

The Impact of ESG Policies on Firm Value: A Bibliometric Analysis of the Literature

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Abstract. *The present study analyzes how the significant expansion of the interest in ESG matters, from both an institutional point of view but especially an academic one, has happened in parallel with the expansion of academic concerns in this field and of dedicated research. This has led to the creation of certain trends, themes and key domains, but in the same measure it has also led to highlighting some areas relevant to ESG topics, but less covered by scientific activity. The dataset used in the bibliometric analysis was based on a series of articles extracted from the Web of Science Core Collection database, through the application of searches that aimed to highlight articles related to specific ESG terms and especially to the correlation of these with firm value. These articles were filtered through the PRISMA methodology. After applying relevant selection criteria and eliminating results that did not contain relevant articles, we reached a total of 1,032 articles published between the years 2021 and 2026. With the help of VOSViewer we combined certain performance indicators of these articles (trends, productivity and citation impact) with science mapping techniques, including here co-authorship analysis, keyword co-occurrence analysis, and bibliographic coupling. The results indicate the presence of well-outlined thematic clusters centered around the key concepts of ESG. Other domains identified indicate the presence of the key concepts of corporate governance and ESG risks. At the same time, the analysis found that there is a significant fragmentation resulting of the ESG indicators and of the ESG frameworks at international level. Thus, the conclusion of the present study underlines the fact that bibliometric analysis instruments are useful both in identifying the consolidation tendencies of the specialized literature in the ESG domain through the synthesis of recent developments, but also in identifying themes and tendencies of future researches like the standardization of ESG frameworks.*

Keywords: environmental social and governance, governance performance, ESG investing, ESG rating, ESG score, financial performance, bibliometric analysis.

Introduction

Global markets are in the middle of major transformations in which, one of the major pressure points is applied by the need and requirement of companies to perform in a sustainable, socially responsible way and with proper corporate governance in place. There is a major shift happening as we speak in the way in which companies and investors now use ESG criteria for their investment decisions. Financial performance in the last period is no longer analyzed only through the lens of purely financial indicators. The evaluation is extended also through the lens of non-financial indicators, as well as the way in which a firm interacts with and relates to social and environmental aspects.

The academic literature shows an accelerated increase of the number of researches dedicated to ESG. A particular emphasis is allocated to the relationship between ESG performance and firms' economic outcomes. Recent empirical studies found a positive link between ESG practices and financial performance. This happens as often firms adopt sustainable strategies for greater stability, reduce operational risk, and improve stakeholder alignment (Bahadori et al., 2021; Shaikh, 2022). Therefore, ESG is these days viewed as a critical factor with a direct impact on the

financial performance and the value creation of a company and, not only as an instrument of compliance or reputational communication.

In addition to the impacts on financial performance, a growing body of research investigates the impact of ESG on firms' market value. The findings indicate that ESG performance contributes to the value of companies both directly and indirectly. The direct contribution comes from improved financial performance while the indirect contribution is generated by the reduced risks perceived by investors (Zhou et al., 2022). The literature underlines the role of corporate governance mechanisms in strengthening this relationship. The impact of ESG on market value is either amplified or diminished by the ownership structure and the quality of the governance systems (Wu et al., 2022). These results show that the ESG impact is not uniform, it is rather dependent contingent on institutional and organizational characteristics.

At the same time, recent research pays greater attention to ESG risk and its implications for the financial stability of companies. ESG is viewed both as a source of value and at the same time as a potential generator of costs and risks. This happens particularly when the implementation and the disclosure of ESG practices are inconsistent or insufficiently substantiated (Cohen, 2023). This duality explains to some extent findings that are not consistent. The literature highlights the need for analytical approaches which are significantly more nuanced, capable of distinguishing between ESG components and the mechanisms through which they influence firm value.

Even though the volume of research examining the ESG–firm value relationship has increased significantly, there is still an obvious conceptual and methodological fragmentation. The generalization of results is limited by differences in the ESG indicators, different rating methodologies, and various empirical models utilized (Khan, 2022). In this context, a systematic mapping of the field is required in order to identify dominant research directions and highlight existing gaps.

Accordingly, the present study starts from the general hypothesis that the scientific literature addressing the relationship between ESG performance and firm value is structured around dominant thematic clusters. This reflects both the positive effects of ESG on financial performance and market value, and the moderating role of corporate governance and ESG risk.

