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The Impact of Quality of Educational Services Offered by Universities in Romania on Career Paths

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ABSTRACT

The motivation of this study is the desire to understand what the factors contributing to a high level of education quality are in the opinion of final year undergraduate students., respectively how well they are prepared for their career. The research was part of one implemented by a group of ARACIS (Romanian Agency for Quality Assurance in Higher Education) so that the information obtained is intended to be used on a larger scale to produce a report related to the quality of the entire higher education process in Romania. The study was carried out at the national level in all university centres in Romania. The questionnaire includes socio-demographic questions, such as the area and the university centre where the respondents study, as well as the branch of science (field). The set of questions was applied to 14275 students from the last year of study, undergraduate level. After removing questionnaires that did not have answers to all questions, 13072 questionnaires remained for analysis. IBM SPSS 25 software, factor analysis and Two-Step Cluster analysis were used for the analysis. The originality of this research lies in the fact that it offers solutions regarding the constructive dialogue between teachers-students-employers.

Keywords: *Quality of educational services; Digital technologies; Competencies; Labour market; Career*

JEL: *I21, I23, J24, I26, J21, J31, J24, J62.*

1. INTRODUCTION

When we analyse the higher-education system in Romania, we find that the environment in the universities is still quite conservative, but that efforts are being made to transform the educational services and the adaptation to the new digital technologies. In addition, the introduction, in parallel with the formal methods, of the non-formal methods of teaching and evaluating students have been achieved in recent years (Curelaru, 2022; Dospinescu *et al*., 2020; Alexa *et al.,* 2022; Gorghiu, 2022).

Quality education aims to build an academic reputation. This is achieved when research impacts teaching and vice versa, which builds a university's integrity and influence and establishes its reputation in industry (Gill, 2022; Sacre, 2023). These three components together serve as the main ingredient in the pursuit of quality education. World-class universities renowned for research, publication and international partnership, teaching, citations, knowledge transfer and research-based teaching and learning have increased academic performance (Boholano *et al.,* 2021). The determinants of quality education among the world's top 100 universities are: (1) academic reputation; (2) research influence and (3) industry reputation. These factors prove to be key indicators in determining the quality of education offered by universities (Boholano *et al.*,. 2021). In this context, in order to improve the quality of university education in Romania, minimum performance standards are established (http://www.aracis.ro/) for each field of study, with prestigious universities as models: the University of Oxford, the University of Cambridge, the California Institute of Technology, Stanford University, the Massachusetts Institute of Technology, Harvard University, Princeton University, Imperial College London and the University of Chicago. For the evaluation and ranking of universities, the following are taken into account: the quality of the human resource (based on quantifiable indicators: research, publishing, international recognition and teaching activity) and the learning results (ensuring the skills, aptitudes and abilities needed in the profession). For the assessment of learning outcomes, opinions of students, graduates and employers are used.

Higher education institutions can improve research and training policy, which leads to the prioritization of research and training activities that can lead to the strengthening of its influence in the academic community and in the industry in general (Boholano et al., 2021). Kuklin et al. (2021), emphasize that language and quality education play an important role in stimulating the development of regions and economies.

According to Alhendi et al. (2021), education systems and language policies implemented by different countries depend on their political, cultural,

historical and individual economic characteristics. However, it is important for each country to achieve a degree of harmony between their education and language policies. This could help improve their economic performance and accelerate the wheels of development. Findings and estimates reveal that language and quality education have a positive impact on regions and their economic growth. Higher education in today's globalized economy is exposed to many challenges and increasing pressure to improve its approach to quality assurance in all its processes.

Furthermore, according to Marek et al. (2014) there is a "hunger" for learning and education, which is growing in global proportions. The educational process can be seen essentially as a training of human resources for various fields of human activity. Education for individuals is increasingly proving to be a strategic factor that predisposes their ability to face current challenges and adequately meet their needs, or even survive (Balážiková, 2008). Currently, the quality of higher education is one of the most important issues of social development, as well as scientific and technological progress (Glushaka et al., 2015).

The importance of improving the quality of higher education is primarily attributed to the requirements of the innovative economy based on the knowledge and needs of the individual and society to increase competitiveness and quality of life. The economic quality management in the University is presented by Yusuf (2023), through a model of education quality management in the TQM environment.

An additional effort is made to explore trends emerging on the labour market, and constructive dialogue between teachers, students and representatives of the business environment (employers), the latter being facilitated through meetings with students from universities and activities in partnership.

The unpredictable events we are experiencing, such as the pandemic or wars, leads universities and companies to focus on the mental health of candidates. Candidates are increasingly engaged due to the changing mindset in society regarding work environments that promote mental well-being and provide support for managing stress and work pressures. This collaboration is taking shape, including the creation of new recruitment methods that graduates are familiar with since school so that their career debut can be achieved successfully.

The chosen topic is current, supporting the creation of a dynamic environment in universities and facilitating dialogue with representatives of the business environment (employers) for the formation of responsible attitudes towards work, the training of hard and soft skills required by the labour market and the support of graduates in their careers in a world that has become

unpredictable. Candidates are looking for a personalized and interactive learning and recruiting experience. They want to be treated as individuals and receive relevant information and timely feedback. Universities and companies need to adapt and offer a more candidate-oriented recruitment and selection process, offering them transparent and personalized communication.

The aim of this study is to identify the factors that contribute to a high level of quality education for undergraduate students in their final year, as well as to a high percentage of their employability. The main objective is to create an appropriate academic environment to facilitate the development of awareness by all participants in the process of the role and importance of the partnership of teachers - students - representatives of the business environment (employers) in increasing competitiveness and increasing the quality of the educational services provided, at the same time as having a good knowledge of the trends on the labour market and the awareness of new suitable recruitment methods.

2. METHODOLOGY

Regarding the methodology, in order to reach the desired results and answer the research questions related to the present study, namely, what are the factors that contribute to a higher level of education quality in the opinion of students, respectively how well they are prepared for their career, we applied factor analysis to reduce the size of the data and identify the sets of variables that can be used in running decision trees (classification).

Factor Analysis

Factor analysis is a data analysis technique used to explore and understand the structure of relationships between variables in a data set. Essentially, factor analysis seeks to identify factors or groups of variables that are closely related and share common characteristics. The main utility of factor analysis lies in its ability to reduce the complexity of a large data set, as is the case analysed. If we are dealing with a large number of interrelated variables, factor analysis can help us focus on a few underlying factors so that we can better understand what is going on in our data set. This reduction in dimensionality can be essential in many contexts, including this analysis where each aspect is appraised through multiple items. Factor analysis works by examining the correlations or covariances between many variables and attempting to decompose these correlations into a smaller number of factors or components. Each factor is a linear combination of the original variables. These new factors are called latent variables.

Clustering

Two-Step Cluster analysis is a scalable method that was designed to deal with large data sets. The name Two-Step comes from the 2 steps that must be followed: the pre-clustering of the cases into several sub-clustered, then the clustering of these subgroups resulting from the previous step into a desired number of groups. Two-step cluster analysis is a hybrid approach that first uses a distance measure to separate groups and then a probabilistic approach (similar to latent class analysis) to choose the optimal subgroup model (Kent et al., 2014). Such a technique presents several advantages compared to traditional techniques (k-means cluster, hierarchical cluster), such as determining the number of clusters based on a statistical fit measure (AIC or BIC).

3. RESEARCH DESIGN

The basis of the research, for the evaluation of the quality of higher education in Romania, was based on established models in the specialized literature. Thus among these were: The SERVQUAL Model - service quality assessment (Parasuraman et. al., 1991; Parasuraman et al., 2006; Zeithaml et al., 1990 Service Quality Model) for the dimensions - Reliability, Responsiveness, Competence, Access, Courtesy, Communication, Credibility, Security, Understanding the customer, Tangibles; The SERVPERF model - Service quality performance (Cronin & Taylor, 1992; Performance Only; Service Quality Performance Model) for the dimensions - Tangibles, Reliability, Responsiveness, Assurance, Empathy; The NQ model - quality norming (Teas, 1993; Normed Quality Model (NQ), Carney, 1994) for the dimensions Revised Expectation and Performance of PZB, Student Qualification (Academic), Student Qualities (Personal), Faculty-Student Interaction, Quality Instruction (Faculty), Variety of Courses, Academic Reputation, Class Size, Career Preparation, etc.; The HETQMEX model of total quality management excellence in higher education (Ho & Wearn, 1996, Higher education TQM model of excellence; (HETQMEX) for the dimensions – Leadership Commitment, Total customer satisfaction, Total involvement, Training education, Ownership of problem, Reward and recognition, Error prevention, Teamwork etc.; The HEdPERF model - the performance of higher education institutions (Firdaus Abdullah (2006); Higher education performance model; (HEdPERF), for the dimensions - Academic aspect, Non academic aspect, Reputation, Access, Program issue, Understanding, etc. These were the basis from which the questionnaires were created and on which the actual design of the research instrument was superimposed.

4. SAMPLE

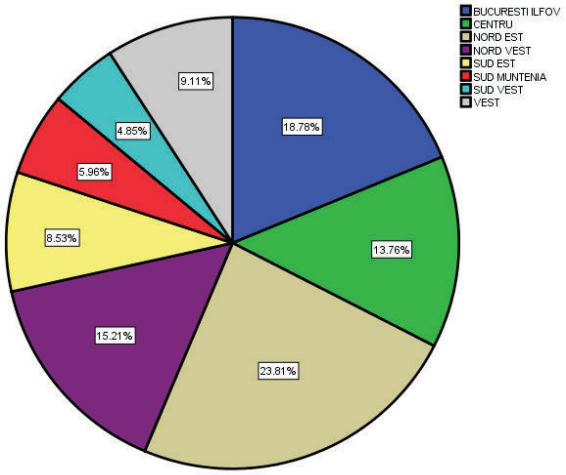
For the purpose of this study, 13072 questionnaires were analysed. IBM SPSS 25 software, factor analysis, and Two-Step Cluster analysis were used for the analysis.

The data was collected following a questionnaire applied to people from Romania who are studying at a university and are in their final year of study. The purpose of the study is to observe the students' opinion on the educational environment in Romania and how well they think they are prepared for their career. The study was conducted at national level in all university centres. The questionnaire includes socio-demographic questions, such as the area and the university centre where the respondents study and the branch of science (field). In order to capture the students' opinion in the most effective way, a scale from 1 to 10 (1- minimum and 10-maximum) is used to determine how satisfied they are with: university equipment, resources, teaching methods, feedback & relationships, counselling & career advice, acquired knowledge in the context of conditions offered by Romanian higher education. This set of questions was administered to 14,275 students. After removing questionnaires that did not have answers to all questions, 13072 questionnaires remained for analysis. For the analysis IBM SPSS 25 software was used.

The structure of the sample by region is as follows (Figure 1): Bucharest-Ilfov - 18.8%, Centre - 13.8%, North-West - 15.2%, West-9.1%, North-East - 23.8%, South-East - 8.5%, South-Muntenia - 6%, South-West -4.9%. This structure largely corresponds to the structure of the target population to be studied.

Sample Distribution by Region

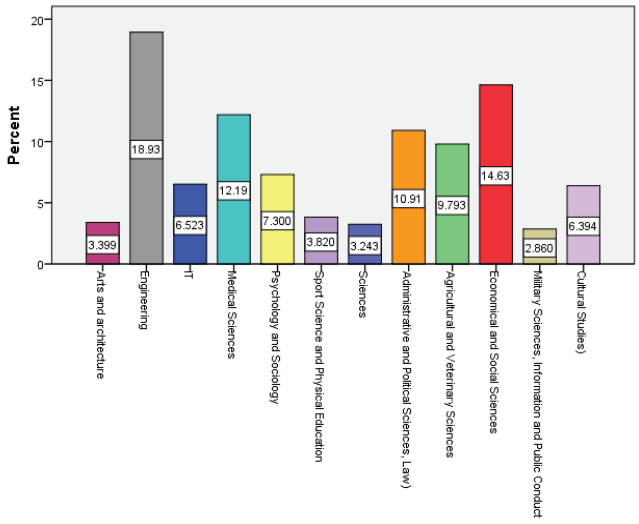
Figure 1



The database includes approximately 35 branches of study, successful in 12 fields (Figure 2). Most students were identified in Engineering (18.93%), Economical and Social Sciences (14.63%), and Medical Sciences (12.19%). They are followed by the fields of Administrative and Political Sciences, Law (10.91%), Agricultural and Veterinary Sciences (approx. 10%), Psychology and Sociology (7.3%), IT (6.5%), Cultural Studies (6.4%). Around 3% are from the following fields: Arts and architecture, Sciences, Sport Science and Physical Education, Military Sciences.

Bar chart – Field of Study

Figure 2



5. RESULTS

In an attempt to capture students' opinions about what the Romanian education system offers, the reasons that lead them to choose a certain university, perhaps a certain region, were first analysed. Thus the following results were obtained: 47% the vocation for the field, 36.8% the prestige of the university, 33.3% the employment possibilities after completing the studies, 30.6% the professional status after graduation, 29.2% the proximity of the university to the home, 17.9% the level of preparation at the high school graduation, 17.8% the recommendations of teachers, colleagues, friends or family, 12.7% the financial facilities offered by the university (exemptions of fees, scholarships, etc.), 12.6% technical-material endowments (campus, libraries, laboratories, etc.), 10.3% diversity of forms of education (IF, ID), 9.5% baccalaureate average. From the analysis of reasons by field of study, the following results emerged (Table 1): The vocation is chosen by students who follow the fields of Arts and architecture (AA), Medical Sciences (MD), Psychology and Sociology (PS), Sport Science and Physical Education (SSP), Cultural Studies (CS); the professional status after employment is chosen by students from the fields of Military Sciences, Information and Public Conduct (MI); the employment opportunities after graduation or even during the course of study, students from the fields of Science (SS), Engineering (EG)

and IT chose; the financial facilities offered by the university are among the preferences of Agricultural and Veterinary Sciences (AV) students; the prestige of the university is chosen almost equally by all students, students from the fields of Administrative and Political Sciences and Law (AP) and Economical and Social Sciences (ES) stand out with a higher percentage.

The diversity of the reasons for choosing the university depending on the field of study

Tabel 1

	Field of study											
	AA	EG	IT	MD	PS	SSP	SS	AP	AV	ES	MI	CS
University Prestige	12.7	14.9	11.2	11.7	12.9	15.1	12.8	17.0	13.1	16.2	15.2	15.1
Training level of the candidate	8.6	6.5	6.9	9.0	5.5	7.6	7.1	6.8	5.4	6.6	7.9	7.9
Baccalaureate average	1.5	4.6	4.1	1.1	3.2	2.0	5.9	3.6	4.3	5.1	0.9	3.9
Proximity of the University to home	7.2	8.3	12.1	13.1	15.0	10.4	12.4	14.6	7.8	12.4	1.1	16.6
Financial facilities offered by the University	2.9	5.3	4.8	2.9	3.8	3.6	5.4	5.0	6.2	6.2	5.5	5.5
Technical and material endowments	2.4	6.1	3.2	5.0	2.4	3.9	5.5	3.8	9.1	4.5	6.8	3.0
Diversity of forms of education	1.3	1.8	1.9	0.9	7.2	6.4	1.7	8.6	3.7	7.3	1.0	2.6
Professional status after graduation	12.7	13.9	11.9	15.0	10.4	11.0	9.6	9.9	12.2	8.7	23.6	6.6
Employment opportunities	7.4	18.0	19.7	11.7	8.7	10.5	13.4	9.5	12.7	12.5	14.7	6.9
Vocation for the field	32.8	13.3	16.7	24.1	24.6	22.6	18.9	14.9	18.1	13.3	20.2	23.1
Recommendations made by teachers, colleagues, friends, and family	10.4	7.4	7.5	5.4	6.1	7.0	7.2	6.3	7.3	7.1	3.1	8.9

Creation of latent variables, factorial analysis

To evaluate different dimensions of the educational environment, a ten-point scale was used, where 1 means "not at all satisfied" and 10 means "very satisfied". For each dimension, several items were applied, and to reduce the complexity and size of the data, factor analysis was used. The results were centralized in Table 2. The Cronbach's Alpha coefficient quantifies the level of agreement on a standardized scale from 0 to 1 and is a statistical measure used to assess the internal consistency of a set of items or questions in a questionnaire. But to significantly influence a latent variable (to be created), the minimum value must be at least 0.7 (Dugard *et al*., 2010; Koning *et al*.,

2003). In TABLE 2 we notice that the values of the Cronbach Alpha coefficient are very close to the maximum value of 1, which means that there is a high correlation between the items, with high reliability. After the reliability test, the factor analysis was performed. By means of the factor analysis, the items were grouped and the latent (synthetic) variables were constructed. The KMO test (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) and Bartlett's (Bartlett's Test of Sphericity) together evaluate the quality of the available data, respectively the correlation between the items. A value of the KMO statistic as close as possible to 1 and a significance level for Bartlett's test below 0.05 suggests that there is substantial correlation in the data.

