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Who leaps first: Status quo of the leapfrogging phenomenon

Jan F. Killmer

Faculty of Human and Business Sciences, Chair of Technology and Innovation Management, Saarland University, Saarbruecken, Germany

Correspondence
Jan F. Killmer, Faculty of Human and Business Sciences, Chair of Technology and Innovation Management, Saarland University, Building C3 1, Room 326, P.O. 15 11 50, 66041 Saarbruecken, Germany.
Email: jan.killmer@uni-saarland.de

Abstract

In an economic environment, the leapfrogging phenomenon manifests itself in various facets and makes it possible to skip stages of development or product generations. However, an overview of the actors that are involved, how they are connected, and the effects that leapfrogging can have is missing. This article thus focuses on identifying relevant research contributions and analyzing their content by text mining. The results reveal that various actors engage in leapfrogging and that this phenomenon plays a major role in the development of countries, for instance. Firms and industries also pursue leapfrogging, for example, to take leading positions in the market (business strategies). An area of research that has received little attention thus far addresses the leapfrogging behavior of consumers. Technological leapfrogging also combines numerous elements of this phenomenon. Therefore, this article derives many relevant topics for research and practice to investigate this phenomenon in a more accurate and targeted manner.

1 | INTRODUCTION

When climbing a staircase, why take every single step and not skip one or more steps to get to your destination faster? This simple thought experiment encapsulates the idea of this article, which focuses on the "leapfrogging" phenomenon in the economic landscape. Leapfrogging is a behavioral mechanism in which either technological innovations are skipped in the course of development (Binz et al., 2012; Brezis et al., 1993; James, 2013) or individual versions of products are deliberately omitted to obtain a more advanced, improved version of the desired technology or innovation (Gallagher, 2006; Heidenreich et al., 2022; Schilling, 2003).

The leapfrogging phenomenon has already gained attention from the public and the scientific community. From the public side, for example, China's state and party leader Xi Jinping has emphasized that innovation is important for global competition and that only through innovation can China leapfrog into the league of great powers (Hirn & Schütte, 2018). Additionally, columns in the science section of Der Spiegel identify the existence and importance of the leapfrogging phenomenon for developing countries and climate change by noting that "Leapfrogging means: a stage of development that has taken place in other parts of the world, mostly in industrialized nations, is left out in other parts of the world, mostly emerging and developing countries" (Stöcker, 2020). Likewise, Handelsblatt presented the phenomenon of leapfrogging in its digital dictionary blog and concluded that above all, leapfrogging is a warning to market leaders not to rest on their laurels, but at the same time, it is an appeal to those who have fallen behind not to give up (Rettig, 2019). From the scientific side, for example, the leapfrogging phenomenon has been studied in connection with development or technology in China (e.g., see Binz et al., 2012; Fan, 2010; Gallagher, 2006), Africa (e.g., see Amankwah-Amoah, 2015; Hugbo, 2019; Welsch et al., 2013), and developing countries in general (e.g., see James, 2013, 2014; Niebel, 2018; Steinmueller, 2001; Watson & Sauter, 2011). Various technologies and product groups, such as telecommunications and mobile phones (e.g., see Huang, 2011; Wei et al., 2005) or the automotive sector (Herrmann et al., 2017; Thoma & O'Sullivan, 2011), have been investigated in connection

with leapfrogging. In addition, leapfrogging has been considered to be a strategy option (e.g., see Chen & Li-Hua, 2011; Hackbarth & Kettinger, 2004; Tan et al., 2018).

Indeed, the leapfrogging phenomenon has many facets and is mentioned in many different areas, but an overview of the topic is missing. It is therefore necessary to structure the multifaceted, interdisciplinary debate so that the definitions and concepts of leapfrogging are clear and delineated to allow the scientific study of the leapfrogging phenomenon to be distinct and the discussion to be constructive and purposeful. According to Davison et al. (2000), "the role of leapfrogging […] is not an easy one. Technology leapfrogging can exist, but leapfrogging alone does not guarantee, or even encourage, prosperity. […] Furthermore, leapfrogging is not an ad hoc kind of activity. There does need to be a compelling vision about the purpose of leapfrogging—who is involved, how, why, etc." (p. 6–7). In relation to environmental leapfrogging, Perkins (2003) notes that "achieving the goals of leapfrogging will require the participation of a large number of private and public actors: firms, governments from developed and developing countries, multilateral development agencies, and so forth" (Perkins, 2003, p. 184). The identification of relevant actors, in particular, has already provided interesting and important insights in various areas, such as technological capabilities and global value chains (Morrison et al., 2008), smart service systems (Anke et al., 2020), digital agricultural innovations (Maria et al., 2021), and market innovations and value creation (Storbacka, 2019). The identification of leapfrogging actors therefore represents an important contribution to the development of a status quo of the leapfrogging phenomenon for an overview of research streams and research gaps so that potential future research avenues for the scientific community become apparent and a distinct call for promising research on this phenomenon can be made.

This paper thus aims to identify the various leapfrogging actors and to shed more light on their interrelationships. It follows the approach of Sullivan et al. (2018) and includes a systematic, quantitative literature review to identify the pertinent leapfrogging literature supplemented by text analysis via software to examine the topic as objectively as possible and to provide appropriate answers to the research question.

The manuscript is structured as follows. First, the conceptual background of the leapfrogging phenomenon is presented. Second, the methodology, including the research approach and procedure, sample selection, and text mining method, is identified. Third, the results of a bird's-eye view analysis (Singleton et al., 2018) followed by determinative and continuative analyses identify the actors of the leapfrogging phenomenon, its effects, the parties that it affects, and its general characteristics and properties. The manuscript ends with a conclusion on the findings, interesting notes on the study's theoretical and practical implications and future research avenues. From a theoretical perspective, the identification of different leapfrogging actors and their connections enables promising starting points for future research. From a management perspective, understanding the leapfrogging phenomenon is of particular interest for business strategy and product policy purposes. It can enable firms to use their resources in a more goal-oriented way and better position themselves in the market.

