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CLIMATE CHANGE AS A PRESSURE FACTOR ON FISCAL BALANCE AND ECONOMIC STABILITY: A BIBLIOMETRIC ANALYSIS AT THE EU LEVEL

SCHIMBĂRILE CLIMATICE CA FACTOR DE PRESIUNE ASUPRA ECHILIBRULUI FISCAL ȘI STABILITĂȚII ECONOMICE: O ANALIZĂ BIBLIOMETRICĂ LA NIVELUL UE

MOȚ Ariana Denisa, masterand, specialitatea: Guvernanță Organizațională și Consultanță Fiscală
ORCID: 0009-0004-4914-2111
Facultatea de Economie și de Administrare a Afacerilor, România, Timișoara, Strada Johann Heinrich Pestalozzi 16
e-mail autor: ariana.mot02@e-uvt.ro

Abstract: *Studiul se axează pe rolul schimbărilor climatice ca factor de presiune asupra echilibrului fiscal și stabilității economice în Uniunea Europeană, prin utilizarea unei abordări bibliometrice. Scopul acestei cercetări este de a evidenția evoluția literaturii de specialitate, principalele direcții tematice și tiparele de colaborare științifică din acest domeniu. În acest sens, a fost realizată o analiză cantitativă pe baza unui eșantion de 719 publicații extrase din baza de date Web of Science Core Collection, pentru perioada 2000–2026. Rezultatele indică o creștere semnificativă a interesului academic, evidențiată prin dinamica ascendentă a publicațiilor și citărilor, în special după anul 2019. Analiza de co-ocurență a cuvintelor-cheie, realizată cu ajutorul VOSviewer, a permis identificarea a cinci clustere tematice majore, care reflectă interdependența dintre dimensiunea socio-economică, politicile climatice, sustenabilitate, tranziția energetică și metodele analitice utilizate. De asemenea, analiza rețelelor de coautorat științific pe țări a evidențiat existența unor poli puternici de cercetare, dominați de economii dezvoltate, dar și o extindere progresivă a colaborărilor la nivel global. Concluziile subliniază caracterul interdisciplinar al domeniului și necesitatea integrării riscurilor climatice în politicile fiscale și macroeconomice. Totodată, rezultatele evidențiază importanța cooperării internaționale și a utilizării unor instrumente analitice avansate pentru o mai bună înțelegere a impactului schimbărilor climatice asupra stabilității economice.*
Key words: ***s**chimbări climatice, echilibru fiscal, stabilitate economică, analiză bibliometrică, Uniunea Europeană*
JEL CLASSIFICATION: Q54, H11, O44

INTRODUCTION

In recent decades, climate change has moved beyond being perceived strictly as an environmental concern and has become a multifaceted process with far-reaching consequences for the global economy (Monasterolo, 2020). In our research, we observe that the deterioration of natural resources, the increasing frequency of extreme weather events, and ongoing ecosystem transformations generate notable economic pressures, affecting both production processes and the resilience of financial markets (Sánchez-García et al., 2025). Consequently, climate change should no longer be approached solely through an ecological lens but rather be considered an essential factor in assessing economic and fiscal risks.

At the level of the European Union, these developments are placing growing pressure on the fiscal equilibrium of Member States. In the context of our research, it becomes evident that adapting to changing climatic conditions, managing the consequences of natural disasters, and supporting the transition toward a low-carbon economy all require significant public spending. At the same time, government revenues may be negatively influenced by economic disruptions—such as reduced productivity in certain sectors or heightened price volatility—which further complicate efforts toward fiscal consolidation. Recent analyses also suggest that climate-related events can disrupt supply

chains, influence labor markets, and alter asset valuations, thereby generating cascading effects across the broader economy (Seghini, 2026).

In addition to the fiscal dimension, climate change poses a major risk to economic stability (Boitan, 2023). These act through both physical risks, associated with environmental degradation and the intensification of extreme phenomena, and transition risks, arising from changes in public policies, consumer preferences, and technological structures. In the absence of appropriate measures, the economic impact may become increasingly pronounced, with estimates indicating significant losses across Europe in the coming decades.

