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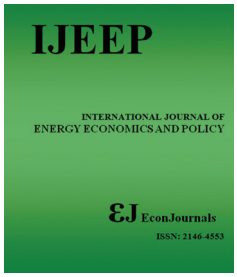

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Environmental Taxation Through a Bibliometric Lens: Finding Leading Voices, Trends, and Gaps

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ABSTRACT

This paper conducts a bibliometric analysis of environmental taxation to assess its role in sustainable development amidst escalating environmental and climate challenges. The study is motivated by the critical need for fiscal mechanisms that generate revenue and promote sustainable practices. Analyzing publication patterns, citations, and thematic evolutions provides a comprehensive review of the academic discourse on environmental taxation, identifying leading contributors, prevalent trends, and notable gaps in the field. Findings indicate a complex array of themes, notably the economic impacts of environmental taxes, their integration with broader fiscal reforms, and their influence on eco-friendly innovations. The research highlights varied implementation strategies and effectiveness across jurisdictions and an increasing interest in linking environmental taxes with renewable energy and public health policies. However, a significant gap exists in empirical research on the long-term effects of these taxes on economic and environmental outcomes, suggesting a need for deeper investigation to inform policy development and refinement. This gap points to future research directions, emphasizing a more integrated and comprehensive approach to environmental fiscal policies globally.

Keywords: Environmental Taxes, Bibliometric Analysis, Government Regulations, Sustainability, Environmental Issue
JEL Classifications: Q58, Q56, H23, H13, O44

1. INTRODUCTION

Environmental taxation has emerged as a pivotal mechanism in pursuing sustainable development, particularly in the context of increasing environmental degradation and climate change. The integration of environmental taxes into fiscal policies serves not only as a tool for revenue generation but also as a means to incentivize environmentally friendly practices among businesses and consumers. This multifaceted approach is underscored by a growing body of literature that examines the effectiveness, challenges, and trends associated with environmental taxation across various jurisdictions. Recent studies highlight the essential role of environmental taxes in promoting sustainable economic growth. For instance, Kotlán et al. emphasize the need for a well-structured tax mix that encourages innovation in environmentally friendly technologies while fostering economic sustainability (Kotlán et al., 2021). This sentiment is echoed by Gago and Labandeira, who argue that environmental taxes are integral to contemporary tax reform processes, suggesting that their implementation can yield dual benefits—environmental protection and economic efficiency (Gago and Labandeira, 2000). Furthermore, Uwaoma's research indicates that when coupled with renewable energy investments, green taxation can significantly mitigate pollution and enhance public health outcomes in the United States (Uwaoma, 2023).

The comparative analysis of environmental tax systems across different countries reveals significant disparities in implementation and effectiveness. Yan et al. provide a comprehensive overview of the environmental tax frameworks in China and the United States, noting that while China's tax revenues from environmental taxation are substantially higher, the relative impact on GDP and overall tax revenue remains a critical area for further exploration (Yan et al., 2019). Similarly, Kozhuhova discusses the trends and

features of environmental taxation within the European Union, highlighting the diverse approaches taken by member states to achieve sustainability goals (Kozhuhova, 2023). This diversity underscores the necessity for a nuanced understanding of how environmental taxation can be tailored to fit specific national contexts. Moreover, the literature identifies several gaps in the current understanding of environmental taxation, particularly its long-term impacts on economic growth and environmental quality. Davydenko points out that effective combinations of environmental taxes with regulatory standards can lead to improved environmental management outcomes (Davydenko, 2023). However, the challenge remains in ensuring these taxes are designed and implemented to maximize their potential benefits while minimizing adverse economic impacts. The work of Pérez and Deza further illustrates this point by examining the implications of tax expenditures in Mexico, suggesting that a careful assessment of tax instruments is necessary to align fiscal policies with environmental objectives (Pérez and Deza, 2021).

Bibliometric studies are essential for mapping future research trajectories and identifying emerging trends in environmental taxation. In Indonesia, the publication of scientific articles addressing the imposition of taxes for environmental purposes remains limited, indicating a gap in the literature that warrants further exploration. By analyzing existing studies related to environmental taxes, bibliometric research can illuminate the future direction of this critical issue. Such insights are invaluable for environmentalists, community stakeholders, and policymakers, as they provide a foundation for informed decision-making and help mitigate mismanagement and knowledge gaps (Gündoğdu and Aytekin, 2022; Safronova et al., 2017).

The bibliometric approach systematically examines scientific literature, allowing researchers to analyze various aspects of environmental taxation, including its development, future outlook, and urgency (Apriantoro et al., 2023; Apriantoro et al., 2024). This method can yield multiple benefits: it provides direct advantages for researchers, offers both direct and indirect benefits for activists and practitioners, and ultimately serves the broader community. Consequently, the study of environmental taxes through bibliometric analysis is innovative and highlights the urgency of addressing this research area (Hobday and McDonald, 2014; Sabau, 2020).

The primary objective of this study is to assess the development and future trajectory of environmental tax issues and gauge the extent to which these issues resonate within the community. By identifying dominant themes and trends, this research aims to provide insights into the evolving landscape of environmental taxation. The findings are expected to benefit individuals and organizations engaged in environmental advocacy and government entities seeking to align their policies with sustainable practices. Ultimately, the goal is to foster a harmonious relationship between human activities and the natural environment, ensuring that future generations can thrive without compromising ecological balance (Laws and Loeber, 2011; Mitra, 2016).