2 | CONCEPTUAL BACKGROUND

Previous studies have attempted to define leapfrogging in their respective contexts. For example, one study indicates that less developed countries take advantage of modern production practices by leapfrogging outdated technologies (Hwang & Tilton, 1990). Furthermore, Watson and Sauter (2011) show in their review that "the ability to adopt, manage and develop new technologies—is a core condition for successful leapfrogging" (p. 185). Gallagher (2006) also bases her empirical assessment of energy leapfrogging on two basic approaches to leapfrogging: first, leapfrogging by passing over technology generations and, second, not only skipping generations but also going further ahead and becoming the technology leader. If leapfrogging is seen more as behavior at an individual level, then the expectation of an enhanced follow-up product is added to the leapfrogging of technology generations (Heidenreich et al., 2022; Kim et al., 2001). Finally, Herrmann et al. (2017) summarize the definition of leapfrogging in terms of concrete products and state that "Thus, the key factor in leapfrogging is that current users of a product (P0) decide against purchasing the new product (P1) with the intent of waiting to purchase the future product generation (P2), once it becomes available" (p. 3). Accordingly, although the leapfrogging phenomenon has uniform basic features (skipping over generations of products/technologies), there are differences in leapfrogging contexts and approaches and in the actors involved in it. This stimulates the motivation for a closer look and investigation of the leapfrogging phenomenon.

3 | METHODOLOGY

3.1 | Research approach and procedure

To explore the leapfrogging phenomenon and determine its actors, this study was developed as a scoping study to identify the different areas and uncover possible links. There are multiple approaches in the field of scoping studies (Arksey & O'Malley, 2005; Sarrami-Foroushani et al., 2015), and this study followed the approach of Sullivan et al. (2018). This approach intends to synthesize the field of interdisciplinary research and reveal the research overlaps between different areas of the literature, and it integrates a systematic, quantitative literature review in a multiphase approach for the subsequent examination of the content through text analysis software. Through a systematic and quantitative literature collection without a subsequent interpretation and selection of the found results, as many relevant sources as possible were identified for further analysis. The purpose of using software was to identify the relevant concepts, namely, the actors involved in leapfrogging as well as other areas within this phenomenon and to enable derivations from the gained knowledge for future research without a subjective influence from a third party and a pure analysis of the obtained results. The exact procedure was as follows. In the first phase, the relevant articles were identified through a systematic, quantitative literature review based on the recommendations by Bartels and Reinders (2011). These relevant articles were then analyzed

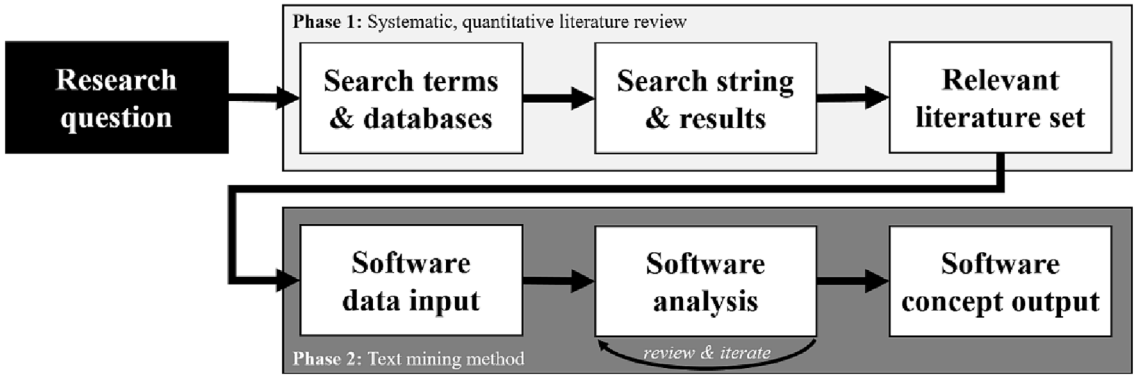

FIGURE 1 Research procedure.

TABLE 1 Methodological approach of the systematic, quantitative literature review.

Search		Database				
Step	Search term	Web of Science	EBSCO Host	Science Direct	JSTOR	Method
1	*leapfrog**	1358	1734	120	465	Searching within abstract, title, and keywords (research articles, all years, and English language)
2	*leapfrog* AND technology OR innovation*	266	299	19	88	
3	*leapfrog* AND technology OR innovation AND hardware OR software OR product OR service*	66	85	5	25	
4	Relevant set (with duplicates)	181				Check for overlaps
5	Relevant set (without duplicates)	∑126				Relevant set without overlaps

in the second phase by using text analytics software (Leximancer), which revealed various concepts and dependencies within the structure. The single phases were consecutively built on one another, and the software analysis also included review and iteration steps to refine the conceptual output, which is graphically represented in the following procedure (see Figure 1).

3.2 | Sample selection

The sample selection was conducted according to the recommendations of Bartels and Reinders (2011) and Greenhalgh (1997). It was based on an automated database search and all research publications up to October 2020 were considered.

To determine the relevant literature, the full texts of each database were searched for different keywords. The chosen search terms referred to the leapfrogging phenomenon under investigation (first step). To further focus the results on the field of study and the research question, the search was supplemented (AND condition) in the course of the investigation (second step) by the terms "technology" OR "innovation." The set of relevant articles (including duplicates) was finally identified through a further concretization (third step) of the search string that utilized the description of the generic terms "technology" and "innovation" based on their formative content (according to their definitions; see Baregheh et al., 2009; Rogers, 2003). Through a manual comparison of the individual articles, 126 articles (without duplications) were finally identified for further investigation through the text mining software. Table 1 provides an overview of the search results found in the individual databases (the detailed results of the systematic, quantitative literature review can be found in chronological order in Appendix S1).

3.3 | Text mining method

To analyze the content of the identified articles and to reveal the concepts they contain, the text mining method was applied. As a form of unstructured ontological discovery, text mining provides detailed conceptual insights by focusing the analysis on the words that authors actually use to create a consistent, nonbiased, and contextual examination of the literature (Biesenthal & Wilden, 2014). Leximancer software (LexiPortal V5) was used for this study. Leximancer software has already been successfully utilized for analysis in various investigations. For example, it has been used in the context of examining academic publications in the tourism sector (Cheng, 2016; Cheng et al., 2018; Jin & Wang, 2016), investigating the representations of homelessness in Australian newspaper articles (MacKinnon, 2015), and analyzing social media data (Tseng et al., 2015). Thus, the software is particularly

suitable for examining concepts in large sets of data (Chen & Bouvain, 2009; Smith & Humphreys, 2006). The approach combines thematic analysis (identifying key concepts) with semantic analysis (linking concepts to one another). This enables the analysis of individual concepts as well as concepts grouped into themes (Mathies & Burford, 2011; Smith & Humphreys, 2006).

