

UDC 378.014.54+001.89:330.341
DOI 10.31733/2786-491X-2023-1-55-69



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ACADEMIC ENTREPRENEURSHIP: A SYSTEMATIC REVIEW OF THE LITERATURE AND AN AGENDA FOR FURTHER RESEARCH

Abstract. The article presents the results of a bibliometric analysis of foreign literature (858 scientific papers) on academic entrepreneurship published in the SCOPUS scientometric database in 1970-2022. The dynamic and structural analysis of publications showed the growing relevance of the international scientific community to the development of academic entrepreneurship. The clustering of scientific research by means of VOSviewer.com allowed us to identify 5 clusters: 1) purpose, role, impact of academic entrepreneurship on innovation, higher education, economic development and competitiveness of the country (region); 2) academic entrepreneurs and development of the academic entrepreneurship ecosystem; 3) interaction (links) between universities and industry, organization of technology transfer; 4) patent activity of universities; 5) academic spin-offs and formation of entrepreneurial universities. The trends in scientific research are identified based on a substantive analysis of the 15 most cited scientific publications. Proposals on the appropriate directions of research on academic entrepreneurship in Ukraine are presented.

Keywords: *academic entrepreneurship, commercialization of university technologies, literature review, bibliometric analysis, WOS-viewer, research trends.*

Introduction. The issue of academic entrepreneurship is not sufficiently represented in the scientific space of Ukraine, although at all levels the opinion about the importance and feasibility of this option for the implementation of the "third mission" of universities is supported. It is generally recognized that academic entrepreneurship is an effective form of interaction between universities, business, state (government) and local (community) institutions. It is thanks to academic entrepreneurship that university researchers can accelerate and shorten the path of transformation of a scientific idea (project, development) into the results of its practical use new products, services, technologies.

Analysis of recent research and publications. On the information platform "Scientific Periodicals of Ukraine" (www.irbis-nbu.gov.ua); we managed to find only 5 articles devoted to this issue and dated 2013-2017. Academic entrepreneurship is considered in them as a factor of socio-economic development of the country and innovative development of higher education and

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science of Ukraine, as a factor of increasing the efficiency of enterprises and formation of innovative potential of the Ukrainian economy. In these works, Ukrainian researchers use the term "academic entrepreneurship", but do not disclose its content in detail. The priority of their attention was the conceptual and methodological foundations of innovative entrepreneurial activity of higher education institutions in the world (Romanovskiy 2015); the role of universities in the innovative development of higher education and the economy as a whole (Romanovskiy, 2015), consideration of the components of the modern innovation infrastructure (technology parks and business incubators), which are identified as priority components of academic entrepreneurship in the formation of the innovative economy of Ukraine (Zhukov, 2017). The article (Gladka, 2013) describes the experience of applying one of the possible forms of academic entrepreneurship – academic business incubation.

Thus, despite the widespread use of special studies in the Ukrainian-language scientific space, there have been almost no special studies devoted to the phenomenon of academic entrepreneurship. In particular, no systematic review and reflection of the world scientific heritage on the developments on this issue, including the use of bibliometric analysis tools, has been conducted.

The purpose of the article is: 1) to conduct a systematic review of the literature on academic entrepreneurship; to determine the dynamic and structural characteristics of the available sources of scientific knowledge, clustering (allocation of research groups according to various criteria), 2) to analyze the main cited sources to form an idea of research trends, 3) to identify the most controversial issues and challenges that concern researchers in order to formulate a program for further research.

Research methodology. The information base of the study was a sample of publications published in the scientometric database SCOPUS (<https://www.scopus.com>) in 1970-2022. The sample was formed by searching for the query "TITLE-ABS-KEY "Academic entrepreneurship", i.e. by the presence of the term "academic entrepreneurship" in the title or keyword of the publication. As of March 25, 2022, 858 scientific papers were identified and became the object of analysis. The analytical processing of the formed sample of scientific publications was carried out using the built-in analytical block "Analysis of Publications" of the SCOPUS scientometric database (dynamic and structural analysis of publications by such criteria as (authors, universities, countries), sorting by level and analysis of citation indices), specialized software VOSviewer version 1.6.5. for building bibliometric maps and identifying clusters, EXCEL software for building analytical tables and graphs. 13 scientific articles and 2 monographs with the highest level of citations were selected to characterize the content direction, methodology, tools and research results

