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Global Value Chains and Firms' Environmental Performance: A Bibliometric Analysis

David Afonso Machado Pires

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David Afonso Machado Pires

Master in International Economics and Management

Supervised by

Professor Ana Teresa Tavares Lehmann

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Abstract

The current green transition and the imperative for companies to adopt more environmentally sustainable practices are leading firms to reconsider their strategies. In parallel to this shift towards a greener economy, there is a phenomenon of utmost relevance in the contemporary international economy, the prevalence of global value chains (GVCs). One of the most important streams of literature in International Business focuses on these global production networks and on their evolution. Within this stream, a growing body of work focuses on how GVCs are evolving, one of the key aspects being how GVCs are adapting to 'grand challenges' such as climate change and the concomitant need for a green transition. In this context, the involved actors in these GVCs, namely lead firms and suppliers, are pressured to create new ways of organizing these globally dispersed production networks to avoid environmental downgrading and, if possible, to achieve environmental upgrading. As firms face mounting pressure from stakeholders to improve their environmental performance, GVCs must reorganize themselves to create greener GVCs.

Considering the emergence of this novel field of study and the recent proliferation of research papers about this contemporary phenomenon, it seems a worthwhile contribution to gather, organize, and systematize all the relevant papers and findings. This dissertation is structured into two chapters. In the first chapter, an extensive literature review is conducted to identify the existing gap in the literature and cement the major themes and concepts regarding the analyzed phenomenon. In the second chapter, a rigorous bibliometric analysis was conducted to assess the key trends and relevant aspects characterizing this literature, which included 81 articles extracted from Scopus and Web of Science. After extracting all the relevant literature, we proceeded to identify all the main research trends in this field of study and its characteristics, notably, the most cited publications, the most relevant journals in the field of study, the most influential authors, among others. This analysis highlights the growing academic interest in this field, attesting to the crucial role of GVCs in the ongoing green transition.

Keywords: Global Value Chains (GVCs), International Business, Environmental Performance, Environmental Sustainability, Green Transition, Bibliometrics, Literature Review.

JEL Codes: Q56; F18; C89

Resumo

A transição verde atual e a necessidade imperativa de as empresas adotarem práticas mais sustentáveis do ponto de vista ambiental estão a levar as empresas a reconsiderar as suas estratégias. Em paralelo, um fenómeno de extrema relevância na economia internacional contemporânea é a prevalência das cadeias de valor globais (CVGs). Uma das correntes mais importantes da literatura em Negócios Internacionais foca-se nas CVGs e na sua evolução. Dentro desta corrente, tem vindo a crescer um conjunto de estudos sobre a forma como as CVGs estão a evoluir, sendo um dos aspetos-chave a sua adaptação aos chamados "grandes desafios", como as alterações climáticas e a necessidade concomitante de uma transição verde. Neste contexto, os atores envolvidos nestas CVGs, nomeadamente as empresas líderes e os fornecedores, são pressionados a criar formas de organizar estas redes de produção globalmente dispersas, de modo a evitar a degradação ambiental e, se possível, alcançar uma melhoria ambiental. À medida que as empresas enfrentam uma pressão crescente por parte dos *stakeholders* para melhorar o seu desempenho ambiental, as CVG devem reorganizar-se para se tornarem mais ecológicas.

Considerando o surgimento deste novo campo de estudo e a recente proliferação de artigos científicos sobre este fenómeno contemporâneo, considera-se uma contribuição relevante reunir, organizar e sistematizar todos os artigos e conclusões pertinentes. Esta dissertação está estruturada em dois capítulos. No primeiro capítulo, é realizada uma extensa revisão da literatura com o objetivo de identificar a lacuna existente e consolidar os principais temas e conceitos relativos ao fenómeno analisado. No segundo capítulo, é conduzida uma rigorosa análise bibliométrica para avaliar as principais tendências e aspetos relevantes que caracterizam esta literatura, a qual incluiu 81 artigos extraídos das bases de dados Scopus e Web of Science. Após a extração da literatura relevante, procedeu-se à identificação das principais tendências de investigação neste campo de estudo e das suas características, nomeadamente as publicações mais citadas, as revistas científicas mais relevantes na área, os autores mais influentes, entre outros. Esta análise evidencia o crescente interesse académico neste domínio, atestando o papel crucial das CVGs na atual transição verde.

Palavras-Chave: Cadeias de Valor Globais (CVG), Negócios Internacionais, Performance Ambiental, Sustentabilidade Ambiental, Transição Verde, Análise Bibliométrica, Revisão de Literatura.

Códigos JEL: Q56; F18; C89

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List of Acronyms

CSR – Corporate Social Responsibility

ESG – Environmental, Social and Governance

FDI – Foreign Direct Investment

GDP – Gross Domestic Product

GHH – Green Haven Hypothesis

GVC – Global Value Chain

IB – International Business

KBV – Knowledge-Based View

LCA - Life Cycle Assessment

MNE – Multinational Enterprise

NGO - Non-Governmental Organization

OECD - Organization for Economic Cooperation and Development

PEH - Porter's Environmental Hypothesis

PHH - Pollution Haven Hypothesis

RBV - Resource-Based View

SCOPUS - SciVerse SCOPUS

SSCM - Sustainable Supply Chain Management

ST - Stakeholder Theory

TiVA - Trade in Value-Added

WoS - Web of Science

Introduction

Understanding recent economic globalization is inseparable from studying global value chains (GVCs). GVCs powered the surge of international trade in the 1990s and account for almost 50% of all trade today (World Bank, 2020). The global economy is increasingly organized around GVCs and these account for a significant share of international trade, gross domestic product (GDP), and employment (Gereffi and Fernandez-Stark, 2019). Recent studies show that GVCs now represent roughly 40 % of global GDP, with approximately 38% of EU exports tied to these chains in 2022 (European Commission, 2024). Moreover, forward GVC participation is shown to significantly boost employment across the EU 27 (Olczyk & Petreski, 2024). Additionally, the OECD, based on its Trade in Value-Added (TiVA) dataset, considers that around 70% of global trade is connected to GVCs (OECD, 2023), and empirical evidence on trade in value-added and intra-industry trade has shown that production stages are increasingly fragmented across several economies (de Backer and Yamano, 2011).

Simultaneously, the UN 2030 Agenda for Sustainable Development emphasized the imperative for companies to reduce their harmful impact on the environment resulting from their production activities throughout their value chains (United Nations, 2015). Furthermore, stakeholders are becoming increasingly aware of the need for a green transition and consequently pressuring firms to make their business models more eco-friendly and reduce their environmental footprint (De Marchi et al., 2019). In addition, with the advent of Environmental, Social, and Governance (ESG) ratings, even traditional stakeholders such as institutional investors are incentivizing eco-friendly business practices. Investors are progressively demanding that firms disclose more ESG reports, with at least 5000 investors representing around US$128.4 trillion in assets under management having signed the Principles for Responsible Investment, backed by the United Nations (Principles for Responsible Investment, 2024).

This trend marks a clear shift in the financial markets towards sustainability-focused investments, especially leading to a proliferation of green financial instruments and funds to fight climate change (Chernyshova, 2021). Consequently, firms are increasingly pressured to improve their environmental performance to comply with international standards and access public and private funding (Chernyshova, 2021).

However, the effectiveness of environmental practices and strategies in GVCs depends on several factors, such as GVC integration, governance models and relationships between lead-firms and suppliers (Buckley and Liesch, 2022). Consequently, it is important to understand the role of GVC participation in firms' environmental performance and adoption of greener practices. In recent years, there has been an increasing interest in academia towards environmental sustainability in the context of GVCs, particularly, how these globally dispersed production networks are impacting the environmental performance of the involved companies (De Marchi et al., 2019). This trend in academic research reflects the ongoing green transition and the growing awareness of the ecological impact associated with global production (Amofa, Oke & Morrison, 2023). The emergence of concepts and frameworks such as Sustainable Supply Chain Management (SSCM), circular economy, Life Cycle Assessment (LCA) and the ESG criteria has further reinforced the scientific research in this field (Amofa, Oke & Morrison, 2023). Yet, the intersection of the literature on GVCs and corporate environmental sustainability in International Business literature continues to be an uncharted area of study (Dimitropoulos et al., 2023), which opens up an important research opportunity that this dissertation aims to contribute to.

The confluence of these two contemporary major trends - the importance of GVC in the global economy, and the green transition imperative -, together with the vast research opportunity in presence, leads us to explore (via a systematic literature review) the following research question: *How do GVCs influence firms' environmental performance*?

In order to answer this question, this dissertation will seek to map out and describe the various dimensions through which GVC participation impacts the environmental performance of companies. It will also seek to identify the main concepts, trends and findings in this area and relate them to the core of international business theory.

To achieve these objectives, a bibliometric analysis was deemed as the most suitable methodology to organize all the relevant extant literature and identify the most interesting research themes and trends in this field of study. For this purpose, after defining the most relevant keywords and extracting all the resulting publications from the Web of Science and Scopus databases, we analyzed the chronological evolution of the extant literature; the main topics; the geographical focus of the publications; the predominant methodologies employed by researchers; the most influential authors, publications and journals; and the keyword clusters and research trend hotspots. By systematically processing this information and gathering it in a single research paper, this analysis seeks to offer a clear systematic review of

the most relevant findings for researchers who wish to enrich the current literature with empirical studies, policymakers involved with the green transition and managers seeking to improve their companies' environmental performance.

Chapter I

1.1. Literature Review

This chapter aims to review the most relevant literature, concepts and theories addressing the theme of the dissertation: the influence of GVCs on firms' environmental performance. This research theme will be analyzed considering the relevant theories in IB, such as Internalization Theory and Global Value Chain Theory. Firstly, it is important to understand the main concepts of this dissertation: global value chain and environmental performance. Then, it is relevant to evaluate the concept of environmental upgrading, which brings together these two concepts. The process of environmental upgrading, and its opposite, environmental downgrading can, in turn, be conceptually analyzed through the lenses of two theoretical frameworks on the influence of GVCs on the environmental performance of firms and the resulting environmental consequences, notably, the Pollution Haven Hypothesis (PHH) and Porter's Environmental Hypothesis (PEH), which are dully explained in this chapter.

1.1.1. Global Value Chain (GVC)

The global value chain is today a well-understood concept and is a widely used framework for analyzing the production networks of companies and their trade patterns in the context of IB theory (Gereffi & Fernández-Stark, 2016). Their role in the 21st-century global economy is of paramount importance by linking countries, firms and workers worldwide (Ponte et al., 2019). GVCs are essentially international production networks characterized by the fragmentation of production chains or activities across several countries (Globerman, 2011). These globally dispersed production networks are structured around the efficient use of resources, recognizing that efficiency differs significantly by location (Kano et al., 2020). This variability between alternative locations often results in a network of subsidiaries, suppliers, and partners operating across national borders, creating an interconnected system of functions and processes through which goods and services are produced, distributed and consumed on a global scale (Kano et al., 2020).

These production networks commonly involve the division of labor in manufacturing processes to be performed where resources are available at competitive costs (Globerman, 2011). This rationalization of production led to a dispersal of tasks around the world, making it sometimes difficult to identify all the countries, directly or indirectly, involved in the manufacturing of one single product (Gereffi & Sturgeon, 2013).

This dispersal of operations motivated multinational enterprises (MNEs), often referred to in this context as lead-firms (as they often lead and orchestrate GVCs' activities), to create mechanisms, structures and rules that dictate how the productive operations are performed and coordinated throughout the production network (Humphrey & Schmitz, 2001). This process is achieved through what Humphrey and Schmitz (2001) define as GVC governance, meaning how certain firms throughout the value chain can define and implement the standards and rules that govern the overall production operations throughout the whole chain. Lead firms (often, MNEs) are considerably dependent on supplier quality and often set standards and create mechanisms to ensure that suppliers contribute positively to the environmental performance of the overall GVC (De Marchi et al., 2019). GVC governance is particularly relevant in the context of enforcing environmental rules and practices that ensure an overall greener value chain by improving the environmental performance of all the dependent firms of the GVC (Humphrey & Schmitz, 2001).

Essentially, GVC governance is a complex organizational system where multiple actors leverage rules, standards, and control mechanisms to coordinate and dictate cross-border production and distribution chains (Gereffi et al., 2005). This complex system is based on the interactions between diverse stakeholders such as lead firms, suppliers, States, consumers, non-governmental organizations (NGOs), and labor unions (Mayer & Phillips, 2017). In the context of this analysis, lead firms and suppliers are the most relevant players in determining the environmental performance of GVC. On one hand, lead firms are charged with multiple governance functions, notably, setting standards and requirements, selecting suppliers, and coordinating activities. Lead firms can fulfill this mission through direct control, contracts and audits (Gereffi et al., 2005). On the other hand, suppliers are responsible for implementing lead firm requirements and developing their capabilities by complying with standards and upgrading their processes (Ponte & Sturgeon, 2014). Both Gereffi et al. (2005) and Ponte and Sturgeon (2014) recognize the inherent power asymmetries in the potential governance typologies, with different governance types

representing differing levels of explicit coordination and power distribution between lead firms and suppliers.

