration, Clusters, and Externalities	AI and Big Data in Regional Studies
Circular Economy, Green and Just Transitions	Demography, Labour Markets, and Migration
Entrepreneurship and Innovation Systems	Financing Regional Development and Change
Gender, Diversity, and Equity in Regional Development	Regional Governance, Policies, and Institutional Change
Global Value Chains and International Business	Peripheral and Cross-border Regions
Populism, Nationalism, and Social Change	Regional Development in the Global South
Regional Inequalities and EU Cohesion Policy	Regional Innovation and Technological Change
Spatial Economy, Infrastructure, and Housing	

The Academic Organizers of the conference are Martin Henning, Roman Martin, Hanna Martin, and Sarah Franz from the Centre for Regional Analysis (CRA), School of Business, Economics and Law, University of Gothenburg, Sweden. The plenary program includes four major sessions across 16-18 June 2026, addressing themes such as spatial theory, place-based policy approaches, historical path dependencies of regions, and future directions for regional studies under uncertainty.

Key administrative dates include the opening of registration on 1 April 2026 and the deadline for presenters and discussants on 19 May 2026.

**More information:** <https://www.regionalstudies.org/events/rsa26/>

<sup>2</sup> Event overview edited by Dimitrios Tsiotas, Associate Professor, RSI J.

## **Academic Profiles**





### **Dr. Jungeun Elly Kim**

Dr. **Jungeun Elly Kim** is affiliated with the Keio University Graduate School of Media Design, Japan. Her areas of expertise include International Business, Strategic Management, Entrepreneurship, and Startup Strategy. She earned a B.A. in Government and International Relations from the University of Sydney, Australia, and her Master's and Ph.D. degrees from the Graduate School of International Studies at Seoul National University, South Korea, specializing in International Business.

Her professional background includes research and policy-related work at the Korea Institute of Public Finance (KIPF) and the Korea Health Industry Development Institute (KHIDI), as well as corporate experience. She is also experienced with the Japanese Advanced Management Program at Chung-Ang University and the Executive Program for Online Marketing at Korea University.

According to her research profiles, her research interests include international business, corporate governance, multinational corporations, entrepreneurship, and digital business, complementing her expertise in strategic management and startup strategy.

**Academic Profile by:  
Dimitrios Tsiotas  
Associate Professor, RSI J**

#### **References**

<https://www.kmd.keio.ac.jp/faculty/jungeun-elly-kim/>  
<https://researchmap.jp/ellykim?utm&lang=en>



### **Dr. Woosik Yu**

Dr. **Woosik Yu** is affiliated with the Department of International Commerce at Keimyung University in the Republic of Korea. Previously, he was affiliated with KIMEP University in Kazakhstan. His research focuses on international trade and economic development, examining how changes in market conditions, such as national policies, trade environments, and external shocks, affect both firm-level performance and country-level growth.

Dr. Yu holds a Ph.D. from Seoul National University, South Korea, an M.Sc. in Operations Research from the London School of Economics (L.S.E.) and Political Science, and a B.Sc. (Honours) in Economics from University College London (U.C.L).

His recent research covers topics in international economics and development, including digitalization and firm profitability, aid-for-trade policies, geopolitical risk and North Korean exports, macroeconomic spillovers in post-Soviet economies, foreign direct investment and trade agreements, global digital inequality, and economic growth.

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**Academic Profile by:**  
**Dimitrios Tsiotas**  
**Associate Professor, RSI J**

### **References**

<http://www.eprc.kr/Lab-Staff>  
[https://scholar.google.com/citations?hl=el&user=08v4H08AAAAJ&view\\_op=list\\_works&sortby=pubdate](https://scholar.google.com/citations?hl=el&user=08v4H08AAAAJ&view_op=list_works&sortby=pubdate)



### **Dr. Panagiota (Giola) Dionysopoulou**

**Dr. Panagiota (Giola) Dionysopoulou** is a distinguished scholar and high-ranking public administration executive specializing in tourism economics, European policy, and public management. She currently serves as the Director General for Tourism Policy at the Hellenic Ministry of Tourism, having previously held the position of Director General for Higher Education at the Ministry of Education and Religious Affairs. Her academic and professional career bridges the gap between theoretical economic research and strategic policy formulation at national and international levels.

#### **Educational Background**

Dr. Dionysopoulou holds a solid academic foundation in business administration and public economics:

Ph.D. in Tourism Economics and Policy – University of the Aegean.

M.Sc. in Public Economics and Policy.

M.Sc. in International and European Studies – University of Athens.

