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INNOVATIVE TRANSFORMATIONS OF THE VALUE CHAIN OF PHARMACEUTICAL ENTERPRISES

ІННОВАЦІЙНІ ПЕРЕТВОРЕННЯ ЛАНЦЮГА СТВОРЕННЯ ЦІННОСТІ ФАРМАЦЕВТИЧНИХ ПІДПРИЄМСТВ

Kopishynska Kateryna, Zinchenko Kateryna
National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

Копішинська Катерина Олександрівна
кандидат економічних наук, доцент,
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»
ORCID: https://orcid.org/0000-0002-1609-2902

Зінченко Катерина Володимирівна
студентка,
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»
ORCID: https://orcid.org/0000-0001-9475-5495

The research is devoted to the substantiation of the necessity of innovative transformations of the value chain of pharmaceutical enterprises. The current state of the international pharmaceutical market and its development scenarios developed by the WTO were analyzed, taking into account the changes caused by the COVID-19 coronavirus pandemic. The typology of value chains is considered and their element-by-element characteristics are given. A new, modern model of interaction in the chain of value creation of products is proposed. The substantiation of efficiency of creation of such chains is given. Based on the correlation analysis, the presence of a linear relationship between the indicators of Pharmaceutical R&D Spend and Revenue was established. To maximize the effect of R&D costs, pharmaceutical companies are recommended to carry out innovative transformations of the value chain, involving external manufacturers of high-tech devices, applications, etc.

Keywords: value chain, innovation, pharmaceutical enterprise, COVID-19.

Метою роботи є вдосконалення наукових положень та розробка практичних рекомендацій щодо інноваційних перетворень ланцюга створення цінності фармацевтичних підприємств. Пандемія коронавірусної хвороби COVID-19 стала викликом для ринку як в цілому, так і для кожного окремого підприємства. Більшість суб'єктів господарювання були змушені переорієнтувати чи диверсифікувати власне виробництво, а ті, хто не встиг внести зміни, – зазнали значних збитків, що вже призвели до перерозподілу ринкових сил. Істотні трансформації відбулись у фармацевтичній галузі, де, на відміну від більшості сфер господарювання, з'явилась низка нових можливостей та напрямів подальшого інноваційного розвитку, що свідчить про актуальність проведеного дослідження. Доходи підприємств світового фармацевтичного ринку стабільно зростають протягом останніх двадцяти років. Пандемія коронавірусної хвороби COVID-19 не змінила цих тенденцій. Світова організації торгівлі, прогнозуючи обсяги реального експорту у 2020 році, розробила три сценарії розвитку подій залежно від тривалості пандемії та характеру обмежувальних заходів. Згідно запропонованих результатів, зростання обсягів експорту за всіма сценаріями планувалось лише для виробників фармацевтичних товарів. У статті було розглянуто типологію ланцюгів створення цінності та наведено їх поелементні характеристики. Запропоновано нову, сучасну модель взаємодії в ланцюзі створення цінності продуктів, яка включає, крім класичних представників, також постачальників наукомістких пристроїв та додатків. Наведено обґрунтування ефективності створення таких ланцюгів. На основі кореляційного аналізу було встановлено наявність лінійної залежності між показниками фармацевтичних витрат на НДДКР та доходом. Таким чином, для максимізації ефекту від витрат на НДДКР, фармацевтичним компаніям рекомендується здійснити інноваційні перетворення ланцюга створення цінності із залученням зовнішніх виробників високотехнологічних пристроїв, програм, що прискорить НДДКР, підвищить їх ефективність та сприятиме зменшенню витрат компаній на виробництво та випуск на ринок нових лікарських засобів та фармацевтичних товарів.

Ключові слова: ланцюг створення цінності, інновації, фармацевтичне підприємство, COVID-19.

