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Bridging the Sustainability Gap: Unraveling the Interplay of Sustainability Disclosure and Cost of Debt

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Abstract

In the contemporary corporate world, environmental responsibility has elevated the importance of sustainability disclosures and their impact on the cost of debt. Conducting the first comprehensive review in this domain, this study analyzed 76 articles from 2008 to 2022 using the Biblioshiny package in the R program (for bibliometric visualization) and VOSviewer version (for bibliographic coupling), employing strict inclusion criteria based on the PRISMA protocol. The investigation was done to check the influence of sustainability disclosures on the cost of debt, including environmental and social dimensions. Additionally, it synthesized perspectives from lending institutions, corporate

governance, earnings management, sustainable business practices, and GHG / Carbon emissions in this relationship. The study has also synthesized the literature with conclusion that high-quality environmental and social disclosures with sustainable practices and reduced carbon emission significantly reduce a firm's cost of debt by minimizing perceived risks, and enhancing reputation, credibility and demand from socially responsible investors. Active engagement in CSR, sustainable practices, proper governance, and stakeholder orientation further contribute to lower the cost of debt. Conversely, inadequate disclosure quality, high carbon emissions, poor environmental records and negative media attention may increase borrowing costs and environmental penalties. This study will help CFOs to develop tailored sustainability strategies in optimization of their cost of debt resulting in higher financial performance. Results of this study are also helpful for policymakers, regulators, financial analysts, auditors, and investors.

Keywords: Sustainability disclosures, cost of debt, sustainability assurance, lending institutions, corporate governance, sustainable business practices, carbon emission, ESG.

1. Introduction

Capitalism, leveraging tools such as private property, a free market system with market-determined prices, capital accumulation through financial systems, competition, and limited government intervention, has propelled humanity to the brink of development and technological advancement that was unimaginable at the start of the 19th century (Teece, 1993). However, this progress has come with significant drawbacks, notably the severe impact on nature due to excessive industrialization. The environmental footprint of industries, marked by overutilization of natural resources, rampant deforestation, and fossil fuel consumption, has led to increased waste, emissions, and pollution, severely disturbing the Earth's natural climate. The global average surface temperature in 2020 was 1.09 degrees Celsius higher than in 1900, marking the most significant temperature rise over any 50 years in the last 2,000 years, particularly from 1970 onwards and greenhouse gas emissions from industries are significantly contributing to global warming (Pörtner et al., 2019). However, insufficient disclosure quality, increased ice melting, more frequent rain and sea storms, droughts, and environmental pollution have all been brought on by this trend, endangering human and marine life and increasing the risk of disease and environmental risks.

The United Nations Framework Convention on Climate Change (UNFCCC), observer firms, civil society organizations, and other stakeholders have taken the lead in addressing the fundamental causes of environmental degradation and global warming in a sustainable manner. The groundwork for these efforts was laid during the United Nations Conference on the Human Environment in Stockholm in 1972. The discussion was on global environmental policy and climate change, followed by the Geneva World Climate Conference (1979), where climate change was identified as a critical issue. Subsequently, the Brundtland Report (1987) linked climate change issues with economic development, leading to the creation of a framework for climate change agreement in the United Nations

Framework Convention on Climate Change (UNFCCC) Adoption (1992). This framework evolved into legally binding emission reduction targets with the Kyoto Protocol (1997). Despite high hopes, COP15 in Copenhagen (2009) and COP18 in Doha (2012) concluded without binding agreements on global GHG emission reductions (Castles, 2010; Mitra & Verma, 2016). A significant breakthrough was achieved at COP21 in Paris (2015), organized by the UNFCCC with solid support from the Obama administration, resulting in a legally binding treaty aimed at limiting global warming to well below 2 degrees Celsius above pre-industrial levels, with ambitions to keep it to 1.5 degrees Celsius, through global commitments (Falkner, 2016). Subsequent COP conferences have focused on further detailing the implementation of the Kyoto Protocol and fulfilling the commitments of the Paris Agreement, such as COP22 in 2016 (implementing the Paris climate agreement in developing countries), COP24 in 2018 (adoption of the Katowice Rulebook for operational guidance of the Paris Agreement), COP25 in 2019 (designing rules for carbon markets), COP26 in 2021 (accelerating actions to fulfil Paris Agreement commitments), and COP27 in 2022 (focusing on climate finance) (Cantat, He, & Chemistry, 2017; Falkner, 2016; Masuda, McLaren, & Poland, 2022).

Despite heightened awareness, commitments, and legal obligations, governments have initiated efforts to address the primary cause of environmental degradation and global warming—greenhouse gas emissions from excessive industrialization—by regulating global corporations sustainably. Nationwide emission targets have been established, which are subsequently reflected in the sustainability reports of corporations worldwide. Consequently, the reporting and assurance of these sustainability reports have become essential elements in addressing this global challenge. Moreover, increased public awareness about environmental degradation, propelled by media and governmental incentives and regulations, has enhanced the sustainability image of corporations in the eyes of stakeholders, including consumers, investors, regulators, employees, and the global supply chain (Deegan, 2013). Thus, the financial fundamentals of corporations are increasingly influenced by their performance in environmental, social, and governance (ESG) criteria. When a company is committed to increasing its carbon mitigation efforts, investors regard it closely despite several other instrumental corporate strategies (Gao, He, & Li, 2022b). Companies can achieve a balance between their financial goals and their environmental aspirations by adopting sustainable technologies. Eco-financial studies identified a risk reduction against environmental factors, also recognized by lenders (Gao & Wan, 2023). Since there is an increased risk noted in greenwashing companies, lenders might want to charge a higher rate for their loans. In this evolving narrative of sustainability and finance, the impact of the cost of debt becomes a defining parameter on how businesses would navigate towards profitability and environmental consciousness parameters (Guidara, Khlif, & Jarboui, 2014a; Hamrouni, Uyar, & Boussaada, 2020). The availability of affordable financing (reduced cost of debt) from financial institutions acts as a fundamental mechanism, prompting companies of all sizes worldwide to strive for more

comprehensive and high-quality sustainability disclosures. This movement is ultimately steering towards a more comfortable planet for humanity.

In the evolving landscape of corporate world, the role of sustainability disclosures has become a pivotal point for understanding their influence on financial metrices, particularly the cost of debt. As organizations worldwide face increasing pressure from their stakeholders to operate sustainably, the transparency provided by these disclosures are very important for financial profile of these companies. Nowadays, the synthesis of literature about sustainability disclosure and its intricate relationship with the cost of debt stands as a crucial and timely inquiry. Sustainability disclosures got immense attention not only for evaluating firms' environmental, social, and governance performance but also for giving insight into their' ethical mindset and financial credibility. Previous empirical studies have identified mixed results regarding the impact of sustainability disclosures on firms' cost of debt, which is dominated mainly by negative relationships. There are many good reasons for this negative relationship, but knowing why the relationship is positive in previous studies is more interesting. A positive relationship has been observed between sustainability disclosures and the cost of debt, attributed to practices such as greenwashing and corporate opportunism, which may mislead less informed external stakeholders but not financial institutions which possess comprehensive market knowledge. A negative relationship has been identified, supported by evidence suggesting that credible sustainability disclosures improve firms' financial fundamentals, brand value, public image, and transparency (Dingwerth & Eichinger, 2010). Additionally, high-quality sustainability disclosures improve comparative analysis between competitors, motivate employees, reinforce organizational information and control processes and reduce information asymmetry, leading to position firms at a valuable place in front of lending institutions (Herzig & Schaltegger, 2006). Financial institutions, being well-informed partners of firms, value all this information and reduce the lending cost of such firms. This study aims to delve deeper into the mixed findings prevalent in existing literature while also charting a course for future research endeavors in the dynamic realm of sustainability disclosure and its influence on the cost of debt.

The cost of debt is the expected rate of return payable to lenders by borrowers against their debt holdings. Financial constraints cost (Meng, Li, Chan, & Gao, 2020), excessive leverage risk (Pomierski, 2009), and personal taxes (Fischer, Krause, Lahmann, & Stimper, 2020) are also included in the cost of debt (Miller, 1977; Scott Jr, 1976). Numerous studies examine the elements influencing capital structure (Gajdosikova & Valaskova, 2022; Mahmood et al., 2023) and the company’s financial decisions (Çam & Özer, 2022). In much theoretical work, corporations determine their ideal debt ratio by weighing the benefits and costs, characterizing the decision between debt and equity in a trade-off scenario. In the past, tax savings that result from interest being deductible have been viewed as the main advantage of debt (Kraus & Litzenberger, 1973). Other advantages include encouraging management to work effectively and getting lenders to monitor the business (Jensen, 1986; Kraus & Litzenberger, 1973; Michael & William, 1976), which

reduces agency costs. Hence, corporate enterprises have given greater attention to sustainability spending because sustainability reporting is still voluntary in many countries (Hemingway & Maclagan, 2004). Therefore, it is essential to examine how the cost of debt is being influenced by sustainability reporting. Carey, Khan, Mihret, and Muttakin (2021) represent a negative association between the cost of debt (COD) and sustainability assurance, specifically in firms that provide accounting assurance and give less importance to their creditors' rights. Shad, Lai, Shamim, and McShane (2020a) further argue that transparent sustainability and financial reporting reduce not only the cost of debt but also the cost of equity. Similarly, Armitage and Marston (2008) identified an inverse relationship between organizational disclosure and cost of debt (COD). Meanwhile, firms attached to financial institutions give importance to rating agencies having more disclosure and will have to bear lower debt costs. According to the stakeholder theory, a company should protect its stakeholders' interests. By resolving debt holders' concerns about sustainability, businesses would be seen as more creditworthy and rewarded with a lower cost of financing (Deegan, 2014; Kanda, 1992). At the same time, the regulatory theory argues that politically connected organizations have a lower cost of debt than non-connected firms (Dunne & McBrayer, 2019; H. Xu, Xu, & Yu, 2021). Moreover, peer effect theory also has a role in the effectiveness of the merchant group's CSR performance and identified that the performance of CSR is inversely correlated with the cost of debt, which also improves as the culture becomes more aligned with CSR values (Wang, Wu, & Humphreys, 2022). Agency theory, on the other hand, purports that high CSR disclosures are the outcome of low conflict of interest between shareholders and the management, which is ultimately because of strong corporate governance and this all ultimately leads towards low cost of debt offered by lenders to high CSR firms and low agency cost (Mahmoudian, Yu, Lu, Nazari, & Herremans, 2023; Raimo, Caragnano, Zito, Vitolla, & Mariani, 2021).

