

## Research trends of the knowledge-based economy: A bibliometric study

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### Abstract

**Purpose:** In recent years, the Knowledge-Based Economy (KBE) has been an emergent field related to Information and Communication Technologies (ICTs). In current business models, organizations need to be part of the digital transformation and create value for customers, which has caused an increase in the number of scientific publications on the KBE. This study aims to analyze the research trends of the scientific literature on the KBE published between 1986 and 2021.

**Design/methodology:** A bibliometric analysis was conducted using the Scopus database. The results were analyzed based on quantity, impact, and structure indicators and topics. In addition, this paper proposes a research agenda for future studies in this field.

**Findings:** The study of the KBE has attracted the interest of the scientific community, especially in 2006, 2010, and 2011. This literature review shows that developed countries (e.g., Poland, Romania, the United Kingdom, the United States, and Germany) have researched this field the most. Terms such as *knowledge-based systems*, *knowledge management*, and *information management* have become more common in the literature and are setting trends. These terms refer to essential components for the advancement of the KBE as an approach that can dynamize the economic development of organizations and countries.

**Originality/value:** This study contributes to the literature because it analyzes the theoretical evolution of the KBE field. In addition, it proposes an agenda for future studies to advance the research fields related to the Triple Helix model of innovation in developing countries

**Keywords:** Bibliometrics, Economic development, Knowledge-based economy

**Jel Codes:** F63, O32

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## 1. Introduction

Nowadays, education and knowledge are fundamental conditions for competitiveness in the labor market because knowledge-based information, economy, and society increase business value (Firsova, Lukashenko & Azarova, 2021; Acevedo-Correa, Valencia-Arias, Bran-Piedrahita, Gómez-Molina & Arias-Arciniegas 2019; Becerril-Elías & Merritt, 2021). This is a result of the rise and development of Information and Communication Technologies (ICTs). ICTs have caused great revolutions in society because, as claimed by Nisbett (2020), they have established a network of connections and given rise to the so-called *knowledge society* (Castro-Galván & Cázares-Garrido, 2022).

Knowledge has been increasingly consolidated as the basis for economic development because the cornerstone of organizations is no longer the amount of mass physical work (as it used to be in the classical conceptions of capitalist economies) but information and lifelong learning (Sum & Jessop, 2013). According to Moisiso (2018), as this demands higher educational attainment, developed countries have made more advances in this regard than their developing counterparts.

As a result, the concept of the Knowledge-Based Economy (KBE) has progressively become more popular and connected with ideas such as information economy, learning economy, creative economy, and information society. Said concept was popularized by the intervention of three international organizations: the Organization for Economic Co-operation and Development (OECD), the European Union (EU), and the World Bank (WB). For Sum and Jessop (2013), the KBE has become the basis for different policies of *knowledge for development*.

Liyanage and Netswera (2022) define the KBE as an economy based on the production, commercialization, and use of knowledge and information in order to achieve sustainable development by investing in human capital, technology resources, and innovation. The context of the current COVID-19 pandemic has confirmed the importance, for current business models, of being part of the digital transformation and creating added value for their customers. In such context, the main assets are information, technology platforms, and innovations (Ciuriak, 2020).

The evolution of the KBE has produced businesses based on this concept, becoming a growing trend that has provided an opportunity to narrow, for example, the gender gap (Falahati, 2021). Additionally, as knowledge will be a key resource in the near future, human talent should be highly trained to work under the special circumstances of new societies, i.e., borderlessness, upward mobility thanks to formal education, and development of skills for success (Nurunnabi, 2017).

Consequently, the KBE is very important in the context of management and international business, especially in emerging countries. This is in agreement with the contributions of Zhaisanova, Kalmakova and Isatayeva (2018), who highlighted the relevance of the science-industry interaction for the KBE. Also, they were interested in addressing the current gaps using means of financing that promote transparency and generate new knowledge that foster business innovation. Shterev, Stoyanova and Parushev (2019) claim that developing countries present limitations related to their business models and base their growth on social leadership, while developed countries base their competitiveness on companies focused on science and research.

In the current competitive business environment, organizations must quickly adapt to transformations. In particular, KBEs require adequate planning and modification of business value models—from using physical

elements and technical resources to employing information-based factors (Rodríguez-Lora, Henao-Cálad & Valencia Arias, 2016; Vinogradova, Nikoliuk & Galimova, 2020).

This begs the following question: *What are the current trends of the publications about the Knowledge-Based Economy?* A bibliometric analysis can provide answers because it uses published documents to establish the importance of the field, the diversity of topics addressed by its authors, and its most prolific institutions and countries (Alvarez-Aros & Álvarez Herrera, 2018). This kind of analysis is widely employed to objectively determine the state of the art of a field of knowledge using quantitative indicators of scientific publications because they are easily accessible through the internet (Chiriță, 2018).

Therefore, this study explores the research trends in the KBE field with two aims: (1) to contribute to the understanding of this economic transformation phenomenon in society and (2) to suggest future studies in this area, in particular, regarding decision-making and government and institutional policy-making to promote KBEs. Additionally, this study aims to narrow a gap found in the literature, i.e., although it has acknowledged the relevance of the KBE over the years, it has not sufficiently addressed its theoretical evolution. For instance, there is only one literature review of this field by Aparicio et al. (2021). They proposed some trends in the KBE field. However, they adopted a single perspective; used the Web of Science database; and retrieved the publications by searching the terms KE or KBE in their title, abstract, or keywords. This study adopts a different approach because the publications were retrieved from the Scopus database, which has great academic and scientific prestige and covers more research articles in all fields (Quintero-Quintero, Blanco-Ariza & Garzón-Castrillón, 2021). Additionally, this study applied a more comprehensive search strategy, which is detailed in the Methodology section.

It is hoped that this study will be useful for other authors not only to better understand the concept of the KBE but also to propose new lines of research and identify theoretical gaps, countries, and research groups that can advance this field. This study identifies the fundamental actors in each one of the components of the Triple Helix model of innovation, as well as trending and emerging topics that should be further researched to define a better way for the three components to collaborate in order to generate knowledge and promote its use.

This paper is structured as follows. Section 2 presents a brief conceptualization of the KBE. Section 3 describes the methodology applied in this bibliometric analysis. Section 4 presents the interpretation and discussion of the results. Section 5 proposes a research agenda for future studies. Finally, Section 6 draws the main conclusions.

## 2. Theoretical framework

According to Centorrino and Naciti (2019), there is no single definition of the KBE. Nevertheless, Harris (2002) highlights the leading role of knowledge generation and distribution as the cornerstones of the economic growth of organizations. Centorrino and Naciti (2019) indicate that the KBE also refers to traditional companies, who need to adopt processes to create and use knowledge in order to be more competitive and generate more value in the industry.

The KBE is not a new concept. Its origins date back to the 1980s and 1990s, when Romer (1986) and Grossman and Helpman (1991) proposed new theories of long-term economic growth focused on the importance of more efficient production with new and improved products and services. These aspects are considered the pillars of the KBE, but it requires additional elements: new investments in education, public expenditure in research and development, maturing the innovation capacity, improving the information infrastructure, and a more adequate environment for market transactions.