When considering environmental sustainability standards and rules, States and NGOs also play a key role (Mayer & Phillips, 2017), albeit less directly as lead firms and suppliers on the environmental performance of the overall GVC. Governments, acting on behalf of States, set policies, regulations and craft trade agreements that inevitably impact the production and distribution process throughout the value chain (Mayer & Phillips, 2017). Additionally, governmental regulations can impact and influence the power dynamics between lead firms and suppliers (Davis et al., 2018). NGOs are also key players in shaping the governance norms and practices across GVCs by setting global standards and monitoring how both lead firms and suppliers comply. NGOs can also leverage their influence through campaigns and certification schemes (Seabrooke & Wigan, 2017). Seabrooke and Wigan (2017) also observe that lead firms are increasingly collaborating with NGOs to design and implement governance solutions in order to improve their overall performance in multiple areas, such as environmental sustainability.

1.1.2. Environmental performance

Environmental performance is understood as the measurable result of strategic activities that manage, positively or negatively, the impact of firms on the surrounding natural environment (Walls et al., 2011). From this broad definition, environmental performance can be seen as the firm's ability to mitigate its impact on air emissions, solid or liquid toxic waste, environmental accidents and excessive exploitation of natural resources (Younis et al. 2016).

GVCs can measure environmental performance using a comprehensive set of quantitative and semi-quantitative indicators based on several factors such as emissions, resource usage, energy, generated waste, management systems, impact on biodiversity, green technology adoption, and costs (Acquaye et al., 2017). These factors can be analyzed at different levels: firm-level, national level, sectoral, and regional. For the present analysis, the firm level is the most relevant, as firm-level data can be compounded in order to assess the overall environmental performance of a GVC (Siewers, Martínez-Zarzoso & Baghdadi, 2024). By gathering data about CO2 emissions, energy, water usage and generated waste, we can objectively assess and quantify the environmental performance of a company (Mastrandrea et al., 2023).

However, when analyzing the environmental performance in the context of GVCs, it is important to refer to frameworks that unify the performance of all the firms involved in the production process (Mastrandrea et al., 2023). Li et al. (2022) developed such a framework to trace both value added and emissions throughout global production networks, allowing a more nuanced understanding of the environmental impact distribution across value chain stages and actors. Li et al. (2022) also stress that this framework allows researchers to more efficiently link MNEs' trade and investment through GVCs to their real environmental impact, notably, CO2 emissions.

In terms of the environmental spillover effects, Mugoni et al. (2024) stress the importance of the transmission of knowledge and green technologies through GVCs, especially from lead firms to their suppliers and upstream firms. These authors also suggest that this transfer plays a key role in the sustainability outcomes of global production networks. In their paper, Mugoni et al. (2024) analyze how the environmental performance concept relates to sustainable supply chain management (SSCM) and how the latter impacts the former. These authors define sustainable SSCM as a firm's strategy to reduce the overall environmental impact of the supply chain, or conversely, to improve the overall supply chain environmental performance. In order to achieve this goal, this management strategy depends on several practices such as green purchasing, green manufacturing, green product design, green distribution, green information systems and reverse logistics. This management strategy is often referred to as green supply chain management (GSCM) (Hasan, 2013). GSCM additionally demonstrates the importance of governance in environmental performance. In fact, Nadeem et al. (2022) found that strong governance can significantly improve environmental outcomes and mitigate potential negative effects of GVC participation while allowing and helping other firms in the global network to improve their environmental performance. This process is commonly known as environmental upgrading (Gereffi and Lee, 2012), which will be explained in the next section.

1.1.3. Environmental upgrading

Upgrading is defined as a key indicator for assessing whether involvement in global value chains contributes to the growth and advancement of participating firms (Gereffi, 2009). It describes the process through which a company enhances its capacity to transition into a more profitable or technologically advanced market segment (Gereffi, 1999). Originally, the concept of upgrading focused mostly on the economic dimensions of changes in products,

processes, and functions throughout the GVC (Humphrey & Schmitz, 2001). As the concept became more widely used in literature, other authors proposed different types of upgrading, such as social upgrading, relating to improvements in working conditions, labor rights, and gender equality (Barrientos, 2019).

Following this evolution of the concept, other authors started to apply the concept of upgrading to the environmental dimension of business throughout GVCs, being first introduced by Gereffi and Lee (2012) in their paper *Why the World Suddenly Cares About Global Supply Chains*. In this paper, the authors define environmental upgrading as the process through which firms improve their environmental performance while participating in GVCs, normally through compliance with sustainability standards and regulations or through the adoption of greener production practices. More precisely, "environmental upgrading takes place when a company improves its environmental performance through changes in product and process technology, management systems, waste and emission treatment and so on" (Jeppesen & Hansen, 2004, p.263).

Later, De Marchi et al. (2019) expanded the concept of environmental upgrading by creating a framework that allows researchers to understand how the process of upgrading unfolds. This framework considers various factors such as governance structures in GVCs, transfer of knowledge, and power relations between lead firms, suppliers and institutions, such as States or NGOs. Khattak and Pinto (2018) have identified that the scientific literature has continuously proven that power structures and relationships within GVCs are the most relevant factor driving environmental upgrading. De Marchi et al. (2013) also developed the definition of environmental upgrading, characterizing it as the process of actors designing and modifying production chains with the goal of mitigating the environmental damage that those operations have. This upgrading is achieved through the adoption of various green practices with the aim of reducing the ecological footprint of the company or its overall supply chain by reducing greenhouse gas emissions, the use of natural resources, etc. (De Marchi et al., 2019).

Lead firms, especially MNEs, play an important role in fostering environmental upgrading through various governance approaches that vary between more cooperative and more coercive measures (De Marchi et al., 2019). However, De Marchi et al. (2019) also recognize that supplier agency is significant and identify some cases when environmental upgrading follows a bottom-up logic instead of being lead-firm driven. Hamel and Prahalad (2005) coined the concept of strategic intent, defining it as the leap that firms with limited resources

and capabilities must make in order to close the gap by developing new competitive advantages. Applying the concept to this context, Khattak and Stringer (2016) observed empirically that suppliers play a crucial role in the process of environmental upgrading, considering it has a competitive edge against alternative supplier choices for lead firms. By adopting and following stricter environmental standards, suppliers manage to attract resources, capabilities and know-how from lead firms, which allows these smaller supplier firms to leverage other forms of upgrading, notably economic upgrading (Khattak & Stringer, 2016).

However, it is also possible for lead firms to push suppliers, especially in the low tiers of the GVC, into situations of economic hardship and even downgrading (Krishnan et al., 2023). This situation is referred to by Krishnan et al. (2023) as the supplier squeeze. This process unfolds when suppliers face increasingly stringent environmental and quality standards and, consequently, experience reduced profit margins because of the costly process of adapting their operations. This happens especially when lead firms impose higher compliance costs without compensating their suppliers for these additional costs in transitioning their production methods (Krishnan et al., 2023). In their paper, Krishnan et al. (2023) thoroughly analyze the Kenya-UK horticulture value chains and detail how lead firms appropriate the value created by the environmental upgrades performed by their Kenyan suppliers. In this context, suppliers are required to adopt more eco-friendly practices and adhere to stricter environmental standards set by lead firms to enhance the lead firms' environmental sustainability credentials. However, this obligation set by downstream actors can strain the financial health of their suppliers, especially if these obligations require investments in technology. This concept exemplifies the power imbalance within GVCs (Ponte, 2019).

Besides the supplier squeeze, suppliers can additionally suffer from environmental downgrading. Referring once again to the Kenya-UK horticulture GVC, Krishnan et al. (2023) observed that Kenyan farmers were effectively environmentally downgraded in response to pressures from UK supermarket chains and exporting companies. Environmental downgrading is connected to the concept of environmental degradation resulting from power balance differences between lead firms and suppliers. This causal connection was initially introduced by Boyce in his article *Inequality as a cause of environmental degradation* (1994). Krishnan et al. (2023) further developed the connection by extending it to a GVC framework. In the empirical case, the authors observed that farmers were forced to

implement practices that led to adverse environmental outcomes, like for example, increased pollution, depletion of natural resources such as water, more intensive usage of fertilizers that led to soil erosion, loss of biodiversity and higher carbon emissions. The framework developed by Krishan et al. (2023) emphasizes that, on the one hand, lead firms, can benefit from environmentally sustainable practices; and on the other, lower-tier actors, in this case the farmers, experienced negative environmental consequences despite their best efforts to follow the sustainability guidelines and goals set by the UK lead firms.

Essentially, suppliers can face two opposite situations in the context of environmental performance in GVCs: environmental upgrading or environmental downgrading. These two outcomes can be analyzed through the lenses of two opposing theoretical perspectives: Porter's Environmental Hypothesis (PEH) and the Pollution Haven Hypothesis (PHH), which will be analyzed in the next sections.

1.1.4. Porter's Environmental Hypothesis (PEH)

When Michael Porter and Claas van der Linde (1995) developed PEH, they weren't envisaging specifically the role of environmental regulation in fostering innovation in the context of GVCs. The thesis presented in their article *Toward a New Conception of the Environment-Competitiveness Relationship* (1995) was crafted with a more general view of the impact that environmental standards and regulations had on industry-level competitiveness and innovation offsets. Essentially, the authors' thesis postulated that well-designed regulations fostered innovation and competition because they pushed firms to improve production methods and processes in order to comply with the imposed environmental standards. This imperative to invest in R&D to achieve more eco-friendly operations would, in turn, make the firm more competitive and productive and eventually recover the initial investment. On top of that, the firm would be managed in a way to renew its competitive advantage in its industry. Despite being presented in their paper in a more general perspective, the authors hinted clearly to the possibility of applying their thesis to a GVC framework when they asserted that "(…) properly designed environmental standards can trigger innovation that may partially or more than fully offset the costs of complying with them. Such "innovation offsets," as we call them, can not only lower the net cost of meeting environmental regulations, but can even lead to absolute advantages over firms in foreign countries not subject to similar regulations." (Porter & van der Linde, 1995, p. 98).

PEH has not yet been explicitly applied to a GVC context in the literature, but some authors have implicitly applied the same theoretical logic. The present dissertation establishes this theoretical connection between the PEH and GVC studies, which, to the best of our knowledge, has never been established so far in the extant literature. The environmental upgrading identified by Khattak and Stinger (2017) in the Pakistani sporting goods industry was, according to the authors, primarily driven by environmental regulatory pressures imposed in the lead firm's home country, which in turn pressured its suppliers throughout the GVC to comply with stricter environmental standards. This is a clear example of how environmental regulation can affect the environmental performance of a whole GVC and spur innovation to comply with new standards, albeit with an extra layer of complexity. Khattak and Stinger (2017) identify that, for supplier firms, stricter environmental rules can become a competitive opportunity and a point of entry into GVCs. On the one hand, supplier firms are pressured to innovate in order to find more sustainable production methods. Yet, on the other hand, this innovation requires large investments. However, as lead firms in an industry search to follow stakeholder eco-friendly preferences, they will look for suppliers that comply with and meet their sustainability standards. For supplier firms, this represents an entry point into an established GVC led by a large MNE. This process was identified by Khattak and Stinger (2017) in the context of the Pakistani sporting goods industry that supplies some of the most recognized brands in the market, such as Adidas, Nike and Puma. Despite being a key exporting sector in Pakistan, this industry has lagged behind in terms of environmental upgrading when compared to similar industries in Bangladesh and Sri Lanka. For example, the authors note that in comparison, various supplier companies in these two countries have adhered to the Leadership in Energy and Environmental Design (LEED) certification, which is a relatively more comprehensive sustainability initiative that goes beyond carbon emission metrics, by considering other factors such as energy and water use. In comparison, Khattak and Stinger (2017) observe that Pakistan supplier firms only follow the International Standards Organization 14001 (ISO), which, despite being internationally recognized as a metric for private environmental policy, is more outdated and insufficient in terms of environmental sustainability measuring. As a consequence, supplier firms from Sri Lanka and Bangladesh have surpassed their Pakistani counterparts in terms of environmental innovation and captured the attention of global brands as a greener alternative.

Another compelling insight from Khattak and Stinger's (2017) study on the Pakistani sporting goods industry is the role of other stakeholders, such as the Pakistan state government and NGOs, that have played a key role in leveraging the presence and weight of this exporting sector to achieve a fair social upgrading. The authors recognize that these same actors are pushing for a similar outcome in terms of environmental impact and escaping the pollution haven status. Khattak and Stinger (2017) do not explicitly refer to PEH in their work, but it is evident to us that the same mechanism is at play in this context. One of the objectives of this literature review was to incorporate these theoretical perspectives that, despite having common ground, were never explicitly connected in the extant literature, to the best of our knowledge.

1.1.5. Pollution Haven Hypothesis (PHH)

The pollution haven hypothesis (PHH) is an alternative view to PEH by suggesting that multinational companies from developed countries can transfer more polluting activities from their chains to developing countries, especially those with less restrictive environmental regulations (Deng et al., 2023). This hypothesis is relevant in the context of this study as it allows us to understand the logic of how GVCs can lead to a worse environmental performance of the firms involved.

The first authors who postulated the PHH, Copeland and Taylor (1994), were studying the environmental effects of trade liberalization under NAFTA. The authors theorized that, in this context, firms operating in the USA and Canada would displace the more polluting activities of their production chains or even the entire firm to Mexico to benefit from its less stringent environmental regulations. The authors developed this hypothesis as a power imbalance between more advanced countries and less developed ones in the context of North-South trade. The authors then concluded that trade liberalization between highly regulated countries (developed economies) with countries with less stringent environmental regulations (developing countries) would lead to a negative environmental outcome, especially for the country on the receiving end.

