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RELATIONSHIP OF DIGITAL AND INDUSTRIAL ASPECTS IN ECONOMIC RESEARCH BASED ON ECONLIT BIBLIOMETRIC ANALYSIS

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The reviews of scientific economic literature show growing complexity of interrelationships between subject areas and discord among different types of publications, registered editions and subject classifications. In this context, the need to comprehend the digitalization trends is becoming more and more acute. This paper presents the results of bibliometric analysis of more than one and half million publications indexed in the electronic bibliographic EconLit database in terms of digital and industrial aspects and interrelation between them. The records, in which the title contains the terms “digital” or “digitization”, “online”, “smart”, “mobile”, “internet”, “computer” or “computing”, “telecommunication” and “software” were attributed to the “digital aspect”. The publications of “industrial aspect” belong to 37 JEL micro categories of four-meso categories with the title of “Industry Studies” (L6 Manufacturing; L7 Primary Products and Construction; L8 Services; L9 Transportation and Utilities). The paper contains a set of indicators for assessment of the digitalization degree of publications reflected in EconLit in 1991–2020. These indicators help to discover the “points of growth” at the intersections of digital and industrial aspects in the research object and subject framework. The presented results showed that the world economic literature continues to pay more attention to the problems and methods of digitalization. Analysis of publication activity by sub-periods of 1991–2020 helped to single out four terms (“online”, “digital”, “smart”, “mobile”) with a pronounced increase in activity. Examples of some notable publications illustrate the most interesting trends. The highest values of “digitalization rates” are in the category L63 Microelectronics, computers, communications. The digitalization rates above average are in L8 Service, where the leader is L86 Information and Internet Services; Computer Software. L7 Primary Products and Construction is only making first steps towards digitalization. The thoughts about future research developments conclude the main section of the article.

Keywords: bibliometric analysis, digitalization, industry studies, publication activity, JEL classification, new research directions

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ВЗАИМОСВЯЗЬ ЦИФРОВОГО И ИНДУСТРИАЛЬНОГО АСПЕКТОВ В ЭКОНОМИЧЕСКИХ ИССЛЕДОВАНИЯХ С ПОЗИЦИИ БИБЛИОМЕТРИЧЕСКОГО АНАЛИЗА НА ОСНОВЕ ECONLIT

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Изучение научной экономической литературы показывает растущую сложность взаимосвязей между предметными областями и отсутствие необходимой согласованности между различными типами публикаций, зарегистрированными изданиями и предметными классификациями. На этом фоне становится все более острой потребность в понимании тенденций цифровизации. В данной статье представлены результаты библиометрического анализа более полутора миллионов публикаций, проиндексированных в электронной библиографической базе данных EconLit, с позиции цифрового и индустриального аспектов и взаимосвязи между ними. Записи, в названии которых содержатся термины «цифровой» или «цифровизация», «онлайн», «умный», «мобильный», «Интернет», «компьютер» или «компьютерные вычисления», «телекоммуникации» и «программное обеспечение» отнесены к «цифровому аспекту». В массив публикаций «индустриального аспекта» отнесены записи EconLit по тридцати семи JEL-микрокатегориям, которые, в свою очередь, входят в четыре мезокатегории с общим подзаголовком «Индустриальные исследования». В их числе: L6 «Обрабатывающая промышленность», L7 «Первичные продукты и строительство», L8 «Услуги», L9 «Транспорт и коммунальные услуги». В статье представлен набор показателей для оценки степени цифровизации публикаций, отраженных в EconLit в 1991–2020 гг. Эти индикаторы помогают обнаружить «точки роста» на пересечении цифровых и индустриальных аспектов в рамках объекта и предмета исследования. Полученные результаты показали, что в мировой экономической литературе продолжается уделяться все больше внимания проблемам и методам цифровизации. Анализ публикационной активности по подпериодам 1991–2020 годов позволил выделить четыре термина («онлайн», «цифровой», «умный», «мобильный») с выраженным ростом активности. Примеры некоторых примечательных публикаций иллюстрируют наиболее интересные тенденции. Наибольшие значения «темпа цифровизации» – у категории L63 «Микроэлектроника, компьютеры, связь». Показатели цифровизации выше среднего – в мезокатегории L8 «Услуги»: в ней лидером является микрокатегория L86 «Информационные и интернет услуги; программное обеспечение». Мезокатегория L7 «Первичные продукты и строительство» делает только первые шаги по пути цифровизации. Мысли о будущих направлениях исследований довершают основной текст статьи.