Officially, the concept of the KBE was introduced by the Organization for Economic Co-operation and Development (OECD, 1996), which defined it as an economy based on the production, distribution, and use of knowledge and information. This definition put the spotlight on the KBE as a scientific paradigm that has created the need for an educational reform with a new lifelong learning model. However, it has also widened the competitiveness gap between developed and developing countries because of the different conditions of their educational systems (Sum & Jessop, 2013). This is a challenge for multiple territories, as claimed by Pineda

(2013), that are not able to adapt to the transformations derived from this kind of economies and run the risk of falling behind in terms of development.

According to Liyanage and Netswera (2022), starting with the new millennium, the KBE has focused on promoting competitiveness. As a result, collaboration and knowledge exchange among different actors have become more relevant. This is evident in two models of innovation: the Triple Helix (connecting university, industry, and government) and the Quintuple Helix (connecting education system; economic system; natural environment; media-based and culture-based public and civil society; and political system).

Therefore, countries in different latitudes have been increasingly investing in ICTs and the exponential use of information and knowledge, which has promoted national economic growth and development, influenced micro and macroeconomic dimensions, and boosted the productivity and innovation of organizations in the territories (Quiroga-Parra, Torrent-Sellens & Murcia-Zorrilla, 2017). These societies have stimulated the generation, incorporation, and dissemination of knowledge (Llona, 2017), promoting innovations not only in the productive sector but also at Higher Education Institutions (HEIs; Frank & Meyer, 2020).

Thanks to the role that the KBE plays in the global political agenda, there has been an increase in the number of studies about it. For example, Khorsheed (2015) described the case of the United Arab Emirates. Due to the global economic crisis, the instability of neighboring countries, and oil price falls, this country has focused on innovation strategies to produce a KBE. Almoli and Evren (2020) found that Qatar faces challenges and has strengths and weaknesses in its transition to this kind of economy, which aims to diversify its income sources, e.g., by investing in non-energy sectors.

Hosseini, Bastani, Salami, Yazdani and Asadi (2020) discussed the concept of KBE and the way it affects agricultural production. They conducted a literature review to highlight the analytical and descriptive methods that had been used in previous studies into it. Their results show that knowledge has a significant influence on productivity. Wirba (2021) conducted a study to establish if Cameroon was transforming itself and moving toward a KBE according to the Knowledge Economic Index (KEI) and the Knowledge Index (KI). His results show that said country is not making progress in this regard and is actually in a decline. Therefore, its policymakers should focus their efforts on promoting, creating, and disseminating knowledge.

The literature also indicates that several authors have been interested in understanding the term knowledge economy. Choong and Leung (2021) thoroughly examined its definition, reviewing its precursors, and found that this field has not reached maturity regarding social-economic knowledge, innovation ideas, technology, and knowledge products.

The KBE has been researched in different geographic areas: the Russian Federation (Mikhaylov & Mikhaylova, 2020), Qatar and Lebanon (Hassen, 2021), China and the US (Peng, 2007), and Sri Lanka (Hadiwattege, Senaratne, Sandanayake & Fernando, 2018). Other studies have investigated particular aspects, such as the competencies that are currently required from engineers in the context of KBEs (Abdulwahed, Balid, Hasna & Pokharel, 2013); the impact of KBEs on quality management processes at service companies (Plumb & Zamfir, 2009); the accelerated diffusion of smart technological developments in educational environments to improve education quality (Kulanthaivel & Ulagamuthalvi, 2020); and the main challenges for innovation and business incubators in the context of the KBE (Al-Mubarak & Busler, 2017).

In Latin America, Mexico has channeled its efforts through public institutions, such as the *Consejo Nacional de Ciencia y Tecnología (Conacyt)*, to invest in science and technology so that the country's economy migrates towards one based on knowledge production. However, even though its doctoral education in this field is remarkable, it has not made advances in international competitiveness (Maldonado-Maldonado, 2019).

Other countries in Latin America present different conditions for the implementation of a KBE. Gutiérrez (2014) found that Bolivia suffers from deficiencies in critical elements required for an innovation system, i.e., financial resources, human resources, productive sector, and innovation agents. On the contrary, Giordano and Pagano (2013) found that Brazil is a model in this field thanks to its economic and industrial vitality. Its national

government has adopted programs to strengthen education and science, which are utterly relevant aspects in this kind of economy.

In Colombia, Burgos (2018) reviewed previous studies to define concepts and methodologies related to the KBE, analyzing its influence on productivity and competitiveness for sustainable development. He found that the country presents deficiencies in these aspects. Therefore, it should implement public policies focused on social, economic, and environmental development to respond to the challenges of the UN 2030 Agenda based on regional training.

### 3. Methodology

Bibliometric studies are carried out to analyze the information and knowledge in scientific publications using different statistical and mathematical models (Gorbea, 2016). Additionally, they are conducted to examine, in hindsight, the dynamics of a field and to calculate indicators to measure the results of its scientific activity (Sanz-Valero, Casterá & Wanden-Berghe, 2014). This bibliometric study aims to show the level of development of the KBE field, the evolution of its research trends, and the topics in its literature. This should provide valuable knowledge for decision-making in corporate and government contexts.

#### 3.1. Defining the search strategy

The first step in this methodology was selecting the keywords according to our specific needs. In this case, we selected the terms “knowledge”, “based”, and “econom”. Boolean operators (AND and OR) were also included to filter the vast amount of information available on Scopus. A truncation operator (?) was implemented to replace some characters in the term “knowledg?” and thus obtain more results (with the derivatives of the word). An asterisk (\*) was employed to retrieve all the forms of the word “econom”. The proximity operator W/1 was used to establish the position of the words in the search string.

Note that this search was restricted to only documents that included all these terms in their *title* in order to delimit this review exclusively to publications whose main topic was KE or the KBE. In contrast, the review by Aparicio et al. (2021) examined more publications because they included documents that featured said terms in the abstract or keywords by using the OR operator, which makes a direct relationship with the topic less likely (especially by including the abstract). Additionally, they acknowledged that one of the limitations of their study was not having included the Scopus database. Hence, this bibliometric study can adequately complement their findings. Considering the circumstances described above, our search string was formulated as follows:

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TITLE (knowledg? W/1 based W/1 econom*) AND ABS (knowledg? W/1 based W/1 econom*) OR KEY (knowledg? OR based OR econom*)
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#### 3.2. Selecting the database

Scopus was selected for this study because it is recognized as a high-quality, reliable source to consult information in indexed journals in different disciplines (Khiste & Paithankar, 2017). This platform offers access to a large number of records that includes abstracts and citations of peer-reviewed scientific publications (Khiste, 2017). This hub of global scientific production was used in this study due to its academic rigor, the up-to-dateness of its records, and its coverage of the topic investigated here.

#### 3.3. Searching for information and filtering results

The search string detailed above retrieved a total of 370 documents published between 1986 (when the first studies in this field appeared) and May 11, 2021 (when the data were downloaded). We confirmed that all these documents were accessible and relevant in the field. The age of these publications was considered as well. This review focused mostly on documents published in the last five years and the overall number of publications (370) retrieved from Scopus. The same search was also conducted on Science Direct and retrieved 20 results.

### 3.4. Results analysis

Quantity indicators were calculated to measure scientific productivity in terms of years, authors, journals, countries, and type of publication. The number of published documents is associated with the productivity of the authors (Velasco, Eiros & San Román, 2012). Quality indicators measure the impact produced by the publications based on citations in other documents, journals, and countries (Virgen, Cobo & Betancourt, 2014). Structure indicators measure the collaboration between the most published and cited authors in the field (Ávila-Toscano, Marengo-Escuderos & Madariaga, 2014). Likewise, they measure the cooperation between different authors and institutions. One of the most important structure indicators is co-authorship, which can be used to calculate the average number of co-authors of the documents, as well as to identify the number of members of a research group (Velasco et al., 2012).