After its proposal, multiple empirical studies were done to test the validity of the PHH (Mani & Wheeler, 1998; Cole & Elliott, 2003). The conclusions were initially mixed, and no study managed to identify clear empirical evidence for the hypothesis (Gill et al, 2018). On the supporting side, Mani and Wheeler (1998) found temporary evidence of the PHH by showing that pollution-intensive industries were indeed moving to developing countries.

Cole (2004) discovered that pollution-intensive industries expanded in developing countries during periods of strict regulations in OECD countries. Cole and Elliott (2005) also found that pollution-intensive industries were more prone to relocate to developing countries. Furthermore, Levinson and Taylor (2008) found that pollution reduction costs had a significant influence on U.S. imports of pollution-intensive goods from developing countries. More recently, Chiriluș and Costea (2023) discovered that in Romania, foreign direct investment (FDI) was leading to environmental degradation, hence proving the PHH.

However, for every paper supporting the PHH, other studies proposed that different factors were at play in the decision to move to developing countries (Gill et al, 2018). For example, Van Beers and van den Bergh (1997) found no significant impact of environmental regulations on the trade of pollution-intensive goods in 21 OECD countries. Smarzynska and Wei (2004) even pointed out that firms sometimes moved to regions with stricter environmental regulations rather than weaker ones. Other authors, despite acknowledging an initial negative environmental impact, argued that economic growth leads developing nations to impose stricter environmental regulations over time (Dinda, 2004) and that environmental regulations spurred technological innovation and increased competitiveness more than leading firms to relocate production to other developing countries (Lanoie et al., 2011).

Gill et al. (2018), in their literature review article about the PHH, also summarized some of the best arguments against the PHH. Notably, the sunk costs of relocation argument, which states that moving production to another country entails high sunk costs - including infrastructure investments, regulatory compliance, and workforce training - making relocation less attractive. Moreover, countries with lax environmental laws often have weak legal systems and poor governance, making them unattractive to foreign investors concerned with legal security and property rights. Other authors argue that relocation of firms from developed countries allows technology transfer and cleaner production methods to spread globally, counteracting pollution-intensive industrial shifts (Kolk, 2013). And finally, the authors mention the contribute of Herzig and Schaltegger (2006) who developed the green haven hypothesis (GHH) argument, that asserts that some firms are more driven by corporate social responsibility (CSR) and sustainability commitments which in turn makes them more likely to invest in eco-friendly operations rather than seeking pollution havens.

In a nutshell, these arguments suggest that firms do not relocate solely based on weak environmental regulations. Instead, they consider other aspects such as economic feasibility,

legal stability and exposure to more technologically advanced environments. Additionally, trade and investment often drive environmental improvements globally by introducing cleaner production methods and fostering innovation in less developed geographies, as predicted by the PEH.

1.2. GVC, Environmental Performance and International Business Theory

The greening effect of global value chains can be analyzed through the lens of certain international business theories and related frameworks. Notably, global value chain theory, internalization theory, stakeholder theory, resource-based view (RBV) and network theory. Firstly, GVC theory is at the core of this analysis by providing the basis for understanding how lead firms and supplier firms adopt environmental practices through their interdependent relationships. Secondly, Internalization theory is relevant here as it explains how and why firms internalize certain operations. When applied to environmental performance analysis, this theory can help explain why firms internalize environmentally focused activities or, alternatively, manage how those activities are performed by their suppliers. Thirdly, the RBV is also relevant by explaining how firms gain competitive advantage through unique resources, in this context, such as environmental capabilities. In GVCs, supplier firms with strong green practices can enhance their position, thus making RBV relevant for understanding why firms invest strategically in environmental performance. Fourthly, stakeholder theory, despite not being classified as a traditional IB theory, is intrinsically related to GVCs as it emphasizes the importance of other stakeholders (governments, NGOs and suppliers) in influencing firm behavior within production networks. Finally, network theory provides valuable insights about the interrelationships among firms in globally dispersed networks that allow environmental performance-enhancing practices and knowledge to spread.

Together, all these theories, both core and peripheral to IB, provide a comprehensive framework for understanding the influence of GVCs on the environmental performance of the participating firms. GVC theory provides the theoretical backbone, while the complementary theories of internalization, network, RBV and stakeholder theory strengthen our understanding of this phenomenon. These relevant theories are analyzed in greater detail below, related to the present theme.

1.2.1. Global Value Chain Theory and Internalization Theory

The change towards more environmentally sustainable practices throughout GVCs brings together environmental considerations and the study of geographically dispersed production networks (Dimitropoulos et al., 2023). Shen et al. (2019) describe the greening of GVC as the green processing of multinational production networks, which include raw material purchasing, production, sale, transportation, and recycling, while focusing on the redistribution of environmental value. The relationships established in the context of these production networks between suppliers and customers can be shaped by the lead firms inside these value chains (De Marchi et al., 2013). These lead firms play an essential role in determining the environmental performance of their suppliers through various governance mechanisms. De Marchi et al. (2013) divide these mechanisms into two types: hands-on and hands-off methods. The authors define the first as strategies that seek to teach and mentor suppliers with workshops and training concerning more eco-friendly practices. The second method consists of imposing standards and design specifications and monitoring their compliance.

According to Humphrey (2014), these practices are an example of what the author considers a weakness of internalization theory. Internalization theory explains how, why, and when MNEs decide to internalize previously externalized activities or between internalizing or externalizing operations (Buckley & Casson, 1976). However, not all firms wish to internalize their supplier manufacturing activities (despite wanting to decide how those activities are performed). As companies often rely today on externalized manufacturing activities conducted by external suppliers in often distant regions, the theory fails to consider how these challenges are overcome. It is in this context that Humphrey (2014) leverages the strengths of GVC theory to complement internalization theory. The author argues that GVC theory allows researchers to understand how and why firms control and oversee externalized activities. Humphrey (2014) describes the concept of GVC governance as consisting of the strategies and mechanisms that lead companies use to dictate and organize a production network throughout the whole GVC. In his article, Humphrey (2014) relates this concept to private and public environmental sustainability standards. Essentially, these standards permit the codification and simplification of governance throughout the multiple GVC links. This, in turn, reduces the complexity needed to respond to market and institutional pressures towards more sustainable practices. According to Shen et al. (2019), this logic is crucial to understanding the process of the greening of GVCs as it explains how and why the lead

actors inside production chains manage to lead their suppliers to adopt green practices and eco-friendly production methods, leading to the greening of GVCs.

According to the traditional view of Internalization Theory (Buckley & Casson, 1976), lead firms would most likely decide to internalize these stages of production in order to control how they are performed. However, while Internalization Theory posits that firms will internalize operations when market-based alternatives are inefficient (Buckley & Casson, 1976), the rise of GVCs has opened a vast spectrum of alternative governance mechanisms that allow lead firms to manage externalized operations more efficiently without having to necessarily own all activities (Gereffi et al., 2005). For Gereffi et al. (2005) this transition from ownership-based governance to a relationship-based governance consists in an extension of Internalization Theory instead of a rejection. This convergence between Internalization Theory and GVC governance has been equally recognized and pinpointed by Hennart (2009). Even Buckley (2011) later entertained this idea in his paper "*International integration and coordination in the global factory*." In it, Buckley engages with GVC theory by discussing the "global factory" concept and recognizing that modern MNEs are increasingly coordinating production without having to own all activities. By doing so, Buckley effectively brought internalization theory closer to GVC theory and GVC governance by recognizing the variety of control mechanisms used in the global factory model. By resorting to the GVC governance concept, researchers can understand how companies manage their externalized activities through various governance mechanisms without having to internalize them (Humphrey, 2014). These governance mechanisms are, in turn, a response to market requirements as investors and clients demand more ecological business models, which leads to the pertinence of considering Stakeholder Theory, described subsequently.

1.2.2. Stakeholder Theory

Stakeholder theory (ST), despite not being traditionally considered an international business theory, is a relevant perspective when explaining what leads firms to adopt greener practices and is increasingly used in the IB literature (Dimitropoulos et al., 2023). This theory argues that companies must align themselves with their stakeholders' interests in order to succeed (Freeman et al., 2004). As stakeholders become increasingly aware of the need for a green transition, the pressure mounts around firms to change their business models (De Marchi et al., 2019). In fact, stakeholders, especially those who are considered indirect stakeholders such as clients and public agencies, are increasingly pressuring companies to

become more eco-friendly and reduce their environmental footprint (De Marchi et al., 2019). In addition, with the advent of ESG ratings, even traditional stakeholders such as institutional investors are incentivizing eco-friendly business practices. Matos and Hall (2007), in an empirical study of the life cycle assessment in the oil and gas and agricultural biotechnology sectors, linked stakeholder pressures to firms' environmental practices and strategies by using ST.

In later years, ST has gained momentum in the IB field, especially when trying to explain stakeholder pressure across borders in the context of GVCs (Barrientos, 2012). For example, De Marchi et al. (2013) in their paper about the Italian furniture industry, focusing on IKEA as a lead firm, analyze how external stakeholders, such as NGOs and consumers, manage to influence lead firms, who in turn pass these pressures down their supply chains. In this case, the authors find a causal connection between stakeholder pressures and the eco-innovations throughout IKEA's value chain in Italy.

Interestingly, Dimitropoulos et al. (2023) add that stakeholder theory can be better leveraged in the context of the environmental practices within GVCs when paired with the resource-based view (RBV). The RBV, explained in the next section, argues that firms are essentially a bundle of resources and that these same resource combinations vary from firm to firm, changing their competitive profile (Penrose, 1959). The sensitivity to stakeholder demands, such as environmental concerns and demands, can be a competitive edge and considered as a differentiating resource inside GVCs (Dimitropoulos et al., 2023).

1.2.3. Resource-Based View (RBV)

As mentioned above, when paired with ST, the RBV presents an insightful perspective on the influence of GVCs on firms' environmental performance and the exchange of strategic resources and knowledge between lead firms and suppliers (Bouguerra et al., 2023). On one side, for suppliers, the sensitivity to stakeholder demands regarding environmental sustainability allows these firms to obtain a competitive edge over alternative suppliers who are less prone to comply willingly with new and more rigorous environmental standards. On the other hand, these proactive supplier firms achieve a stronger position inside GVCs and better access to new resources and know how which further strengthens their position inside these production networks (Rungtusanatham et al., 2003). Rungtusanatham et al. (2003) evaluated the impact of supply chain linkages on general operational performance. The framework developed by these authors also helps to understand how these linkages within

GVCs can impact the involved firms' environmental performance. For lead firms, these linkages with environmentally oriented suppliers contribute to sustained competitive advantage arising from gains in efficiency in resource utilization, collaboration in R&D regarding greener production methods (Bouguerra et al., 2023), *inter alia*.

It is also worth noting the Knowledge-Based View (KBV), a relevant extension of the Resource-Based View (RBV) and an influential theory in International Business. This theory posits that knowledge is the most strategically significant resource of a firm (Teece, 1998). In the context of IB literature, the KBV helps explain how MNEs create and leverage knowledge from a global perspective to gain competitive advantage (Teece, 1998). In his highly cited and influential paper, "*Capturing Value from Knowledge Assets: The New Economy, Markets for Know-How, and Intangible Assets*", David Teece postulates that firms must develop internally capacities and systems that create new knowledge to sustain their competitive advantage. Beyond being created, this knowledge and the resulting competitive edge must be continually renewed and adapted. This is particularly important in the context of IB, as MNEs must ensure that this knowledge is adapted to different markets and institutional landscapes. This theory is built upon Teece's earlier work with Pisano and Schuen (1997) on dynamic capabilities and the firm's need for reconfiguring their knowledge and routines to adapt to changing markets. The KBV is also relevant for its insistence on internal knowledge transfer systems and mechanisms, something that is crucial to GVC governance (Humphrey, 2014). Beuter Júnior et al. (2019) build directly on Teece, Pisano, and Shuen (1997) work, defining knowledge-based dynamic capabilities (KBDC) as the firm's ability to acquire, generate and modify knowledge. Moreover, these authors related these theories to sustainable innovation, using a green-plastic case to illustrate how MNEs deploy KBV to develop environmentally sustainable technologies and practices. More recently, Forés et al. (2023) also leveraged the dynamic capabilities perspective to understand the environmental performance of family-owned firms.

The dynamic capabilities perspective is, in fact, another theoretical lens worth including in this analysis. As stated so far, the green transition represents today one of the most important challenges for companies and GVCs. This volatile environment pressures these entities to develop new internal and external competencies and adapt to new standards and demands from stakeholders. Teece, Pisano and Schuen (1997) understand these adaptations as dynamic capabilities, that is, the firms' ability to face these challenges by developing new processes and changing existing ones to adapt to new business landscapes. Teece et al. (1997)

also recognize the importance of the relational assets or resources within GVCs, specifically between lead firms and local suppliers. This collaboration permits these firms to not only adapt and resist to volatile environments, but it also allows them to capitalize on them and renew competitive advantage *vis-à-vis* less proactive companies. This evokes Dunning's Eclectic Paradigm, also known as the OLI framework, which seeks to explain when firms should cross borders and invest abroad. According to Dunning (1979), a firm can engage in FDI when it combines ownership (O), location (L) and internalization (I) advantages. In the context of environmental sustainability, the capacity to adopt and implement greener practices can be considered as an ownership advantage and a strategic asset. Dunning (2000), in his later work, enriched his Eclectic Paradigm by incorporating broader and more dynamic factors, such as relational assets, recognizing these external ownership assets as an important source of competitive advantage. GVCs depend frequently on these relational assets to thrive as they are built on inter-firm linkages, collaboration and trust-based relationships (Dunning, 2003). Gallemore, Jespersen, and Olmsted (2022) went on to apply the concept of relational assets in the context of sustainability and environmental performance within GVCs. The authors applied this framework to the palm oil industry and recognized the importance of inter-firm linkages to promote environmental sustainability in GVCs. By allowing local suppliers of palm oil to have access to more resources and thereby enhancing their ability to implement more sustainable practices, these trust-based GVCs effectively enhanced the environmental performance of these firms.