The study analyzes scientific documents indexed in the Web of Science database for the period 2021–2026, in order to capture the most recent consolidation trends of the ESG research. Techniques of applied co-authorship, keyword co-occurrence, and bibliographic coupling are applied in order to identify the structure of the ESG–firm value domain and in order to identify research directions which are recently emerged.

The structure of the paper is the following: in Section 2, the Literature Review reviews the relevant articles mentioned above; the Methodology is presented in Section 3 and breaks down the data and the way we used the bibliometric approach; Results and Discussion are presented in Section 4 which focuses on reporting the performance and science-mapping results; and the Conclusion is presented in Section 5 by summarizing the findings, the limitations, and future directions that the future research should focus on.

Literature review

In the last 20 years, ESG has become a central part in the analysis of corporate performance. The literature reflects this new approach and has evolved from viewing ESG as a reputational instrument or a response to regulatory imperatives to actually incorporating ESG as a relevant economic contributor to the financial performance, the firm value, and the risk profile of companies.

A first important stream of research analyzes the relationship between ESG performance and financial performance of companies. Bahadori et al. (2021), based on results measured in emerging markets, show that firms with ESG scores on the higher end are presenting better financial performance. Their conclusions coincide with the result of Shaikh (2022), who, based on an international sample demonstrates that the integration of ESG performance philosophy into the overall corporate strategy is correlated with better operational performance and lower risks.

Similarly, Chen et al. (2023) find that a better ESG performance influences in a positive manner the financial outcomes of various companies. However, evidence also points to results that are not consistent and they are more heterogeneous; the bibliometric and meta-analysis done by Khan (2022) indicate that although the ESG–performance relationship is mostly positive, its size and direction will depend on the ESG measurement methods, sector, and the geographical region.

A second major research direction focuses on the impact of ESG on firms’ market value. Zhou et al. (2022) propose a method in which financial performance is actually a variable between ESG and a firm value. Wu et al. (2022) introduce a more nuanced approach where the ownership structure also matters in the ESG correlation. Accordingly, the positive correlation of ESG with the value of a company is enhanced where governance mechanisms reduce agency conflicts.

In parallel, recent literature pays an increased attention to the ESG risk and its implications for corporate valuation. Cohen (2023) investigates the impact of ESG risks on firm value. This is applicable especially when such risks are associated with potential regulatory sanctions or reputational damage. His findings indicate that not only the level of ESG performance matters, but also the nature and materiality of risks associated with each component - E, S, or G.

A distinct branch of the literature examines the relationship between ESG and the cost of financing. Apergis et al. (2022) demonstrate that ESG scores are negatively correlated with the cost of debt. This finding proves the idea that ESG compliance is a strong indicator of reduced perceived risk, and hence credit institutions are inclined to allow more favorable financing conditions. At the sectoral level, Liu et al. (2023) extend this perspective to the banking sector. They show that ESG performance is associated with a significant reduction in non-performing loans.

Nevertheless, the literature does not lack findings that are not clear or ambiguous, especially when we investigate the context of capital market reactions. Feng et al. (2022) distinguish between ESG and CSR and calculate differences between short- and long-term effects on stock returns. The authors conclude that CSR tends to support long-term returns. However, at the same time in certain contexts, ESG scores may generate negative effects on returns.

In addition, an emerging theme concerns the quality of the ESG reporting and the risk of “strategic disclosure.” Cerciello et al. (2023) show that sustainability practices may have an adverse short-term profitability effect when the reporting is incomplete or deficient. This result underscores the importance of distinguishing between actual ESG performance and ESG communication.

Overall, the existing literature indicates that ESG is a multidimensional construct with complex effects on financial performance, firm value, and risk. The factors that are correlated with the ESG performance include, among others, financial performance, ownership structure, reporting quality and institutional context. These findings justify the need further investigations performed on an in-depth basis using empirical methods to assess the existence of the relationship between ESG and economic outcomes, and to clarify the mechanisms through which this relationship operates.

This hypothesis supports the relevance of using bibliometric methods to identify dominant clusters, preferred themes and their evolution over time. These methods offer a structured overview of the current state of knowledge based on the review of the literature. The research field addressing

ESG and firm value is fragmented from a methodological and conceptual standpoint. This is reflected by the diversity of approaches utilized, the ESG indicators, and rating sources used in procuring the data.