Some previous studies also represent the significance of sustainability reporting in improving business efficiency, performance, and regulatory perspectives such as Stepanova and Rabotinskiy (2014) examined 38 published articles in the review and focused on the relationship of corporate governance and cost of debt with a conclusion that the relationship has mixed findings and depends on the debtholders' estimation of the dominant effect in a particular market at a specific time. Another study by Fangyuan and Ying (2020) more interestingly discussed the relationship between the quality of accounting information disclosures and the cost of debt. High-quality financial information disclosures lower debt costs and improve enterprises' investment efficiency. Benlemlih (2017) discusses the impact of CSR on firms' financing decisions and concludes that high CSR firms are induced towards equity dominance in their financing decisions. Adedeji, Popoola, and San Ong (2017) discuss the impact of the culture of developing or emerging economies on sustainability disclosure; Christensen, Hail, and Leuz (2021) further discuss

the relationship between CSR disclosure as well as sustainability reporting standards and their ultimate impact on the economy of United States.

Critical analysis of past studies regarding sustainability disclosures' influence on firm financial performance and capital structure results in a conclusion that there is not a single review study which has discussed the influence of sustainability disclosures on cost of debt with further digging in the review literature identified that there are no studies with discussion on environmental and social disclosures quantity and quality influence on cost of debt of firms. Moreover, past review studies have never discussed lending institutions, firm corporate governance and earnings management roles from the perspective of sustainability disclosures' influence on the cost of debt. Lastly, GHG emissions influence on the cost of debt has yet to be discussed in past review studies regarding sustainability disclosures and the cost of debt relationship.

After a detailed review of past papers regarding the influence of sustainability disclosures on the cost of debt, this study has identified some research gaps which can make value addition in the field of sustainability disclosures and its influence on the cost of debt of firms and mold these research gaps into our study research questions which are as follows;

1) What are the influential aspects, tendencies, and considerations regarding the influence of sustainability disclosures on the cost of debt literature?
2) Whether environmental and social disclosure quantity and quality influence the cost of debt?
3) How do lending institutions, corporate governance and earnings management influence the relationship between ESG/CSR disclosures and the cost of debt?
4) How do sustainable business practices/initiatives and GHG/Carbon emissions influence the cost of debt?
5) To suggest a roadmap for future researchers, what compendious tactics can be drawn from the former literature of sustainability disclosures and the cost of debt?

This article examines the nexus between sustainability disclosures and the cost of debt, exploring how improved transparency and accountability can potentially reduce unsystematic risk of firms and ultimately the borrowing costs. Through a systematic examination of existing literature, this article seeks to draw the mechanisms through which sustainability disclosures influence lenders' perceptions which ultimately influence their credit decisions, thereby affecting the cost of capital, specifically the cost of debt for businesses committed to sustainable operations. This study significantly contributes to corporate finance and sustainability disclosures in many ways. First, this is the first review study that will synthesize the literature regarding the influence of sustainability disclosures on the cost of debt. Second, this review study will discuss the most influential aspects of sustainability disclosures' influence on the cost of debt literature, such as top journals and top contributing author countries, on the basis of citations and the number of authors participating. Third, this review will contribute theoretically by synthesizing the literature regarding environmental and social disclosure quantity and quality influence on the cost of

debt. Fourth, this review study will also contribute by discussing the lending institutions, corporate governance and earnings management perspective of ESG/CSR disclosures and the cost of debt relationship. Fifth, this review study contributed by discussing sustainable business practices/initiatives and GHG/Carbon emission influence on the cost of debt relationship. Lastly, this review study has provided future research direction based on some unexplored areas for future research in the field by suggesting some topics so that further value addition may be possible.

This study provides financial managers, lending institutions, regulators, and stakeholder's valuable insights. For financial managers, it helps them match environmentally friendly practices with financial markets. Money lenders get benefits when they know how sustainability reporting affects risk assessment. Our results can help regulators improve their reporting systems. Many stakeholders learn helpful information to make good choices about doing business with them. Our research, illuminates the impact of sustainability disclosure on the cost of debt, contributes to academic knowledge and practical decision-making in the global financial landscape.

The remainder of the article unfolds as follows: the materials and methods section delineates the methodology employed in this review, the findings section elucidates the pivotal aspects uncovered in the investigation, the discussion of clusters section delves into the identified clusters in depth, the discussion and future research directions from findings of clusters section extrapolates on the discussion and points toward future directions, and finally, the conclusion section brings the study to a close, summarizing its findings and implications.

2. Materials and Methods

In this article, we conduct a systematic review of the literature on this topic in order to understand the impact of sustainability disclosures on the cost of debt and different perspectives on this relationship by systematically searching the literature on Scopus and then further reviewing the literature identified by Scopus with a software called VOSViewer. From VOSViewer, bibliometric coupling has been done in software so that commonalities in the references may be identified, and literature was further reviewed thoroughly within the groups of papers identified in bibliometric coupling to do our review systematically. Web of Science/ Clarivate is also another authentic database but this study has utilized Scopus because Scopus provides a wide range of articles in certain fields as compared to Web of Science (Mongeon & Paul-Hus, 2015), increasing use of Scopus in systematic review papers in rapidly evolving fields (Zhu & Liu, 2020) and more comprehensive coverage (Singh, Singh, Karmakar, Leta, & Mayr, 2020). The Scopus database, a dependable and impartial source of reputable article journals, is a fundamental requirement of systematic review (Elsevier, 2023), that is why Scopus is searched extensively with the alternative keywords. A team of specialists advises on keywords for this study after conducting a thorough search that results in the publication of all relevant

papers on the subject. The query generated by the suggested keyword combinations was executed in the Scopus advance search on December 1, 2022. The choice of Scopus is supported by its reputation as a reliable and frequently updated source with critical tools like the h-index, justifying its commercial availability and expense as essential for analyzing and evaluating scientific activity (Aguillo, 2012; Hirsch, 2005; Kumar & Firoz, 2018a). Following are the keywords utilized in the query that is run on Scopus to get relevant articles: Corporate social responsibility disclosure, sustainability disclosure, environmental disclosure, corporate social disclosure, voluntary disclosure, cost of debt, cost of debt capital, and cost of debt financing.

The search on all Scopus-available publications looked for terms in inverted commas in their titles, abstracts, and keywords. The first round of search results was limited to peer-reviewed journals in English that cover the following topics: business management and accounting, social sciences, economics, or econometrics and finance, and at the end, environmental sciences and energy. 81 items from the initial filters were critically examined by reading their main titles and abstracts. The inclusion criteria are the existence of both variables (sustainability disclosures and cost of debt). Hence, we further shortlisted these articles by removing irrelevant papers from the list of publications. After reviewing the titles and abstracts, 76 articles were chosen. After a debate with a panel of experts, irrelevant articles are eliminated.

After carefully finalizing 76 articles, they were analyzed on VOSViewer. This software has an option known as "bibliographic coupling", which puts these articles into different groups that share certain similar traits altogether. Kumar and Firoz (2018a) say that the method of bibliometric coupling used to make groups of subjects close together uses the number of shared references in articles. This is done by seeing how much these references overlap so you can understand whether or not two different topics are similar. This is why research linking, or bibliometric coupling, is more correct and ideal for systematic reviews (Li, Chen, & Xiang, 2022b).

The co-occurrence pattern is used in VOSViewer to perform bibliometric coupling, which results in the presentation of clusters in various colors. Co-occurrences are caused by the presence, frequency, and familiarity of overlapped references inside the data (Eck & Waltman, 2014). Additionally, the distance in the references of each cluster indicates how closely related the references are; the closer the distance, the closer the references are, and the higher the density, the closer they are to one another. Three clusters containing the colors red, green, and blue were found using bibliometric coupling co-occurrence analysis on the list of 76 articles. Accordingly, articles that fall under each color cluster are connected by their shared references and reflect a particular area of research or aspects of our core topic.

The third phase involves reading each cluster's articles and compiling qualitative data on a spreadsheet to examine the articles' content qualitatively, helping to understand how each stream has developed and identifying unexplored areas for future research.

Accordingly, research design & methodology is displayed in Figure 1.

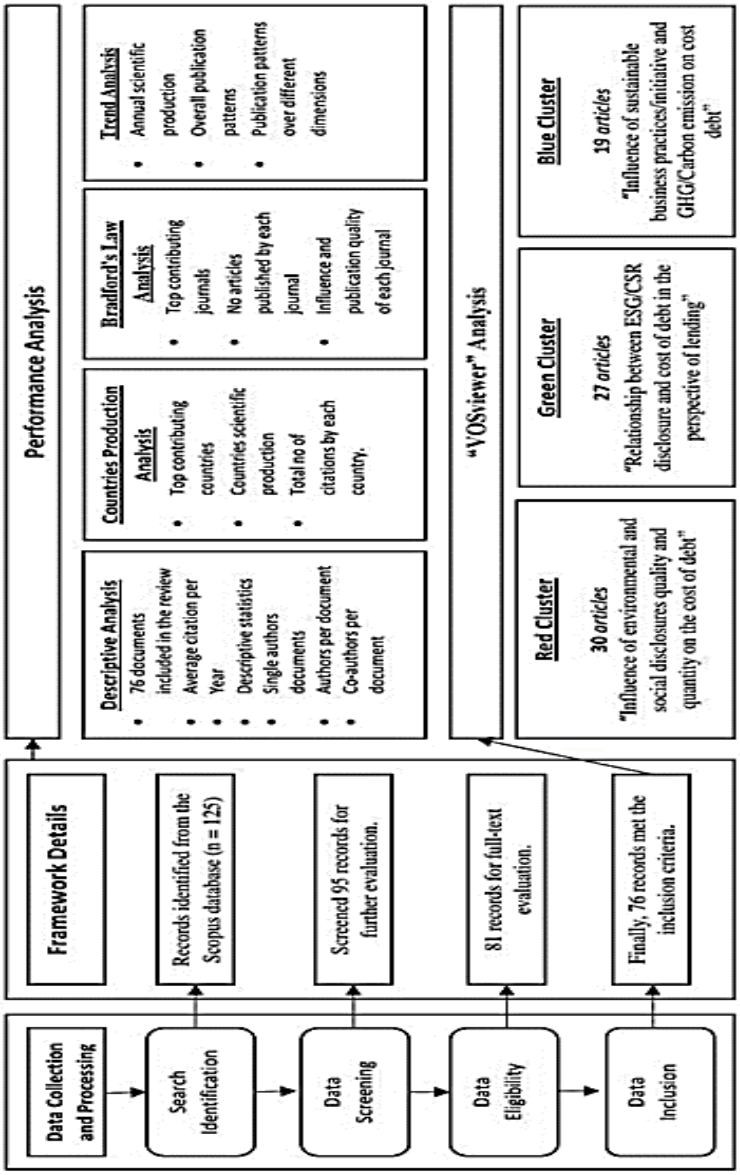

Figure 1. Research design and methodology

2.1 Bibliometric Analysis and Visualization

In this research, the Biblioshiny package with the R program is used to get critical information and tables essential to our study. According to Moral-Muñoz, Herrera-Viedma, Santisteban-Espejo, & Cobo (2020), Biblioshiny is an excellent program that offers comprehensive, relevant research or bibliometric analysis with some kind variety of options divided into informational sources, relevant records, concerning authors, constructivist approaches, social hierarchy, etc. Table 1 provides some basic details of 76 selected articles from 55 journals published between 2008 to 2022. Only seven papers had one author out of the 220 who contributed to these documents. The collaboration index, which is 3.09, represents significant cooperation in the disclosure of sustainability and cost of debt literature. The writers (authors or contributors) per document ratio is 2.89. Each document has an average of 3.08 co-authors.