1.2.4. Network Theory

As mentioned before, Gereffi et al. (2005) identified a shift from ownership-based governance to relationship-based governance. The relational dimension of how GVCs operate is of the utmost relevance to the current analysis and it evokes another relevant theory, Network Theory.

This theory was initially proposed by different authors, but it was Johanson and Mattsson (1988) who established it as a pillar of International Business studies. Essentially, Johanson and Mattsson (1988) advanced a wider view of the internationalization process a firm undertakes, seeing it less as an isolated entity and following a slow and incremental path as purported by the Uppsala Model. For these authors, the relationships established within international networks composed of various stakeholders are essential for the internationalization process of firms, more than isolated transactional exchanges. In fact,

managing these relationships is a key strategy for firms to access resources, information, knowledge and dynamic capabilities and an opportunity window to access foreign markets where the network operates.

This theory allows us to understand how GVCs can influence the transmission of environmentally friendly know-how and practices. These globally dispersed production networks not only facilitate market entry and international expansion but also play a critical role in promoting collaborative efforts toward environmental sustainability between key stakeholders such as lead firms and suppliers. Sustainable standards often require strict and complex practices unknown to upstream suppliers in less technologically and institutionally sophisticated environments (Gereffi et al., 2005). This, in turn, requires collaboration and cooperation between lead firms and suppliers in order to comply with the demands of stakeholders. Following this rationale, we can observe how Network Theory highlights trust-based relationships, knowledge transfer, and relational governance mechanisms that enables cooperation (Johanson & Vahlne, 2009).

Interestingly, Kolk and Pinkse (2005) brought together all these concepts, integrating Network and GVC theories with environmental sustainability. The authors argue that belonging to a network can boost regulatory and normative pressures towards sustainability, especially when lead firms align their environmental objectives with those of their partners (Kolk & Pinkse, 2005). This is largely evident in relational GVC governance structures where lead firms design environmental standards in cooperation with suppliers and work closely with their partners to implement them. In this sense, network theory enriches our understanding of international expansion operations while providing, at the same time, a valuable perspective for studying how sustainability is operationalized within GVCs.

In conclusion to the literature review, by having established the conceptual and theoretical basis of the topic of study, and having identified the main concepts and research gap, the first step of the bibliometric study can be implemented: identifying and defining the most relevant keywords for the extraction of relevant publications.

Chapter 2 - A bibliometric analysis of the impact of GVC on firms' environmental performance

2.1. Methodology

The chosen methodology for answering the research question underlying this dissertation is a bibliometric analysis. Considering the proliferation of literature about the greening of global value chains, such analysis will allow to gather and systematize the work done so far in this topic of research.

Bibliometry allows researchers to have a general view of trends in research within each field and topic by identifying and quantifying vast volumes of scientific data (Nicholas & Ritchie, 1978). Pritchard (1969) put forward the "bibliometric" term by defining it as a mathematical and statistical approach to literature and scientific studies that seek to quantify the literature of a given field of knowledge. Bibliometrics allows researchers to establish connections between aspects such as main research themes, most influential papers, most cited authors, the chronological evolution of contributions to the field, etc. (Ozdagoglu et al., 2020). By compiling all this unstructured data through quantitative methods, we can provide valuable insights and contributions to existing literature and the advancement of research in this field (Donthu et al., 2021).

Bibliometry has gained popularity in the early stages of research on a new topic of study, since it allows researchers to map and quantify all the scientific output and identify potential avenues of research (Cheng et al., 2024). In their paper, Cheng et al. (2024) evaluate the merits of the bibliometric analysis as a method to face the overwhelming influx of new publications in various scientific fields. The authors consider that bibliometric reviews are superior to more traditional literature reviews as it allows a wider perspective of the research trends and hotspots in a specific field of study. Moreover, bibliometric analyses were facilitated and, consequently, popularized with the emergence of software tools and programs such as VoS Viewer (van Eck & Waltman, 2009) that allow researchers to visualize networks of authors, concepts and research hotspots. Interestingly, to provide a perspective on the growing popularity of bibliometric analyses, Cheng et al. (2024) undertook a bibliometric analysis of the bibliometric articles published in English between the years 2000 and 2023. The authors identified an exponential increase over the past 20 years, with the numbers climbing from 51 published reviews in the year 2000 up to 3434 articles in 2022 (Cheng et al., 2024). Concerning our research topic, Koberg and Longoni (2019) identified

66 articles in their systematic literature review up to 2019 relating to environmental sustainability and GVCs, indicating an emergence of academic interest in this field. The present bibliometric analysis provides novelty to this academic landscape by focusing specifically on the concept of environmental performance instead of the broader term of environmental sustainability.

After defining the research topic, we set out to identify the most relevant databases for sourcing the bibliography. The two chosen sources were SCOPUS and Web of Science (WoS), considered the two leading bibliographic databases (Zhu and Liu, 2020). Both platforms allow a thorough extraction of scientific data in high volume from a multitude of disciplines (Zhu and Liu, 2020). SCOPUS was launched by Elsevier in 2004, and it has evolved into the world's largest abstract and citation database of peer-reviewed scientific literature. As of early 2025, it encompasses over 99 million documents sourced from more than 7000 publishers globally (Elsevier, 2024). The database includes over 2.4 billion cited references, with coverage extending back to 1788. This extensive archive facilitates comprehensive bibliometric analyses and enhances the accuracy of author profiles. To complement SCOPUS, we have the Web of Science, which was originally developed by Thomson Scientific and is now managed by Clarivate Analytics. It was first launched in 1997, and as of 2025, the platform includes over 91 million records, including journal articles, conference contributions, and books. It also provides access to more than 2.95 billion cited references, with coverage dating back to 1864 (Clarivate, 2025).

After choosing the two most appropriate and comprehensive bibliographic data sources, a series of combinations of pertinent keywords were selected, in coherence and following the main research topic and related concepts, as seen in *Table 1*.

Table 1 - Keyword Combinations

Keywords		Keywords Combination
("Global Value Chain*" OR "GVC*" OR "Global Supply Chain*") AND	"Environmental Performance*"	Combination 1
	"Green Supply Chain*"	Combination 2
	"Environmental sustainability*"	Combination 3

	"Green practices*"	Combination 4
	"Environmental Governance*"	Combination 5

With these combinations of keywords in hand, we performed an extraction on the 30th of April 2025 from both Scopus and WoS. We restricted our analysis, first by document type, preferring to select only *Articles* and *Review Articles* given their higher scientific credibility, considering the fact that scientific papers published in journals are peer-reviewed. Then we restricted the extraction by language, selecting English as the only relevant publishing language. Finally, we restricted the extractions by the field of study, prioritizing Business, Economics and Finance, Management, and Environmental Studies. Each extraction was organized in an Excel spreadsheet with the following fields: Authors, Article Title, Source Title, Document Type, Publication Year, Author Keywords, Abstract, and Number of Citations.

Table 2 – Results of extractions

Keywords Combination	SCOPUS	WoS	Total (WoS + SCOPUS)	Total (WoS + SCOPUS) free of duplications
Combination 1	35	31	66	
Combination 2	23	17	40	
Combination 3	41	12	53	
Combination 4	3	2	5	
Combination 5	33	45	78	
	Total of extractions		242	
Total of combinations of keywords from WoS and SCOPUS free of duplications				165

Source: Own elaboration.

Following the extractions from the bibliographic databases, each of the CSV files from both WoS and SCOPUS was merged, consolidated, and rigorously cleaned of duplicates, as seen in Figure 2. Subsequently, the resulting list was filtered into several aspects of interest, such

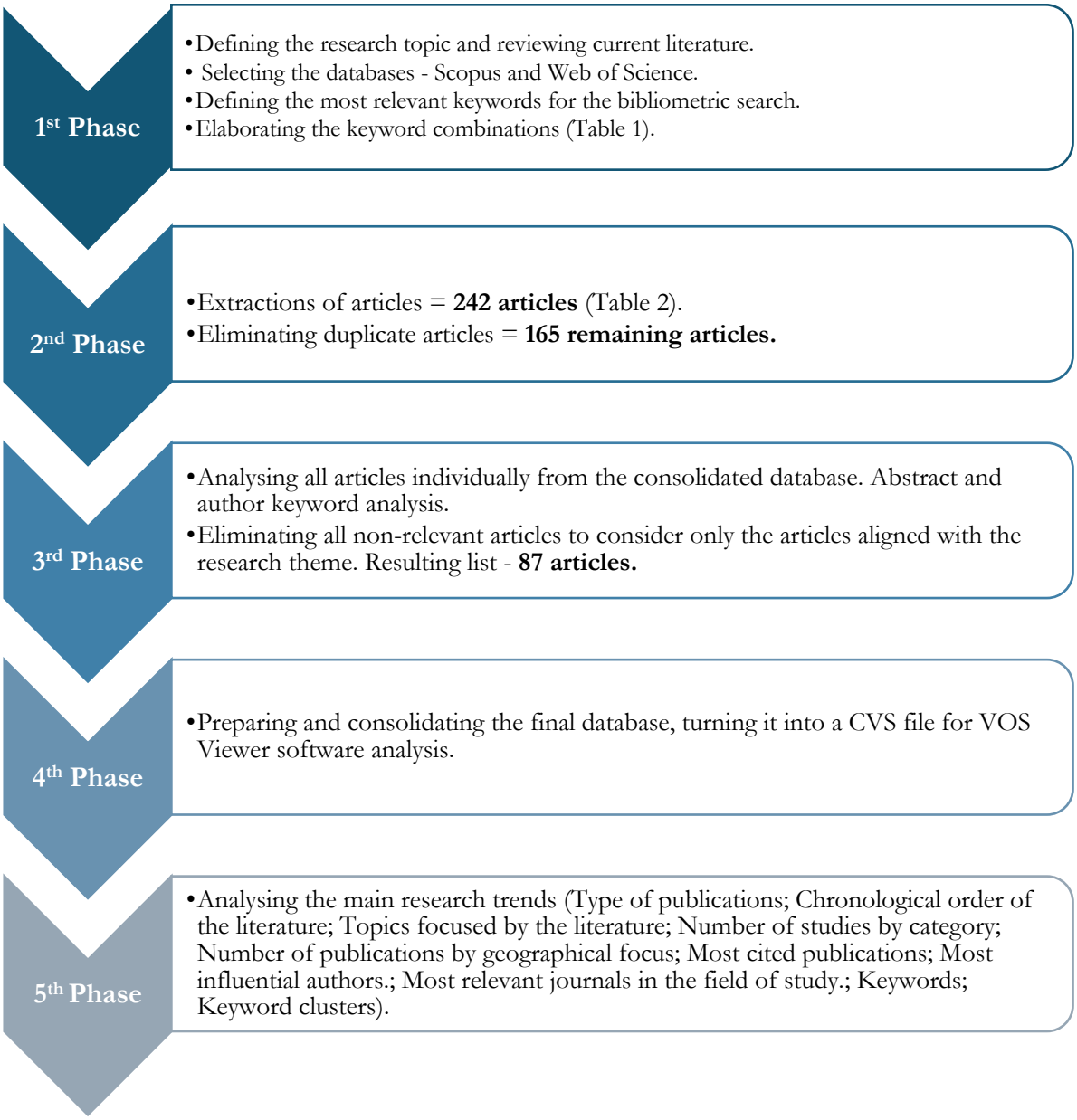
as article language, type, and field of study. After that, the resulting file consisted of 165 articles.

Following this step, a careful analysis of the title, abstract and keywords of each article was performed to assess its relevance to the bibliometric analysis and explore the patterns that the extracted information can provide (Linnenluecke et al., 2019). After this article-by-article analysis, the resulting list consisted of 87 scientific papers that were considered pertinent for this study.

After selecting the relevant articles, the VOSviewer software, a widely used program for constructing and visualizing bibliometric maps, was employed, allowing the analysis of large datasets and research trends (van Eck & Waltman, 2009). This tool proved particularly valuable throughout our bibliometric analysis, as it enabled the creation of maps based on network data, allowing us to observe, explore and interpret relevant relationships, connections, and clusters across various criteria. Additionally, this program permits the identification of networks that include scientific publications, journals, authors, and keywords, thus providing insights into research trends, relationships, and key actors in a certain area of research (Altay and Balim, 2024).

To ensure the correct application of the software, all data had to be standardized and compiled into a single CSV file. The initial extraction of publications from Scopus is already provided in CSV format. In contrast, data from the Web of Science (WoS) is typically exported in Excel format. Therefore, we reviewed all articles retrieved from WoS that were not included in the Scopus extraction. A verification process was conducted to determine which of these WoS articles were also available in the Scopus database, and those that were found were added to the Scopus extraction. For articles that were exclusive to WoS, we manually inserted them into an Excel file using the correct format. This file was then converted into a CSV format, allowing all publications to be compiled into a single dataset for analysis using VOSviewer. Figure 1 presents, in a summarized version, the implementation of all the phases of this bibliometric analysis.