In this context, the specialized literature has advanced rapidly in recent years, reflecting researchers' growing interest in the interactions among climate change, fiscal policies, and economic stability. For this reason, we used a quantitative bibliometric analysis for the period 2000 - 2026, a relevant tool for assessing the evolution of this field and identifying the main research directions, emerging trends, and dominant scientific contributions. Therefore, this paper aims to analyze the evolution and structure of research in this field, highlighting the main thematic directions, emerging trends, and patterns of scientific collaboration at the European Union level. In this sense, we used a quantitative bibliometric analysis for the period 2000–2026. This method allows us to systematically evaluate the literature and gain a thorough understanding of how climate change is integrated into the analysis of fiscal balance and economic stability.

Thus, the main contribution of our research is to extend the traditional analytical framework by integrating a complex bibliometric perspective on the relationship between climate change, fiscal balance, and economic stability at the level of the European Union. The novelty lies in combining structural analysis of the literature, using co-occurrence and co-authorship networks, with the assessment of thematic diversity using the Shannon index, which enables a more nuanced understanding of the degree of interdisciplinarity and conceptual fragmentation in the field. Thus, our research not only identifies the main directions of scientific development but also provides a synthetic measure of the balance among them, contributing to a clearer picture of the maturity and dynamics of the analyzed field.

CONTENT

To conduct a brief analysis of the bibliographic sources in the field of research, we examined publication and citation dynamics as indicators of the evolution of scientific interest. To highlight trends and relationships in existing research, we conducted a quantitative bibliometric analysis, which enabled us to investigate the scientific output on the topic under study. This analysis aims to identify the dominant research trends and the contributions with major impact.

In addition, it is important to outline how climate change influences fiscal outcomes and economic stability through societal transformations and policy responses. Extreme weather events and the depletion of natural resources trigger changes in consumption patterns, labor markets, and demographic dynamics (Khan et al., 2019). These changes drive the adoption of climate-related fiscal strategies and measures, such as renewable energy investments and environmental taxation, which in turn affect public revenues and expenditures (Catalano et al., 2019). Ultimately, these processes contribute to fiscal balance and economic stability, highlighting the interconnected nature of climate, society, and fiscal policy.

The analysis begins by selecting a sample of articles on climate change, economic stability, and fiscal balance. To create this dataset, we used the Web of Science – Core Collection platform and entered the following keywords relevant to our study: “climate change” AND (“fiscal balance” OR “economic stability”). The first search yielded 4754 articles. To narrow the data to accurately reflect our focus of interest, we applied inclusion-exclusion filters, including limiting the analyzed period to 2000-2026, selecting only articles and book chapters written in English, and analyzing one or more EU27 member countries. In this way, we limited the analysis to 719 relevant articles that meet our requirements. The entire search process can be seen in Figure 1.