Table 1 Basic Description of Sustainability Disclosures and Cost of Debt Literature

Description	**Results**
Time Period	2008:2022
Journals	55
Articles	76
Average Citations Per Document	26.16
Number of Authors	220
Documents With One Author	7
Number of Authors Per Document	2.89
Number of Co-Authors per Document	3.08
Collaboration Index	3.09

Figure 1 shows the annual output of publications regarding sustainability disclosures and the cost of debt literature. The number of articles published for our chosen studies between 2008 and 2016 was relatively low. However, an increasing trend has been noticed in the number of publications on the subject after 2016.

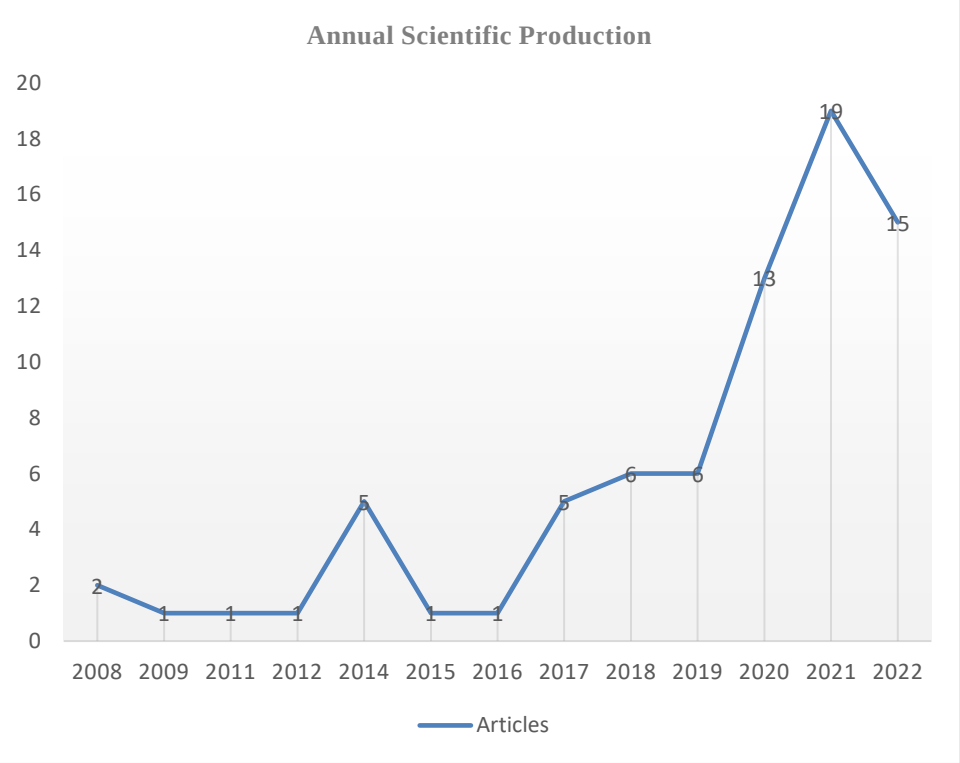

Figure 2: Annual Scientific Production

2.2 The Analysis of Countries and Regions

Following that, we examine each nation's publication trend. About 36 nations and territories contributed to the research articles overall. Figure 2 shows the geographic distribution of articles published on the influence of sustainability disclosures on the cost of debt. The USA, China, Australia, Italy, and the UK are the most influential countries in publications on the influence of sustainability disclosures on the cost of debt.

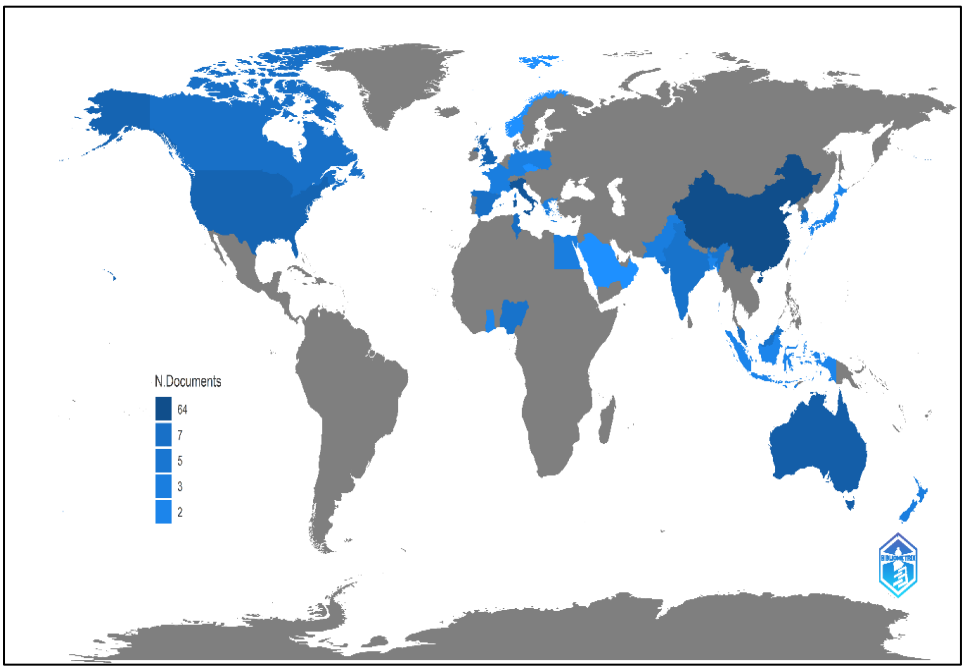

Figure 3: Geographical Distribution – Influence of Sustainability Disclosure on Cost of Debt Literature

3. Findings

Since 2008, researchers have started publications on the relationship between sustainability disclosures and the cost of debt, which is very interesting because these concepts are pretty old. However, publications on this relationship emerged in 2008, and then researchers further dug into the field and explored different perspectives.

Table 2 details the number of authors contributed from each country and the number of citations from 220 authors. Authors from the USA are at the number one position in participation in these publications, with 29 authors and 1345 citations. Twenty-three authors from Italy participated in these publications with 43 citations. Chinese authors got the third slot in the number of authors participating, and these authors got 172 citations.

Spain and the UK are in the fourth slot with 15 15 authors and have 54 and 296 citations. Citations represent the quality of research, and here, we have to note that in the case of some countries, fewer authors got more cations, such as the USA, Australia, UK, Germany and China.

Table 2: Top Nations Based on Number of Author's Participation and Their Citations

Region	Number of Authors Participated	Citations
USA	29	1345
Italy	23	43
China	21	172
Spain	15	54
UK	15	296
Australia	13	506
Malaysia	12	64
South Korea	12	81
Canada	11	0
Germany	10	178

In order to comprehend the significance of current trends, it is crucial to be aware of those journals that publish articles on a given subject and what value they are considered to have in academic societies. Whereas, in order to classify the journals that have written articles about sustainability disclosures' influence on the cost of debt, we have adopted Bradford law, which classifies the journals into three further zones, where zone-1 demonstrates the top influence and quality journals, zone 2 is moderately influential and quality, while journals with little impact on literary societies are in zone 3.

The top three journals are Sustainability (Switzerland), Journal of Business Strategy and the Environment, and Journal of Business Ethics. According to Bradford law, these journals are all in zone 1 and have published 6, 4, and 4 articles, respectively. The top 10 journals in this field are all in Zone 1, which indicates the importance of our subject, as seen in Table 3.

Table 3: Bradford's Law-Based Journal Rankings

Journals	Rank	Freq	CumFreq	Zone
Sustainability (Switzerland)	1	6	6	1
Business Strategy and The Environment	2	4	10	1
Journal of Business Ethics	3	4	14	1
Social Responsibility Journal	4	3	17	1
Ecological Economics	5	2	19	1
Investment Management and Financial Innovations	6	2	21	1
Journal of Cleaner Production	7	2	23	1
Journal of Corporate Finance	8	2	25	1
Management Decision	9	2	27	1
Academia Revista Latinoamericana De Administracion	10	1	28	1

Understanding a topic's publication pattern year over year is crucial, and an upward trend indicates that scholars are putting much effort into a field, which ultimately brings about more opportunities for future researchers. Table 4 gives specific information about the publications' trends in the fields of sustainability disclosures' influence on the cost of debt. In the first decade of the twenty-first century, only a few articles were published on the subject. However, as the second decade proceeded, research studies substantially increased. This trend was boosted in 2017 when five articles were published, although the number of publications per year at the start of 2020 reached double digits with 13, 19, and 15 publications in 2020, 2021, and 2022, respectively.