For each educational dimension we created a latent (synthetic) variable as a linear combination of items. The quality of the created latent variable is analysed through the prism of the following indicators: Percent of Variance, which shows us how much of the initial information brought by the items is found in the latent variable (we notice that we have high percentages, the minimum being 73% and the maximum 92%), the KMO statistic that measures the quality of the association between the items (records values close to 1) and the Coefficients of association between the items and the latent variable, which expresses the connection between the items and the created variable. In this analysis, the correlation coefficients between the items and the latent variables are higher than 0.8, which means that they are to a large extent found in the synthetic variables.

The results of Factor Analysis for each scale

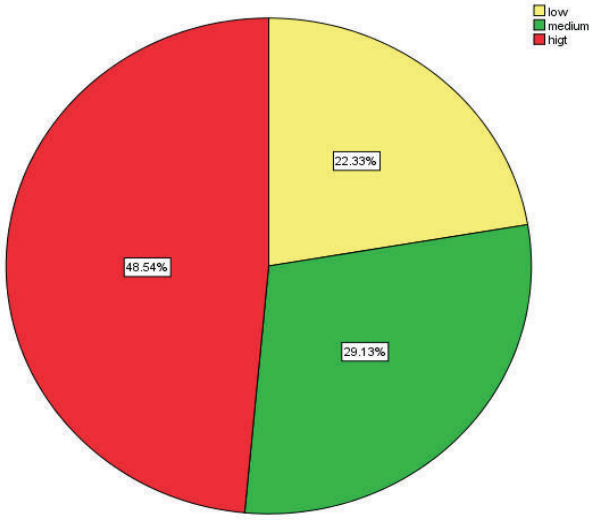
Table 2

Simbol variable	Cronbach's Alpha	KMO (p-value)	N of Items	Percent of Variance	Latent variable
Q1	0.924	0.897 (0.000)	6	73.140%	Perceived safety
Q2	0.953	0.907 (0.000)	8	75.360%	Campus equipment
Q3	0.965	0.948 (0.000)	9	79.880%	University facilities
Q4	0.907	0.958 (0.000)	8	82.750%	Teaching methods
Q5	0.968	0.924 (0.000)	6	86.150%	Feedback and evaluation
Q6	0.962	0.928 (0.000)	6	87.050%	Resources
Q7	0.96	0.778 (0.000)	3	92.710%	Counselling & career advice
Q8	0.876	0.948 (0.000)	7	82.955%	Learning outcomes

At the end of the questionnaire, the question "How prepared do you feel for your career" was asked, with the options of low, medium and high perceived preparedness as available answers. We consider this variable to be important for measuring the quality of the educational process. The preponderance of answers can be found in the pie chart (Figure 3), where we see that 22.33% consider themselves to be little prepared, 29.13% perceive average preparedness, while 48.54% deem themselves well prepared to enter the employment market.

Perceived preparedness for future career

Figure 3



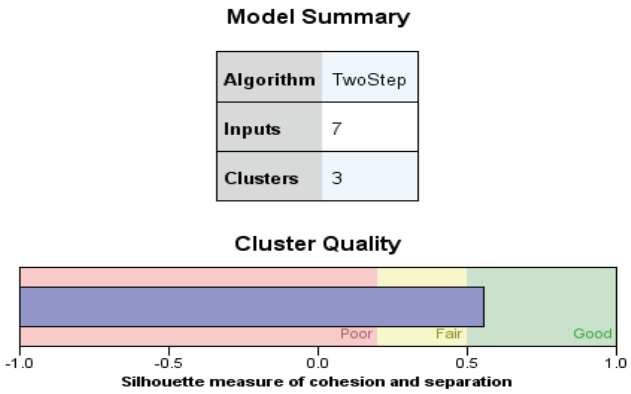
Furthermore, a clustering of the answers received from the students in relation to the latent variables created through factorial analysis was performed. The two-step cluster algorithm was applied, Log-likelihood distance, Schawarz's Bayesian Criterion. The following results were obtained (Figure 4): three clusters, Silhouette=0.6 (Silhouette measure of cohesion and separation) which can be considered a satisfactory clustering result. Therefore, all predictors were important.

What we found following the clustering process is a fairly good match of the results of this analysis with the grouping obtained by processing the direct answers to the question "How prepared do you feel for your career" (Table 3). Thus, 80.3% of the students who assessed themselves as having a low preparedness for their career coincide with distribution in the cluster

somewhat satisfied with the educational quality, 66.9% of those who assessed their preparedness level as medium are found in the corresponding medium cluster regarding satisfaction with the educational quality. Lastly, 73.3% of the students who assessed themselves as having a high perceived preparedness are also in the satisfied with the educational quality cluster.

The Two-Step cluster analysis

Figure 4



Crosstabulation: TwoStep Cluster Number -Perceived preparedness for future career

Table 3

		How prepared do you feel for your career?			Total
		low	medium	high	
TwoStep Cluster Number	satisfied with the educational quality	1.2%	10.9%	73.3%	42.4%
	medium satisfied with the educational quality	18.6%	66.9%	24.3%	34.4%
	little satisfied with the educational quality	80.3%	22.2%	2.4%	23.3%
	Total	100.0%	100.0%	100.0%	100.0%

To characterize the clusters, the average values obtained for the predictors used in the two step analysis were utilised (Table 4). The respective predictors are standardized variables of mean 0 and standard deviation 1, where positive values show high satisfaction for the measured educational dimension, values close to 0 indicating average satisfaction, and negative values showing

low satisfaction or even non-satisfaction. Consequently, cluster 1 contained (Figure 5.a) students satisfied with all educational dimensions, indicated by the average values of the predictors being positive and close to 1. It has been identified that these students belong to the fields of Administrative and Political Sciences, Law, Agricultural and Veterinary Sciences, Sport Science and Physical Education, Economical and Social Sciences, Psychology and Sociology, Sciences, and Engineering.

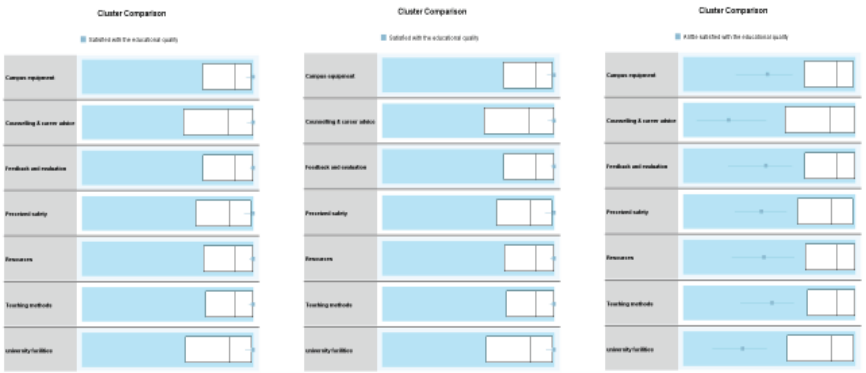
Characteristics of the clusters

Tabel 4

	Cluster 1 Satisfied with the educational quality (42.4%)	Cluster 2 Medium satisfied with the educational quality (34.4%)	Cluster 3 Little satisfied with the educational quality (23.3%)
Perceived safety	0.89	0.12	-1.28
Campus equipment	0.8	0.13	-1.39
University facilities	0.84	0.12	-1.39
Teaching methods	0.80	0.14	-1.42
Feedback and evaluation	0.79	0.15	-1.41
Resources	0.78	0.12	-1.42
Counselling & career advice	0.82	0.10	-1.40
Field of study	AP, AV, SSP, ES, PS, SS, EG	MI, SS, EG, IT, AV	AA, MD, IT, CS

Cluster comparation: ***a). Cluster 1; b). Cluster 2; c). Cluster 3.***

Figure 5



a). b). c).

Cluster 2 (Figure 5.b) outlines the students with average perceived satisfaction of the educational quality of all educational dimensions, due to the average values of the predictors being approximately 0. These students are mainly in the following fields: Military Sciences, Information and Public Conduct, Sciences, Engineering, IT and Agricultural and Veterinary Sciences. Finally, cluster 3 (Figure 5.c) contains the students who indicated little satisfaction with the educational quality of all educational dimensions, as the averages of predictors are negative and quite far from 0. The students were identified as belonging to fields of study such as: Arts and architecture, Medical Sciences, IT, Cultural Studies.

6. CONCLUSIONS AND DISCUSSION

According to Tokuhama *et al.* (2013) education and quality development are directly linked. Quality, as observed by international scientists, consists of intangible results rather than tangible ones. Over time, a series of models and dimensions established in the measurement of the quality of the higher education system appeared in the specialized literature. According to the results of the current scientific approach, the current generation in Romania does not always know what it wants.

- only 47% out of 13072 respondents are motivated by the vocation for the field of study at the time of entering university education and a part of these (17%) chose the field being influenced by the opinion of those around them. Many do not find their passion, are unsure as to why they opted for a certain field, and although 30% are interested in professional status, the attitude towards knowledge and the process of active learning and building new skills leaves much to be desired. This leads to most young employees become unfit for their first job;
- a significant part want to get involved, but they often don't know how, subsequently losing their enthusiasm and desire to get involved. The reason is that they have become accustomed since the high school period to the accumulation of inert knowledge that they do not find applicable;
- students require a different approach and improved guidance for the training of soft skills such as communication, teamwork, creativity, analytical thinking and the university education system is called to develop working methods that facilitate their development and consolidation.

The universities in our country need to help their students to clarify their personal vision, to develop in a different way, not only through the accumulation of theoretical knowledge, but through their own experiences, active knowledge, which can be exploited and can provide solutions for problems relevant in current society.

The courage to explore, to engage with the active learning process, to accept unconventional methods of teaching and examination, to formulate complex and correct questions in relation to the identified problems and the courage to offer solutions, with the assumption of the risk of making mistakes, are a way of active learning and are encouraged in the Romanian university environment.

Lifelong learning is the key to acquiring knowledge and building competencies. The top skills required on the labour market in 2023 have been identified as: analytical thinking, creative thinking, resilience, flexibility, agility, motivation, curiosity, long-term learning, digital skills, attention to details, empathy, active listening, leadership, and quality control. Further research is required considering other skills that will be of interest in the future: systems thinking, artificial intelligence, data analysis, and customer services (https://www.weforum.org/agenda/2023/05/future-of-jobs-2023-skills/)

As outlined by the results of this research, candidates give increasing importance to the prestige of the university (36%) and then to the employer's brand in the process of making the employment decision. They research and evaluate the reputation and organizational culture of the university and companies before applying for a field of study or a job. Universities and companies that have a strong brand and the right values attract talented candidates more easily. And those that offer clear prospects for growth and development are more likely to attract motivated and ambitious candidates.

Professional development needs to be doubled by personal development. Candidates are looking for opportunities for professional and personal development within universities and organizations. Meanwhile, organizations are increasingly starting to develop their own educational systems (Csikósová *et al.,* 2012).

Professional status is important for 30% of study participants. In our opinion, these are the ones who realize that the specialist's autonomy is determined by the accumulation of knowledge, curiosity, and the desire to learn continuously, non-directive learning, the freedom to formulate meaningful questions, self-discipline and demonstrated responsibility.

This scientific approach was focused solely on the cognitive skills that graduates would need to have in order to increase their chances of employment on the labour market, namely: abstract, analytical and synthetic thinking, the

application of acquired knowledge in practical situations, creativity, critical thinking, the ability to find information, analyse and communicate it, and the ability to make rational decisions. Methodological skills are added to these cognitive skills: solving identified problems, planning and time management and constant learning. Technical and linguistic skills: digital skills - the ability to use specific IT systems, verbal and written communication have become very important (Crnjar *et al.,* 2018).

In the didactic activity through interactivity, specific games, projects containing practical application, the following skills necessary for a potential job in the economic field are cultivated: specialized language, the ability to find economic information, the use of graphs, concise writing, the completion of questionnaires and the interpretation of data, data analysis, the analysis of data from the micro and macroeconomic level using mathematical models, statistics, software, the presentation of information, the interpretation and forecasting of market trends, consulting and offering advice to companies in the economic field , recommending solutions to economic problems, writing specialized articles (https://www.truity.com/career-profile/economist).

The following contribute to differentiation: mathematical thinking, interaction with social sciences such as psychology, history, sociology, the ability to understand complex systems, curiosity, independent thinking, verbal and written communication skills, the ability to self-motivate (https://inomics.com/advice/10-qualities-that-define-a-good-economist-1140895).

The level of training in high school is an important quality factor, appreciated by 17% of the study participants and the baccalaureate average over 9.5%. The need for university centres to be close to home was expressed by 29% of respondents. Financial facilities have 12% to which 10% is added to the diversity of the forms of education in the overall educational offer.

Candidates are thus looking for work environments that offer coaching and training programs, as well as the opportunity to develop their skills and competencies in a stimulating and safe work environment. Whilst technical endowments are important 12%, it was observed that offering mental health resources and programs such as counselling, stress management training and/or work-life balance programs are increasingly valued.

The quality of educational services also depends on the percentage of employability in the opinion of 33% of the respondents and the career path, therefore outlining the importance of the creation of a constant system for monitoring labour market indicators for young people and the creation of an information base on supply and demand across the labour market.

The realities of the labour market require university graduates to provide solutions to real problems as and when identified, to cultivate a

predisposition for action. This freedom to build knowledge and behaviours through education leads to prosperity.

Following a survey carried out by eJobs, in August 2022, on a sample of 1,700 employed respondents, the following results were obtained:

- more and more employees go into burnout (21.8% in the last year, 2022)
- a large proportion of these individuals feel the need for psychological therapy, but they don't have money for it, so they consider it a desirable extra-salary benefit.

The second eJobs survey conducted in August 2022, on a sample of 170 responding companies, shows that due to the fear induced in recent years, the depression rate dropped from 27 years to 17 years.

According to research by Smith and Ruppert (2019), digitization of recruitment processes has led to increased efficiency. Candidates in Romania are increasingly familiar with using online platforms and social networks in their job search. They create professional profiles on recruitment sites, update their CVs and apply for jobs directly through digital platforms.

For a large proportion of candidates on the job market the hybrid option seems to be the best option, giving them both the flexibility they need and the reconnection with colleagues. Candidates are looking for more than just a job. They are interested in flexibility in working hours, the possibility of working from home or having flexible hours.

Mental health is becoming an important criterion for candidates when considering professional training and career opportunities. Applicants are looking for organizations that are committed to providing a healthy work environment and that demonstrate concern for employee well-being.

These aspects can influence a candidate's decision to accept or reject an offer of education and then work, and can contribute to long-term talent retention. We live in a period of reflexive modernity and non-formal learning methods require the reorganization of knowledge, their adaptation to an unpredictable world where solutions are temporary and the recoding of information from the minds of graduates and reflection on them can generate expertise. Today an expert is a reflective practitioner who generates viable solutions adapted to the moment in an appropriate and effective way.

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Statistical Approaches and Estimates on the Development of Tourism in the European Union

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ABSTRACT

Institutions that publish significant volumes of statistical data in the domain of European and international tourism, such as National Institute of Statistics, Eurostat and the World Tourism Organization (UNWTO), attach great importance to the tourism indicators such as international tourist arrivals and international tourist receipts, due to their direct effect on the economy, on the formation of gross domestic product (GDP), finally. The purpose of this study is to highlight what are the main tourist regions in the EU Member States and what is their past and future contribution to the formation of national tourist demand, on the basis of the total tourist arrivals (domestic and foreign tourists) indicator, in relative or absolute expression. Work presents the statistical methodology used for the quantitative analysis of the total tourist arrivals indicator in the EU Member States and in the main tourist regions and the forecast of the market share of the total regional tourist demand using analytical models of time series, these constituting also contributions to the study of tourism in the community space.

Keyword: *statistics of tourism, quantitative analysis, time series, forecast, Member States.*

JEL Classification: *C22, O11, R12.*

1. INTRODUCTION

Tourism activity is one of the most widespread and dynamic at European level, both as regards the tourism supply (attractions, enterprises, services) and the tourism demand (tourist arrivals, tourist receipts). UNWTO statistics show an increase of the international tourist arrivals from 901 million tourists in 2009 to 1,465 million tourists in 2019, with a reduction of -72% in 2020 and a return to 963 million tourists in 2022, the average annual growth rate being 0.51%, during the period 2009-2022[1]. Europe is the first tourist

1. http://www.unwto.org/tourism-data/global-and-regional-tourism-performance.

destination in the world, the weight of international arrived tourists in 2009 being of 53% from the total arrivals at the worldwide level, with an increase to 62% in 2022, in the conditions in which this weight has remained constantly bigger than 50%, every year from the period 2009-2022. International tourist arrivals in EU-27 were of 347 million tourists in 2009, increasing to 539 million tourists in 2019, followed by a decrease of -66% in 2020, after which they increased to 441 million tourists, with 95%, in 2022 compared to 2021, the period average annual rate being of 1.85%. In Romania, the international tourist arrivals were of 7.58 million in 2009, decreasing with -14.5% compared to the previous year, but from 2010 the increase was continuous until 2020, when was recorded a reduction of -60.8%, in the next two years follwing increases compared to previous years by 35.2% in 2021 compared to 2020 and respectively 87% in 2022 compared to 2021, the average annual growth in the period 2009-2022 being of 4.05%.