Figure 1 - Flowchart with the phases of the bibliometric analysis's implementation.



Source: Own elaboration.

2.2. Main Research Trends

In this section, we will present the results of our bibliometric study on the impact of GVCs on firms' environmental performance. By analyzing the main research trends of this topic of study, we seek to facilitate the understanding of the state of the art regarding this research question and identify the limitations of the existing literature and possible avenues for future research.

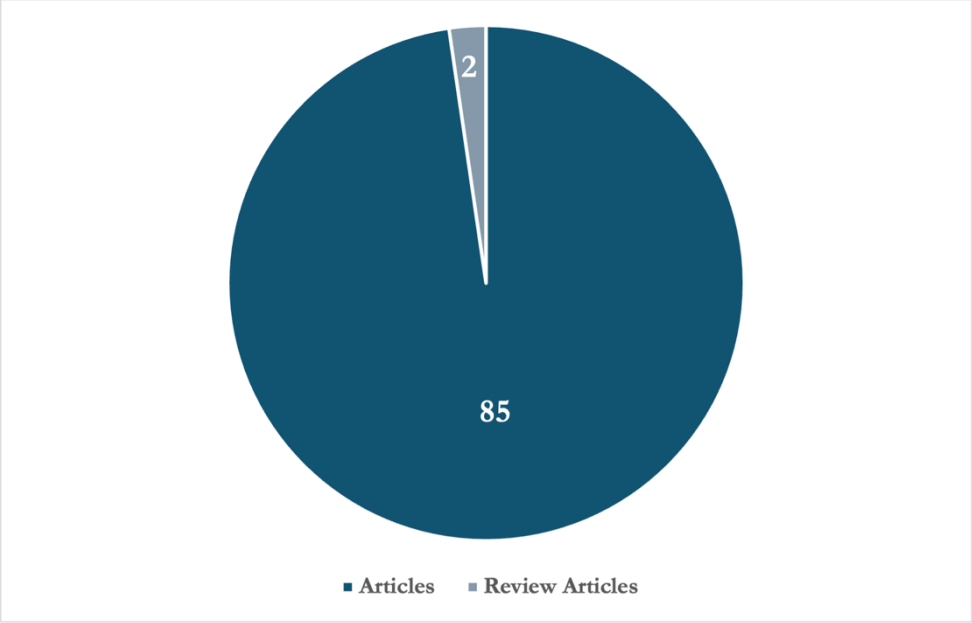
This analysis will be structured around several topics of interest, notably:

(1) Type of publications.
(2) Chronological order of the literature.
(3) Most common methodological approaches.
(4) Main themes focused on by the literature.
(5) Number of studies by category.
(6) Number of publications by geographical focus.
(7) Keywords.
(8) Keyword clusters.
(9) Most cited publications.
(10) Most relevant journals in the field of study.
(11) Most influential authors.

2.2.1. Type of Publications

If we consider the division of the most relevant output of our topic of study by type of publication, we can observe that most (97.7%) of the contributions are *Articles*, (85 publications), and a small minority, 2.3% (2 publications), are *Review Articles*, as seen in Figure 2.

Figure 2 - Number of articles by type of publication.

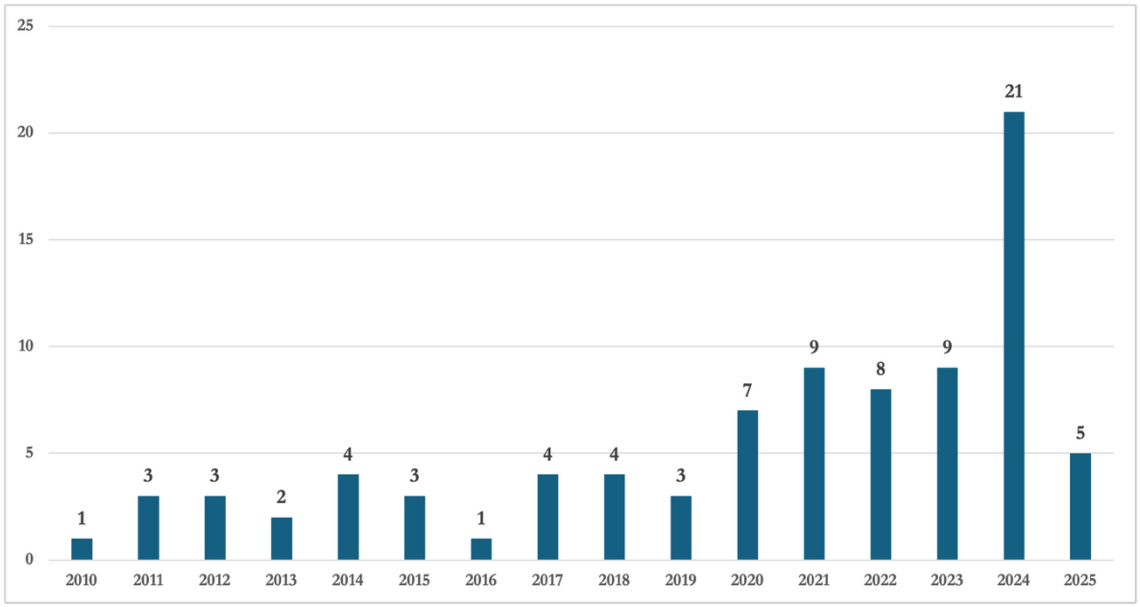


Source: Own elaboration.

2.2.2. Chronological Order of the Literature

The scientific output about the relationship between GVCs and environmental performance shows an upward trend, as can be observed in Figure 3.

Figure 3 - Number of publications by year.



Source: Own elaboration.

The oldest publication available on this research theme was published in 2010 by Tan Teong Jin and Suhaiza Zailani, titled "*Antecedents and outcomes study on green value chain initiatives: A perspective from sustainable development and sustainable competitive advantage.*" In this paper, the authors acknowledged the emergence of green global value chains by studying the impact of GVC-led initiatives on the environmental performance and sustainable competitive advantage of Malaysian supplier firms. The authors focused primarily on the role of environmental certifications and, interestingly, related their findings to Michael Porter's theory by establishing a relationship between GVCs and sustainable development and the resulting sustainable competitive advantage.

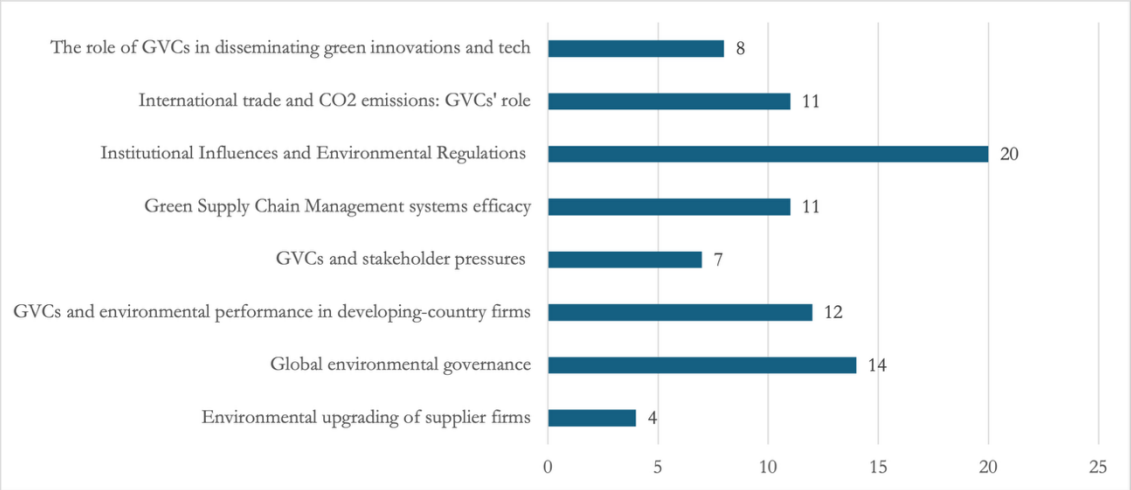
Regarding the chronological evolution of the literature, we can observe that between 2010 and 2019, only 28 papers were published, representing a scarce 32.18% of publications in one decade. However, starting in 2020, we can discern an upward trend reaching its peak in 2024 with around 21 papers published, representing 24.14% of our total dataset. This implies an increasing academic interest in our topic of study and an emerging field of scientific output with great potential.

2.2.3. Themes focused by the reviewed literature

To discern the main themes focused on by extant literature, we proceeded to carefully analyze each article individually. As we undertook this analysis, we identified eight general themes under our main research theme. Considering the role of GVCs in improving firms' environmental performance and the main aspects surrounding this phenomenon, we identified the following themes of research: (1) The role of GVCs in disseminating green innovations and tech; (2) International trade and CO2 emissions: GVCs' role; (3) Institutional Influences and Environmental Regulations; (4) Green Supply Chain Management systems efficacy; (5) GVCs and stakeholder pressures; (6) GVCs and environmental performance in developing-country firms; (7) Global environmental governance; (8) Environmental upgrading of supplier firms.

As can be observed in Figure 4, the theme that attracts the most attention in the current literature is institutional influences and environmental regulations connected to how GVCs work as global carriers of these forces towards environmental sustainability. Of our total dataset, this theme represents 22.99% (20 publications). The following theme drew academic interest was global environmental governance. By this, we understand all the publications that focus on the structures and mechanisms that shape how GVCs organize themselves in order to achieve higher levels of environmental performance. This theme represents 16.09% (14 publications). Another common research subject of interest was the role of GVCs in improving the environmental performance of firms in developing or emerging economies. These studies represented a 13.79% slice of our total (12 publications). Of the identified research subjects, the most under-researched is the environmental upgrading of supplier firms, representing only 4.60% of our total collection of publications.

Figure 4 - Number of publications by research themes focused by the literature.



Source: Own elaboration.

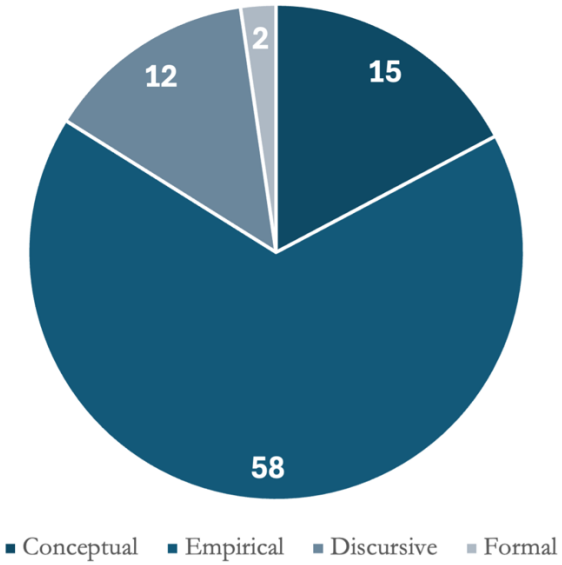
2.2.4. Number of studies by category

When analyzing the literature about the present research topic, it is also critical to evaluate the methodologies that the researchers use in their articles. As postulated by Castro, Silva and Teixeira (2011), followed by Pato and Teixeira (2016), these methodologies and the investigative tools applied in each publication allow us to categorize the literature in four distinct groups: conceptual, appreciative/discursive, empirical, and formal.

Conceptual articles refer to publications that focus on the development of theories and concepts without employing any data or empirical analysis. In contrast, studies employing appreciative or discursive methodologies engage in critical exposition, often through interpretive or reflective analysis of case studies. Alternatively, the empirical category includes publications based on the systematic analysis of data using econometric or statistical techniques. And finally, works built upon formal methodologies are characterized by the application of mathematical formulations or analytical modeling to explore theoretical constructs (Pato & Teixeira, 2016).

As can be observed in Figure 5, most of the publications of our dataset are empirical, with this methodological category representing 66.67% of the total. In second place we have the conceptual category with 17.24%, and then in third the discursive articles, representing a 13.79% slice. And finally, the least frequent type of articles is of the formal category, with only 2.30%

Figure 5 - Number of studies by category.



Source: Own elaboration.