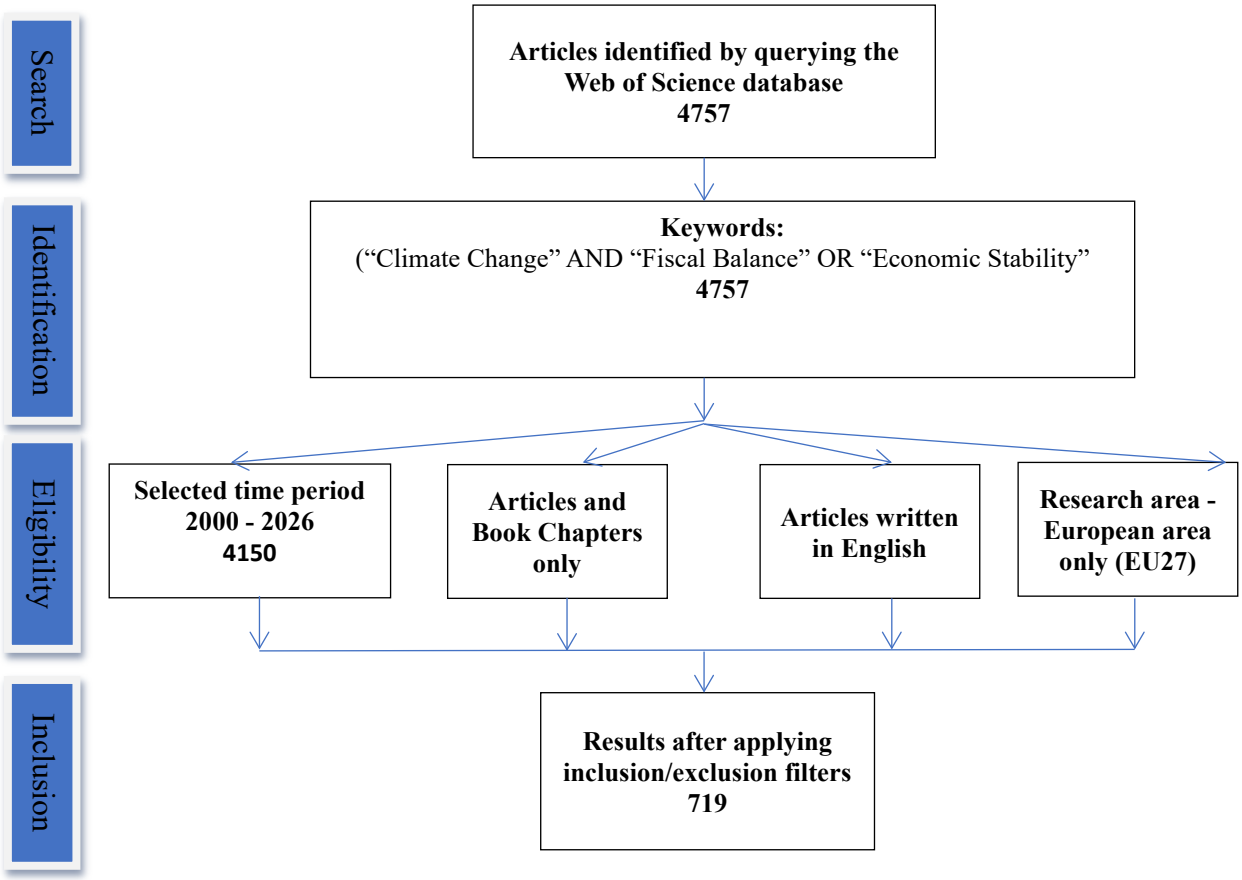

Figure 1. Collection of studies on the impact of climate change on fiscal sustainability and economic stability in Europe, EU27.
Source: Data processed by the author

Before developing the bibliometric analysis itself, we also considered it important to assess the performance of the specialized literature, to identify the evolution of publications and citations in the field of climate change, and to examine their impact on fiscal balance and economic stability. For this analysis, we used the functionality of the Web of Science Core Collection platform, following the previously applied search and filters. Thus, in Figure 2, we observe an upward trend in both citations and publications on the link between climate change, fiscal balance, and economic stability. After a modest initial period, the field has experienced accelerated development, especially after 2020, and citation dynamics have accelerated even more after 2019, indicating not only the expansion of research but also an increase in its impact. Overall, the evolution suggests the consolidation and maturation of this field, which is in a phase of significant expansion, as well as increased scientific interest in this topic.

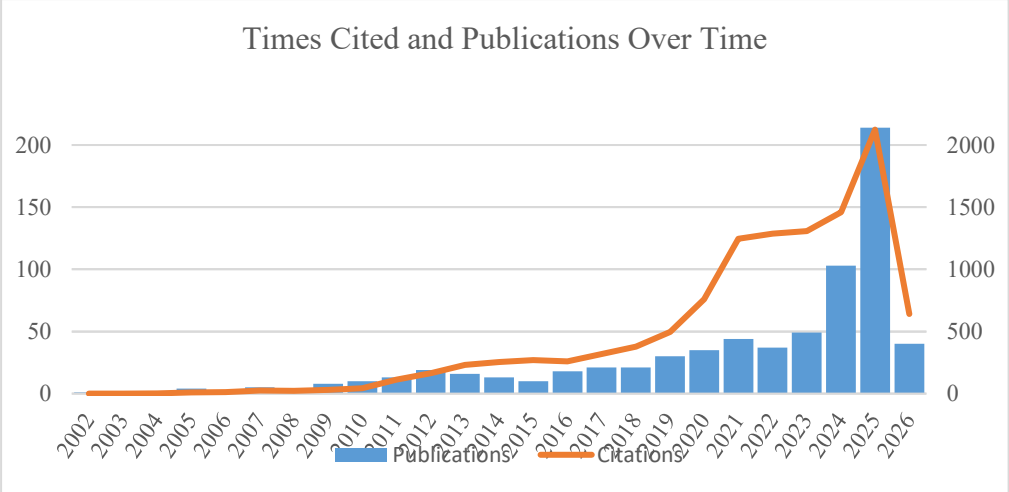

Figure 2. Performance Analysis of specialized literature
Source: Own processing via Web of Science Core Collection