B.Sc. in Business Administration – Athens University of Economics and Business (AUEB/ASOEE)

#### **Academic & Teaching Experience**

With multi-year teaching experience in Higher Education, Dr. Dionysopoulou lectures at both undergraduate and postgraduate levels. Her curriculum focuses on the Organization and Management of Services, Tourism Sector Operations, and European Policy. She is an active faculty member and lecturer at: The Hellenic Open University (EAP) The University of West Attica (UNIWA) The National Centre for Public Administration and Local Government (EKDDA)

#### **Research Focus & Editorial Contributions**

Dr. Dionysopoulou's research interests lie at the intersection of regional development, sustainable tourism planning, and Total Quality Management (TQM) in public institutions. As a researcher, she has contributed to tourism development studies for the Hellenic National Tourism Organization (GNTO) and collaborated with the Laboratory of Research and Tourism Satellite Accounts at the University of Patras. She actively represents Greece in high-level international forums, shaping global tourism agendas through her participation in the Tourism Advisory Committee of the European Commission, the OECD Tourism Committee, and various organs of the World Tourism Organization (UNWTO). Her scientific papers are published in international peer-reviewed journals, and her research footprint is tracked across global databases like Google Scholar.

#### **Key Publications**

Her authorship focuses on the structural and political dimensions of European integration and its impact on regional tourism.

Key works include:

Monographs: Dionysopoulou, P. (2012). *European Tourism Policy: The Prospects of its Formulation within the Framework of European Integration*. Athens: Papazisis Publishers.

Book Chapters & Collective Volumes: Dionysopoulou, P. (2017). "The Framework of Tourism Policy in the European Union". In *Epitome of Hellenic Tourism: Tourism, Tourism Development, Contributions of Greek Scientists*. Athens: Papazisis Publishers.

**Academic Profile by: Dimitrios Kouzas, RSI J**



## **Book Reviews**





**Panagiota (Giola) Dionysopoulou**  
***Tourism Policy at the International, European and National Level.*** Athens: Papazisi Publications, 2024.  
**ISBN: 978-960-02-4117-4.**

Tourism is one of the most externally exposed and sensitive sectors of any economy, subject to political, social, and environmental fluctuations that directly shape tourist demand. In her new book, Panagiota Dionysopoulou — General Director of Tourism Policy at the Greek Ministry of Tourism and Doctor of Tourism Economics and Policy from the University of the Aegean — offers a comprehensive analysis of tourism policy across three interconnected levels: international, European, and national. The work introduces the reader to the complex ecosystem of tourism governance, highlighting the critical role of political stability as a determinant of tourist demand and underscoring the potential of intercultural dialogue as a driver of sustainable tourism development.

The book examines the institutional actors responsible for designing and implementing public tourism policy, arguing that effectiveness depends on flexibility, market awareness, and an integrated, holistic approach to regulation. It connects tourism policy goals directly to the UN 2030 Agenda's Sustainable Development Goals (SDGs), positioning tourism not merely as an economic engine but as a vehicle for environmental, social, and cultural advancement. The priorities set by the United Nations World Tourism Organization (UNWTO) — encompassing sustainability, biodiversity protection, competitiveness, and multi-level governance — are analyzed in depth alongside the strategic framework of the Greek Ministry of Tourism.

At the national level, the author details Greece's long-term strategic plan for improving the competitiveness, quality, authenticity, resilience, and sustainability of its tourism product. Key initiatives discussed include the National Observatory of Sustainable Tourism Development and the establishment of Destination Management Organizations (DMOs). The volume is prefaced by Alexandros Vassilikos, President of the Hellenic Hotel Chamber and President of HOTREC, who emphasizes the foundational role of tourism in Greece's GDP and regional development. Accessible yet academically rigorous, this book is an essential reference for researchers, policymakers, and practitioners engaged with tourism governance at any level.

**Book Review by D.Kouzas RSI J**



## **GUIDELINES**

**for the Writers & a format model for the articles  
submitted to be reviewed & published in the journal**



# Regional Science Inquiry Journal

(EconLit, Scopus, RSA I) – [www.rsijournal.eu](http://www.rsijournal.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.

**Name LAST NAME**

Professional Title, Workplace  
E-mail Address

**Name LAST NAME**

Professional Title, Workplace  
E-mail Address

### **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.**

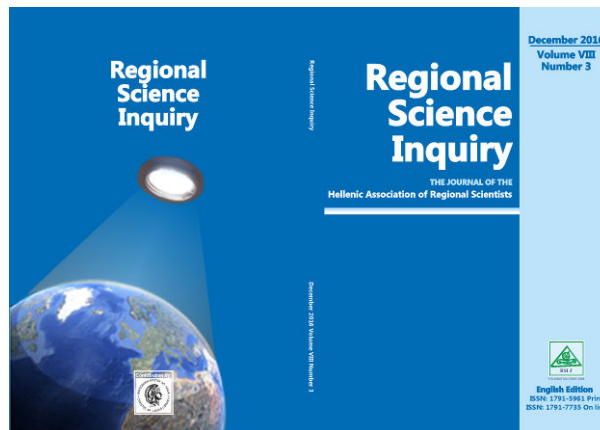
### 5.1.1. Reference inside the text

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**

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

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 6 spacing 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 you with 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  $ax^2$  in your text, you must insert it as an imaged, 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://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%B%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 - SMS0800000000000001.” United States Department of Labor.

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