Formulation of the main material. The problem of academic entrepreneurship has been attracting the attention of the international scientific community for more than 50 years, and the interest in its consideration is growing (Fig. 1). This is confirmed by the annual number of publications, which increased from less than 2 units in 1970-2003, to 6.2 units in 2004-2008, 32.4 units in 2009-2013, 60.2 units in 2014-2018, 88 units in 2019-2022. That is, over the past less than 15 years (2009-2022), the total number of publications increased by more than 18.5 times compared to the 35 previous years (1970-2008 (respectively, 814 and 44 publications). The structure of

publications by type of scientific output (Fig. 2) is dominated by scientific articles – 649 publications, although more format products have been prepared: 15 books and 34 literature reviews.

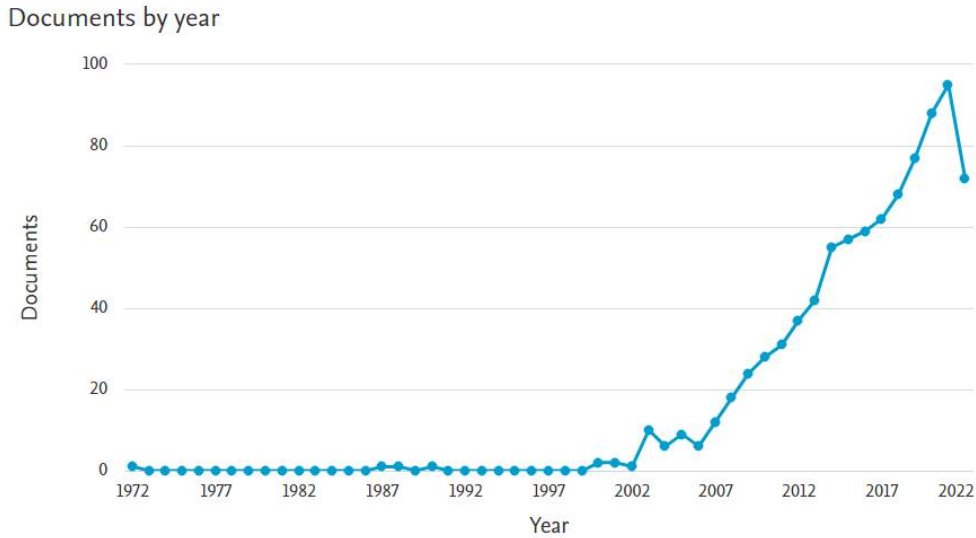


Fig. 1 – Dynamics of scientific productivity (publication activity) by the term "Academic entrepreneurship" in 1970-2022

Source: built on articles' data from scopus.com

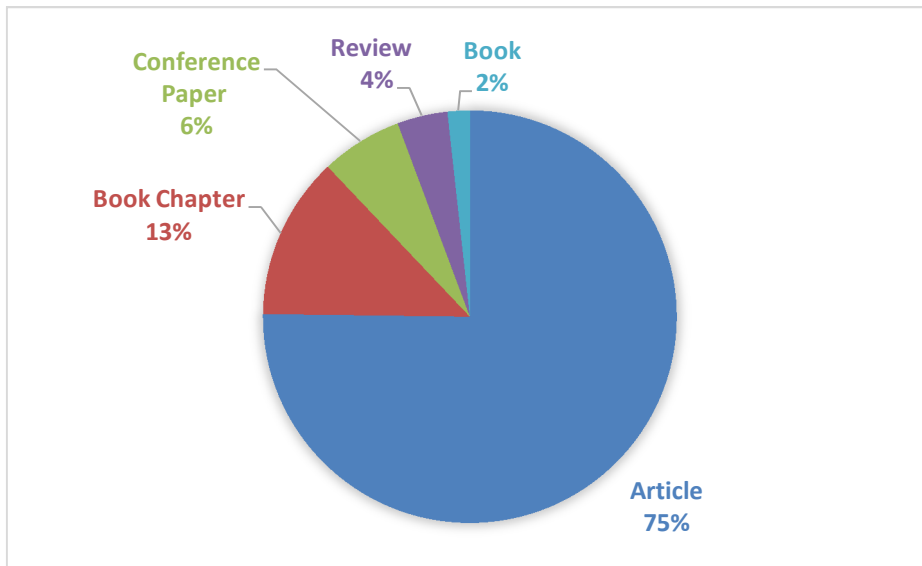


Fig. 2 – Structure of scientific publications on academic entrepreneurship in 1970-2022 by type of scientific product