In conclusion, exploring environmental taxation through a bibliometric lens reveals a complex interplay of voices, trends, and gaps in the literature. As countries grapple with the pressing challenges of climate change and environmental degradation, the role of environmental taxation will undoubtedly remain a critical area of inquiry. Future research should aim to bridge existing gaps, particularly in understanding the long-term implications of these taxes on both economic and environmental outcomes.

2. METHODOLOGY

In this study, the researchers employ bibliometric analysis as their primary methodology. Bibliometric analysis involves the statistical examination of journals, books, and other scholarly works, and it falls within the broader field of scientometrics (Apriantoro et al., 2024; Apriantoro and Septianozakia, 2024). The main objective of utilizing bibliometric methods is to delineate the structure of scientific research within a specific field. This approach allows researchers to process large volumes of data and provide objective insights from multiple sources (Apriantoro et al., 2024).

The data for this study was gathered using the Boolean search feature in Scopus, which enables the combination or exclusion of keywords (using operators such as AND, NOT, and OR) to refine search results. The researchers traced the history of publications related to the keyword "Environmental Taxation," starting from the first article published in 1969 up to the present year, 2023. The data collection was conducted on March 15, 2023. The researchers assessed the number of available documents; if fewer than 500 articles were found, alternative research methods would be considered. However, if the number exceeds 500, bibliometric methods will be deemed appropriate.

Scopus was selected for this analysis due to its extensive range of publications, making it suitable for bibliometric studies. The researchers also utilized tools such as VOSviewer to facilitate the research process (Yu et al., 2023), Microsoft Excel (Yang et al., 2022), and Rstudio (Gandrud, 2013). The research methodology was informed by previous studies that employed bibliometric techniques, including analyses of risk management in banking and assessments of international carbon progress and prospects.

The initial step in the research process involved identifying significant issues currently prominent in both media and academia. Following this, a literature review was conducted to explore these pressing issues, which helped determine the relevant keywords for the study. These keywords were subsequently used to search for articles that correlate with the research focus.

After that, we do a search using our keywords with the Boolean search feature in Scopus, namely (TITLE-ABS-KEY (environmental AND taxation)), and the keywords produce 4,560 documents, then sorting again:

- The subject area of research is only the realm of economics, econometrics, finance and business, management, and accounting
- Publications final not proses *in press*
- Just an article in English

- Document type just article
- The source journal only

So, we filtered only 1,272 documents.

The concluding phase of the research included a thorough review of the chosen texts. Using Rstudio, the researchers carried out a quantitative analysis to detect patterns, including annual document distribution, the occurrence of journals, trends in authorship, links to institutions, contributions from different regions, and topics covered. Network mapping and graphical representations were done using VOSViewer, with Microsoft Excel supporting further data management. This detailed methodological framework facilitated a detailed comprehension of the bibliometric context of the specified field of study. The research flow can be described as Figure 1:

3. RESULTS AND DISCUSSION

3.1. Annual Publications

Figure 2 depicts the number of scientific documents produced annually from 1969 to 2023. A noticeable trend in the data is the fluctuation in production over the years, with several periods of increase and stability.

From 1969 until the early 1980s, the production remained relatively low and stable, not exceeding five documents per year. This period likely represents the nascent field stage with limited research activity. A gradual increase is observed from the mid-1980s through the 1990s, suggesting a growing interest and perhaps advancements in the field that spurred more research.

The early 2000s show some fluctuation, but the number of publications remains below 30 annually. The most significant growth occurs from 2005 onwards, with a more marked increase from 2011 to 2023. This sharp rise could indicate several factors, such as increased funding, the establishment of new research centers, or a response to technological advancements and global demands that have made this field more relevant.

A unique point of interest is the peak years of 2015, 2022, and 2023, where the production jumps significantly, reaching near or over 100 publications. These spikes could be associated with specific global or scientific events, such as policy changes,