Ключевые слова: библиометрический анализ, цифровизация, индустриальные исследования, публикационная активность, классификация JEL, новые направления исследований

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Introduction

A word search in titles and other parts of the bibliographic description of foreign (Scopus, Web of Science, Google Scholar) and domestic (elibrary.ru) publications, conducted in March 2021, confirmed the main conclusion drawn in [1] and in a number of other studies. In recent years, we have been observing noticeable growth of research on digitalization (or the digital aspect) in general, and economics and management in particular. The number of publications in this area is constantly increasing. There is a growing complexity of interrelationships between subject areas and discord among different types of publications, registered editions and subject classifications. The need to comprehend the digitalization trends is becoming more and more acute.

The Scopus citation system uses the ASJC classification. It singles out two macro categories for economics and management out of 27 general categories. It presents 14 micro categories out of 334. At the same time, the economic editions worldwide apply the JEL subject classification. At the end of 2020, it had 859 micro categories. Electronic bibliography EconLit, in addition to books and articles in scientific journals, takes into account articles in collective volumes, PhD dissertations and working papers. In the

latter, they provide new research directions at the intersections of subject categories. Because of these facts, the problem of monitoring the accumulated economic knowledge in various available databases and identifying emerging research areas using bibliometric analysis remains urgent.

The object of the research is publications in EconLit from January 1, 1991 to March 31, 2021 (hereinafter – the observation period) related to meso categories with the general subtitle “Industry Studies”: L6 Manufacturing; L7 Primary Products and Construction; L8 Services; L9 Transportation and Utilities.

The subject of the research will be publications, in which the title contains the terms “digital” or “digitalization”, “online”, “smart”, “mobile”, “internet”, “computer” or “computing”, “telecommunication” and “software”. We will assume that publications with these terms relate to the “digital aspect” of economic research. If necessary, it is possible to expand the subject of research by searching the indicated keywords not only in the titles, but in other parts of EconLit records as well.

The purpose of the study is to assess and, if possible, to illustrate the relationships in time for 1991–2020 and in the space of JEL subject categories from the standpoint of the industrial and digital aspects within the framework defined by the object and subject of the research.

Three interrelated research tasks are the following:

1. To give an aggregated assessment of the publication dynamics for the terms of the “digital aspect” based on the total number of records in EconLit for three adjacent periods of 1991–2021.
2. To provide an aggregated assessment of the digitalization degree of publications reflected in EconLit for the observation period, for all JEL micro categories included in the meso categories L6, L7, L8 and L9.
3. To refine the findings based on the expansion of the object base with the digitalization examples of some notable publications.

Research methodology and database. The methodology is based on the concept of system-innovative bibliometric analysis and mapping of economic literature [2], which is detailed in an original combination of three methods: 1) terminological and lexical analysis, 2) determining the characteristics of publication activity, 3) structural-morphological analysis. The source of information was the online version of the EconLit electronic bibliography and its 1,501,620 records of all six types of publications. These publications date to the period from January 01, 1991 (the date of introduction of the new version of the JEL subject classification), and until March 31, 2021.

Detailing the methodology and the results of solving the first problem – an aggregated assessment of the dynamics of publications based on the selected digitalization terms out of the total number of records in EconLit. NP denotes the total number of records in EconLit for a certain period with corresponding specification in each case. Table 1 shows the results of sequential pairwise partitioning of the period 1991–2021 (as of 21.03.2021) so that the corresponding NP amounts are approximately equal and the growth rate (T) is close to unity. The letter N in the column designations indicates the number of records by periods that have the last two digits of the calendar year: N9108 – from 1991 to 2008, N0921 – from 2009 to 2021, N0914 – from 2009 to 2014, N1521 – from 2015 to 2021, N1517 – from 2015 to 2017, N1821 – from 2018 to 2021. The end years of the allocated periods are after the designation of the growth rate T.

