sustainability

Systematic Review

The Intrinsic Links of Economic Complexity with Sustainability Dimensions: A Systematic Review and Agenda for Future Research

María Guadalupe Montiel-Hernández , Carla Carolina Pérez-Hernández * and Blanca Cecilia Salazar-Hernández

Institute of Economic Sciences and Management, Universidad Autónoma del Estado de Hidalgo, Pachuca 42160, Mexico; maria_montiel@uaeh.edu.mx (M.G.M.-H.); bsalazar@uaeh.edu.mx (B.C.S.-H.)
* Correspondence: carla_perez@uaeh.edu.mx

Abstract: What are the intrinsic connections between economic complexity and sustainability dimensions? To address this question, we have conducted the first Systematic Mapping Study of the literature related to the economic complexity theory, employing databases such as *Scopus*, *Web of Science*, and *Semantic Scholar* following the PRISMA statement complemented with a science mapping technique. Our endeavor has culminated in the compilation of 687 documents published between 2006 and 2022. The findings of this systematic review reveal a thematic and semantic network that interconnects economic complexity with the following dimensions of sustainability: (1) Economic, (2) Social and Human, (3) Environmental, (4) Political, and (5) Cultural. The results offer compelling evidence that research into economic complexity is actively striving to promote studies that are pertinent to the challenges articulated by the 2030 Agenda for Sustainable Development. Furthermore, we propose five avenues for shaping a future research agenda based on the emerging research trends detected through in-depth analysis. In conclusion, we affirm that economic complexity stands as a robust theory that aids in comprehending the multidimensional challenges arising from the pursuit of sustainable development.

Keywords: economic complexity; sustainability dimensions; systematic literature review; PRISMA statement; systematic mapping study

check for updates

Citation: Montiel-Hernández, M.G.; Pérez-Hernández, C.C.; Salazar-Hernández, B.C. The Intrinsic Links of Economic Complexity with Sustainability Dimensions: A Systematic Review and Agenda for Future Research. *Sustainability* **2024**, *16*, 391. https://doi.org/10.3390/su16010391

Academic Editor: Stephan Weiler

Received: 20 October 2023
Revised: 14 December 2023
Accepted: 22 December 2023
Published: 1 January 2024

1. Introduction

The future is already here, it is just not evenly distributed [1]. One way to chart an agenda for future research is to identify, among hundreds of documents, clues about emerging trends that will shape the future of a research field. The current systematic review is an exploration of the present and past of economic complexity theory related to sustainability dimensions, aiming to glimpse, for the first time, the potential future of this connection.

In pursuit of sustainability, nations must consider multiple dimensions: economic, social, environmental, political, cultural, and human development [2–7]. Surprisingly, economic complexity has been applied to understand these kinds of factors (such as economic growth, inequality, social and financial inclusion, emissions, policy implications, green economy, etc.), also using statistical comparisons or robust econometric studies with the metric of EC as a variable to provide evidence in the economic geography field and unraveling various types of relatedness (as a metric of EC). Applications range from classic studies of product space for understanding economic diversification to novel applications of relatedness techniques for depicting proximities among musical genres [8], sports [9], and diseases [10]. This paper constitutes a systematic literature review, whose central question is as follows: What are the emerging research trends bridging economic complexity and sustainability dimensions? Addressing this question is crucial for outlining a research agenda that proposes future studies contributing to the understanding of sustainable development dimensions (from local to global scales) and the resolution of urgent challenges to achieve inclusive and environmentally sustainable economic growth, utilizing complexity techniques as investigative tools.

By definition, economic complexity (EC) is understood as the use of "network science and machine learning techniques to explain, predict, and advise changes in economic structures" [11] (p. 1). This novel approach considered a new paradigm in the field of economics [12], has experienced a publication growth rate of 30%. Seminal works [13,14] have been published in high-impact journals. Notably, Utrecht and Harvard universities are the most frequent affiliations in publications on the topic. Various governments and institutions have embraced complexity metrics as a guide for data-driven decision-making. This underscores the relevance of economic complexity theory, which has been applied to diverse knowledge domains and multiple geographical contexts over 17 years.

This article explores an uncharted relationship between economic complexity and various dimensions of sustainability, including economic, social, environmental, cultural, political, and human aspects. This Systematic Literature Review (SLR) unveils emerging thematic connections—topics that are not yet consolidated or are underdeveloped—and subtle or peripheral connections, representing rarely addressed subjects within the realm of economic complexity. The emerging papers identified through the SLR may indicate novel perspectives, innovative applications, or new approaches to complexity methods.

Currently, there are five literature reviews on EC, including two narrative reviews [11,12] and three systematic reviews: Junior et al.'s work focuses on detecting regional or municipal applications of the Economic Complexity Index (ECI), compiling 287 documents [15]. Ferraz et al. link economic complexity specifically with sustainable development, diversification, and industrial policy, using a collection of 374 articles published between 1988 and 2020 (including complex systems literature) [16]. Bahrami et al.'s review compiled 111 articles, clarifying the connection between economic complexity and regional competitiveness [17].

While valuable, these reviews collectively expose a significant research gap: they do not explore the connections between economic complexity and sustainability dimensions, instead focusing on specific themes or aspects. Consequently, these reviews offer a partial perspective on the studies and applications of EC.

To address this gap, this paper presents a systematic literature review of economic complexity, using databases such as Scopus, Web of Science, and Semantic Scholar. This effort compiles 687 documents, forming an exclusive collection of complexity research utilizing Hidalgo and Hausmann's [14] approach, published between 2006 and early November 2022. This compilation enables the identification of the intrinsic links between economic complexity and dimensions of sustainability (as a general aim).

Explicitly, this work addresses the following objectives: (O-1) Recognize the evolution of bibliometric indicators about economic complexity literature, (O-2) identify emerging themes of economic complexity linked to sustainability dimensions, and (O-3) detect gaps and future lines of research of this interconnection.

Therefore, the general research question is as follows: What are the intrinsic connections between economic complexity and sustainability dimensions? Specifically, (RQ-1) how have bibliometric indicators on economic complexity literature evolved? (RQ-2) What are the emerging thematic connections of economic complexity derived from its intrinsic links with sustainability dimensions? And (RQ-3) what gaps and future research directions have been identified?

Consequently, this study contributes to the existing literature in two main ways: firstly, it pioneers the detection of thematic connections of EC, synthesizing their implications across all sustainability dimensions (intrinsically detected). Secondly, through an in-depth review, existing research gaps are identified, and a future research agenda is formulated, aiming to undertake studies linking economic complexity and sustainable development across its various spheres or dimensions.

To achieve the proposed objectives, this article is structured as follows: the next section provides a conceptual background on economic complexity theory and sustainability dimensions, followed by an explanation of the methodology developed for the systematic literature review. Subsequently, data collection and analysis procedures are detailed, followed by Section 4. Gaps and future research directions are outlined, and conclusions and reflections close the paper.

2. Economic Complexity: What Is It, and Why Should We Care about Its Intrinsic Relation to Sustainability Dimensions?

In this section, we unfold the concepts of economic complexity and sustainability dimensions with the aim of highlighting the need to discover their connections and the emerging themes that arise from the study of the combination of both subjects.

2.1. Economic Complexity

This section conceptualizes economic complexity theory, which, despite being young, has garnered substantial recognition from both scholars and decision-makers. Nevertheless, economic complexity is a recent paradigm; it has its precedent in complex systems. In that sense, Arthur argues that conventional economic theory does not study the development of patterns created by agents; it only seeks analytical solutions. Starting from the premise of complex systems with multiple elements, he introduces the economics of complexity, which operates outside of equilibrium because its elements are in constant flux. In this framework, strategies, actions, and time play important roles. Accepting complexity allows us to identify how the economy evolves and examine behaviors, not only at an individual level but collectively. He considers the impact of interactions between the elements of an economy; this complexity tends to grow as systems evolve [18,19]. It represents an alternative paradigm as it studies the interactions of the economic system with external elements, such as social life, political institutions, human behavior, pandemics, economic inequality, and technology, among others. To do this, one must accept the complexity of phenomena in the economy, which is composed of evolving networks of institutions, technologies, and agents. From this perspective, change is an endogenous phenomenon [20,21].

The economics of complexity have drawn inspiration from natural sciences, computer science, and mathematics, which have coevolved with systemic thinking to have a broad, dynamic, holistic, and long-term view of policies. Perspectives on complexity in economics are interested in historical aspects, path dependence, and irreversibility related to the endogeneity of technological change and innovation processes [22]. Sustainability and climate change require an economic analysis, starting from their integral complexity, thus providing an understanding of the behavior of actors and economic systems. This understanding is useful for the creation of policies that enable the transition to a more sustainable economy through the promotion of innovation and network analysis for understanding economic systems and processes [23].

Researchers from MIT and Harvard University have developed a complexity approach to economic development, called "economic complexity" [14]. This perspective implicitly follows some characteristic elements of the complexity scientific paradigm that emerged in the second half of the twentieth century but focuses on a practical application to economic development [24].

It is also important to note that research on economic complexity is associated with two main approaches: (1) Relatedness, which measures the overall affinity between a specific activity and a location. It explains path dependencies (which refers to a concept in economics and historical analysis that suggests the development of a system is influenced by its historical trajectory) and predicts which activities will grow or decline in a location, and (2) the complexity metric, also known as the knowledge intensity measure or the Economic Complexity Index (ECI) [25]. Table 1 shows the attributes of EC metrics.

Table 1. Attributes of economic complexity metrics. Source: Own elaboration based on Hidalgo [25].

(1) Metric of Relatedness	(2) Metric of Complexity
• Measures the affinity between a specific activity and its geographic location. • Predicts which activities are likely to grow or decline in each location. • Anticipates changes in specialization patterns, as well as the probability of a location entering or exiting a specific activity. • Relates to absorptive capacity: the ability to absorb new knowledge is determined by the level of knowledge in related areas. • Identifies that learning requires interaction between similar activities but not to the extent of being considered direct competitors (clusters).	• Utilizes information to estimate the diversity, ubiquity, and availability of factors involved in an economy. • Serves to measure the ability of an economy to generate and distribute wealth. • Applies dimensional reduction techniques that preserve the identity of variables and consider their interactions. • Predicts economic growth, income inequality, and greenhouse gas emissions. • Complexity metrics were initially applied to trade data, but it has been demonstrated that they can be used with technological patents, employment, and occupations.

2.2. Economic Complexity Metrics

According to Hidalgo and Hausmann [14], a binary matrix M is constructed based on the location quotients (LQ) of the "places" (i.e., countries, cities, or regions) taking into account the different expressions of "knowledge outcomes" that could be reflected in terms of exported products [26,27] or value added by industry [26,28], employment by industry [29,30], economic units, or the number of firms per sector [31], Gross Product per worker [32], payroll by industry [25], patents [33,34], scientific publications [35,36], or even these last two in combination [37], or multidimensionally, involving data on published research, patents, and trade [38]. "Knowledge outcomes", for instance, exports are denoted by x in Equation (1). In this matrix M, the rows represent the locations (denoted by i), the columns could be, for example, the products (denoted by j), $M_{ij} = 1$ whether the region i has an LQ in the "product" $j > 1$, and $M_{ij} = 0$ otherwise.

$$LQ_{ij} = \frac{x_{ij}/\Sigma_p x_{ij}}{\Sigma_i x_{ij}/\Sigma_i \Sigma_j x_{ij}} \quad (1)$$

The sum of the ranks of M is the diversity of a location, i.e., the number of products/industries in which it is competitive, i.e.,: $Diversity_i = \sum_j M_{ij}$, while the sum of the columns of M represents the ubiquity of an industrnoy or "product" (the number of locations in which it is concentrated), i.e., $Ubiquity_j = \sum_i M_{ij}$.

The Economic Complexity Index (ECI) is defined as the eigenvector associated with the second-largest eigenvector in the matrix $\widetilde{M}$. That is, $\widetilde{M} = D^{-1}S$, where D is the diagonal matrix formed from the vector of diversity values and S is a matrix in which the lines and columns correspond to the locations whose entries are given by

$$S_{ii'} = \sum_j \frac{M_{ij} M_{i'j}}{U_j} \quad (2)$$

where S is a symmetrical matrix of similarity, which corresponds to how similar the productive basket is in two locations.

To conclude, the proximity matrix (product space, metric of relatedness) is calculated using a network analysis function that calculates the relationship between localities and "products" based on their co-occurrence matrix (adjacency). "Different normalization procedures are proposed, such as: association strength, cosine, Jaccard, and an adapted version of the association strength that we refer to as the probability index" [39], as shown below:

$$\varnothing_{ii'} = \frac{\Sigma_j M_{j,i} M_{j.i'}}{max(U_{i,0},\ U_{i',0})} \quad (3)$$

where $M_{j,i} = 1$ if location j has a "product" i with an $LQ \geq 1$, and 0 otherwise. $U_{i,0}$ is the ubiquity of "product" i. More detailed information about the methodological formulation can be found in Hidalgo [25].