Figure 1: Environmental Taxation Bibliometric research flow

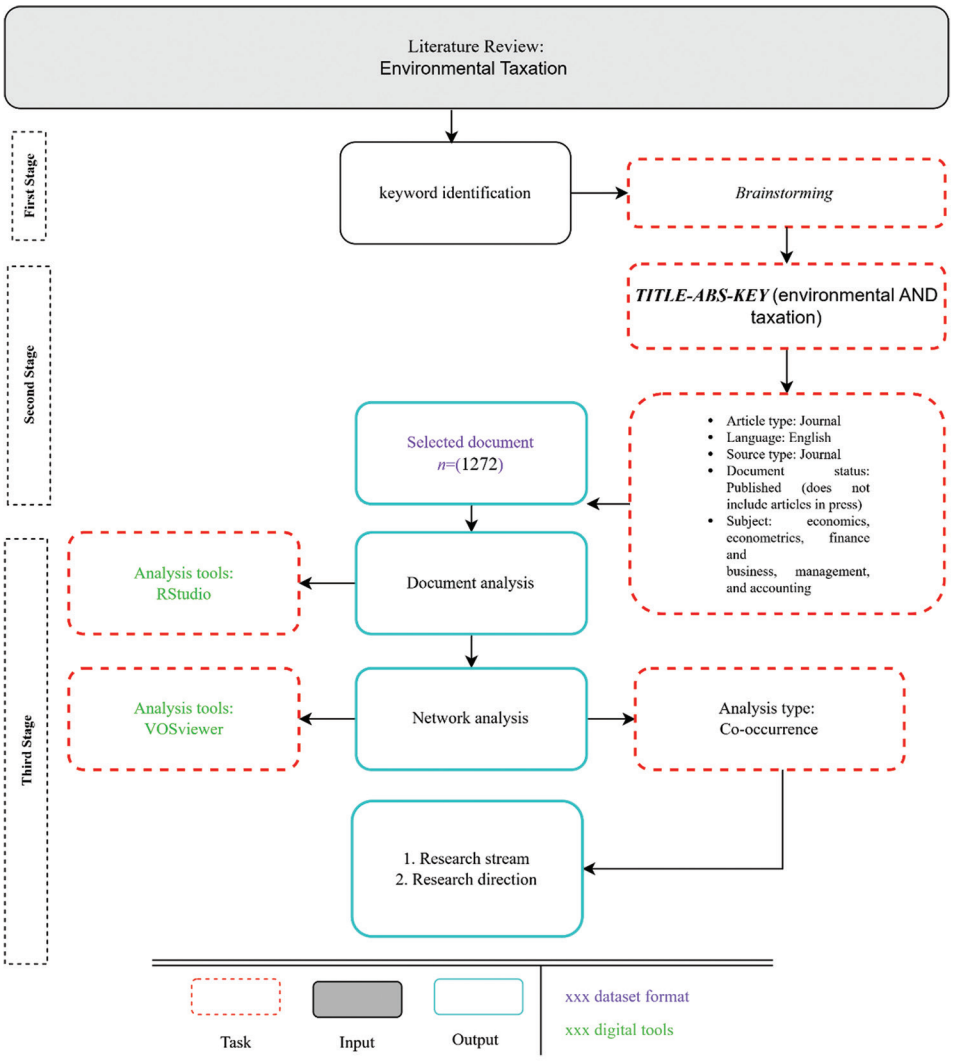
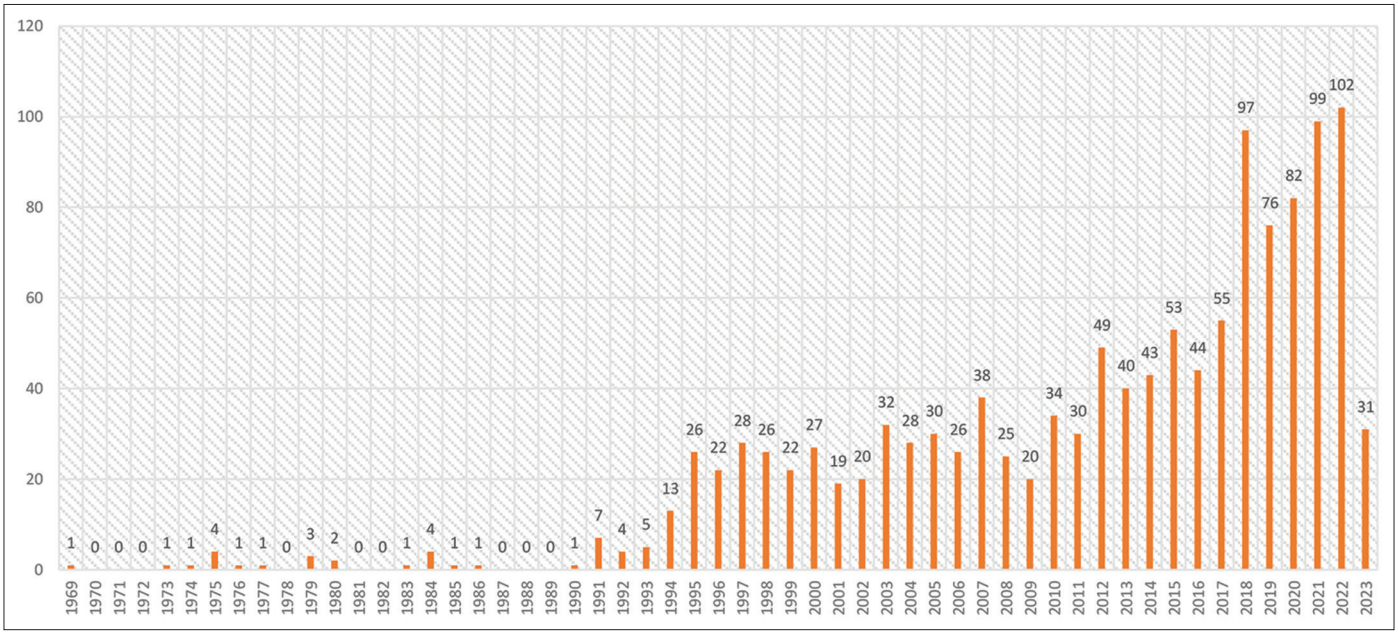


Figure 2: Annual scientific production



significant discoveries, or international collaborations that drove heightened research activity. Conversely, the decline in 2021 to a lower figure could reflect global disruptions such as the COVID-19 pandemic impacting research outputs.

Table 1 shows the growth of the number of publications, which lists scholarly publications from 1969 to 2023 and provides valuable insights into the trends and evolution of research output over more than five decades. This data is instrumental in understanding the development of interest and resource allocation in a particular field.

Initially, from 1969 to 1993, there was a slow and incremental growth in the number of publications. In the first two decades, we have witnessed only a modest increase from 2 publications in 1969-1973 to 17 by 1989-1993. This modest growth could indicate the early stages of the field's development, where research activities were likely constrained by funding, academic interest, and research infrastructure.

A significant surge in publications was observed during the 1994-2003 period, with 235 publications recorded over these two 5-year intervals. This sharp increase may reflect advancements in technology, increases in research funding, or both, leading to a substantial rise in research activities. This period may also mark a broader global recognition of the field's importance, stimulating more research and publications.

From 2004 to 2023, the number of publications continued to grow significantly, reaching its peak in 2019-2023 with 390 publications. This growth signifies the possible maturation of the field as a significant area of research, with a well-established knowledge base that encourages further hypotheses and subsequent studies. This phase likely includes increased international collaboration, improved publication platforms, and heightened global awareness of the issues addressed by this field.