The scientific articles that present researches related the correlation between ESG and the value of companies are still fragmented from a methodological and conceptual point of view. There are a number of diverse approaches, ESG indicators which are not consistent and various rating methodologies deployed in these researches. This also is maintained at the in the ratings provided by specialized agencies which use inconsistent methods in their measurements. The result of this inconsistent methodologies applied generate results which are not omogenous as well as interpretations which might vary significantly (Khan, 2022; Gopang et al., 2025). This fragmentation is impacting the comparability of the studies on this theme and the integration of of conclusions regarding the impact of ESG on firm value.

Hence, there is strong need to identify the gaps in the research which needs to be filled in with proper investigations in order to provide the fundamental consolidation needed in this field. Taken into consideration the rapid growth on basis that are not consolidated and sometimes divergent of the ESG literature, this bibliometric analysis intends to show and provide an image of the field as structured as possible. Hence, the study combines various indicators, starting from the those which describe the performance of an article (citation impact) with other techniques which include science-mapping. The bibliometric methods hence identifies the most relevant sources and contributors grouped by clusters of themes covered in the ESG researches.

Therefore, the next section presents the data collected and bibliometric methods used in this study.

Methodology

The study uses a bibliometric approach in order to map the ESG-firm value relationship. The bibliometric analysis combines the description of performance indicators, with a focus on those on productivity and citation impact with the science-mapping techniques. This approach, performed using VOSviewer ensures a structured approach which can then be further reproduced on future studies.

The search was performed in the Topic (TS) field using the following query: TS = ((ESG OR “environmental social governance” OR “environmental social and governance”) AND (“ESG performance” OR “ESG rating” OR “ESG ratings” OR “ESG score”)).

The search period covered 2021-2026, in order to capture the most recent stage of consolidation of ESG research. This period is characterized by an increased number of academic and institutional articles in sustainability and corporate performance. This initial search provided 1,130 documents. The study selection process was documented in accordance with the PRISMA flow diagram to ensure transparency and reproducibility in the study selection process. The screening process followed five steps: identification, removal of incomplete records and verification of duplicates, screening, eligibility, and inclusion of the analyzed documents. Web of Science was the only database used for the identification of relevant literature which allowed for elimination of the risk of duplicating records during the selection process. The final dataset excluded articles which were non-academic and which didn’t have a direct relevance to the ESG-firm value relationship. PRISMA is used here for the purposes of reporting on the dataset construction. On the other hand, it does not intend to perform a qualitative review of the articles and scientific papers included in the study.

As a first step, a temporal filter to select more recent articles from the period 2021 to 2026 was applied. Then, a thematic filter based on Web of Science Categories was again applied in order to ensure the relevance to the research domain. The following categories were selected: Economics, Business, Management, Business Finance, Environmental Studies, and Environmental Sciences.

The VOSviewer software was used for performing the bibliometric analysis which allowed for generating graphic visualization for the relationship identified of the bibliographic networks. The following analytical techniques were applied to the final sample of 1,032 documents:

- Co-authorship analysis – in order to detect the collaboration networks among authors and countries;
- Keyword co-occurrence analysis - to visualize the main research themes and directions;
- Bibliographic coupling analysis – in order to identify the main thematic clusters.

This methods provide a solid basis for interpreting the results and to formulate the research conclusions.