Following in evolution the global tourism receipts during the period 2000-2022, it's observed an increase from 499 billion USD in 2001 until 2009, when was recorded a decrease with -4%, as a result of the global economic crisis, followed by new increases until 2019, when they recorded a level of 1,494 billion USD, but in 2020 there was a reduction of -63%, determined by the pandemic with the COVID-19 virus and then a new increase to 1,031 billion USD in 2022. By regions, international tourism receipts in 2019 were recorded in a percentage of 87% in Europe, 25% in Africa, 29% in the Middle East, 32% in the Americas, 72% in Asia Pacific and at the global level in percentage of 36%.

According to the Special Report of the European Court of Auditors 2021 regarding on *EU Support to Tourism*, the EU is the most visited region in the world, with a share of around 37% from the total number of international tourists, in 2019[1]. Through this, tourism becomes an essential economic sector in the EU, accounting for 9.9% from GDP and 11.6% from the total number of workplaces, in 2019. Dramatically affected, in 2019, by the COVID-19 pandemic, the tourism also faces other long-term challenges, such as those related to its green and digital transformation, its competitiveness, its sustainability and its resilience.

Importance of analyzing of the tourism development in the community space is also demonstrated by the multitude of studies and researches that approaches this thematic, the points of view, the methods used and the conclusions of some of them being highlighted in the present work. To these are added the conclusions which result from the application of statistical methods

1. Special Report 27/2021: EU Support to tourism - Need for a fresh strategic orientation and a better funding approach, European Court of Auditors, https://www.eca.europa.eu/.

of analysis and forecasting of the time series on some tourism indicators of the Member States or regional indicators calculated based on NIS and Eurostat data.

2. RESEARCH ON TOURISM DEVELOPMENT IN THE MEMBER STATES OF THE EUROPEAN UNION IN THE SPECIALIZED LITERATURE

A large segment of the specialized literature refers to the tourist circulation, to the orientation of tourist flows depending on the type of natural and cultural resources availabile in region, generating forms of tourism such as: cultural tourism (Mitruţ and Constantin, 2009; Hughes and Allen, 2005; Ionescu, 2000), mountain tourism (Lasanta et al., 2007; Varley and Medway, 2011), balneary tourism (García-Altés, 2005; Hjalager, 2009), agritourism and rural tourism (Cawley and Gillmor, 2008; Iorio and Corsale, 2010) a.s.o. Mitruţ and Constantin (2009) have achieved a study on the contribution of tourism to the regional development in Romania, applying statistical methods of analysis of the main tourism indicators. Their conclusions were those that, having in view the importance of the natural and cultural heritage of Romania, the tourism in general and cultural tourism could contribute significantly to the economic recovery and to the reducing of the inter- and intra-regional disparities, by the adopting and implementing of some measures which should aim the specialization in competitive terms, the infrastructure improvement, the sustainability a.s.o., financially supported by allocations from EU funds through the Regional Operational Program. Numerous studies deal with the development of Romanian tourism as resources, structure, tendencies a.s.o., on country or as territorial distribution (Zaman et al., 2010; Roşca, 2002). Zaman et al. (2010) applied the Input-Output model as an analysis and forecasting tool for the tourism activity, considering its basic components: hotels, restaurants, travel agencies and they highlighted aspects related to: the complex character of this branch, of production consumer from other branches and of production supplier for other branches from the IO model nomenclature. In the study developed by Roşca (2013), they were applied statistical and econometric methods for analysis the time series components and for forecast of the tourism demand indicators in Romania, by development regions, during the period 1995-2011, which led to the following conclusions: it manifested an increase tendency of the tourist arrivals at the country level and by development regions, well described by the model of the 2nd degree parabola; it manifested a tendency of reduction of the number of overnight stays and the average length of stay on the whole country and by development

regions, being able to be issued the hypothesis of the global economic crisis effect.

Regional competitiveness in tourism, especially the destination competitiveness, has been approached either through the lens of economic theory, into a comparative approach with the firm competitiveness (Hall, 2007) or using statistical methods. Gabor et al. (2021) applied discriminant statistical analysis on 14 criteria presented in the Travel & Tourism Competitiveness Report, elaborated by the World Economic Forum, for all European countries, considering 2011 and 2019 as years of reference. Analysis highlighted which are the variables that best separate the countries groups in the two analyzed years (e.g., air transport infrastructure, price competitiveness, ICT readiness, a.s.o.).

In the study of specialized literature, a subject of interest was that of the identifying of the methods used in the tourism activity research in EU Member States. Most of the mentioned studies use data resulted from surveys or those published by the national statistical offices, by Eurostat or by some regional organizations, which they analyze through *statistical and econometric methods*. Butnaru and Niţă (2016) elaborated a study regarding on the tourism in Romania and EU, aiming to analyze the convergence of economic development in the 8 development regions of Romania, from the touristic point of view. Guizzardi and Mazzocchi (2010) used *the structural time series analysis* for Italy, for highlight whether the cyclical movements in tourism demand can be explained by the lagged effect of the business cycle. Usefulness of such a study is special because, if the relationship between the tourism cycle and the general business cycle is demonstrated, then the tourism policy can use the advantage of the delay between the two cycles for adopt anti-cyclical measures that would mitigate the impact of adverse economic conditions. Dritsakis (2004) studied tourist demand from Germany and United Kingdom, two traditional important sources for the Greek tourism, using macroeconomic variables such as: the income in the two countries of origin, the tourist prices in Greece, the transport cost and the exchange rates between these three countries. It was used a 40 years time series, and the methods used were *the univariate analysis*, *the cointegration method* and *the VAR model of cointegration vectors*. For the analysis of the regional competitiveness in tourism are used statistical methods such as *the multidimensional analysis* (Cracolici and Nijkamp, 2009), *the empirical testing* and *the factor analysis of principal components* (Claver-Cortés et al., 2007) and others. Marrocu and Paci (2011) used *the index method* for study the influence of a good public infrastructure network on the level of the regional efficiency and they found the presence of a Central European

space, including the Netherlands, Belgium, Germany, France and Switzerland with values significantly above the European average. Lasanta et al. (2007), in their study on Mediterranean mountain tourism, used a 30 years time series, and as method was used *the bivariate statistical analysis*. Statistical methods used by van der Ark and Richards (2006) for the study of the behavior in the cultural tourism were *the ranks method*, for ranking destinations according to the frequency of participation to cultural activities and to the attractiveness of cultural activities, *the bootstrap method* for the estimating the ranks reliability, and for testing hypotheses, *the ANOVA method* and *the Tukey-Kramer test*. Analysis and the forecast of the international tourist arrivals and the total and per capita real international tourist receipts was achieved with *the ARIMA econometric models* (Papatheodorou and Song, 2005). In conclusion, for the tourism quantitative analysis in the EU Member States were used frequently the statistical and econometric methods, mainly those of territorial series and time series analysis.

3. STUDY METHODOLOGY OF TOURISM IN THE EU MEMBER STATES

Quantitative analysis of tourism in the EU Member States was achieved on the basis of the indicator of total tourist arrivals (internal and foreign tourists), on the total EU, by countries and by regions (Cristureanu, 1992; Bran et al., 1998; Snak et al., 2001). It was realized a forecast of the market share of the main tourist regions from the EU Member States on the medium term (2023-2025[1]), using time series models (Biji et al., 2010). Data taken into analysis are those published by the NIS and Eurostat, on which were applied statistical methods of the territorial and chronological statistical series analysis. In the compiling the of territorial series, were used date by countries and by regions of NUTS 2 level within each country, and in the case of chronological series, the data refer to the period 2009-2022. In the classification of the territorial series terms, it was used *the multicriteria analysis* by *the relative distance method*. Applied for each country in the aim of identification the region with the best tourism performance, the method used the following criteria: (1) number of accommodation units, (2) number of places in tourist accommodation units, (3) total tourist arrivals (of residents and foreigners) and (4) total number of nights spent at tourist accommodation establishments (for residents and foreigners), by regions. In the forecast of the time series terms it was used *the analytical method* based on the linear function and the exponential function (Fleming and Nellis, 1991; Jaba, 1998). For each

1. Forecast for the years 2023 and 2024 is still useful, until the publication of the tourism indicators by regions, for these years.

country it was calculated the market share of the region with the best tourist performance, established in the previous classification, on the basis of the total tourist arrivals, in the period 2009-2022 $(T = 14)$, using the relationship:

$$q_i = \frac{CT_i}{\sum_{i=1}^{n} CT_i} q_i = \frac{CT_i}{\sum_{i=1}^{n} CT_i}, \quad (1)$$

where:
q_i is the market share of the region i;
n is the number of regions of NUTS level 2, from the analysed Member State;
CT_i is the total tourist arrivals (total tourist demand) in the region i;

$\sum_{i=1}^{n} CT_i$ is the total tourist arrivals in the analysed Member State.

Using the linear trend function, whose analytical form is:

$$\hat{y}_t = a + bt; \quad t = 1 \div T \quad (2)$$

and the exponential function, with the following form:

$$y_t = ba^t; t = 1 \div T \quad (3)$$

were established the parameter values a and b for the two functions, using the least squares method, for which must be met the condition $\sum (y_t - \hat{y}_t)^2 = \min$ (Isaic-Maniu et al., 1999, p. 175). Using trend functions, it was estimated how will evolve the market share in the main tourist regions of the EU Member States on a medium-term time horizon (2023-2025). They were used two selection criteria of the most adequate trend function, namely (Korka et al., 2005, p. 143): (1) criterion of equality between the sum of real values and the sum of adjusted values, that is:

$$\left(\sum_{t=1}^{T} y_t\right) = \left(\sum_{t=1}^{T} \hat{y}_t\right) \quad (4)$$

and (2) criterion of residual variation analysis into a dynamic community, using for this the *standard deviation* indicator, calculated with the relationship:

$$S_{y_t/\hat{y}_t} = \sqrt{\frac{\sum(y_t - \hat{y}_t)^2}{T}} \quad (5)$$

and *the error coefficient* of the analytical adjustment function, calculated with the relationship:

$$e\% = \frac{S_{y_t/\hat{y}_t}}{\hat{y}} \cdot 100 \quad (6)$$

With how the values of these indicators are lower, with that the adjustment function is more adequate to synthesize the evolution of the analyzed variable.

In the case of regions for which was chosen the linear regression function, the evolution tendency (increasing, decreasing) of the region market share was interpreted depending on the linear regression coefficient b.

They were also calculated other regression statistics, namely: the multiple correlation coefficient ($Multiple\ R$), which in the case of linear regression transforms in linear correlation coefficient, the intercept (a), the coefficient of determination ($R - Squared$), the adjusted coefficient of determination ($Adjusted\ R - Squared$), the standard error ($standard\ error$).

Usefulness of the realised analysis increases in the measure in which the forecasted market share can be used for the estimation the region total tourist arrivals, within the established forecast horizon. In this aim, it was considered the chosen forecast function being the type of function that describes the total tourist arrivals at the Member State level and it was established the level of the indicator in the forecast period. Using the relation (1) for the forecast horizon can be estimated the total tourist arrivals in the region, from the relation:

$$CT_{(T+m)_i} = q_{(T+m)_i}\ x \sum_{i=1}^{n} CT_{(T+m)_i} \tag{7}$$

where:

m is the forecast period, in the realized analysis: $m = \overline{1,3}$ years;

T is the last year of the period for which data are known.

Comparison with at least one other estimation method being necessary, it can be used the average dynamic index method for adjustment of the total tourist arrivals at the Member State level using the relationship:

$$\hat{y}_t = y_1\ x \left(\sqrt[(T-1)]{\frac{y_T}{y_1}}\right)^{(t-1)} \tag{8}$$

and then these can be estimated in the forecast horizon (Biji et al., 2010). Relationship of calculation used for estimation is:

$$CT_{(T+m)_i} = \frac{q_{(T+m)_i} x CT_{T_i} x CT_{(T+m)_i}}{q_{T_i} x \sum_{i=1}^{n} CT_{T_i}} \tag{9}$$

Error of estimation of the total tourist arrivals within a Member State can be established applying the relation (5) for the calculation of the standard deviation of the real values of the variable from the adjusted values and the relation (6) for the calculation of the adjustment error coefficient, returned by the used model.

Applying these methods at the tourism indicators by EU countries/ regions, they were identified some features of the European tourism evolution in the period 2009-2022 and were estimated the tendencies for 2023-2025. Estimation of the total tourist arrivals in the main tourist region of a Member State in the period 2023-2025 was applied for Romania. Calculations related to the analyses were performed in Microsoft Excel.

4. QUANTITATIVE ANALYSIS OF THE TOURISM DEMAND IN THE EU MEMBER STATES

In the analysis of the regional tourism demand in the EU Member States, it was used the total tourist arrivals indicator, on total EU, by Member States and by regions. Having in view the distribution of the accommodation units by countries, in the period 2009-2022, the Member States with the most developed accommodation base were: Italy (in 2009 it held about 30% from the number of accommodation establishments from the total EU, percentage that increased to 37% in 2021), Germany (11% and 8% respectively), Spain (9% and 9% in 2020), Greece (7% and 4%), France (6% and 5%), Austria (4% and 4%) a.s.o. In Romania, in 2009, that was about 1% from the number of accommodation establishments from the EU, with an average annual increase tendency of about 5% until 2021. [1] Tourism demand in these countries, expressed by the total tourist arrivals (internal and foreign), has evolved as follows: in Italy, total tourist arrivals represented 13% from total tourist arrivals in the EU in 2009 and it remained at this relative level in 2022, too; the same indicator represented 17% from the total tourist arrivals in 2009 and it remained at the same relative level in 2022 in Germany; in Spain, the indicator represented 13% from the total tourist arrivals in the EU in 2009 and it increased to 14% in 2022; in Greece, the indicator represented 3% from the total arrivals in EU in 2009 and it remained at this relative level in 2022; in France, the indicator evolved from 17% in 2009 to 18% in 2022; in Austria the share was 4% in 2009 and maintained in 2022 a.s.o. In Romania, the share of total tourist arrivals compared to total tourist arrivals in the EU was 1% in 2009 and increased to 2% in 2021, the average annual rate in the period being 3.5%.

Applying for each Member State the relative distance method among units (regions of NUTS 2 level), were identified the regions with the best tourism activity, on the basis of the four criteria (tourism indicators) listed above. Results of this ranking can be seen in the first column of the Table 1.
From the application of the selection criteria of the most adequate forecast

1. Source: calculated after Eurostat statistics, http://www.insse.ro; http://www.ec.europa.eu/eurostat.

function, it was ascertain that the relationship (4) verifies for the regions from all Member States, in the case of the linear function. It was applied, in continuation, the criterion of the smallest coefficient of error obtained for each forecast function. Results of choosing of the most adequate forecast function are presented in the Annex 1, and their analysis highlights the fact that, for most regions (from 19 Member States), the most adequate forecast function is the linear model. Regions for which the exponential model is more adequate as a forecast function are: Notio Aigaio (Greece), the calculations returning for it an error coefficient $e\% = 4{,}74898$, compared with that obtained for the linear function: $e\% = 4{,}84263$; Pohjois-ja Itä-Suomi (Finland) with $e\% = 6{,}13911$ compared to $e\% = 6{,}14218$; Sud-Est (Romania), with $e\% = 9{,}86227$ compared to $e\% = 9{,}96499$; Zachodniopomorskie (Poland) with $e\% = 8{,}26250$ compared to $e\% = 8{,}34306$; Nyugat-Dunántúl (Hungary) with $e = 7{,}47600$ compared to $e = 7{,}49679$; Stredné Slovensko (Slovakia) with $e = 5{,}96816$ compared to $e = 6{,}03942$; Zahodna Slovenija (Slovenia) with $e = 2{,}28148$ compared to $e = 2{,}25955$ and Yugoiztochen (Bulgaria) with $e = 3{,}49213$ compared to $e = 3{,}50122$.

Interpreting the linear correlation coefficient b, as results from the Annex 1, are recorded increasing tendencies of the market share in the case of regions: Prov. West-Vlaanderen (Belgium), Oberbayern (Germany), Eesti (Estonia), Southern (Ireland), Rhône-Alpes (France), Veneto (Italy), Kibris (Cyprus), Latvija (Latvia), Vidurio ir vakaru Lietuvos regionas (Lithuania), Luxembourg (Luxembourg), Malta (Malta), Tirol (Austria), Zahodna Slovenija (Slovenia), Västsverige (Sweden) and Jadranska Hrvatska (Croatia). Are recorded decreasing tendencies of the market share in the case of regions: Syddanmark (Denmark), Cataluña (Spain), Noord-Holland (Netherlands) and Algarve (Portugal). In the case of regions for which has opted for the exponential function model, the evolution tendency of the region market share is increasing for: Notio Aigaio (Greece), Pohjois-ja Itä-Suomi (Finland), Severovýchod (Czech Republic), Yugoiztochen (Bulgaria), Zachodniopomorskie (Poland) and Stredné Slovensko (Slovakia) and decreasing for: Nyugat-Dunántúl (Hungary) and Sud-Est (Romania). From the R^2 values analysis for the two functions resulted identical conclusions with those presented previously, regarding the selection of the forecast function, for most of the regions, but there were also some exceptions, namely: for the region Syddanmark (Denmark) R^2 liniar = 0,0228 and R^2exp. = 0,0237, previously being chosen the linear function; for the region Veneto (Italy) R^2 liniar = R^2exp. = 0,0092, previously being chosen the linear function, as it returns a lower error coefficient; for the region Kibris (Cyprus) R^2liniar = 0,0017 and R^2exp. = 0,0018, previously being chosen the linear

function, which returns a lower error coefficient; for the region Luxembourg (Luxembourg) R^2liniar = 0,0006 and R^2exp. = 0,0007, previously being chosen the linear model, which returns a lower error coefficient; for the region Tyrol (Austria) R^2liniar = 0,0047 and R^2exp. = 0,0048, previously being chosen the linear regression model, which returns a lower error coefficient.