For the digital term, the label “All” indicates the search results in all fields of the record. The label “TI” for “digital” as well as the terms in other lines concern the search results for the “term in the title”.

The bold type highlights the cases when the rate of growth of the term frequency is above the average level showed in the NP line. We see that in the last decade in the world scientific literature, indexed in the authoritative electronic bibliographic EconLit database, the number of works marked with such explicit terms of the era of the digital economy as “online” and “digital” has grown most rapidly. Between these terms, the frequency of the term “smart”, which modern smartphones and artificial intelligence works are closely related to, is also growing rapidly. The fast development of mobile service has found expression in absolute and relative volumes of the term “mobile”.

We emphasize that the year 1991 is the starting point in Table 1, so there is consistency of calculations when solving research problems 1 and 2. Nevertheless, the conclusions will not fundamentally change if

we take into account the small number of publications of the considered type published before 1991. The first work with the term “online” in the title appeared in 1982 [3]. Then we see only four publications until 1991. Taking this into account, $T = 5.21$. The word “smart” can be first spotted in relation to Scottish damask linen industry in 1963 [4], then there are 17 other works published until 1991 that leads to $T = 4.78$. “Digital” in the title appears in 1968 [5], with seven additional publications afterwards, resulting in $T = 2.53$.

Table 1. Comparative analysis of aggregated publication activity by selected terms of the “digital aspect”

Term	N9108	N0921	T2108	N0914	N1521	T2114	N1517	N1821	T2117
NP	745,902	755,718	1.01	399,209	356,527	0.89	205,158	151,567	0.74
online	351	1,854	5.28	440	1,190	2.70	508	683	1.34
smart	202	1,052	5.21	1,360	3245	2.39	1,403	1,847	1.32
digital (all)	1,544	4,605	2.98	682	1,172	1.72	600	572	0.95
digital (TI)	636	1,630	2.56	340	712	2.09	362	351	0.97
mobile	616	1,418	2.30	689	729	1.06	383	347	0.91
internet	1,598	1,583	0.99	799	784	0.98	452	332	0.73
computing	378	344	0.91	351	203	0.58	136	67	0.49
software	763	554	0.73	191	165	0.86	103	62	0.60
computer	899	356	0.40	180	164	0.91	95	68	0.72
telecommunication	1,884	630	0.33	403	227	0.56	141	87	0.62

For the “All” case, the gain will be 12 units, and $T = 2.96$. The term “mobile” was in the scientific economic literature since 1963 in relation to “mobile homes” [6]. Until 1991, there were 58 such records in EconLit. This fact resulted to a slight decrease in the growth rate (2.1 versus 2.3). Since the term “internet” first appeared only in 1992 [7], this did not affect the results in Table 1. Starting with the term “computing”, there is a sharp increase in the number of publications with the analyzed terms until 1991 (marked by D90), and, accordingly, an even greater decrease in growth rates: computing [8] – $D90 = 103$, $T = 0.72$; software [9] – $D90 = 130$, $T = 0.62$; computer [10] – $D90 = 557$, $T = 0.24$; telecommunication [11] – $D90 = 312$, $T = 0.29$.

Detailing the methodology and the results of solving the second problem – assessing the degree of digitalization by micro categories included in the meso categories L6, L7, L8 and L9. As in the solution of the first research task, we extracted the Econlit data for two adjacent periods (1991–2008 and 2009–2021) and used the search variant “terms in the title”. The search covered all 37 micro categories included in meso categories L6, L7, L8, and L9 from the following list (the number in parentheses is the total number of records in 1991–2021):

Industry Studies (InSt): Manufacturing:

- L60 (18371) InSt: Manufacturing: General.
- L61 (3652) Metals and Metal Products; Cement; Glass; Ceramics.
- L62 (6896) Automobiles; Other Transportation Equipment; Related Parts and Equipment.
- L63 (4605) Microelectronics; Computers; Communications Equipment.
- L64 (2132) Other Machinery; Business Equipment; Armaments.
- L65 (7085) Chemicals; Rubber; Drugs; Biotechnology; Plastics.
- L66 (11168) Food; Beverages; Cosmetics; Tobacco; Wine and Spirits.
- L67 (3893) Other Consumer Nondurables: Clothing, Textiles, Shoes, and Leather Goods; Household Goods; Sports Equipment.
- L68 (955) Appliances; Furniture; Other Consumer Durables.
- L69 (286) InSt: Manufacturing: Other.