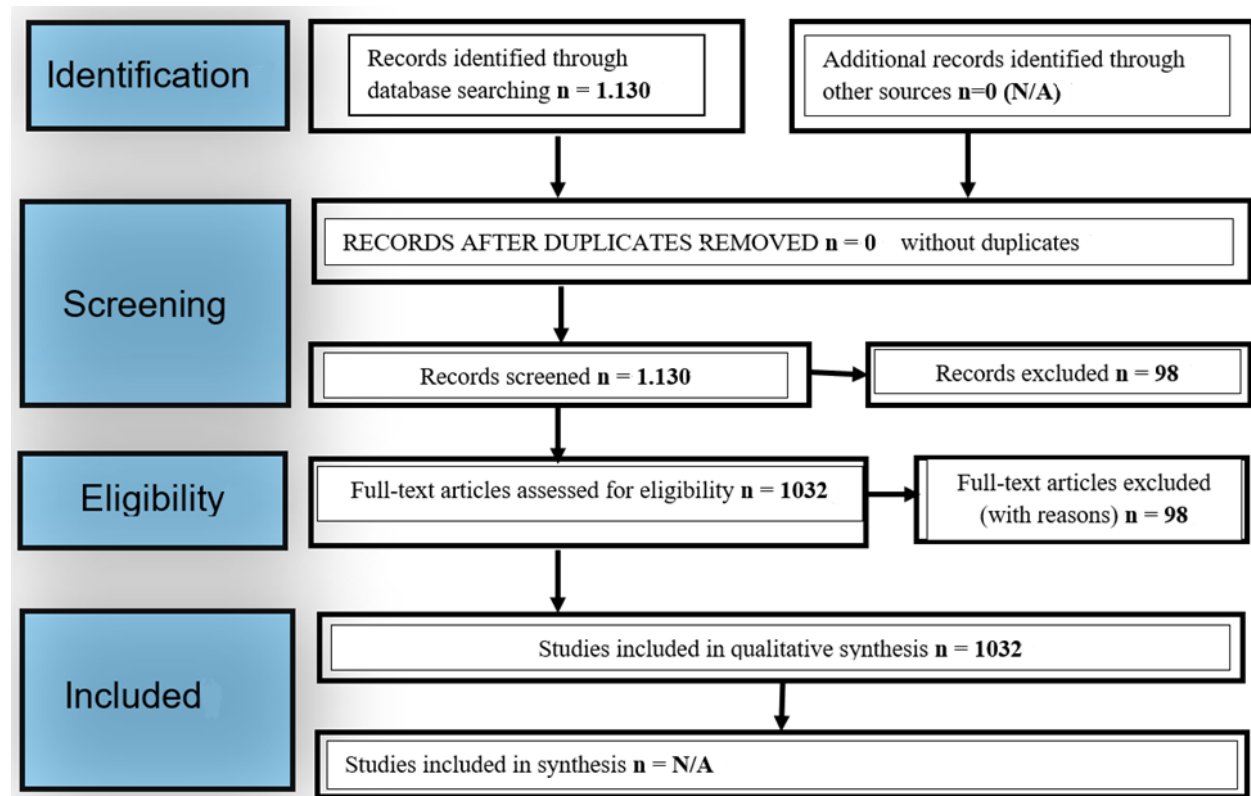


Figure 1. PRISMA Flow Diagram

Results and discussions

This section reports the results of the bibliometric analysis. We first present the indicators which focus on the descriptive performance like the publication trends, productivity, and citation impact and then present the results produced by VOSviewer with regards to the science-mapping techniques applied which further describe the co-authorship, keyword co-occurrence, and the bibliographic coupling criteria.

Performance analysis

The standard practice in the bibliometric review is to start with reporting the performance indicators that capture the productivity in terms of number of publications and impact through

total citations. These indicators provide a preliminary overview of the main publication channels as well as of the contributors to the ESG-firm value research stream, in the same time complementing the science-mapping analyses presented in the following sections.

For the period analyzed 2021 to 2026, the number of publications on the ESG–firm value relationship show a strong increasing trend. The number of articles increases from 41 (2021) to 97 (2022) and 132 (2023), followed by a sharp acceleration in 2024 (270) and a peak in 2025 (464).