The Location Quotient (mentioned in Equation (1)) stands as one of the oldest and most widely utilized metrics for assessing the structure of industries at the state and local levels in the field of regional analysis and policy. This metric gauges the level of activity within a region's industrial sector (e.g., the proportion of total employment or establishments) in comparison to a national standard. A location quotient exceeding 1 indicates a specialization in that sector within the region. These quotients play a crucial role in pinpointing sectors that exhibit clustering within a particular area. Furthermore, as regional specialization in industries can lead to cost advantages for businesses, location quotients serve to represent localization economies. They identify locations that offer a dense labor market and a readily available supply of specialized inputs and equipment and facilitate the exchange of knowledge spillovers. When utilized to measure industry specialization, researchers often explore the impact of location quotients on additional regional indicators, such as changes in industry employment or the initiation of new business ventures [40–42].

Specifically, economic complexity is both an academic field and a concept. As an academic field, this approach explores the geography and dynamics of economic activities using methods inspired by ideas from complex systems, networks, and computer science. However, what makes the field of economic complexity somehow unique is that it studies the geography of activities using an outcomes-based approach. In other words, instead of trying to figure out what capabilities or factors drive an economy, it uses data on the geography of economic activities to infer the presence of bundles of capabilities [43]. The analogy of genotypes and phenotypes [44] is useful to understand this characteristic.

Genotypes correspond to knowledge and capabilities (intangible elements), while phenotypes correspond to outcomes (visible and tangible elements).

Mealy and Coyle [45] argue that a more precise way to think about ECI is as a type of dimensionality reduction tool. Dimensionality reduction algorithms aim to reduce high-dimensional data (data with many random variables) to a space of much fewer dimensions. One analogy to the ECI is the Dewey Decimal System for classifying books. Housing all sorts of books on various topics, libraries try to solve the problem of how best to place books on shelves such that they can roughly minimize the time people spend searching for any title. The Dewey Decimal System aims to place books about similar topics close together on the library shelf so people who are interested in each topic know where to look. The ECI metrics are similar in spirit.

Hence, it is widely recognized that economic growth, development (viewed across its multiple dimensions), technological change, income inequality, spatial disparities, and resilience all emerge from hidden systemic interactions. Economic complexity maps the structure of these interactions and elucidates how they shape various socioeconomic processes, making valuable predictions regarding economic change [12].

On the other hand, relatedness is akin to recommender systems, similar to those used to predict clicks or purchases online but used, instead, to predict the activities that a region is more likely to enter or exit in the future [25].

Economic complexity methods allow for quantifying and comparing elements related to sustainable development—economic, social, and environmental—by leveraging data on the geographic distribution of economic activities to estimate the implicit presence of multiple factors [38].

Nowadays, researchers immersed in this field are using this approach to unravel problems and challenges related to sustainability (viewed from its various dimensions). However, there is no study that integrates or reflects upon this connection. Hence, the present work aims to fill this gap and provide a future research agenda.

Finally, it is noted that digital data visualization platforms (e.g., Economic Complexity Atlas: (https://atlas.cid.harvard.edu, accessed on 21 December 2023) Economic Complexity

Observatory: (https://oec.world, accessed on 21 December 2023) have contributed to democratizing tools and metrics derived from the application of economic complexity. Their purpose is to serve policymakers and the public by enabling interactive data queries regarding the complexity of regions and products.

2.3. Dimensions of Sustainability

Sustainability is fundamentally about adapting to a new ethic of living on the planet and creating a more equitable and just society through the fair distribution of social goods and resources in the world [46]. Originally, Brundtland [47] defined sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

The three pillars of sustainability typically encompass economic, social, and environmental aspects [5,6]. Nevertheless, culture is gradually emerging out of the realm of social sustainability and being recognized as having a separate, distinct, and integral role in sustainable development [7]. Within the field of sustainability, culture is analyzed in terms of cultural capital, defined as traditions and values, heritage and place, arts, diversity, and social history [3]. Parallelly, other emerging dimensions include politics [2,4] and human development; the first one is reflected by policy, politics, decision-making, and government issues [48], while the second one is captured by the Human Development Index, education, and human capital.

According to Quiroga Martínez [49], based on the United Nations Department of Economic and Social Affairs, the dimensions of sustainability are fundamentally integrated by the following:

Economic Dimension: Reflected in the economic structure (economic performance, trade, financial level, productivity), consumption and production patterns, energy use, waste management and generation, circular economy, and transportation.

Social Dimension: Represented in issues related to equity (poverty, gender equity, women's roles, social exclusion/inclusion), health (nutritional status, mortality, drinking water, health provision), employment, housing (housing conditions), safety (crime), and population (population change).

Environmental Dimension: Comprising topics related to the atmosphere (climate change, ozone layer depletion, air quality), earth (agriculture/food security, forestry, desertification, urbanization), oceans, seas, and coasts (coastal area, fishing, blue economy), drinking water (quantity and quality of water), biodiversity (ecosystems and species), sustainable use of natural resources, and sustainable tourism, among other topics.

According to Aerni [50], the United Nations Sustainable Development Goals (SDGs) can harness economic complexity to explore potential pathways toward sustainable and inclusive economic growth. Furthermore, in accordance with Cakir et al. [51], countries that achieve high levels of economic complexity (meaning a high level of diversity in productive capabilities and a low level of ubiquity products that reflect a kind of sophistication) in a holistic manner are well equipped to respond to external shocks through internal processes that can also impact their future export structure and sustainability (in terms of resilience). This helps them enhance not only their economic complexity but also their sustainability, thereby enabling them to reconcile economic growth with environmental and social concerns.

There is a misunderstanding that sustainability only involves environmental issues. But here, we try to unravel the dimensions of sustainability in order to see a more comprehensive landscape of the links of sustainability with EC studies. We consider that to achieve inclusive sustainability, a sustainable climate, a sustainable economy, and sustainable political systems are required. Therefore, the sustainability concept comprises many dimensions: economic, environmental, social (including human development), cultural, and political; it is mainly referred to as profits, planet, and people (see Supplementary Materials S1).

2.4. Importance of Economic Complexity and Dimensions of Sustainability

The implicit themes within the dimensions of sustainability can be interpreted as a system of signals that facilitate the assessment of our countries' and regions' progress toward sustainable development. For instance, when we observe the social dimension, researchers focused on "equity" can study a diverse array of signals such as poverty, gender equity, the role of women, and social inclusion/exclusion, primarily. Thus, analyzing these through the lens of economic complexity allows for the explanation of the implications of these "signals", making it feasible to generate data-driven proposals for decision-making. In this regard, for example, Barza et al. [52] have identified that economic complexity contributes not only to economic growth but also to improved outcomes in the labor market (less gender inequity in this case). Therefore, various researchers in this academic field [32,52–62] have contributed to the understanding of "equity" using either the approaches of relatedness or complexity (data science and network science) or employing the ECI as a point of comparison with other variables through robust geostatistical and econometric studies.

Hence, these findings contribute to the expanding body of literature that highlights the social, economic, and environmental significance of economic complexity. In other words, EC realizes that "a unit of GDP generated through the production of X-rays should be cleaner and more inclusive than a unit of GDP generated through iron ore mining" [38] (p. 2).

Gaining an understanding of the implications of economic complexity on themes arising from sustainability dimensions can be beneficial in identifying new forecasts, impacts, or previously unexplained relationships that may enhance our comprehension of various phenomena within the realm of sustainable development. Following Safi et al. [63], countries should emphasize and further enhance their economic complexity, because more complex economies are well prepared to adapt to global climate change and reduce emissions. This stems from their outstanding innovative and technical development capabilities. In other words, policies promoting economic complexity can be an effective strategy for reducing carbon emissions and contributing to promoting sustainable development. The reason is that we can use EC techniques to predict the activities that a location will enter or exit in the future, or to explain variations in the future; such as Economic Growth (through the Economic Complexity Index) [13], Emissions (through the Product Emission Intensity Index, PEII) [64], and Inequality (Product Gini Index, PGI) [53].

3. Methodology of the Systematic Literature Review/Systematic Science Mapping

The Systematic Literature Review (SLR) enables the synthesis of existing information on a topic, encompassing both quantitative and qualitative facets, thus facilitating the analysis of a subject's behavior [65,66]. Moreover, by synthesizing information, broader insights can be derived, and more comprehensive understandings can be formulated [67].

Based on the above, it was decided to employ the methodology of SLR following the PRISMA statement [67] complemented with the Systematic Scientific Mapping [68] to identify and select studies, followed by an in-depth analysis of documents related to relevant articles (due to their citation) and articles concerning emerging and peripheral/subtle topics (reflecting trends). This approach overcomes some of the limitations of other literature reviews conducted and offers a comprehensive view of the links of economic complexity. Specifically, the methodological process consists of four main phases: (1) location of the information, (2) text preprocessing and package utilization, (3) semantic and thematic analysis, and (4) in-depth analysis. Each of the steps mentioned above is detailed in Figure 1.

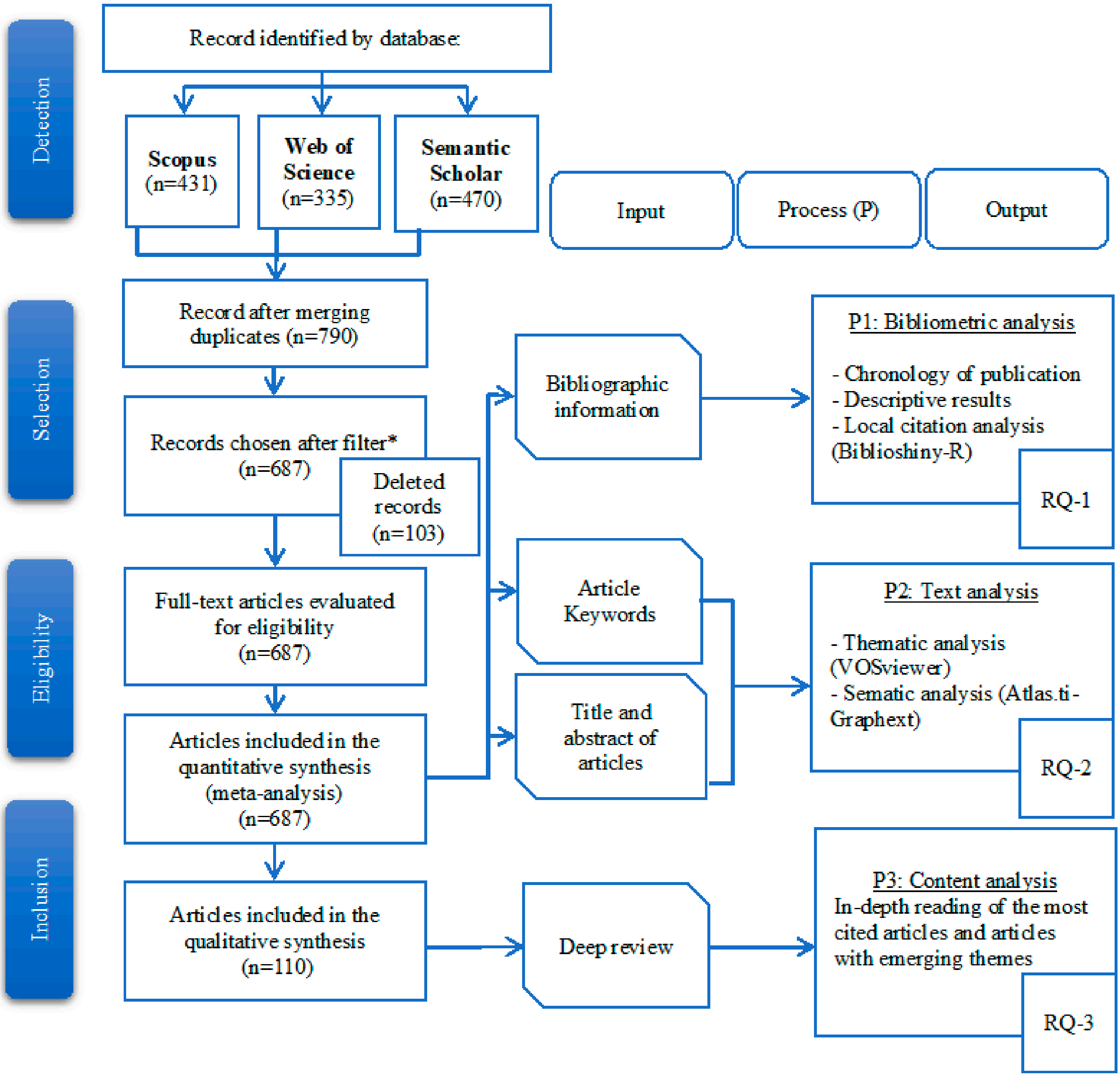

Figure 1. The PRISMA flow diagram for the systematic review detailing the database searches, the number of abstracts screened, full texts retrieved, and the complementary technique for the Systematic Mapping Study powered by *Atlas.ti* [69] and *Graphext* [70]. Note: RQ = Research Questions: (RQ-1) How have bibliometric indicators on economic complexity literature evolved? (RQ-2) What are the emerging thematic connections of economic complexity derived from its intrinsic links with sustainability dimensions? And (RQ-3) What gaps and future research directions have been identified? For process 1, referred to as "bibliometric analysis", we employed the R package. For process 2, known as "text analysis", we utilized *VOSviewer* [71] to construct the thematic network and *Atlas.ti* for conducting qualitative–semantic analysis of the compiled documents. Additionally, *Graphext* was used for the visualization and interaction with the data from our systematic review. The main filter* is compile only literature about EC, according to Hidalgo and Hausmann [14] approach. Source: Own elaboration.

The PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), published in 2009, was designed to assist authors of systematic reviews in transparently documenting the rationale behind the review, what the authors did, and what they found [72]. Our research has applied the PRISMA statement with the aim of enhancing the transparency of the process and the quality of the conducted research. Therefore, the PRISMA checklist is included as Supplementary material that can be consulted at the end of this document (see Supplementary Materials S2).

3.1. Location of the Information

To locate the studies, the following databases were employed: (a) Scopus, (b) Web of Science, and (c) Semantic Scholar. Consensus was achieved regarding the keywords, resulting in the selection of a total of 17 terms closely aligned with the currents of the literature associated with the theory of economic complexity (see Supplementary Materials S3). The search covers the period from 2006 to November 2022. The query string was formulated in the English language. However, language was not specified as an exclusion criterion, so all languages detected by the databases were included in the search string. The queries within Semantic Scholar were conducted iteratively using the keywords, whereas, for Scopus and Web of Science, a query string was employed.

For the compilation, the following types of materials were considered: scientific articles, working papers, preprints of articles, and books. Initially, *Scopus* yielded 431 documents, while *Web of Science* provided 355 records, and *Semantic Scholar* contributed 470 items. After merging similar entries, a total of 790 documents were available. Through the review and examination of each title, abstract, and reference, the documents unrelated to economic complexity [14] were excluded. In this process, 103 documents were removed, resulting in a final count of 687 records for further processing in the context of bibliometric analysis and text analysis, leading to the creation of semantic and thematic networks. Finally, 110 documents were selected for in-depth analysis, covering articles that are highly cited by topic and those that encompass emerging subjects.

3.2. Text Analysis: Thematic and Semantic Network (Mapping Study)

VOSviewer offers a user-friendly graphical interface that provides easy access to the VOS (Visualization of Similarities) mapping technique. Moreover, the software comprehensively supports the visualization and interactive examination of bibliometric maps [59].

In this regard, a thematic analysis of the compiled documents for the SLR was conducted using the *VOSviewer* version 1.6.20. Co-occurrences of keywords (defined as topics) and their proximity between terms were analyzed based on their mutual appearance in publications [73]. Additionally, a thesaurus or dictionary of words was constructed to eliminate "noise words" (elements that do not reflect a theoretical or empirical topic) and to relate topics that can be considered synonyms or similar themes (For example, the topics or keywords such as "carbon dioxide", "carbon emission", "carbon footprint", "carbon intensity", "carbon neutrality target", and "carbon reduction" were all replaced by the term "carbon emissions". Similarly, topics stated in singular and plural forms were substituted with their plural denomination).

At the end of this stage, 5 clusters related to sustainability and its main topics were identified: (1) Economic Dimension, (2) Social and Human Dimension, (3) Environmental Dimension, (4) Political Dimension, and (5) Cultural Dimension.

For the semantic–qualitative analysis, *ATLAS.ti*, version 9 was employed, which is specialized software for qualitative data analysis that enables the extraction, categorization, and interlinking of data segments from various documents [74].

In this case, we performed theoretical coding for each document compiled in the SLR. We assigned a label or code to each document based on the topics of sustainability dimensions by reading its title and abstract. This process created the semantic network. We then loaded the semantic network into Graphext to create a dashboard that facilitated interaction with the SLR data and the implemented coding.

According to Cantero [75], the process of theoretical coding is not an independent stage but rather an extension of open and axial coding, with a higher level of abstraction.

The purpose of this coding is to derive a central category that expresses the research phenomenon and integrates the categories and subcategories from open and axial–qualitative coding. During this process, an initial taxonomy was constructed based on the conceptual background reviewed in Section 2.3 of this document to establish a set of categories and subcategories related to sustainability dimensions and themes. These were used as codes in the performed text analysis. Three representative documents were selected from each of the coded themes, considering the most cited or emerging/subtle ones, thus forming a compilation of 110 articles for in-depth analysis.

3.3. In-Depth Analysis

After the selection of the 110 publications for in-depth analysis, a comprehensive reading of each of them was conducted, and a reading record sheet was filled out to capture various characteristics of each document. These characteristics included the research database utilized, techniques employed, study scope, identified gaps, and the main outcomes of the document. Subsequently, a synthesis of the most relevant findings from these articles was performed to pinpoint gaps and research opportunities associated with the study of sustainability dimensions within the framework of economic complexity.

4. Results and Discussion

Within the literature review on economic complexity, the local citation reveals that the top three authors (with the highest local citation) are César Hidalgo, Ricardo Hausmann, and Ron Boschma. Analyzing the top ten local citations is valuable for pinpointing the cluster of researchers with substantial citation centrality within the scientific community focused on the subject matter.

On the other hand, the universities (affiliations) detected most frequently in the compiled documents include Utrecht University in the Netherlands and Harvard University in the United States of America (USA). In third place is the University of Economics Ho Chi Minh City (UEH). Furthermore, *Environmental Science and Pollution Research*, *Regional Studies*, and *Research Policy* are among the journals with the highest number of detected publications.

The scientific production related to the theory of economic complexity has experienced an increase in recent years. During the period 2006–2022, it has shown a publication growth rate of 30%. Furthermore, it was found that the strongest collaboration link between countries is established by the Netherlands and Sweden (frequency = 13), followed by the USA and the Netherlands (frequency = 12). However, for instance, in the case of Mexico, which falls within the fourth quintile with a high number of publications, it lacks a significant collaboration link with other countries.

The growth over time of the publication rate can be observed in the Supplementary Materials S4, where it is notable that starting from the year 2016, there is a significant increase in studies related to economic complexity (ten years after its introduction). Within the temporal series of our investigation, the number of articles has grown from two in the year 2006 to a total of one hundred and forty-two documents in the year 2022.

Figure 2 shows the SLR Network. In the visualization, each node represents a document from the SLR. The node thickness is determined by the document's citation count, while node colors correspond to different dimensions of sustainability.

Figure 3 presents the thematic network organized by sustainability dimension, where nodes represent the topics connected to studies on economic complexity, and circles denote clusters reflecting sustainability dimensions. For instance, the blue oval represents the "ecological dimension" of sustainability, where topics such as Emissions, Environmental Factors, and Energy are clearly grouped. An important feature of the network is that small and peripheral nodes represent emerging or subtle topics (less frequently associated with economic complexity research). Examples include financial inclusion, cultural and creative industries, fertility, historical perspectives (colonization, universal exhibitions, and migration with historical context), and the digital economy. As Rey [76] notes, these pioneering topics within research fields can evolve into comprehensive bodies of knowledge. Such investigations often occur in domains that are inherently challenging to study, with limited precedent, unconventional approaches, and, frequently, only a handful of researchers working on those lines. Consequently, these topics may be regarded as future research opportunities.

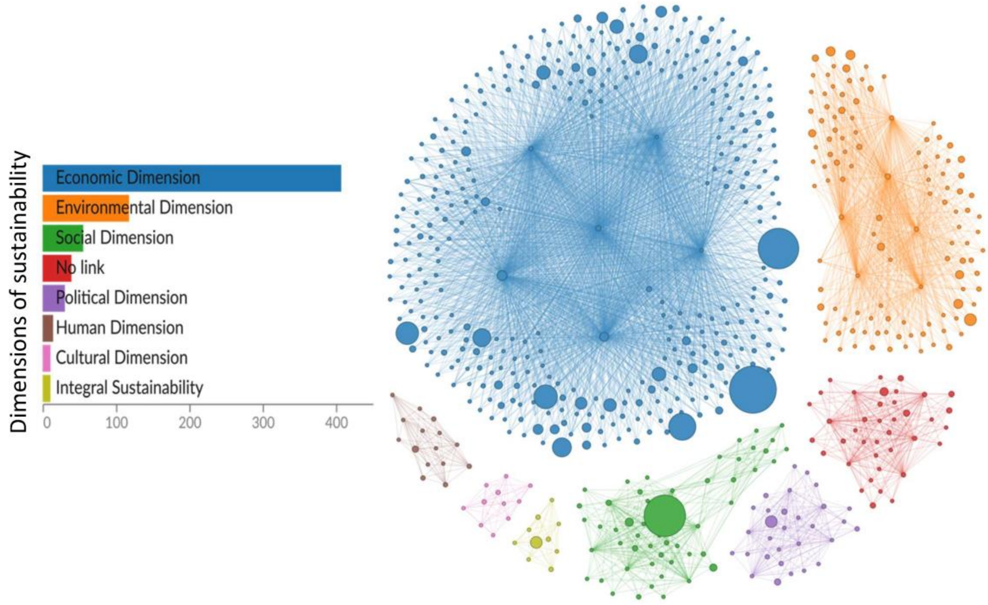

Figure 2. SLR Network. Note: See Supplementary Materials S5 and S6 to consult the data. Available at: https://public.graphext.com/525e0f3004ff5139/index.html?section=graph&colorMap=graphext_cluster&areaMap=CITATION (accessed on 21 December 2023).

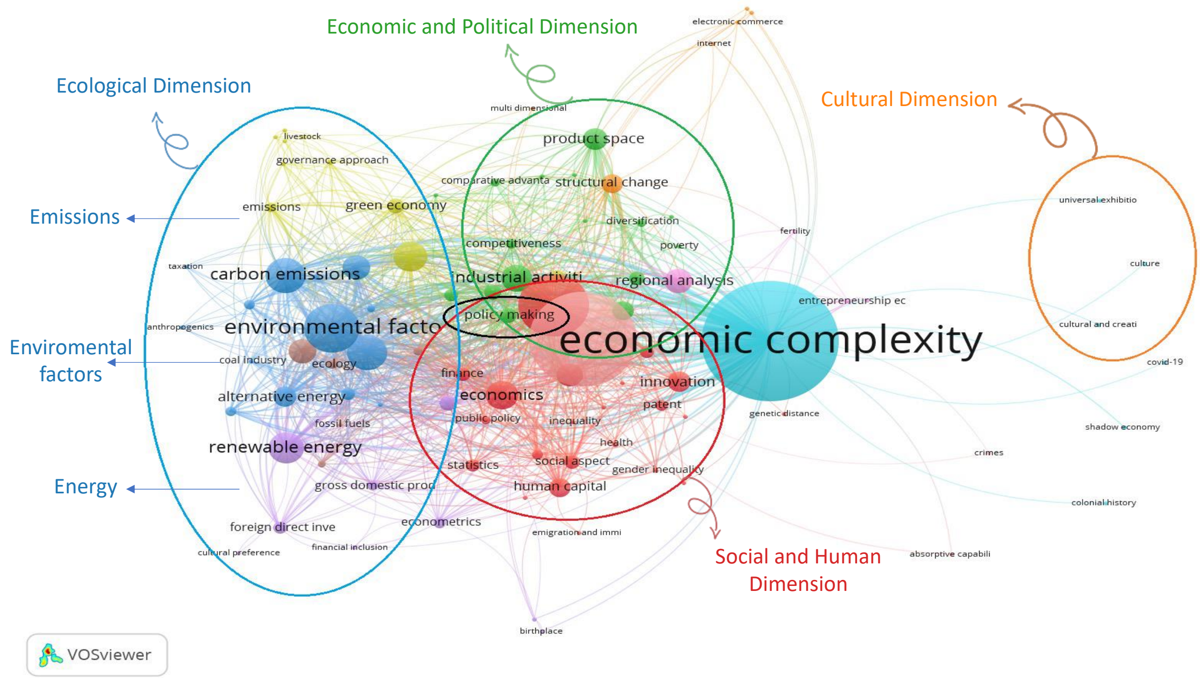

Figure 3. The links of economic complexity with sustainability dimensions—Significant keywords in the co-occurrence analysis. Source: Own elaboration.

4.1. Economic Dimension of Sustainability (Connected to EC Studies)

Here, it is important to remember that the economic dimension of sustainability involves mainly the economic structures that encompass the relationship between the various sectors of the economy (trade, productivity, GDP, etc.). One of the trends in economic complexity is the utilization of subsets of high-granularity data to showcase strategies of smart specialization towards various types of economies and link them with their economic, social, and/or environmental implications. In this context, the findings and gaps reflected by the literature are listed below.

Green Economy: A green economy is characterized by low carbon emissions, efficient resource usage, and social inclusion [77]. Initially, the interconnection between this type of economy and complexity was explored by Huberty and Zachmann [27], Fraccascia et al. [78], and Dordmond et al. [79]. More recently, Mealy and Teytelboym [80], based on economic complexity notions, developed new measures related to the green economy and its productive capabilities. In Latin America, this methodology has been applied at the subnational level in Mexico [81] and Argentina [82,83]. The mentioned works provide empirical evidence to promote the green productive potential of these regions.

However, there is still substantial effort required in this domain, as debates regarding green product listings continue to yield inconclusive results. A European environmental advocacy group stated that out of a list of 665 tentatively environmentally friendly products, only 140 items (20% of the list) would be beneficial to the environment [84]. This highlights the need to reflect on green product taxonomies and recognize that the six-digit Harmonized System (HS) nomenclature often fails to capture green products, such as organic foods derived from agriculture or products embedded in green or circular business models.

Circular Economy: The only study captured by our SLR that directly connects the circular economy with economic complexity is the work of Ha [85], who found that economic complexity and product proximity have favorable impacts on circular economy performance. However, an adverse effect arises after economic complexity performance reaches a certain level. In other words, economic complexity is an essential enabler of the circular economy, but excessive development of economic complexity can hinder this process.