InSt: Primary Products and Construction (PP&C):

- L70 (657) InSt: PP&C: General.
- L71 (7358) Mining, Extraction, and Refining: Hydrocarbon Fuels.
- L72 (2542) Mining, Extraction, and Refining: Other Nonrenewable Resources.
- L73 (1341) Forest Products.
- L74 (1728) Construction.
- L78 (562) InSt: PP&C: Government Policy. L79 (5) InSt: PP&C: Other.

InSt: Services:

- L80 (3795) InSt: Services: General.
- L81 (10156) Retail and Wholesale Trade; e-Commerce.
- L82 (9335) Entertainment; Media.
- L83 (16049) Sports; Gambling; Restaurants; Recreation; Tourism.
- L84 (5680) Personal, Professional, and Business Services.
- L85 (830) Real Estate Services.
- L86 (9593) Information and Internet Services; Computer Software.
- L87 (705) Postal and Delivery Services.
- L88 (1835) InSt: Services: Government Policy.
- L89 (168) InSt: Services: Other.

InSt: Transportation and Utilities:

- L90 (719) InSt: Transportation and Utilities: General.
- L91 (1115) Transportation: General.
- L92 (12097) Railroads and Other Surface Transportation.
- L93 (4348) Air Transportation.
- L94 (13849) Electric Utilities.
- L95 (3141) Gas Utilities; Pipelines; Water Utilities.
- L96 (9613) Telecommunications.
- L97 (727) Utilities: General.
- L98 (12154) InSt: Utilities and Transportation: Government Policy.
- L99 (17) InSt: Utilities and Transportation: Other.

We used the following steps to calculate the indices in Tables 2 and 3.

1. We found the total record numbers for the first and second periods for each JEL code in the examination list.
2. We found the records with the terms of the “digital aspect” in the titles for the same periods and JEL codes.
3. We calculated the corresponding ratios for each term and JEL code (column DE) separately for the first period (K1) and the second period (K2) by means of dividing the frequencies of these terms by the number of records, in percent (Tables 2 and 3).

The data labeled with “digital” includes the terms “digital” and “digitalization”, and the data labeled with “computer” includes the terms “computer” and “computing”.

We distributed the columns with the term names in descending order of coefficients for the total number of records for the second period. Values that are greater than or equal to the overall average ratios given in the NP line are in bold.

There are no lines L69 in Table 2 and L99 in both Tables due to the lack of publications of the required type.

Unexpectedly, it turned out that the overwhelming majority of publications with codes from the L7 meso-region do not have any of the subject terms under consideration in their titles. Therefore, Tables 2 and 3 present the results only for meso categories L6, L8 and L9.