Source: built on articles' data from scopus.com

The issue of academic entrepreneurship is interdisciplinary. This is confirmed by the interest in research in this area of specialists in such fields of knowledge as: Business, Management and Accounting – 651 (40.2 %), Social Sciences – 261 (16.1 %), Economics, Econometrics and Finance – 225 (13.9 %). Specialists in engineering, decision sciences, computer science, arts and humanities, environmental science, medicine, agricultural and biological

sciences are also interested in researching this issue, which is probably the result of the development of academic entrepreneurship in universities of this specialization.

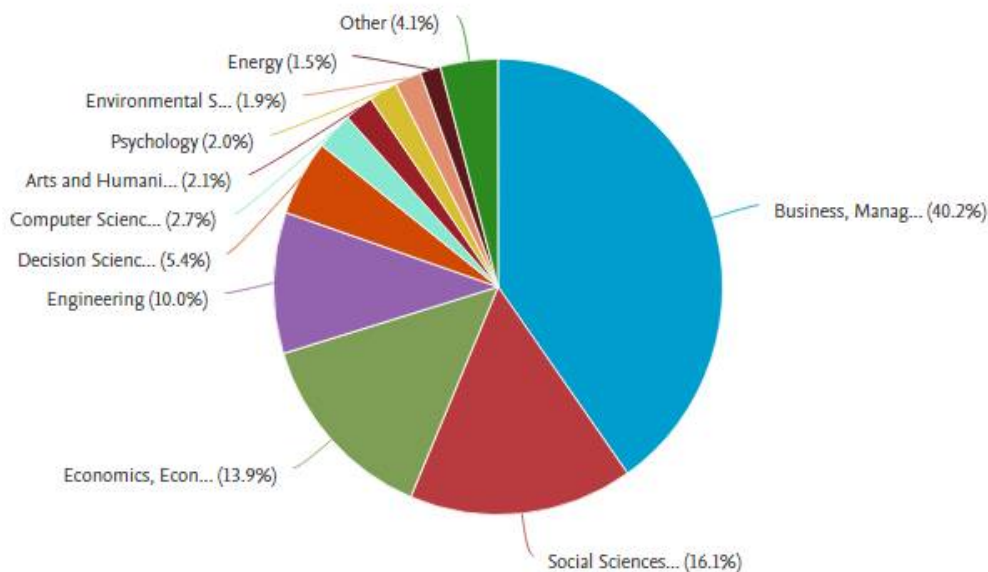


Fig. 3 – Structure of scientific publications on academic entrepreneurship in 1970-2022 by field of knowledge

Source: built on articles' data from scopus.com

Table 1 shows the leaders among countries, universities and authors in terms of the number of publications on various aspects of academic entrepreneurship. The list of countries is dominated by the developed countries of America and Europe, although younger European countries and Asian "tigers" also show significant interest. That is, the importance of development and the positive impact of academic entrepreneurship is well recognized on all continents and regardless of the level of development of the country. It is clear that developed countries popularize their own experience and present the results of global efforts, while developing countries study the global experience and present the first results of its implementation, as well as highlight national peculiarities and innovations that have been developed.

The list of universities with the largest number of publications is dominated by classical and technological universities, which were the first to realize the benefits of the concept of academic entrepreneurship after the adoption of the Bayh-Dole Act in 1980 in the United States and later similar laws in other countries. These laws created a legal framework for the commercialization of university technologies, introduced a unified patent policy and removed licensing restrictions; allowed universities to own patents obtained under federal research grants.