Table 1: Growth of the numbers of publications

Time frame	Number of publications
1969-1973	2
1974-1978	7
1979-1983	6
1984-1988	6
1989-1993	17
1994-1998	115
1999-2003	120
2004-2008	147
2009-2013	143
2014-2018	292
2019-2023	390

3.2. Geographical Analysis

Table 2 provides the global distribution of scholarly output across various countries, illuminating the volume of research produced and potentially reflecting the level of investment in and focus on academic research within these regions.

The United States leads with a significant margin at 321 publications, more than double that of China, the next closest at 152 publications. This discrepancy underlines the United States' robust research infrastructure and its leading role in global scientific endeavors. China's position at second, with a substantial 152 publications, indicates its rapid rise as a major player in scientific research, likely supported by increased governmental investment in research and development.

The United Kingdom and Germany follow, with 127 and 101 publications highlighting their longstanding contributions to the academic community. These figures reflect a robust research tradition and established academic institutions in Europe.

Further analysis shows a broad representation from various European countries like France, Italy, the Netherlands, and Spain, as well as smaller nations such as Norway and Switzerland,

suggesting a diverse and active research environment across Europe. This can indicate the effective utilization of collaborative research frameworks and funding opportunities provided by entities such as the European Union.

Countries like Japan, Australia, and Canada, though not matching the output of the top European countries, still show significant scholarly activity, underscoring their commitment to sustaining high research standards.

Interestingly, the data includes countries like Brazil, India, and South Korea, each contributing over 20 publications. This inclusion indicates the growing scientific capabilities in emerging economies, driven by increased investments in education and research.

This regional distribution of publications highlights the current state of global research activity and reflects geopolitical, economic, and educational dynamics influencing scientific output across the world. Such data is invaluable for policymakers, educational institutions, and international research collaborations, providing a basis for strategic decisions in research funding, partnerships, and development priorities.

Table 2: Region-wise frequency of publications

Region	Frequency
United States	321
China	152
United Kingdom	127
Germany	101
France	95
Italy	74
Netherland	64
Spain	59
Canada	59
Australia	58
Japan	49
Norway	46
Sweden	42
Switzerland	35
Greece	25
Finland	22
Brazil	21
India	20
South Korea	20
Taiwan	20

Figure 3 displays the number of documents published by authors from various countries, categorized into Single Country Publications (SCP) and Multiple Country Publications (MCP). This distinction provides insights into the nature of research collaborations and the extent of international cooperation in scholarly work.

The United States dominates in SCP and MCP, with a significantly higher number of publications overall. This suggests a robust national research infrastructure capable of independent and collaborative projects, underscoring the U.S.'s leading position in global research.

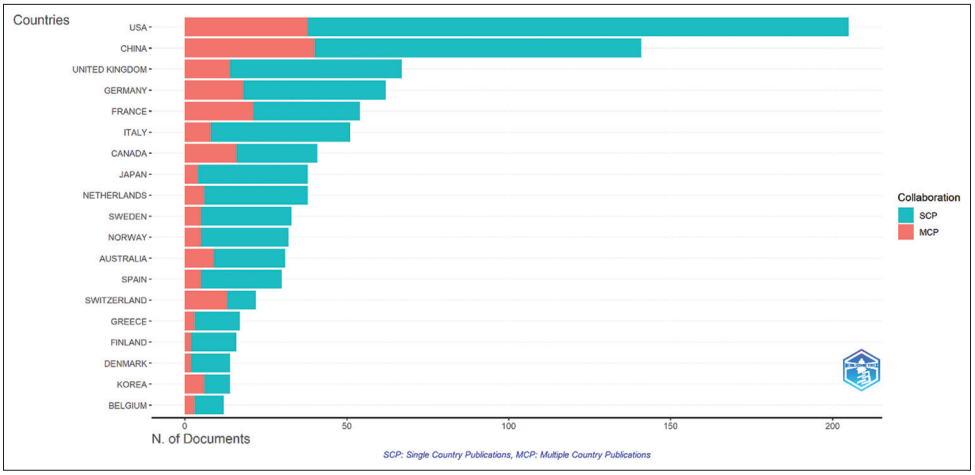
China also shows substantial output, with a noticeable balance between SCP and MCP. This indicates China's growing role in producing domestic research and participating in international collaborations.

The United Kingdom, Germany, France, and Italy show similar patterns, with a healthy mix of SCP and MCP, implying active participation in international projects and a robust national research capability. The prevalence of MCP among these European nations highlights the continent's emphasis on collaborative research efforts, potentially driven by European Union policies and funding mechanisms that encourage cross-border cooperation.

Countries like Japan, Canada, and Australia, while having fewer publications than the leading European nations, still display a significant number of MCP relative to their SCP. This could indicate these countries' strategic alignment towards international collaboration to enhance their research scope and impact.

Smaller countries like Switzerland, Norway, and Belgium, despite their smaller size, show impressive engagement in MCP. This suggests that these countries leverage international collaborations to overcome national research capacity and funding limitations.

Figure 3: Geographical distribution (corresponding authors)



The chart illustrates a trend where nations with robust research ecosystems tend to engage more in MCP, leveraging international collaborations to advance their research agendas. This geographical distribution not only underscores the interconnected nature of modern scientific research but also highlights the varying degrees to which different nations participate in global knowledge creation.

Understanding these dynamics is crucial for policymakers and academic leaders to foster environments supporting national research initiatives and international collaborations, vital for addressing complex global challenges and advancing scientific frontiers.