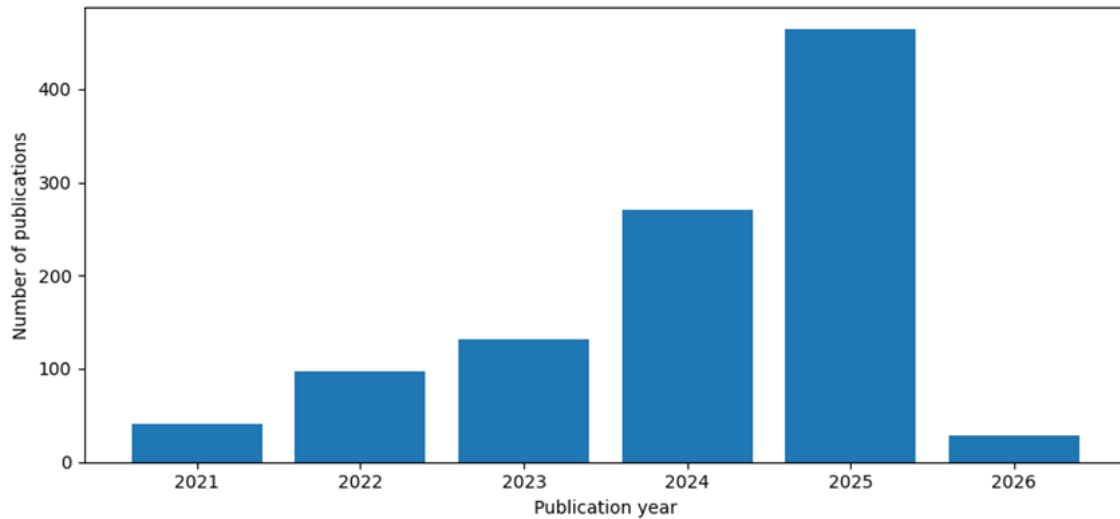


Figure 2. Number of documents published by year during the analyzed period 2021 - 2026

Source: Author's own research based on data extracted from Web of Science, 2026.

The publication trend indicates a fast expansion of ESG-firm value research, with the maximum growth concentrated in the last two full year of 2024 and 2025.

Table 1. Most productive journals (Top 10)

No.	Journal	Publications	Total citations (TC)
1	Sustainability	137	2,163
2	Corporate Social Responsibility and Environmental Management	68	1,177
3	Business Strategy and the Environment	46	1,721
4	Finance Research Letters	37	1,008
5	International Review of Financial Analysis	25	1,302
6	Research in International Business and Finance	21	926
7	International Review of Economics & Finance	21	395
8	Business Strategy and Development	17	275
9	Applied Economics	17	212
10	Borsa Istanbul Review	13	650

Source: Author's own research based on data extracted from Web of Science, 2026.

The results show that research output is concentrated in a small number of sustainability and finance journals. *Sustainability* is the most productive channel in the dataset selected.

Table 2. Most productive countries (Top 10)

No.	Country	Publications	Total citations (TC)
1	China	288	7,007
2	India	92	1,703
3	USA	90	2,130
4	Italy	84	2,229
5	England	69	2,538
6	South Korea	52	603
7	Malaysia	50	1,109
8	Spain	45	1,341
9	Turkey	45	338
10	France	38	955

Source: Author's own research based on data extracted from Web of Science, 2026.

China, the USA, and several European countries provide the largest number of publications and citations which prove the productivity and substantial influence in the field resulting from this geographical regions.

Table 3. Most productive authors (Top 10)

No.	Author	Country	Publications	Total citations (TC)
1	Albitar Khaldoun	England	7	598
2	Paolone Francesco	Italy	7	253
3	Buallay Amina	Malaysia	6	138
4	Lu Wein-Min	China	6	105
5	Hussainey Khaled	England	5	452
6	Wang Hanlei	China	5	117
7	Kweh Qian Long	China	5	105
8	Ting Irene Wei Kiong	Malaysia	5	105
9	Liu Heying	China	5	82
10	Elamer Ahmed A.	England	4	162

Source: Author's own research based on dataset extracted from Web of Science, 2026.

The productivity based on author is diverse. There is a small group of recurring contributors accounting for the highest publication counts and citation impact.

Table 4. Most cited documents (Top 10)

No.	Reference (first author, year)	Source	Total citations (TC)
1	Duque-Grisales, 2021	Journal of Business Ethics	679
2	Chen Zhongfei, 2022	International Review of Financial Analysis	599
3	Eliwa Yasser, 2021	Critical Perspectives on Accounting	530
4	Zhou Guangyou, 2022	Business Strategy and the Environment	497
5	Fang Mingyue, 2023	Economic Modelling	368
6	Khan Muhammad Arif, 2022	Research in International Business and Finance	351

No.	Reference (first author, year)	Source	Total citations (TC)
7	Shakil Mohammad Hassan, 2021	Resources Policy	332
8	Aydogmus Mahmut, 2022	Borsa Istanbul Review	326
9	He Feng, 2024	International Review of Financial Analysis	314
10	Lee Michael, 2023	Journal of Business Research	284

Source: Author's own research based on data extracted from Web of Science, 2026.

The most cited documents form the main intellectual references of the field and they are largely aligned with the main thematic streams identified in the science-mapping results.

Science mapping results

To examine collaboration patterns and thematic structures in the ESG–firm value literature, we report science-mapping results based on co-authorship networks, keyword co-occurrence, and bibliographic coupling.



Figure 3. Co-authorship by Authors

Source: Author's own research using VOSviewer.