Table 4: Annual Production of Articles

All articles (76 Articles) (Sustainability disclosures and cost of debt)		**Red cluster (30 Articles)** (Sustainability disclosures quality and quantity and cost of debt)		**Green cluster (27 Articles)** (Lending institutions, corporate governance and earnings management)		**Blue cluster (19 Articles)** (Sustainable business practices GHG/Carbon emission and cost of debt)	
Year	**Articles**	**Year**	**Articles**	**Year**	**Articles**	**Year**	**Articles**
2008	2	2008	1	2008	1	2014	2
2009	1	2009	1	2011	1	2015	1
2011	1	2012	1	2017	2	2016	1
2012	1	2014	3	2018	3	2017	1
2014	5	2017	2	2019	2	2018	3
2015	1	2019	2	2020	5	2019	2
2016	1	2020	6	2021	7	2020	2
2017	5	2021	8	2022	6	2021	4
2018	6	2022	6			2022	3
2019	6						
2020	13						
2021	19						
2022	15						
Total	**76**		**30**		**27**		**19**

The data in Table 4 indicate that the connection between sustainability disclosures and the cost of debt is a significant issue in management and accounting. However, by reviewing the patterns of publications in the clusters shown in Figure 4, it is possible to determine which aspects or dimensions of this topic are most studied by researchers. First, the red cluster covers most of the literature, with 27 articles on the topic showing an upward tendency similar to the overall trend of the entire body of literature. In addition, the red cluster is the oldest. It is related to sustainability disclosures, quality, and quantity influence on the cost of debt. It is still researched in current years with many publications (6, 8 and 6) in 2020, 2021 and 2022, respectively. The green cluster has 27 published articles on lending institutions' role, corporate governance, and earnings management perspective in the relationship between sustainability disclosures and the concept of debt. This cluster

again started publications in 2008, and in the last three years, significant publications have explained the in-trend publications of the lending institutions' role, corporate governance, and earnings management perspective of sustainability disclosures and cost of debt relationship. The last cluster is a blue cluster, with 13 articles published and related to sustainable business practices; the perspective of GHG emissions influences the cost of debt. This cluster got publications late, the first one in 2014, and currently, in the last three years, there are fewer publications in this cluster compared to the red and green clusters. It seems that researchers have explored this area of research, and there is a need to dig further into the sustainable business perspective of GHG emissions and the debt relationship.

Table 5: Top Articles Throughout Each Cluster According to Bibliographic Coupling

Red cluster (30 Articles) (Sustainability disclosures quality and quantity and cost of debt)			**Green cluster (27 Articles)** (Lending institutions, corporate governance and earnings management)		**Blue cluster (19 Articles)** (Sustainable business practices GHG/Carbon emission and cost of debt)	
Rank	**Article**	**T.C**	**Article**	**T.C**	**Article**	**T.C**
1	(Wang, Sewon, & Claiborne, 2008) Voluntary disclosure (quantity) & COD	451	(Ye & Zhang, 2011) CSR disclosure (lending institution) & COD	264	(Jung, Herbohn, & Clarkson, 2018) Carbon emission & COD (sustainable business practices)	256
2	(Michels, 2012) Environmental Disclosure (quality) & COD	353	(Armitage & Marston, 2008) CSR disclosure (corporate governance) & COD	198	(Hoepner, Oikonomou, Scholtens, & Schröder, 2016) Sustainability reporting & COD	180
3	(Shad, Lai, Shamim, & McShane, 2020b) Sustainability disclosure quality & COD	145	(La Rosa, Liberatore, Mazzi, & Terzani, 2018) Corporate social performance (lending institution) & COD	122	(Lassala, Apetrei, & Sapena, 2017) Sustainability & COD (sustainable business practices)	104

4	(Luo, Guo, Zhong, & Wang, 2019) Environmental information disclosure quality & COD	91	(Magnanelli & Izzo, 2017b) Corporate social performance (corporate governance) & COD	113	(Li, Eddie, & Liu, 2014b) Carbon emission & COD	72
5	(Du, Weng, Zeng, Chang, & Pei, 2017) Environmental Performance (quality and quantity) & COD	80	(Gong, Huang, Wu, Tian, & Li, 2021a) CSR disclosure (regulators) & COD	64	(Shad et al., 2020a) Sustainability reporting & COD (sustainable business practices)	36
6	(Chouaibi, Rossi, & Zouari, 2021) Corporate social and environmental responsibility (quantity and quality) & COD	79	(Erragragui, 2018) ESG disclosure (lending institution) & COD	62	(Caragnano, Mariani, Pizzutilo, & Zito, 2020) GHG emission & COD	31
7	(Carey et al., 2021) Sustainability assurance (quality) & COD	64	(Bhuiyan & Nguyen, 2019) CSR performance (earnings management) & COD	50	(Maaloul, 2018) Carbon emission & COD (sustainable business practices)	29
8	(Fonseka, Rajapakse, & Richardson, 2019) Environmental information disclosure quality and quantity) & COD	63	(Suto & Takehara, 2017) CSR disclosure (corporate governance) & COD	50	(Kumar & Firoz, 2018b) Sustainability & COD (sustainable business practices)	15

9	(Chiesa, McEwen, & Barua, 2021) Environmental performance (quality and quantity) & cost of debt capital	59	(Yeh, Lin, Wang, & Wu, 2020) CSR performance (earnings management) & COD	48	(Uryszek, 2015) Sustainable Initiatives & COD (sustainable business practices)	11
10	(Guidara, Khlif, & Jarboui, 2014b) Voluntary disclosure (quantity) & COD	39	(Hamrouni, Uyar, & Boussaada, 2019) CSR disclosure (lending institution) & COD	42	(Lau, 2019) Sustainability Practices & COD (sustainable business practices)	10

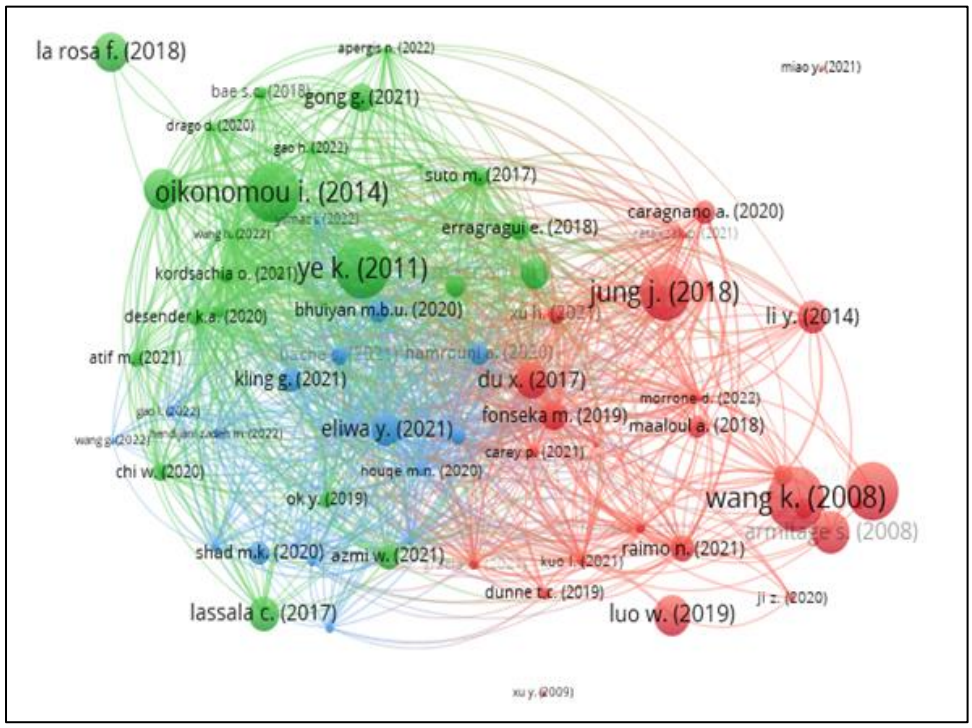

Figure 4: Bibliographic Coupling

3.1 Cluster Explanation - ***Red Cluster (30 Articles)***

Influence of Environmental and Social Disclosures Quality and Quantity on The Cost of Debt

The red cluster consists of 30 articles, and it is the largest cluster in our co-citation analysis, which represents the impact of environmental and social disclosure quantity and quality on the cost of debt, followed by the impact of sustainability assurance on the cost of debt. However, sustainability assurance is attached to the quality of disclosures. It ensures the proper establishment of sustainable business practices by implementing a sustainability code of conduct in the corporate sector.

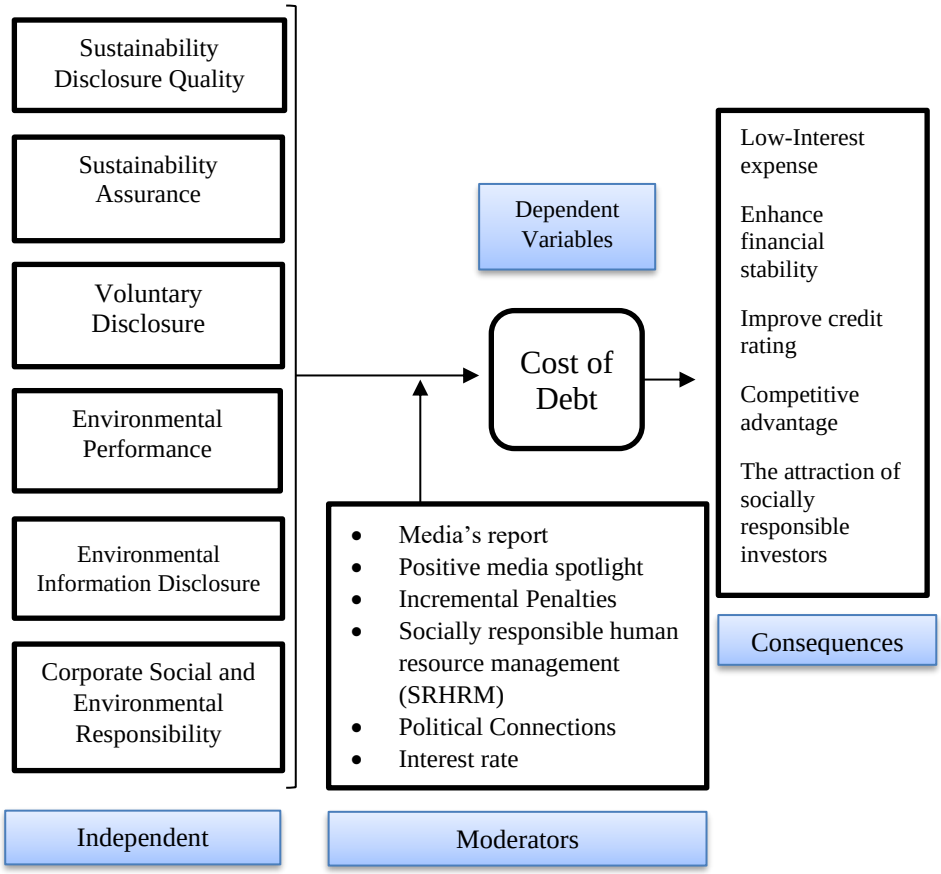

Figure 5: A Framework for Influence of Sustainability Disclosures Quality and Quantity on The Cost of Debt