Table 2. Four terms of the “digital aspect” with increasing digitalization rates

DE	Online		Digital		Mobile		Smart	
	K1	K2	K1	K2	K1	K2	K1	K2
NP	0.05	0.25	0.09	0.23	0.08	0.19	0.03	0.14
L60	0.01	0.21	0.06	0.31	0	0.02	0	0.23
L61	0	0.09	0.07	0.09	0	0	0	0
L62	0.14	0.38	0.1	0.05	0	0.13	0.03	0.35
L63	0.29	0.69	2.06	1.84	0.82	4.88	0.08	0.51
L64	0	0	0.24	0.23	0	0	0	0.08
L65	0.06	0.19	0.03	0.03	0	0.03	0	0.06
L66	0	0.27	0	0.03	0.03	0.05	0.03	0.05
L67	0	1.17	0.17	0.05	0	0.05	0	0.09
L68	0	0.53	0.26	0.18	0.51	0.18	0	1.07
S	0.06	0.32	0.27	0.25	0.09	0.35	0.02	0.19
L80	0.09	1.17	0.09	2.34	0	0	0	
L81	2.71	6.45	0.67	1.17	0.38	0.71	0.13	0.06
L82	0.83	2.36	3.64	3.97	0.46	0.95	0	0
L83	0.18	1.01	0.04	0.17	0.14	0.1	0	0
L84	0.43	0.62	0.06	0.47	0.49	0.07	0	0
L85	0	0.23	0	0.23	0	0	0	0
L86	1.79	7.18	4.28	6.80	0.73	3.18	0.12	0.69
L87	0.38	0.45	1.15	2.71	0	0	0	0
L88	1.08	1.87	8.5	2.50	0.18	1.79	0.18	0.16
L89	1.32	0	0.66	0	0	0	0	0
S	0.99	3.14	1.74	2.12	0.34	0.85	0.05	0.2
L90	0	0	0	0	0	0.4	0	0
L91	0	0.33	0	0.5	0	0	0	0
L92	0	0.26	0	0.17	0.05	0.17	0.03	0.37
L93	0.17	0.55	0.06	0.08	0.06	0.16	0.06	0.16
L94	0	0.08	0	0.01	0.03	0.04	0.03	1.71
L95	0	0.05	0	0.05	0	0	0	0.56
L96	0.22	0.43	2.06	2.88	6.11	19.55	0.03	0.43
L97	0	0	0.27	0	0	0	0	0.85
L98	0	0.08	0.91	0.58	2.05	3.05	0	1.18
S	0.08	0.20	0.54	0.31	2.03	2.80	0.01	0.56

It is possible to consider the micro category L96 Telecommunications as a semantic indicator of the analysis, since only in it we see complete coincidence of the subject term and the name of the micro category. Considerable values of the K1 and K2 coefficients reflect this case. The number of tokens in the title in the second period decreased by 66%, which almost coincided with the overall decrease in the NP line amounting to 67%. The close link between the development of mobile communications and telecommunications services leads to a significant increase in K2 in the “mobile” column and in the L96 row.

Table 3. Four terms of the “digital aspect” with decreasing digitalization rates

DE	Internet		Telecommunication		Computer		Software	
	K1	K2	K1	K2	K1	K2	K1	K2
NP	0.25	0.21	0.25	0.08	0.17	0.09	0.1	0.07
L60	0.08	0.21	0.04	0.01	0.23	0.07	0.13	0
L61	0	0.09	0	0	0.14	0.09	0.07	0.04
L62	0.21	0.2	0.03	0.03	0.17	0.1	0.1	0.08
L63	0.62	0.28	1.89	0	10.16	2.49	1.85	0
L64	0.12	0.15	0	0	0.36	0.23	0.24	0.08
L65	0.09	0.06	0.03	0.06	0.11	0.11	0.09	0.11
L66	0.27	0.09	0	0	0.09	0.03	0.03	0.04
L67	0.23	0.19	0	0	0.06	0.05	0	0
L68	0.26	0.18	0	0	0	0.18	0	0
L69	0.60	0.83	0.6	0	0.6	0	0.6	0
S	0.19	0.16	0.21	0.01	1.16	0.23	0.27	0.03
L80	0.41	0	0.13	0.17	0.22	0.17	0.13	0
L81	5.26	1.87	0.06	0.03	0.16	0.06	0.03	0.09
L82	1.69	1.54	0.55	0.23	0.15	0.08	0.18	0.13
L83	0.69	0.37	0.02	0	0.14	0.05	0	0.02
L84	0.36	0.35	0	0.1	0.18	0.2	0.43	0.15
L85	2.02	0.92	0.25	0	0.25	0.23	0	0
L86	16.93	15.82	1.77	0.4	3.39	1.88	9.12	7.28
L87	0	0.9	0.38	0.45	0	0	0	0
L88	7.05	7.96	2.17	0.47	0	0.47	1.08	0.55
L89	1.32	0	0.66	0	0.66	0	0	0
S	4.96	3.26	0.54	0.14	0.84	0.34	2.01	1.07
L90	0	0	4.24	0.4	0.64	0	0	0
L91	0.19	0	1.74	0	0	0	0	0
L92	0.16	0.07	0.45	0.05	0.24	0.05	0.03	0
L93	0.28	0.39	0.45	0	0.22	0.16	0	0
L94	0.03	0.06	0.43	0.15	0.05	0.02	0	0.01
L95	0	0.1	0.5	0.05	0.08	0	0	0
L96	5.83	4.85	29.08	15.36	0.58	0.24	0.09	0.24
L97	0	0.85	0.53	0.28	0.00	0.28	0	0
L98	1.9	0.65	17.22	4.05	0.11	0.04	0	0
S	1.52	0.69	11.46	2.56	0.26	0.07	0.03	0.03