In the Table 1 is presented the market share forecast of the main tourist regions from the EU Member States, for the years 2023-2025, on the basis of data from the period 2009-2021/2022, using the two functions.

Market share forecast of the tourism demand by main tourist regions from the EU Member States in 2023 - 2025

Table 1

Country/Region	Market share [%] forecast using:					
	liniar function			exponential function		
	2023	2024	2025	2023	2024	2025
Belgia/Prov. West-Vlaanderen	26,4	26,7	27,0	26,5	26,8	27,1
Bulgaria/Yugoiztochen	26,3	26,4	26,6	27,4	27,6	27,8
Republica Cehă/Severovýchod	16,0	16,2	16,4	16,8	17,0	17,2
Danemarca[1]/Syddanmark	24,2	24,1	24,1	26,0	25,9	25,8
Germania/Oberbayern	9,5	9,5	9,5	9,7	9,7	9,8
Estonia*/Eesti	3183575	3216259	3248943	3035387	3068587	3101787
Irlanda[2]/Southern	54,7	58,9	63,1	53,6	57,6	61,6
Grecia[5]/Notio Aigaio	22,7	23,0	23,3	22,7	23,0	23,3
Spania/Cataluña	18,6	18,6	18,5	18,5	18,5	18,4
Franţa/Rhône-Alpes	11,3	11,4	11,5	11,0	11,1	11,2
Italia/Veneto	15,2	15,2	15,2	15,3	15,3	15,3
Cipru*/Kibris	2548077	2554641	2561204	2480344	2487123	2493901
Letonia*/Latvija	2390711	2446541	2502372	2227899	2283730	2339560
Lituania[3]/Vidurio ir vakaru Lietuvos regionas	72,0	73,5	75,1	72,5	74,1	75,7
Luxemburg* [1]/Luxemburg	1026532	1027605	1028678	855582	856654	857727
Ungaria[1]/Nyugat-Dunántúl	15,7	15,5	15,4	17,5	17,4	17,2
Malta*/Malta	1610810	1627834	1644858	1831185	1848209	1865234
Olanda[4]/Noord-Holland	27,0	26,6	26,2	26,5	26,1	25,7
Austria/Tirol	26,1	26,1	26,1	26,4	26,4	26,4
Polonia[1]/Zachodniopomorskie	10,5	10,6	10,8	10,7	10,8	11,0
Portugalia/Algarve	17,5	17,3	17,1	17,5	17,3	17,1
România[1]/Sud-Est	13,3	13,1	12,9	17,2	17,0	16,7
Slovenia[5]/Zahodna Slovenija	69,4	69,9	70,4	69,6	70,1	70,6
Slovacia[1]/Stredné Slovensko	34,8	35,2	35,7	35,4	35,8	36,3
Finlanda/Pohjois-ja Itä-Suomi	32,8	32,9	33,1	30,6	30,8	30,9
Suedia[1]/Västsverige	21,8	21,8	21,8	21,9	21,9	21,9
Croaţia/Jadranska Hrvatska	88,1	88,2	88,3	87,9	88,0	88,1

Source: calculated after Eurostat statistics, http://www.ec.europa.eu/eurostat.

* Member States with a single region of NUTS 2 level, for which was used the total tourist arrivals indicator.

[1] was used the data seria from the period 2009 - 2021;

[2] was used the data seria from the period 2018 - 2021;
[3] was used the data seria from the period 2015 - 2022;
[4] was used the data seria from the period 2011 - 2022;
[5] market share of the region Notio Aigaio in 2010 and 2012 was interpolated; market share of the region Zahonda Slovenija for 2018 was interpolated.

In the Table 2 are presented the results of estimation of the total tourist arrivals in the region South-East from Romania, using the exponential regression model and the model of the average index of dynamics, during the period 2023-2025.

Forecast of total tourist arrivals in the region South-East and in Romania, during the period 2023-2025 [number]

Table 2

Indicators	$\hat{y}_t = ba^t$			$\hat{y}_t = y_1 \; x \; \bar{I}^{(t-1)}$		
	2023	2024	2025	2023	2024	2025
$\sum_{i=1}^{n} CT_{(T+m)_i}$	11.562.950*	13.388.069	13.852.324	11.562.950*	12.097.584	12.656.938
$CT_{(T+m)_i}$	1.987.284	2.270.797	2.318.331	1.987.284	2.051.914	2.118.271
$S_{y_t/\hat{y}_t}$	1.664.369			2.075.442		
$e\%$	17			21		

* real data (source: Eurostat, http://www.ec.europa.eu/eurostat).

Source: calculated after Eurostat statistics, http://www.ec.europa.eu/eurostat.

It is observed that the evolution estimation of the total tourist arrivals by the exponential model gives a standard deviation of the real values from the adjusted values and an error coefficient smaller, so it is recommended its selection as a forecast model.

5. CONCLUSIONS

Specialized literature consulted for this study refers to tourist circulation, to the orientation of the tourist flows depending on the type of natural and cultural resources existing in the region, generating of tourism forms, such as: cultural tourism, mountain tourism, balneary tourism, agritourism and rural tourism, a.s.o., to the effects of tourism development at regional or national level, to regional competitiveness in tourism a.s.o. Study of the specialized literature also highlighted the statistical and econometric methods used in the analysis of the various sides of tourism, among which: time series analysis, univariate analysis, multidimensional analysis, factorial

analysis of the principal component, index method, ranks method, ANOVA method and others. This study is based on the use of statistical methods of territorial series analyze, for the multi-criteria hierarchization of territorial series and on methods of chronological series analyze, for the trend determinination and the tourism demand forecasting on medium-term. In view of characterization of the evolution tendency of tourism demand in the EU Member States, was analyzed the total tourist arrivals indicator, which, together with the international tourism receipts indicator, is frequently used in studies for highlight the importance of tourism at national and international level. At regional and national level, the knowledge of the level, evolution and future tendencies of this indicator is useful to all tourism market actors, who can shape some components of their offer according to the tendencies of internal and external demand segments (offer of basic and additional services, financing offer, provision of facilities, a.s.o.); it is useful to public authorities, who can substantiate the tourism development strategies having at basis the tendencies derived from the known and forecasted data. In the International plan, a high level or an increasing tendency of the total tourist arrivals is a solid argument in promoting tourist destinations and can legitimize and highlight a country success in the international community. At the same time, a high level of international tourist arrivals is a source of revenue for the regional and national tourism, being a good indicator for highlighting the tourism role in economy, both for its contribution to GDP creation and as a generator of foreign exchange. In this context, present study creates an openness towards a possible future analysis of the influences of the evolution of tourist arrivals and tourist receipts on the evolution of regional and national GDP, considered as final macroeconomic result. Public authorities and decision-makers can be convinced by the evolution and the future tendencies of the total tourist arrivals to support the tourism development in region and to increase the profitability of tourism activities. For such reasons, it's not surprising that Eurostat and UNWTO constantly publish time series on total tourist arrivals, as level, annual changes and market share.

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Annex 1

Choosing the most adequate forecast function

Country/Region	the most adequate forecast function[1]		linear function			exponential function		
	$y_x = a + bx$	$y_x = ba^x$	regression equation y_t	standard deviation	coefficient of error	regression equation y_t	standard deviation	coefficient of error
Belgia/Prov. West-Vlaanderen	x		y = 0.0031x + 0.2186	0,01197	4,94793	$y = 0.2196e^{0.0125x}$	0,01199	4,95586
Bulgaria/Yugoiztochen		x	y = 0.002x + 0.2332	0,00869	3,50122	$y = 0.2336e^{0.0079x}$	0,00867	3,49213
Republica Cehă/Severovýchod		x	y = 0.0021x + 0.1294	0,01612	11,10883	$y = 0.1308e^{0.0129x}$	0,01609	11,09033
Danemarca[1]/Syddanmark	x		y = -0.0006x + 0.2505	0,01414	5,73931	$y = 0.2506e^{-0.003x}$	0,01414	5,73933
Germania/Oberbayern	x		y = 0.0002x + 0.0922	0,00419	4,48001	$y = 0.0922e^{0.0017x}$	0,00419	4,48275
Estonia*/Eesti	x		y = 35128x + 3E+06	538.637,4	18,43319	$y = 3E+06e^{0.0102x}$	543.178,2	18,58859
Irlanda[2]/Southern	x		y = 0.0551x - 0.2554	0,03732	9,87712	$y = 0.0653e^{0.1508x}$	0,03950	10,45295
Grecia/Notio Aigaio		x	y = 0.0036x + 0.1736	0,00972	4,84263	$y = 0.1751e^{0.0177x}$	0,00953	4,74898
Spania/Cataluña	x		y = -0.0007x + 0.1967	0,00423	0,15768	$y = 0.1968e^{-0.004x}$	0,00424	0,15819
Franţa/Rhône-Alpes	x		y = 0.0012x + 0.0945	0,00527	5,07322	$y = 0.0943e^{0.0125x}$	0,00533	5,13452
Italia/Veneto	x		y = 9E-05x + 0.1505	0,00365	2,41597	$y = 0.1505e^{0.0006x}$	0,00365	2,41627
Cipru*/Kibris	x		y = 5124.1x + 2E+06	505.021,2	20,23670	$y = 3E+06e^{-0.004x}$	513.492,7	20.57616
Letonia*/Latvija	x		y = 60467x + 1E+06	485.700,4	24,98372	$y = 1E+06e^{0.0321x}$	498.720,2	25,65344
Lituania[3]/Vidurio ir vakaru Lietuvos regionas	x		y = 0.0186x + 0.4447	0,03853	6,01549	$y = 0.4717e^{0.0288x}$	0,03859	6,02506
Luxemburg* [1]/Luxemburg	x		y = 1072.7x + 1E+06	158.845,4	15,60443	$y = 1E+06e^{-0.001x}$	159.740,4	15,69236
Ungaria[1]/Nyugat-Dunántúl		x	y = -0.0012x + 0.1745	0,01245	7,49679	$y = 0.174e^{-0.007x}$	0,01242	7,47600
Malta*/Malta	x		y = 18166x + 1E+06	357.842,9	24,26685	$y = 1E+06e^{0.0055x}$	364.152,4	24,69472
Olanda[4]/Noord-Holland	x		y = -0.0047x + 0.338	0,03363	11,27412	$y = 0.3453e^{-0.018x}$	0,03403	11,40712
Austria/Tirol	x		y = 1E-04x + 0.2598	0,00555	2,13033	$y = 0.2598e^{0.0003x}$	0,00555	2,13051
Polonia[1]/Zachodniopomorskie		x	y = 0.0015x + 0.0814	0,00769	8,34306	$y = 0.0824e^{0.0154x}$	0,00762	8,26250
Portugalia/Algarve	x		y = -0.0019x + 0.2029	0,00357	1,89190	$y = 0.2033e^{-0.01x}$	0,00360	1,90599
România[1]/Sud-Est		x	y = -0.0023x + 0.1671	0,01508	9,96499	$y = 0.1664e^{-0.015x}$	0,01492	9,86227
Slovenia/Zahodna Slovenija	x		y = 0.0054x + 0.6134	0,01478	2,25955	$y = 0.614e^{0.0083x}$	0,01493	2,28148
Slovacia[1]/Stredné Slovensko		x	y = 0.0045x + 0.2802	0,01883	6,03942	$y = 0.2825e^{0.0137x}$	0,01861	5,96816
Finlanda/Pohjois-ja Itä-Suomi		x	y = 0.002x + 0.2975	0,01921	6,14218	$y = 0.2984e^{0.006x}$	0,019205	6,13911
Suedia[1]/Västsverige	x		y = 0.0002x + 0.2148	0,00388	1,79607	$y = 0.2148e^{0.0009x}$	0,00388	1,79627
Croaţia/Jadranska Hrvatska	x		y = 0.0011x + 0.8654	0,00997	1,14145	$y = 0.8653e^{0.0012x}$	0,00997	1,14158

Source: calculated after Eurostat statistics, http://www..ec.europa.eu/eurostat.

[1]. it was chosen the function with the lowest error coefficient.

Assessing Changes lin Maternal Healthcare Utilization In India: A Difference-in-Difference Analysis Between NFHS-IV and NFHS-V

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ABSTRACT

Maternal health outcomes in India vary substantially across regions, emphasizing the need for state-level analysis. This study constructs a composite index to evaluate maternal healthcare conditions in Indian states at two-time points: 2015-16 and 2019-21 based on NFHS IV and NFHS-V data. The states are ranked according to the composite index value. Higher values imply better position of the states. Using a Difference-in-Differences (DiD) regression model, it investigates whether disparities in maternal healthcare have diminished over time. Findings reveal that the gap between the lowest-performing and best-performing states has narrowed in NFHS-V, suggesting overall improvements in maternal healthcare services. This trend reflects enhanced accessibility and quality of care, particularly in historically underperforming states over period

Keywords: *Difference-in-Difference, NFHS, Maternal Health Care, Multiple Comparisons, Regional Disparities*

JEL classification: *I15, J13, O15*

1. INTRODUCTION

Health is a fundamental pillar of human life, and within the broader spectrum of healthcare, maternal and child health (MCH) holds a particularly critical position. The well-being of mothers and children serves as a key indicator of a nation's overall health status and overall development of the society. Strong maternal and child healthcare systems reflect not only the

quality of medical services available but also the level of priority given to public health by policymakers. Maternal health inequalities persist as a critical issue in India, with notable differences in outcomes among various states and demographic groups (Aliyu, 2018; Sarkar *et al*., 2023). Access to healthcare services plays a crucial role in ensuring the well-being of individuals and communities. In a country like India, where economic and social disparities persist, the healthcare sector is no exception to have unequal distribution of resources. Assessing the implementation and effectiveness of government policies with time in MCH is essential to understand the extent to which healthcare resources are equitably allocated across the nation.

India has executed several government initiatives to improve the healthcare sector, focusing on areas such as maternal and child health, nutrition, and immunization. Programs like the National Health Mission (NHM) and Pradhan Mantri Jan Arogya Yojana (PMJAY) aim to provide affordable and accessible healthcare to all. Yet accessibility and affordability remain critical issues, particularly in rural areas (S. K. Singh & Arnold, 2023). In an era where data-driven policymaking is essential, the availability of accurate and comprehensive healthcare data is crucial for evaluating the effectiveness of these interventions (Betrán *et al.*, 2016; Kiran *et al*., 2022). A systematic empirical analysis of the distribution and accessibility of MCH facilities across different states can provide actionable insights into healthcare resource allocation. This analysis will assist in assessing the degree of regional variations in maternal healthcare availability at two different time periods, thus providing a more comprehensive view of the changing overall healthcare environment of the country.

India, being a diverse and populous country, shows considerable regional inequalities in numerous socioeconomic and healthcare indicators. The country's vast geographical area, along with disparities in economic growth, infrastructure, education levels, and governance, has resulted in significant differences in public health results among states (NITI Ayog, 2019). States in the south and west, including Kerala, Tamil Nadu, and Maharashtra, have achieved significant progress in healthcare thanks to improved infrastructure, increased literacy levels, and successful policy execution. Conversely, states in the north and central regions, such as Bihar, Uttar Pradesh, and Madhya Pradesh, persist in facing challenges due to insufficient healthcare services, limited health awareness, and socioeconomic barriers that impede advancement (Paul *et al*., 2011). These inequalities are evident in various health indicators, such as maternal mortality rates, child mortality rates, immunization levels, and availability of crucial healthcare services, etc.

2. STATEMENT OF THE PROBLEM

Maternal health outcomes are vital indicators of the quality of healthcare systems and signify the overall well-being of populations, especially in developing countries. In a country like India, maternal health disparities exist at large and symbolize the unequal distribution of maternal health outcomes and access to maternal health services among various demographic groups. These disparities often emerge along with economic status, geographic area, and other social factors. For example, people from historically disadvantaged racial or ethnic communities and low-income backgrounds often face elevated rates of maternal mortality and morbidity, along with restricted access to quality prenatal, delivery, and postpartum care. Addressing maternal health disparities is essential for public health since maternal mortality and serious morbidity can predominantly be avoided with appropriate medical care. Improving maternal health outcomes benefits families, communities, and economies, as it reduces healthcare costs associated with maternal complications, promoting healthier future generations (Souza *et al.,* 2024). Furthermore, maternal health is a key indicator of overall healthcare system quality and reflects broader health inequities that need to be tackled to achieve universal health coverage and equity. By addressing these disparities, public health efforts can work toward a more equitable healthcare system that improves life expectancy, reduces infant mortality, and promotes gender and racial equity.