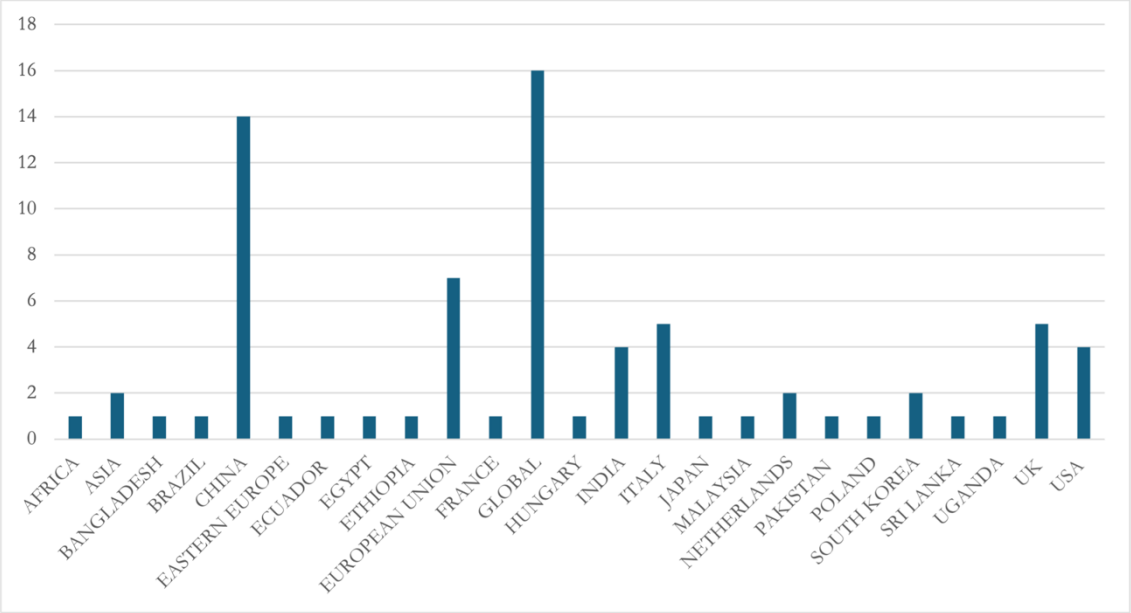
From these results, we can infer that there is a clear empirical dominance in the literature, suggesting that the field is largely driven by real-world data and case studies, and a focus on observable phenomena. This fact, paired with the lack of conceptual and discursive/appreciative articles, suggests that there is room in the literature for theory development that better integrates GVCs and sustainability by proposing new constructs to explain emerging phenomena. The lack of discursive/appreciative represents also an opportunity for researchers who want to expand critical approaches in this field and take the debate beyond performance and efficiency analyses. And finally, the underrepresentation of formal articles signals that methodological rigor is rare in the field and is a current gap in the literature. Future research could focus on developing formal tools that predict or optimize sustainability performance in GVCs (Dimitropoulos et al., 2023).

2.2.5. Number of publications by geographical focus

As analyzed in the previous section, two-thirds of the publications in our dataset are empirical studies, and a large majority of these select one or more geographies as their research focus. In this section, we will evaluate which countries, regions, or continents are studied in the literature. For this purpose, a careful analysis of the abstracts and, in some cases, of the whole publication was performed to discern the geographies the authors focused on. Out of the 87

publications composing our dataset, 19.5% (17 articles) did not mention a specific geography as they were more conceptual and theoretically focused. Another category of studies that stood out was the publications with a global perspective, which centered their analysis on the impact of GVCs on firms' environmental performance in 10 or more countries, dispersed around the world. Such examples were two studies focused on the Belt and Road Initiative (BRI). The remaining publications (62.07%) are geographically focused on one country of a specific region. As we can see in Figure 6, the country that stands out with 16.09 % is China (14 publications), followed by the European Union (7 studies), and finally Italy and the United Kingdom (UK) with 4 publications each.

Figure 6 - Number of studies by geographical focus.



Source: Own elaboration.

A common thread throughout this geographical focus analysis was that publications centered in developing or emerging economies (e.g., Bangladesh, Pakistan, Uganda, Sri Lanka) had as their focal point the role of GVCs in improving the environmental performance of supplier firms. While studies focusing on developed economies (e.g., the United Kingdom, France, Netherlands) had as their focal point the role of lead firms, such as MNEs, or of institutional pressures and environmental regulations.

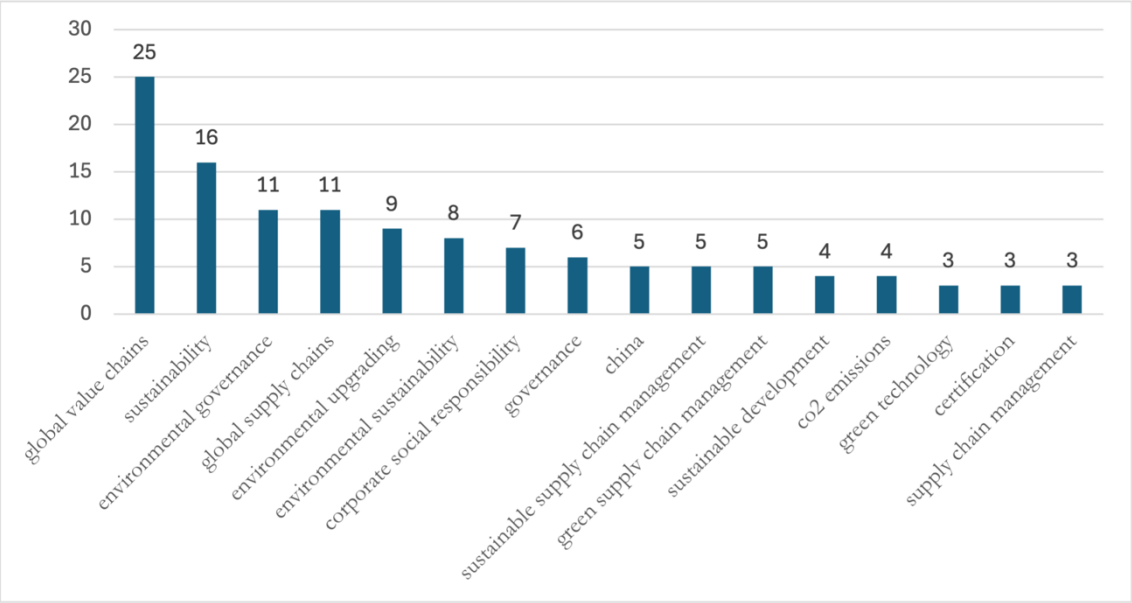
2.2.6. Topics focused on the analyzed literature

Identifying the main topics addressed by the literature is crucial for recognizing the most common research themes. This analysis was done, first, with the identification of the most frequent keywords mentioned by the authors of the publications. Secondly, by examining the relationships between keywords and the clusters they form using the VOS Viewer software tool.

2.2.6.1. Occurrence of keywords

In our extraction from both Scopus and WoS, we included a field for authors' keywords per publication. In this context, we opted to exclusively use "author keywords" as they are selected by the respective authors to represent the core themes of their research. As such, these keywords are more accurate in providing insights into emerging research topics than those generated by Keyword Plus (Donthu, 2021). Additionally, indexed keywords tend to be broader and reduce conceptual clarity, potentially distorting thematic analysis (Zupic & Čater, 2014). Adding to this restriction, we selected only keywords with a minimum occurrence of 3 times and aggregated similar keywords. For example, "global value chain", "global value chains", "GVC", and "GVCS" were all aggregated under "global value chains" to reduce keyword dispersal. Coy-Aceves and Corona-Vasquez (2022) implemented these same rules in their bibliometric analysis in order to reach higher keyword relevancy.

Figure 7 - Occurrence of author keywords mentioned in the publications.



Source: Own elaboration.

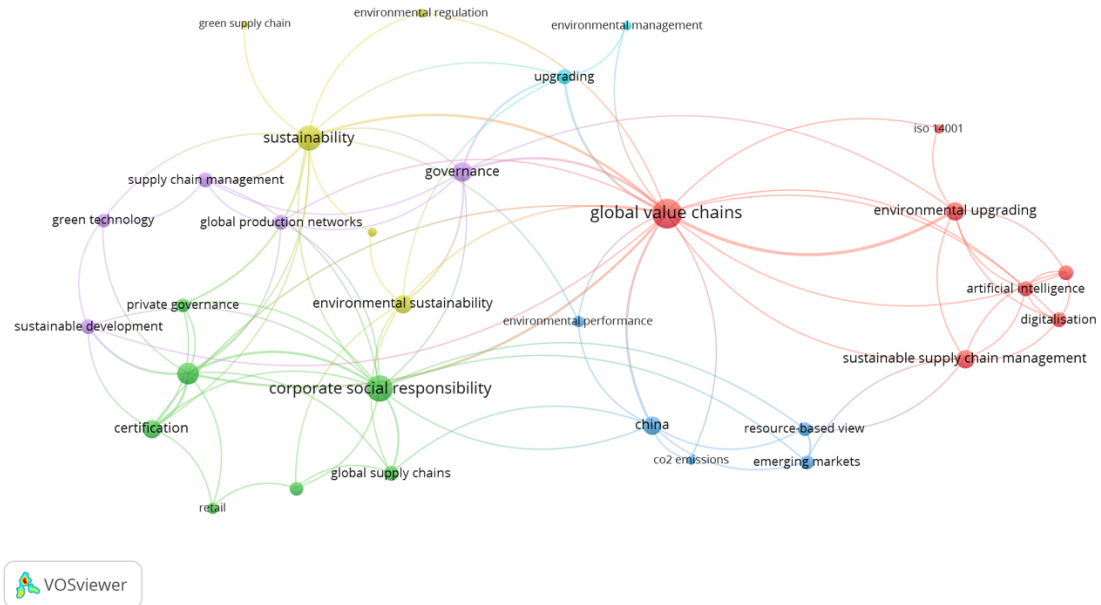
As seen in Figure 7, we can observe that the keywords with the most impact are Global Value Chains, with 25 occurrences, followed by Sustainability (16) and Environmental Governance (11). The importance of these keywords will be further developed in the next section.

2.2.6.2. Keyword clusters

The next step of the keyword analysis is to identify and examine the clusters of keywords that often arise together in the literature and that are thematically connected. In this analysis, and in line with Callon et al. (1983), van Eck and Waltman (2009), and Zupic and Čater (2014), the minimum occurrence threshold was lowered to two occurrences to identify low frequency keywords as they can potentially point towards relevant sub-categories of research interest, niche research topics and emerging themes. By doing so, the expansion of our scope allowed us to identify new emerging clusters (van Eck & Waltman, 2009).

On Figure 8, we can identify two main clusters (red and green) and two minor clusters (purple and blue) representing both emerging themes and niche research topics that are connected to the three main clusters.

Figure 8- Keyword Clusters.



Source: own elaboration based on VOSviewer data.

The red cluster focuses on:

Red cluster		
Global value chains	Environmental upgrading	
Digitalization	Sustainable supply-chain management	Artificial intelligence

This keyword cluster focuses primarily on GVCs and their role in improving and upgrading the participating firm's environmental performance through the transfer of green technologies or digital technologies related to Industry 4.0 (i.e., artificial intelligence, big data analytics, and blockchain). In line with this theme, the publication "*Industry 4.0 in sustainable supply chain collaboration: Insights from an interview study with international buying firms and Chinese suppliers in the electronics industry*" by Kunkel et al. (2022) is the article that best represents this cluster. Kunkel et al. (2022) evaluate the role of GVCs in fostering collaboration and the exchange of information between buyer firms and supplier firms. According to the authors, digital technologies, specifically the ones connected to Industry 4.0, are revolutionizing the relationships inside GVCs and changing sustainable supply chain management. This phenomenon exemplifies some relevant conclusions from network theory, as was seen in the previous chapter. Notably, Johanson and Vahlne (2009) put an emphasis on the knowledge transfer developed inside GVCs, as Kunkel et al. (2022) evidenced in the Chinese electronics industry. In addition to network theory, this phenomenon also evokes the KBV. As developed in the literature review section, the KBV insists on the internal knowledge transfer systems and mechanisms that shape the relationships inside globally dispersed production networks.

The red cluster is thematically connected to the purple cluster, which focuses on:

Purple cluster		
Governance	Supply-Chain management	Green technology
Global production networks	Sustainable development	

The KBV is also relevant in the context of this cluster for its insistence on internal knowledge transfer systems, something that is crucial to GVC governance (Humphrey, 2014). In this cluster, the concept of governance is related to green technology, bridging the red and purple clusters together and stressing the importance of GVCs in fostering the transfer of knowledge and technology globally. More broadly, these clusters also relate to the RBV as

the transfer of resources (knowledge-based resources) creates and develops competitive advantage arising from collaboration in R&D regarding greener production methods (Bouguerra et al., 2023).

The green cluster focuses on:

Green cluster		
Corporate Social Responsibility	Private governance	Retail
Multinational Corporations	Global supply-chains	Certification

This keyword cluster is centered around the role of GVCs in transmitting and rippling CRS certifications, both public and private, that impose environmental sustainability standards on MNEs and consequently on their suppliers dispersed throughout their GVCs. This cluster is better represented by the publications "*Governing Global Supply Chain Sustainability through the Ethical Audit Regime*" by LeBaron, Lister and Dauvergne (2017) and "*Big brand sustainability: Governance prospects and environmental limits*" by Dauvergne and Lister (2012). Lister and Dauvergne emerge as the most influential authors in this context of environmental regulation and the role of MNEs in expanding their global reach through their respective GVCs. In their 2012 article, Dauvergne and Lister analyze how the stakeholder pressures (both public and private) towards environmental sustainability in the lead-firms (MNEs) markets are changing the power relations inside GVCs. This phenomenon observed by the authors exemplifies the conclusions from the stakeholder theory section in the previous chapter. De Marchi et al. (2013), in their analysis of the furniture industry and the role of IKEA in pressuring Italian supplier firms to comply with stricter environmental standards, emphasized the role of stakeholder pressure, notably NGOs and consumers, towards greener production practices

The blue cluster focuses on:

Blue cluster		
Environmental Performance	China	Emerging Markets
Resource-Based View	CO2 emissions	

This cluster is primarily centered on emerging markets, particularly but not exclusively on China, and the role of GVCs in improving the environmental performance of the firms in these countries. This cluster also includes CO2 emissions, which is a recurring theme in the

analyzed literature, notably, the role of GVCs in transferring CO2 emissions through trade to emerging countries, particularly China. This cluster is also specifically connected to the RBV. In this context, the publication that best exemplifies this cluster is "*Unlocking Sustainability through Supply Chain Visibility: Insights from the Manufacturing Sector of Bangladesh*" by Emon and Khan (2024). In this article, the authors analyze the sustainable supply chain management in Bangladeshi manufacturing firms, focusing on how supply chain connectivity and visibility (SCV) affect environmental performance. Using the Resource-Based View, Emon and Khan (2024) found that connectivity enhances information sharing and improves environmental sustainability outcomes. This article exemplifies the concept of relational assets developed by Dunning (2000), described as external ownership assets and an important source of competitive advantage. Relating this to GVC theory, GVCs often rely on relational assets, such as trust, collaboration, and inter-firm linkages for success (Dunning, 2003). In par with Emon and Khan's (2024) findings, Gallemore, Jespersen, and Olmsted (2022) applied this concept to the palm oil industry, showing that trust-based relationships help local suppliers access resources and adopt greener practices, which leads to improved environmental performance for the participating firms in emerging economies.