The co-authorship analysis performed with the help of VOSviewer applied the criterion of a minimum of two authors per publication. There are three distinct author clusters which are visually identified in Figure 3. The number of nodes is relatively limited and the level of connections is moderate. These characteristics suggest that the field is in a consolidation stage and it is still characterized by recurring collaborations but done in a fragmented manner.

The structure of the clusters indicates the presence of homogeneous research groups within which collaboration is intense. In the same time the groups present a limited degree of interaction among themselves. This result confirms the existence of parallel research directions oriented toward specific themes of research, particularly the financial performance, the ESG risk, or other regional particularities in the implementation of sustainability policies. The presence of authors occupying intermediary positions within the network suggests a “bridging” role of certain authors which facilitate the transfer of ideas across clusters. Hence, they would contribute to the overall cohesion of the field.

From a bibliometric perspective, there is an uneven distribution of academic productivity and influence which is resulting from the intensity of links and the size of nodes. There is a limited number of authors concentrating collaborations and playing a central role in structuring the network. This result signals the conceptual and methodological fragmentation of ESG research

which is consistent with the existing literature. It also shows a variance of the approaches used in analyzing the relationship between ESG and firm value.

The co-authorship analysis confirms the hypotheses formulated above about the expected results of the bibliometric research. The ESG-firm value research field is structured around several distinct thematic clusters. It does also exhibit a moderate degree of academic integration. This structure justifies the use of the bibliometric methods and highlights the need to significantly further intensified inter-cluster collaboration.

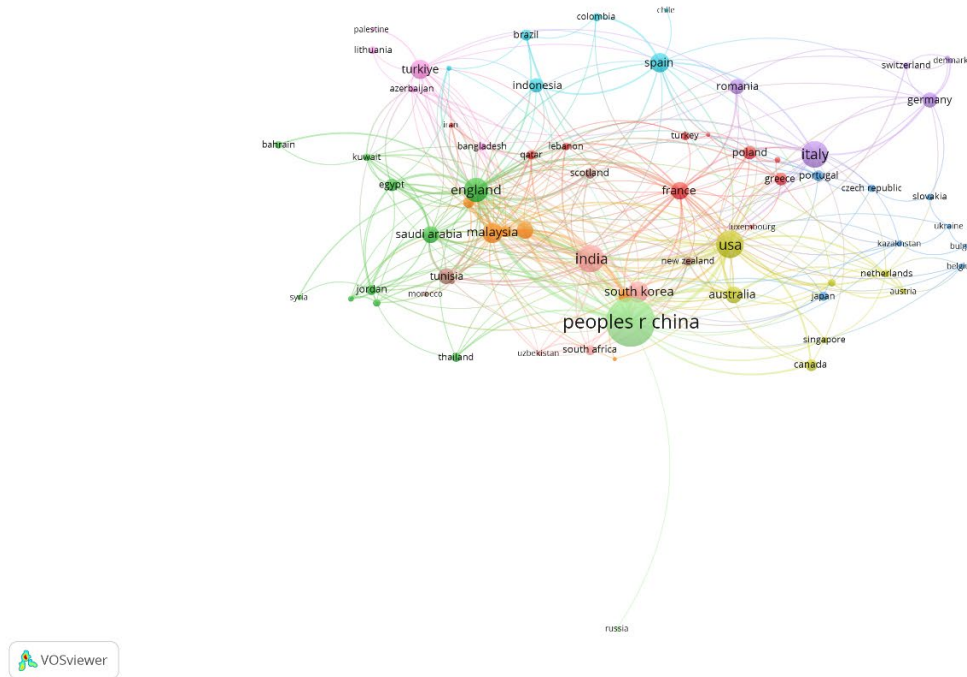


Figure 4. Co-authorship by Countries

Source: Author's own research using VOSviewer

Figure 4 presents the international co-authorship network generated in VOSviewer. The image highlights the geographical distribution and also the intensity of collaboration in the ESG-firm value research.

The network is dense and organized around several regional clusters, indicating a large participation and hubs that have multiple connections. China is the central collaboration node which reflects a high productivity in this research field as well as strong international connectivity. There are other hubs which are influential like USA, India, UK or Italy and they play a similar bridging role with regional communities. European countries appear to have a pattern of more intense collaboration among themselves while clusters in Asia show regional groupings within emerging markets contexts. North America and Oceania, reflecting the Anglo-Saxon culture elements have strong interconnections and appear oriented towards capital markets. Overall, the maps prove the internationalization of the field. In the same time, the presence of regional clusters still indicates a pattern of regional behaviors influenced by the local institutions and geographical specificities.