3.1.1 Sustainability Disclosures Quality and Cost of Debt

Sustainability disclosure quality was a shift in the second stage in the evolution of sustainability disclosure phenomenon because prototypes are made in the labs first. Then, pilot studies are conducted in the natural environment and when discoveries are made commercialization happens with new updated versions. As regulators, standard-setting organizations, and, in some cases, industry groups globally felt that this phenomenon had strengthened its roots, they started to convert this plant into an enormous tree, which can give many benefits in the form of fruits and shade. Now, only reporting is not enough to lower the cost of debt, but the quality of sustainability disclosures has gotten more attention. That is why Luo et al. (2019), which is the most cited article in this cluster regarding environmental, social governance (ESG) disclosure and cost of debt (COD), presents that the quality of a firm's environmental information disclosure has a significant negative impact on debt financing cost (Houqe, Ahmed, & Richardson, 2020). Miao, Zhou, and Dai (2021a) evaluated the quality of CSR disclosure response in different situations by considering the property rights of Chinese privately owned companies and also took into account some forensic effects and dissimilar forms of disclosures and revealed that CSR quality negatively impacts debt financing cost. Moreover, CSR quality facilitates the stimulation of organizations' innovation capacity. However, positive and negative media reporting is the ultimate deciding point here because dissimilarities in reporting create problems of comparability and reduce the credibility of sustainability information. High CSR disclosures with positive media reporting result in strengthening the credibility of a firm’s supply chain, lowering their financial risk and reducing the cost of debt of privately owned firms and vice versa (Bhuiyan & Nguyen, 2020; Gao, He, & Li, 2022a).

Furthermore, environmental administrative penalties in Chinese firms result in a high cost of debt because it raises questions about the quality of disclosures. However, incremental disclosure acts as a moderator in this connection, implying that without altering the level of disclosure, the cost of debt could not be affected by environmental administrative penalties (Ding, Appolloni, & Shahzad, 2022). Meanwhile, Gong, Huang, Wu, Tian, and Li (2021b) analyze the penalties in the Chinese corporate sector and their impact on debt cost and CSR performance as a moderator in this association. They found that all the penalized firms have to bear more COD, whereas the firms with high CSR performance advantageously entertained a lower cost of debt (Gong et al., 2021a; Yeh et al., 2020). Ultimately, it shows a direct association between penalties and emissions, discouraging businesses from greenhouse gas emissions (Maaloul, 2018; Maaloul & Wegener, 2022).

Firms with lengthy CSR reports, higher CSR scores, and adoption of GRI guidelines enjoy a lower debt cost. Small firms with more integrity in their CSR disclosure will consequently enjoy a lower debt cost (Li et al., 2022b). lenders give more weightage to the social aspect of sustainability disclosures in non-listed small firms with more social information disclosures in ESG reports and ultimately influence more reduction of cost of debt because high social spending and disclosures improve the quality and credibility of information and

reduce information asymmetry in smaller firms because information asymmetry is a severe concern in non-listed smaller firms for lending institutions (Dunne & McBrayer, 2019; H. Xu et al., 2021).

Firms committed to their sustainability disclosure activities not only typically incur lower costs of debt but also enhance their credibility and reduce financial risks (Luo et al., 2019) but there are some moderators such as quality of sustainability disclosures, GRI guidelines implementation, media reporting regarding company, size of the company and environmental penalties make the simple negative relationship between sustainability disclosures and cost of debt very complex (Gao et al., 2022b; Miao, Zhou, & Dai, 2021b).

3.1.2 Sustainability Assurance and Cost of Debt

After focusing on sustainability disclosure quality regulators, standard-setting organizations, and industry groups tried to objectify and verify sustainability disclosures with sustainability assurance, mainly by accounting assurers and occasionally through third-party assurers. This process is the same as firms' ensuring their financial reports with external auditors. A negative association between the cost of debt and sustainability assurance is identified in firms, specifically those that have hired accounting assurers for sustainability reporting Carey et al. (2021). Furthermore, Kuo, Kuo, and Chen (2021) further revealed that with accounting assurers for sustainability reports, mandatory sustainability assurance also strengthens the negative relationship between sustainability disclosures and the cost of debt because accounting assurers improve the credibility and reliability of sustainability-related disclosures, which creditors trust more as compared to third party sustainability assurances from non-accounting assurers (H. Xu et al., 2021). Moreover, sustainability reporting transparency and overall financial and non-financial reporting quality reduce the liquidity requirements of firms and easy access to debt capital at minimal cost (Zadeh, Magnan, Cormier, & Hammami, 2021).

3.1.3 Environmental and Social Information Disclosures

In recent studies, environmental and social disclosures are dominant compared to the governance component of sustainability disclosures in enhancing firms financial standing and strengthening the stakeholder’s relationship, resulting in access to favorable financing. A strong media presence and integrated responsible human resource strategies with sustainable environmental practices are a good recipe for low-cost financing form creditors. ESG disclosure and environmental information disclosure (EID) with more excellent visibility results in better access to third-party financing resources under more favorable terms (Apergis, Poufinas, & Antonopoulos, 2022) because visibility is related to more media involvement and usage of different communication channels which enhance inelastic market share (Raimo et al., 2021), improve revenues and better financial fundamentals (Eliwa, Aboud, & Saleh, 2021). Better financial fundamentals not only improve a firm's financial credibility but also the reputation of the firm in front of all

stakeholders (Apergis et al., 2022), specifically the regulators, customers, investors and lending institutions (Houqe et al., 2020; Mahmoudian et al., 2023). Meanwhile, socially responsible human resource management (SRHRM) magnifies the negative relationship between corporate environmental responsibility (CER) and the cost of debt because SRHRM reduces regulatory and legal risks with the attraction of inelastic ethical investors in the long run (Gangi, D'Angelo, Daniele, & Varrone, 2021). Furthermore, Gangi, D'Angelo, Daniele, and Varrone (2020) also identified a negative relationship between corporate social and environmental responsibilities (CSER) and the cost of debt. Gao and Wan (2022) linked a firm's corporate environmental responsibility (CER) with its financial performance and COD's mediating role. High financial performance induced by minimized cost of debt and high operational efficiency through corporate environmental responsibility (CER) is the idea revolving around stakeholder theory (Hamrouni et al., 2019). Additionally, enterprises with solid governance and environmental practices also reduce the cost of debt (Erragragui, 2018; Prasad et al., 2022). Besides this, Pirgaip and Rizvić (2023) discussed the integration of financial and non-financial reporting's impact on weighted average cost of capital, the cost of debt and equity by stating that high-quality non-financial reporting only reduces the cost of debt and remains indifferent in the case of the cost of equity. Whereas high information disclosures reduce the weighted average cost of capital because of the reduction in information asymmetry between managers and lenders, ultimately lowering the cost of capital (Arslan, Chengang, Komal, & Chen, 2023; Talbi & Omri, 2014). Meanwhile, sustainability disclosures and the cost of debt and equity are further dependent on the orientation of firms. Shareholder-oriented firms only identified a negative relationship between CSR performance and cost of equity, whereas this relationship became positive in stakeholder-oriented firms (Bacha, Ajina, & Saad, 2020; Desender, López-Puertas, Pattitoni, & Petracci, 2020).

Upon examining the red cluster, this study uncovered exciting insights that are briefly presented here. First, sustainability disclosures with positive media reporting reduce the cost of debt and promote innovation in firms. Second, environmental administrative penalties are a bad sign for the negative relationship between sustainability disclosure and debt cost because they question sustainability disclosures' reliability and quality. Third, in the case of smaller non-listed firms, social information disclosures are significant because they reduce information asymmetry, which is essential for lenders and reduces the cost of debt for these firms. Fourth, sustainability assurance significantly reduces firms' debt costs when hiring accounting assurors. Meanwhile, firms with more CSR transparency and better quality of reporting will bear lower debt costs. Fifth, the firm's high-quality environmental disclosure reduces the environmental and environment-relevant litigation risk and the cost of debt because dedicated environmental strategies signal positively to all stakeholders.

*3.2 Cluster Explanation - **Green Cluster (27 Articles)***

Relationship Between ESG / CSR Disclosure and Cost of Debt in The Perspective of Lending Institutions, Corporate Governance and Earnings Management

The green cluster consists of 27 articles, and it is the second largest cluster in our co-citation analysis, which represents the impact of corporate social responsibility (CSR) and corporate social performance (CSP) and their impact on the cost of debt. This cluster discusses CSR disclosures and corporate social performance in different contexts, such as corporate disclosure, CSR disclosure, mandatory CSR disclosure, CSR activities, CSR transparency, and CSR performance. Whereas the cost of debt (COD) on which the impact of CSR disclosure and corporate social performance is being identified in this cluster is addressed in such a way as the cost of debt, cost of debt capital, debt financing cost, and interest rate on debt as a proxy of debt cost. Different theories, such as agency and regulatory theories, are used to build a link between CSR disclosure and the cost of debt.