For this investigation, in accordance with the research procedure, during the course of the Leximancer analysis, different iteration steps were taken with adjustments within different stages of the software to ensure a meaningful outcome. To increase comprehensibility and clarity, the so-called "noise" was removed in accordance with Cheng and Edwards (2019). Furthermore, following Hyndman and Pill (2018), identical terms (mostly singular and plural versions) were combined manually. Through additional content analysis, related terms were also included (combined). The proper names also determined by Leximancer were removed from the concept list following the recommendations of Crofts and Bisman (2010). And, in accordance with Sullivan et al. (2018), words improperly identified as concepts were also manually excluded.

4 | RESULTS

4.1 | Bird's-eye view analysis

Following the research approach, the 126 articles related to the leapfrogging phenomenon (see Appendix S1) were analyzed by using the text analytics tool Leximancer. First, the results are presented from a bird's-eye view in a concept map with a topical network (Haynes, Green, et al., 2019; Leximancer Pty Ltd, 2019; Singleton et al., 2018). Within this visualization, the concepts (determined by the software) are represented by individual dots (whose size varies according to the frequency of co-occurrence). Links between these concepts are also visible, and related areas are colored and graphically cumulated in themes. The coloring of these themes reflects their relevance according to the color wheel. The proximity and possible overlap of individual themes represent their semantic relationship (Campbell et al., 2011; Rooney, 2005). Following the approach of Haynes et al. (2019), the theme size adjustment (34% in this case) makes it possible to work with a moderate number of predefined themes for a better follow-up analysis.

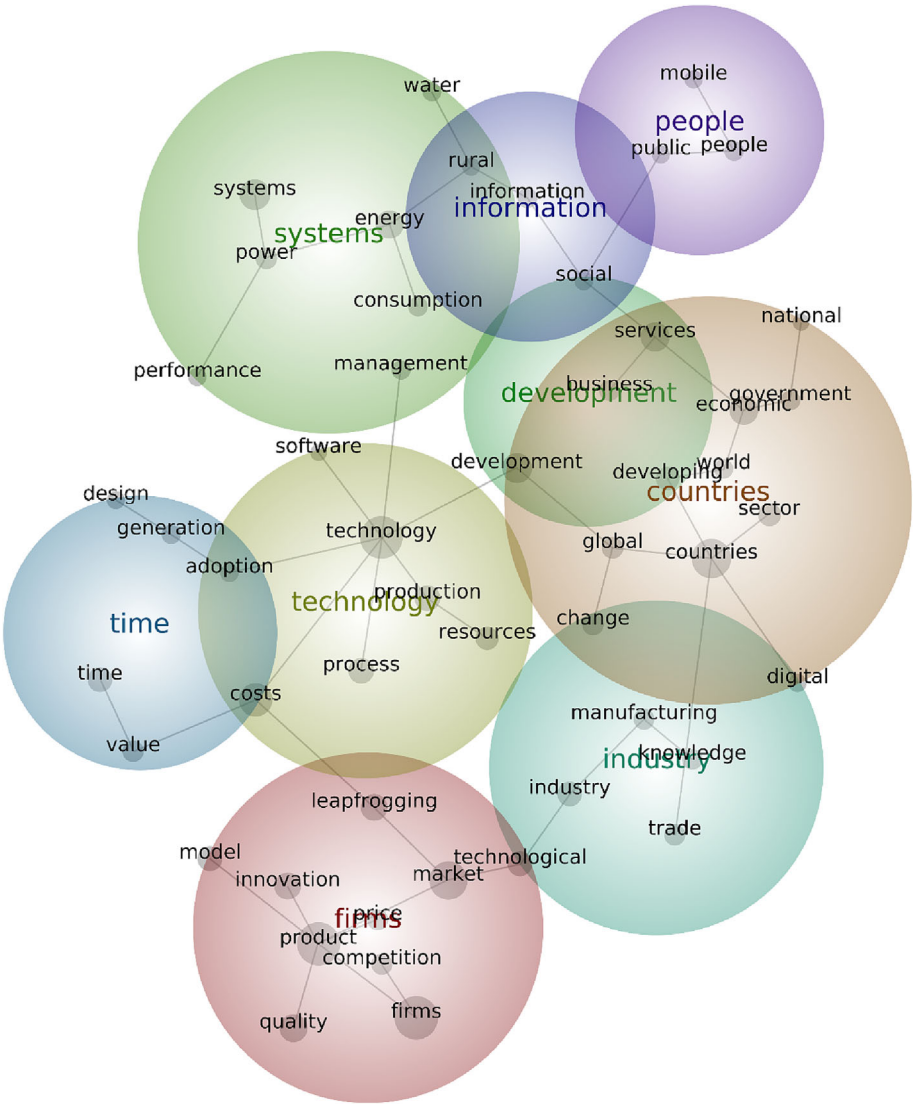

FIGURE 2 Concept map (bird's-eye view analysis).

The summarizing concept map displays the various concepts forming the individual themes while showing their interdependencies (see Figure 2). An overview of all identified concepts with their respective count and relevance is provided in Appendix S2.

4.2 | Determinative analysis

As the initial analysis from the bird's-eye view showed, Leximancer was able to identify different concepts and themes within the leapfrogging phenomenon. Following the approach of Randhawa et al. (2016) to identify focus areas within the research field "by interpreting the semantically closely related themes (and concepts) and reading contextual text samples (from the […] articles) that form the themes" (p. 758), the following three main regions of interest were identified:

1. the actors in the leapfrogging phenomenon;
2. the effects of and parties affected by leapfrogging; and
3. the characteristics and properties of the leapfrogging phenomenon.

The confirmation of emerging themes and concepts through a manual analysis of individual articles is important, according to Crofts and Bisman (2010). As specified by Haynes, Garside, et al. (2019), "zooming in" on the data provided by Leximancer enables an even better and more in-depth analysis. Leximancer software was tested by Smith and Humphreys (2006) for its "validity, stability, reproducibility, correlative validity and functional validity" (Liesch et al., 2011, p. 25). On closer examination, the item of interest for more extensive investigations is not only the presence of concepts but also their absence (Liesch et al., 2011; Randhawa et al., 2016).