3.3. Sources Analysis

Table 3 offers a comprehensive view of the productivity and impact trends among key journals in environmental and economic studies, measured through metrics such as total articles, H-index, total citations, and 1st year of publication. The Journal of Environmental Economics and Management stands out with a robust output of 802 articles since its inception in 1975, reflecting substantial research activity and a consistent contribution to the field. Its high H-index of 38 underscores the significant influence and credibility of the research it publishes, as evidenced by 4630 total citations. These figures indicate a high degree of both productivity and impact, suggesting that the research adds to the literature volume and is extensively utilized and cited in further scholarly work.

Another notable example is the Journal of Cleaner Production, initiated in 1994, which has rapidly accumulated 691 articles and a commendable H-index of 34, accompanied by 3729 citations. This quick accumulation and high citation count signify the journal's immediate relevance and pivotal role in advancing discussions on sustainable production methods. The high citation per article ratio, approximately 5.4, indicates the quality and impact of the published articles, indicating that the journal's contributions are prolific and influential.

To further break down these metrics, calculating growth and productivity involves looking at annual publication increases and average citations per article. For instance, if we were to calculate the average annual citations for the Journal of Environmental Economics and Management, dividing its total citations by the number of years since its first publication gives an insight into its enduring relevance in the scholarly community.

Such analysis highlights the historical context and evolution of these journals and their adaptability and response to changing academic and global priorities. Older journals, like the Journal of Environmental Economics and Management, have shown sustained growth and influence over several decades, while newer journals, such as the Journal of Cleaner Production, have quickly established themselves as key players in specific niches within environmental and economic research. These metrics collectively reflect the dynamics of academic publishing and the evolving dialogue in environmental and economic studies, providing valuable insights for researchers, policymakers, and academicians in navigating and contributing to these fields.

3.4. Author and Citations Analysis

Table 4 authors local impact illustrates various critical bibliometric indicators for analyzing the productivity and influence of selected authors within their respective fields. These metrics include the H-index, G-index, M-index, total citations, number of publications, and the start year of publications, which collectively offer a detailed portrait of each author's scholarly impact.

The H-index, a vital indicator of an author's productivity and citation impact, shows that authors like Van Der Ploeg F lead with

Table 3: Details of top sources of publication

Journal	Total articles	H index	Total citations	First publication
Journal of environmental economics and management	802	38	4630	1975
Journal of cleaner production	691	34	3729	1994
Environmental and resources economics	360	32	4008	1992
Energy economics	192	30	260	1992
Resources and energy economic	149	24	1979	1993
Ecological economics	296	21	2448	1989
Journal of public economics	131	14	949	1972
Resources, conservation, and recycling	122	14	1200	1988
Resources policy	63	13	481	1974
International tax and public finance	15	9	876	1994

Table 4: Authors local impact

Authors	H_Index	G_Index	M_Index	TC	NP	PY_Start
Van Der Ploeg F	8	9	0.258	446	9	1993
Bovenberg Al	7	8	0.226	898	8	1993
Aronsson T	6	9	0.231	94	12	1998
Cremer H	6	6	0.231	251	6	1998
Fredriksson Pg	6	7	0.231	161	7	1998
Gahvari F	6	7	0.231	190	7	1998
Lin B	6	6	0.75	213	6	2016
Xu X	6	6	0.75	456	6	2016
Zhang Y	6	8	1.5	69	8	2020
Zhang Z	6	7	0.545	431	7	2013

an H-index of 8, indicating that he has at least eight publications, each cited a minimum of 8 times. This metric is complemented by the G-index, where Van Der Ploeg F scores a 9, suggesting his top 9 most-cited papers have collectively received significant citations, highlighting the profound impact of his most influential works.

The M-index provides insights into the consistency of an author's impact over time by considering their active years in publishing. For instance, Zhang Y, who started publishing in 2020, has an impressive M-index of 1.5, demonstrating a rapid accumulation of impactful publications within a short span. This suggests a quick rise in his academic influence compared to peers with longer publishing tenures.

Total citations and the number of publications offer additional layers of understanding. Van Der Ploeg F's 446 citations across nine publications suggest a broad and sustained influence, underlining the significance of his research contributions over the years. In contrast, newer authors like Zhang Y have quickly established a strong citation record with fewer publications, indicating highly impactful research that resonates well within the academic community soon after publication.

The starting year of publication, such as 1993 for Van Der Ploeg F and 2020 for Zhang Y, helps contextualize their career trajectories and the evolution of their scholarly impact. Authors who began publishing earlier have had more time to build their reputation and influence through sustained contributions. In contrast, newer entrants like Zhang Y have demonstrated the ability to quickly establish a strong presence in their fields.

Collectively, these metrics underscore the quantity of each author's scholarly output and highlight the quality and lasting relevance of their work. Such detailed bibliometric analysis is invaluable for academic evaluations, strategic planning in research careers, and understanding the influence dynamics within the scholarly community.

Table 5 provides a comprehensive view of citation metrics for selecting influential academic documents, presenting data on Total Citations, TC per Year, and Normalized TC for each. These metrics collectively offer insights into the documents' impact and ongoing relevance within the academic community. Horbach et al. 2012, with an impressive 821 citations, stands out as the most influential work on this list. Its TC per Year is notably high at 68.42, indicating sustained annual interest, which may reflect the document's importance in addressing current research trends or foundational issues in its field. The high Normalized TC of 19.43 further confirms its strong impact, highlighting its relevance even after accounting for its publication date.