The leader among the researchers in terms of the number of publications is Michael Wright, Professor of Entrepreneurship at Nottingham University Business School, Nottingham, United Kingdom, one of the most famous British economists and a recognized founder of research in entrepreneurship, economics and management. A significant contribution to the development of the subject area of academic entrepreneurship was made by such scholars as

Einar Rasmussen (Small Business Economics, Norway); Fini Riccardo (Alma Mater Studiorum Università di Bologna, Bologna, Italy); Meoli Michele (Università degli Studi di Bergamo, Bergamo, Italy); Giustina Secundo (Full Professor in Management Engineering at Department of Management, Finance and Technology University LUM Giuseppe Degennaro (Bari, Italy); Henry Etzkowitz (International Triple Helix Institute, Silicon Valley, United States); Rosa Grimaldi (Alma Mater Studiorum Università di Bologna, Bologna, Italy); Silvio Vismara (Università degli Studi di Bergamo, Bergamo, Italy).

Table 1

Top 10 countries, universities and authors of publications on academic entrepreneurship

Countries	Docu-ments	Universities	Docu-ments	Author	Docu-ments
United States	185	Imperial College Business School	27	Wright, M.	19
United Kingdom	129	Universiteit Gent	24	Rasmussen, E.	14
Italy	116	Alma Mater Studiorum Università di Bologna	21	Fini, R.	12
Germany	84	Nord universitet	17	Meoli, M.	12
Spain	67	Università degli Studi di Bergamo	16	Secundo, G.	11
Sweden	58	Lunds Universitet	15	Etzkowitz, H.	10
Belgium	43	KU Leuven	14	Grimaldi, R.	10
China	37	Universität Augsburg	13	Vismara, S.	10
Norway	37	Università degli Studi di Napoli Federico II	13	Cunningham, J.A.	9
France	36	Högskolan i Halmstad	13	Guerrero, M.	9
Netherlands	34	Itä-Suomen yliopisto	12	Audretsch, D.B.	8
Finland	29	Universita del Salento	11	Knockaert, M.	8
Canada	26	Universidade da Beira Interior	10	Montonen, T.	8
Portugal	24	Universitetet i Oslo	10	Siegel, D.S.	8
Brazil	22	Friedrich-Schiller-Universität Jena	10	Czarnitzki, D.	7
Poland	22	University of Cambridge	10	Eriksson, P.	7

Source: formed on data from scopus.com

The number of citations to publications in the SCOPUS scientometric database also confirms the interest in the study of academic entrepreneurship. During 2010-2022, there was a rapid increase in the number of citations of publications devoted to the issues of academic entrepreneurship (Fig. 4). Their

annual number increased from 422 (2010) to 1345 (2015) and 4012 (2022). In total, since 1970, these publications have been cited by different authors 24.2 thousand times.

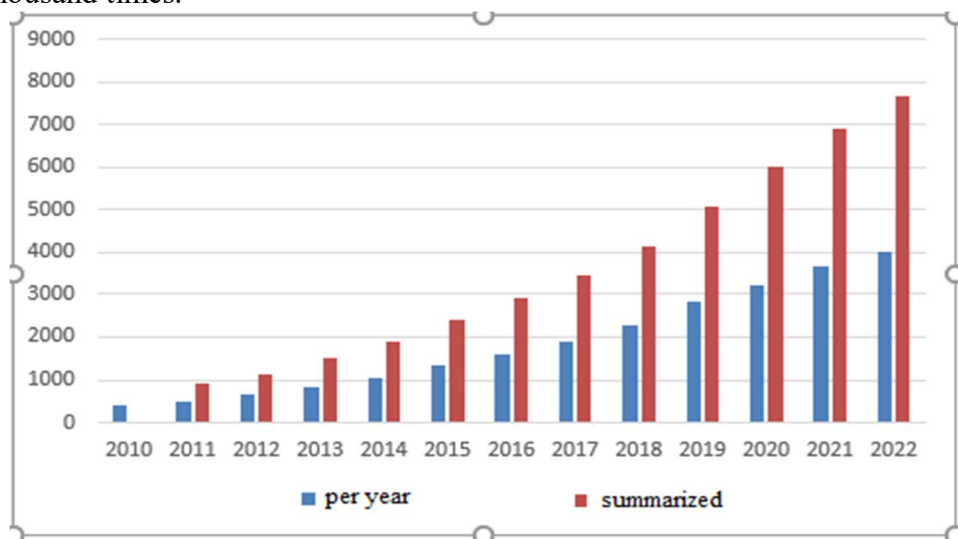


Fig. 4 – Dynamics of citations of publications on academic entrepreneurship in 2010-2022