As the determinative analysis revealed, research on *(1) The actors in the leapfrogging phenomenon* has attracted the most attention (see the red and orange coloring for *firms* and *countries*). The actors that are engaged in the leapfrogging phenomenon are firms, industry, and countries. In addition to the concepts to be assigned to each topic individually, so-called technological leapfrogging is the unifying element across all identified actors, which is fittingly described by Chen et al. (2012) as "a non-continuous technological advance behavior among different technological curves, aiming at catching up with or leaping those pioneers' technology capability, a breakthrough in independent technological innovation as the core" (p. 1424). Additionally, the adoption of innovative or cutting-edge technology in a field of application in which no prior technology has been adopted is referred to as "technology leapfrogging" (Etoundi et al., 2016). Goldemberg et al. (1994) suggest that in the course of energy efficiency improvements in developing countries, technological leapfrogging can be enhanced by simultaneous leapfrogging in different areas, such as institutions, management, and entrepreneurship in general. Although technological leapfrogging is a unifying element for all actors, other aspects of leapfrogging can also be identified for different actors. For example, recent research has added the area of environmental leapfrogging to the pure aspects of competition between industrial sectors within technological leapfrogging to achieve sustainable economic development, which is also reflected in more sustainable consumer consumption patterns called lifestyle leapfrogging (Schroeder & Anantharaman, 2017). Additionally, with energy leapfrogging, the research focus is drawn to the evolution of developing countries and their access to technologies, which allows them to shorten the course of development on emissions and energy consumption that industrialized countries undertook in the past (van Benthem, 2015).

To summarize these various aspects of leapfrogging, leapfrogging is seen in this literature as a type of strategy or behavioral pattern used by different actors to either catch up with actors in leading positions in the economy or to overtake them directly. Countries represent the aggregated form of actors, which include industry and single firms. Which is reflected in the following dissection of the separate themes.

Firms are the most dominant theme within the analysis (red coloring). Considering the connections and dependencies, it is notable that "leapfrogging" is located within the theme of *firms* and that there is a strong focus on "product" and "market." Thus, research has mainly studied leapfrogging in a firm context from a strategic perspective in a competitive environment. Firms, for example, are faced with a decision to imitate or leapfrog their competitors when a new generation of products is launched (Sudharshan et al., 2006). Alternatively, they try to catch up by monitoring technological developments (leapfrogging different technology generations), thereby keeping up with the leading competitors, as Lee et al. (2005) show for Korean firms in their examination of digital TV. Additionally, Athreye and Godley (2009) compare the leapfrogging strategies of US and Indian firms in the pharmaceutical industry (US firms, 1940s; Indian firms, 1990s) to eliminate their lagging position in the market through internationalization efforts and technological endeavors. Notably, some articles mention that consumers are leapfrogging actors, as, for example, their adoption of efficient products can further influence the leapfrogging of countries (Schroeder & Anantharaman, 2017) or that firms have to face the challenge of consumers leapfrogging their products (Heidenreich et al., 2022; Herrmann et al., 2017).

For the theme *industry*, according to its rather low relevance within the entire investigation (green-cyan coloring), industry, as a leapfrogging actor, is only a link between firms and countries since industry represents an aggregation of the different firms of an industry sector. Additionally, especially from the country point of view, research refers less to individual firms and more to entire industry branches. For example, Chen et al. (2012) show that laggard firms and developing countries are engaged in this new innovation mode. In addition, in their empirical analysis, the Chinese Ministry of Railways specified high-speed train development within the manufacturing industry, but development was realized by individual firms. Moreover, Yap and Rasiah (2017) ask, "What constitutes the kind of capabilities needed in latecomer firms to transit to the advanced level and to leapfrog the others to become industry leaders?" (p. 2). It becomes obvious that firms are competing with one another (pursuing a business strategy) to take a leading position within their field, and "industry" therefore represents only an aggregation of "firms." In contrast,

countries benefit from the further development of industry as a whole (e.g., through "knowledge").

Countries represent the second predominant theme (orange coloring). The content analysis shows that leapfrogging has enormous potential for developing countries to catch up with industrialized countries to thus close the gap between them. As Iyer (2018) shows in his case study on leapfrogging in India in the area of smart manufacturing, India needs to catch up in the fields of critical technologies and comparative advantages, and it requires a political framework to make the leap from Industry 2.0 to Industry 4.0. In addition, Hadzimustafa (2011) emphasizes that "for developing countries, knowledge offers possibilities to short cut development phases, leapfrog technologies, and more quickly integrate into the global economy by becoming more attractive to international investors" (p. 23). Moreover, Schäfer et al. (2014) describe how the emergence of mobile communications enabled the African continent to leapfrog the industrialization path of Western countries (via fixed telecommunications). This has increased economic development in various areas, such as agricultural trade (exchange of market prices), money transfers (via SMS), mapping for productive land (by using the GPS function of devices), and in rural areas, the training of health workers (through telemedicine). Furthermore, in the field of manufacturing and industrialization processes, China has managed to achieve considerable success through technological leapfrogging by imitation (Lai et al., 2016). As countries represent the most aggregated level of actors in the leapfrogging phenomenon, it is not surprising that the largest and most far-reaching consequences have been documented in relation to country development. The leapfrogging interactions and strategies of firms and industries contribute at least in part to this. In addition to answering the original research question about actors, the analysis reveals further aspects of the leapfrogging phenomenon. However, the results did not reveal the role of individuals (consumers or customers) as possible actors in the leapfrogging phenomenon (see the continuative analysis).

(2) The effects of and parties affected by leapfrogging have been identified. The contributing themes to this research aspect are *development*, *information*, *systems*, and *people*. As these themes are closely mapped to *countries* and even *development* shows a large overlap, it seems evident that the leapfrogging of countries creates and/or influences these areas. On closer examination, the relatively dominant *systems* theme (yellow-green coloring) is the driving force behind the content of the leapfrogging effects and the affected parties. Welsch et al. (2013) identify the leapfrogging opportunities for sub-Saharan Africa by implementing new, smart power systems and show that leapfrogging traditional versions is a special option for developing countries to catch up with industrialized countries. They also draw parallels to the successful introduction of mobile phones in Africa by pointing to the new opportunities that it brings for people, which could also be achieved in the area of new energy systems. In the context of urbanization and increasing energy consumption, Schroeder and Anantharaman (2017) point out that the introduction of low-energy housing in China and a systematic pursuit of this goal could address these increased demands (according to the requirements of people and the environment) and thus leapfrog the classical progression. Furthermore, Schäfer et al. (2014) emphasize leapfrogging possibilities in the field of water supply for developing countries, especially rural areas. Additionally, in the field of information and communication technologies (ICT), Thamodaran and Ramesh (2010) note that "it has enabled countries to leapfrog traditional modes of service delivery and make manifold improvements in process effectiveness and efficiency. Widespread adoption and application (of ICT) [...] is presently considered to be the key factor behind boosting competitiveness and developing an informed society" (p. 98).