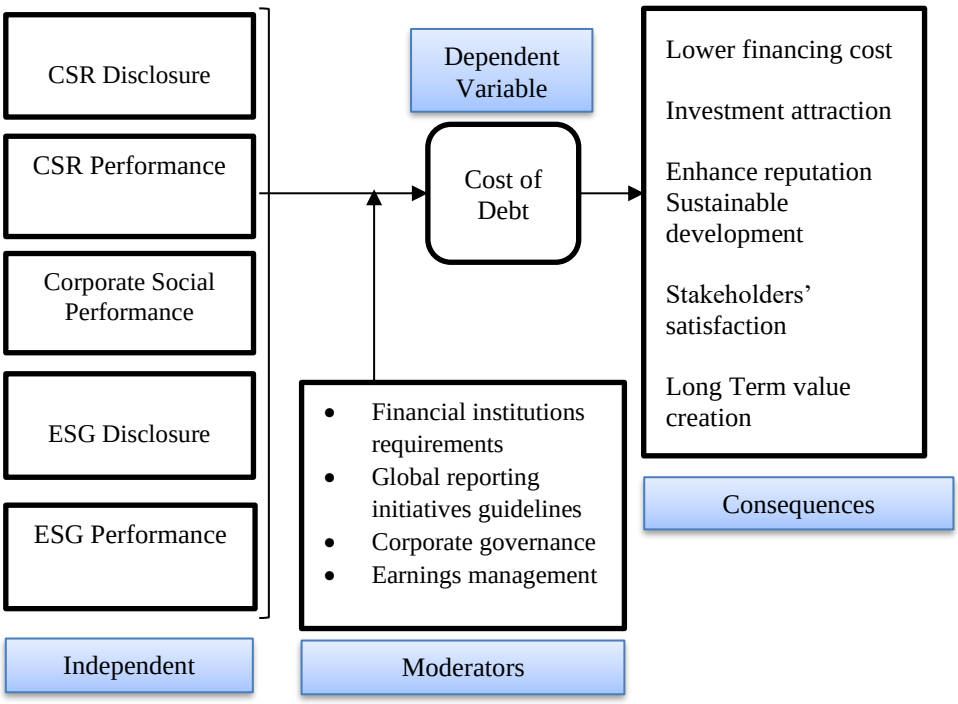

Figure 6: Theoretical Framework for Lending Institutions, Corporate Governance and Earnings Management Perspective

3.2.1 ESG Disclosures from The Perspective of Lending Institutions

This section focuses on the outcome of ESG disclosures in improving the transparency of information firms provide to lending institutions, which ultimately influences the financing cost lending institutions offer to high ESG disclosure firms. Armitage and Marston (2008) have the highly cited article in this cluster regarding CSR disclosure and cost of debt (COD), which discloses a negating relationship between CSR disclosure and cost of debt because more disclosures show the confidence of firms in sustainable activities and results in high transparency. Sustainable business practices and transparency are crucial for financial institutions and credit rating agencies' decision-making (Eliwa et al., 2021). Moreover, Du et al. (2017) also found a significant but negative association between corporate environmental performances and the cost of debt because lenders support a company's investment in reducing CSR deficiencies and, as such, present a solid and definite justification for the stakeholder value maximization view. In this sense, lenders use environmental performance as a critical tool to assess corporate risks and set interest rates for debt (Du et al., 2017). In borrowing firms, ESG score and ESG rating are correlated with the cost of debt because they mainly disclose their obligations towards their ESG, which eventually reduces their default risk. On the other hand, firms with low ESG scores are thought to be riskier (Apergis et al., 2022). At the same time, CSR disclosure in hazardous firms tends to increase with an ultimate increment in their long-term debts. This further reflects that with the association of firms with lending institutions, the sustainability disclosures also improve (Boachie & Tetteh, 2021; Ye & Zhang, 2011). Moreover, Y. Li et al. (2022b) analyze the above association with the moderating effect of "Green Financial System Guidelines" (GFSG), and they found that the GFSG reinforce CSR's contribution to lowering corporate debt costs (Li, Chen, & Xiang, 2022a; Sandra et al. 2021).

3.2.2 Real Earnings Management, Corporate Governance and Culture Aspect of COD

This section explores the complex interplay between real earnings management, corporate governance and their combined effect on the cost of debt, alongside the broader implications of sustainability disclosures on a firm's financing costs in different corporate cultures. While evaluating the association of CSR and debt cost in the context of real earning management (Michels, 2012). Bae, Rong, Kim, and Cheng (2022) found a positive significant association between the cost of debt and real earning management because with high real earnings management firm’s financial risk become higher as well. More interestingly, CSR mitigates the negative impact on the cost of debt caused by real-earning management (Arslan, Chengang, Bilal, Siddique, & Yahya, 2022; J.-C. Bae et al., 2022; Chouaibi & Zouari, 2022). Besides this, the greater implication of CSR activities in the firms negatively impacts equity and debt costs equally, demonstrating that a firm's financing cost negatively correlates with its CSR disclosure (Bhuiyan & Nguyen, 2019). Furthermore, Wang et al. (2008), with 177 citations, represent a positive association between state and foreign ownership as well as the equity return and voluntary disclosure. However, it did not find any significant association between the cost of debt and voluntary

disclosure benefits. In comparison, another study employs a negative association between voluntary and unverifiable disclosure and the cost of debt. Subsequently, this association is negative but significantly impacts the cost of debt of shorter earnings (Guidara et al., 2014b; Michels, 2012). Public corporations benefit from CSR disclosure in the form of improved credit ratings and cheaper borrowing costs, and private firms get the same advantages by improving public image, high market share and more revenues (Bae, Chang, & Yi, 2018; Chi, Wu, & Zheng, 2020).

Sustainability-aligned corporate culture is also very important for high CSR performance in aligned merchant firms as compared to non-aligned merchant firms in China because organizational culture represents the core mindset of owners and, ultimately, the managers of firms. Window dressing and greenwashing represent the contradictory position of firms in cultural beliefs and sustainability practices, which ultimately shatter the confidence of external stakeholders, specifically the lending institutions, and result in the high cost of debt. Peer effect theory (Wang et al., 2022). Furthermore, good corporate governance mechanisms moderate the negative relationship between sustainability disclosures and the cost of debt (Ratajczak & Mikołajewicz, 2021b; Y. Xu, Slaughter, & Hakim, 2009) because corporate governance mechanisms also enhance accountability, transparency, stakeholder engagement, operational efficiency, and reduce information asymmetry and idiosyncratic risk of the firm. These are all the inbuilt factors of good corporate governance and high sustainability disclosures that induce lending institutions to reduce the cost of debt of firms (Feng & Wu, 2023a; Ji, Yu, & Yang, 2020).

Following the analysis of the green cluster, this study has revealed compelling insights, succinctly summarized here. First, rating agencies and financial institutions consider CSR scores an essential indicator in assessing business status, while rating agencies give better ratings to firms with high CSR scores. Financial institutions charge low costs of debt from firms with high CSR scores. Second, firms with high idiosyncratic risk usually have a high cost of debt, but high financial pressure may induce firms to more ESG disclosures, which ultimately reduces their cost of debt. Third, real earnings management results in a high cost of debt in firms. However, in some scenarios, CSR mitigates the negative consequences of real earnings management and is utilized as a trade-off for earnings management. Fourth, Chinese merchant group members have better CSR performance and an inverse correlation with the cost of debt than non-group members.

*3.3 Cluster Explanation - **Blue Cluster (19 Articles)***

Influence of Sustainable Business Practices and GHG / Carbon Emissions on Cost Debt

The blue cluster, which the VOS-viewer identified from our list of chosen articles, is the smallest. This cluster focuses on the presence of carbon emission and sustainability and their impact on debt cost. In this cluster, Carbon and Sustainability disclosures are being discussed in different contexts, such as carbon emission, Carbon risk and carbon risk

awareness, sustainability, sustainability assurance, sustainability practices, sustainability reporting, and business sustainability initiatives. Furthermore, at the end of this cluster, this study will also analyze the impact of greenhouse gas (GHG) emissions on the cost of debt.

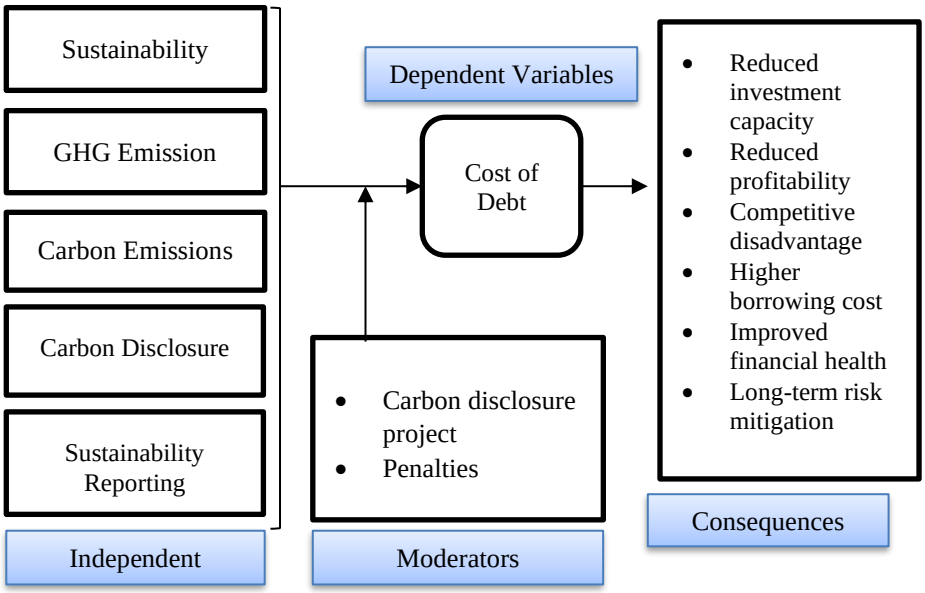

Figure 7: Theoretical Framework for Influence of Sustainable Business Practices and GHG Emissions on Cost Debt

3.3.1 Carbon Emissions and Cost of Debt

This section explores the relationship between carbon emissions and the cost of debt, illustrating how carbon reduction efforts and carbon emissions intensity influence financing cost, alongside the evolving perspectives of investors and lending institutions on climate-related risks and sustainable development. A part of the sustainability literature focuses on the impact of carbon emissions on the cost of debt. In this context, Jung et al. (2018), with 136 citations, analyze a positive association between carbon risk (measured by voluntary disclosures in carbon disclosure project (CDP)) and cost of debt, which explains lower carbon emission (more carbon reduction activities disclosures) results in lower cost of debt. Besides, a positive association between the cost of debt and the intensity of a firm's carbon emission is also present (Caragnano, Mariani, Pizzutilo, & Zito, 2020), explaining that using renewables in firm energy needs results in lower carbon intensity and reduces the cost of debt. Furthermore, investors and lenders are now more conscious of climate-related risks because high carbon emissions with high carbon intensity may result in prospective future regulatory penalties, carbon taxes and operational disruptions due to

stricter environmental regulations (Caragnano et al., 2020). On the other hand, energy transition of firms from fossil fuel to renewables requires capital injection which reduces cash inflows of firms. This is a short-term phenomenon because, ultimately, this transition results in lower environmental and financial risks, improved margins, and high cash flows. Thus, the cash flow perspective of the transition of firms towards low-intensity carbon emission in the short run negatively influences cash flows (Wang, Feng, & Huang, 2021). That is why sustainable development may raise the cost of debt, but in the long run, this transition improves cash flows (Kumar & Firoz, 2018b; Li et al., 2014b). Lenders see low carbon intensity emission firms as more innovative and fundamentally strong, which is why they charge lower debt costs from these firms (Amanullah & Lyu, 2022). Furthermore, every unit increase in greenhouse gas emissions increases the cost of debt by an average of 11 to 15%. Furthermore, lenders also consider greenhouse gas emissions while deciding loan approvals and penalizing polluting firms (Deegan, 2013; Li, Eddie, & Liu, 2014a).