The indicators employed in this review were calculated based on the information about authors, journals, institutions, and countries found in documents published between 1986 and 2021. Finally, a comparative analysis of the KBE field was manually conducted using a database (Excel file) created with the retrieved information. Said analysis used two time windows (i.e., 1986–2017 and 1986–2020) to delimit new trends and emerging topics in this field (Peralta, Frías & Chaviano, 2015). The period of the last four years (i.e., 2017–2021) was analyzed due to its importance for growing and decreasing trends, which sheds light on the topics that should be included in the research agenda that will be proposed.

The indicators were calculated using Python because it (1) is open-source software that makes it easy to present the information in simple language (Troyano, Cruz, González, Vallejo & Toro, 2018), (2) is efficient in organizing quality and structure indicators, (3) has statistical potential, and (4) guarantees uniformity in figures and data analysis. Figure 1 details the process followed in this study.

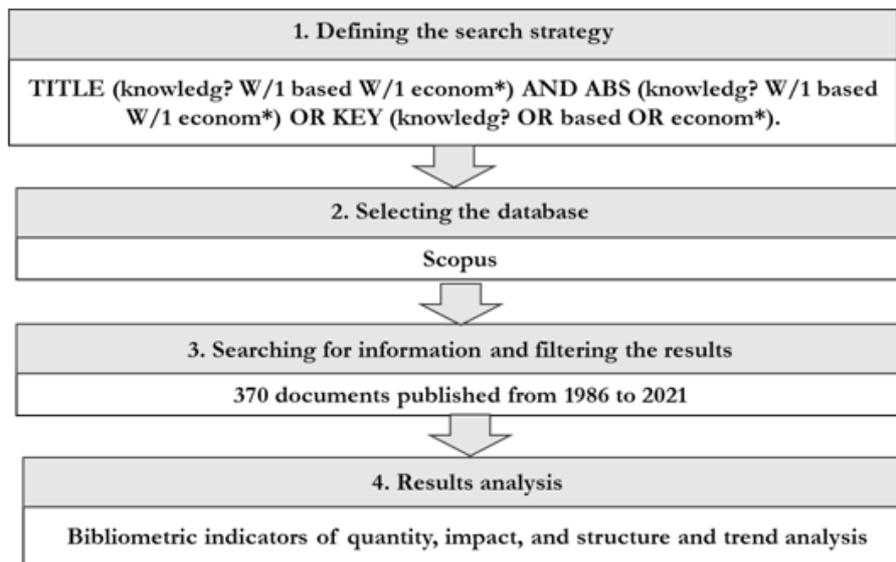


Figure 1. Steps in the bibliometric analysis conducted in this study

## 4. Results

### 4.1. Quantity indicators

#### 4.1.1. Annual productivity

Figure 2 presents the number of publications on the KBE between 1986 and 2021 (370 publications in total). It shows a growing but modest interest in this field from 1997 to 2002. Afterward, there was an increase in number

of publications from 2005 to 2011, which was the most productive year in the selected period (28 articles). Said period also includes 2006 and 2007, which saw a more limited academic and scientific production (23 and 17 articles, respectively). In the last 10 years, 2012 and 2013 exhibit constant productivity. In general, the number of publications decreased from 2014 to 2021, but it was relatively high in 2018 and 2020 (18 and 20 documents, respectively).

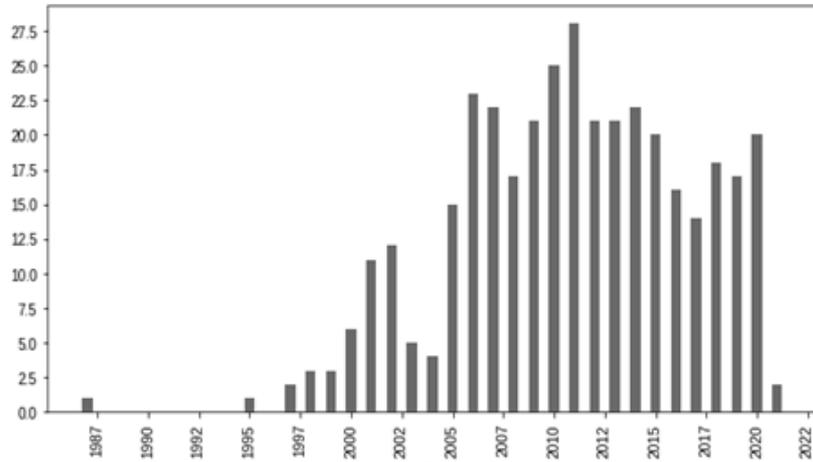


Figure 2. New publications by year

Figure 3 presents the running total of publications over the period examined here. It includes an exponential curve (dashed black line) and a sigmoidal curve (blue dashed line). The latter exhibits a better fit ( $R^2 = 0.938$ ) and indicates the existence of a maximum production peak. Said figure also shows that, overall, the number of publications has increased by 28.3% every year and by 5.3% annually in the last five years.

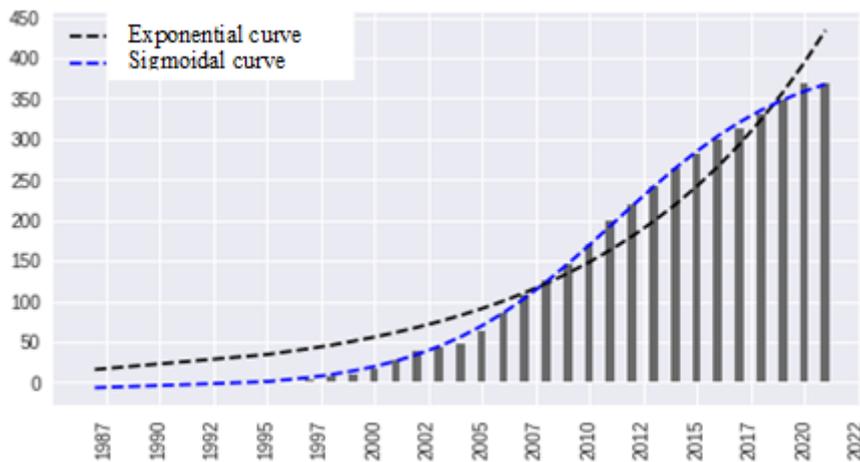


Figure 3. Running total of number of publications

#### 4.1.2. Annual productivity of journals and proceedings

Figure 4 details the top ten journals and proceedings (among 160 publication outlets) in terms of number of publications about the KBE. *The Journal of the Knowledge Economy* is on top (16 documents). With considerably lower numbers, further down the list are the *Proceedings of the European Conference on Knowledge Management (ECKM)* and the *International Journal of Knowledge-Based Development* (7 and 5 publications, respectively). These data are important to assess probable differences or imbalances in the coverage of the journals.