With these aspects taken together, it can be observed that the impact of leapfrogging is largely determined by the actor countries. Firms and industries contribute to leapfrogging outcomes. The theme of *people* is slightly misleading, and it remains questionable why individuals (consumers or customers) were identified, not as actors, but solely as affected parties.

Finally, *(3) the characteristics and properties of the leapfrogging phenomenon* close the investigation and confirm the origin of leapfrogging. The themes included are *technology* and *time*. *Technology* represents the second most important theme of the research (yellow coloring), and *time* is inferior in comparison (blue-cyan coloring). This last region *(3)* of interest in the investigation summarizes the previously presented aspects of leapfrogging and shows in detail the characteristics of leapfrogging that should be emphasized and what this phenomenon is based on. In particular, technological leapfrogging, which is connected with the areas of production, resources, the processes to be used, and the adoption of different generations of technology, becomes apparent. Moreover, the temporal aspect becomes clear through the different technology stages in which countries are located or with which firms have to work, and it shows that leapfrogging occurs only in connection with several product/technology generations, development stages, and so on. The results found by the determinative analysis, that is, the three main regions of leapfrogging, are captured within the original concept map (see Figure 3).

4.3 | Continuative analysis

In addition to identifying the actors involved in the leapfrogging phenomenon, clarifying the role of individuals (consumers or customers) and showing whether they play a role of their own in the leapfrogging phenomenon or are merely a "result" or "outlet" of the leapfrogging actions and strategies of firms, industry, and countries, a continuative analysis was undertaken following Liesch et al. (2011) and Randhawa et al. (2016). The apparent absence of the theme or concept of consumers/customers requires a more detailed investigation. Various studies underline the importance of consumer leapfrogging and its possible negative effects for innovation-driven firms (Goldenberg & Oreg, 2007; Lobel et al., 2016). Kim et al. (2001), for example, state that consumer leapfrogging is a vital part of firms' product launch strategies because it influences their marketing efforts and resource allocation. And van Rijnsoever and Oppewal (2012) empirically

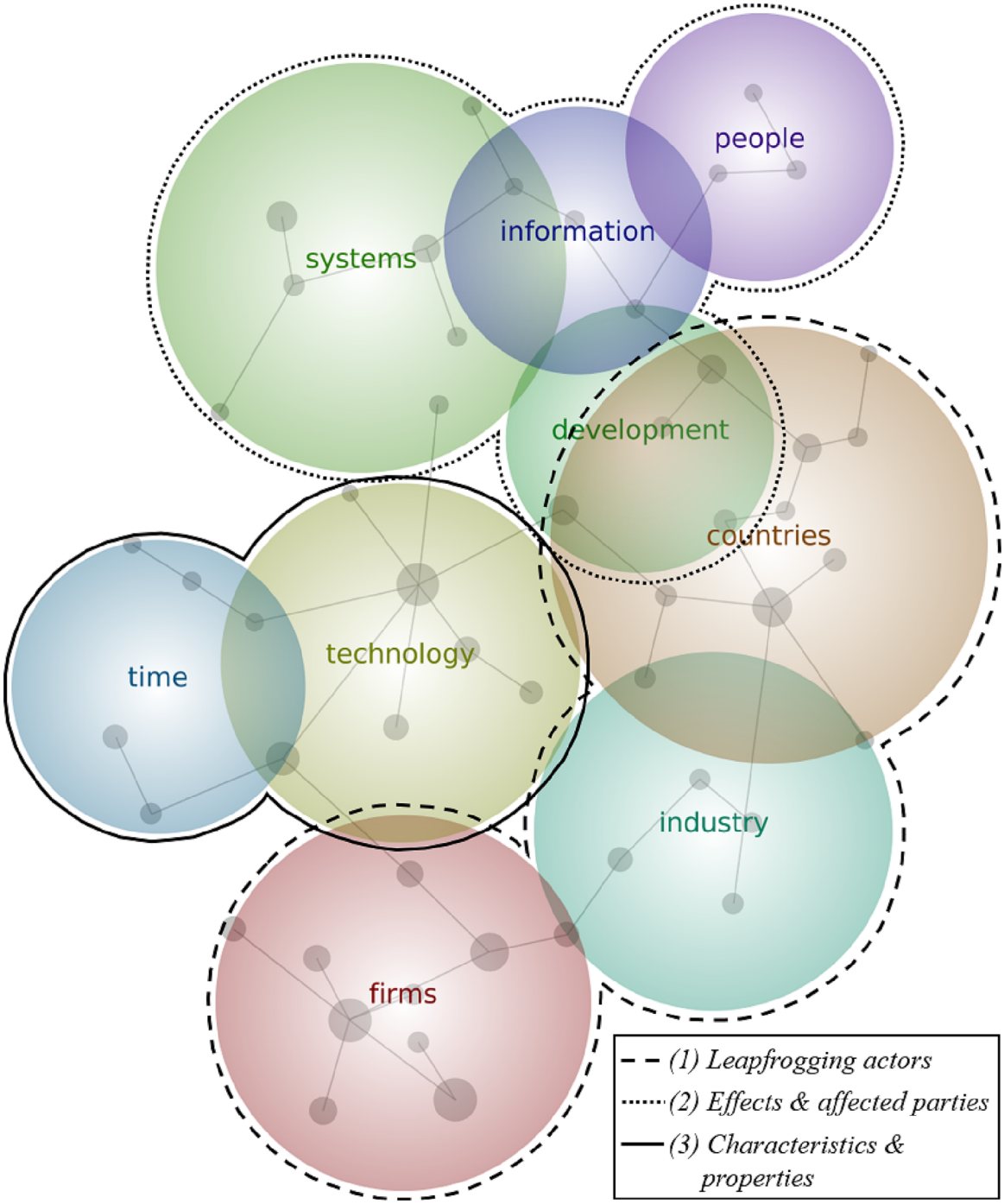

FIGURE 3 Concept map (determinative analysis).

demonstrate the leapfrogging of consumers of the first generation of DVD players who retain their videocassette recorders before acquiring the subsequent generation of DVD recorders.