Therefore, greater empirical evidence is expected to emerge (at the micro-, meso-, and macroeconomic levels) and in-depth investigations into the interactions between economic complexity and circularity are anticipated. This would be valuable in providing critical information to decision-makers across various contexts and in seeking optimal pathways to promote economic complexity and a circular economy. As a result, it would contribute to the achievement of Sustainable Development Goal (SDG) 12, "Responsible Consumption and Production".

Blue Economy: The concept of "Oceans Economy" or "Blue Economy" is recent and originated from the United Nations Conference on Sustainable Development held in Rio de Janeiro in 2012. This economy is understood as the "sustainable industrialization of the oceans for the benefit of all" [86] (p. 3). Under the lens of economic complexity, Qi et al. [87] started the study of the structure of this economy and conducted an analysis of the blue-product space using a limited subset of 26 blue products. Subsequently, Qi [88] detected that countries with greater blue diversity also reported higher incomes and economic growth.

However, there are currently no sub-national studies examining the interconnection between economic complexity and the blue economy. Nevertheless, the need for governments to address Sustainable Development Goal 14, "Conserve and Sustainably Use the Oceans, Seas, and Marine Resources", is irrefutable. Therefore, regional research that utilizes this interconnection may serve to design policies and strategies to enhance the blue economy in the studied regions.

Orange Economy: Creative and Cultural Industries (CCIs), known as the Orange Economy, encompass a series of interrelated activities that transform ideas into goods and services, often with value based on intellectual property [89]. It is important to question how this type of economy has been studied from the perspective of complexity. Initially, in Italy (a country with a long historical tradition in culture and creativity), Lazzeretti et al. [90] and Innocenti and Lazzeretti [91] applied complexity techniques and identified an affinity among creative industries (such as architecture, advertising, photography, arts and entertainment, computer programming, and broadcasting). They concluded that these industries should not be analyzed in isolation, as they alone are insufficient to promote local growth and development. The Orange Economy requires the presence of related sectors to generate synergies and facilitate the exchange of knowledge and ideas. Burlina et al. [92] conducted empirical research in the Italian context and used the Economic Complexity Index (ECI) as an indicator to capture the interactive social nature characteristics of the Orange Economy and its impact on firm performance. They calculated two different ECIs (one for industries related to the Orange Economy and another for the rest of the economy). Their most significant finding was that the complexity of the Orange Economy, but not the economic complexity of the rest of the economy, is important for the performance of creative and cultural industry firms. However, the effect is relatively weak.

Outside the Italian context, our SLR does not capture other studies combining complexity methods for understanding the Orange Economy. What is the behavior of this type of economy in other contexts? How could industries such as film, video games, fashion, gastronomy, or crafts be studied using complexity methods? The answer remains unknown, and the availability of hard and comparable data could present a major challenge.

Digital Economy: There is limited empirical evidence regarding the association between digitization and "natural resource rents". However, Mai et al. [93] detected a reduction in "total natural rents" for countries with a high level of economic complexity. Similarly, Ha [94] identified that digitization positively influences economic complexity, suggesting that increasing digital businesses is an effective way to enhance the economic complexity of regions. This finding aligns with Lapatinas' [95] discovery of a positive effect of the internet on economic sophistication. This has interesting policy implications, suggesting that implementing policies that increase internet access accelerates the productive capacity and sophistication levels in an economy.

However, due to the absence of data concerning digital products and services within classification systems, there remains a gap in research that can utilize complexity techniques to map the geography of digital trade. Rahmati et al. [96] conducted a noteworthy study measuring digital proximity in the information technology sector and found that companies able to embrace the digital sector increased their intangible value compared to those that did not. However, there is still much to investigate regarding the connection between the digital economy and complexity.

Informal or Shadow Economy: Economic complexity has been employed to examine the effects of the informal (or shadow) economy, revealing a nonlinear relationship between economic complexity and the informal economy. Additionally, economic complexity may have a positive impact on economic growth and productivity, making it an effective tool for reducing the informal economy and thereby enhancing economic growth [97]. Nguyen [98] found that economic complexity can benefit both the formal and informal economy, with greater benefits for the first one. Laguna et al. [99], in an empirical study in Colombia, discovered that informal sectors produce unsophisticated products and consequently employ cheap labor with low levels of productive knowledge, reflected in a low complexity index.

Urban Economy: Muneepeerakul et al. [100] analyzed occupations and the network of specializations as determinants of urban performance, studying the diversification, specialization, and growth of urban economies due to the possibility of an industry attracting skills from an urban economy and creating new occupations with a mix of abilities. It has been noted that the economic development of countries is related to their urbanization processes during their economic growth phase. However, when countries have achieved economic growth, the importance of urbanization diminishes [101,102].

A common thread among the studies of the types of economies is that, in all instances, significant implications emerge concerning industrial and environmental policies. The utilization of complexity methods offers data and potential strategies for decision-makers. This perhaps elucidates why, thematically, the political dimension of sustainability is implicitly interwoven with economic sustainability in connection to our SLR.

4.2. Political Dimension of Sustainability (Connected to EC Studies)

The importance of considering the interconnection between economic complexity and various types of economies is highlighted to enable the design of policies and strategies that promote, for instance, the creative and cultural industry, environmentally friendly products, circular and digital economies, and more. The objective here is to enhance sustainable development within the specific contexts. Therefore, relying solely on national-level empirical data is insufficient; it is equally imperative to emphasize more precise regional analyses to achieve differentiated policies for effective implementation.

It is evident that policy formulation should be contextually tied to regions, considering capacities, technologies, resources, and other factors that ensure policy appropriateness for each region and enhance success upon implementation. In this regard, Chen et al. [103] suggest that productive knowledge, resources, and existing capacities in territories play a vital role in generating effective industrial policies.

The industrial history of regions should be considered in policy generation as it contextualizes limitations and opportunities. Moreover, it has been observed that new industries can flourish in regions with similar industries to which they are technologically connected. Therefore, regional policies should focus on fostering related industries that drive regional industrial branching, rather than industries in decline [104].

Hidalgo [11] developed a framework centered around four key questions, called the "4W framework" (what, when, where, and who). The 4W framework provides a more comprehensive, nuanced, and complete checklist for industrial development strategy. Economic complexity methods are considered more connected to development strategy than politics, or they tend to underscore the importance of focusing policies on learning. They help contemplate topics like migration, transportation, and export promotion as instruments for knowledge attraction, generation, and dissemination.

4.3. Social and Human Dimensions of Sustainability (Connected to EC Studies)

Is a more complex economy also more inclusive? This question has been a subject of investigation by various authors within the field of economic complexity. A seminal work was conducted by Hartmann et al. [53], where they explored the Product Gini Index (PGI) and discovered that economic complexity is a negative and significant predictor of income inequality. In other words, less complex production structures engender inequalities (on a macro level, at the national scale). The research proved crucial in triggering an emerging wave of studies related to socio-economic aspects connected with income inequality, gender equity [52,54,55,58,59], and social, financial, and LGBT community inclusion [32,56,105].

Inclusion: Regarding financial inclusion, González-Sierra et al. [32] conducted an empirical study in Mexico, and they show that regions with high economic complexity are also regions with high levels of financial inclusion (in terms of usage, i.e., demand for financial products), while regions with significantly low complexity are associated with financial exclusion (in terms of access, or supply of financial products). Additionally, the contribution to economic prosperity and the strengthening of productive capacities and innovation from the inclusion of the lesbian, gay, bisexual, and transgender (LGBT) community has also been studied. It has been found that such inclusion reduces discrimination and promotes creativity, innovation, and resilience. Furthermore, a positive correlation between economic complexity and tolerance for gender diversity has been confirmed [105,106].

Emerging studies on the social dimension of sustainability are related to health and fertility. Both aspects are of special interest to policymakers, and their analysis opens the debate about the positive and adverse effects related to ecological footprint and the economy from a population and health perspective.

Fertility: Kazemzadeh et al. [107] discovered that the effect of fertility rate on the ecological footprint is positive and significant, implying that improving fertility rates will increase the ecological footprint. Their research indicates that the most effective way for emerging economies to reduce environmental degradation is by decreasing fossil fuel consumption, replacing it with renewable energy, and reducing fertility rates. Simultaneously, it was observed that higher economic complexity is associated with a higher Total Fertility Rate, with economic complexity driving fertility development, reduced inequality, and higher education levels [108]. This is relevant considering the finding of Alola et al. [109], who studied fertility rates' impact on ecological footprint in 16 European Union countries and discovered that fertility rate positively affects ecological footprint in the short term. However, in the long run, fertility rate has a negative effect on the ecological footprint.

The critical question that needs to be investigated in various contexts in the future is whether the reduction in fertility rates due to decreased human activities improves the environment. The reduction in fertility rates and the increase in the elderly population pose challenging questions for both society and researchers. For instance, a question that requires further study is as follows: Does the use of advanced technologies to replace young labor result in environmental degradation due to increased industrial and electronic waste? Therefore, as highlighted by Kazemzadeh et al. [107], examining the less obvious policy implications of fertility rate on the environment is crucial.

Health: Additionally, there is an ongoing effort to map the space–disease affinity [10]. The authors analyze the effect of economic development on health aspects in countries and demonstrate that higher per capita income leads to more complex diseases. However, the behavior of economic complexity is different; Vu [57] provides evidence that countries exporting complex products have better health conditions than those whose economy relies on basic products, which can influence the achievement of higher levels of economic complexity.

Inclusion, viewed from various perspectives, has been the concern of a group of researchers who are setting the path for further exploration of the social dimension of sustainability through more comprehensive, specific, or complementary analyses supported by complexity techniques.

4.4. Cultural Dimension of Sustainability (Connected to EC Studies)

The SLR exhibits relatively limited empirical evidence directly linking economic complexity to topics implicit in the cultural dimension of sustainability. However, there are interesting representative works that reflect the potential to interweave such topics and obtain valuable findings, as shown below:

Culture: Kwan and Chiu [110] question whether creativity and human development are driven by cultural diversity. The literature has highlighted that linguistic diversity, for instance, can create communication barriers. The importance of distinguishing between types of diversity based on beliefs, values, and ethno-linguistic diversity is emphasized. Such reasoning has a positive relationship with innovation and a negative one with economic complexity, human development, and regional technological advancement. Lapatinas et al.'s [111] study environmental culture and its relationship with economic complexity, i.e., the impact that a region's level of economic complexity can have on its inhabitants' attitudes towards environmental care. It was found that an increase in economic complexity enhances the likelihood of engaging in voluntary environmental activities and becoming a member of environmental organizations.

Music: Recently, complexity techniques have been linked with music genres. A study by Klement and Strambach [112] developed the music-genre space, distinguishing that new music genres emerge from local knowledge sources and urban music. The authors suggest that new music genres are more likely to emerge with at least 50% of their original genres present in their birthplaces. They also identified that "semi-related" variety promotes musical innovation. However, neither specialization nor variety alone fosters innovation in creative industries, and not all forms of related variety are equally important for explaining the level of innovation in symbolic knowledge (sounds or images) constructed within a social context. In other words, excessive accumulation of symbolic knowledge in a specialized field may limit opportunities for creation and innovation in the same field [8].

For Duxbury and Gillette [3], social history is part of cultural sustainability. In this regard, our SLR has detected that economic complexity is not only useful to predict the future of productive structures but also helps us understand the past. A trio of studies has focused on undertaking this understanding from a historical context.

Colonization: Keneck-Massil and Nvuh-Njoya [113] evaluate the effect of colonization on contemporary economic complexity using variables such as the Economic Complexity Index, mortality rate of settlers, and Gross Domestic Product (GDP) per capita at purchasing power parity. Among their findings, they highlight that settler mortality impacts the overall capabilities of former colonies today. Additionally, colonies with a high settler mortality rate exhibit low levels of economic complexity, implying a decreasing relationship between settler mortality and economic complexity.

The Historical Formation of Knowledge Agglomerations: Koch et al. [114] used data on the biographies of over 22,000 historically famous individuals born between the years 1000 and 2000 to estimate the contribution of immigrants, emigrants, and local famous individuals to the knowledge specializations of European regions. They found that the probability of a region developing specialization in a new activity increases with the presence of immigrants with knowledge of that activity and specialized immigrants. They also found that the probability of a region losing one of its existing areas of specialization decreases with the presence of specialized immigrants in that activity and related activities.

Universal exhibitions, 1855–1900: Using information from the catalogs of five universal exhibitions held in Paris in the second half of the 19th century (1855, 1867, 1878, 1889, 1900), Domini [115] relates intelligent specialization from a historical perspective and confirms the close connection between production and export structures, technological capabilities, and economic growth. The study demonstrates that universal exhibition data can reveal the production of some political entities (countries), even before they were mature enough to compete in international markets and thus be exported. This is the first application of the Economic Complexity Index (ECI) to the pre-World War II era. A significant relationship is observed between the ECI, the level of GDP per capita, and the long-term growth of GDP.

According to the findings of our literature review, the cultural dimension of sustainability has not been comprehensively explored. Few studies have previously linked economic complexity from a historical and cultural perspective. Therefore, these investigations could serve as a starting point to provide insight into how to analyze these issues, either through studies of relatedness or complexity approach.