Исследование посвящено обоснованию необходимости инновационных преобразований цепочки создания ценности фармацевтических предприятий. Проанализировано текущее состояние международного фармацевтического рынка и разработанные ВТО сценарии его развития с учетом изменений, вызванных пандемией коронавируса COVID-19. Рассмотрена типология цепочек создания ценности и дана их поэлементная характеристика. Предлагается новая, современная модель взаимодействия в цепочке создания ценности продуктов. Дано обоснование эффективности построения таких цепочек. На основе корреляционного анализа установлено наличие линейной зависимости между показателями расходов на исследования и разработки в фармацевтике и выручки. Для максимального эффекта от затрат на НИОКР фармацевтическим компаниям рекомендуется проводить инновационные преобразования цепочки создания ценности с привлечением внешних производителей высокотехнологичных устройств, приложений и т. д.

Ключевые слова: цепочка создания ценности, инновации, фармацевтическое предприятие, COVID-19.

Problem statement. The pharmaceutical industry in developed countries is one of the most dynamic and profitable, but at the same time acts as a special market segment regulated by public authorities and controlled by insurance medicine. In recent years, pharmacy is beginning to integrate with the field of medical services [1]. The COVID-19 coronavirus pandemic has posed a serious challenge to both the economy as a whole and to individual businesses. Most companies were forced to reorient their operations, and those who did not resort to such measures suffered significant losses, which have already led to a redistribution of market positions. The pharmaceutical industry has undergone special changes, where, unlike most others, many new opportunities have emerged. Given the implementation of innovative transformations in all areas of activity, pharmaceutical companies have the opportunity to take a competitive position in a relatively short time. The niche of drug development for treatment and vaccination against COVID-19 has become especially relevant. Thus, the main current development trends can be considered the ability of pharmaceutical companies to involve innovation in all business processes, from the purchase of raw materials to after-sales service to consumers.

Analysis of recent research and publications. The research of the problems of the pharmaceutical market and the influence of various factors on it is devoted to the works of such domestic scientists as, in particular, Degtyarev N.M., Pestun I.B., Gnit A.M., Karameesh D.V., Mnushko Z.M. The publications of these scientists cover current issues of investment and innovation development of the pharmaceutical industry of Ukraine, but many issues related to the development of the pharmaceutical market remain little researched and require in-depth study [2]. This topic is widely studied at the international level, including by such international organizations as the WTO [3]. Ukrainian scientists Geets V.M. and Seminozhenko V.P. [4], systematically considering the issues of increasing the competitiveness of domestic products, structural reforms, development of information infrastructure, etc., related to the further development of innovation in Ukraine, pay less attention to the role of innovation in the value chain. Kharazishvili Y.M. and Lyashenko V.I. emphasizes the role of scientific and technological progress in achieving sustainable industrial development. These scientists noted the components and indicators of sustainable industrial development [5, p. 7–8] and emphasized their low level. At the same time, they did not suggest ways to solve the problems identified above. Despite the large number of scientific publications on the transformation of the value chain, in our opinion, there is still a lack of systematic research, including those that demonstrate the analysis of the state and prospects of interaction of its individual parts, from a scientific point of view and taking into account global changes.

Formulation of the goals of the article. The purpose of the article is to improve the scientific provisions and develop practical recommendations for innovative transformations of the value chain of pharmaceutical companies.

The main research material. The global pharmaceutical market has experienced significant growth in recent years. As of end-2019, the total global pharmaceutical market was valued at about 1.25 trillion U.S. dollars. This is significant increase from 2001 when the market was valued at just 390 billion U.S. dollars. The pharmaceutical market plays a key role in how people get medications and what people pay for medication (Figure 1). Globally, the United States has emerged as the leading market for pharmaceuticals, followed by the group of emerging markets. Emerging markets can include middle and low-income countries such as Brazil, India, Russia, Colombia, Egypt etc. [6]. Starting in 2020, the worldwide COVID-19 coronavirus pandemic will only accelerate current market growth trends.