Source: Author's own research using VOSviewer.

Corporate social responsibility and stakeholder theory form major clusters in the Figure 5 above. It also indicate that the newer ESG concept is frequently approached as an follow-up concept to the older version of CSR. Another cluster of key words is grouped around the financial implications of ESG, as it includes specific concepts of market value and cost of capital. The visual analysis based on co-occurrence of author keywords does confirm the literature's strong interest in the relationship between sustainability and financial performance.

DOI: 10.2478/picbe-2026-0094, pp. 1233-1246, ISSN 2558-9652 |
 Proceedings of the 20th International Conference on Business Excellence 2026

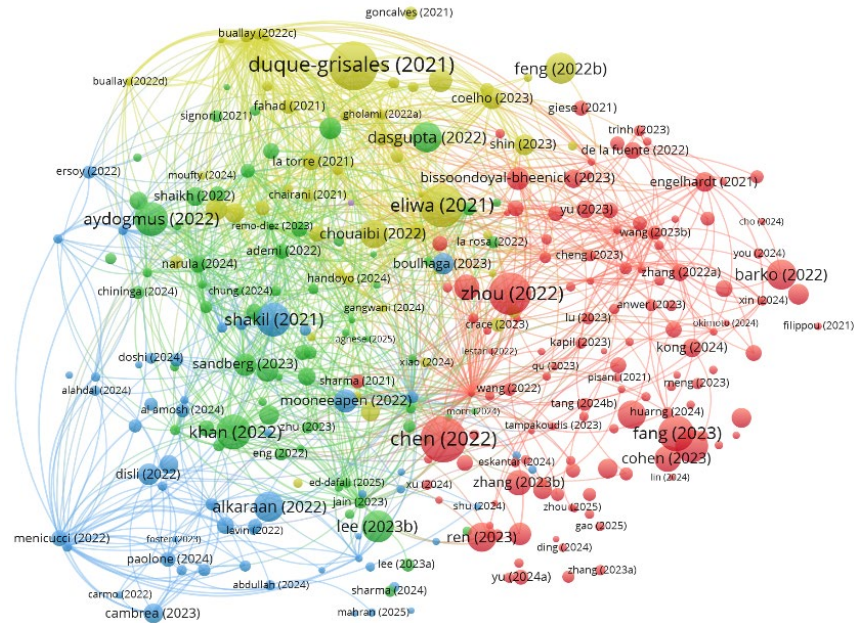


Figure 6. Bibliographic Coupling of Documents

Source: Author's own research using VOSviewer.

The bibliographic coupling map of documents emphasizes the structure of the ESG-firm value literature by connecting papers that use similar references. The network shows a dense configuration with three clusters that are clearly distinguished. It is revealed hence that the field has developed from a structured core to a diversified network of specialized streams. In order to facilitate the interpretability of the image, the visualization above is based on 302 documents that met the threshold set of 15 citations per document.

A highly visible cluster (yellow) is centered around contributions such as Duque-Grisales (2021) and other closely connected papers that form part of the mainstream ESG - value discussion and in the end become influential. The coupling signal within this cluster indicates a base of references which are significantly shared among contributors which further provide analytical approaches in their work. This is consistent with research linking ESG performance and disclosure to valuation-related outcomes.

A second red cluster has at its center the work performed by Zhou (2022), Chen (2022), and Cohen (2023). There is a dense network of connections which indicate that they provide a stream of references to the research communities around themes like governance, investor behaviors and the implications on valuations of the risks associated with the ESG factors.

A third blue and green cluster is relying upon Aydogmus (2022), Khan (2022), Shakil (2021) and their related researches. This stream is focused on the diversity of measurements of the ESG factors. In the same time they are using an empirical methodology when designing their research. They do provide a perspective into the resilience of the ESG factors. That is done by focusing on the ongoing debates about the ESG ratings, on the comparability of various methodologies used to measure ESG and also on the conditions under which ESG affects firm value. Several papers identified are located near the boundaries of the cluster in the areas where the nodes are located between the red and green and blue communities, which indicate a unifying approach of the contributions which further bridge otherwise distinct themes.

Overall, the bibliographic coupling results prove a thematic organized research domain with a strongly connected core and increasing specialization. Hence, it does support the utility of the bibliometric mapping in order to identify the dominant research streams and the underexplored junctions for future empirical work.