To clarify the role of individuals (consumers or customers) in the leapfrogging phenomenon, a new project was launched with Leximancer software. The initial basis provided by the systematic, quantitative literature review was maintained. By examining the frequent word and name terms, it was revealed that the software recognized "consumer(s)" and "customer(s)" as words and "consumers" as names. These terms were then combined into a user-defined concept of "consumers," and this new concept was manually added to the concept list in accordance with the recommendations of Sullivan et al. (2018). Following the "profiling" advice in the Leximancer User Guide, Release 5.0 (Leximancer Pty Ltd, 2019), this new concept along with the concepts of "countries," "firms," and "industry" were set as required concepts. This allowed the investigation of all actors from the highest aggregation level, that is, countries, through industry and separate firms to individuals, that is, the lowest aggregation level. All

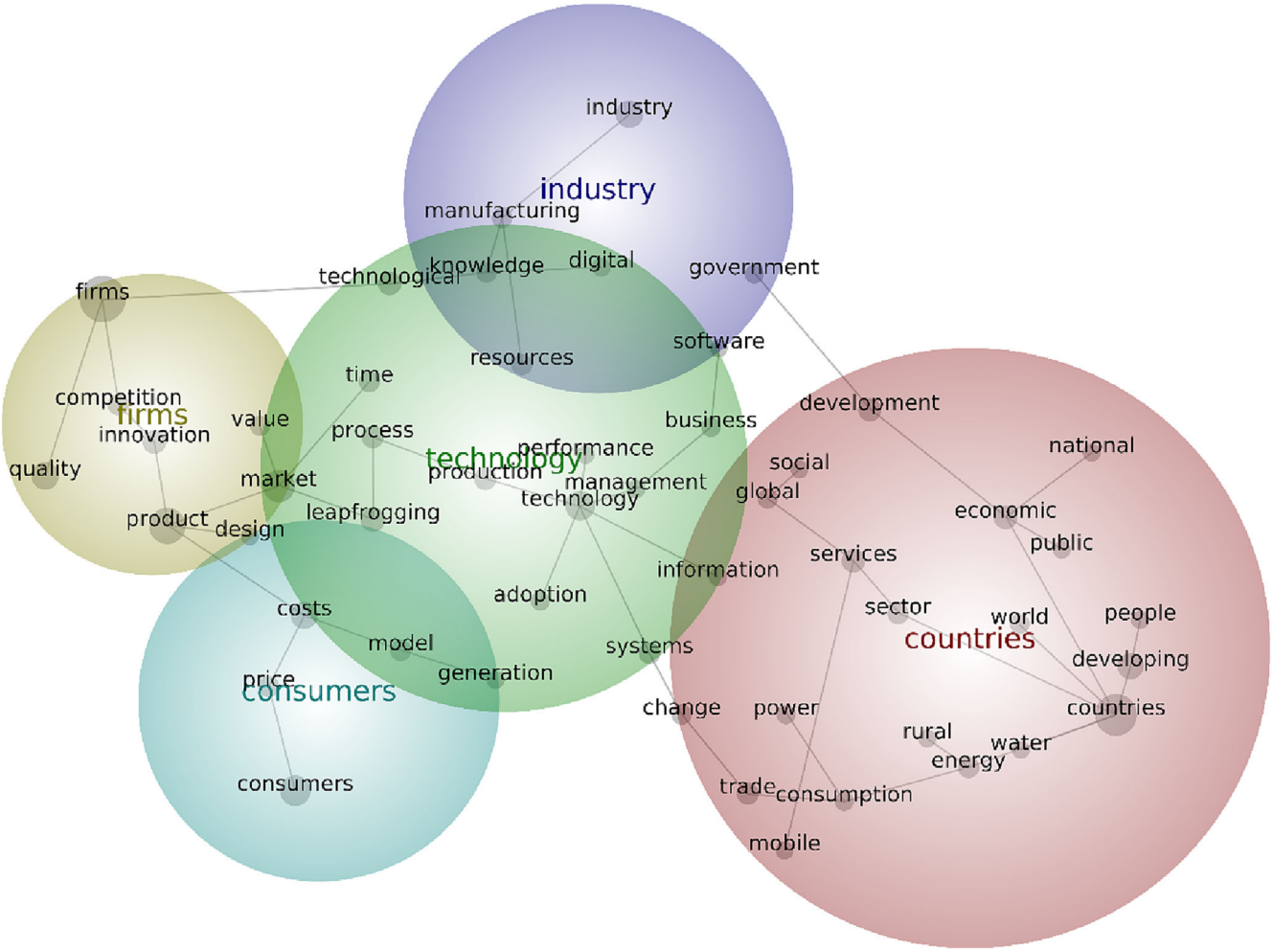

FIGURE 4 Concept map (continuative analysis).

other settings in the project were kept according to the initial to ensure later comparability.

After these adjustments were made and the essential components became the focus, the leapfrogging actors (set as required concepts) and the newly gained concept map (setting: 55% theme size) appeared to be much more structured. It now becomes clear that consumers are included among the actors. The summarizing concept map of the continuative analysis displays the various concepts that form the leapfrogging actor themes while also showing their interdependencies (see Figure 4). An overview of all identified concepts with their respective count and relevance is provided in Appendix S3.

When deepening the continuative analysis, the relevance of the individual themes is the first thing to consider. It is obvious that *countries* is the most important theme (red coloring) but that *firms* is also very relevant to the research (yellow coloring). *Consumers*, on the other hand, are less prominent (blue coloring). Furthermore, the spatial distance of the concept of "consumer" shows its obviously minor role in connection with the leapfrogging phenomenon. The *consumer* theme, nevertheless, overlaps with the *technology* and *firms* themes. As Schroeder and Anantharaman (2017) indicate in their research on emerging economies, "To date, leapfrogging scholarship has been disproportionately focused on technological solutions, (…) and failing to bring the domain of consumption or human behaviour under its purview. This neglect of so-called soft factors such as consumer behaviour and consumption patterns has significantly limited the explanatory and transformative power of the idea of leapfrogging" (p. 6).

Other articles that address consumers as leapfrogging actors or parties show that, for example, consumer behavior can be changed by leapfrogging information technology (IT) applications (in an e-commerce context), thereby increasing overall economic efficiency, as Martinsons (2008) shows by using cases from China as an example. Additionally, Welsch et al. (2013) point out that consumers will benefit greatly from the introduction of smart grids in sub-Saharan Africa if the traditional pathways to energy production and electricity supply are leapfrogged. Also, van Benthem (2015) emphasizes in his article on the energy leapfrogging of developing countries "that technology leapfrogging has been present on two accounts. Individual technologies have leapt to a higher degree of energy efficiency, and the typical LDC (less developed country) consumer has leapt to a more energy-rich lifestyle using technologies that were not typically available to consumers in ICs (industrialized countries) several decades ago" (p. 126).