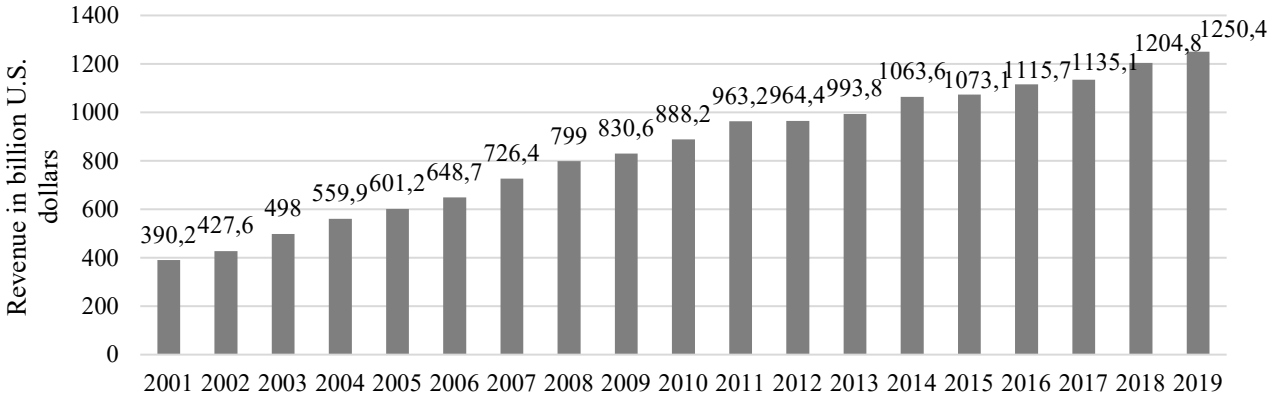

Figure 1. Revenue of the worldwide pharmaceutical market in 2001–2019

Source: [6]

Predicting the economic effects of the crisis, caused by the pandemic, is complex, with many interrelated factors.

WTO (World Trade Organization) proposed three scenarios of the duration of the pandemic and the containment measures. In an optimistic scenario, the measures will stay in place for three months and after that, there will be a V-shaped recovery. In a less optimistic scenario measures stay in place for six months, leading to a U-shaped recovery. In a pessimistic scenario, the suppression measures will have to stay in place for the entire year of 2020 with limited recovery in 2021, leading to an L-shaped recovery [7].

Table 1 displays the projected percent changes in global trade by sector for the three scenarios, together with the initial share (in 2019) of the different sectors in total trade. Contrary to the other sectors, trade of Basic Pharmaceutical Products is projected to rise, because it is an important input into the sector Health Care, whose demand in the government sector is assumed to rise by

Table 1

Percent changes of global real exports per sector under different scenarios in 2020

	Initial shares	V-shaped	U-shaped	L-shaped
Agriculture	2,10%	-6,5	-11,2	-12,7
Fossil fuels	10,70%	-5,5	-10,8	-13,4
Processed Food	4,80%	-7,4	-12,6	-13,9
Petroleum, coal products	12,90%	-7,7	-13,8	-16,3
Basic pharmaceutical products	2,40%	7,9	6,6	8,7
Other manufacturing	10,10%	-8,2	-20,7	-30
Metals	7,80%	-6,8	-13,8	-17,5
Computer, electronic and optic	4,00%	-10,5	-19	-22,6
Electrical Equipment	10,60%	-8,8	-18,9	-24,1
Machinery and equipment	6,20%	-8,7	-15,8	-18,8
Motor vehicles	6,90%	-5,6	-17,3	-26,1
Transport equipment nec	2,40%	-9,7	-19,3	-23,5
Utilities	0,50%	-17,3	-31	-32,6
Construction	0,60%	-11,6	-20,8	-21,6
Retail	1,80%	-11	-21,5	-24,5
Accommodation and recreation	1,70%	-19,2	-35,8	-37,4
Other transport	2,90%	-12,6	-24,8	-26,8
Air transport	1,40%	-18,2	-33,5	-34,9
Business Services	8,80%	-10,6	-19,6	-21,5
Other Services	1,00%	-12,3	-19	-20,4
Health care	0,40%	-1,2	-6,4	-8
Total	**100,00%**	**-8,1**	**-16,6**	**-20,4**

Source: adapted from [7]

50% [7]. It should be stressed that Basic Pharmaceutical Products is the only sector, which is expected to grow.