2.2.7. Most cited publications

The current section will analyze the most influential publications of our dataset, which is an essential part of a bibliometric analysis, as it allows us to evaluate the reach of the most cited publications in this research theme.

Table 3 identifies the 20 most cited publications. It can be noted that 10 papers have more than 50 citations and that 7 publications have more than 100. The two most cited publications are "Efficiency meets accountability: Performance implications of supply chain configuration, control, and capabilities" by Parmigiani, Klassen & Russo (year), published on Journal of Operations Management, which has 280 citations, and "Big brand sustainability: Governance prospects and environmental limits" by Dauvergne & Lister (year), published on Global Environmental Change-Human and Policy Dimensions, which was cited 226 times.

Table 3 – Ranking of the 20 most cited publications.

Rank	Publications	Authors	Year	Journal	Citations
1	Efficiency meets accountability: Performance implications of supply chain configuration, control, and capabilities	Parmigiani, A; Klassen, RD; Russo, MV	2011	Journal of Operations Management	280
2	Big brand sustainability: Governance prospects and environmental limits	Dauvergne, P; Lister, J	2012	Global Environmental Change-Human and Policy Dimensions	226
3	Environmental Strategies, Upgrading and Competitive Advantage in Global Value Chains	De Marchi V.; Di Maria E.; Micelli S.	2013	Business Strategy and the Environment	217
4	Green supply chain coordination considering government intervention, green investment, and customer green preferences in the petroleum industry	Zhang X.; Yousaf H.M.A.U.	2020	Journal of Cleaner Production	178
5	Corporate investments in supply chain sustainability: Selecting instruments in the agri-food industry	Rueda X.; Garrett R.D.; Lambin E.F.	2017	Journal of Cleaner Production	175
6	Sustainability governance of chains and networks: a review and future outlook	Bush, SR; Oosterveer, P; Bailey, M; Mol, APJ	2015	Journal of Cleaner Production	144
7	Governing Global Supply Chain Sustainability through the Ethical Audit Regime	LeBaron G.; Lister J.; Dauvergne P.	2017	Globalizations	131
8	Where Chain Governance and Environmental Governance Meet: Interfirm Strategies in the Canned Tuna Global Value Chain	Havice, E; Campling, L	2017	Economic Geography	86
9	Improving Environmental Performance in Your Chinese Supply Chain	Plambeck, E; Lee, HL; Yatsko, P	2012	MIT SLOAN Management Review	82
10	Sustainability strategies by companies in the global coffee sector	Bager, SL; Lambin, EF	2020	Business Strategy and the Environment	79
11	Exploring the challenges in implementing supplier environmental performance measurement models: A case study	Genovese A.; Lenny Koh S.C.; Kumar N.; Tripathi P.K.	2014	Production Planning and Control	75
12	The greening of global value chains: Insights from the furniture industry	De Marchi V.; Di Maria E.; Ponte S.	2013	Competition and Change	74
13	Reassessing pollution haven effect in global value chains	Duan, YW; Ji, T; Yu, TT	2021	Journal of Cleaner Production	73
14	Industry 4.0 in sustainable supply chain collaboration: Insights from an interview study with international buying firms and Chinese suppliers in the electronics industry	Kunkel S.; Matthess M.; Xue B.; Beier G.	2022	Resources, Conservation and Recycling	64

15	Opening up the firm: What explains participation and effort in voluntary carbon disclosure by global businesses? An analysis of internal firm factors and dynamics	Hsueh, L	2019	Business Strategy and the Environment	57
16	Developing closed loop supply chains for environmental sustainability: Insights from a UK clothing case study	Ashby, A	2018	Journal of Manufacturing Technology Management	56
17	Assessing sustainability performance of global supply chains: An input-output modeling approach	Wang, H; Pan, C; Wang, QW; Zhou, P	2020	European Journal of Operational Research	51
18	Sustainable Triple-A Supply Chains	Erhun F.; Kraft T.; Wijnsma S.	2021	Production and Operations Management	51
19	The hidden costs of environmental upgrading in global value chains	Ponte, S	2022	Review of International Political Economy	49
20	Environmental upgrading of apparel firms in global value chains: Evidence from Sri Lanka	Khattak A.; Stringer C.; Benson-Rea M.; Haworth N.	2015	Competition and Change	48

Source: Own elaboration.

2.2.8. Most influential journals

The objective of this section is to evaluate the most relevant scientific journals that published articles on the research topic, specifically the influence of GVCs on firms' environmental performance. Our dataset includes 87 publications from 52 distinct scientific journals. Of these, ten journals published two or more papers on our research topic, as shown Table 4, which accounts for 40% of the total scientific output within our dataset. The most prominent journals were the Journal of Cleaner Production and Business Strategy and Environment, with 8 and 5 publications, respectively.

Considerations based on the total number of citations per journal reveal that the Journal of Cleaner Production and Business Strategy and Environment captured the majority of citations in this field of study, as illustrated in Table 4, with the former documenting 81 citations per publication and the latter 73 citations per publication.

Another essential step in assessing the quality and performance of the most relevant scientific journals in our research topic is to evaluate their impact factors. Notably, this includes the Journal Citation Reports (JCR), released by Clarivate Analytics and based on WoS data, and the SCImago Journal Rank (SJR), released by Elsevier and based on Scopus data.

Specifically, the SJR operates on a 3-year citation window and considers the number of citations a journal receives. It also assigns different weights to each citation depending on the prestige of the citing journals; high-ranking journals carry more weight (SCImago, 2025).

JCR, alternatively, has as its main metric the Journal Impact Factor (JIF), which is calculated by dividing the total number of citations received in a given year by all articles published in that journal during the two previous years (Clarivate, 2025). Given the importance of these two metrics, the respective reports were added to the ten most relevant scientific journals with 2 or more publications in our topic of study, as shown in Table 4. *Energy Economics* and *Business Strategy and the Environment* are the two highest-rated and most influential scientific journals in our analyzed dataset and the most relevant in terms of quality scientific output on our topic of research.

Table 4 - Ranking of journals with most publications on the topic and their impact factors.

Rank	Journals	Number of Publications	Impact Factor JIF 2023	Impact Factor SJR 2024	Fields of Study
1	Journal of Cleaner Production	8	9.0	2.174	Business, Management and Accounting, Energy; Environmental Science; Engineering.
2	Business Strategy and the Environment	5	10.8	3.609	Business, Management and Accounting; Environmental Science; Social Sciences.
3	International Journal of Production Economics	5	8.8	2.833	Business, Management and Accounting; Decision Sciences; Economics, Econometrics and Finance; Engineering.
4	Energy Economics	3	12	3.919	Economics, Econometrics and Finance; Energy.
5	Structural Change and Economic Dynamics	3	4.8	1.406	Economics, Econometrics and Finance.
6	Sustainability	3	2.7	0.688	Computer Science; Energy; Environmental Science; Social Sciences.
7	Competition and Change	2	2.6	2.054	Business, Management and Accounting
8	Ecological Economics	2	6.3	2.088	Economics, Econometrics and Finance; Environmental Science.
9	IEEE Transactions on Engineering Management	2	3.8	1.134	Business, Management and Accounting; Engineering.
10	Production Planning and Control	2	5.1	2.198	Business, Management and Accounting; Computer Science; Decision Sciences; Engineering.

Source: Own elaboration with data extracted from SCImago and Elsevier.

2.2.9. Most influential authors

In this section, we will analyze the relevance of the authors in our dataset. Of the 87 publications composing our dataset, 233 different authors were identified, with the number of publications per author varying between 1 and 5. Around 94% (218) of authors participated in one individual publication, with the remaining 6% (15 authors) having published between 2 and 5 articles regarding our research theme, as seen in Table 5.

Table 5 - Number of publications per author.

Number of Publications	Number of Authors	Number of Publications per Author
1	218	93.56%
2	11	4.72%
3	3	1.29%
5	1	0.43%

Source: Own elaboration.

Despite these results, measuring the importance of an author by the total number of papers published on a given research theme does not suffice. To further evaluate the relevance of an author, it is common practice to resort to the index developed by Hirsch in 2005, the h-index. The h-index is defined as follows, "*A scientist has index h if h of his or her Np papers have at least h citations each and the other (Np - h) papers have ≤ h citations each.*" (Hirsch, 2005, p.16569), this means that if an author has an h-index of 10, this author published 10 articles that received 10 or more citations. According to Costas and Bordons (2007), the h-index allows researchers to evaluate both the quantity and quality of the scientific work of a particular author and to avoid the one-hit wonders, as one highly cited publication does not translate automatically into a high h-index (Harzing et al., 2013).

On Table 6, the authors who published two or more papers are ranked by the number of publications and their respective h-index. The h-index for each author was retrieved from the SCOPUS database.

Table 6 - Ranking of the most influential authors

Rank	Author	Number of Publications	H-Index
1	Stefano Ponte	5	44
2	Peter Dauvergne	3	30
3	Valentina de Marchi	3	29
4	Jane Lister	3	14
5	Eric F. Lambin	2	91
6	Hokey Min	2	41
7	Inmaculada Martínez-Zarzoso	2	33
8	Ling Yun He	2	30
9	Ximena Rueda	2	20
10	Almut Schilling-Vacaflor	2	19
11	Hui Wang	2	14
12	Maria Therese Gustafsson	2	13
13	Joo, Hye-young	2	7
14	Geng Huang	2	7
15	Xi Lin	2	6

Source: Own elaboration.

On Table 6, we can observe that the author with the highest number of contributions to our research theme is Stefano Ponte, with 5 publications and "*The greening of global value chains: Insights from the furniture industry*" being his most cited contribution. Following Stefano Ponte, Peter Dauvergne, Valentina de Marchi and Jane Lister published 3 papers each. In contrast, the authors with the highest h-index score do not completely overlap with the number of publications ranking. As shown in Table 6, the three authors with the highest h-index are:

1. Eric F. Lambin, from Stanford University, United States, with 254 publications and 54 798 citations.
2. Stefano Ponte, from Copenhagen Business School, Denmark, with 107 publications and 8 291 citations.
3. Hokey Min, from Bowling Green State University, United States, with 174 publications and 6 643 citations.

Considering both the quantity and the quality of the contributions of the evaluated authors on our dataset, we can conclude that Stefano Ponte stands out as the most influential and prolific researcher on the influence of GVCs on the environmental performance of the participating firms in these globally dispersed production networks.

Concluding remarks

Considering the importance of GVCs in today's global economy and the increasing awareness of the imperative for a global green transition, the purpose of this dissertation was to systematically review the extant scientific literature on the relationship between GVC participation and the environmental performance of the participating firms. The main contribution of this work lies in its development of a quantitative bibliometric analysis of the existing literature, which identified prevailing trends and patterns, offering a foundation for future research in this field. Preceding this analysis, a comprehensive literature review was conducted to contextualize the core issues and concepts under examination and to establish the theoretical framework that underpins the dissertation.

In line with this aim, the bibliometric analysis consisted of a thorough examination of the metadata of the scientific output in our field of study, which allowed us to identify main trends and characteristics of the literature. This metadata included the chronological evolution of the literature, the types of studies, the methodologies applied by the researchers, the geographical focus of the publications, the themes focused by the authors, the incidence of keywords and the resulting clusters and, finally, the most influential authors, scientific journals and publications in this field of study.

The extracted portfolio included 87 publications which encompassed a period between 2011 and 2025 revealing, first, that the emergence of this theme of research is still relatively recent, and second, that there is an upward trend in scientific output in this field, with 2024 being the year that registered the highest number of published articles. Considering the growth of academic interest in this research field, the existence of systematic literature reviews such as the present work will enable future research by providing key insights and clues.

Considering the type of scientific documents, the methodologies employed by the authors and the most common research themes, we concluded that the large majority of publications are articles, particularly empirical articles. The less common employed methodology was the formal one, which means that there is a gap in providing contributions that explore theoretical constructs with analytical modeling and mathematical formulas. Concerning the most common themes, we identified that the themes "Institutional Influences and Environmental Regulations" and "Global environmental governance" were the ones with the highest number of publications. The research theme "Environmental upgrading of supplier firms" was the one with the lowest number of published contributions (4 publications). However, three of these articles were among the most influential and cited

contributions, which implies a nascent niche of research that future scientific investigation can explore.

Considering the global nature of GVCs and the phenomenon under study, it was also relevant to analyze the geographical focus of the literature. China and the European Union emerged as the most commonly examined regions.

Concerning the most influential scientific journals in this field of research, we observed that the *Journal of Cleaner Production* was the one with the highest number of publications. Nevertheless, *Energy Economics* and *Business Strategy and the Environment* were the most influential ones regarding their respective impact factor metrics.