4.5. Environmental Dimension of Sustainability (Connected to EC Studies)

In this dimension, there are seemingly opposing or divergent findings. While most studies indicate that an increase in economic complexity will result in improved environmental quality, there is evidence that refines this effect by considering income levels and the developmental status of countries. Empirical evidence also exists in certain contexts, suggesting that higher complexity is linked to adverse environmental effects.

Emissions: In France, positive long-term environmental effects have been observed where an increase in economic complexity (EC) translates to a reduction in CO_2 levels [116]. A study conducted in 67 countries found that EC contributes to the reduction in per capita greenhouse gas emissions [64]. In contrast, economic complexity amplifies greenhouse gas emissions, having a stronger effect in countries with lower economic complexity (scope: 25 EU countries) [117].

Environmental degradation: In a USA context, Pata [118] detected that economic complexity is negatively correlated with environmental degradation. Similarly, Lapatinas et al. [95] confirmed a positive correlation between the increase in economic complexity and the improvement in environmental quality (scope: 88 countries). While Dogan et al. [119] found that enhancing the Economic Complexity Index aids environmental improvement (scope: 28 OECD countries). In contrast, in a Latin American context, Alvarado et al. [120] have detected that the increase in economic sophistication exacerbates environmental degradation, with its impact differing across countries depending on their income levels. For instance, in countries classified as high and upper-middle income, greater economic complexity leads to a rise in per capita ecological footprint. Conversely, in nations characterized as lower-middle and low income, enhanced economic complexity results in a reduction in the ecological footprint.

Ecological footprint: Ahmad et al. [121] found that "a higher level of economic complexity facilitates ecological footprint mitigation". Consequently, emerging countries should accelerate economic complexity with a stronger institutional framework. Their study covers 20 emerging countries. Set in opposition, Yilanci and Pata [122] discovered empirical evidence in China that implies that energy consumption and economic complexity both contribute to an increase in the ecological footprint in both the short and long term, while Huang et al. [123], showed empirical findings revealing that economic complexity augments pollution levels, while renewable energies significantly diminish them (from the perspective of E-7 countries). Conversely, in G-7 countries, economic complexity, along with other factors, notably enhances environmental quality. Substantial disparity exists among these countries.

Resources: Regarding resources, Mai et al. [93] found a reduction in "total natural rents" for countries with a high level of EC (26 European countries). Additionally, the increase in EC is strongly linked to future improvements in a country's resource efficiency [124]. Meanwhile, a study in the USA detected that renewable energy consumption translates to a higher ECI, economic growth, and the export of more complex products [85].

Green and Circular Economy: According to Ha [85], in the European Union, the effect of economic complexity on circularity performance is ambiguous. If negative effects outweigh positive ones, economic complexity can adversely affect circularity performance. Meanwhile, Mealy and Teytelboym [80] have confirmed that countries with a higher Green Complexity Index tend to exhibit lower CO_2 emissions. This result is opposite to Simdi and Seker [125]. They studied a sub-topic of environmental sustainability called "food safety". Their findings showed that per capita GDP, Economic Complexity Index, and livestock population increase CO_2 emissions. They discovered that high livestock population and meat consumption will necessitate the adoption of cultured meat in the future.

The growing literature on economic complexity and the environment suggests that this approach can be a useful lens to better understand how productive structures and technological capabilities can be steered into the sustainable transition. However, studies on the relationship between economic complexity and environmental indicators are quite heterogeneous in terms of the data and the analytical techniques they employ. As a consequence, comparing their results is not always straightforward [126].

These challenges or inconsistencies raise concerns and reveal research opportunities. Future studies could explore the impact of economic complexity in different contexts, such as using other proxies like water footprint. Utilizing analytical techniques that have been explored by other authors or discovering novel approaches could offer significant value. There is a wide range of studies on ecological footprint, but very little research related to water. Economic complexity offers the feasibility to study, for example, the virtual water trade, sustainable tourism, or food security, among other aspects.

5. Suggestions for Future Research

In the preceding section, we discussed emerging and peripheral studies from the SLR along with resulting gaps that link economic complexity with the dimensions of sustainable development. In this section, we will address suggestions for a future research agenda. This systematic literature review has demonstrated that there are still many open challenges when connecting the use of complexity to the understanding of the economic–political, social–human, environmental, and cultural dimensions of sustainable development.

Consequently, we propose five avenues for future research on these interconnections, with the aim of comprehending the issues and challenges of sustainable development from the perspective of economic complexity:

(1) **Economic and Political Dimension:** Expand the variety of regional-scale studies that combine complexity methods with diverse types of economies (green, blue, orange, circular, urban, informal, social and solidarity economy, etc.) to analyze their implications in terms of policy (economic, regional, urban, industrial, environmental).
(2) **Social–Human Dimension:** Extend studies that link economic complexity with types of inclusion (social, gender, financial) and diverse social issues specific to regions (fertility rate, corruption, crime, health, poverty, housing, etc.).
(3) **Cultural Dimension:** Conduct studies with unconventional data aspects related to cultural sustainability (e.g., music and sports, social history, cultural environment) at different scales.
(4) **Environmental Dimension:** Explore various environmental indicators (e.g., emissions, food security, energy, natural resources, ecological footprint, water footprint, etc.) and assess, using robust analytical techniques, their impacts (positive or negative) on economic complexity in geographical contexts different from those already studied.
(5) **Integral Sustainability:** Analyze regional multidimensional complexity (involving data on published research, patents, and trade) and its relation to inclusive and green growth.

We anticipate a growing number of studies in the future that will intricately connect economic complexity with one or more dimensions of sustainability. Currently, there is a growing body of literature that interconnects economic complexity and the environmental dimension of sustainability, suggesting that this kind of combined approach is valuable and can be extended to better understand how social, human, cultural, and political sustainability is explained by their productive structures and capabilities.

We believe that to embark on a research agenda that bridges sustainable development and economic complexity, an essential step is to delve into the analysis of multidimensional complexity [38] at a subnational (regional) level. This is because macro-scale results cannot be easily generalized to other geographical scales, such as states and provinces. In this regard, it is essential to explore appropriate proxies of capabilities at the regional level; this is especially crucial since not all municipalities or provinces possess an export-oriented focus, yet they exhibit a productive inclination linked to a prevalent economic framework (such as the blue economy, orange economy, green economy, circular economy, informal economy, digital economy, social and solidarity economy, etc.). This vocation should also be investigated at a more focused regional scale to promote context-specific differentiated policies.

Economic complexity provides policymakers with useful roadmaps for smart specialization and ways to achieve the goals of economic growth, inclusivity, and green development. Therefore, we believe that in the future, the 4W approach (4W: what approaches, focused on identifying target activities and/or locations; when approaches, focused on the timing of related and unrelated diversification; where approaches, focused on the geographic diffusion of knowledge; and who approaches, focused on the role played by agents of structural change. The goal of this approach is to provide a framework that groups, organizes, and clarifies the policy implications of economic complexity and facilitates its continued use in regional and international development [11].) will be widely used to dissect the industrial development strategies of regions.

Conversely, the diverse array of themes encompassing the social dimension of sustainability unveils promising research prospects to further explore emerging subjects identified in our comprehensive literature review. These encompass areas like crime, violence, corruption, LGBT inclusion, financial and social inclusivity, fertility, and health. The way these topics can be analyzed is by comparing them with the Economic Complexity Index and studying their elasticities with these factors, or by leveraging network science in conjunction with complexity studies to unpack various types of relatedness.

Regarding the cultural dimension of sustainability, it is important to highlight that these themes are still in their early stages, and in most instances, they are connected to the utilization of non-traditional data analyzed using complexity methods. Research studies like Koch et al. [114], Knuepling and Broekel [9], Garas et al. [10], Klement and Strambach [112], and Chinazzi et al. [127] serve as significant reference points to inspire the use of economic complexity with data from atypical sources. The study of social history using complexity techniques is also emerging to understand the past, historical context, and the processes that shaped economies as we know them today.

Furthermore, in the future, the environmental dimension of sustainability will need to address the paradox that green innovations require not only "green" inputs but also "brown" inputs in productive activities, as green innovation may be associated with increased energy consumption and emissions [93]. The contradictions linked to the phenomenon where countries boasting higher economic complexity simultaneously achieve low-carbon economic objectives, yet complex economic structures have demanded more energy and increased energy demand also produces more harmful pollutants must be unraveled. Therefore, some studies have considered the growing economic complexity as a cause of environmental degradation. These contradictions offer future research opportunities across different scales and geographical contexts.

Lastly, it is important to note that economic complexity research has evolved beyond its original reliance solely on hard data extracted from international trade. It has now incorporated novel and more detailed hard data from diverse areas of interest (diseases, sports, blue economy, etc.). Moreover, gradually in the future, economic complexity studies will also involve soft data (qualitative data: generally descriptive and not following the standard research process that hard data typically require most of the time) from online collaboration repositories or non-conventional data platforms. Examples of this can be seen in studies that utilize platforms such as pantheon.world or Last.fm to unpack historical migration affinity and musical genre contexts, respectively. The use of unconventional data will be a challenge that researchers in this field will have to address.

6. Conclusions

This research shows the first Systematic Mapping Study of the literature conducted on the theory of economic complexity, utilizing the databases *Scopus*, *Web of Science*, and *Semantic Scholar*, and managing to compile a collection of 687 documents. This compilation allowed for the discovery of emerging thematic connections related to economic complexity.

Our research begins with the following question: What are the intrinsic connections between economic complexity and sustainability dimensions? Now, in Figure 4, you can notice that this question has been solved with a deep immersion into the literature of EC. The results reflect the multiple dimensions of sustainability and the broad spectrum of topics that have been studied in connection with the economic complexity approach.

This work goes beyond certain limitations encountered in other conducted systematic reviews and provides a comprehensive perspective on the links of economic complexity. However, our study does have certain limitations. Firstly, among all the existing databases, we only employed three (*Scopus*, *Web of Science*, and *Semantic Scholar*), which, despite being robust, exclude non-indexed or embedded documents in other databases. Secondly, the searches in *Semantic Scholar* were iterative and did not utilize the query chain. Thirdly, the English-written queries introduce a bias towards documents in that language when generating results. Fourthly, the keywords might exclude documents that, despite applying complexity, are not labeled with our predefined query. Furthermore, future studies could analyze the extrinsic connections of economic complexity with any dimension of sustainability, making a search for "economic complexity" and after that making a separate search for "sustainability" literature and only focusing on the intersection of the two queries. Here, the purpose was to go deep into the economic complexity literature and find its intrinsic links with sustainability dimensions.

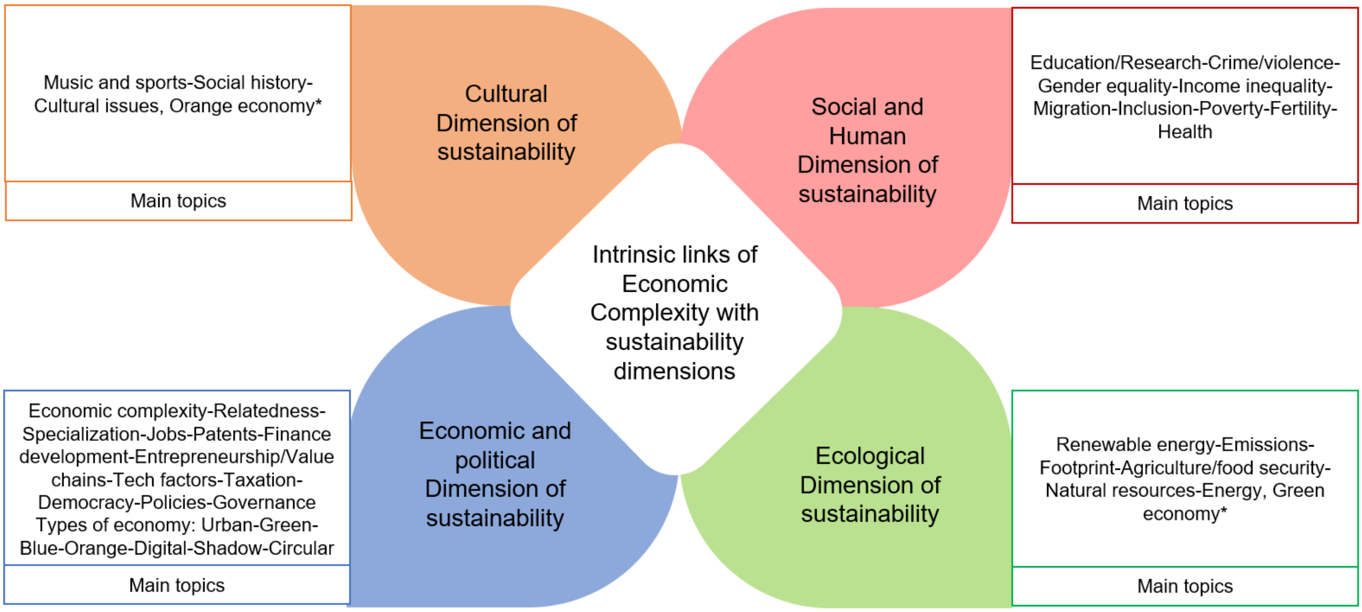

Figure 4. What are the intrinsic connections between economic complexity and sustainability dimensions? * Means topics that are in more than 2 dimensions. Source: Own elaboration based on the diagram of Duxbury and Gillette [3] "Four well-beings of community sustainability". Note: Economic and political dimensions of sustainability have focused on topics like different types of relatedness [29,37,128], urban economy [100–102], green economy [78,80,129], blue economy [87,88], orange economy [90–92], digital economy [94,96], shadow economy [97–99], specialization [115,130,131], jobs [132–134], patents [41,135], finance development [136,137], entrepreneurship [137–139], value chains [140,141], tech factors [142–144], circular economy [85,145,146], democracy [147–149], policies [11,103,104], governance [150,151], and taxation [95,119], which have been studied in connection with EC. Similarly, the social and human dimensions of sustainability have been concerned about issues such as education/research [35,152,153], inclusion [32,56,105], poverty [60–62], fertility [107,108], migration [114,154,155], income inequality [53–55], crime/violence [156,157], gender equality [52,58,59], health [10,57], and human development [158–160]. The intrinsic links of EC with "Environmental dimension of sustainability" are mainly renewable energy [118,161,162], emissions [64,116,163], footprint [122,164,165], agriculture/food security [125,166], natural resources [93,120,124], and energy [117,121,167], while the intrinsic links of EC with "Cultural dimension of sustainability" detected are only music and sports [8,9,112], social history [113–115], and cultural issues [110,111].