Source: built on articles' data from scopus.com

The VOSviewer.com program was used to cluster academic entrepreneurship publications by keywords (which indirectly reflect the research topic). The program identified 2,648 keywords that were included in these publications and created a visualization of their frequency of use (Fig. 5). Given the wide variety of keywords, the selection criterion was the use of this word in at least 15 publications. The diameter of the circle in fig. 5 reflects the number of publications in which this word is used as a keyword.

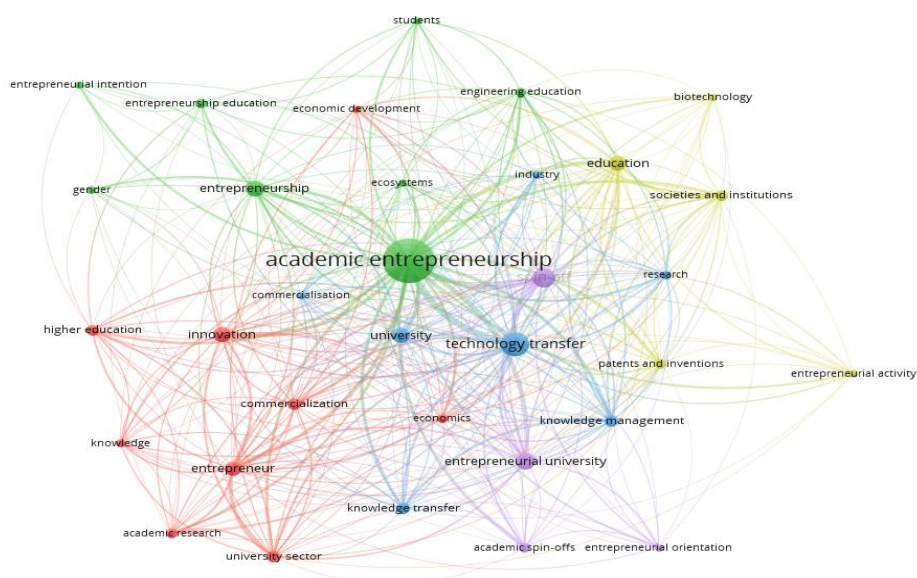


Fig. 5 – Keywords that were most often used in publications on academic entrepreneurship

Source: data from VOSviewer.com

Table 2 shows the most frequently used 33 keywords (optimized number based on the prepared thesaurus to avoid technical repetition – singular/plural, different spelling of the same words, country names, etc.), the number of times they are used, and the link strength – the number of connections found between them. The latter serves as the information basis for cluster analysis.

The clustering of keywords (keywords belonging to the defined clusters are also presented in Table 3), conducted by the VOSviewer.com program, allows us to distinguish 5 clusters of research and provide a generalized description of their content:

- Cluster 1 – purpose, role, impact of academic entrepreneurship, commercialization of knowledge and technologies for innovation, higher education, economic development and competitiveness of the country (region)

- Cluster 2 – the object of research is academic entrepreneurs (their needs and demands), the formation of students' entrepreneurial intentions and the development of entrepreneurial education, as well as the formation of an academic entrepreneurship ecosystem;

- Cluster 3 – the publications of this cluster study the interaction (connections) between universities and industry, as well as the organization of technology transfer, which is considered as a tool for knowledge transfer and a component of knowledge management;

- Cluster 4 – covers publications devoted to the patenting activities of universities (preparation and registration of patents and inventions), as well as the participation of educational institutions in business activities (obtaining passive income from intellectual property);

- Cluster 5 is devoted to the study of the preparation and conduct of entrepreneurial activities by universities through the creation of academic spin-offs; their transformation into "entrepreneurial universities".

We will provide a brief description of the most influential (cited) publications on academic entrepreneurship recognized by the international scientific community.