The bibliometric analysis was conducted using VOSviewer (Nees & Waltman, 2019), enabling us to visualize relationships among publications. In this framework, we conducted two analyses: a keyword co-occurrence analysis and a scientific co-authorship map by country, to capture how common theoretical bases, research themes, and international collaborations are interconnected in studies focused on the impact of climate change on fiscal balance and economic stability.

The keyword map, generated with VOSviewer, illustrates the co-occurrence relationships among the main concepts in the analyzed literature, highlighting the field's thematic structure and dominant research directions. These are grouped into five distinct clusters, presented in Figure 3. Cluster 1 brings together concepts related to the socio-economic dimension of instability, including behavior, crises (financial and health), income, migration, and health, suggesting an interest in the determinants and effects of economic imbalances in the context of external shocks. Cluster 2 is centered on the relationship between climate change and public policy responses, incorporating terms such as “policy,” “resilience,” and “impacts,” which point to a clear emphasis on adaptation strategies and risk management. Within the framework of our research, cluster 3 captures the connection between sustainability and economic performance, bringing into focus elements like innovation, entrepreneurship, and sustainable development.

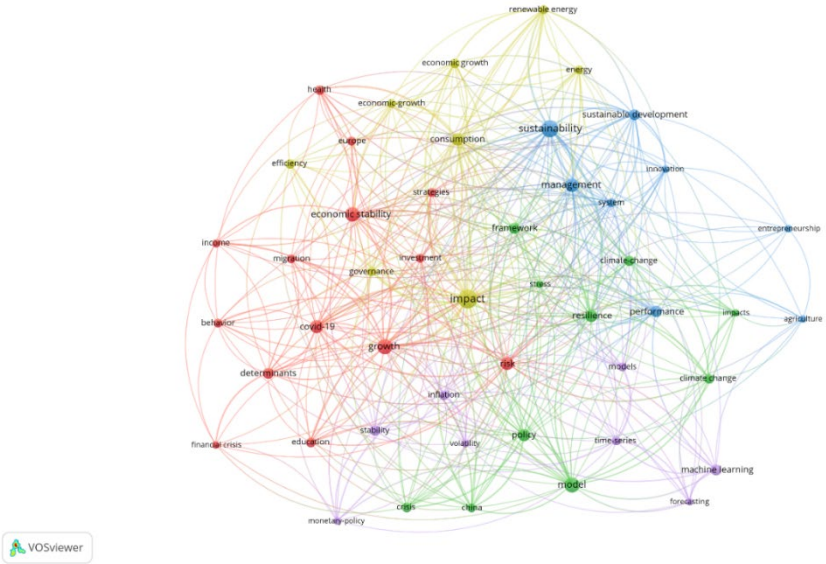

Figure 3. Keyword Network
Source: Author’s processing in VOSviewer

Cluster 4 brings together themes related to economic growth, consumption, and energy, with a focus on renewable energy and energy efficiency, thus outlining the main dimensions of the green transition. As for cluster 5, it has a predominantly methodological and macroeconomic character, including models, time series, and machine learning techniques, as well as variables such as inflation and volatility. These elements highlight the use of advanced tools to analyze and anticipate the effects of climate change.

Overall, the results indicate a strong interdependence among climatic, political, and economic factors, underscoring the complex and interdisciplinary nature of the field under analysis. In addition, the map of co-authorship at the country level highlights how international scientific collaborations are structured, with countries grouped into seven distinct clusters, as illustrated in Figure 4, depending on the intensity of ties and academic impact.