An important role in the further development of the pharmaceutical sector will be played, in particular, by the involvement of innovative technologies in the production, promotion and supply of its products to the final consumer. Therefore, there should be expected changes in the value chain of the pharmaceutical industry.

According to the criterion of market power distribution and the direction of knowledge and information flows, depending on the role of TNCs and independent suppliers, value chains are divided into «producer driven» and «buyer driven». «Producer driven» value chains are created in high-tech sectors, which actually include the pharmaceutical industry, where there is the highest fragmentation of the production process. Due to its high science intensity, leading companies control the design of the product, as well as, for the most part, its full production cycle, which can be carried out in several countries. Directly, the leading company pays significant attention to product knowledge and scientific and technical developments carried out at headquarters, subsidiaries or dependent suppliers (Figure 2) [7, p. 21].

Participants in the current value chain are actually manufacturers of pharmaceutical products, which are engaged not only directly in the production but also in the development of new drugs, their testing, development; as well as suppliers of raw materials for production, packaging, transportation of products, the policy of cooperation of which directly affects the pricing of the manufacturer.

The main problem at this stage of market development for manufacturers was the lack of legislation in Ukraine on certification of innovative products, which suspends the possibility of further development, as well as intellectual property, when innovations can achieve effective results, but the country is unable to access innovations and financially sound conditions. For such cases, there are provisions at the national and international levels to facilitate access to innovation when it is hindered by intellectual property.

The next link is the distributors who sell the products and act as traders under the contract based on the agreement on the right to sell in a particular region. The company's agreement provides for the distributor to perform a number of functions related to the sale of goods: advertising in the region, pre-sale preparation of technically complex goods, providing customers with services, market analysis and customer feedback on their products, etc.

Distributors can be supermarkets, wholesalers, dealers, brokers, etc.; may be either a subsidiary of the producer or an independent firm operating on a contractual basis (especially in foreign markets). It is this link in the value chain that is directly responsible for the image of the manufacturer in the market, because their overpricing of medicines leads to the fact that the main mission of all pharmaceutical manufacturers is not realized, as quality of life and human well-being are associated with quality medicines at an affordable price.

The ultimate intermediary between the producer and the consumer in the value chain of pharmaceuticals is retail pharmacies. This link is the most formalized, because it is influenced by legislative innovations, projects, proposals and changes to codes, laws, regulations. Retail pharmacies are engaged in the purchase, storage and sale of finished drugs through the pharmacy and its structural units (including drugs manufactured in the pharmacy) directly to citizens for their personal consumption, health care facilities (except pharmacies), as well as enterprises, institutions and organizations without the right to resell them.

Addressing the problem of regulatory pressures and uncertainties requires pharmaceutical companies to work more closely with regulators, politicians and to work purposefully with existing players and new entrants of the market, which specialize in data or innovative diagnostic tech-

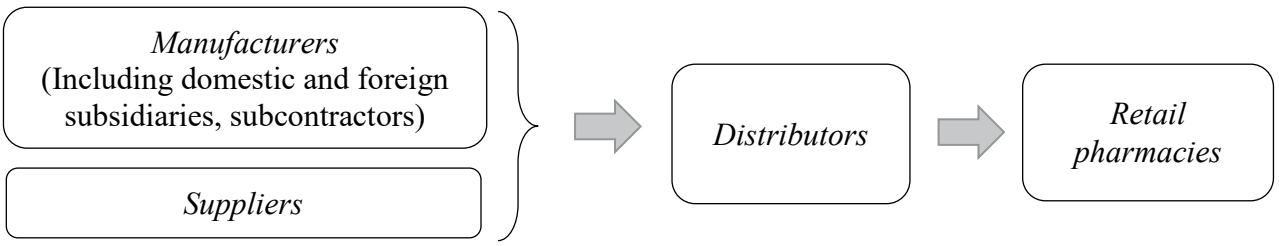

Figure 2. «Producer driven» value chains

Source: adapted from [8]