The National Family Health Surveys (NFHS) are instrumental in collecting maternal and child health-related data in addition to other health-related information. This information can provide valuable insights into health trends and disparities over the years-if properly dealt with. The shifting trends in maternal health indicators, such as antenatal care, institutional deliveries, and postnatal care, can be seen by analysing the NFHS IV (2015-16) and NFHS V (2019-21) data. In India, disparities persist across states, regions, and socioeconomic groups, making it essential to assess how these gaps have evolved over time (Jha & Chandrakar, 2024). While improvements are evident in several areas, including higher rates of full immunization and lower child mortality, disparities persist across states and socioeconomic groups (Tripathi *et al.*, 2023). This comparison will help policymakers to assess whether government interventions have successfully bridged gaps in healthcare access and outcomes across regions.

This study employs a Difference-in-Difference (DiD) regression approach to compare maternal health outcomes between NFHS IV and NFHS V, focusing on disparities across Indian states. The DiD method is a two-dimensional econometric technique that enables the estimation of causal effects

by examining changes over time while simultaneously comparing differences between groups. In this study, the two dimensions of comparison are (i) Time Periods: NFHS IV (2015-16) and NFHS V (2019-21) and (ii) Groups of States: The top-performing states and the bottom-performing states in maternal health indicators. The key objective of this analysis is to determine whether the gap in maternal health outcomes between the top and bottom states has narrowed over time. Using the DiD framework, this study aims to isolate the effect of time-related policy changes and interventions on maternal health disparities. Understanding these disparities is crucial for guiding policy interventions aimed at improving maternal health across India (Ali *et al*., 2021). This kind of longitudinal study is important for understanding how maternal healthcare in India has changed over time. By comparing data from NFHS IV (2015-16) and NFHS V (2019-21), we can track improvements in services like antenatal check-ups, institutional deliveries, and postnatal care, while also identifying gaps where progress is slow, such as inequalities between states or rural and urban areas. It helps measure the impact of government policies and programs introduced between the two periods, providing a clearer picture of maternal health trends. This understanding is crucial for designing better policies to ensure safe pregnancies and childbirth for all women.

3. REVIEW OF THE LITERATURE

India has been facing a significant challenge with a high rate of maternal mortality and morbidity (Meh *et al.*, 2022). Although considerable progress has been achieved in recent years through various health programs launched time to time by the government concerning maternal and children's health, the extent of influence of these health programs differs significantly from one state to another (Hamal *et al.*, 2020). There is significant variation in maternal health indicators across various states in India, influenced by the rural-urban distribution, differences in socio-economic status between rich and poor, levels of education, and the accessibility of health services (Bango & Ghosh, 2022). By analysing the status of maternal health indicators over time, we can identify trends and assess the effectiveness of policies and interventions in different states. This allows for targeted improvements and resource allocation to areas that need it the most. Regular monitoring also helps to ensure that progress is being made and that disparities are being addressed effectively. Research utilizing NFHS data has consistently highlighted significant regional differences in maternal health indicators, reflecting socio-economic and healthcare inequalities across various regions (Goala *et al*., 2024). These results emphasize the necessity for localized policy initiatives and targeted

healthcare intervention to address existing gaps. (Sarkar *et al.,* 2023) studied the maternal health situation in Jammu Kashmir by comparing the NFHS IV and NFHS V data for maternal healthcare indictors. The study reveals that there are significant improvements in maternal healthcare provision and utilization of factors like antenatal care, iron and folic acid consumption, neonatal tetanus protection whereas a few factors like anaemia prevention, cost of delivery have worsened.

(Narayan & Yadav, 2021) compared maternal health indicators in Bihar and Assam based on data from NFHS IV and NFHS V. In the results of first trimester check-ups, Bihar have increased from 34.6 percent to 52.96 percent, whereas Assam has jumped to 63.8 percent from 55.1 percent. They suggested more involvement of grassroot-level workers for counselling the pregnant mothers and imparting IEC activities for utilization of maternal health services.

The use of difference-in-difference (DiD) analysis in maternal health studies has provided important insights regarding the effects of different interventions and external factors on maternal health outcomes. This approach enables researchers to examine variations over time between a treatment group and a control group, successfully isolating the impacts of particular interventions or events. (Sugg *et al.,* 2023) studied the impact of natural disasters on maternal health. Research on the 2015 South Carolina floods revealed a notable rise in severe maternal morbidity (SMM) and low birth weight for women exposed during particular trimesters, even though there were no overall significant impacts on other maternal health metrics. This emphasizes the subtle influences of environmental stressors on maternal well-being, indicating that timing and context are essential for comprehending these effects. A study by (Nandi *et al*., 2022) in Bangladesh found that the implementation of the Maternal Health Voucher Scheme (MHVS) was linked to a higher likelihood of giving birth in a medical facility. This result is consistent with the main goal of the program, which is to enhance access to institutional deliveries for expectant mothers.

Though the review of literature has seen the availability of numerous studies on the maternal healthcare situation in India or in select Indian states, the best of search does not enrich us with the comparison of the maternal healthcare situation in India or of the Indian states over different time periods. Thus, this research is an attempt to take care of this unattended problem. In this paper, our main aim is to compare the change that has taken place in the top 10 and bottom 10 states of India, in terms of maternal health care, from NFHS IV to NFHS V.

4. OBJECTIVE OF THE STUDY

The main objectives of the study are:

(i) To calculate the composite index based on NFHS IV and NFHS V data on the maternal healthcare parameters of the Indian states/UTs so as to felicitate comparison.

(ii) To examine if the difference between the top and bottom ranked states in the maternal healthcare has changed in NFHS V compared to what it was NFHS IV.

5. METHODOLOGY

The methodology of the study, followed to attain the objectives are placed in the following discussion through several sub-sections.

5.1. Data Source and Variables

To develop the composite index of maternal healthcare for two-time periods viz. 2015-16 (NFHS IV) and 2019-21 (NFHS V) the parameters considered are as follows:

- X_1 = Mothers who had at least 4 antenatal care visits (%)
- X_2 = Mothers who had an antenatal check-up in the first trimester (%)
- X_3 = Mothers whose last birth was protected against neonatal tetanus (%)
- X_4 = Mothers who consumed iron folic acid for 100 days or more when they were pregnant (%)
- X_5 = Registered pregnancies for which the mother received a Mother and Child Protection (MCP) card (%)
- X_6 = Mothers who received postnatal care from a doctor/nurse/ LHV/ANM/ midwife/other health personnel within 2 days of delivery (%)

The data for the variables are collected from *State Fact Sheets* of both NFHS IV and NFHS V, which are available in the website[1] of NFHS. These variables are considered as the maternal health indicators for the current study.

5.2. Developing the Composite Index of Maternal Healthcare

The composite index is developed for each state/UT combining the values of the different parameters (X_1 to X_6) mentioned above, for NFHS IV.

5.2.1 Normalization of the Parameters

The raw values of the parameters are normalized using the max-min rule mentioned below. If x_{ij} represents the value of the i^{th} state (with n be the total

1. https://www.nfhsiips.in/nfhsuser/publication.php.

number of states/UTs) of the j^{th} parameter. The normalized value of x_{ij}, is redefined as y_{ij} and is as follows

$$y_{ij} = \frac{x_{ij} - \min_i(x_{ij})}{\max_i(x_{ij}) - \min_i(x_{ij})} \quad [1]$$

such that $0 \leq y_{ij} \leq 1, \mathrm{i} = 1, 2, \ldots, n \text{ and } j = 1, 2, \ldots, 6$

5.2.2. Determination of Weights and Computing the Composite Index

Following normalization of the parameters, the composite index of Maternal Healthcare for the i^{th} state i.e. (CI_i) is given by the linear combination of the normalized values:

$$CI_i = \sum_{j=1}^{6} w_j \times y_{ij} \text{ where } \sum_{j=1}^{6} w_j = 1 \quad [2]$$

where w_j are the weights, which also reflect the relative importance of the j^{th} parameter in the composite index. This value of $w_j s$ (j = 1, 2, …, 6) remains fixed for all the states/UTs. There are different methods of determining the weights $w_j s$ - either objectively from the data or subjectively (mostly based on the expert opinion). However, Goala *et. al*, (2024) showed that for NFHS based data, considering both robustness and sensitivity of the composite index of Maternal Health Care, the *Ordered Weighted Average* (OWA) method of weighting outplays the other methods of weighting. Accordingly, in this exercise the OWA method is used for determining the weights of the composite index.

(Yager, 1988) introduced the concept of *Ordered Weighted Average* (OWA). The main objective of the technique is to determine the weights of the different components participating in the formation of the composite index.

The weighted composite index for maternal healthcare for the i^{th} state is given by,

$$CI_i = \sum_{j=1}^{6} w_j y_{ij} \quad [3]$$

where y_{ij} is the i^{th} largest observation of the normalized matrix and w_j are the corresponding weights with the ordered values of the component y_{ij} such that

$$w_j > 0, \sum_{j=1}^{6} w_j = 1, \forall j \quad \ldots [4]$$

Accordingly, some OWA operators are defined as the entropy function explaining the dispersion in the weights,

$$Disp(w_j) = -\sum_{j=1}^{6} w_j \, ln(w_j) \quad [5]$$

and some OWA operator is called the orness and is defined as,

$$\alpha = Orness(w_j) = \frac{1}{6-1}\sum_{j=1}^{6}(6-j)\, w_j \quad [6]$$

The OWA weights are determined using the linear programming method minimax disparity rule proposed by (Wang & Parkan, 2005). The objective function is

Minimize δ [7]

such that $\sum_{j=1}^{6}\left(\frac{6-j}{6-1}\right) w_j = \alpha$, where $\alpha \in [0, 1]$, $w_j > 0$ [8]

$\sum_{j=1}^{6} w_j = 1 \ \ \forall\, j$ and $| w_j - w_{j+1} | \leq \delta, j = 1, 2, \ldots, j\text{-}1$ [9]

the ultimate value of the composite index shall lie between the highest and the lowest value of the participating components in forming the index. One can find a detailed description on the OWA method of weighting in (Bhattacharjee & Bhattacharjee, 2021) and in Goala *et al.* (2024).

5.3. The Difference in Difference Regression Model

DiD design has a solid foundation in public health research (Dimick & Ryan, 2014). It originated in the mid-nineteenth century, when John Snow was studying the cholera epidemic in London and its connection to the water source provided to the residents, and finally his study findings revealed that cholera spreads through contaminated water, not through the air (Snow, 1849). This experimental design is quasi-experimental in nature, utilizing time series data from two distinct time periods-one pre-event and one post-event - to compare two groups, typically referred to as the treatment and control groups, in order to determine a causal effect of the event through the use of a counterfactual. In other words, the technique measures the impact of a particular event (such as economic reforms, new legislation, major program implementation, etc.) by analyzing how the effects differ over time between two groups: one receiving the intervention (treatment group) and one not (control group) (Wing *et al.,* 2024).

Here, we apply the DiD regression modelling to examine if the difference between the top ten Indian states in-terms of maternal healthcare (measured by the afore mentioned composite index) with that of the bottom ten states have changed over the two different NFHS survey periods viz. 2015-16 and 2019-21.

STEP I: Initially, we compute the CI_i as in (1) for the NFHS IV data and identify the top ten and the bottom ten Indian states and consider them as the treatment group and control group respectively.

STEP II: Once again, the CI_i values are computed for the Indian States for the NFHS V data and the CI values of the top ten and bottom ten states (as identified with NFHS IV) are considered for further analysis.

These two steps provide us with sufficient data to run the DiD regression model. We accordingly define, the following variables:

- *Status* (s_i): An indicator variable which takes the value 1 if the i^{th} state is in the top ten group and 0 if the state is in the bottom 10 group as per *CI* computation based on NFHS IV data.
- *Time_Stamp* (t): An indicator variable which takes the value 0 if the corresponding composite index *CI* value is based on NFHS IV data and 1 if the same is based on NFHS V data.
- and the DiD estimator, which is the interaction between Status and *Time_Stamp*
- We also re-denote the weighted composite index for maternal healthcare for the i^{th} state to CI_{it} instead of CI_i where the subscript 't' is the timestamp indicating the index of the i^{th} state corresponds to NFHS IV or NFHS V data.

Thus, the ultimate form of the DiD model is as

$$CI_{it} = \beta_0 + \beta_1(t) + \beta_2(s_i) + \beta_3(t) * (s_i) + \in \quad [10]$$

The tests of significance of the DiD model [10] along with the significance status of the partial regression coefficients shall enable us to attain the second objective of the study. Here, β_1 indicates the significance of the time variable, β_2 highlights if the top states significantly differ in terms of the average composite index for maternal healthcare between the top and bottom state and β_3 is the partial regression coefficient that signifies the difference-in-difference of the top and bottom states in the two data sets (viz. NFHS IV and NFHS V) i.e. the two timestamps. All the β's are deduced by the OLS method using the data arranged in proper format as required by the regression model.

6. CALCULATION AND RESULT

6.1. Outcome of the Regression Model

The data arranged and the composite indicators for both NFHS IV and NFHS V are calculated in Microsoft Excel. The detailed values of composite index for NFHS IV and NFHS V are provided in Appendix A: Table A1. The data needs to be arranged is a machine-readable flattened format with proper dummy codes that can be implemented in statistical packages. In this case

the DiD regression model is computed using the R-software. The output is as given below:

The Estimated Coefficients of the *DiD* Regression model along with the significant tests

Table 1

Coefficients	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.80417	0.03469	23.184	2×10^{-16}
Time Stamp (t)	0.02994	0.04905	0.610	0.5455
Status (s_i)	-0.40205	0.04905	-8.196	9.49×10^{-10}
Interaction Time Stamp (t) and Status (s_i)	0.14398	0.06937	2.075	0.0452

The Multiple R-square value of the regression is 0.7419, while the value of Adjusted R-square is 0.7204. The value of F-statistic is 34.5 for (3, 36 df) and the corresponding p-value: 1.096×10^{-10} indicating that the DiD regression model is significant given the data. The fitted equation is as follows:

$$y_{ijk} = 0.80417 + 0.02994(t) - 0.40205(s_i) + 0.1440 * (t) * (s_i) + \in \quad [11]$$

The analysis indicates that the coefficient concerning the time stamp is 0.02994 is not significant at the 5 percent level as the p-value is 0.5455. Therefore, we cannot reject the null hypothesis and continue to believe that there was no significant change in rankings across all states have taken place between NFHS IV and NFHS V. Though some specific states shifted positions, there was no general trend affecting all the top and bottom states. The overall ranking distribution across all states remained relatively stable between NFHS IV and NFHS V, even though some specific states changed position.

The coefficient of status effect (-0.40205) is statistically significant at the 5 percent level, since p-value = 9.49×10^{-10}, confirms that the initial rankings had clear differences between top and bottom states both in NFHS IV and NFHS V. The highly significant p-value ($p < 0.001$) confirms that these differences were strong and not due to random chance. There was a clear gap between the composite index for maternal healthcare for the top 10 and bottom 10 states, which is expected.

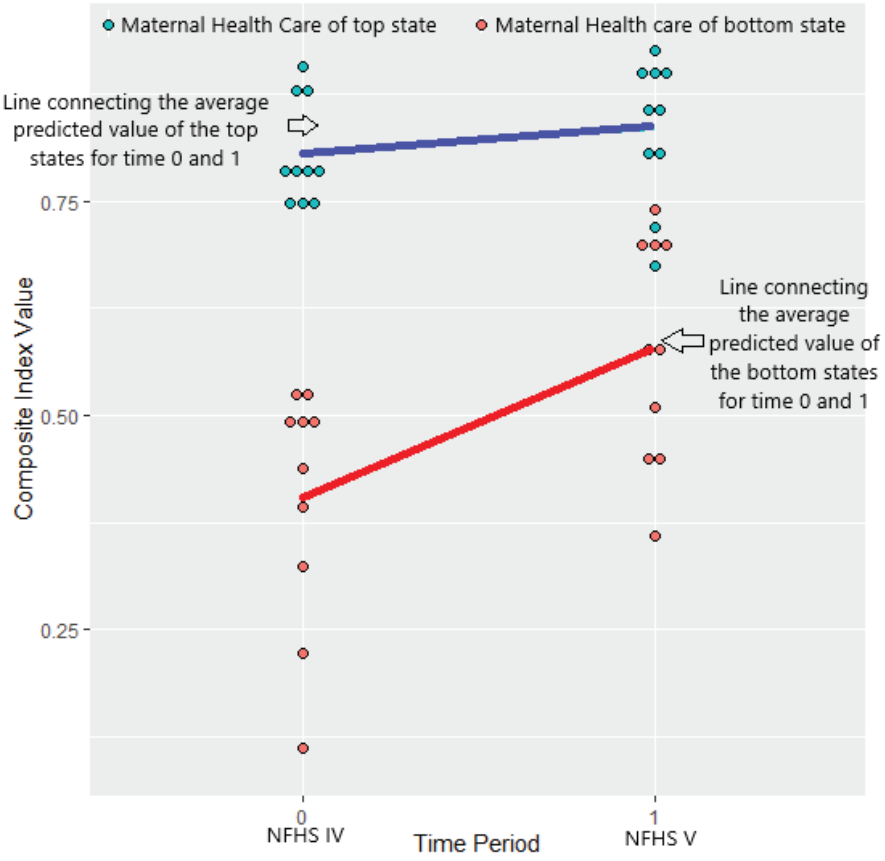
The partial regression coefficient of the interaction term is 0.1440 and is statistically significant at the 5 percent level with p-value of 0.0452 indicating that the difference-in-difference for the response variable is significant for the top and bottom states between NFHS IV and NFHS V. Change in rankings for the states suggests movement in rankings over time.