The monograph Shane (2004) is considered a fundamental classic. Academic entrepreneurship: University spinoffs and wealth creation. Academic entrepreneurship: University spinoffs and wealth creation, which has been cited in 1053 scientific papers. Its FWCI (average normalized citation index) is 14.43, which demonstrates that the actual level of citations exceeds the expected level based on the average for this field of knowledge). It systematically and reasonably explains the mechanism, importance and role of university technology commercialization and university capital creation in the United States and other countries; provides a retrospective of the development of university spin-offs.

It provides an in-depth analysis of four main factors that jointly influence the activities of spin-offs: the university and societal environment, the technology developed at universities, the industries in which spin-offs operate, and the people involved. It describes in detail the process of creating a spin-off, transforming spin-off technology into new products and services, market research for these new products and services, and attracting financial resources. The factors that enhance and impede the effectiveness of university spin-offs are systematized, as well as the impact they have on atherosclerotic universities.

Table 2

**The most used keywords of scientific publications in the subject area
of "academic entrepreneurship" in 2010-2022**

Keyword	Occurrences	Total link strength	Cluster
entrepreneur	63	230	1
innovation	65	179	
commercialization	40	133	
economics	24	99	
academic research	28	95	
higher education	34	93	
knowledge	18	68	
economic development	15	61	
academic entrepreneurship	560	1020	2
entrepreneurship	80	143	
engineering education	24	99	
ecosystems	17	62	
students	16	51	
entrepreneurship education	28	49	
gender	18	34	
entrepreneurial intention	16	30	
technology transfer	173	492	3
knowledge management	42	167	
university	67	152	
knowledge transfer	43	122	
research	24	99	
industry	18	70	
commercialisation	16	59	
education	67	228	
societies and institutions	32	141	4
patents and inventions	28	95	
entrepreneurial activity	20	49	
spin-off	115	321	5
entrepreneurial university	83	220	
academic spin-offs	29	70	
entrepreneurial orientation	16	45	

Source: formed on the data from VOSviewer.com

The monograph by Wright, Clarysse, Mustar & Lockett (2007), dedicated to systematizing the experience and achievements of academic entrepreneurship in Europe, is also highly recognized by the scientific community (394 references, FWCI=4.93). It is a comprehensive study that addresses such issues as: public policies to promote academic spin-offs, types of spin-offs; institutional level processes: incubation models; firm level processes: development phases and models; entrepreneurial teams in spin-offs; financial constraints and access to finance. The monograph concludes with

conclusions and recommendations for policy makers on the necessary policy corrective measures.

Table 3 presents a systematic description of the 13 scientific articles with the highest number of citations (citation level is in the range of 301 – 1313).

Table 3

**Systematic description of the most cited scientific articles
on academic entrepreneurship**

Author/Year / Title	Object of research	Methodology used	Results and conclusions	Recognition identifiers²
1. Perkman, M., Tartari, V., McKelvey, M., (...), Salter, A., Sobrero, M. (2013) Academic engagement and commercialisation: A review of the literature on university-industry relations	university-university relations with non-academic organizations and commercialization: a comparative analysis of the preconditions and implications for the individual scientist and the university	a sample of scientific articles that publish the results of empirical research; a comparative analysis of the methodology and research results	linkages and commercialization are different objects of study that require different analytical and methodological techniques. There is a need for a reliable and comparable national and international evidence base for the formation of the legal framework and implementation of effective policies at the level of individual universities	1313 32,5 1656
2. Etzkowitz, H. (2003) Research groups as "quasi-firms": The invention of the entrepreneurial university	content and prerequisites of the first and second academic revolutions; factors of distinguishing the "third mission" of universities; formation of the model of an entrepreneurial university based on the experience of Stanford	analysis of literature sources, two interviews to test hypotheses	recognition of the university as a collective entrepreneur, a regional organizer of innovations, a natural incubator for future entrepreneurs, a testing ground for interdisciplinary research and the emergence of new industrial sectors	889 11,63 311