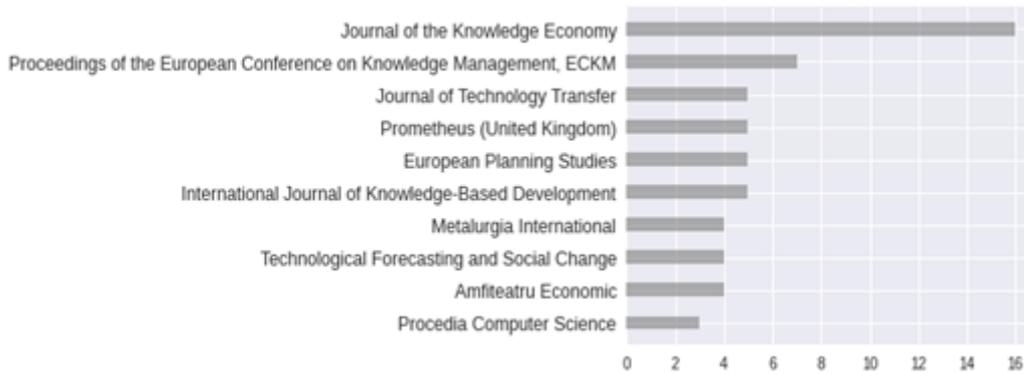


Figure 4. Top ten journals and proceedings by number of publications

#### 4.1.3. Author productivity

Figure 5 presents the top ten most productive authors in this field based on their number of publications (Andrés-Rodríguez, Andrés-Iglesias & Fornos-Pérez, 2021). It was found that Leydesdorff (*Universiteit van Amsterdam*) is the most prolific author with 6 documents, followed by Czyż (*Uniwersytet im Adama Mickiewicza w Poznaniu*), Birch (*York University*), and Abdulwahed (*Qatar University*), with 4 contributions each. These authors are affiliated to universities in countries with advanced economies. They investigate common topics related to computer science, engineering, mathematics, and decision sciences, among others, which have become the basis for knowledge development and the progress of society. After the fifth position in this list, each author has three documents. Additionally, 732 authors have published all the academic production analyzed here. Among them, 17.8% of the authors published 25% of the total production in this field; 45.3% published 50% of the total; 72.6% published 75% of the total; and 78.2% published 80% of the total. This indicates that the publications are not concentrated in a large number of authors.



Figure 5. Top ten authors by number of publications

#### 4.1.4. Productivity by country

Figure 6 shows the top ten most productive countries in this field. Poland is on top (33 documents), followed by Romania (28). The United Kingdom (26 publications) and the United States (24) are in third and fourth place, respectively. These countries are recognized as developed nations and are listed in the ranking of the richest countries according to their GDP per capita (International Monetary Fund, 2022). In addition, they make the largest investments in R&D, activities considered to be pillars of the knowledge economy. In terms of concentration, 93 countries published the 370 documents. More specifically, 14.5% of these nations published

50% of the total production in this field; 31.9% published 75% of the total, and 36.2% published 80% of the total.

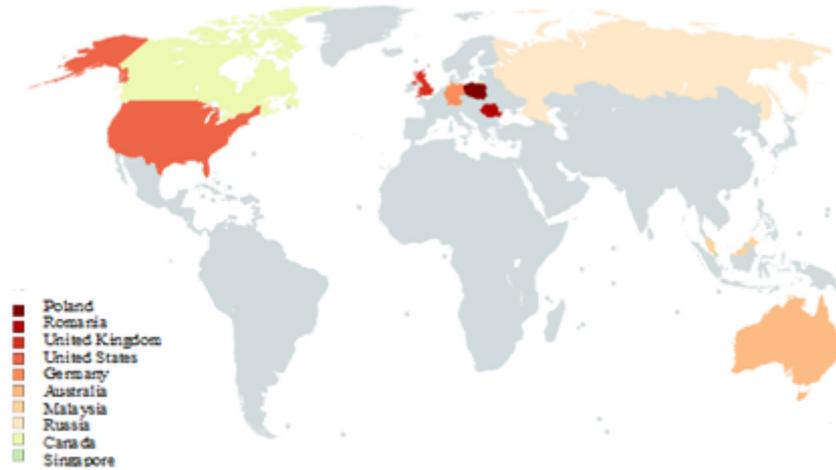


Figure 6. Productivity by country

#### 4.1.5. Productivity by type of publication

Another aspect of scientific productivity is the type of publication (Figure 7). Research articles, which are a valuable means to exchange knowledge, represent the largest percentage of documents in this field (63.2% of the total). Conference papers are in second place (21.4%), which indicates a wide dissemination of this topic in academic events.

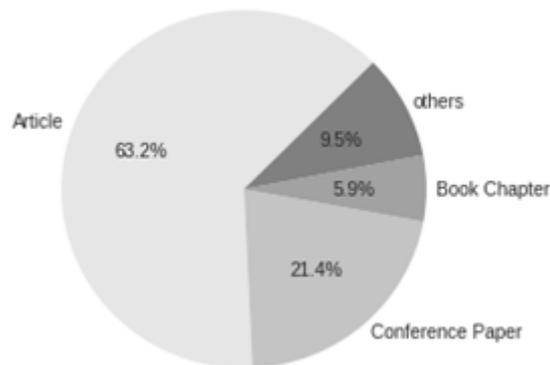


Figure 7. Productivity by type of publication

## 4.2. Quality indicators

### 4.2.1. Most cited journals and proceedings

Figure 8 lists the top ten most cited journals and proceedings in this area (among 160 publication outlets). *The Journal of Technology Transfer* is on top (941 citations per document), followed by *The Journal of the Knowledge Economy* (171), *Research Policy* (151), *World Development* (150), and *The International Business Review* (141).

It was found that, in general, these journals and proceedings participate in the discussion adopting different approaches, i.e., technology development, information use, and economics. For instance, *The Journal of Technology Transfer* focuses on studies on technology transfer in different fields of knowledge; hence, it is a good reference

regarding the impact of the knowledge economy from not only the economic perspective but also that of the technological aspects involved in it. Some journals have a closer relationship with economic sciences and business, which indicates that they deal with the direct impact of the KBE on economies in several regions and at different scales. Their discussions revolve around policy-making that enables organizations, the industry, academia, and the government to respond to challenges as important actors in the economy and its progress. Thus, their results are focused on those areas.

A comparison of this top ten with that of the most productive journals and proceedings reveals that the two lists share several publication outlets. Thus, it can be inferred that the documents published in *The Journal of the Knowledge Economy*, *The Journal of Technology Transfer*, and *European Planning Studies* have a high impact on the dissemination of knowledge in this field.

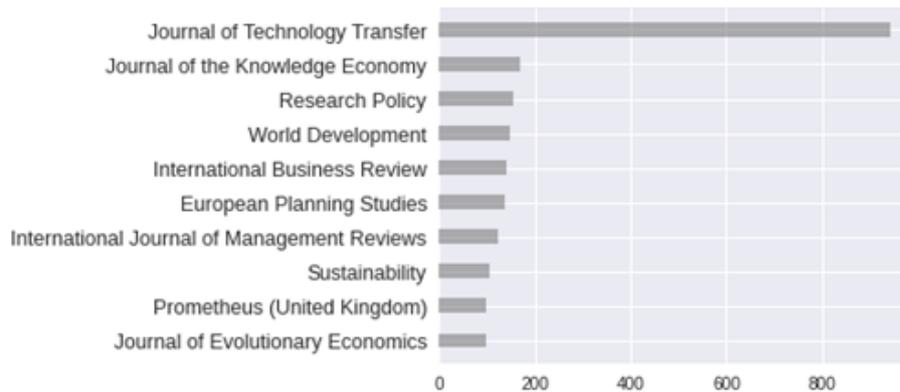


Figure 8. Most cited journals and proceedings

#### 4.2.2. Most cited countries

Figure 9 shows the top ten most cited countries in this field. Canada is on top (852 citations), followed by the United Kingdom (572), The Netherlands (421), Australia (257), and the United States (244). These countries are characterized by great economic growth and investments in the infrastructure of their universities and R&D centers, which are recognized worldwide, as well as their high indices of scientific productivity, as shown above (for the United Kingdom and the United States). In general, authors from 93 countries were cited a total of 4,872 times in the KBE field. More specifically, 2.9% of those nations concentrate 25% of the total number of citations; 7.2% concentrate 50% of the total, 14.5% concentrate 75% of the total, and 20.3% concentrate 80% of the total.