Despite these limitations, this study outlines the main bibliometric indicators regarding the literature on economic complexity, the connections between sustainability dimensions and economic complexity, and the research gaps related to emerging and subtle trends in this interconnection.

Our systematic literature review reveals that economic complexity resonates across various disciplines of knowledge. This is reflected in researchers' tendency to combine topics that would typically be analyzed in isolation. The research documents compiled in this review mostly address phenomena that scholars tend to study in a combined manner: viable development (economic and environmental aspects), equitable development (socioeconomic elements), and livable development (social and environmental themes). We observe a dialogue between sustainability dimensions that economic complexity can capture through its unique tools: network science, data science, and computational sciences.

The uses and applications of economic complexity seem boundless when considering the numerous themes that fit within each sustainability dimension. Economic complexity is a potent theory that aids in understanding the multidimensional problems arising from the pursuit of sustainable development and enables a focused analysis of certain dimensions or, alternatively, the parallel assessment of the impacts of economic growth, inequality, and emission intensity.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16010391/s1, File S1: Dimensions and themes of Sustainability, File S2: PRISMA checklist, File S3: Search strategy and inclusion/exclusion criteria, File S4: descriptive results, File S5: List of references of the articles included in the SLR and its metadata and classification, File S6; List of references analyzed in depth. Reference [168] is cited in the supplementary materials.

Author Contributions: M.G.M.-H.: Conceptualization, Methodology, Software, Visualization, Data curation; C.C.P.-H.: Methodology, Visualization, Data curation, Writing—Original draft preparation; B.C.S.-H.: Methodology, Writing—Reviewing and Editing. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Data are contained within the article and Supplementary materials.

Acknowledgments: The authors thank the editors and anonymous referees whose comments are highly appreciated. They also thank César A. Hidalgo for commenting on earlier presentations of the ideas behind this paper.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Dator, J. *Introducción a Los Estudios de Futuros*; Entro de Diseño, Cine y Televisión: Ciudad, Mexico, 2017.
2. Redclift, M. The Multiple Dimensions of Sustainable Development. *Geography* **1991**, *76*, 36–42.
3. Duxbury, N.; Gillette, E. Culture as a Key Dimension of Sustainability: Exploring Concepts, Themes, and Models. 2007. Available online: https://cercles.diba.cat/documentsdigitals/pdf/E130054.pdf (accessed on 27 May 2022).
4. Pawłowski, A. How many dimensions does sustainable development have? *Sustain. Dev.* **2008**, *16*, 81–90. [CrossRef]
5. Purvis, B.; Mao, Y.; Robinson, D. Three pillars of sustainability: In search of conceptual origins. *Sustain. Sci.* **2019**, *14*, 681–695. [CrossRef]
6. Dalampira, E.S.; Nastis, S.A. Back to the future: Simplifying Sustainable Development Goals based on three pillars of sustainability. *Int. J. Sustain. Agric. Manag. Inform.* **2020**, *6*, 226. [CrossRef]
7. Wiktor-Mach, D. What role for culture in the age of sustainable development? UNESCO's advocacy in the 2030 Agenda negotiations. *Int. J. Cult. Policy* **2020**, *26*, 312–327. [CrossRef]
8. Klement, B.; Strambach, S. How do new music genres emerge? Diversification processes in symbolic knowledge bases. *Reg. Stud.* **2019**, *53*, 1447–1458. [CrossRef]
9. Knuepling, L.; Broekel, T. Does relatedness drive the diversification of countries' success in sports? *Eur. Sport Manag. Q.* **2020**, *22*, 182–204. [CrossRef]
10. Garas, A.; Guthmuller, S.; Lapatinas, A. *The Development of Nations Conditions the Disease Space*; Publications Office of the European Union: Luxembourg, 2019. [CrossRef]
11. Hidalgo, C.A. The policy implications of economic complexity. *Res. Policy* **2023**, *52*, 104863. [CrossRef]
12. Balland, P.-A.; Broekel, T.; Diodato, D.; Giuliani, E.; Hausmann, R.; O'Clery, N.; Rigby, D. The new paradigm of economic complexity. *Res. Policy* **2022**, *51*, 104450. [CrossRef]
13. Hidalgo, C.A.; Klinger, B.; Barabási, A.-L.; Hausmann, R. The Product Space Conditions the Development of Nations. *Science* **2007**, *317*, 482–487. [CrossRef]
14. Hidalgo, C.A.; Hausmann, R. The building blocks of economic complexity. *Proc. Natl. Acad. Sci. USA* **2009**, *106*, 10570–10575. [CrossRef] [PubMed]
15. Junior, E.; Fagundes, M.B.B.; Figueiredo, A. Economic Complexity: A Systematic Review of Literature. *Desafio Online* **2020**, *9*, 116–137. [CrossRef]
16. Ferraz, D.; Falguera, F.P.S.; Mariano, E.B.; Hartmann, D. Linking Economic Complexity, Diversification, and Industrial Policy with Sustainable Development: A Structured Literature Review. *Sustainability* **2021**, *13*, 1265. [CrossRef]
17. Bahrami, F.; Shahmoradi, B.; Noori, J.; Turkina, E.; Bahrami, H. Economic complexity and the dynamics of regional competitiveness a systematic review. *Compet. Rev.* **2022**, *33*, 1–34. [CrossRef]
18. Arthur, W.B. Complexity and the Economy. *Science* **1999**, *284*, 107–109. [CrossRef] [PubMed]
19. Arthur, W.B. *Complexity Economics: A Different Framework for Economic Thought*; Oxford University Press: Oxford, UK, 2013.

20. Arthur, W.B.; Beinhocker, E.D.; Stanger, A. *Complexity Economics: Proceedings of the Santa Fe Institute's 2019 Fall Symposium (Dialogues of the Applied Complexity Network)*; SFI Press: Santa Fe, NM, USA, 2020.
21. Krakauer, D.C. Complex Economies: From the Keynesian orbit to the darwinian worm. In *Complexity Economics: Proceedings of the Santa Fe Institute's 2019 Fall Symposium (Dialogues of the Applied Complexity Network)*; Arthur, W.B.; Beinhocker, E.D.; Stanger, A. (Coord.); SFI Press: Santa Fe, NM, USA, 2020.
22. Scrieciu, S.Ş.; Zimmermann, N.; Chalabi, Z.; Davies, M. Linking complexity economics and systems thinking, with illustrative discussions of urban sustainability. *Camb. J. Econ.* **2021**, *45*, 695–722. [CrossRef]
23. Foxon, T.J.; Kohler, J.; Michie, J.; Oughton, C. Towards a new complexity economics for sustainability. *Camb. J. Econ.* **2013**, *37*, 187–208. [CrossRef]
24. Moreno-Casas, V. The Harvard-MIT complexity approach to development and Austrian economics: Similarities and policy implications. *Rev. Austrian Econ.* **2021**, *36*, 515–539. [CrossRef]
25. Hidalgo, C.A. Economic complexity theory and applications. *Nat. Rev. Phys.* **2021**, *3*, 92–113. [CrossRef]
26. Koch, P. Economic complexity and growth: Can value-added exports better explain the link? *Econ. Lett.* **2021**, *198*, 109682. [CrossRef]
27. Huberty, M.; Zachmann, G. *Green Exports and the Global Product Space: Prospects for EU Industrial Policy*; Bruegel Working Paper 2011/07; Bruegel: Brussels, Belgium, 2011.
28. Gómez-Zaldívar, M.; Gómez-Zaldívar, F. Municipal Economic Complexity in Mexico: Productive Capabilities, Wealth, Economic Growth, and Business Sophistication. *Rev. Reg. Stud.* **2023**, *53*. [CrossRef]
29. Neffke, F.; Henning, M.; Boschma, R. How Do Regions Diversify over Time? Industry Relatedness and the Development of New Growth Paths in Regions. *Econ. Geogr.* **2011**, *87*, 237–265. [CrossRef]
30. Hane-Weijman, E.; Eriksson, R.H.; Rigby, D. How do occupational relatedness and complexity condition employment dynamics in periods of growth and recession? *Reg. Stud.* **2022**, *56*, 1176–1189. [CrossRef]
31. DataMéxico DataMéxico | Data México. Available online: https://www.economia.gob.mx/datamexico/ (accessed on 15 August 2023).
32. González Sierra, J.; Pérez-Hernández, C.C.; Mendoza Moheno, J. Inclusión financiera y complejidad económica en México. *Rev. Mex. Econ. Finanz.* **2023**, *18*, 1–25. [CrossRef]
33. Boschma, R.; Martín, V.; Minondo, A. Neighbour regions as the source of new industries. *Pap. Reg. Sci.* **2016**, *96*, 227–245. [CrossRef]
34. Balland, P.-A.; Rigby, D. The Geography of Complex Knowledge. *Econ. Geogr.* **2017**, *93*, 1–23. [CrossRef]
35. Guevara, M.; Hartmann, D.; Aristarán, M.; Mendoza, M.; Hidalgo, C.A. The research space: Using career paths to predict the evolution of the research output of individuals, institutions, and nations. *Scientometrics* **2016**, *109*, 1695–1709. [CrossRef]
36. Balland, P.-A.; Boschma, R. Do scientific capabilities in specific domains matter for technological diversification in European regions? *Res. Policy* **2022**, *51*, 104594. [CrossRef]
37. Catalán, P.; Navarrete, C.; Figueroa, F. The scientific and technological cross-space: Is technological diversification driven by scientific endogenous capacity? *Res. Policy* **2020**, *51*, 104016. [CrossRef]
38. Stojkoski, V.; Koch, P.; Hidalgo, C. Multidimensional Economic Complexity: How the Geography of Trade, Technology, and Research Explain Inclusive Green Growth. *arXiv* **2022**, arXiv:2209.08382.
39. Balland, P.A. Economic Geography in R: Introduction to the EconGeo Package. 2017. Available online: https://ssrn.com/abstract=2962146 (accessed on 21 December 2023). [CrossRef]
40. Pominova, M.; Gabe, T.; Crawley, A. The Pitfalls of Using Location Quotients to Identify Clusters and Represent Industry Specialization in Small Regions. *Int. Financ. Discuss. Pap.* **2021**, *2021*, 1–25. [CrossRef]
41. Boschma, R.; Balland, P.-A.; Kogler, D.F. Relatedness and technological change in cities: The rise and fall of technological knowledge in US metropolitan areas from 1981 to 2010. *Ind. Corp. Chang.* **2014**, *24*, 223–250. [CrossRef]
42. Hoover, E.; Giarratani, F. *An Introduction to Regional Economics*, 3rd ed.; Alfred A. Knopf: New York, NY, USA, 1985.
43. OEC. Métodos | OEC-The Observatory of Economic Complexity. Available online: https://oec.world/es/resources/methods#economic-complexity (accessed on 15 August 2023).
44. Hidalgo, C.A. *Why Information Grows: The Evolution of Order, from Atoms to Economies*; Basic Books: London, UK, 2015; ISBN 0-465-04899-4.
45. Mealy, P.; Coyle, D. To them that hath: Economic complexity and local industrial strategy in the UK. *Int. Tax Public Financ.* **2022**, *29*, 358–377. [CrossRef]
46. Darlow, A. Cultural Policy and Urban Sustainability: Making a missing link? *Plan. Pract. Res.* **1996**, *11*, 291–302. [CrossRef]
47. Brundtland, G.H. Report of the World Commission on Environment and Development: Our Common Future. United Nations. 1987. Available online: https://digitallibrary.un.org/record/139811?ln=en (accessed on 27 May 2022).
48. UNESCO Decenio de las Naciones Unidas de la Educación para el Desarrollo Sostenible, 2005–2014: El Decenio en Pocas Palabras-UNESCO Biblioteca Digital. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000141629_spa (accessed on 15 August 2023).
49. Quiroga Martínez, R. *Indicadores de Sostenibilidad Ambiental y de Desarrollo Sostenible: Estado del arte y Perspectivas*; Serie manuales/Naciones Unidas, Comision Económica para América Latina y el Caribe; Naciones Unidas, CEPAL, Div. de Medio Ambiente y Asentamientos Humanos: Santiago de Chile, Chile, 2001; ISBN 978-92-1-321911-9.