One of the innovations at the end of the XX century concerns the use of power line supports for fiber-optic communication lines. This has the reflection in the coefficients at the intersection of the “Telecommunications” column and the L94 Electric Utilities row.

One may consider Tables 2 and 3 as a kind of “maps of the sea of economic research”. Cells with the number “0” are the “sea surface”. As we move along the map, we come across the emerging “islands of

digitalization”, each with its own publications reflected in EconLit. Of course, a more detailed description of these sections requires a much larger volume (for example, as done in [12]).

Noteworthy is the “leap” of digitalization in the L60 category. Here you can find a “systematic literature review” under the intriguing title “Smart Factory as a Key Construction in Industry 4.0” [13].

For both periods and on average, the highest values of “digitalization rates” are in the category L63 Microelectronics, computers, communications. For it, the “online” and “smart” aspects are important. The related issues of innovation, knowledge integration and learning are also discussed [14]. We also see an increase in the coefficient of the L67 category, which includes “clothing, textiles, footwear, and leather goods”. These products are subject to fashion, and for this, as stated in the article [15], it is necessary to “respond quickly” using “logistics Internet platforms”, while not forgetting to use stochastic dynamic programming to optimize management decisions.

The analysis of the coefficients for the L65 category led to the article [16], the title of which begins with the question: “Is the Genie Out of the Bottle?” Although the article appeared in January 2019, its content (conducting clinical trials of drugs using digital platforms and social networks) takes on a new dimension during the pandemic. Article [17] in relation to the L68 micro category presents an interesting combination of the production of “green smart furniture” and the “innovative business model of the company” that deals with this production.

In the online column in the L8 Service section, we see a significant number of cells with digitalization rates above average. If we select the micro category L81 and the records from 2015 only, we find 305 entries. By topics, among them with the definition of online are the following: retailer (72), shopping (64), markets (39), order (21), offline (20), auctions (16), platforms (16), and customer (13). Adding the term “digital” to the title yielded one book with two words “marketing” in the title [18] and 4 journal articles. One abstract contains the following important statement for a correct understanding of digitalization: “automation will not replace lawyers, but will help them and make their work more efficient” [19].

Moving to micro category L82 yielded 82 entries since 2015 with topics corresponding to the name of the micro category: advertising (26), newspaper (7), online game (7), music (6), ratings (5), etc. Already at the level of publication titles, questions about the effectiveness of online advertising [20] and the usefulness of “following the crowd” [21] inevitably arise.

Micro category L86 Information and Internet Services; Computer Software, thanks to its subject, seems to “permeate” all columns in tables 2 and 3 with significant levels of digitalization. A sample of 1000 records with the L86 code for 2017–2021 shows the following initial frequency distribution of topics: digital (154), platform (76), software (76), social media (60), broadband (56), China (43), cyber, security (38), review (33), search, Google (32). For 2018–2021, we found 994 records, in which, in addition to the previous one, the topics mobile (65), economic growth (44) and digital economy (27) appeared. Of course, blockchain and digital currency were among the issues discussed [22].

The growing frequency of the term “smart” in category L94 Electric Utilities is of great interest. Among the 170 records, we see “smart meter” (57 entries), “smart grid technology” (10), “smart home” (8), “smart charging” (often together with “electric vehicles”) (7). If we go to the total level of EconLit then we find 1273 records including different combination with the word “smart”: city (220), grid (127), growth (118), specialization (85), metering (79), money (64), climate (51), energy (38), economics (32), card (31), home (27), market (20), innovation (15), policy (10).