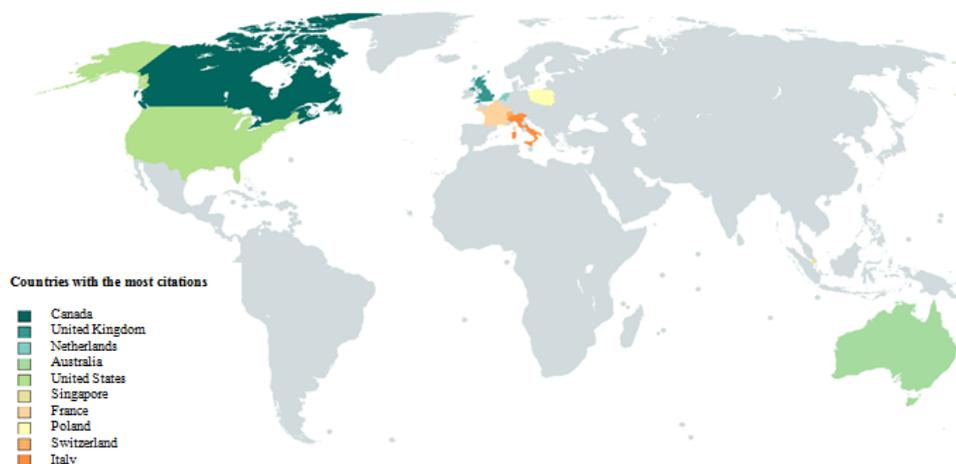


Figure 9. Most cited countries

### 4.2.3. Most cited authors

Figure 10 lists the top ten most cited authors in the KBE field. Their number of citations is an indicator of their impact. However, said indicator does not reflect the quality of the information contained in their documents but the impact of their publications on the field in general (Dorta & Dorta, 2010).

Feldmann and Bercovitz are the two most cited authors (420 citations each). Their 2006 publication entitled *Entrepreneurial Universities and Technology Transfer: A Conceptual Framework for Understanding Knowledge-Based Economic Development* is the most cited document in this field. This paper presents a framework to understand the role of universities in knowledge-based innovation systems based on social, economic, and political aspects. Leydesdorff is in third place (417 citations), followed by Cooke (349).

There are 732 authors and 4,872 citations in this field. More specifically, 1.1% of the authors concentrate 25% of the total number of citations, 4.2% concentrate 50% of the total, 16.0% concentrate 75% of the total, and 19.9% concentrate 80% of the total. This means that the highest percentage of citations is concentrated in a small number of authors who contribute the most to advances in this field. They stand out as leaders and lay the foundations for future studies.

A correlation was found between Leydesdorff and Papaioannou, who have the highest number of publications and as well as citations (which is an indicator of quality). This is in agreement with Jiménez-Navia, Villa-Enciso, and Bermúdez-Hernández (2020), who suggest that the leading authors in a field of knowledge can be identified by analyzing their quality and quantity indicators together.

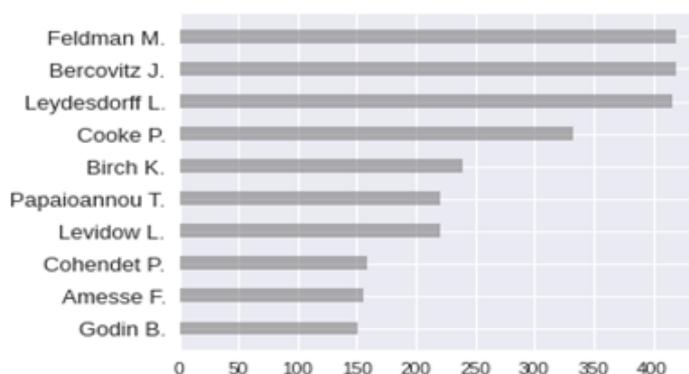


Figure 10. Most cited authors

### 4.3. Structure indicators

For Mishra, Prasad, Babu and Yadav (2020), structure indicators can be used to analyze the connections and collaboration between authors, countries, and topics, which are usually shown as social networks. Such networks are composed of nodes (vertices) and links. In a bibliometric study, the nodes are authors or researchers who are connected by undirected links that represent co-authorship (Rose & Kitchin, 2019).

#### 4.3.1. Network of most cited authors

Figure 11 is a network of the authors who collaborate with others and whose publications have been cited more than 50 times. The latter criterion was applied due to the maturity identified in this field. The more mature the field, the higher this number can be. In total, 28 authors met this criterion. The formation of disconnected subnetworks is evident, which implies a relative disconnection between those who research the KBE. There are four triads and five dyads of co-authorship, which have published the 15 most cited articles. One of the most impactful triads in terms of citations is formed by Gibney J., Copeland S., and Murie A. In particular, Gibney J. and Murie A. are affiliated to the University of Birmingham (UK). Copeland S. works at the University of Surrey, which is also located in the UK. This shows that several authors do not work for the same research centers or universities, but they establish co-authorship relations because they are in the same country. The co-authorship

triad formed by Ahrweiler P., Pyka A., and Gilbert N. has the highest number of citations in the KBE field. Pyka A. and Ahrweiler P. are affiliated to the University of Hohenheim and the Johannes Gutenberg University Mainz, respectively (both in Germany). In turn, Gilbert N. is affiliated to the University of Surrey (UK). This co-authorship relation demonstrates the connection between several research centers and universities in different countries.