50. Aerni, P. Decentralized economic complexity in switzerland and its contribution to inclusive and sustainable change. *Sustain. Switz.* **2021**, *13*, 4181. [CrossRef]
51. Cakir, B.; Schluep, I.; Aerni, P.; Cakir, I. Amalgamation of Export with Import Information: The Economic Complexity Index as a Coherent Driver of Sustainability. *Sustainability* **2021**, *13*, 2049. [CrossRef]
52. Barza, R.; Jara-Figueroa, C.; Hidalgo, C.A.; Viarengo, M. *Knowledge Intensity and Gender Wage Gaps: Evidence from Linked Employer-Employee Data*; Elsevier: Amsterdam, The Netherlands, 2020. [CrossRef]
53. Hartmann, D.; Guevara, M.R.; Jara-Figueroa, C.; Aristaran, M.; Hidalgo, C.A. Linking Economic Complexity, Institutions, and Income Inequality. *World Dev.* **2017**, *93*, 75–93. [CrossRef]
54. Lee, K.-K.; Vu, T.V. Economic complexity, human capital and income inequality: A cross-country analysis. *Jpn. Econ. Rev.* **2020**, *71*, 695–718. [CrossRef]
55. Chu, L.K.; Hoang, D.P. How does economic complexity influence income inequality? New evidence from international data. *Econ. Anal. Policy* **2020**, *68*, 44–57. [CrossRef]
56. Hartmann, D.; Bezerra, M.; Lodolo, B.; Pinheiro, F.L. International trade, development traps, and the core-periphery structure of income inequality. *Economica* **2019**, *21*, 255–278. [CrossRef]
57. Vu, T.V. Economic complexity and health outcomes: A global perspective. *Soc. Sci. Med.* **2020**, *265*, 113480. [CrossRef]
58. Ben Saad, M.; Assoumou-Ella, G. Economic Complexity and Gender Inequality in Education: An Empirical Study. *Econ. Bull.* **2019**, *39*, 321–334.
59. Nguyen, C.P. Gender equality and economic complexity. *Econ. Syst.* **2021**, *45*, 100921. [CrossRef]
60. Pugliese, E.; Chiarotti, G.L.; Zaccaria, A.; Pietronero, L. Complex Economies Have a Lateral Escape from the Poverty Trap. *PLoS ONE* **2017**, *12*, e0168540. [CrossRef]
61. Felipe, J.; Kumar, U.; Arnelyn, A. *How Rich Countries Became Rich and Why Poor Countries Remain Poor: It's the Economic Structure...Duh!* Elsevier: Amsterdam, The Netherlands, 2010. [CrossRef]
62. Gnangnon, S.K. Economic complexity and poverty in developing countries. *Econ. Aff.* **2021**, *41*, 416–429. [CrossRef]
63. Safi, A.; Wei, X.; Sansaloni, E.M.; Umar, M. Breaking down the complexity of sustainable development: A focus on resources, economic complexity, and innovation. *Resour. Policy* **2023**, *83*, 103746. [CrossRef]
64. Romero, J.P.; Gramkow, C. Economic complexity and greenhouse gas emissions. *World Dev.* **2020**, *139*, 105317. [CrossRef]
65. Denyer, D.; Tranfield, D. Producing a systematic review. *Sage Handb. Organ. Res. Methods* **2009**, *4*, 671–689.
66. Manterola, C.; Astudillo, P.; Arias, E.; Claros, N. Revisiones sistemáticas de la literatura. Qué se debe saber acerca de ellas. *Cir. Esp.* **2013**, *91*, 149–155. [CrossRef]
67. Siddaway, A.P.; Wood, A.M.; Hedges, L.V. How to Do a Systematic Review: A Best Practice Guide for Conducting and Reporting Narrative Reviews, Meta-Analyses, and Meta-Syntheses. *Annu. Rev. Psychol.* **2019**, *70*, 747–770. [CrossRef]
68. Núñez-Merino, M.; Maqueira-Marín, J.M.; Moyano-Fuentes, J.; Castaño-Moraga, C.A. Industry 4.0 and supply chain. A Systematic Science Mapping analysis. *Technol. Forecast. Soc. Chang.* **2022**, *181*, 121788. [CrossRef]
69. ATLAS.ti. ATLAS.ti | The #1 Software for Qualitative Data Analysis. Available online: https://atlasti.com (accessed on 17 November 2023).
70. Graphext. Graphext | No-Code Data Analytics. Available online: https://www.graphext.com/ (accessed on 13 December 2022).
71. VOSviewer. VOSviewer-Visualizing Scientific Landscapes. Available online: https://www.vosviewer.com (accessed on 17 November 2023).
72. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. Declaración PRISMA 2020: Una guía actualizada para la publicación de revisiones sistemáticas. *Rev. Esp. Cardiol.* **2021**, *74*, 790–799. [CrossRef]
73. van Eck, N.J.; Waltman, L.; Dekker, R.; van den Berg, J. A comparison of two techniques for bibliometric mapping: Multidimensional scaling and VOS. *J. Am. Soc. Inf. Sci. Technol.* **2010**, *61*, 2405–2416. [CrossRef]
74. Sabariego-Puig, M. El análisis cualitativo de datos con ATLAS.ti. *REIRE. Rev. D'innovació I Recer. En Educ.* **2014**, *7*, 119–133.
75. Cantero, D.S.M. Teoría Fundamentada y Atlas ti. *Rev. Electrónica Investig. Educ.* **2014**, *16*, 104–122.
76. Rey, J. Investigación de frontera: Traer un futuro al presente. *Cuad. Fund. Gen. CSIC* **2011**, *5*, 98–99.
77. PNUMA. Hacia una Economía Verde: Guía para el Desarrollo Sostenible y la Erradicación de la Pobreza. Available online: http://www.unep.org/explore-topics/green-economy (accessed on 15 August 2023).
78. Fraccascia, L.; Giannoccaro, I.; Albino, V. Green product development: What does the country product space imply? *J. Clean. Prod.* **2018**, *170*, 1076–1088. [CrossRef]
79. Dordmond, G.; de Oliveira, H.C.; Silva, I.R.; Swart, J. The complexity of green job creation: An analysis of green job development in Brazil. *Environ. Dev. Sustain.* **2021**, *23*, 723–746. [CrossRef]
80. Mealy, P.; Teytelboym, A. Economic complexity and the green economy. *Res. Policy* **2020**, *51*, 103948. [CrossRef]
81. Pérez-Hernández, C.C.; Salazar-Hernández, B.C.; Mendoza-Moheno, J.; Cruz-Coria, E.; Hernández-Calzada, M.A. Mapping the green product-space in mexico: From capabilities to green opportunities. *Sustain. Switz.* **2021**, *13*, 945. [CrossRef]
82. Palazzo, G.; Feole, M.; Gutman, M.; Bercovich, S.; Pezzarini, L.; Lourenco, M.B.D.; Mascarenhas, T.B. *El Potencial Productivo Verde de la Argentina*; Fundar: Buenos Aires, Argentina, 2021.
83. Belmartino, A. Green & Non-Green Relatedness: Challenges and Diversification Opportunities for Regional Economies in Argentina. 2022. Available online: http://nulan.mdp.edu.ar/id/eprint/3697 (accessed on 27 May 2022).

84. World Trade Green Products. Available online: https://insidetrade.com/daily-news/ngo-leaks-ega-product-list-finds-only-20-percent-items-would-help-environment (accessed on 15 August 2023).
85. Ha, L.T. What are the impacts of economic complexity and product proximity on nations' circularity? An empirical approach using statistical analysis. *Environ. Sci. Pollut. Res.* **2023**, *30*, 90256–90275. [CrossRef]
86. Smith-Godfrey, S. Defining the Blue Economy. *Marit. Aff. J. Natl. Marit. Found. India* **2016**, *12*, 58–64. [CrossRef]
87. Qi, X.; Xiao, W.; Xiang, X. The spatial pattern of the blue product development of nations: An empirical analysis based on product space theory. *Ocean Coast. Manag.* **2021**, *207*, 105596. [CrossRef]
88. Qi, X. Building a bridge between economic complexity and the blue economy. *Ocean Coast. Manag.* **2022**, *216*, 105987. [CrossRef]
89. IDB. IDB | Inter American Development Bank. Available online: https://www.iadb.org/en (accessed on 17 October 2023).
90. Lazzeretti, L.; Innocenti, N.; Capone, F. Does Related Variety Matter for Creative Industries. 2015. Available online: http://econ.geo.uu.nl/peeg/peeg1510.pdf (accessed on 27 May 2022).
91. Innocenti, N.; Lazzeretti, L. Do the creative industries support growth and innovation in the wider economy? Industry relatedness and employment growth in Italy. *Ind. Innov.* **2019**, *26*, 1152–1173. [CrossRef]
92. Burlina, C.; Casadei, P.; Crociata, A. Economic complexity and firm performance in the cultural and creative sector: Evidence from Italian provinces. *Eur. Urban Reg. Stud.* **2022**, *30*, 096977642211253. [CrossRef]
93. Mai, N.T.; Ha, L.T.; Hoa, T.T.M.; Huyen, N.T.T. Effects of Digitalization on Natural Resource Use in European Countries: Does Economic Complexity Matter? *Int. J. Energy Econ. Policy* **2022**, *12*, 77–92. [CrossRef]
94. Ha, L.T. Digital Business and Economic Complexity. *J. Comput. Inf. Syst.* **2022**, *62*, 162–175. [CrossRef]
95. Lapatinas, A.; Kyriakou, A.; Garas, A. Taxation and economic sophistication: Evidence from OECD countries. *PLoS ONE* **2019**, *14*, e0213498. [CrossRef]
96. Rahmati, P.; Tafti, A.R.; Westland, J.C.; Hidalgo, C. When All Products Are Digital: Complexity and Intangible Value in the Ecosystem of Digitizing Firms. *IEEE Pers. Commun.* **2020**, *8*, 10–17. [CrossRef]
97. Ha, L.T.; Dung, H.P.; Thanh, T.T. Economic complexity and shadow economy: A multi-dimensional analysis. *Econ. Anal. Policy* **2021**, *72*, 408–422. [CrossRef]
98. Nguyen, C.P. Does economic complexity matter for the shadow economy? *Econ. Anal. Policy* **2022**, *73*, 210–227. [CrossRef]
99. Laguna, M.; Hernández, I.; Godoy, J.M. Informality, economic complexity, and internalization of rules. *Front. Sociol.* **2023**, *8*, 1163326. [CrossRef]
100. Muneepeerakul, R.; Lobo, J.; Shutters, S.T.; Goméz-Liévano, A.; Qubbaj, M.R. Urban Economies and Occupation Space: Can They Get "There" from "Here"? *PLoS ONE* **2013**, *8*, e73676. [CrossRef]
101. Di Clemente, R.; Strano, E.; Batty, M. Urbanization and economic complexity. *Sci. Rep.* **2021**, *11*, 3952. [CrossRef]
102. Gomez-Lievano, A.; Patterson-Lomba, O. Estimating the drivers of urban economic complexity and their connection to economic performance. *R. Soc. Open Sci.* **2021**, *8*, 210670. [CrossRef]
103. Chen, Z.; Poncet, S.; Xiong, R. Inter-industry relatedness and industrial-policy efficiency: Evidence from China's export processing zones. *J. Comp. Econ.* **2017**, *45*, 809–826. [CrossRef]
104. Boschma, R. Regional Diversification and Policy Intervention. *Europa XXI* **2012**, *22*, 68–77. [CrossRef]
105. Vu, T.V. *Does LGBT Inclusion Promote National Innovative Capacity?* Elsevier: Amsterdam, The Netherlands, 2020. [CrossRef]
106. Vu, T.V. Linking LGBT inclusion and national innovative capacity. *Soc. Indic. Res.* **2022**, *159*, 191–214. [CrossRef]
107. Kazemzadeh, E.; Fuinhas, J.A.; Salehnia, N.; Osmani, F. The effect of economic complexity, fertility rate, and information and communication technology on ecological footprint in the emerging economies: A two-step stirpat model and panel quantile regression. *Qual. Quant.* **2022**, *57*, 737–763. [CrossRef]
108. Innocenti, N.; Vignoli, D.; Lazzeretti, L. Economic complexity and fertility: Insights from a low fertility country. *Reg. Stud.* **2021**, *55*, 1388–1402. [CrossRef] [PubMed]
109. Alola, A.A.; Bekun, F.V.; Sarkodie, S.A. Dynamic impact of trade policy, economic growth, fertility rate, renewable and non-renewable energy consumption on ecological footprint in Europe. *Sci. Total Environ.* **2019**, *685*, 702–709. [CrossRef]
110. Kwan, L.Y.-Y.; Chiu, C.-Y. *Cultural Diversity (Fractionalization) and Economic Complexity: Effects on Innovation Performance and Human Development*; Oxford University Press: Oxford, UK, 2018; ISBN 978-0-19-045567-5.
111. Lapatinas, A.; Litina, A.; Zanaj, S. The Impact of Economic Complexity on the Formation of Environmental Culture. *Sustainability* **2021**, *13*, 870. [CrossRef]
112. Klement, B.; Strambach, S. Innovation in Creative Industries: Does (Related) Variety Matter for the Creativity of Urban Music Scenes? *Econ. Geogr.* **2019**, *95*, 385–417. [CrossRef]
113. Keneck-Massil, J.; Nvuh-Njoya, Y. Did colonisation matter for comparative economic complexity? *Econ. Lett.* **2021**, *203*, 109851. [CrossRef]
114. Koch, P.; Stojkoski, V.; Hidalgo, C.A. *The Role of Immigrants, Emigrants, and Locals in the Historical Formation of Knowledge Agglomerations*; Elsevier: Amsterdam, The Netherlands, 2022. [CrossRef]
115. Domini, G. Patterns of specialization and economic complexity through the lens of universal exhibitions, 1855–1900. *Explor. Econ. Hist.* **2022**, *83*, 101421. [CrossRef]
116. Can, M.; Gozgor, G. The impact of economic complexity on carbon emissions: Evidence from France. *Environ. Sci. Pollut. Res.* **2017**, *24* (Suppl. S19), 16364–16370. [CrossRef] [PubMed]