Conclusion

The bibliometric analysis highlights that there is significant development of the literature addressing the impact of ESG policies on firm value in the recent years. By applying the criteria into VOSviewer we obtain results which indicate the existence of several dominant thematic clusters which are centered on financial performance, risk, and cost of capital. The performance analysis identifies the most productive and influential journals, countries and authors.

The analysis also reveals a large degree of fragmentation from a methodological point of view as result of the diversity of the ESG indicators, of applying different evaluation methodologies, and varied practices in various geographical contexts. The level of integration is therefore moderate.

From an overall perspective, the study summarizes the evolution and structure of the research focusing on the ESG-firm value relationship based on a Web of Science dataset and bibliometric mapping. The study identifies an area which needs more investigation as there is a clear fragmentation in the understanding of how the ESG influences the value of various companies.

The studies converge on the fact that this correlation results from reduction in the overall corporate risk, better financial stability, and the strengthening of investor confidence. A number of studies focused on these causes and it is clearly evidenced Shaikh, 2022; Chen et al., 2023. Bahadori et al., 2021 goes further and it refines the conclusions in specific markets and different institutional contexts. At the same time, evidence suggests that the correlation of ESG to value of the firms is not uniform and is being conditioned by institutional, sectoral, and geographical environments in which firms operate, as well as by the maturity of the markets analyzed.

A second major theme identified in key studies analyzes the role of corporate governance as a mechanism for increasing firm value through ESG. Recent research articles show that the ESG and the market value are influenced to a large extent by the intensity of the ownership structure and the quality of the governance mechanisms. Wu et al., 2022 suggests that ESG investments are valued more strongly in contexts characterized by effective governance. Similarly, the corporate commitments are legitimized by the transparency and the consistency in the ESG disclosures. Per a contrario, their absence or deficient transparency of the ESG disclosures will limit the economic benefits (Cerciello et al., 2023).

Another relevant theme rotates around the relationship between ESG, risk, and financial resilience. Recent studies show that ESG can at the same time be a factor that contributes to the creation of value for companies but can also become a cost generator and increase the corporate risk factor when it is implemented deficiently or communicated inadequately. Apergis et al. (2022) show that better ESG scores are associated with a lower cost of debt since it is widely known that credit markets incorporate ESG information into their risk assessment and interest levels. Cohen (2023) demonstrates that exposure to ESG risks will likely negatively affect firm value, especially in those moments when such risks are perceived as important and managed improperly. This duality explains the divergent findings in the literature and underscores the need for approaches that distinguish between ESG dimensions and their role within different corporate strategies.

From a methodological perspective, the bibliometric analysis mapping results confirm the existence of significant fragmentation of the conceptual framework as well as of the ESG literature. Khan (2022) highlights considerable differences among ESG ratings, measurement indicators, and empirical models. These variations limit significantly the comparability of various studies as well as the generalization of the research results. Nevertheless, the configuration of clusters and linkages suggests ongoing consolidation of the field, with increasing attention to mechanisms such as ESG risk management, governance mechanisms, and long-term valuation implications (Zhou et al., 2022).

The conclusions of this paper demonstrate the fact that the bibliometric analysis is a useful methodology for mapping the structure, dynamics, and the evolution of the literature on the central theme under consideration which investigates the ESG-firm value relationship. The main contribution of this paper is to provide a structured and reproducible overview of principal research directions. In addition, the paper contributes at identifying the gaps and also the need for greater standardization in the ESG measurement system as well as the need for a more consistent integration of a firm value generating factors. These results should be interpreted as descriptive evidence from bibliometric mapping and should not be read as a proof of the ESG-firm value correlation.

The study has a limitation which results from the fact that the articles selected were used from a single database (Web of Science). This could exclude other relevant contributions which are published in other databases. Another limitation is emerging from the fact that the predominant descriptive nature of the bibliometric analysis does not allow for testing the direct causal relationships. Furthermore, the articles selected were limited to 2021 and hence older articles which could have provided relevant insights risk to be excluded and historical perspectives could have been omitted. In the alternative, this could have been done by using other multiple databases, applying complementary empirical methods, and enlarging the pool of comparative studies across regions and sectors. An important step forward will be achieved when the ESG performance measurement tools would be more consolidated and integrated to reduce the existing fragmentation and to strengthen the scientific knowledge in this domain.

Acknowledgment

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

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