² Number of references / FWCI/ Number of views

Author/Year / Title	Object of research	Methodology used	Results and conclusions	Recognition identifiers²
3. Walter, A., Auer, M., Ritter, T. (2006) The impact of network capabilities and entrepreneurial orientation on university spin-off performance	the impact of network capacity (the ability to access external resources) and entrepreneurial orientation on the organizational efficiency of spin-offs.	database of 149 university spin-offs, regression analysis	predictors of the success of university spin-offs were identified; the impacts between the variables under study were evaluated; and relevant recommendations were formulated	762 10,64 430
4. Bercovitz, J., Feldman, M. (2008) Academic entrepreneurs: Organizational change at the individual level	the influence of individual and organizational factors on the perception and participation in academic entrepreneurship	survey of 1970 university professors; regression analysis	recommendations aimed at creating organizational prerequisites for engaging the largest possible share of university professors in academic entrepreneurship have been formulated	545 13,44 278
5. Grimaldi, R., Kenney, M., Siegel, D.S., Wright, M. (2011) 30 years after Bayh-Dole: Reassessing academic entrepreneurship	30 years of experience of academic entrepreneurship after the adoption of the Bayh-Dole Act in the United States; evolution of the role of universities in the commercialization of research and forms of academic entrepreneurship	review of the literature, which publishes the results of empirical research	academic entrepreneurship has changed. The existing models are not suitable for everyone. New ideas and research are needed	514 10,4 246

Author/Year / Title	Object of research	Methodology used	Results and conclusions	Recognition identifiers²
6. Gulbrandsen, M., Smeby, J.-C. (2005) Industry funding and university professors' research performance	consequences and impacts of academic entrepreneurship at the personal level	a survey of 1967 full-time university professors in Norway	a significant relationship between industry funding and research performance was confirmed: professors involved in academic entrepreneurship have higher publication activity and better entrepreneurial results	492 6,03 167
7. Powers, J.B., McDougall, P.P. (2005) University start-up formation and technology licensing with firms that go public: A resource-based view of academic entrepreneurship	the impact of certain sets of resources on success in technology commercialization and academic entrepreneurship	multi-source data on 120 universities	the success of technology commercialization and academic entrepreneurship is determined by the set of university financial, human and organizational resources	429 9,5 176
8. Jain, S., George, G., Maltarich, M. (2009) Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity	socio-psychological processes underlying the participation of research professors in commercialization activities	70 hours of interview data from a leading US public research university	Academic entrepreneurs' perception of a hybrid role identity (primary academic persona and secondary - commercial persona); use of delegation mechanisms and buffering to improve visibility in their hybrid role identity	407 7,27 182

Author/Year / Title	Object of research	Methodology used	Results and conclusions	Recognition identifiers²
9. Klofsten, M., Jones-Evans, D. (2000) Comparing Academic Entrepreneurship in Europe -The Case of Sweden and Ireland	the influence of gender, age, previous entrepreneurial experience, work experience and university environment on entrepreneurial academic activity	analysis of quantitative data and interviews with professors from universities in Norway and Iceland	The potential for academic entrepreneurship is high. In particular, there is a high degree of involvement in soft activities, such as consulting and contract research, and a low degree of involvement in the creation of organizations through technological spin-offs.	351 1,9 90
10. Bozeman, B., Fay, D., Slade, C.P.(2013) Research collaboration in universities and academic entrepreneurship: The-state-of-the-art	collaboration (between university researchers at the individual level and with researchers from other sectors, including industry. There are 2 types of cooperation:	a critical review of the literature on research collaboration	suggestions for improving the research: more levels of analysis and interaction between them; more rigorous impact measurement; more research on "abuses" of collaboration; increased attention to the motives for collaboration and the social psychology of collaborative teams.	333 12,32 430
11. Goldfarb, B., Henrekson, M. (2003) Bottom-up versus top-down policies towards the commercialization of university intellectual property	national policy to promote the commercialization of knowledge created by universities; prerequisites for success and results of commercialization of university technologies	comparative analysis of national policies, outcomes of university technology transfer and academic entrepreneurship in the United States and Sweden	there may be various national models that take into account the legal framework, the mentality of scientists, the adequacy of funding sources, the level of competition, the motivation for entrepreneurship, the structure of academic remuneration, the level of patent protection and other factors	329 7,75 165