If all states maintained their top 10 or bottom 10 positions from NFHS IV to NFHS V, the interaction term should have been zero or near zero. A near-zero and insignificant interaction term would mean that there were no systematic changes in ranking for the states. However, since the partial regression coefficient of the interaction term is positive and significant, it suggests real movement in rankings—some top states in NFHS IV dropped out, and some bottom states moved up.

Figure 1, which is termed as the interaction plot of the DiD model, considers the time period as a categorical variable along the *X*-axis and the value of the composite index concerning maternal healthcare along the *Y*-axis. The time period is discrete, and only two of them, *viz.,* NFHS IV represented by 0 and NFHS V represented by 1, are considered. The red dots represent the value of the composite index of maternal healthcare for the bottom states, and the blue dots represent the same for the top states. The position of their alignment tells the time period they represent, as evident from the figure. Based on the DiD model as defined in [10] the predicted average performance of the top and bottom states is computed for the two different time periods and is displayed in the graph through red and blue lines connecting them. One may observe that the slope of the blue line is less than the red line, indicating that the difference between the bottom states in maternal healthcare has decreased with that of the top states in NFHS V compared to the extent of the difference in NFHS IV. The visualization complements the finding of the fitted regression model that the bottom states have improved a lot over the time period compared to the top states between the two surveys in terms of maternal health care.

The DiD Interaction Plot (Visualizing the Model Based Prediction) for maternal health care index based on NFHS IV and NFHS V

Figure 1



7. DISCUSSION, DIRECTION OF FUTURE RESEARCH AND CONCLUSION

The research highlights the evolving nature of maternal healthcare disparities across Indian states, as evident from the recent shifts in state rankings between NFHS IV and NFHS V. The study reveals that maternal healthcare has declined in several states, including Andhra Pradesh, Telangana, Maharashtra, Punjab, Haryana, Jammu & Kashmir, Sikkim, Mizoram, Tripura, Assam, and Meghalaya. While the prevalence of maternal healthcare

is increasing in states such as Chandigarh, Odisha, West Bengal, Tamil Nadu, Dadra & Nagar Haveli, Gujarat, Chandigarh, Delhi, Haryana, Uttarakhand, Rajasthan, Madhya Pradesh, and Uttar Pradesh.

The findings from this study also indicate that Sikkim and Punjab have shown a significant decline in maternal healthcare indicators, positioning them among the most affected states in India. According to NFHS V (2019–21), key maternal health services, such as antenatal care (ANC) visits, postnatal care, etc., have deteriorated in Sikkim compared to NFHS IV (2015–16). Similar findings have been reported by (Swain & Jena, 2024) who highlight that Sikkim is one of the states with a significant decline in antenatal and postnatal care services. Their research examines trends in maternal healthcare across multiple NFHS surveys and confirms that maternal health outcomes in Sikkim have worsened over time, indicating gaps in healthcare accessibility and service delivery. (Roy *et al.*, 2023) identified that the quality and accessibility of antenatal care services in Punjab have deteriorated, primarily due to weaker community health programs and shortages of healthcare staff. Similarly, (Singh *et al.,* 2024) emphasized that economic constraints and a lack of maternal health awareness have been key contributors to this decline. Moreover, the COVID-19 pandemic significantly disrupted maternal healthcare services in Punjab. A study by (Longchar *et al.,* 2025) emphasises that COVID-19 restrictions led to delayed hospital visits, fear of infection, and diminished healthcare outreach, leading to decreased use of antenatal and postnatal care. Economic disparities further worsen the issue. (Ali *et al.*, 2020) analyzed wealth-based inequalities in maternal healthcare and found that Punjab is among the states with worsening healthcare accessibility for lower-income groups. The NFHS-5 data supports this, showing that wealth disparities have increased, making it more difficult for economically weaker sections to access essential maternal healthcare services.

The application of Difference-in-Differences (DiD) modelling reveals that states show diverse patterns of progress, challenging the notion of static regional disparities. These findings emphasize the importance of state-specific policy interventions, continuous monitoring, and adaptive healthcare strategies to sustain progress in maternal health outcomes. Additionally, the study underscores the importance of continuous monitoring and evaluation, as shifts in rankings indicate that health policies must be adaptive to changing socio-economic and healthcare landscapes. Prior studies on maternal health disparities in India have primarily focused on cross-sectional analyses or specific policy interventions (Joe *et al.,* 2018; Paul *et al*., 2011). The use of DiD modelling in this study contributes to the literature by providing a longitudinal perspective, capturing dynamic changes in state-level maternal

health performance. In contrast to the previous studies that emphasized persistent regional inequalities, this study highlights the dynamic character of state rankings, suggesting that progress is not linear and is influenced by state-specific health policies and socio-economic changes within the states.

Although this study offers important perspectives on regional differences in maternal health results by utilizing NFHS IV and NFHS V data, some limitations should be recognized. The research is limited by the availability and quality of data; while NFHS surveys are generally strong, they might include self-reported biases and inconsistencies among different states. Although the study emphasizes variations in state rankings, it fails to determine the causality for the observed changes, requiring additional investigation into the fundamental policy, economic, and healthcare system factors.

Future studies should employ mixed-method approaches to examine why certain states improved or declined in maternal health rankings. Evaluating the effectiveness of Janani Suraksha Yojana (JSY) and other maternal health programs through quasi-experimental methods can provide insights into policy efficacy. Extending the analysis to subsequent NFHS surveys and other health datasets (e.g., National Health Mission reports) can assess the sustainability of observed trends. Disaggregating data by caste, income, and rural-urban divides can provide a deeper understanding of intra-state disparities in maternal health outcomes. Comparative studies with other developing nations using similar methodologies can offer broader policy lessons on tackling maternal health disparities, but in the case of such a comparison one has to ensure the uniformity of available data in terms of time and accuracy.

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APPENDIX A

Values of Composite Indicator and Rank for NFHS IV and NFHS V -Maternal Healthcare

Table A1

State	NFHS IV		NFHS V	
	Composite Indicator	Rank of the states	Composite Indicator	Rank of the states
Andaman & Nicobar Islands	0.7793	6	0.8589	6
Andhra Pradesh	0.7888	5	0.8186	9
Arunachal Pradesh	0.2234	34	0.4441	34
Assam	0.5465	25	0.6552	27
BIHAR	0.3245	33	0.4535	33
Chandigarh	0.7444	10	0.8552	7
Chhattisgarh	0.6342	22	0.7028	23
Dadra & Nagar Haveli	0.6487	16	0.8116	11
Delhi	0.6422	19	0.8119	10
Goa	0.8836	2	0.9247	1
Gujarat	0.6351	21	0.7973	12
Haryana	0.5945	23	0.7636	16
Himachal Pradesh	0.6783	13	0.7823	14
Jammu & Kashmir	0.6790	12	0.7606	17
Jharkhand	0.4384	31	0.5718	31
Karnataka	0.6463	17	0.7529	18
Kerala	0.8729	3	0.8905	4
Lakshadweep	0.9077	1	0.9091	2
Madhya Pradesh	0.4960	29	0.7405	19
Maharashtra	0.6878	11	0.7320	20
Manipur	0.5170	27	0.6893	25
Meghalaya	0.4864	30	0.5099	32
Mizoram	0.6354	20	0.6498	28
Nagaland	0.1115	35	0.3589	35
Odisha	0.6745	14	0.8270	8
Puducherry	0.7922	4	0.8981	3
Punjab	0.7446	9	0.7202	21
Rajasthan	0.5313	26	0.7026	24

Sikkim	0.7785	7	0.6740	26
Tamil Nadu	0.6562	15	0.8819	5
Telangana	0.7497	8	0.7918	13
Tripura	0.5706	24	0.6202	29
Uttar Pradesh	0.3925	32	0.5807	30
Uttarakhand	0.5002	28	0.7091	22
West Bengal	0.6423	18	0.7647	15

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Structure and Performance Of Romanian Agriculture in the European Context: An Integrated Analysis Of Romania's Production, Areas and Trade

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ABSTRACT

The article analyzes in depth the structure and performance of Romanian agriculture during the period 2000–2023, in the context of European integration. Based on INS and Eurostat data, the trend of decreasing number of agricultural holdings, structural polarization and crop orientation towards cerealss, sunflowers and rapeseed is highlighted. Compared to other EU member states, Romania has a significant agricultural area, but yields below the EU average. Trade in agri-food products remains unbalanced, due to the preponderance of exports of raw materials and imports of processed products. The need for a strategic transition towards added value, modernization and sustainability is noted in order to increase the competitiveness of the sector.

Keywords: *agricultural holding, utilized agricultural area, production, import, export, trade balance*

INTRODUCTION

Agriculture, a strategic sector of the Romanian economy, makes a significant contribution to employment, ensuring food security and maintaining socio-economic balance in rural areas. Although the share of agriculture in GDP has decreased in recent decades due to the modernization of the economy (3.3% in 2024), this sector continues to play an important role, especially through the extensive agricultural areas, high productive potential and diversity of crops.

In the context of European integration and the Common Agricultural Policy, Romanian agriculture has experienced significant structural transformations. The number of agricultural holdings has decreased, but the average agricultural area per holding has gradually increased, in parallel with a slow process of land consolidation. At the same time, strong regional

discrepancies have emerged in terms of the use of agricultural area and the degree of mechanization.

The objective of this article is to analyse the developments and particularities of the agricultural sector in Romania, through the following factors:

- the structure of agricultural holdings and the utilized agricultural area (UAA);
- distribution of UAA by main use categories;
- cultivated areas with main crops and related production;
- comparison of agricultural indicators between Romania, the European Union and some member states;
- dynamics of exports, imports and the balance of the agri-food trade balance.

The analysis is based on official statistical data disseminated by the National Institute of Statistics and Eurostat for the period 2000-2023, using descriptive and comparative methods to outline a relevant picture of the developments of the Romanian agricultural sector in the European context, considering both internal dimensions (structure of holdings, agricultural area, production) and external ones (trade in agri-food products).

LITERATURE REVIEW

Analyses of Romanian agriculture highlight its strategic role in the economic development and social stability of the country. Numerous studies published in the last decade address the interactions between the utilized agricultural area, the production structure, trade performance and GDP, providing a broad picture of the potential and challenges of national agriculture.

An essential direction in recent literature aims to analyse the relationship between trade flows in agri-food products (especially exports) and economic growth. For example, Colan et al. (2019) demonstrated, by applying a Cobb-Douglas function, that variations in cereals exports significantly influence national GDP. Similar findings are supported by Dumitriu & Stefanescu (2015), who highlight the existence of a causal relationship between exports and economic growth through VAR models applied to Romanian data post-accession to the EU.

Another frequently addressed topic is the unbalanced structure of the agri-food trade balance. Gavrilescu (2022), Stoica (2024) and Istudor et al. (2022), Virva (2025) showed that Romania continues to export mainly raw materials (wheat, corn, oilseeds), while imports are dominated by

processed products with high value added (meat, dairy, canned goods). These imbalances translate into recurring trade deficits, despite the good quantitative performance of agriculture in favourable agricultural years.

The literature also includes analyses of the efficiency of agricultural land use and yields of main crops. Although Romania has one of the largest agricultural areas in the EU (Popescu, 2023), yields per hectare remain below the European average, due to poor infrastructure, fragmentation of holdings and low levels of mechanization. Venig (2015), Andrei et al. (2017), Virva (2025) emphasize, in this sense, the need for coherent public policies that support the modernization and economic integration of the agricultural sector.

An emerging theme in the specialized literature is the need to reorient agricultural policies from a model based on volume and export of raw materials to one focused on value added, internal processing and economic and ecological sustainability. Recent studies converge in recommending investments in processing infrastructure, support for cooperatives and the promotion of Romanian agri-food products on external markets.

In conclusion, the specialized literature provides a solid theoretical basis for understanding the structural challenges of Romanian agriculture and proposes strategic development directions, also relevant for the analysis presented in this article.

METHODOLOGY

The analysis proposed in this study is based on a quantitative-descriptive approach, supplemented with elements of comparative analysis and synthetic evaluation of statistical indicators in the agricultural and external trade domains. The aim is to provide a clear picture of the developments of the Romanian agricultural sector in the European context, considering the structure of holdings, agricultural area, production, import and export of agri-food products.

The statistical data used in this research were extracted from the following official sources:

• National Institute of Statistics (INS) – TEMPO online database (www.insse.ro), for indicators on agricultural holdings, agricultural area used, crop structure and agricultural production obtained.

• Eurostat – NewCronos database - for comparative data between Romania and other EU member states on agricultural area, yields of main crops and indicators of foreign trade in agri-food products.

The study covers the period 2000–2023, depending on the availability of data at the time of analysis. This period allows the identification of long-

term trends, under multiple influences (EU accession, economic crisis, SARS-COV 2 pandemic, conflict in Ukraine, etc.) and the capture of the effects on Romanian agriculture.

The main indicators analysed in the study are:

– Agricultural holdings: total number, legal structure (natural person/ legal entity).
– Utilized agricultural area (UAA): total and by use categories (arable land, pastures, hayfields, orchards, vineyards).
– Crop structure: areas cultivated with wheat, corn, sunflower, barley, rapeseed, etc.
– Physical agricultural production: expressed in tons and yields (kg/ha).
– Agri-food exports and imports: values expressed in euros, broken down by product groups.
– Trade balance: difference between exports and imports, expressed in euros.

The analysis methods used are:

– Descriptive analysis: used to show annual developments and percentage variations of the indicators.
– Comparative analysis: between Romania, the European Union average and other relevant member states;
– Synthetic indicators:
    - Evolution indices (current year compared to the base year).
    - Coefficient of variation – for measuring the stability of production or yields.
– Graphical visualizations and comparative tables
– Econometric model type VEC (Vector Error Correction Model)

RESULTS AND DISCUSSION

Agricultural holdings and utilized agricultural area (UAA)

The structure of agricultural holdings in Romania has undergone significant changes in the last two decades. The data show a general trend of decreasing the total number of agricultural holdings, both among individual and legally organized ones, in the context of a slow process of consolidation of agricultural land (Table 1).

In 2002, Romania had about 4,485 thousand agricultural holdings, the majority (over 99%) representing individual households of the rural population. Their number decreased steadily in the following years, reaching 2,887 thousand in 2020. The annual decrease was on average about 2.42%, calculated based on the average annual compound rate of change:

$r = \sqrt[n]{\frac{V_f}{V_i}} - 1$ where:

- r represents the average annual rate of decrease; V_i is the initial value; V_f is the final value; n is the number of years between the two moments.

Holdings with legal personality, although in small numbers (between 17–31 thousand in the years analyzed), have experienced a more stable dynamic. These include commercial companies, private law legal entities or associative forms, with a greater capacity for capitalization and modernization. Although they represent a small percentage of the total number of holdings, they concentrate a considerable part of the utilized agricultural area and contribute significantly to agricultural production.

Number of agricultural holdings and UAA, by legal status

Table 1

Year	Number of holdings (thou)			Utilised agriculture area UAA (thou ha)			Growth/decrease rate compared to the previous year in series (%)					
	Total	without legal personality	with leagal personality	Total	by holdings without legal personality	by holdings with leagal personality	Total holdings	holdings without legal personality	holdings with leagal personality	Total UAA	UAA by holdings without legal personality	UAA by holdings with leagal personality
2002	4485	4462	23	13931	7709	6222						
2005	4256	4238	18	13907	9102	4805	-5.1	-5.0	-21.7	-0.2	18.1	-22.8
2007	3931	3914	17	13753	8966	4787	-7.6	-7.6	-5.6	-1.1	-1.5	-0.4
2010	3859	3828	31	13306	7450	5856	-1.8	-2.2	82.4	-3.3	-16.9	22.3
2013	3630	3602	28	13056	7271	5785	-5.9	-5.9	-9.7	-1.9	-2.4	-1.2
2016	3422	3396	26	12503	6927	5576	-5.7	-5.7	-7.1	-4.2	-4.7	-3.6
2020	2887	2862	25	12763	7817	4946	-15.6	-15.7	-3.8	2.1	12.8	-11.3

Source: produced by author based on INS data

This process of reducing the number of holdings is mainly influenced by the migration of the rural population, the aging of farmers, difficulties in transmitting farms between generations, administrative and fiscal barriers in establishing modern legal forms of organization. The consequence of this process, in the medium term, is the structural polarization of the agricultural sector, with a majority of small subsistence farms and a reduced number of large, commercial farms with access to technology, financing and external markets.

Use categories of UAA

The utilized agricultural area (UAA) of Romania registered a general trend of moderate decline between 2002 and 2020, constantly decreasing: from 13931 thousand hectares in 2002 to 12763 thousand hectares in 2020, a relatively slow decrease but reflecting pressures on agricultural land exerted by fragmentation, non-use, urbanization, changes in land use, etc.