In contrast to this more widespread view of the consumer as the "recipient" and "profiteer" of leapfrogging by, for example, countries, only a few articles specifically address leapfrogging as consumer behavior. Chanda and Bardhan (2008), for instance, show in their mathematical model of consumer buying behavior in a multigenerational product market that there is a clear indication of leapfrogging and switching behavior. Zhao and Jagpal (2006) also consider leapfrogging as a potential consumer or purchasing behavior in their model on the effect of a secondhand market for durable consumer goods. In addition, in their study on the optimal response to the introduction of a new generation product, Sudharshan et al. (2006) point out that firms' decision to invest in a new technology depends heavily on consumer demand and whether consumers are willing to switch to the new technology.

However, in this analysis, only Herrmann et al. (2017) focus specifically on the consumer behavior of leapfrogging and its possible determinants. In their empirical study, they focus particularly on consumers' leapfrogging behavior, which is defined as replacing the current product with the next-generation product instead of its latest version. They also point out the special position and critical impact of consumer leapfrogging behavior for firms when they introduce a new product to the market. The authors show that leapfrogging behavior is determined more by the current product itself and the switching costs than by the functions and properties of the new product. They conclude by emphasizing that future research should consider consumer leapfrogging behavior (Herrmann et al., 2017). In addition, switching costs for consumers are also considered by Schilling (2003) in her examination of technological leapfrogging in the US video game console industry. She suggests addressing these switching costs through, for example, appropriate strategies such as offering money-back guarantees to customers.

5 | CONCLUSION

Leapfrogging has been previously identified as a behavior or strategy engaged in by various actors within the economy (e.g., see Binz et al., 2012; Gallagher, 2006; Herrmann et al., 2017). However, the specific actors in this context have not yet been examined in detail, and the potential impact of the leapfrogging phenomenon has been identified only in particular cases. This article thus focused on the identification of the different actors in leapfrogging and the effects and descriptive elements of the phenomenon. Through an overview of the leapfrogging phenomenon and an analysis of the scientific contributions in the context of technologies and innovations, several valuable insights were gained.

First, the analysis identified the actors involved in the leapfrogging phenomenon and showed the connections between them. Then, a more detailed determinative investigation identified the specific leapfrogging behaviors or actions of each actor. Countries represent the most aggregated actor, and the research describes how, for example, developing countries catch up with developed countries through leapfrogging actions (e.g., see Hadzimustafa, 2011; Iyer, 2018; Schäfer et al., 2014). It was also possible to identify industries and firms as actors in this context and to demonstrate that a leading position in the competition can be achieved through the pursuit of a leapfrogging strategy (e.g., see Athreye & Godley, 2009; Schilling, 2003; Yap & Rasiah, 2017). The continuative analysis confirmed that consumers (or customers) are also leapfrogging actors. Through their leapfrogging behavior, they influence firm performance, that is, product sales, and through their consumption behavior, they can affect the development of entire industries and countries (e.g., see Herrmann et al., 2017; Schroeder & Anantharaman, 2017; Sudharshan et al., 2006).

Second, the effects of leapfrogging on various parties and sectors were shown in the context of countries' development. Rural areas in particular and the population in general benefit from leaps in a country's development, and systems such as water and energy supply are improved through technological leapfrogging (e.g., see Schäfer et al., 2014; Thamodaran & Ramesh, 2010; Welsch et al., 2013). Considering these effects of and parties affected by "country" leapfrogging, similar aspects for industries or firms are apparently lacking. By grouping firms and industries and overarching them in countries, individual aspects can be applied to these other actors, as well. However, especially in the area of firms, a closer look at consumers could uncover further insights.

Third, the analysis revealed the characteristics and properties of the leapfrogging phenomenon. In particular, the aspect of technological leapfrogging is a summarizing factor and therefore emphasizes the technology relatedness of this phenomenon. Different technology stages or different generations of products, for example, are skipped to keep pace with the competition or to take a leading position, and the temporal relationship (i.e., the existence of different generations and their temporal distances) in the context of leapfrogging also becomes clear as a result (e.g., see Chen et al., 2012; Etoundi et al., 2016; Goldemberg et al., 1994). Newer forms of leapfrogging, such as environmental or lifestyle leapfrogging and the deepening of energy leapfrogging, were also demonstrated (e.g., see Schroeder & Anantharaman, 2017; van Benthem, 2015). No uniform definition of this phenomenon could be derived or recognized, but the essential aspects became clear and could thus be seen coherently, regardless of the actors and the circumstances. Therefore, in accordance with the research question, it was possible to identify the leapfrogging actors, reveal other aspects and characteristics of this phenomenon, and provide a foundation on which research and practitioners can build.

6 | THEORETICAL IMPLICATIONS

The approach to exploring the leapfrogging phenomenon within this study identified several interesting and valuable insights for research. By examining this phenomenon within the economy, the insights gained can be divided into three main areas.

First, this research represents the first overview of the leapfrogging phenomenon in relation to the thematic fields of technology and innovation in the context of economies. On the one hand, this study identified the various actors who engage in leapfrogging. These actors

include countries, which have been studied most thoroughly thus far (e.g., see Goldemberg et al., 1994; Levin & Thomas, 2016; Schäfer et al., 2014), as well as industry and firms, which have also been investigated regarding their leapfrogging actions (e.g., see Lee et al., 2005; Sudharshan et al., 2006; Yap & Rasiah, 2017). A more in-depth analysis, however, also identified consumers as leapfrogging actors (e.g., see Herrmann et al., 2017; Schroeder & Anantharaman, 2017; Welsch et al., 2013). On the other hand, this study determined the effects of country leapfrogging (e.g., see Schäfer et al., 2014; Thamodaran & Ramesh, 2010) and particular leapfrogging characteristics described in more detail. Specifically, technological leapfrogging is thereby the dominant topic (e.g., see Chen et al., 2012; Etoundi et al., 2016).