3.3.2 Sustainability and Cost of Debt

This section examines the relationship between sustainability disclosures and cost of debt in the perspective of, how macroeconomic fundamentals and firm-specific financial metrics such as return on assets influence the cost of debt in the context of sustainability initiatives. Higher debt service costs are found to be an obstacle while achieving sustainability in European Union economies because of the already high public debt at the governmental level and budget deficits in these economies (Corsetti et al., 2015). On the other hand, sustainability practices in the Association of Southeast Asian Nations were found to be more negatively associated with COD (Gracia & Siregar, 2021; Uryszek, 2015). A country's macroeconomic fundamentals significantly impact direct funding regarding sustainable business practices (Gong et al., 2021b) as it relates to social and environmental frameworks and the availability of governmental financing and facilitation for these activities (Arslan, Khan, Latif, Komal, & Chen, 2022). A study on the firms listed through the Spanish capital market reveals that the organizations having sustainability profile will have to bear the lower cost of debt, but this is only possible when the return on asset (ROA) is high with the current level of leverage (Lassala et al., 2017). At the end of this cluster, Lau (2019) argues that the firms having more excellent business sustainability initiatives (BSI) will have to bear lower debt and equity costs because the preference of investors and lenders regarding sustainable investment is growing, which results in more investment firms with the adoption of business sustainability initiative (BSI), but these initiatives decrease the firm's profitability in some cases (Schaltegger, Lüdeke-Freund, Hansen, & development, 2012). The strong relationships between the BSI level and its financial advantages demonstrate the value of sustainability reporting and disclosures for making decisions (Lau, 2019).

3.3.3 Sustainability Reporting in Different Sectors and Cost of Debt

The impact of sustainability disclosures on the cost of debt varies between energy-generating firms that rely on renewable sources and those that use fossil fuels. Electricity-generating firms based on fossil fuel and thermal fuels, such as coal and gas-based electricity firms, show a less significant negative relationship between sustainability disclosures and the cost of debt (Fonseka et al., 2019). In contrast, alternative and renewable fuel-based electricity generation, such as wind and solar firms, shows a robust negative relationship between sustainability disclosures and the cost of debt (Morrone, Schena, Conte, Bussoli, & Russo, 2022). Fossil fuel-based firms face many problems, such as their negative image after all the global awareness, regulatory restrictions and investors' and lenders' preferences (Ali, Nadeem, Pandey, & Bhabra, 2023; Amanullah & Lyu, 2022). Moreover, real estate industries with high environmental information disclosure will enjoy lower debt costs because the real estate sector is directly affected by climate change Y. Li et al. (2014a). Further, there are other factors which improve the competitive advantage and financial fundamentals of REIT, such as regulatory requirements regarding energy efficiency and emission (reduce regulatory risk), consumers and tenant preferences, easy access to green bonds and sustainable financing instruments (Feng & Wu, 2023b) with high occupancy rate (a primary indicator of the success of REIT's) and investor preferences results in lower debt financing cost for high sustainability disclosures REIT's (Amanullah & Lyu, 2022; Fonseka, Tian, & Al Farooque, 2020). Furthermore, the services sector naturally emits less emissions, but their social aspect is essential because of more indulgence of human resources (Gao et al., 2022b; Miao et al., 2021b). That is why corporate social performance, compared to overall sustainability disclosures, gains center stage in determining the negative relationship between sustainability disclosures and the cost of debt in the services sector. (Magnanelli & Izzo, 2017b; Suto & Takehara, 2017).

Upon examining the blue cluster, this study unearthed fascinating insights, concisely outlined here. First, firms with carbon risk did not respond to the CDP project and will get more debt costs than those who responded (to the CDP project). Meanwhile, firms with high carbon emission intensity will have to bear more costs of debt and penalties than less polluting firms. Second, GHG emission has a direct positive influence on firms' COD. Third, high environmental information disclosures in energy firms result in a lower cost of debt except for environment-polluting energy firms (coal-based and furnace-oil-based) compared to environment-friendly energy firms (renewable resources based such as hydro, wind and solar). Fourth, the residential real estate sector will have lower debt costs than the commercial real estate sector.

4. Discussion

After reviewing all the literature, this study concluded that sustainability disclosure profoundly impacts firms' cost of debt. One of the most exciting influences is that companies with transparent and robust sustainability reporting practices tend to receive lower interest rates on their debt capital (Gracia & Siregar, 2021; Shad et al., 2020b).

Lenders increasingly recognize the value of sustainable practices in mitigating environmental (Gao et al., 2022b) and social risks (Sun et al., 2022), which translates into greater confidence in the company's long-term financial stability (Gracia & Siregar, 2021; Shad et al., 2020b). Additionally, firms with robust sustainability disclosures often attract socially responsible investors (Jung, Herbohn, & Clarkson, 2018), expanding their investor base (Magnanelli & Izzo, 2017a) and potentially reducing the perceived risk (Sun et al., 2022), thereby leading to lower borrowing costs.

In the subsequent section, this study will address the responses to the research questions and objectives previously introduced at the beginning of this study on the effect of sustainability disclosure influence on the cost of debt. In order to address our first question, which is about the inflectional aspects of sustainability disclosure and cost of debt literature, the following is the response:

The annual output regarding publications on sustainability disclosures' influence on the cost of debt literature started publications in 2008. Initially, publications were relatively low, but after 2016, steady growth has been noted. A total of 76 studies have been reviewed, and all the journals that published this work are in zone 1 according to Bradford's law, representing the quality of articles included in this review. Sustainability (Switzerland), Journal of Business Strategy and the Environment, and Journal of Business Ethics are the most influential journals discussing the literature and influence of sustainability disclosure on the cost of debt. Furthermore, authors from the United States, Italy, China, and Spain are the countries that contribute the most to authors' participation in publications, with 29, 23, 21, and 15 articles, accordingly.

In order to answer our second research question regarding the influence of environmental and social disclosure quantity and quality on the cost of debt, this study draws the following insights from the literature. Firstly, studies have identified that with quality environmental information disclosure cost of debt decreases (Gao et al., 2022b; Magnanelli & Izzo, 2017a) because higher-quality disclosures provide lenders and investors valuable insight regarding firm's environmental performance (Ramos-Meza et al., 2021), risk management (Jung et al., 2018), and sustainability practices of firms (Gracia & Siregar, 2021), thus reducing the perception of information risk associated with the company. As a result, lenders are more willing to provide debt at a lower cost (Gao et al., 2022b). However, some studies show that the effect of revealing information on debt costs may be different for all cases (Ding et al., 2022). For example, the connection between CSR disclosure quality and debt cost in Chinese companies may depend on ownership structure (Amanullah & Lyu, 2022; H. Li et al., 2023) or media focus (Gao et al., 2022b). Unlike good news in the press, which can cut down debt costs because of increased trust, negative media reporting results in punishment by the regulators for not doing the right things, which results in higher debt costs (Shad et al., 2020b; Sun et al., 2022). However, the incremental disclosure acts as a moderator, indicating that without changes in disclosure level, the cost of debt may not be

significantly affected by environmental penalties (Ding et al., 2022; Gangi et al., 2021; Gracia & Siregar, 2021). Secondly, the quantity of environmental and social disclosures can also influence the cost of debt (Bilal et al., 2023; Dhoraisingam Samuel, Mahenthiran, & Ramasamy, 2022; Gangi et al., 2021). Firms that provide more extensive and transparent CSR reports, particularly those adhering to global reporting guidelines, tend to enjoy a lower cost of debt (Shad et al., 2020b; Sun et al., 2022). This could be because more comprehensive disclosures enhance the firm's credibility (Gracia & Siregar, 2021) and reduce information asymmetry (Magnanelli & Izzo, 2017a) between lenders and borrowers, resulting in lower perceived risk and, consequently, lower borrowing costs (Gao et al., 2022b; Jung et al., 2018). Furthermore, sustainability assurance can play a role in shaping the cost of debt (Shad et al., 2020b). Companies that undergo sustainability assurance, particularly from accounting firms that prioritize creditor rights (Sun et al., 2022), may experience a decrease in their cost of debt (Gangi et al., 2021). Assurance can show that a business is open and responsible. This makes loan providers feel sure and lowering the cost of borrowed money (Dhoraisingam Samuel et al., 2022). Moreover, the connection between being responsible for our environment and debt costs can be affected by things like company management (Dhoraisingam Samuel et al., 2022) and focusing on what others want or need. Companies with reasonable control and care for the environment usually pay less debt costs. Also, how CSR performance relates to debt cost can change depending on the corporate governance system used by a company (Amanullah & Lyu, 2022). How well a company does CSR might make borrowing money more expensive in shareholder-oriented firms but better in stakeholder-focused firms. This suggests that aligning CSR efforts with the company's overall governance and accountability philosophy can influence the cost of debt (Dhoraisingam Samuel et al., 2022; Gracia & Siregar, 2021). Overall, the literature indicates that both the quality and quantity of environmental and social disclosures influence firms' debt costs. High-quality disclosures and comprehensive reporting reduce debt costs by mitigating perceived risks and high credibility. On the other hand, low disclosure quality, penalties and negative media attention may increase borrowing costs. Moreover, with CSR participation, implementing green methods in firms will likely result in cheaper debt costs. This is especially true with good company governance, plus a focus on people who are directly involved in firm management. These findings magnify the importance of integrating environmental and social considerations into a firm's overall disclosure strategies and governance practices to potentially reduce the cost of debt (Amanullah & Lyu, 2022; Gao et al., 2022b; Jung et al., 2018; Sun et al., 2022).