Table 5: Document citations

Document	Total citations	TC per year	Normalized TC
Horbach et al., 2012	821	68.42	19.43
Goulder, 1995	657	22.66	10.89
Krass et al., 2013	470	42.73	11.96
Gallagher and Muehlegger, 2011	444	34.15	9.48
Bovenberg and Goulder, 1996	408	14.57	6.97
Gössling et al., 2005	402	21.16	11.20
van Kooten et al., 1995	334	11.52	5.54
Mena et al., 2011	312	24.00	6.66
Lovely and Popp, 2011	286	14.30	5.92
Herring and Roy, 2007	285	16.76	5.56

In comparison, other documents like Goulder. (1995) and van Kooten et al. (1995), despite having substantial total citations (657 and 334 respectively), show lower TC per Year (22.66 and 11.52) and lower Normalized TC (10.89 and 5.54). These figures suggest that while these works were impactful at the time of publication, their influence may have diminished slightly over time or become more niche. On the other hand, Gallagher and Muehlegger, 2011 and Krass et al. (2013) exhibit strong yearly citation rates of 34.15 and 42.73, respectively, which point to their ongoing significance and potential relevance to current academic discussions.

The Normalized TC metric, which adjusts for the document's age, allows for a fair comparison between older and newer works, emphasizing those with a lasting influence relative to their publication date. For instance, the sustained impact of Horbach et al. (2012), with a high Normalized TC, underscores its foundational role within its field, while documents with lower Normalized TC values indicate more time-bound or specific influences.

3.5. Conceptual Structure and Network Analysis

Figure 4 illustrates a comprehensive visualization of fundamental environmental economics and policy themes, depicting how various concepts are interrelated based on their co-occurrence in the literature. The map is structured around two main dimensions that collectively explain about 66.10% of the variance in data, with Dimension 1 (49.83%) likely capturing the breadth of topics from policy frameworks to economic impacts and Dimension 2 (16.27%) potentially representing the shift from theoretical models to practical applications.

Central to the map are pivotal themes such as "environmental taxes," "environmental policy," and "economic instruments," indicating their foundational role in discussions on environmental economics. These core topics act as bridges, linking detailed economic theories with specific environmental strategies and demonstrating their integral role in shaping the field's discourse.

To the left of the map, there is a dense cluster of terms, including "pollution control," "tax system," and "subsidy system." This clustering strongly focuses on environmental management's regulatory and fiscal tools, highlighting how pollution control measures are frequently analyzed in conjunction with economic instruments like taxation and subsidies.

On the right side, the map shifts focus towards "carbon emission," "greenhouse gases," and "emissions trading." This area emphasizes the mechanisms of carbon management and the implementation of trading systems to mitigate emissions. The proximity of terms related to "greenhouse gas" to "climate change" reinforces the connection between emissions management and broader climatic impacts, underscoring the critical nature of these discussions.

Furthermore, terms on the periphery, such as "sustainable development" and "environmental management," while still linked to the central nodes, suggest emerging fields or newer focus areas that are expanding the traditional boundaries of environmental economics. These peripheral topics indicate evolving research directions that may become more central as the field develops.

Content analysis is a technique used to review the content of a publication article in order to get thematic conclusions from a particular topic, either done manually or with the help of software. (Mody et al., 2021). In the end, the results of analyzing these various papers provide new insights for future researchers on relevant topics in the subject of environmental tax research.

Figure 5 provides a detailed mapping of keyword interactions within the domain of environmental economics, as depicted through the clustering and interconnectivity of various terms. This visualization highlights several prominent clusters, each representing a specific thematic focus that underscores the interdisciplinary nature of environmental economics.

At the core of the visualization, the dominant cluster around "taxation" reflects its centrality in discussions about environmental policy. This cluster closely ties in with "emission control," "carbon taxes," and "environmental policy," illustrating the integral role of fiscal tools in environmental regulation. Such clustering indicates that taxation strategies are often discussed alongside measures for controlling emissions, underscoring their importance in regulatory frameworks.

Adjacent to this, the dense red cluster featuring terms like "environmental policy," "public policy," and "economic instruments" suggests a focus on the mechanisms through