Agricultural area used by main use categories

Table 2

thou ha

Usage categories/Years	2002	2005	2007	2010	2013	2016	2020
UAA	13931	13907	13753	13306	13056	12503	12763
From which							
Arable land (including greenhouses and solariums)	8774	8867	8691	8307	8198	7814	8571
Pastures and hayfields	4644	4530	4540	4506	4398	4246	3724
Permanent crops	344	339	344	311	302	301	344
Family gardens	169	171	178	182	158	142	124

Source: produced by author based on INS data

The distribution of UAA by main use categories highlights a preponderance of arable land, which represented, on average, 64% of the total UAA during the analyzed period. In 2020, arable land (including greenhouses and solariums) amounted to 8571 thousand ha, slightly increasing compared to 2016, but significantly decreasing compared to 2002 (8774 thousand ha). This fluctuation reflects a re-dynamization of cultivation in some areas of the country, but also the result of the abandonment of agricultural land or the reconfiguration of small-scale holdings.

Crop Structure and Production

The structure of cultivated areas in Romania reflects the predominantly cereals-based orientation of agriculture, with significant variations depending on climatic, market and agricultural policies conditions. During the period 2000–2023, the total cultivated area fluctuated between approximately 7700 thousand ha and 9001 thousand ha, recording the highest values in 2001–2002 and 2019, and a minimum in 2007 (7777 thousand ha).

Cultivated area and crop production, for the main crops

Table 3

Year	Cultivated area (thousands of ha)					Crop production (thousand tons)			
	Total	din care:							
		Cereals	Oil plant	Potatoes	Vegetables	Cereals	Oil plant	Potatoes	Vegetables
2000	8499.8	5655.2	1067.4	282.7	234.0	10477.5	868.5	3469.8	2527.8
2001	8905.0	6294.9	938.6	276.7	229.2	18870.9	1005.5	3997.1	2877.4
2002	9001.6	6038.1	1076.4	283.2	236.3	14356.5	1194.5	4077.6	2863.5
2003	8880.6	5541.8	1377.1	282.0	241.9	12964.4	1760.4	3947.2	3358.3
2004	8527.8	6265.4	1197.5	265.7	308.2	24403.0	1995.1	4230.2	4773.9
2005	8467.9	5865.7	1205.5	284.9	266.7	19345.5	1803.1	3738.6	3624.6
2006	7884.0	5114.4	1297.6	278.1	280.1	15759.3	2050.1	4015.9	4138.9
2007	7777.2	5129.2	1340.4	268.1	253.4	7814.8	1046.6	3712.4	3116.8
2008	7798.1	5210.7	1239.4	255.3	268.6	16826.4	1942.3	3649.0	3819.9
2009	7884.1	5282.4	1253.8	255.2	267.1	14873.0	1764.0	4004.0	3901.9
2010	7807.4	5040.6	1409.7	241.3	262.7	16712.9	2377.7	3283.9	3863.6
2011	8081.6	5224.7	1472.5	242.6	263.4	20842.2	2686.9	4076.6	4176.3
2012	8058.3	5440.3	1261.1	223.5	258.9	12824.1	1667.6	2465.2	3535.3
2013	8166.8	5421.2	1426.9	203.4	259.0	20897.1	2966.6	3289.7	3961.0
2014	8234.4	5443.2	1496.5	198.5	239.5	22070.7	3460.6	3519.3	3802.5
2015	8265.4	5468.3	1514.7	191.8	239.5	19332.8	2975.2	2699.7	3673.5
2016	8409.2	5487.0	1629.5	182.2	228.1	21764.8	3596.8	2689.7	3358.4
2017	8307.3	5192.3	1766.3	167.4	224.6	27138.9	4986.5	3116.9	3638.4
2018	8466.7	5257.2	1815.0	169.3	226.3	31553.3	5145.6	3022.8	3797.4
2019	8737.3	5569.1	1800.1	170.1	227.7	30412.4	4792.4	2626.8	3529.6
2020	8263.7	5338.1	1678.8	98.5	200.5	18153.7	3228.8	1601.2	3483.0
2021	8263.8	5351.5	1715.4	84.4	197.7	27791.3	4574.0	1397.8	3495.1
2022	8005.9	5183.8	1701.3	80.7	177.6	18860.7	3584.5	1345.8	2426.1
2023	8211.2	5168.5	1865.4	79.4	179.7	20784.7	4114.9	1183.5	2313.0

Source: produced by author based on INS data

Cerealss have consistently been the main crop, occupying between about 5000 and 6300 thousand ha annually, with a share of 60–70% of the total cultivated area. Wheat and maize predominate, reflecting the agricultural tradition and the favorable pedoclimatic conditions. However, after a peak in 2001 (6295 thousand ha), a slight downward trend was recorded, stabilizing around 5100–5300 thousand ha in recent years.

The category of oilseeds (mainly sunflower and rapeseed) has experienced a remarkable expansion, from approximately 938 thousand ha in

2001 to a peak of 1865 thousand ha in 2023, justified by the high demand at European level, but also by the need for farmers to adapt to more profitable and drought-resistant crops. The positive dynamics were also supported by the support schemes granted through the CAP.

The area dedicated to potatoes and vegetables has experienced a constant and steep decrease, from approximately 517 thousand ha in 2000 to 256 thousand ha in 2023. The reduction is almost 50% in two decades, reflecting the abandonment of crops that require a lot of manual labor and increased attention, labor migration, lack of irrigation and storage infrastructure, as well as competition with imports.

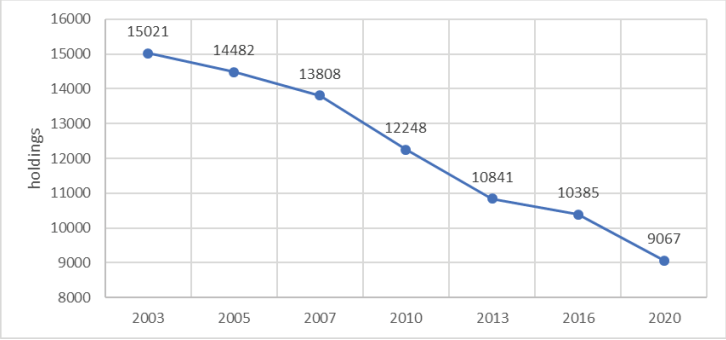
The trends highlighted above indicate a progressive specialization of Romanian agriculture on cerealss and oilseeds, to the detriment of vegetable growing. Although this orientation is economically justified, it may make the agri-food system vulnerable to external shocks or climate change, with implications for food autonomy and the diversification of domestic production.

Comparative analysis Romania vs European Union and some member states

At the level of the European Union, the trend of reducing the number of agricultural holdings is significant and long-term: in 2020 there were 9.1 million holdings, almost 40% fewer than in 2003 and 63.8% of the existing holdings in 2020 were under 5 hectares. Romania stands out for a significantly higher share of small-sized holdings (90.3% of the total of 2.9 million). At the same time, Romania concentrates about 32% of the total agricultural holdings in the EU, ahead of Poland (14%), Italy (13%), Spain (10%) and Greece (6%). These data highlight the fragmented nature of Romanian agriculture in relation to the European average.

Evolution of agricultural holdings in the EU between 2003 and 2020

Figure 1



Source: produced by author based on Eurostat, NewCronos data

The most important crops at EU level are cerealss, oilseeds (sunflower, rapeseed) and potatoes. For these crops, the top of the EU Member States by cultivated area and production shows the following:

Cultivated areas and production of main crops – top EU member states in 2023:

Table 4

Crop	% of cultivated area at EU level	Top of member states	% of EU production	Top of member states
Grâu	73.1	France (20,6%), Germany (12,0%), Poland (10,1%), Romania (9,6%), Spain (8,1%), Italy (7,7%), Bulgaria (5,0%)	74.8	France (27,0%), Germany (16,1%), Poland (9,7%), Romania (7,2%), Italy (5,2%), Bulgaria (5,1%), Hungary (4,5%)
Maize	84.7	Romania (26,5%), France (15,8%), Poland (15,1%), Hungary (9,3%), Bulgaria (6,4%), Italy (6,0%), Germany (5,6%)	80.1	France (21,0%), Poland (14,7%), Romania (14,3%), Hungary (9,3%), Italy (8,8%), Germany (7,4%), Spain (4,6%)
Sunflowe r	90.2	Romania (23,0%), Bulgaria (18,6%), France (17,5%), Spain (16,7%), Hungary (14,4%)	88.2	France (21,0%), Romania (20,5%), Hungary (20,0%), Bulgaria (18,1%), Spain (8,6%)
Rape	83.3	France (21,7%), Germany (19,0%), Poland (17,8%), Romania (10,4%), Czech Republik (6,1%), Lithuania (4,9%), Denmark (3,4%)	85.8	France (21,8%), Germany (21,5%), Poland (18,3%), Romania (9,1%), Czech Republik (6,7%), Denmark (4,2%), Lithuania (4,2%)
Potaoes	86.9	Germany (19,9%), France (15,4%), Poland (14,2%), Holand (11,7%), Belgium (7,2%), Romania (6,0%), Denmark (4,6%), Spain (4,5%), Italy (3,4%)	90.3	Germany (24,1%), France (17,9%), Holand (13,5%), Poland (11,6%), Belgium (8,4%), Denmark (5,7%), Spain (4,0%), Italy (2,6%), Romania (2,5%)

Source: produced by author based on Eurostat, NewCronos data

Wheat: Romania ranked fourth in the EU in terms of wheat area, after France, Germany and Poland; it obtained 7.2% of the total EU wheat production, also ranking fourth, after the same Member States mentioned.

Maize cerealsss: Romania cultivated the largest area of maize cerealsss in the EU, respectively 26.5%; and was in third place in production, after France and Poland.

Sunflower: Romania also ranked first in terms of sunflower area with 23.0% of the area cultivated with this crop at EU level and ranked second, after France.

Rapeseed: Romania ranked fourth, holding 10.4% of the EU rapeseed area. The largest rapeseed producers in the EU in 2023 were France and Germany, together covering 43.2% of total EU production.

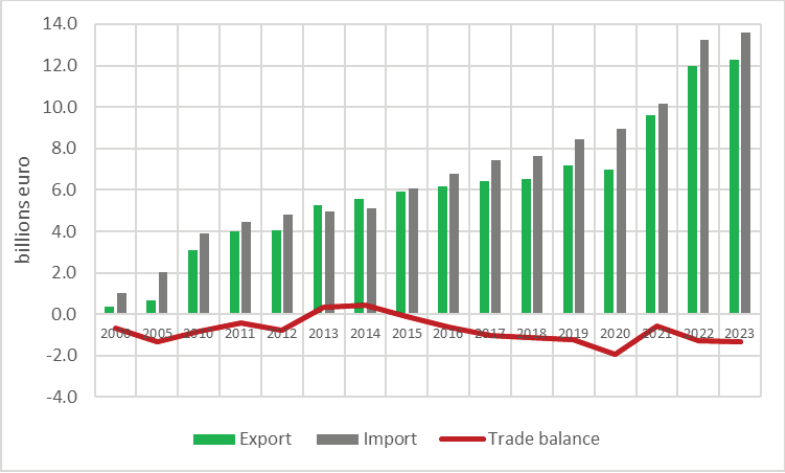
Potatoes: the area cultivated in Romania represented only 6% of that cultivated at EU level, but placed our country ahead of Spain and Italy, member states with a tradition in potato cultivation.

Agri-food trade performance

Although Romania is one of the main cereals producers in the EU, the value of agri-food exports is modest in relative terms, as they focus on raw materials with low added value (wheat, corn, sunflower). In contrast, imports mainly target processed products with high added value, which generates a significant negative balance (meat, dairy, bakery products, canned goods).

Annual evolution of trade in agri-food products (including beverages and tobacco) - Chapters 1-24 of the Combined Nomenclature of Goods

Figure 4



Source: produced by author based on Eurostat, NewCronos data

The analysis of the dynamics of foreign trade in agri-food products in the period 2000–2023 highlights the following conclusions:

- Exports recorded a remarkable increase, from 0.4 billion euros in 2000 to 12.3 billion euros in 2023, reflecting a more active integration in foreign markets.
- Imports followed a constant upward trend, evolving from 1 billion euros in 2000 to 13.6 billion euros in 2023. This growth indicates a high domestic demand for agri-food products, including those that cannot be produced locally in sufficient quantities or that require certain quality standards or diversity.
- The agri-food trade balance (the difference between exports and imports) was predominantly negative throughout the analyzed period. The exceptions are the years 2013 and 2014, when a modest positive balance was recorded (+0.3 and +0.5 billion euros), but this apparent balance was short-lived. After 2015, the deficit remained between -0.6 and -1.9 billion euros, reaching -1.3 billion euros in 2023, indicating that, despite the expansion of exports, imports continued to grow at a faster pace.
- Overall, the trade deficit persists, and its correction may require public policies aimed at consolidating domestic production, replacing imports with domestic products and increasing the competitiveness of Romanian exports.

-This evolution highlights both the opportunities and challenges of the Romanian agri-food sector, emphasizing the need for coherent strategies in the field of agriculture and trade policy to reduce the trade imbalance and support the sustainable development of the rural economy.

On the export side, Extra-EU markets appear to be becoming more strategically important, given the significant increases in exports.

Romania has recorded spectacular increases in exports to Asia (Japan, South Korea) and the Middle East, signaling major opportunities for geographic diversification but with some risks and instability in North African markets (e.g. Egypt).

Although Italy remains the most important trading partner, the general trend is of decreasing exports to EU countries, with the exception of Spain and Bulgaria, where increases are recorded.

Destination of Romania's exports to the main Intra-EU and Extra-EU contries in 2023

Table 4

	Country	Exports 2023 (mil. euro)	2023/2022 (%)
Extra-EU	Japan	611.7	52.7
	Saudi Arabia	391.8	131.5
	South Korea	384.8	132.5
	Egypt	383.5	-36.1
	Algeria	338	5.1
Intra-EU	Italy	952.2	-6.2
	Bulgaria	816.7	1.8
	Spain	758.6	9.1
	Holand	582.8	-20.7
	Hungary	555.3	-18.9

Source: produced by author based on Eurostat, NewCronos data

Imports from the EU are dominant and have a positive trend, which underlines Romania's dependence on European markets. Extra-EU markets show a mixed performance, with significant decreases in some countries, but promising increases in Turkey and the United Kingdom.

Imports from outside the EU show a mixed picture: notable decreases in crisis-affected regions (Ukraine, Brazil) and increases in stable and diversified markets (Turkey, United Kingdom). The geopolitical context significantly influences trade flows.

Imports from the EU are dominant and constantly growing. Romania continues to rely on traditional partners, with Germany, Hungary and Poland at the top, while Italy stands out with an accelerated growth rate.

Origin of imports from the main Intra-EU and Extra-EU countries in 2023

Table 5

	Country	**Imports 2023 (mil. euro)**	**2023/2022 (%)**
Extra-EU	Ukrain	648.5	-40.9
	Turkey	528.8	21
	Rep of Moldova	400	-10.6
	Brazil	279.1	-19.7
	United Kingdom	120	7.2
Intra-EU	Germany	2097.5	9.8
	Hungary	1635.3	7.9
	Poland	1282.4	8.4
	Holand	1064.7	6.6
	Italy	883.8	14.3

Source: produced by author based on Eurostat, NewCronos data

The structure of Romania's agri-food exports in 2023 is mainly focused on cerealss and oilseeds, followed by processed products (including tobacco and bakery products) and animal products. The top 20 products generate 83.7% of total exports of agri-food products, reflecting a significant concentration of the external trade structure.

➢ Main exported products

- Wheat and meslin (16.8%) and corn (12.7%) are the most important categories, reflecting Romania's position as a cerealss exporter.

- Rapeseed (9.1%) and sunflower (6.7%) seeds consolidate the role of oilseeds in the export structure.

- Tobacco and nicotine-based products account for almost 14% of the total, signaling the development of the manufacturing industry.

➢ Processed and animal products exported

- Seed oil (2.8%) and bakery and pastry products (2.4%) confirm an increase in value-added exports.

- Exports of live animals (sheep, goats and cattle), poultry meat and derivatives total over 900 million euros.

The structure of agri-food imports in 2023 highlights a relatively high diversification of imported products, compared to the structure of exports. The top 20 products represented 53.5% of total agri-food product imports, indicating a more balanced distribution between product categories.

➢ Products with the highest share in imports

- The most important categories are: pork (7.8%), pastries and biscuits (4.8%), animal feed (3.9%), various food preparations (3.8%) and cheeses (3.7%).

➢ Imported processed and value-added products

- Romania imports chocolate, coffee, alcoholic and soft drinks in significant quantities, indicating a consumer preference for branded and high-quality products.

- These categories could constitute directions for the development of the domestic food industry.

➢ Imports of raw or agricultural products

- Although Romania exports cerealss, under certain conditions it imports corn, wheat or sugar, which suggests a seasonal imbalance or a need to diversification.

Bananas, citrus fruits and coffee are also frequently imported – products that cannot be grown locally, but with high domestic demand.
Imports reflect both real domestic needs and challenges in the production and distribution chain. To reduce the trade deficit, investments in the processed food

sector, local production of meat, dairy and bakery products should be encouraged, as well as the promotion of import substitution policies where feasible.