In order to answer our third research question regarding the perspective of lending institutions (Burger, 2022), corporate governance (Maaloul, Zéghal, Ben Amar, & Mansour, 2023), and real earnings management (Puspita & Utami, 2022) with sustainability disclosures and cost of debt, past literature has identified that lending institutions decision making is based on company's creditworthiness and risk profile (Burger, 2022; Chang, Fu, Jin, & Liem, 2022). When a company shows good CSR disclosure practices and performance by making clear and comprehensive reports, it can

improve its image and be seen as a better firm in managing financial risk. This might cause the cost of debt to go down (Gigante & Manglaviti, 2022). On the other hand, if a company does not share information regarding CSR disclosures and performance and is not good at being green and sustainable, banks might think it is not safe to lend money, resultantly enhance borrowing costs (Maaloul et al., 2023; Puspita & Utami, 2022). That is why the relationship between CSR disclosures and the cost of debt can be multidirectional and depends on the company's quality of sustainability disclosures and the financial risk perception of lenders regarding the company. Secondly, corporate governance is essential in shaping a firm's sustainability practices, strategies and high-quality disclosures (Dhoraisingam Samuel et al., 2022). A company with strong corporate governance structures is more likely to integrate sustainable business practices into its strategic planning and disclose relevant ESG actions and achievements transparently (Chang et al., 2022). Good corporate governance improves the dependability and reliability of sustainability disclosures (Dhoraisingam Samuel et al., 2022), increases investor confidence in firms' financial and non-financial reporting (Gigante & Manglaviti, 2022), and may reduce debt cost by signaling better financial risk management to lenders (Puspita & Utami, 2022). On the other hand, companies with weak corporate governance structures may lack enough oversight and spurs to prioritize sustainability hard work, leading to limited or low-quality ESG/CSR disclosures (Gigante & Manglaviti, 2022). This lack of transparency may worry lending institutions, causing them to charge more for borrowing because they think a lousy management structure will put extra risk on their money (Yuan, Li, Xu, & Shang, 2022). On the other hand, earnings management can also affect the relationship between ESG / CSR disclosures and debt costs. Businesses that use accrual accounting to boost their financial numbers might damage investors' confidence and consistency of financial performance, resulting in their image of being sustainable also being affected by such actions (Burger, 2022; Gigante & Manglaviti, 2022). Such practices erode investor trust and may lead to higher debt costs as lenders become wary of potential financial inconsistencies and associated risks.

With the intention of answer the fourth research question concerning the influence of GHG emissions disclosures on the cost of debt, previous literature has identified that firms with low GHG emissions and low GHG emission intensity tend to appreciate decrease costs of debt (Kozak, 2021; Lee & Choi, 2021; Pizzutilo, Mariani, Caragnano, & Zito, 2020). Such as, firms that disclose their carbon risk and keenly respond to carbon disclosure initiatives (Carbon Disclosure Project) are perceived as more environmentally responsible and low financially risky in front of monetary institutions (Ali, Nadeem, Pandey, & Bhabra, 2022). This environmentally and financially responsible image results in reduce-interest rates and low cost of debt (Caragnano et al., 2020; Garzón-Jiménez & Zorio-Grima, 2021). Firms that clasp sustainable development and share environmental information are perceived as creditworthy partners for lenders, which decrease the cost of financing these organization (Maaloul & Wegener, 2022). This suggests that investors and lenders value transparency

in sustainability activities and disclosures, rewarding firms with lower debt costs (Choi, Lee, Park, & Sohn, 2022; Palea & Drogo, 2020). On the other hand, high carbon-emitting firms tend to face higher debt costs because lenders penalize high-polluting firms and high lending costs (Gerged, Matthews, & Elheddad, 2021; Pizzutilo et al., 2020). That is the case with energy firms because of their high emissions and higher environmental risks, except for renewable energy firms (Lee & Choi, 2021; Maaloul & Wegener, 2022).

Furthermore, the relationship between sustainability practices and the cost of debt varies across different regions and sectors (Choi et al., 2022; Palea & Drogo, 2020). For example, sustainability practices in the Association of Southeast Asian Nations firms are negatively associated with debt costs. In contrast, in European Union economies, transitioning towards sustainability business practices is less likely to reduce debt costs because already high budget deficits do not allow governments to subsidize the transition towards sustainability practices (Kozak, 2021; Palea & Drogo, 2020). In that case, already high ROA firms move quickly towards sustainable business practices and get benefits in reducing their cost of debt by lending institutions. In summary, sustainable business practices (Gracia & Siregar, 2021), low carbon emissions (Caragnano et al., 2020), and environmental disclosure (Ratajczak & Mikołajewicz, 2021a) generally lead to reduction in costs of debt, as they enhance a firm's reputation and reduce perceived financial risk. On the other hand, high carbon emissions led to environmental risks and result in high debt costs for polluting firms.

5. Conclusion

Previous review studies have tried to make sense of empirical research by looking at the link between corporate governance and the cost of debt (Kordsachia, 2021; Ratajczak & Mikołajewicz, 2021a), as well as the quality of financial information disclosure and the cost of debt financing (Xu et al., 2021). Moreover, studies have explored the association between sustainability disclosure and firm performance, drawing upon various theoretical frameworks such as institutional theory (Eliwa et al., 2021), legitimacy theory (Jiménez & Grima, 2020; Kuo et al., 2021), and stakeholder theory (Jiménez & Grima, 2020; Kuo et al., 2021). Despite the widespread adoption of systematic literature review under the PRISMA protocol in business management and accounting, no single review study has conducted a systematic literature review specifically on the influence of sustainability disclosure on the cost of debt. All the prior review papers identified at the start of the conclusion are masterworks about the influence of sustainability disclosure in firms' operations in certain aspects, which allows us to identify gaps, which this study has used to guide the structure of this review paper by managing these research gaps in the research questions presented in the introduction section. These research questions have first tried to explore the most influential aspects of sustainability disclosures and cost of debt literature, then explored the influence of environmental and social disclosures quantity and quality on the cost of debt, then reviewed the role of lending institutions, corporate governance and earnings management in the relationship between ESG / CSR disclosures and cost of

debt, then synthesized the impact of sustainable business practices / initiative and GHG / Carbon emission on the cost of debt.

However, poor disclosure quality, fines, and unfavorable press coverage could make borrowing more expensive. Businesses with green approaches and CSR involvement are likelier to have lower debt expenses. This is predominantly true when they practice strong management and take into account the needs of others. Because they are viewed as less hazardous and attract more attention from investors and lenders who care about people and the environmental changes, firm utilize sustainable practices and reduce carbon emissions typically earn cheap lending charges from lenders. However, excessive carbon emissions and a history of environmental mishaps damage a company's reputation among all parties involved, raising its risk profile and driving up debt expenses.

Previous research has shown that sustainable business activities, reduce GHG emissions, and high environmental disclosures generally lead to decrease debt costs, improving a firm's reputation and decreasing perceived financial risks. On the other hand, high carbon emissions and environmental risks tend to increase the cost of debt for polluting firms. Additionally, the impact of sustainability on debt costs can vary across different regions and industries, making it essential for firms to tailor their sustainability strategies accordingly to manage their borrowing costs effectively.

5.1 Recommendations

Regarding the total number of articles and their citations, the US, Italy, China, and Spain are the leading research centers for sustainability and COD literature. These research centers should collaborate with the necessary departments in emerging economies to set climate standards. According to our research study on sustainability and COD, developing economies place less importance on climate challenges. Therefore, a combination of incentives and punishments should be used to encourage emerging economies to join global efforts to combat climate change. Moreover, consistency and comparability are phenomena that prospective researchers should address by designing frameworks to synthesize results effectively for more precise insights. If regulators are uncomfortable with mandatory sustainability disclosures, then at least a minimal criterion must be decided to cater to greenwashing. Lastly, academicians must give importance to extensive subsample analysis based on different commonalities to further explore and clarify the influence of sustainability disclosures in various sectors of economies.

5.2 Practical Implications of The Study

The findings of this review study on the impact of sustainability disclosure on the cost of debt have some important practical implications for corporate financial managers, lending institutions, regulators, and stakeholders. Firstly, corporate financial managers should leverage this study's outcome to match their financial plans with environmentally friendly practices for ethical reasons and to optimize financial outcomes. Secondly, money

lenders/financial institutions could refine their risk assessment and make more reliable lending decisions when they know how sustainability reporting affects risk assessment. The results of this study can help regulators regulate the environment and mend their policies specifically for the companies who made disclosures, but those disclosures are just eyewash. Thirdly, regulators gain a practical tool for enhancing disclosure frameworks, ensuring they capture the nuanced impact of sustainability on financial dynamics. Fourthly, this study helps the stakeholders align their engagements with businesses committed to sustainable practices. It would benefit them to learn helpful information to make good choices about doing business with them. Our research, illuminates the impact of sustainability disclosure on the cost of debt, contributes to academic knowledge and practical decision-making in the global financial landscape.

5.3 Limitations of The Study:

This systematic literature review is based on the influence of sustainability disclosures on the cost of debt, and the term sustainability disclosures specifically lacks standardization, which results in a lack of consistency and comparability across different studies. This lack of standardization affects the conclusions drawn from the studies, which is challenging. Secondly, sustainability disclosures are still voluntary in some sectors of the United States of America; sustainability disclosures are mandatory, but overall, they are voluntary in the UK, Canada, Australia, and partially in India. These are big economies, and the voluntary nature of sustainability disclosures results in selective disclosures, which may not compare to the sustainability disclosure performance of firms. Thirdly, this variable nature of sustainability disclosures affects the cost of debt. The dynamics of the cost of debt are different in different regions and sectors, complicating the generalizability of results. Fourthly, a more significant issue with sustainability disclosures is greenwashing, in which firms focus on improving the image of firms and mislead stakeholders, specifically creditors, potentially affecting the cost of the firm's debt. These study limitations demand an accurate assessment of sustainability disclosures in methodological and analytical contexts.

5.4 Future Directions:

The rationale for future research agenda in sustainability disclosures influencing the cost of debt is presented here so prospective researchers may not reinvent the wheel in this field, and a genuine value addition to the body of knowledge should be possible. First, the upcoming researchers should investigate the influence of sustainability disclosures and cost of debt from the perspective of management and board political connections perspective because past literature has identified the importance of political connections in corporate financing, but the differentiation between management and board of director’s political connections has never been studied in past literature. Second, prospective researchers should investigate this relationship from the perspective of democratic and dictatorial governance systems. Past literature has investigated this relationship from the perspective of developed and emerging economies. Third, based on this review, the upcoming studies

should investigate the influence of industry-specific characteristics on the sustainability-disclosure and cost of debt relationship. Fourth, the upcoming studies must investigate the relationship from the perspective of top management team characteristics such as top management age, gender, professional education, nationality and experience. Past literature has focused on the board characteristics, but it is actually the management who is on the driving seat. Fifth, upcoming researchers could investigate this relationship from the perspective of differences between the big four sustainability assurors and non-audit background sustainability assurors and the resultant confidence that institutional investors show to a firm during debt financing. Sixth, future studies could assess the impact of technological advancements (e.g., artificial intelligence) on the relationship between sustainability disclosure and the cost of debt. Seventh, the upcoming research should explore the impact of carbon pricing mechanisms, such as carbon taxes or cap-and-trade systems, on the cost of debt. Eight, future researchers might examine the relationship between sustainability disclosure and the cost of debt during financial crises.

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