117. Neagu, O.; Teodoru, M.C. The Relationship between Economic Complexity, Energy Consumption Structure and Greenhouse Gas Emission: Heterogeneous Panel Evidence from the EU Countries. *Sustainability* **2019**, *11*, 497. [CrossRef]
118. Pata, U.K. Renewable and non-renewable energy consumption, economic complexity, CO_2 emissions, and ecological footprint in the USA: Testing the EKC hypothesis with a structural break. *Environ. Sci. Pollut. Res.* **2021**, *28*, 846–861. [CrossRef]
119. Dogan, B.; Chu, L.K.; Ghosh, S.; Truong, H.H.D.; Balsalobre-Lorente, D. How environmental taxes and carbon emissions are related in the G7 economies? *Renew. Energy* **2022**, *187*, 645–656. [CrossRef]
120. Alvarado, R.; Ortiz, C.; Ponce, P.; Toledo, E. *Renewable Energy Consumption, Human Capital Index, and Economic Complexity in 16 Latin American Countries: Evidence Using Threshold Regressions*; Elsevier: Amsterdam, The Netherlands, 2021; ISBN 978-0-12-824441-8.
121. Ahmad, M.; Ahmed, Z.; Majeed, A.; Huang, B. An environmental impact assessment of economic complexity and energy consumption: Does institutional quality make a difference? *Environ. Impact Assess. Rev.* **2021**, *89*, 106603. [CrossRef]
122. Yilanci, V.; Pata, U.K. Investigating the EKC hypothesis for China: The role of economic complexity on ecological footprint. *Environ. Sci. Pollut. Res.* **2020**, *27*, 32683–32694. [CrossRef] [PubMed]
123. Huang, Y.; Haseeb, M.; Usman, M.; Ozturk, I. Dynamic association between ICT, renewable energy, economic complexity and ecological footprint: Is there any difference between E-7 (developing) and G-7 (developed) countries? *Technol. Soc.* **2022**, *68*, 101853. [CrossRef]
124. Ma, F.; Wang, H.; Schandl, H.; Fishman, T.; Tan, X.; Li, Y.; Shi, L.; Wang, P.; Chen, W.-Q. Exploring the relationship between economic complexity and resource efficiency. *Resour. Conserv. Recycl.* **2022**, *186*, 106530. [CrossRef]
125. Simdi, H.; Seker, A. A change is gonna come: Will traditional meat production end? *Environ. Sci. Pollut. Res.* **2022**, *29*, 30470–30485. [CrossRef]
126. Caldarola, B.; Mazzilli, D.; Napolitano, L.; Patelli, A.; Sbardella, A. Economic complexity and the sustainability transition: A review of data, methods, and literature. *arXiv* **2023**, arXiv:2308.07172v1.
127. Chinazzi, M.; Gonçalves, B.; Zhang, Q.; Vespignani, A. Mapping the physics research space: A machine learning approach. *EPJ Data Sci.* **2019**, *8*, 1–18. [CrossRef]
128. Hidalgo, C.A. Economic complexity: From useless to keystone. *Nat. Phys.* **2018**, *14*, 9–10. [CrossRef]
129. Montresor, S.; Quatraro, F. Green technologies and Smart Specialisation Strategies: A European patent-based analysis of the intertwining of technological relatedness and key enabling technologies. *Reg. Stud.* **2019**, *54*, 1354–1365. [CrossRef]
130. Balland, P.-A.; Boschma, R.; Crespo, J.; Rigby, D.L. Smart specialization policy in the European Union: Relatedness, knowledge complexity and regional diversification. *Reg. Stud.* **2018**, *53*, 1252–1268. [CrossRef]
131. Asheim, B.T. Smart specialisation, innovation policy and regional innovation systems: What about new path development in less innovative regions? *Innov. Eur. J. Soc. Sci. Res.* **2018**, *32*, 25–28. [CrossRef]
132. Gala, P.; Camargo, J.; Magacho, G.; Rocha, I. Sophisticated jobs matter for economic complexity: An empirical analysis based on input-output matrices and employment data. *Struct. Chang. Econ. Dyn.* **2018**, *45*, 1–8. [CrossRef]
133. Farinha, T.; Balland, P.-A.; Morrison, A.; Boschma, R. What drives the geography of jobs in the US? Unpacking relatedness. *Ind. Innov.* **2019**, *26*, 1022–1988. [CrossRef]
134. Adam, A.; Garas, A.; Katsaiti, M.-S.; Lapatinas, A. Economic complexity and jobs: An empirical analysis. *Econ. Innov. New Technol.* **2021**, *32*, 25–52. [CrossRef]
135. Rigby, D.L. Technological Relatedness and Knowledge Space: Entry and Exit of US Cities from Patent Classes. *Reg. Stud.* **2015**, *49*, 1922–1937. [CrossRef]
136. Botta, A.; Caverzasi, E.; Russo, A. When complexity meets finance: A contribution to the study of the macroeconomic effects of complex financial systems. *Res. Policy* **2020**, *51*, 103990. [CrossRef]
137. Ajide, F.M. Economic complexity and entrepreneurship: Insights from Africa. *Int. J. Dev. Issues* **2022**, *21*, 367–388. [CrossRef]
138. Neffke, F.; Hartog, M.; Boschma, R.; Henning, M. Agents of Structural Change: The Role of Firms and Entrepreneurs in Regional Diversification. *Econ. Geogr.* **2014**, *94*, 23–48. [CrossRef]
139. Nguyen, C.P.; Nguyen, B.; Tung, B.D.; Su, T.D. Economic complexity and entrepreneurship density: A non-linear effect study. *Technol. Forecast. Soc. Chang.* **2021**, *173*, 121107. [CrossRef]
140. Arbatli, E.C.; Hong, G.H. *Singapore's Export Elasticities: A Disaggregated Look into the Role of Global Value Chains and Economic Complexity*; International Monetary Fund: Singapore, 2016. [CrossRef]
141. Donadoni, M.; Caniato, F.; Cagliano, R. Linking product complexity, disruption and performance: The moderating role of supply chain resilience. *Supply Chain Forum Int. J.* **2018**, *19*, 300–310. [CrossRef]
142. Parcu, P.L.; Innocenti, N.; Carrozza, C. Ubiquitous technologies and 5G development. Who is leading the race? *Telecommun. Policy* **2022**, *46* (Suppl. S4), 102277. [CrossRef]
143. Balland, P.-A.; Boschma, R. Mapping the potentials of regions in Europe to contribute to new knowledge production in Industry 4.0 technologies. *Reg. Stud.* **2021**, *55*, 1652–1666. [CrossRef]
144. Kazemzadeh, E.; Fuinhas, J.A.; Koengkan, M. The impact of income inequality and economic complexity on ecological footprint: An analysis covering a long-time span. *J. Environ. Econ. Policy* **2022**, *11*, 133–153. [CrossRef]
145. Lara, J.; Tosi, A.; Altimiras-Martin, A. Critical Raw Materials and Economic Complexity in Latin America. *Apunt. Cenes* **2018**, *37*, 15–51. [CrossRef]
146. Fan, Y.V.; Jiang, P.; Tan, R.R.; Aviso, K.B.; You, F.; Zhao, X.; Lee, C.T.; Klemeš, J.J. Forecasting plastic waste generation and interventions for environmental hazard mitigation. *J. Hazard. Mater.* **2022**, *424*, 127330. [CrossRef] [PubMed]

147. Yue, J.; Zhou, S. Democracy's comparative advantage: Evidence from aggregated trade data, 1962–2010. *World Dev.* **2018**, *111*, 27–40. [CrossRef]
148. Whetsell, T.A.; Dimand, A.-M.; Jonkers, K.; Baas, J.; Wagner, C.S. Democracy, Complexity, and Science: Exploring Structural Sources of National Scientific Performance. *Sci. Public Policy* **2021**, *48*, 697–711. [CrossRef]
149. Ahmed, Z.; Adebayo, T.S.; Udemba, E.N.; Murshed, M.; Kirikkaleli, D. Effects of economic complexity, economic growth, and renewable energy technology budgets on ecological footprint: The role of democratic accountability. *Environ. Sci. Pollut. Res.* **2022**, *29*, 24925–24940. [CrossRef]
150. Albassam, B.A. Building an effective knowledge management system in Saudi Arabia using the principles of good governance. *Resour. Policy* **2019**, *64*, 101531. [CrossRef]
151. Barros, F., Jr.; Brotherhood, L.; Rodrigues, V. Economic complexity and corporate governance. *Appl. Econ. Lett.* **2022**, *29*, 68–71. [CrossRef]
152. Boschma, R.; Capone, G. Institutions and diversification: Related versus unrelated diversification in a varieties of capitalism framework. *Res. Policy* **2014**, *44*, 1902–1914. [CrossRef]
153. Alshamsi, A.; Pinheiro, F.L.; Hidalgo, C.A. Optimal diversification strategies in the networks of related products and of related research areas. *Nat. Commun.* **2018**, *9*, 1328. [CrossRef] [PubMed]
154. Valette, J. Do Migrants Transfer Productive Knowledge Back to Their Origin Countries? *J. Dev. Stud.* **2018**, *54*, 1637–1656. [CrossRef]
155. Bahar, D.; Rapoport, H.; Turati, R. Birthplace diversity and econoimc complexity: Cross-country evidence. *Res. Policy* **2020**, *51*, 103991. [CrossRef]
156. Rıos, V. The Impact of Crime and Violence on Economic Sector Diversity. Harvard. 2017. Available online: https://scholar.harvard.edu/files/vrios/files/crimeanddiver2017_v4.pdf (accessed on 15 August 2022).
157. Madni, G.R.; Khan, B. Siege of Violent Crimes through Economic Complexity and Institutions. *Int. Multidiscip. J. Soc. Sci.-Rimcis* **2019**, *8*, 146–163. [CrossRef]
158. Hartmann, D. *Economic Complexity and Human Development*; Taylor and Francis: River Thames, UK, 2014. [CrossRef]
159. Ferraz, D.; Moralles, H.F.; Costa, N.D.; Rebelatto, D.A.D.N. *Economic Complexity and Human Development: Comparing Traditional and Slack Based Data Envelopment Analysis Models*; Elsevier: Amsterdam, The Netherlands, 2019. [CrossRef]
160. Le Caous, E.S.; Huarng, F. Economic Complexity and Human Development: Moderated by Logistics and International Migration. *Sustainability* **2021**, *13*, 1867. [CrossRef]
161. Gozgor, G. A new approach to the renewable energy-growth nexus: Evidence from the USA. *Environ. Sci. Pollut. Res.* **2018**, *25*, 16590–16600. [CrossRef]
162. Wang, Z.; Ben Jebli, M.; Madaleno, M.; Doğan, B.; Shahzad, U. Does export product quality and renewable energy induce carbon dioxide emissions: Evidence from leading complex and renewable energy economies. *Renew. Energy* **2021**, *171*, 360–370. [CrossRef]
163. Neagu, O. Economic Complexity and Ecological Footprint: Evidence from the Most Complex Economies in the World. *Sustainability* **2020**, *12*, 9031. [CrossRef]
164. Shahzad, U.; Fareed, Z.; Shahzad, F.; Shahzad, K. Investigating the nexus between economic complexity, energy consumption and ecological footprint for the United States: New insights from quantile methods. *J. Clean. Prod.* **2021**, *279*, 123806. [CrossRef]
165. Ikram, M.; Xia, W.; Fareed, Z.; Shahzad, U.; Rafique, M.Z. Exploring the nexus between economic complexity, economic growth and ecological footprint: Contextual evidences from Japan. *Sustain. Energy Technol. Assess.* **2021**, *47*, 101460. [CrossRef]
166. Idsardi, E.F.; Schalkwyk, H.D.; Viviers, W. The Agricultural Product Space: Prospects for South Africa. In Proceedings of the International Association of Agricultural Economists 2015 Conference, Milan, Italy, 9–14 August 2015.
167. Gozgor, G.; Lau, C.K.M.; Lu, Z. Energy consumption and economic growth: New evidence from the OECD countries. *Energy* **2018**, *153*, 27–34. [CrossRef]
168. Hausmann, R.; Hwang, J.; Rodrik, D. What You Export Matters. *J. Econ. Growth* **2006**, *12*, 1–25. [CrossRef]