Thus, group 1 is mainly composed of European countries, especially those in Central and Eastern Europe, where Italy, the Netherlands, and Poland stand out for their high numbers of publications and citations, as well as solid connections, suggesting the existence of a well-consolidated regional core. On the other hand, group 2 outlines the main pole of research at the global level, bringing together major players such as the USA, France, and China, which record the highest citation counts and degree of connectivity, indicating a significant influence on research directions.

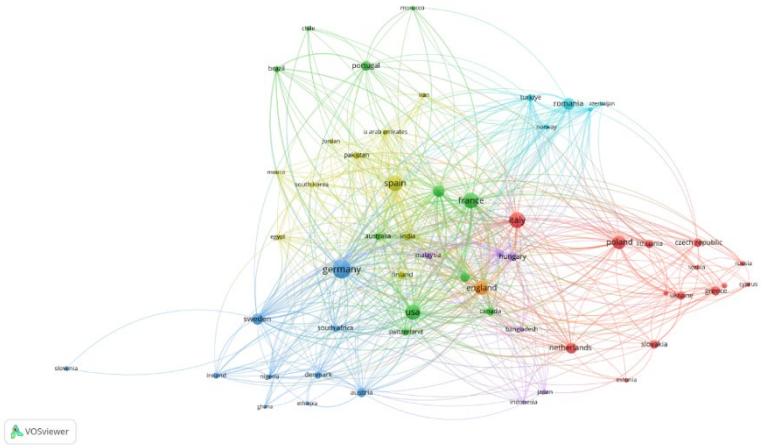

Figure 4. Scientific co-authorship network, based on the countries where the documents were published.
Source: Author's processing in VOSviewer

Group 3 brings together developed European economies, such as Germany and Sweden, alongside emerging countries, highlighting a mixed network characterized by solid ties and constant contributions. As for Group 4, it stands out for its high geographical diversity, with countries such as Spain, India, and Pakistan recording significant citation volumes, suggesting active involvement in the themes analyzed. Group 5 is mainly made up of countries in Asia and the Middle East, where a moderate level of collaboration is observed, but also a visible increase in relevance in the field. In the case of Group 6, which also includes Romania, the results indicate a network in the process of consolidation, characterized by intensified ties and increasingly active participation in international research. Finally, Group 7, represented exclusively by England, stands out as a central actor, with a very high academic impact and a superior strength of connections, confirming its role as a global hub within the co-authorship network.

To complete the bibliometric analysis, we assessed the thematic diversity of the specialized literature using the Shannon index (Dušek & Popelková, 2017), calculated from the distribution of keywords. The role of this indicator is to measure the degree of diversity and the balance of thematic structures.

The calculation of the Shannon index [1] is based on the distribution of articles by thematic categories, each being reported to the total number of publications analyzed, and the final index results from combining these values into a synthetic measure of diversity (Konopiński, 2020):

$$H' = -\sum(p_i \cdot \ln(p_i)) \qquad \textbf{[1]}$$

where p_i represents the proportion of articles related to a certain category out of the total publications included in the analysis.

Higher values of this index suggest a varied thematic structure and a high level of interdisciplinarity. In contrast, low values indicate a concentration of research around a limited number of dominant topics. Thus, this index represents a useful tool for assessing the interdisciplinary character of a field and for analyzing its developments over time or in comparison between different regions. Thematic diversity is essential in bibliometric analysis because it highlights the degree of interdisciplinarity in research, and the use of the Shannon index allows us to assess the distribution and balance across fields.

The database used to calculate the Shannon index consisted of the main keywords from the 719 articles retrieved from the Web of Science Core Collection. Of these, only 652 records presented complete data on the keywords. Next, we manually grouped them into distinct thematic categories, based on conceptual proximity and content similarities. The categories were defined to reflect the main research directions identified in the literature (economy and finance, environment and sustainability, technology, health, society, etc.), thereby enabling coherent data structuring and a relevant interpretation of the thematic distribution. Both the thematic groups and the Shannon index result can be seen in Table 1. As can be seen, the dominant theme is "economy and finance" (68 articles), followed by "environment, climate and sustainability" (43 articles), "health and medicine" (26 articles), and "society, demography and migration" (20 articles).