Figure 4: Conceptual structure map

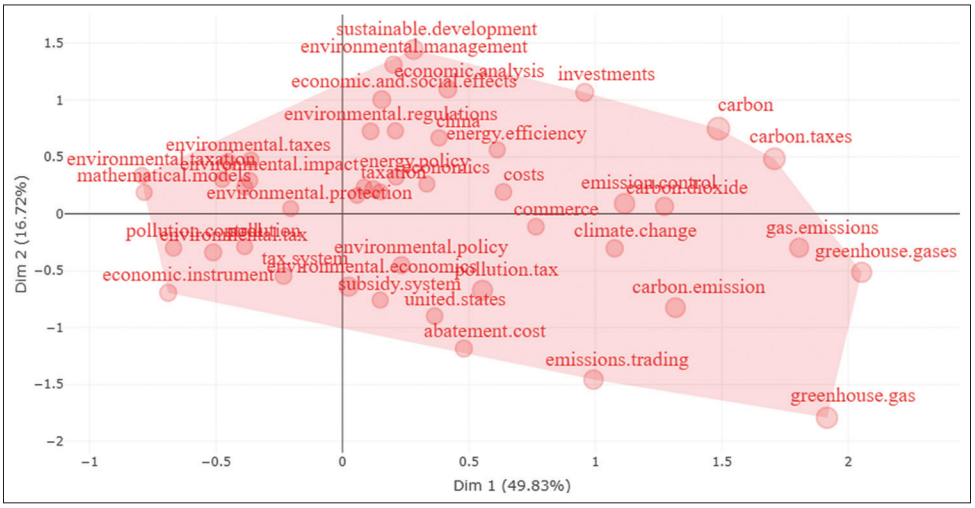


Figure 5: Network visualization co-occurrence

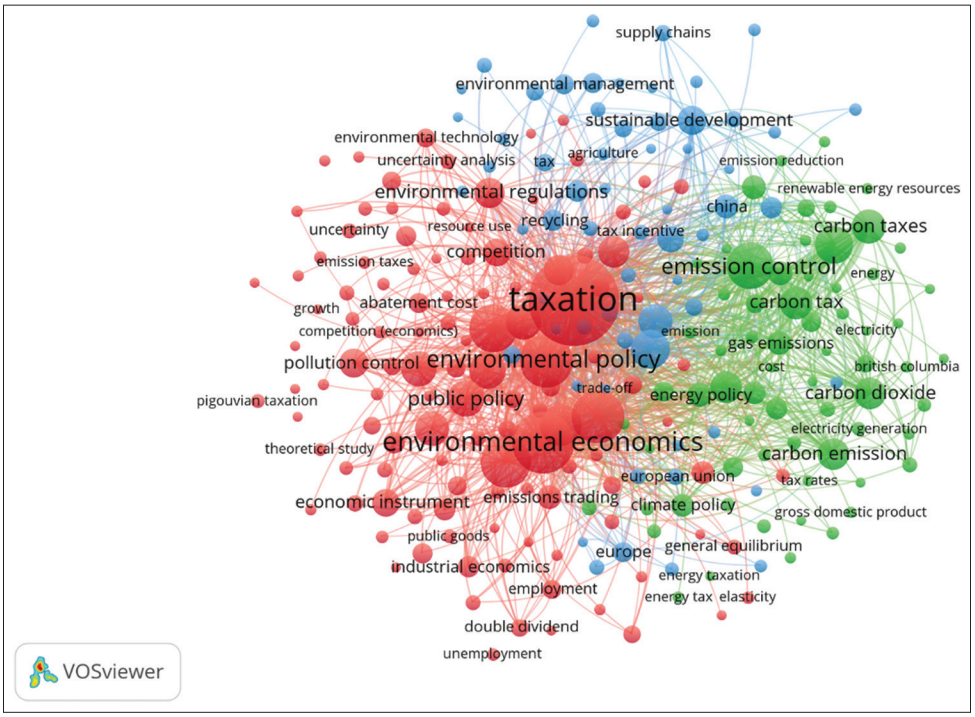
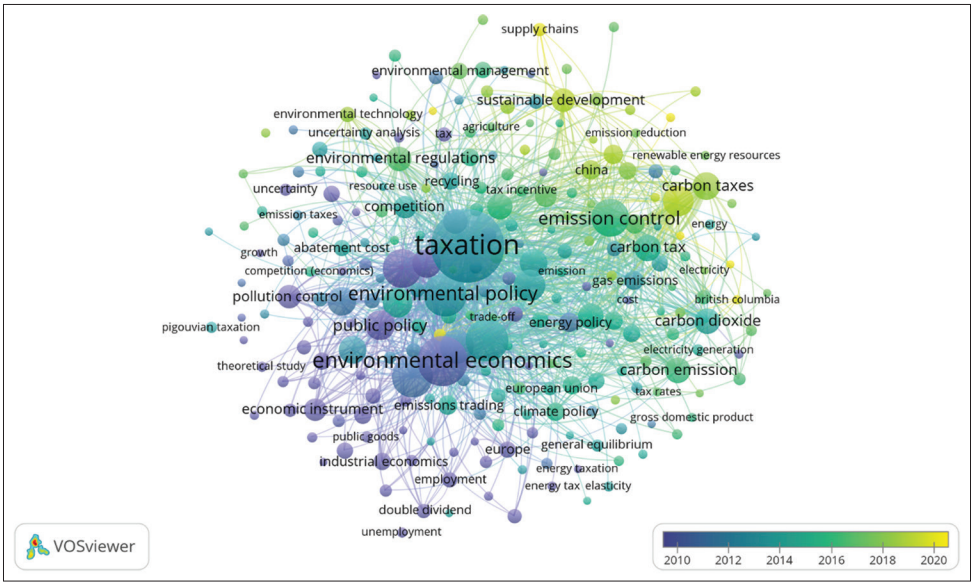


Figure 6: Overlay visualization



which environmental objectives are achieved through policy-making. This signifies a robust dialogue within the literature on how policies are designed and the economic tools that support environmental goals.

The green cluster, encompassing "carbon dioxide," "emissions trading," and "climate policy," points towards a concentration on managing greenhouse gas emissions and the policy instruments like emissions trading systems that are used to handle these challenges. This indicates active research and policy discussions on emissions management and climate change mitigation.

Notably, peripheral topics such as "sustainable development" and "environmental management" appear less central but are crucial to the broader context of environmental economics. Though on the edge of the main clusters, these areas highlight the expanding scope of research that includes sustainable practices and comprehensive environmental management strategies.

The visualization also reveals the interconnectedness of these clusters, with links between economic modeling terms like "general equilibrium" and broader economic impacts such as "gross domestic product" to environmental policies. This interplay showcases the profound economic implications of environmental decisions, connecting macroeconomic outcomes with micro-level policy instruments.

Figure 6 provides an insightful visual representation of the shifts in research focus within the field of environmental economics from 2010 to 2020. Using a color gradient from blue to yellow to denote the timeline, this visualization highlights how topics have varied in prominence over the decade, with blue indicating earlier years and yellow denoting more recent focus.