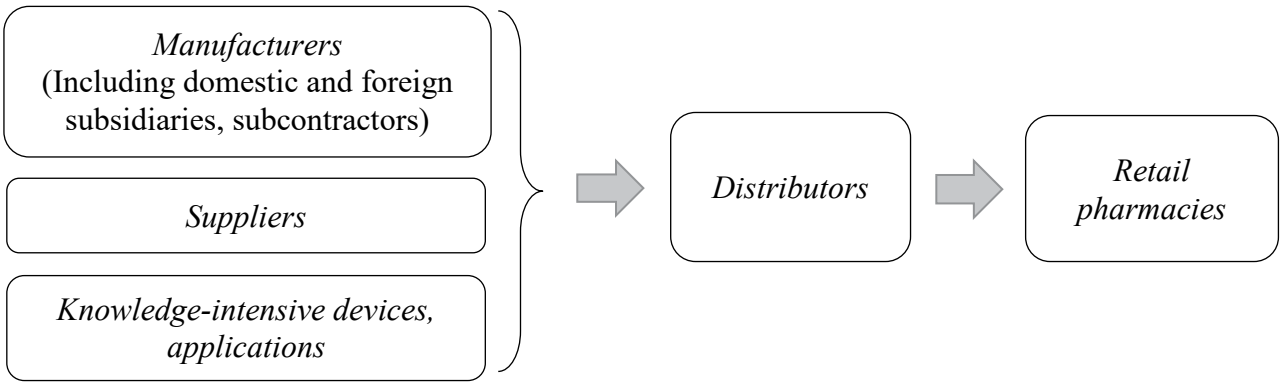

Figure 3. New «Producer driven» value chains

Source: developed by the authors

nologies. In today's digital environment, using virtual reality technology, a real-time disease surveillance program the medical community receives improved analytics and a deeper understanding of the disease with larger volumes of patient data. This approach has obvious advantages in drug development, and can help physicians tailor treatment to the needs of individual patients after they become ill, rather than using standard treatment defined by the general population.

Pharmaceutical companies' collaboration with manufacturers of devices, applications can change the entire pharmaceutical value chain and require a new operating model and a new organizational culture that is more responsive and responsive. It will be necessary to establish the right working relationship between the culture of the pharmaceutical company, which is based on strict safety requirements, complex regulations and methodological approach based on the scientific method, and the innovative culture of technology companies, which is based on transparency, iteration, experimentation, constant changes, characterized by rapid development, agility of decision-making [9].

The new pharmaceutical chain (Figure 3) will include in the first link not only manufacturers and suppliers of raw materials for production, packaging, transportation of products, but also suppliers of high-tech devices, applications that will increase the efficiency and effectiveness of innovative activities.

Pharmaceutical companies invest heavily in research and development. In Figure 4 presents the total revenues of the pharmaceutical industry and the costs of research and development for the period 2010-2019.

You can see that there is a gradual increase in both indicators. The growth rates of revenues of the pharmaceutical industry and expenditures of enterprises on research and development for the period 2010–2019 (Figure 5) have similar trends. We can assume that there is a relationship between these indicators.