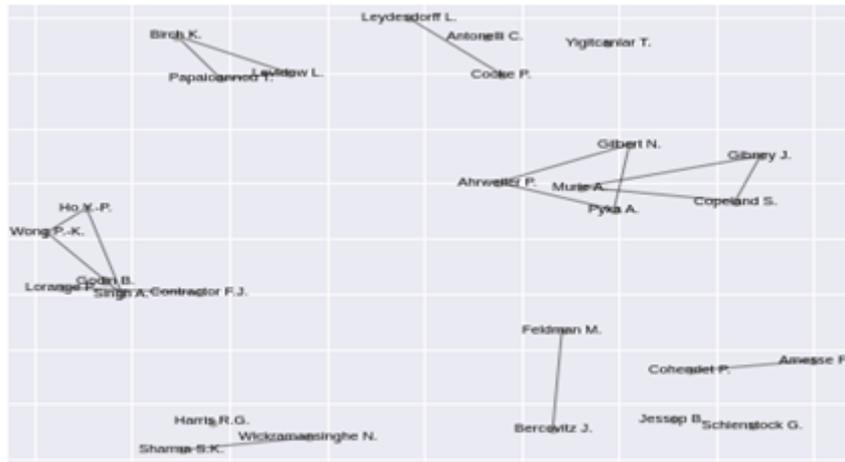


Figure 11. Network of most cited authors

#### 4.3.2. Network of most published authors

For the next step in this analysis, Figure 12 presents the network of collaboration between authors. In total, 13 authors have published three or more documents about the KBE. This criterion was applied due to the maturity identified in this field. The more mature the field, the higher this number can be. This network shows weak links between authors, and there is only one dyad and one triad of co-authorship according to the criterion above. Additionally, there is low proximity between the nodes. This means that the scientific production is greatly dispersed because, as seen in the productivity indicators, most authors prefer to publish alone. The co-authors in the only triad here are Birch K., Levidow L., and Papaioannou T. They have published three documents where all of them are co-authors. Levidow L. and Papaioannou T. are affiliated to The Open University in the UK. Birch K. is currently affiliated to the York University in Toronto, Canada, but he has previously worked in the UK for the University of Glasgow. Thus, his co-authorship relation with the UK has prevailed.

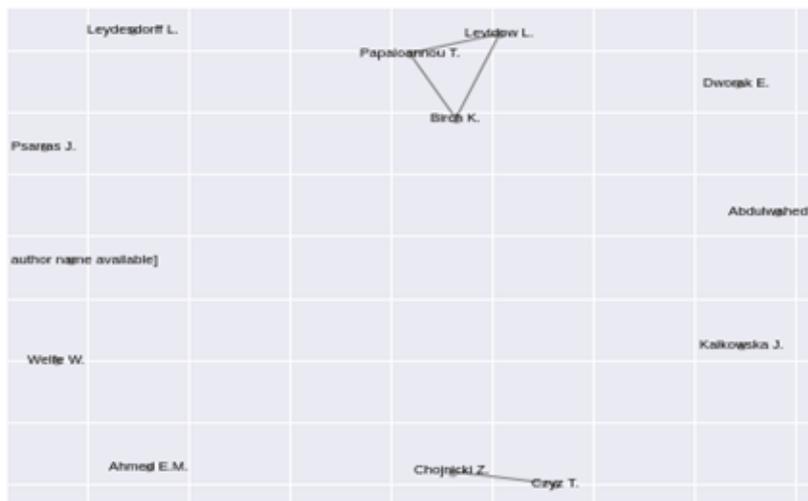


Figure 12. Network of most published authors

#### 4.4. Trend analysis

This subsection examines the behavior of the keywords in this field (which represent relevant topics) during the period studied here in order to accomplish the main research objective of this review: to analyze the research trends in the scientific literature about the KBE. Figure 13 lists the trending topics in KBE research and shows their growth from 2017 to 2020. This period was selected because the quantity indicators showed a renewed interest in the KBE after 2017. Additionally, this analysis considered the relevance of these topics in chronological terms, that is, the currency of the topics in more recent studies.

Some of the growing topics include knowledge-based systems, knowledge management, and information management. These topics refer to essential components for the advancement of the KBE as an approach that can dynamize the economic development of organizations, solve needs, and help to identify opportunities for societies. Likewise, this analysis confirms the importance of economic development, innovation, and information technology strategies as keys to generate value for economies and governments.

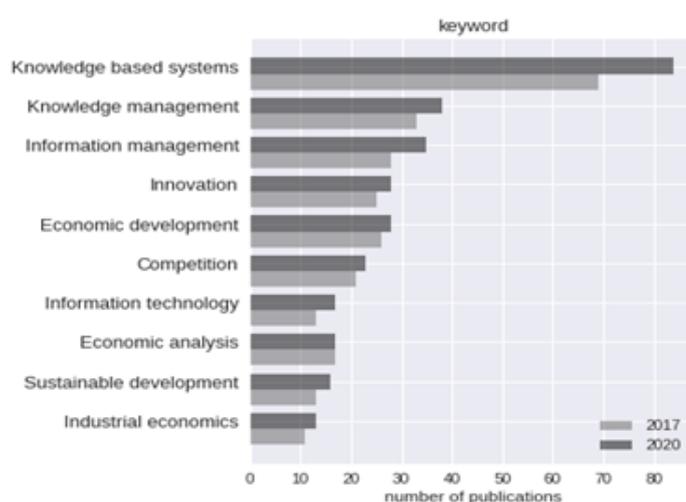


Figure 13. Trends in the KBE field

Analyzing research trends based on keywords enables us to suggest behaviors in this field. Keywords represent the topics that are addressed in the body of the documents but not present in other sections, such as the title. Thus, we can identify topics that have become more relevant. For example, Knowledge-Based Systems (KBSs) are important in the KBE because, in a society where education and knowledge are particularly valuable, they are means for human capital development. Additionally, these systems satisfy corporate needs in a globalized market (Firsova et al., 2021) where different sectors currently base their growth on the popularization and application of knowledge-intensive activities. As a result, KBSs improve business competitiveness by generating multidisciplinary approaches that combine context, corporate structure, strategies, links with other organizations, and impact on areas of influence (Lafuente, Vaillant & Vendrell-Herrero, 2019).

Aldulaimi, Kharabsheh, Al shishany and Alazzawi (2020) and Amirat and Zaidi (2020) highlight the importance of human talent training for economic development and wealth creation based on the generation and implementation of knowledges and skills in different economic sectors. Another common topic in the documents reviewed here is *Knowledge Management* (KM). Evidently, KM is important for the consolidation of countries' economies in the global economic context and that of KBEs (Gharamah, Noordin, Ali & Brohi, 2018). Also, KM can serve as a basis for innovation processes and increasing work performance, especially if applied to tacit knowledge (Polak & Jurczyk-Bunkowska, 2017).

In the KBE field, *information management* is related to taking advantage of product and process innovation, as well as business models, to successfully transform individual knowledges into corporate knowledge (Yang & Wenxia,

2017). In this regard, Alnafrah, Mouselli and Bogdanova (2020) hold that, in the current context of structural transformations, digitization processes should be accelerated, especially in developing countries, in order to improve their conditions of economic and social sustainability.

According to Vinogradova et al. (2020), organizations should implement information systems as efficient instruments to plan corporate work and contribute to the adequate management of the available resources and the achievement of financial results. For Asongu and Odhiambo (2020), *information technologies* are essential tools that promote the migration toward KBEs. Nevertheless, Sebubi, Zlotnikova and Hlomani (2020) report that, in some emerging countries, the infrastructure limitations of these technologies hinder the transformation to KBEs.

The results of the studies into the KBE confirm that education and the cooperation between government agencies, higher education institutions, and the business sector are especially relevant for *innovation*. Education should be funded and strengthened as a source of innovation. For instance, mutual investments funds can be formed to improve educational infrastructure and the protection of intellectual property (Goryainova, Maksimova, Zhdanova & Ermilova, 2020).

Yeo and Lee (2020) attach great importance to the combination of human talent qualification and technology innovation to narrow the salary and employability gaps caused by the accelerated technological advance. It is necessary to strengthen educational systems and their infrastructure to promote the development and improvement of competencies that enable individuals to face the challenges of technological transformations. As a result, human talent development promotes the KBE.