Central themes such as "taxation" and "environmental policy" are depicted in blue and green hues, indicating their longstanding significance and sustained focus within the academic dialogue throughout the decade. These areas have consistently served as foundational elements of environmental economics, reflecting their enduring relevance in both scholarly and policy-making arenas.

Conversely, emerging themes like "carbon taxes" and "emissions trading" are shown in greener to yellower tones, signifying their relatively recent ascent in scholarly attention. This trend likely mirrors the global shift towards market-based mechanisms for environmental regulation, responding to the urgent need for effective policy solutions in light of worsening climate crises.

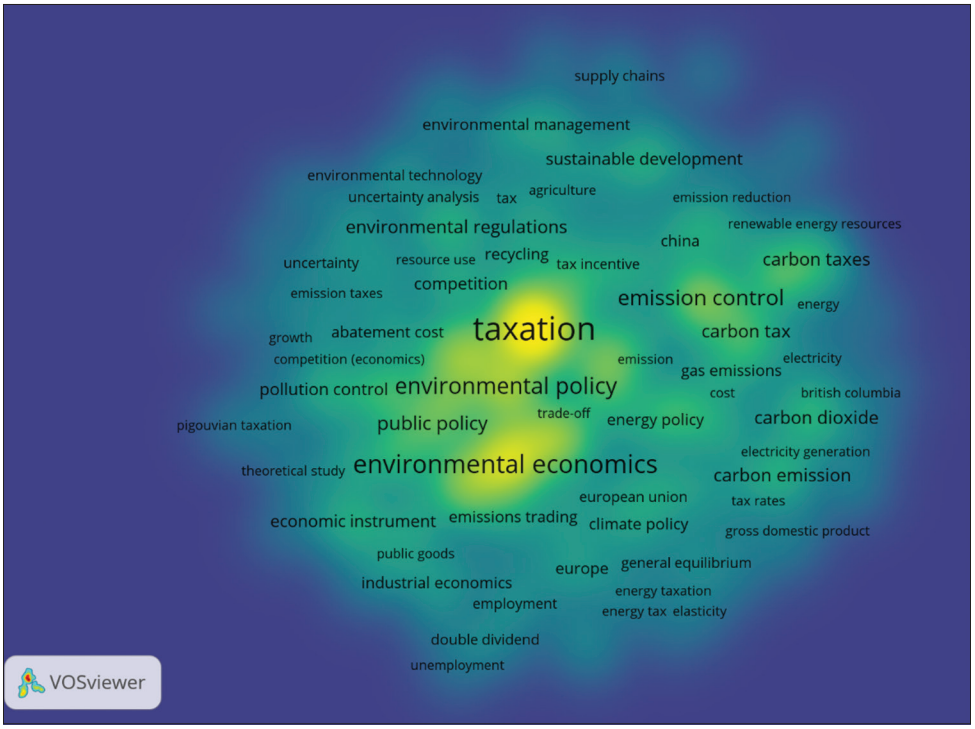
The visualization also organizes related themes into clusters, illustrating the interconnected nature of topics within environmental economics. For example, "carbon emission," "energy policy," and "carbon dioxide" cluster closely together, emphasizing the close conceptual links between energy policies and their environmental impacts, particularly in terms of carbon emissions.

Newer areas of focus, such as "supply chains" and "sustainable development," appear on the periphery in lighter shades, indicating their emerging relevance. These topics are gaining traction, suggesting broadening the field to include comprehensive approaches to sustainability that incorporate economic, environmental, and supply chain perspectives.

Figure 7 presents a compelling graphical representation of the concentration and distribution of research topics within environmental economics, employing a color gradient to depict areas of high and low density of keyword occurrences. This type of visualization serves as a heat map, where darker areas signify denser concentrations of research activity, indicating major focal points or hubs of scholarly interest.

The keyword "taxation" appears as a prominent dark spot in this visualization, reflecting its significant role and frequent discussion within the field. This central positioning and darker hue suggest that taxation is a critical and extensively studied topic in environmental economics, likely due to its importance in policy-making for environmental management.

Figure 7: Density visualization



Surrounding this central node, other closely related terms such as "carbon taxes," "emission control," and "environmental policy" also show darker shades, indicating strong interconnections and a high volume of research activity. These terms cluster around the central theme of taxation, emphasizing the focus on economic instruments used to regulate and mitigate environmental impacts.

Additionally, peripheral areas such as "sustainable development" and "supply chains" are lighter, suggesting emerging or less densely covered topics within the field. Despite their lighter shade, their presence indicates growing interest and the expanding boundaries of environmental economics to include broader sustainability issues that intersect with economic considerations.

The density of keywords like "carbon emission" and "energy policy" towards the right side of the visualization suggests a specific focus within the discipline on energy production and its environmental implications. This darker gradient highlights its importance in contemporary research, driven by global climate change and carbon management concerns.

4. CONCLUSION

This bibliometric analysis conclusively demonstrates that environmental taxation is a rapidly expanding and critically important field, evidenced by the significant growth in academic output during peak years like 2015, 2022, and 2023, highlighting a global urgency to address sustainable fiscal mechanisms. The United States dominates the field, with substantial contributions from China and the European Union indicating broad international engagement. Van Der Ploeg F is a pivotal author whose influential works helped shape the global discourse. There is a clear trend toward integrating environmental taxation with broader economic and public health policies, emphasizing the need to explore the empirical impacts of these policies.

This analysis not only maps the current landscape but also suggests future directions for research, particularly the need for longitudinal studies that assess the long-term economic and environmental outcomes of taxation policies and more comparative analyses that can offer insights into the efficacy of environmental taxes across different global contexts. These future research avenues are essential for developing more effective and contextually adapted environmental taxation strategies worldwide.

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