To establish the nature of the relationship between the indicators, we use the Pearson correlation coefficient. The correlation coefficient ranges from −1 to 1. A value of 1 implies that a linear equation describes the relationship between X and Y perfectly, with all data

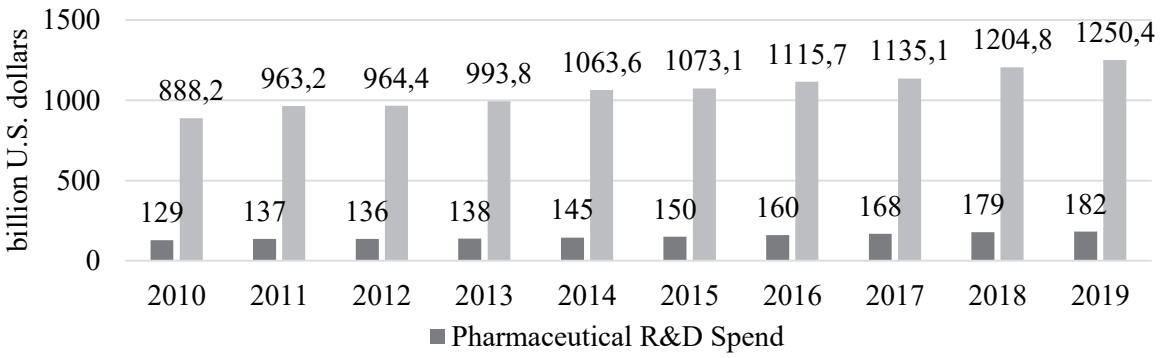

Figure 4. Worldwide Total Pharmaceutical R&D Spend and Revenue in 2010–2019

Source: [6; 10]

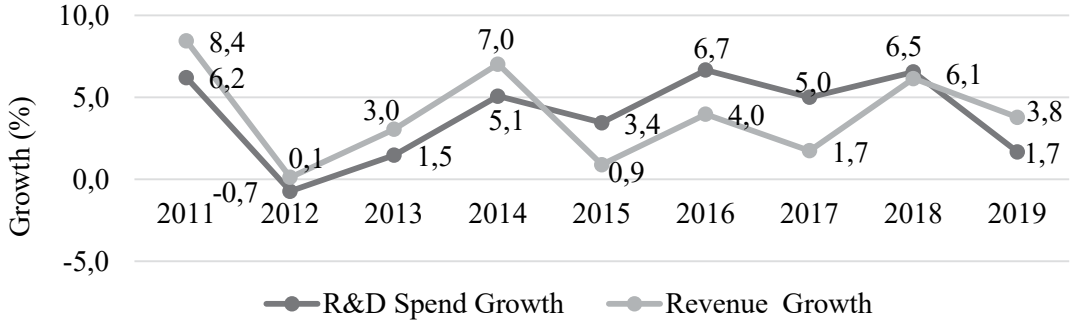

Figure 5. Growth Rates of Pharmaceutical R&D Spend and Revenue in 2010–2019

Source: calculated by the authors

points lying on a line for which Y increases as X increases. A value of −1 implies that all data points lie on a line for which Y decreases as X increases. A value of 0 implies that there is no linear correlation between the variables [11].

Using the data on the change in Total Pharmaceutical R&D Spend and Revenue (Figure 4), was calculated the correlation coefficient and presented the results of the calculation in table 2.

Table 2

Calculation of correlation coefficient for Total Pharmaceutical R&D Spend and Revenue

Indicator	Variation coefficient, %	Correlation coefficient, r
R&D Spend (X)	4	0,98
Revenue (Y)	9	

Source: calculated by the authors

According to the results of the calculation of the correlation coefficient between Total Pharmaceutical R&D Spend and Revenue, the presence of a linear relationship between the indicators was established. This means that as the income of pharmaceutical companies increases, so can the cost of research and development. In order for R&D costs to be as efficient as possible, pharmaceutical companies should transform the value chain by involving external manufacturers of high-tech devices, applications that will speed up R&D processes, increase their efficiency and help reduce companies' production and marketing costs.