Author/Year / Title	Object of research	Methodology used	Results and conclusions	Recognition identifiers ²
12. Siegel, D.S., Wright, M. (2015) Academic Entrepreneurship: Time for a Rethink?	effectiveness and acceptability of existing models and forms of academic entrepreneurship for all types of universities;	analysis of literature and results of previous studies	It is necessary to rethink the accumulated experience and develop new formats of academic entrepreneurship, to accept the diversity of models and to place greater emphasis on the interconnections between teaching, research and entrepreneurial activity	316 14,66 163
13. Guerrero, M., Cunningham, J.A., Urbano, D. (2015). Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom	entrepreneurial university: characteristics, mission, impact of teaching and research activities of entrepreneurial universities, various forms of academic entrepreneurship on economic growth	multi-source data for a 3-year period for 147 UK universities, including a group of entrepreneurial universities; structural equation modeling (SEM) .	a theoretical framework for studying the impact of entrepreneurial universities on the formation of human capital, knowledge capital and entrepreneurial capital is proposed; tools for testing these impacts by means of structural equation modeling are tested	301 10,82 434

Source: developed by the authors based on the results of familiarization with the text of certain scientific publications and on the basis of information from csopus.com

The presented scientific articles are diverse in terms of the object and results of the study, which is evidence of the multidimensionality of academic entrepreneurship. They have different information support and methodology, which confirms the possibility of conducting both qualitative (literature analysis, case studies) and quantitative research (multi-source data on the development of academic entrepreneurship in individual universities and countries) using powerful tools of economic and mathematical modeling. There is a growing interest in the author's empirical research, which involves conducting their own surveys and interviews with academic entrepreneurs from the world's leading business universities.

Conclusions. The study of the problems of academic entrepreneurship is a rapidly developing sector of scientific knowledge that enjoys increased attention of the scientific community and other stakeholders; it is characterized by a variety of content (5 clusters of scientific research are distinguished),

research objects and tools; the proposals and recommendations developed in them are not only scientific but also of high practical value, as they can be used by university management, supervisory institutions (ministries) and governmental.

Ukraine urgently needs to conduct such studies, as there is currently a lack of reliable information on the involvement of university faculty, staff and students in certain forms of academic entrepreneurship; understanding the preconditions, drivers, obstacles, results achieved and impacts of its development. The best research from the international scientific community can serve as a model for designing such studies, but it is imperative to take into account numerous national peculiarities at the individual, mental, organizational and institutional levels. The conclusion that was made public almost 10 years ago – academic entrepreneurship has changed, the forms and mechanisms of its implementation need to be rethought; there may be special national and specific organizational models (due to the specifics of individual universities) – should be recognized as an axiom and be the basis for future research.

Conflict of Interest and other Ethics Statements

The authors declare no conflict of interest.

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Лариса ЛІГОНЕНКО, Леся ГРИЦЯК

**АКАДЕМІЧНЕ ПІДПРИЄМНИЦТВО: СИСТЕМАТИЧНИЙ ОГЛЯД
ЛІТЕРАТУРИ ТА НАПРЯМИ ПОДАЛЬШИХ ДОСЛІДЖЕНЬ**

Анотація. Представлено результати проведеного бібліометричного аналізу іноземної літератури (858 наукових робіт), присвяченої академічному підприємництву та розміщеної у наукометричній базі SCOPUS протягом 1970-2022 рр. Проведений динамічний та структурний аналіз публікацій засвідчив зростаючу актуальність міжнародної наукової спільноти до розвитку академічного підприємництва. Проведена кластеризація наукових досліджень засобами VOSviewer.com дозволила виокремити 5 кластерів:

1) призначення, роль, вплив академічного підприємництва на впровадження інновацій, вищої освіти, економічний розвиток та конкурентоспроможність країни (регіону);

2) академічні підприємці та розвиток екосистеми академічного підприємництва;

3) взаємодія (зв'язки) між університетами та промисловістю, організація трансферу технологій;

4) патентна діяльність університетів;

5) академічні спін-оффи та становлення підприємницьких університетів.

Визначені тренди наукових досліджень на основі змістовного аналізу 15-ти найбільш цитованих наукових публікацій. Викладені пропозиції щодо доцільних напрямів дослідження академічного підприємництва в Україні.

Ключові слова: академічне підприємництво, комерціалізація університетських технологій, огляд літератури, бібліометричний аналіз, WoS, тренди наукових досліджень.

Submitted: 10.01.2023

Revised: 15.02.2023

Accepted: 01.03.2023