Second, by continuing to analyze the actors and thus confirming consumers as leapfrogging actor, this study identified their participation and revealed future research potential concerning this actor. Some articles refer to consumers as leapfrogging actor (e.g., see van Benthem, 2015; Welsch et al., 2013; Zhao & Jagpal, 2006), but only one article in this investigation addresses leapfrogging as a specific consumer behavior with the identification of the corresponding determinants (see Herrmann et al., 2017). The underrepresentation of this behavior within the study, the potential for this behavior to significantly influence firms' marketing efforts and resource allocations (Kim et al., 2001), its empirical confirmation as consumer behavior in the home entertainment market, and the relationship between the early introduction of a product and its successor version (van Rijnsoever & Oppewal, 2012), for example, show the need for future research in this area. The effects of consumer engagement in leapfrogging pose corresponding challenges in the future, especially for firms and their (marketing) strategies in a multigenerational context (e.g., see Jahanmir & Cavadas, 2018; Killmer & Heidenreich, 2022; Sudharshan et al., 2006). Due to the impact of consumer leapfrogging, for example, on the cash flow of firms (Lobel et al., 2016), on entire industries, and ultimately on countries, its identification represents an important point for future research.

Third, the text analysis tool Leximancer used in the applied multiphase research approach was also confirmed to be suitable. This software was previously used, for instance, to create research agendas in the fields of open innovation (Randhawa et al., 2016) and innovation resistance (Huang et al., 2021), and this study showed that it can also be used to successfully demonstrate the exploration of an economic phenomenon such as leapfrogging. Leximancer was able to determine the actors, effects, and properties of the leapfrogging phenomenon. The demonstrated applicability should be beneficial for other research fields and applications and may reveal and possibly close further research gaps.

7 | MANAGERIAL IMPLICATIONS

The study of the leapfrogging phenomenon also offers interesting starting points and insights from a management perspective. The research on the phenomenon as a whole has produced different findings, which can be divided into three main areas.

First, starting with the party identified as the largest actor in leapfrogging, for countries, leapfrogging represents a great opportunity, especially for developing countries. Their chance to catch up by leapfrogging different stages of, for instance, technological developments compared to industrialized countries represents enormous potential for the population and existing industry (e.g., see Aggarwal, 1999; Hadzimustafa, 2011). By leaving the path of development that industrialized countries have taken, decisive advantages have already been achieved in certain regions, such as the African continent (e.g., see Schäfer et al., 2014; Welsch et al., 2013). Therefore, developing countries, their governments, and their industries should try to catch up with the rest of the world, or at least reduce their backlog, by leapfrogging different stages of development.

Second, the pursuit of leapfrogging as a business strategy for firms in the context of technological leapfrogging offers them opportunities to reduce the gap that separates them from their competitors or to take a leading position in the market (e.g., see Athreye & Godley, 2009; Lee et al., 2005). In this context, various development stages are also skipped but with specific reference to individual technologies or products. Firms should therefore always consider leapfrogging as a business strategy option, either for their development or as a precaution against competitors' actions. If a firm is aware of this, then it can likely better respond to and actively participate in market developments. However, this solely focus on competition also harbors risk.

Third, as the continued analysis in this article also identified consumers as leapfrogging actors, consumer leapfrogging behavior represents an important starting point from the management perspective. Management is directly affected by this behavior and must react accordingly. When consumers leapfrog, they skip product generations to wait for future products and improvements, which can cause firms to miss their initial sales targets, potentially lose market shares to competitors, and fail to diffuse products in the market successfully (e.g., see Jahanmir & Cavadas, 2018; Weiber & Pohl, 1996). Since very few studies, including Herrmann et al. (2017) and Heidenreich et al. (2022), have examined the specific determinants of consumer leapfrogging and because research in this area is still relatively scarce, firms should analyze this consumer behavior more closely and consider countermeasures, like suitable marketing strategies (Killmer & Heidenreich, 2022).

8 | LIMITATIONS AND FUTURE RESEARCH AVENUES

As presented, this study provided an overview of the leapfrogging phenomenon, including its actors, effects, and characteristics. Although the use of a systematic research methodology reduces the biases often related to expert consultations and traditional literature reviews, the results are still affected by the range and style of the underlying research framework and techniques. Therefore, this study has some limitations, which, in turn, may open up fruitful avenues for future research.

First, the criteria selected for the systematic, quantitative literature review might be criticized in that their selection and combination did not identify all relevant research contributions that describe the leapfrogging phenomenon. Although in the first step of the analysis, an attempt was made to include all possible variants of the term leapfrogging with the help of an asterisk (*), an objection would be justified since the combination of the term with the topics of technology and innovation narrowed the search field. Therefore, the choice of other criteria and algorithms could lead to further perspectives on leapfrogging to explain this phenomenon even more extensively.

Second, the articles collected from the systematic, quantitative literature review included only already published articles (existing research); thus, ongoing investigations and unpublished insights were not considered. It is recommended that the study be repeated at a later date to allow the incorporation of even more findings, to form an even broader basis for analysis that uses text mining software, and to confirm the results presented.

Third, since the analysis was conducted using text mining software (Leximancer), it is possible that the analysis did not capture all of the important nuances of the leapfrogging topic. Although such software has proven to be useful in many areas (e.g., see Cheng, 2016; Cheng et al., 2018; Jin & Wang, 2016; MacKinnon, 2015; Tseng et al., 2015), its use remains an important limitation of this research. However, the aim of this research was to conduct a scoping study and to shed light on all facets of the leapfrogging phenomenon in the context of the economy, identifying actors, connections, and characteristics. Consequently, to validate the results, a more extensive qualitative and meta-analysis of this research area should be carried out.

Fourth, although the themes and concepts identified by the software represent the leapfrogging phenomenon in some sense, these findings were confirmed only by the textual analysis. Other researchers might achieve further insights and statements about the leapfrogging topic; thus, researchers are encouraged to repeat this study and contribute even more perspectives to the exploration of the leapfrogging phenomenon.

Fifth, the identification of consumers as leapfrogging actors could be confirmed only through further continuative and textual analysis, which of course represents an intrusion into the original investigation. This manual intervention in the research provided an even more comprehensive picture of the actors within the leapfrogging phenomenon, but it should be confirmed through further research.

Finally, the leapfrogging phenomenon remains an interesting field of research with broad areas of interest, and there is a need for further explanations and (uniform) definitions of different aspects of leapfrogging. Consumer leapfrogging behavior in particular offers considerable research opportunities and has far-reaching consequences for firms and, thus, for industries and countries. In the future, it will be helpful to better understand this phenomenon with all of its facets, to classify its effects accordingly and, ultimately, to influence its consequences.

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DATA AVAILABILITY STATEMENT

Data are available in the Supporting Information.

ORCID

Jan F. Killmer https://orcid.org/0000-0002-1859-1596

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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