In knowledge-based societies, the accelerated emergence of advanced technologies offers multiple possibilities to generate smart educational institutions, which is achieved by employing several tools (systems, platforms, programs, and methods). In particular, innovative, student-centered, and technological approaches favor the quality of educational practices and significant learning experiences. These strategies can include context-based learning incorporating virtual resources (practical learning), electronic material (e-books), flipped classroom methods, gamification tools, and collaborative learning, among others (Kulanthaivel & Ulagamuthalvi, 2020).

In addition, in knowledge-based societies, the synergy for innovation development is the result of collaborative work between universities and companies. This benefits the generation of collaboration networks and the deployment of the potential existing in universities because they are some of the main promoters of innovation for the development of society (da Silva & Marques, 2020). Nevertheless, according to Azizi and Moradi (2019), the links established between the actors in the innovation system (i.e., government, industry, and university) should be strengthened by means of concrete investment.

It is clear then that, in the knowledge economy, organizations, individuals, and communities generate, exchange, and employ several types of knowledge efficiently (Skrodzka, 2016) in order to achieve several types of development (e.g., *economic development*). This knowledge is supported by the human capital in different economies, specifically KBEs, where most companies offer products and services supported by cutting-edge, knowledge-intensive technologies.

For this reason, in developing countries, the challenge to be able to compete in the market in adequate conditions is developing human talent. This requires high-quality training and institutions that can promote the development and comprehensive well-being of human capital and the population at large (Clarke & Gholamshahi, 2018).

As mentioned by Sycheva, Budagov and Novikov (2020), people should be prepared to program and assign tasks to electronic computing machines, which demands an educational process on this topic that meets the requirements of the business sector. In turn, this will facilitate the sustainability of organizations and contribute to countries' competitiveness (Escalante-Ferrer, Torres-Salazar, & García-Garnica, 2020).

## 4.5. Evolution of topics

This section presents the topics in the KBE field in three periods to analyze their evolution over time. The first period reflects its initial advances, the second one covers its growth and consolidation, and the third one represents its current state. In the first period, the number of publications was low due to the novelty of the topic. The second period is longer and includes more publications that address the most common topics in this area. Finally, the third period comprises the last three years and shows the new research trends in this field.

### 4.5.1. 1986–2003 period

In the first period of the publications about the KBE (1986–2003), the authors explored the association between knowledge and the optimization of productive environments, which is mediated by decision-making and advanced technological systems that enable organizations to develop institutional capabilities and provide products and services that are satisfactory for several stakeholders (Fisher & Nof, 1987).

Likewise, several researchers highlighted the importance of knowledge about advanced technologies to plan local and regional economic development. Said knowledge reduces the uncertainty that organizations experience in their daily operations and is a basis for the establishment of new companies and the restructuring of existing ones considering differences between the actors involved and opportunities and constraints for success (Van Geenhuizen, Nijkamp & Rijckenberg, 1997).

On the other hand, during this period, the authors shed light on the role that universities should play due to the significance of knowledge generation and distribution and the provision of qualified human talent for economic growth (Vicente, 2000). As a result, innovation took on importance and the authors focused their efforts on defining regional innovation systems, particularly in developed countries. Several researchers considered that such systems were the most effective strategies to consolidate the development of industries in the knowledge economy because they strengthen public policies to promote cooperation networks, maintain the competitive equilibrium, and foster industry clusters (Park, 2001).

### 4.5.2. 2004–2018 period

From 2004 to 2018, there was an important number of studies in the KBE field. They show the evolution of different aspects of it: the relevance of knowledge to promote progress and grow the economy; the distribution of resources; and the generation of knowledge-based networks by different actors (companies, governments, and citizens), especially in developed economies, where the increase in economic efficiency has been clear (thanks to the increase in technical capacity and efficiency and the use and optimization of information resources).

In this period, the authors conceptualized the consolidation of open innovation systems focused on different sectors (public, private, government, and established social collaboration networks, among others), which improve collective learning and innovation processes in knowledge structures (Ginevičius & Korsakiene, 2005; Chen, 2008; Yu & Zhou, 2007).

Likewise, they repeatedly analyzed the (political, economic, and social) factors that influence education in the knowledge economy, as well as the crucial contribution of education to innovation systems, its relationship with companies, and its strong link with value creation and economic progress (Menkhoff, Evers, Wah & Fong, 2011; Mousavi, Moeinfar & Amouzesh, 2013; Bano & Taylor, 2015).

Their explorations constantly questioned the changes in the knowledge-based society, demonstrating that competitiveness, scientific research, and innovation systems and processes are decisive, especially if they are based on knowledge utilization and dissemination. Another topic widely investigated in this period was the role that those in charge of designing and leading polities (in different contexts) play in advancing learning and aligning capabilities to inspire sustainable development strategies in global contexts that present widening

(technological, social, economic, and cultural) gaps (Menkhoff et al., 2011; Mousavi et al., 2013; Bano & Taylor, 2015).

Consequently, the authors reflected on the value of knowledge management systems and the importance of their adequate implementation at educational institutions. They also highlighted the influence of the integration of knowledge types and sources on the internationalization processes of small and medium-sized enterprises in emerging economies. Additionally, managing large amounts of data became a point of difference in a scenario where accessibility, data abundance, and dissemination speed changed the perception of the quality of all the stored information and the right way to use it (Carayannis, Ferreira, Jalali & Ferreira, 2018; Gharamah et al., 2018).

#### 4.5.3. 2019–2021 period

In the third period, some topics gained further importance in the KBE field, e.g., the integration of ICTs, the role of education, and innovation processes in KBEs. However, based on keyword occurrences in the documents examined here, other new trends emerged in this field. One of them is the integration of knowledge and innovation in development processes. In said integration, national governments play a key role, capturing existing structures in each context by creating territorial innovation systems, as reported by Mikhaylov and Mikhaylova (2020). In addition, governments can promote public policies that articulate the KBE with satisfying the specific needs of each context (Choi, Huber, Kim, Kwon & Shi, 2020).

Another emergent topic in this period is the articulation of business intelligence processes with big data as a new way to employ the amount of information currently available. This articulation can reduce the existing gap between organizations and their business intelligence processes, which clearly contributes to the consolidation of KBEs (Abu-Rashed, Almafali & Ballard, 2020). This integration (applying data mining and other tools derived from the Internet of Things) can not only strengthen the productive sector but also support the migration to smart cities, a new city model in which technology is widely incorporated (Watson, Musova, Machova & Rowland, 2020).

Finally, another topic that emerged—and that we consider important—is the concept of smart pedagogy and smart institutions. Adopting this concept, universities, high schools, and other educational institutions can incorporate new technological advances and optimize innovation systems using strategies such as flipped classroom, learning by doing, or context-based learning. According to Firsova et al. (2021), this confirms the importance that education has gained as a strategy for social mobility (consequently, for improving living conditions) and as a factor of high differentiation among professionals in the labor market. Figure 14 details the evolution of topics in the KBE field in the three periods detailed above.