Conclusions. A study of the current state of the international pharmaceutical market and the presentation of scenarios for its development by the WTO revealed that the pandemic of the coronavirus disease COVID-19 has significantly accelerated the current market growth trends. This situation encourages pharmaceutical companies to attract innovative technologies in the production, promotion and supply of their products to the final consumer. These trends necessitate the transformation of the value chain of pharmaceutical companies.

A new, modern model of interaction in the value chain of pharmaceutical products was proposed, which includes, in addition to the classic representatives, also suppliers of high-tech devices and applications that will facilitate the innovative component of the manufacturer. In addition, the new chain provides for close interaction of its functional components to facilitate and accelerate the implementation of business processes and the combination of cross-functional responsibilities at all stages.

Based on the correlation analysis, the presence of a linear relationship between the indicators of Pharmaceutical R&D Spend and Revenue was established. To maximize the effect of R&D costs, pharmaceutical companies should carry out innovative transformations of the value chain, involving external manufacturers of high-tech devices, applications and more.

REFERENCES:

1. Derzhavni sayt Ministerstva ekonomiky, torhivli ta sil's'koho hospodarstva Ukrayiny. Derzhavna pidtrymka ukrayins'koho eksportu [Ministry of Economic Development and Trade of Ukraine. State support of Ukrainian exports]. Retrieved from: http://www.ukrexport.gov.ua/ukr/prom/ukr/26.html (accessed 14 March 2021).

2. Kovinko, O. M., Stakhova, A. I., & Vovk, A. P. (2017). Farmatsevtychnyy rynok Ukrayiny yak rushiynyy vazhil' ekonomichnoho rozvytku [The pharmaceutical market of Ukraine as a driving lever of economic development].

Naukovyy visnyk Uzhhorods'koho natsional'noho universytetu – Scientific Bulletin of Uzhhorod National University, 11, 56–59. Retrieved from: http://www.visnyk-econom.uzhnu.uz.ua/archive/11_2017ua/14.pdf (in Ukrainian)

3. Methodology for the WTO trade forecast. Economic Research and Statistics Division, World Trade Organization. Retrieved from: https://www.wto.org/english/news_e/pres20_e/methodpr855_e.pdf (accessed 14 March 2021).

4. Heiets, V.M., & Seminozhenko, V.P. (2006). *Innovatsiyni perspektyvy Ukrayiny [Innovative prospects of Ukraine].* Kharkiv: Konstanta. (in Ukrainian)

5. Lyashenko, V. I., Kharazishvili Y. M. (2017). Problemy otsinky ta intehral'ni indeksy staloho rozvytku promyslovosti Ukrayiny [Evaluation problems and integrated indices of sustainable development of Ukrainian industry]. *Naukovyy zhurnal «Ekonomika Ukrayiny» – Scientific Journal «Economy of Ukraine»,* 2(663), 3–23.

6. Revenue of the worldwide pharmaceutical market from 2001 to 2019. Statista. Retrieved from: https://www.statista.com/statistics/263102/pharmaceutical-market-worldwide-revenue-since-2001/ (accessed 14 March 2021).

7. Interconnected Economies: Benefiting From Global Value Chains. The official site of The Organisation for Economic Cooperation and Development. Retrieved from: http://www.oecd.org/sti/ind/interconnected-economies-GVCs-synthesis.pdf (accessed 14 March 2021).

8. Gereffi, G. (2001). Shifting Governance Structures in Global Commodity Chains, With Special Reference to the Internet. *American Behavioral Scientist*, 44(10), 1616–1637. Retrieved from: https://transportgeography.org/contents/cha-pter7/freight-transportation-value-chains/producer-buyergcc-2/ (accessed 14 March 2021).