We considered the problems brought up for discussion within the framework of the conferences IN-PROM and ECOPROM in the recent years and could not ignore the following findings: in one title “clusters teach to accelerate regional smart specialization” [23], “innovative regions” are considered from the position of “smart innovation policies” [24], and there is a “smart innovation ecosystem” [25].

Features of digitalization of research within the meso category L7 Primary Products and Construction. EconLit makes it possible to conduct a search both for the “micro category–term” pair using the search phrase **subjdesc: L70 title: digital**, and for the entire set of the studied terms that characterize the processes

of digitalization of research at once. In this case, the phrase will be longer: **subjdesc: L70 title: digital OR title: digitization OR title: online OR title: smart OR title: mobile OR title: internet OR title: computer OR title: computing OR title: telecommunication OR title: software.**

If you remove the words **title:** in the above phrase, then EconLit displays the publications with the search term in all fields of record. The described search option for all terms and for micro categories of meso category L7 at once, conducted on April 1, 2021, gave the following results:

L70(4; 21). L71(10; 139). L72(3; 57). L73(3; 45). L74(13; 65). L78(1; 15).

In parentheses, the first number is the total number of publications containing the search terms in their titles; the second number is the search result in all fields of the record.

L70. Two of the four papers in the title search are working papers that explore developments in the US telecommunications industry in 1990s. A working paper published in 2014 considers the topic of Smart Cities in China. A digitalization term in an article dated 2020 can be found in the phrase “Online Citizen Participation” [26]. In other publications of this micro category, the digital aspect is associated with the use of computer modeling, as well as with the analysis of the development of telecommunications.

L71. Of the 10 publications found in the term-in-title variant, there are three units focused on software (2004, 2008 and 2018), three on smart (“smart economy” in 2016, “smart policy” in 2017, “smart sanctions” in 2020). We see “mobile offshore drilling” in [27], “cloud computing” in [28], “internet of things” in [29], and “online big data-driven oil consumption forecasting” in [30].

In the search option for all fields, the frequency distribution of terms turned out as follows: software (31), online (25), computer (25), internet (23), telecommunication (17), computing (12), smart (9), mobile (9), digital (5). A comparison with the data in Tables 2 and 3 indicates a slower digitalization of studies in comparison with other meso categories.

Among the works with the term “digital” in abstracts, we wish to highlight three articles. The first paper presents the “digital elevation model” for assessing the social contribution to the work of mines [31]. The second paper discusses the widespread use of “digital components” in complex systems for analyzing accidents at coalmines [32]. The third article concerns the search for answers to three calls to electric power industry (decarbonization, decentralization and digitalization) [33].

Similarly, it is possible to analyze in more details other publications that touch on digitalization issues, both in the remaining micro categories of the L7 meso category, and included in the L6, L8, and L9 meso categories.

General conclusions, discussion questions and possible research directions. The presented results of bibliometric analysis based on the EconLit electronic bibliography showed that the world economic literature continues to pay more attention to the problems and methods of digitalization.

This process is complex, and for a more complete understanding of it, it is necessary to use not only the term “digital” and its derivatives, but also other related terms reflecting the ongoing changes. We suggested one of the possible sets of such terms (digital or digitization, online, smart, mobile, internet, computer or computing, telecommunication and software). Analysis of publication activity by the sub-periods of 1991–2020 helped to single out four terms (online, digital, smart, mobile) with a pronounced increase in publication activity.

The JEL subject classification, in contrast to ASJC, makes it possible to assess the relationship between digital and industrial (by 37 micro categories) aspects of economic research with more details. This article is the first example (in the world literature) of such an assessment.

The obvious ambiguity of terminological and lexical analysis with the help of well-known bibliographies and electronic libraries is not only the choice of the terms themselves and their combinations, but also the choice of fields for search (by names, by names and keywords, etc.). This was especially evident in the analysis of micro categories of the meso category L7 Primary Products and Construction.

A possible direction for the development of the analysis can be a comparison of the results based on EconLit with the results of assessing the degree of digitalization of economic research based on the records from the Scopus database.

In all cases, we must not forget that bibliometric analysis, like any statistical or model study, presupposes addition from the side of meaningful analysis of both the texts of scientific publications and real economic problems.

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