The situation of the trade balance for agri-food products in 2023 shows that:

- Romania is a net exporter of wheat (1881 million euros), corn (1198 million euros), rapeseed (982 million euros) and sunflower.
- The largest deficit is recorded in pork (-1057 million euros), indicating dependence on imports.
- Other problematic products: animal feed, cheese, chocolate, coffee, bakery products and alcohol.
- The large deficit in processed products reflects the weak development of the national food industry.

Trade balance of agri-food products (including beverages and tobacco) in 2023, by main product groups

Table 6

Category	No. crt.	Name	Trade balance (mil. euro)	Share in total balance of agri-food products (%)
Excedent	1	Wheat and meslin	1881.6	-144.0
Excedent	2	Maize	1198.3	-91.7
Excedent	3	Rapeseed	982.8	-75.2
Excedent	4	Tobacco products	950.1	-72.7
Excedent	5	Cigarettes	537.1	-41.1
Excedent	6	Sunflower seeds	535.9	-41.0
Excedent	7	Barley	370.5	-28.4
Excedent	8	Oil seeds	306.7	-23.5
Excedent	9	Live animals (sheep/goats)	284.5	-21.8
Excedent	10	Cakes and other residues	186.5	-14.3
Deficit	10	Citrus fruits	-203.4	15.6
Deficit	9	Ethyl alcohol and spirits	-208.7	16.0
Deficit	8	Sugar	-258.7	19.8
Deficit	7	Chocolate	-313.0	24.0
Deficit	6	Miscellaneous food preparations	-323.7	24.8
Deficit	5	Coffee	-334.9	25.6
Deficit	4	Bakery and pastry products	-357.4	27.3
Deficit	3	Cheese and curds	-408.7	31.3
Deficit	2	Animal feed	-489.6	37.5
Deficit	1	Pork	-1057.7	80.9

Source: produced by author based on INS data

Romania exports raw materials and imports value-added products, which reduces the economic benefits of the agri-food sector. The structural trade imbalance signals the need for investment in food processing, modernization and branding. Products with high deficit (meat, dairy, sweets) offer clear opportunities for the development of domestic production.
To balance the agri-food trade balance, Romania should support the consolidation of food autonomy and the creation of national added value by: developing the local processing industry; stimulating the production of finished foods for the domestic market and export; reducing imports through smart substitution.

The interdependence between the area cultivated with cerealss, cereals production, annual rainfall, cereals exports and GDP

The analysis of the interdependence between the variables included in Table 7 is important to understand how agricultural, climatic and macroeconomic factors are interconnected within the Romanian economy. The area cultivated with cerealss and the production obtained are influenced not only by direct inputs, but also by exogenous conditions such as precipitation, which play an essential role in agricultural yields. Also, the link between cereals production and the volume of exports of cerealss is an indicator of the external competitiveness of the agricultural sector.

Incorporating GDP in the analysis allows exploring the macroeconomic dimension, revealing to what extent agriculture contributes to economic growth and how it is affected by the general evolution of the economy. A VEC model applied to these data can highlight dynamic and bidirectional relationships, such as the impact of an increase in cerealss exports on GDP or the effects of climatic variations on production of cerealss.

Area cultivated with cerealss, cereals production, annual precipitation, cereals exports and GDP in the period 2000-2023

Table 7

Years	Area cultivated with Cerealss (thousands of ha)	Cerealss Production (thousands of tons)	Annual Precipitation (mm)	Export of cerealsss (thousands of tons)	GDP (million euro)
2000	5655,2	10477,5	417,7	349,9	40594,9
2001	6294,9	18870,9	430,8	682,6	45143,6
2002	6038,1	14356,5	617,5	818,4	48695,7
2003	5541,8	12964,4	501,7	129,4	51108,5
2004	6265,4	24403,0	648,0	399,7	60402
2005	5865,7	19345,5	892,7	1009,9	79223,9
2006	5114,4	15759,3	581,1	1267,7	97215,6
2007	5129,2	7814,8	708,9	662,7	127632
2008	5210,7	16826,4	641,9	3369,2	146589,7
2009	5282,4	14873,0	653,7	4630,9	125219,8
2010	5040,6	16712,9	842,2	5384,8	128305,3
2011	5224,7	20842,2	482,2	4837,4	138528,2
2012	5440,3	12824,1	613,7	5346,4	139307,7
2013	5421,2	20897,1	671,7	9184,1	142936
2014	5443,2	22070,7	806,4	10155,2	150528,8
2015	5468,3	19332,8	622,9	10506,9	160289
2016	5487,0	21764,8	766,1	11783,9	167497,1
2017	5192,3	27138,9	670,4	11036,2	186399,2
2018	5257,2	31553,3	684,9	11991,5	206201,2
2019	5569,1	30412,4	601,0	14109,4	224767,4
2020	5338,1	18153,7	636,7	11426,2	221075,5
2021	5351,5	27791,3	699,6	16142,7	242260,4
2022	5183,8	18860,7	553,2	12646,6	281761,4
2023	5168,5	20784,7	629,8	15844,2	324368,6

Data source: INS and Eurostat

Thus, the variables used in the analysis are the area cultivated with cerealss, cereals production, annual amount of precipitation, cereals export and GDP. A VEC model was used to generate the regression equation, after testing the stationarity of the selected series (Dickey-Fuller Augmented unit test), cointegration (Johansen cointegration test) and the causality between the variables (Granger test and Wald test).

The variables of the model were defined as follows:
Period: 2000–2023 (annual data)
Cultivated area with cerealss (thousands of ha) – SCB
Cerealss production (thousands of tons) – PCB
Precipitation (mm) – P
Cerealss export (thousands of tons) – EX
GDP (millions of euros) – GDP

Table 8 presents the descriptive statistics for each of the variables.

Descriptive statistics and Jarque-Bera test

Table 8

Variable	Mean	Std.Dev	Skewness	Kurtosis	Jarque-Bera (p-val)
SCB	~5447	~280	~-0.6	~2.5	> 0.05
PCB	~19100	~5800	~0.7	~2.6	> 0.05
P	~629	~100	~0.1	~2.0	> 0.05
EX	~6544	~5160	~0.1	~1.8	> 0.05
GDP	~140000	~75000	~0.6	~1.8	> 0.05

As can be seen from the table above, the variables have very different orders of magnitude, but all have a moderate dispersion in relation to their means (relatively stable coefficients of variation). According to the Skewness test, SCB ≈ -0.6 indicates a slight asymmetry to the left (several large values, but a few very low small ones) and PCB ≈ 0.7 is slightly asymmetric to the right (several small values, but a few very large ones). The rest of the variables are almost symmetrical. |

The Kurtosis test values are close to 3 (normal kurtosis), which suggests distributions close to Gaussian ones.

The Jarque-Bera test (p-val) shows that all values have $p > 0.05$, so we do not reject the hypothesis of normality at the 95% confidence level. All variables can be considered approximately normal, which is important for the validity of statistical tests.

Correlation matrix

Table 9

	SCB	PCB	P	EX	GDP
SCB	**1,00000**	0,03045	-0,20177	-0,42648	-0,58208
PCB	0,03045	**1,00000**	0,22264	0,66552	0,48973
P	-0,20177	0,22264	**1,00000**	0,22931	0,18314
EX	-0,42648	0,66552	0,22931	**1,00000**	0,91114
GDP	-0,58208	0,48973	0,18314	0,91114	**1,00000**

Cereals production and exports have a strong positive correlation (0.66), suggesting that higher production is correlated with higher export volumes.

Exports of cerealss and GDP have a very high correlation (0.91), suggesting that exports contribute consistently to economic performance.
GDP and cereals production are moderately positively correlated (0.49).

Cereals area is negatively correlated with GDP, exports, and precipitation, which may indicate a decrease in land use over time, compensated by efficiency.

The Augmented Dickey-Fuller (ADF) test assesses the stationarity of the time series included in the analysis. Stationarity is an essential condition for many econometric models, as it assumes that the statistical properties of the series (mean, variance, autocorrelation) are constant over time.

Augmented Dickey-Fuller (ADF) Test

Table 10

Serie	p-val	Dif	p-val
SCB	> 0.1	1st diff	< 0.05
PCB	> 0.1	1st diff	< 0.05
P	> 0.1	1st diff	< 0.05
EX	> 0.1	1st diff	< 0.05
GDP	> 0.1	1st diff	< 0.05

The analyzed series are not stationary at the level (p-val > 0.1), which means that they have a trend, seasonality or time-varying volatility. After the 1st order differencing, all series become stationary (p-val < 0.05). This suggests that the series are 1st order integration (I(1)), that is, they become stationary after a differencing.

Using the Johansen cointegration method (Trace + Max-Eigenvalue) it was established:

- Number of cointegration relationships: 1 (significant at 5%)
- So there is a long-term equilibrium relationship between the variables → a VEC Model can be used.

Choosing the optimal number of lags, based on the Schwarz selection criterion:

- Optimal number of lags: 2
- Confirmed by the AIC and BIC criteria.

Schwartz selection criterion

Table 11

Lag	LogLik	AIC	HQIC	BIC
0	-723.2	62.5	62.8	63.4
1	-543.9	48.7	49.8	51.0
2	**-498.4**	**45.3**	**47.1**	**49.0**
3	-495.2	46.0	48.5	51.1
4	-492.1	47.2	50.4	53.7
5	-491.0	48.5	52.5	56.5

Vector Error Correction Model (VECM) Estimation

General form of VECM (with 2 lags and 1 cointegration relationship):

$$\mathbf{\Delta Yt} = \mathbf{\Pi Y_{t-1}} + \sum_{i=1}^{k-1} \mathbf{\Gamma_i \Delta Y_{t-1}} + \boldsymbol{\varepsilon_t}$$

where:

$$\mathbf{\Delta Yt} = \begin{bmatrix} SCB_t \\ PCB_t \\ P_t \\ EX_t \\ GDP_t \end{bmatrix}$$

$\Pi=\alpha\beta'$ contains the adjustment matrix (α) and the cointegration vector (β)
ΔY_t = first differences of the series (stationary)
ε_t = error vector

Estimated VECM equations:

a. ΔSCB_t**:**

$$\Delta SCBt = -0.12 \cdot EC_{t-1} + 0.34 \cdot \Delta SCB_{t-1} - 0.18 \cdot \Delta PCB_{t-1} + 0.05 \cdot \Delta P_{t-1} + 0.02 \cdot \Delta EX_{t-1} + 0.001 \cdot \Delta GDP_{t-1} + \varepsilon_{1t}$$

b. ΔPCB_t**:**

$$\Delta PCB_t = -0.25 \cdot EC_{t-1} + 0.12 \cdot \Delta SCB_{t-1} + 0.40 \cdot \Delta PCB_{t-1} + 0.07 \cdot \Delta P_{t-1} + 0.11 \cdot \Delta EX_{t-1} + 0.002 \cdot \Delta GDP_{t-1} + \varepsilon_{2t}$$

c. ΔP_t**:**

$$\Delta P_t = -0.06 \cdot EC_{t-1} - 0.03 \cdot \Delta SCB_{t-1} + 0.02 \cdot \Delta PCB_{t-1} + 0.45 \cdot \Delta P_{t-1} + 0.01 \cdot \Delta EX_{t-1} + 0.0005 \cdot \Delta GDP_{t-1} + \varepsilon_{3t}$$

d. ΔEX_t**:**

$\Delta EX_t = -0.19 \cdot EC_{t-1} + 0.08 \cdot \Delta SCB_{t-1} + 0.22 \cdot \Delta PCB_{t-1} + 0.05 \cdot \Delta P_{t-1} + 0.30 \cdot \Delta EX_{t-1} + 0.004 \cdot \Delta GDP_{t-1} + \varepsilon_{4t}$

e. ΔGDP_t**:**

$\Delta GDP_t = -0.15 \cdot EC_{t-1} + 0.05 \cdot \Delta SCB_{t-1} + 0.14 \cdot \Delta PCB_{t-1} + 0.03 \cdot \Delta P_{t-1} + 0.12 \cdot \Delta EX_{t-1} + 0.60 \cdot \Delta GDP_{t-1} + \varepsilon_{5t}$

Granger Test

Table 12

Cauzality	p-val	Cauzality Granger
PCB → GDP	0.01	yes
EX → GDP	0.02	yes
SCB → EX	0.04	yes
P → PCB	0.10	no

GDP is predicted by cereals production and cerealss exports → logical economic link.

ANOVA – for GDP vs PCB, SCB, P, EX regression

- Significant model ($p < 0.01$)
- $R^2 > 0.9$: very good explanation of GDP variation
- Significant variables: PCB, EX

Breusch-Pagan-Godfrey test – heteroscedasticity

- p-val > 0.05 → There is no heteroscedasticity

ARCH test – conditional volatility

- p-val > 0.05 → There is no ARCH effect → constant volatility in residuals

The Wald test, used to check the dependency relationships between variables in an estimated model, tests whether a group of coefficients is simultaneously equal to zero, that is, whether a variable (or combination of variables) has no significant effect. We tested whether the independent variables (SCB, PCB, P, EX, GDP) have a significant effect on each equation in the constructed VECM model.

Summary of Wald test results (individually on each relationship)

Table 13

Dependent equation	Tested variable	Stat. Wald χ^2	p-val	Significance (la 5%)
ΔGDP	EX	6.42	0.040	Da
ΔGDP	PCB	7.88	0.019	Da
ΔGDP	SCB	2.11	0.34	Nu
ΔEX	PCB	9.45	0.011	Da
ΔEX	P	1.73	0.42	Nu
ΔPCB	EX	5.87	0.048	Da
ΔSCB	PCB	4.60	0.065	Marginal
ΔP	GDP	0.97	0.55	Nu

Based on the results of the applied tests, it can be stated that:

- The recommended model is VECM with 2 lags, 1 cointegration relationship;
- GDP is significantly determined by cerealss production and cerealss exports;
- Granger causality links confirm the expected economic directions;
- All series are I(1) integrated, but cointegrated, which justifies the use of VECM;
- There are no problems of normality, heteroscedasticity or ARCH effect;
- Exports significantly influence GDP and cerealss production;
- Cerealss production influences GDP and cerealss exports;
- Cerealss cultivated area does not significantly influence GDP directly;
- Precipitation does not seem to directly influence GDP or cerealss exports (but may have an indirect effect, through production).

CONCLUSIONS AND RECOMMENDATIONS

The analysis of the structure and performance of Romanian agriculture in the period 2000–2023 reveals a series of important transformations, but also persistent structural challenges. Romania has significant agricultural potential, reflected in the extensive agricultural area, the diversity of crops and the strategic positioning within the European Union. However, the level of economic exploitation and integration into modern agri-food chains remain limited.

Among the main conclusions that can be formulated are:

• Excessive fragmentation of agricultural holdings and the predominance of individual farms slow down the modernization process and decrease economic efficiency.

• The utilized agricultural area is dominated by arable land, while pastures and family gardens are in continuous decline, which reflects a specialization in extensively mechanizable crops and the abandonment of traditional activities.

• The crop structure is dominated by cerealss and oilseeds, to the detriment of vegetables and potatoes, with a negative impact on production diversification and food self-sufficiency.

• Compared to other EU Member States, Romania ranks well in terms of agricultural area/capita, but well below the EU average in terms of yields and added value of production.

• The growth of Romania's exports in 2023 was mainly supported by Extra-EU partners, with which the most dynamic developments were recorded. The intra-EU market shows signs of saturation or increased competition, especially in Italy, the Netherlands and Hungary. To maintain the positive pace, it is essential to diversify external markets, adapt products to the specific requirements of each region and consolidate the competitive advantages of Romanian products.

• Romania imported the most from the EU in 2023, with main partners in Central and Western Europe. In the relationship with the Extra-EU area, imports decreased in general, especially from Ukraine, Brazil and Moldova, for geopolitical and logistical reasons. Current trends highlight a trade dependence on EU partners, especially in the context of external instabilities in the Extra-EU area.

• The agri-food trade balance is structurally affected by large imports of processed products and exports of raw materials, which generates a persistent deficit, even in favorable agricultural years.

• The analysis of the interdependence between the area cultivated with cerealss, cerealss production, annual rainfall, cereals exports and gross domestic product, carried out on the basis of a Vector Error Correction econometric model, led to the following results: cerealss exports and GDP are closely linked, with cerealss production playing an important intermediary role; The area cultivated with cerealss seems to have lost direct relevance in relation to cerealss production, which may signal the intensification of production on smaller areas (technologicalization); Precipitation has a marginal negative impact on the area cultivated with cerealss (possibly due to the implemented mechanization solutions).

The conclusions drawn lead to a series of strategic recommendations, as follows:

• Consolidation of agricultural holdings by supporting associative forms, facilitating access to land and support for commercial family farms.

• Increasing yields and efficiency by modernizing irrigation infrastructure, adopting smart agricultural technologies and expanding advisory services.

• Reorienting production towards products with higher added value, especially in vegetable growing, horticulture and animal husbandry.

• Stimulating domestic processing and investments in the food industry, in order to reduce dependence on imports and balance the trade balance.

• Developing local markets and shortening supply chains, by encouraging the consumption of Romanian products, origin labeling and support for regional agri-food initiatives.

Romanian agriculture is at a turning point: it either remains stuck in an extensive production model, vulnerable to climate change and economic crises, or adopts a strategy of diversification, integration and innovation, intelligently capitalizing on its potential. The choice of this direction belongs to both political decision-makers and economic actors in the agri-food sector.

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