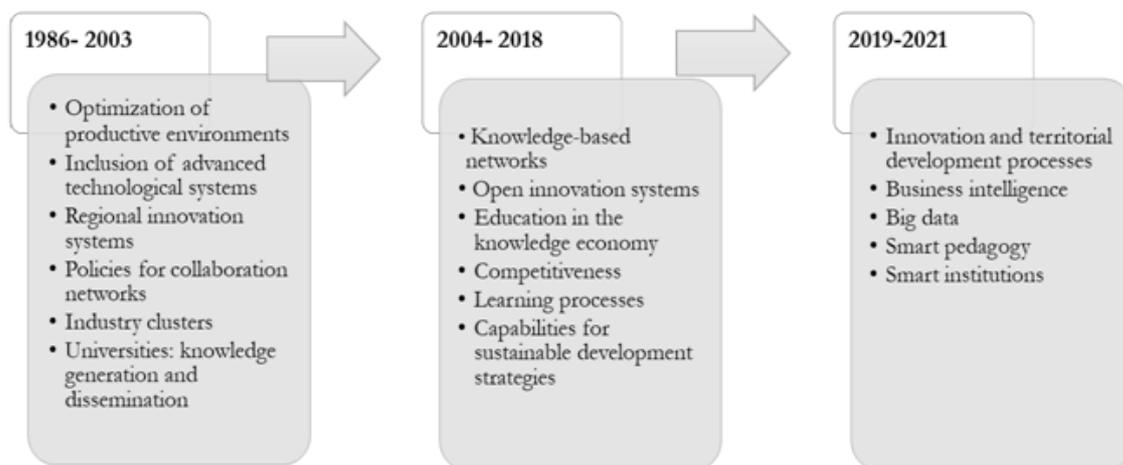


Figure 14. Timeline of the evolution of topics in the KBE field

## 5. Research agenda

This review has shown the behavior of the KBE field over time in terms of emerging topics. Now, it will also propose a research agenda derived from the analysis above.

One of the lines of research in the proposed agenda should be the consolidation of territorial innovation systems because they are strongly related to societies' development dynamics. Hence, future studies on KBEs should further investigate this relationship, especially in Latin America because this region has not published any documents in this field (as seen in the productivity indicators by country reported above).

Another line of research should be *the role of education in KBEs* because (as demonstrated by the authors who have contributed to the KBE field over time) the integration of new technologies in educational processes has been key to knowledge consolidation processes and, consequently, to the qualification of the professionals demanded by the labor market. Therefore, future research in this area should further examine the impact that educational institutions (at all levels) have on KBEs and their contribution to the consolidation of the latter.

*Capabilities for generating sustainable development strategies* is another important trending topic that will surely be further consolidated over time thanks to the Sustainable Development Goals (SDGs). In this regard, basing economies on knowledge will clearly contribute to the development of strategies to achieve the 17 SDGs in the 2030 Agenda. Thus, future studies in this field should identify the way in which the KBE will contribute to global sustainability.

Although it was already a relevant topic in the 1986–2003 period, *policy-making for the consolidation of cooperation networks* is still important. This is because governments (at different levels) are adopting new governance approaches that include creating collaboration systems that involve public and private actors. Furthermore, collaboration networks broaden territorial development perspectives thanks to the global connections that have been produced by globalization. Certainly, KBEs make a substantial contribution to said networks. Consequently, further studies should examine (1) the way in which KBEs can contribute to the creation of cooperation networks and (2) the impact of KBEs on the economic and social development of territories.

## 6. Conclusions

This bibliometric study reveals the importance that knowledge has gained as the foundation of current economies. As a result, the KBE has been positioned as a growing trend in management studies, and (tacit and explicit) corporate knowledge is an intangible asset that organizations (regardless of their sector) should manage. This explains why the quantity, quality, and structure indicators reported above indicate that the most common keywords in the reviewed documents are *knowledge-based systems, knowledge management, information management, economic development, innovation, competency, and information technologies*.

Consequently, it is necessary to consolidate ecosystems based on which governments and the productive sector can promote innovation, adopting tools such as information and knowledge management. Undoubtedly, this will enable economies to develop further.

The panorama described above shows the emerging topics that constitute research areas for the scientific community in the KBE field, which contributes to its literature. Nevertheless, these topics also reveal a practical implication of the results. More specifically, consolidating KBEs implies a series of actions, and organizational studies can contribute to it with conceptual foundations and the generation of solutions to the problems faced by companies and other actors in the ecosystems in this kind of economies.

This analysis also underlines the relevance of two other related topics: (1) business intelligence, which requires the design and implementation of strategies, technologies, qualified staff training, instruments, and infrastructure to adequately manage data and information and (2) data intelligence, which is based on the use of tools such as bigdata and favors predictive (trend) analyses and strategic decision-making for organizations.

Additionally, aspects such as smart pedagogy and smart institutions are key for development because education has assumed an essential role that includes the use of technology tools and the generation of collaborative,

reflective, and self-managed experiences. Said tools favor the improvement of students' skills and learning, which are decisive for the transformation and dynamization of organizational processes, more growth possibilities, and social prosperity.

This study confirmed the interest of developed countries in the KBE field by establishing that they have made the greatest contributions to its advances in different sectors. This is due to the fact that they can satisfy several requirements of innovation and the existence of suitable scenarios to develop this kind of economies in their regions. In addition, the OECD, the EU, and the World Bank have promoted this tendency since the 1980s (although, as a topic, it is introduced in the early 1960s).

This review identified the journals and proceedings that have made the biggest contributions to the KBE field in terms of productivity and impact. Moreover, it listed the publications that focus on the technological and economic aspects of the KBE. The publications are concentrated in a few authors who can be considered leaders in this field thanks to their advances. The co-authorship networks indicate that researchers in this field prefer to write alone. This results in high dispersion and the fact that new authors publish by joining already-established subnetworks. This is an important finding because the KBE is a field that should connect several fields of experience and knowledge and thus promote innovation derived from networked research.

This article presents a systematic collection of information about trending topics in the KBE field in several periods based on production, impact, and structure (network) indicators. Furthermore, this paper proposes a research agenda that can guide future studies in terms of strategies, policies, and applications. Considering its theoretical contribution, this review is a useful source of information for future bibliometric studies.

This review also poses new questions that require further research. For example, considering the importance of innovation systems in KBEs, it would be interesting to examine the impact of developing territorial innovation systems in emerging countries on their social, economic, and technological aspects. A practical implication of this review is that this field should be further studied in emerging nations and economies because, according to the bibliometric indicators above, research into KBEs is led by developed countries. This poses challenges for developing countries in terms not only of their education and research systems but also of the consolidation of their government policies and the actions of organizations responsible for dynamizing their economies.

Another important question is that of the role of educational institutions. In particular, it would be relevant to ask what said institutions are doing to develop and improve students' skills in the use of technological resources in their academic practices, which is an instrument to consolidate KBEs. It would also be greatly interesting to determine the main changes that educational systems should apply or implement at different institutions (at all levels) to further dynamize learning practices that favor the advancement of KBEs. At a more macro level, it is possible to ask what actions the leaders of developing economies are taking to promote and strengthen collaboration networks in KBEs and how they integrate the actors (government, academia, industry, and society) to generate strategies focused on sustainable territorial development and preserving the planet.

A possible limitation of this review can be the fact that it used one database, i.e., Scopus, which can produce some biases and restrictions, for example, in terms of language because it only indexes documents in English. As a consequence, references in other languages (from multiple geographic regions) are not included, which could have influenced the analysis and interpretation of the findings. Additionally, Scopus can restrict the access to the full text of some documents (which are not open access). Finally, future studies can adopt a mixed-methods approach, integrating quantitative and qualitative aspects, to obtain more in-depth results about this field and offer new perspectives.

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