Table 1. Shannon Diversity Index Based on Thematic Distribution

CATEGORY	No. of Items	Proportion (p_i)	$\ln(p_i)$	$p_i \times \ln(p_i)$
"Economy & Finance"	68	0,10429	-2,26054	-0,23576
"Environment, Climate & Sustainability"	43	0,06595	-2,71884	-0,17931
"Agriculture & Food"	19	0,02914	-3,53561	-0,10303
"Technology & Artificial Intelligence"	18	0,02761	-3,58967	-0,09910
"Health & Medicine"	26	0,03988	-3,22195	-0,12848
"Society, Demography & Migration"	20	0,03067	-3,48431	-0,10688
"Politics & Governance"	13	0,01994	-3,91510	-0,07806
"Energy"	13	0,01994	-3,91510	-0,07806
"Transport & Infrastructure"	7	0,01074	-4,53413	-0,04868
"Urban Planning & Regional" "Development"	8	0,01227	-4,40060	-0,05400
"Behavior & Management"	14	0,02147	-3,84099	-0,08248
"Natural & Technical Sciences"	12	0,01840	-3,99514	-0,07353
"Conflict & Security"	5	0,00767	-4,87061	-0,03735
Others	386	0,59202	-0,52421	-0,31034

SHANNON INDEX = 1.30472

Source: Data processed by the author

The Shannon index is H = 1.30472, indicating a moderate level of diversity. Although the literature covers a relatively wide range of topics, it is not evenly distributed across the different

fields. More specifically, there is a significant concentration of work around certain dominant themes, while other research directions are underrepresented.

A relevant element in interpreting the results is the very high share of the "Others" category (386 articles), which reflects a considerable dispersion of topics that do not fit into the main defined thematic groups. This aspect may indicate, on the one hand, the emergent and interdisciplinary character of the field, where new or niche concepts frequently appear, and on the other hand, a lack of conceptual convergence in the use of keywords. In other words, the research is fragmented at the level of terminology, even though there are common points at the general thematic level.

At the same time, within the well-defined categories, "Economy & Finance" and "Environment, Climate & Sustainability" carry the highest weights, confirming that the core of the research centers on the interaction between the economic and climate dimensions. The presence of other categories, such as "Health & Medicine", "Society, Demography & Migration", or "Technology & Artificial Intelligence", although with lower weights, highlights the extension of the analysis towards indirect effects and mechanisms of transmission of climate risks in the economy. Overall, the value of the Shannon index suggests that the field is in a consolidation stage, in which thematic diversification is already visible, but not completely balanced. This structure may favor future research development by more coherently integrating concepts and reducing fragmentation, especially regarding the definition and use of keywords.

CONCLUSIONS/RECOMMENDATIONS

The analysis in our study highlighted that research on the impact of climate change on fiscal balance and economic stability is undergoing accelerated development, marked by a significant increase in both scientific output and academic impact. The bibliometric results indicate a sharp thematic diversification and an increasingly pronounced integration of the climate dimension into economic and fiscal analyses.

At the same time, the cluster structure revealed by our research confirms the field's interdisciplinary nature, in which economic, social, environmental, and methodological perspectives intersect. The analysis of collaboration networks suggests that scientific activity is concentrated around major academic poles, but also highlights a gradual expansion of international participation, including from emerging economies. This aspect underscores the essential role of scientific cooperation in understanding and managing the effects of climate change, especially in the context of the European Union, where the challenges are common but the solutions may vary depending on the particularities of each state.

In this context, we consider it appropriate to strengthen international collaborations and to direct future research towards a deeper integration of climate risks into fiscal and macroeconomic policies. It is also necessary to develop more advanced analytical tools that allow for more precise assessments of the impact of climate change on economic stability.

Last but not least, the results of our study highlight the need for a closer integration of academic research and the decision-making process, so that public policies are based on rigorous, up-to-date analyses. For future research directions, we recommend expanding the analysis by using additional databases, deepening the relationship between climate risks and fiscal policies at the sectoral level, and integrating advanced econometric methods that can more accurately capture the long-term effects on economic stability.

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Coordonator științific: LOBONȚ Oana Ramona
ORCID: 0000-0002-2942-3715
Facultatea de Economie și de Administrare a Afacerilor, România, Timișoara,
Strada Johann Heinrich Pestalozzi 16
e-mail: oana.lobont@e-uvt.ro