The two most cited publications were "*Efficiency meets accountability: Performance implications of supply chain configuration, control, and capabilities*" by Parmigiani, Klassen and Russo, and "*Big brand sustainability: Governance prospects and environmental limits*" by Dauvergne and Lister. These articles were published respectively in 2011 and 2012. It should be taken into consideration that a substantial proportion of the analyzed literature was published after 2020, which means that, despite not yet being highly cited, more recent publications are still relevant contributions.

Considering the most influential authors, Stefano Ponte and Eric F. Lambin emerged from our analysis as the most productive and relevant researchers in the field of study.

Another relevant stage of this bibliometric study was the analysis of the author keywords, both their frequency and the clusters they formed. The keyword network analysis was performed using the VOSviewer software. Considering the occurrence of keywords, the most commonly employed by authors were Global Value Chains, Sustainability, and Environmental Governance. Concerning the keyword clusters, three central clusters emerged from our analysis: firstly, a cluster focused on Corporate Social Responsibility, environmental certification and regulations, secondly, a cluster focused on the role of GVCs in disseminating resources, notably technology and knowledge, that foster the environmental upgrading of supplier firms, and thirdly, a cluster centered on the role of GVCs in improving the environmental performance of firms from emerging countries with a particular focus on China.

This systematic literature review allowed us to conclude that GVCs can be a positive influence on the environmental performance of firms, especially firms in emerging countries. Which legitimizes the PEH. However, several publications, notably by Stefano Ponte, caution that GVCs can lead supplier firms to environmental downgrading and worsened

environmental performance when lead firms push the costs of adapting to stricter and greener production processes down to their suppliers, which validates the PHH.

Based on the performed literature review that delved into the traditional IB theories and framed the relevant concepts of this topic of study, we observed that these theories and concepts have to be frequently paired with less traditional IB theories and paired in unique ways to frame this phenomenon and its characteristics. This implies that there is significant room for conceptual contributions that allow future research to interpret the complexities of this subject. The adaptation of the concept of upgrading in GVCs to the environmental dimension is such an example.

Despite these findings, this investigation has its limitations. First, as was previously stated, the publications in this field are still relatively recent and scarce. However, this means that this investigation is more relevant for appearing at such an early stage of the emergence of this field of study. Secondly, in conducting a bibliometric analysis, the selection of keywords is a critical methodological step, as achieving an optimal balance between overly narrow and excessively broad terms presents a significant challenge. Consequently, some relevant studies in our theoretical framing of this study were not encompassed in our extracted list of publications, evidencing a fragility in our choice of keyword combinations. Despite all these acknowledged limitations, the use of a rigorous methodology ensures that this dissertation constitutes a novel and valid contribution to the field.

As previously noted, the influence of GVCs in the environmental performance of firms is an emerging field of study, and accordingly, it presents numerous avenues for future research. Future studies could incorporate formal modeling to analyze how GVC structures influence environmental outcomes, such as optimization models for sustainable supply chain design within GVCs. This would contribute to the analytical depth of the literature on this field of study. As was previously mentioned, environmental upgrading at the supplier level remains underexplored. Future research could investigate how GVCs enable or hinder such upgrading, especially in emerging economies, by resorting to case studies or mixed methods. Future work could also clarify when GVCs foster environmental upgrading (PEH) or lead to downgrading (PHH), ideally through sector-specific or cross-country comparative studies that consider regulatory and governance contexts. And finally, other regions and countries remain excluded from the geographical focus of this field of study, notably Latin America, Africa and Southeast Asia, which presents a research opportunity to explore how regional contexts affect the environmental impacts of GVC participation.

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Appendices

Table A 1 – 87 articles aligned with the research theme.

Publication Year	Authors	Article Title
2011	Parmigiani, A; Klassen, RD; Russo, MV	Efficiency meets accountability: Performance implications of supply chain configuration, control, and capabilities
2012	Dauvergne, P; Lister, J	Big brand sustainability: Governance prospects and environmental limits
2013	De Marchi V.; Di Maria E.; Micelli S.	Environmental Strategies, Upgrading and Competitive Advantage in Global Value Chains
2020	Zhang X.; Yousaf H.M.A.U.	Green supply chain coordination considering government intervention, green investment, and customer green preferences in the petroleum industry
2017	Rueda X.; Garrett R.D.; Lambin E.F.	Corporate investments in supply chain sustainability: Selecting instruments in the agri-food industry
2015	Bush, SR; Oosterveer, P; Bailey, M; Mol, APJ	Sustainability governance of chains and networks: a review and future outlook
2017	LeBaron G.; Lister J.; Dauvergne P.	Governing Global Supply Chain Sustainability through the Ethical Audit Regime
2017	Havice, E; Campling, L	Where Chain Governance and Environmental Governance Meet: Interfirm Strategies in the Canned Tuna Global Value Chain
2012	Plambeck, E; Lee, HL; Yatsko, P	Improving Environmental Performance in Your Chinese Supply Chain

2020	Bager, SL; Lambin, EF	Sustainability strategies by companies in the global coffee sector
2014	Genovese A.; Lenny Koh S.C.; Kumar N.; Tripathi P.K.	Exploring the challenges in implementing supplier environmental performance measurement models: A case study
2013	De Marchi V.; Di Maria E.; Ponte S.	The greening of global value chains: Insights from the furniture industry
2021	Duan, YW; Ji, T; Yu, TT	Reassessing pollution haven effect in global value chains
2022	Kunkel S.; Matthess M.; Xue B.; Beier G.	Industry 4.0 in sustainable supply chain collaboration: Insights from an interview study with international buying firms and Chinese suppliers in the electronics industry
2019	Hsueh, L	Opening up the firm: What explains participation and effort in voluntary carbon disclosure by global businesses? An analysis of internal firm factors and dynamics
2018	Ashby, A	Developing closed loop supply chains for environmental sustainability: Insights from a UK clothing case study
2020	Wang, H; Pan, C; Wang, QW; Zhou, P	Assessing sustainability performance of global supply chains: An input-output modeling approach
2021	Erhun F.; Kraft T.; Wijnsma S.	Sustainable Triple-A Supply Chains
2022	Ponte, S	The hidden costs of environmental upgrading in global value chains
2015	Khattak A.; Stringer C.; Benson-Rea M.; Haworth N.	Environmental upgrading of apparel firms in global value chains: Evidence from Sri Lanka
2020	Ponte, S	Green Capital Accumulation: Business and Sustainability Management in a World of Global Value Chains
2021	Golgeci, I; Makhmadshoev, D; Demirbag, M	Global value chains and the environmental sustainability of emerging market firms: A systematic review of literature and research agenda
2017	Choi, SB; Min, H; Joo, HY; Choi, HB	Assessing the impact of green supply chain practices on firm performance in the Korean manufacturing industry
2014	Mallidis, I; Vlachos, D; Iakovou, E; Dekker, R	Design and planning for green global supply chains under periodic review replenishment policies
2024	Schilling L.; Seuring S.	Linking the digital and sustainable transformation with supply chain practices
2020	Lau H.; Shum P.K.C.; Nakandala D.; Fan Y.; Lee C.	A game theoretic decision model for organic food supplier evaluation in the global supply chains
2020	Grabs, J	Assessing the institutionalization of private sustainability governance in a changing coffee sector
2018	Choi, SB; Min, H; Joo, HY	Examining the inter-relationship among competitive market environments, green supply chain practices, and firm performance
2014	Elder, SD; Lister, J; Dauvergne, P	Big retail and sustainable coffee: A new development studies research agenda
2022	Shi, QL; Shan, YL; Zhong, C; Cao, Y; Xue, R	How would GVCs participation affect carbon intensity in the? Belt and Road Initiative? countries?
2022	Jensen F.; Whitfield L.	Leveraging participation in apparel global supply chains through green industrialization strategies: Implications for low-income countries
2023	Ardekani Z.F.; Sobhani S.M.J.; Barbosa M.W.; de Sousa P.R.	Transition to a sustainable food supply chain during disruptions: A study on the Brazilian food companies in the Covid-19 era
2021	Ramanathan U.; Mazzola E.; Mohan U.; Bruccoleri M.; Awasthi A.; Garza-Reyes J.A.	How selection of collaborating partners impact on the green performance of global businesses? An empirical study of green sustainability
2015	Acquaye A.A.; Yamoah F.A.; Feng K.	An integrated environmental and fairtrade labelling scheme for product supply chains
2021	Poulsen, RT; Ponte, S; van Leeuwen, J; Rehmatulla, N	The Potential and Limits of Environmental Disclosure Regulation: A Global Value Chain Perspective Applied to Tanker Shipping
2022	Maeno, K; Tokito, S; Kagawa, S	CO2 mitigation through global supply chain restructuring
2018	Schouten, G; Hospes, O	Public and Private Governance in Interaction: Changing Interpretations of Sovereignty in the Field of Sustainable Palm Oil

2024	Schilling-Vacaflor A.; Gustafsson M.-T.	Towards More Sustainable Global Supply Chains? Company Compliance with new Human Rights and Environmental Due Diligence Laws
2022	Tennhardt, L; Lazzarini, G; Weisshaidinger, R; Schader, C	Do environmentally friendly cocoa farms yield social and economic co-benefits?
2024	Song, YG; Wang, ZQ; Song, CQ; Wang, JH; Liu, R	Impact of artificial intelligence on renewable energy supply chain vulnerability: Evidence from 61 countries
2024	Ali M.U.; Wang Y.	Does the Participation Degree in Global Value Chains Influence Carbon Emission Transfer Through International Trade in Belt and Road Countries?
2011	Lin, RJ	Moderating effects of total quality environmental management on environmental performance
2014	Khanna M.; Liao Y.	Globalization and voluntary environmental management in developing countries
2021	Alanya-Rosenbaum S.; Bergman R.D.; Gething B.	Assessing the life-cycle environmental impacts of the wood pallet sector in the United States
2021	Wang, H; Pan, C; Ang, BW; Zhou, P	Does Global Value Chain Participation Decouple Chinese Development from CO2 Emissions? A Structural Decomposition Analysis
2020	Valodka, I; Snieska, V; Mihi-Ramirez, A	Impact of the International Trade on the EU Clothing Industry Carbon Emissions
2023	De Marchi V.; Gereffi G.	Using the global value chain framework to analyze and tackle global environmental crises
2022	Virdin, J; Vegh, T; Ratcliff, B; Havice, E; Daly, J; Stuart, J	Combatting illegal fishing through transparency initiatives: Lessons learned from comparative analysis of transparency initiatives in seafood, apparel, extractive, and timber supply chains
2024	Siewers, S; Martínez-Zarzoso, I; Baghdadi, L	Global value chains and firms' environmental performance
2023	Nadeem, M; Lou, SQ; Wang, ZL; Sami, U; Ali, SA; Abbas, Q; Artan, S	Efficiency of domestic institutional arrangements for environmental sustainability along the way to participate in global value chains: evidence from Asia
2023	Kholaif M.M.N.H.K.; Xiao M.; Hamdy A.	Covid-19's effect on green supply chains and environmental sustainability; innovative technologies moderation
2021	Mook A.; Overdevest C.	What drives market construction for fair trade, organic, and GlobalGAP certification in the global citrus value chain? Evidence at the importer level in the Netherlands and the United States
2023	Ali, E; Gniniguè, M; Awade, NE	Sectoral value chains and environmental pollution in Africa: can development policies target digitalization and structural transformation to enhance environmental governance?
2023	Barbaglia, M; Bianchini, R; Buttice, V; Elia, S; Mariani, MM	The role of environmental sustainability in the relocation choices of MNEs: Back to the home country or welcome in a new host country?
2022	Damberg S.V.; Hartmann J.; Heese H.S.	Does bad press help or hinder sustainable supply chain management? An empirical investigation of US-based corporations
2010	Jin T.T.; Zailani S.	Antecedent and outcomes study on green value chain initiatives: A perspective from sustainable development and sustainable competitive advantage
2024	Chaudhuri R.; Singh B.; Agrawal A.K.; Chatterjee S.; Gupta S.; Mangla S.K.	A TOE-DCV approach to green supply chain adoption for sustainable operations in the semiconductor industry
2024	Liu, WJ; Heugens, PPMAR	Cross-sector collaborations in global supply chains as an opportunity structure: How NGOs promote corporate sustainability in China
2012	Reps, N; Braun, B	Going green - environmental upgrading and value chain coordination in the Indian automotive industry
2024	Cheng, JJ; Yu, ZX; Xue, ZJ; Yang, Y; Shi, XP	Firms' GVC positioning and corporate environmental performance: Micro evidence from China
2024	Krishankumar, R; Ramanujam, N; Zavadskas, EK; Ravichandran, KS; Gandomi, AH	Ranking Barriers Impeding Sustainability Adoption in Clean Energy Supply Chains: A Hybrid Framework With Fermatean Fuzzy Data
2023	Huang G.; He L.-Y.; Lin X.	Deterioration or improvement? Intermediate product import and enterprises' environmental performance

2016	Yang N.; Colvin C.; Wong Y.-Y.	A resource-based view of corporate social responsibility and DMNES rising from China's high-tech industry
2011	Goffnett S.P.; Jenicke L.O.; Palaniswami S.; Kang H.	The roles of ISO 14001, research institutions and professional organizations in environmental performance
2018	Szalavetz, A	Impact of greening on the upgrading of manufacturing subsidiaries' technological capabilities - A Hungarian perspective
2024	Emon M.M.H.; Khan T.	Unlocking Sustainability through Supply Chain Visibility: Insights from the Manufacturing Sector of Bangladesh
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