9. Zinchenko, K. V., Smolyar L. H. (2020). Innovatsiyna diyal'nist' farmatsevtychnykh pidpryyemstv v umovakh pandemiyi [Innovative activity of pharmaceutical enterprises in conditions pandemic]. *Ukrayins'ka naukovo-praktychna konferentsiya z mizhnarodnoyu uchastyu «Hlobalizatsiya napryamiv formuvannya promyslovoho potentsialu v umovakh postindustrial'nykh transformatsiy» – Ukrainian scientific-practical conference with international participation «Globalization of directions of industrial potential formation in the conditions of post-industrial transformations»*, December 16, 2020, 420–423. Retrieved from: http://ktpe-conf.kpi.ua/v2020 (accessed 14 March 2021).

10. World Preview. Outlook to 2024. Evaluate Pharma. Retrieved from: https://info.evaluate.com/rs/607-YGS-364/images/EvaluatePharma_World _Previ-ew_2019.pdf (accessed 14 March 2021).

11. The Correlation Coefficient r. *Introductory Business Statistics*. Retrieved from: https://open-textbc.ca/introbusinessstatopenstax/chapter/the-correlation-coefficient-r/ (accessed 14 March 2021).

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ:

1. Державний сайт Міністерства економіки, торгівлі та сільського господарства України. *Державна підтримка українського експорту*. URL: http://www.ukrexport.gov.ua/ukr/prom/ukr/26.html (дата звернення: 14.03.2021).

2. Ковінько О.М., Стахова А.І., Вовк А.П. Фармацевтичний ринок України як рушійний важіль економічного розвитку. *Науковий вісник Ужгородського національного університету,* 2017, 11, 56–59. URL: http://www.visnyk-econom.uzhnu.uz.ua/archive/11_2017ua/14.pdf (дата звернення: 14.03.2021).

3. Методологія прогнозу торгівлі СОТ. *Відділ економічних досліджень та статистики Світової організації торгівлі*. URL: https://www.wto.org/english/news_e/pres20_e/methodpr855_e.pdf (дата звернення: 14.03.2021).

4. Геєць В.М., Семиноженко В.П. *Інноваційні перспективи України*: монографія. Харків: Константа, 2006.

5. Ляшенко В.І., Харазішвілі Ю.М. Проблеми оцінки та інтегральні індекси сталого розвитку промисловості України. *Науковий журнал «Економіка України»*, 2017, 2(663), 3–23.

6. Дохід на світовому фармацевтичному ринку з 2001 по 2019 рік. *Statista*. URL: https://www.statista.com/statistics/263102/pharmaceutical-market-worldwide-revenue-since-2001/ (дата звернення: 14.03.2021).

7. Взаємозв'язані економіки: вигода від глобальних ланцюгів створення вартості. *Офіційний сайт Організації економічного співробітництва та розвитку.* URL: http://www.oecd.org/sti/ind/interconnected-economies-GVCs-synthesis.pdf (дата звернення: 14.03.2021).

8. Гереффі Г. Зміна структур управління в глобальних товарних ланцюгах. *American Behavioral Scientist,* 2001, 44(10), 1616–1637. URL: https://transportgeography.org/contents/chapter7/freight-transportation-value-chains/producer-buyergcc-2/ (дата звернення: 14.03.2021).

9. Зінченко К.В., Смоляр Л.Г. Інноваційна діяльність фармацевтичних підприємств в умовах пандемії. Українська науково-практична конференція з міжнародною участю «Глобалізація напрямів формування промислового потенціалу в умовах постіндустріальних трансформацій», 16 грудня 2020 року. 420–423. URL: http://ktpe-conf.kpi.ua/v2020 (дата звернення: 14.03.2021).

10. Світовий огляд. *Outlook to 2024. Evaluate Pharma.* URL: https://info.evaluate.com/rs/607-YGS-364/images/EvaluatePharma_World _Previ-ew_2019.pdf (дата звернення: 14.03.2021).

11. Коефіцієнт кореляції r. *Introductory Business Statistics*. URL: https://open-textbc.ca/introbusinessstatopenstax/chapter/the-correlation-coefficient-r/ (дата звернення: 14.03.2021).