UDK (311+330):[339.5:661.12]:001.53-047.44(061.1ЄС+100)
JEL Classification: F49, L65, O14 **Doi: 10.31767/su.3-4(98-99)2022.03-04.08**

O. B. Salikhova,
DSc in Economics,
Leading Researcher,
Department of Modeling and Forecasting of Economic Development,
State Organization
"Institute for Economics and Forecasting of NAS of Ukraine",
E-mail: salikhova_elena@ukr.net
ORCID: https://orcid.org/0000-0002-7669-6601

Foreign Trade in High-Tech Products: Economic and Statistical Aspects

In the conditions of the globalization of high-tech production, which had led to diversified sourcing of many important industrial components, statistical evaluations of the volume of trade in high-tech goods, specifically the export, can be misleading (in terms correlation with real local innovative and technological potential). At the same time, though traditional statistics of international trade in high-tech products and does not give all the necessary data about value chains, but, nevertheless, it can shed light on on territorial location of high-tech production and its changes under the influence of global processes on the one hand and on the other – to identify failures of the policy, which often leads to negative consequences. This work seeks to deepen understanding on the economic dimensions of high-tech activity, as well as to statistical estimates of International trade flows of high-tech goods (on the example of the EU).

Results of research show the growing trade deficit EU high-tech trade: according to the results of 2021 – €6,8 billion (before the outbreak of the pandemic COVID-19, a trade surplus amounted €17,4 billion). Such a negative trend is based on the growing of trade deficit with China (of electronics-telecommunications and computers and office machines); also has seen stable (over a 10-year period among) growth in imports of high-tech pharmacy.

The global COVID-19 pandemic, which caused supply disruption blockages and shortage of many intermediate goods (including inputs to EU high-tech industry), showed, that with globalization and offshoring, as well as the active policies of the governments third countries, the external trade dependency developed, which can be called "component dependency". It is shown basing on the example of the pharmaceutical industry, that the new EU strategic documents adopted in response to the COVID-19 crisis, the programmes of EU Member States and investment business-projects of European companies laid the groundwork for the elimination of the industry's vulnerabilities and for capacity-building for production and export of Europe's high-tech industry.

The author substantiates that the development of new statistical systems of monitoring and analysis of production and international trade in high-tech must be considered as a common undertaking of statisticians and political decision-makers, since the latter its use to guide their choices of policy tools.

Statistics on Trade in Value Added, proposed not so long ago by OECD, does more meaningful measures of local inputs in global advanced technology sector, but measuring trade in value added relates to industries' activity rather than to products, as in conventional trade statistics. Therefore, this approach it is advisable to to use in addition to traditional statistics of international trade in high-tech goods.

Key words: *EU, foreign trade, high-tech products, pharmaceutics, offshoring, relocation of production.*

Introduction. By 1784, the English mechanic James Watt had created a machine called the universal steam engine, which became the drive for various mechanisms. Steam engines were improved and used to solve various technical problems: the drive of machine tools, ships, crews for transporting people on the roads, locomotives on the railways. In the 19th Century Ricardo laid the foundation of international trade theory, when countries exported what they manufactured. At the time, any businessman in the world importing a steam engine from England knowed that everything (from the steel of the wheels to the boiler pressure gauge) are of English origin. In time, the concept of country of origin for manufactured goods has become obsolete as the various operations, from the design of the product to the manufacture of the components, assembly and marketing have spread across the world, creating international production chains. Today as before engine manufacturing is the most valuable part of making a machine, and the most high-tech. The UK remains one of the leading their manufacturers and makes, for example, the third highest volume of engines for car in Europe, behind Germany and France. But the real paradox is who is in fourth place: Hungary. Being cheap and close to southern Germany made it a magnet for Audi, which has steadily transferred engine production

from Ingolstadt to "Audi Hungaria" in Gyor [1]. It's the same in the pharmaceutical industry. The cases of countries that are recipients of foreign technologies (due to TNC investment), on which territories powerful high tech pharmaceutical production facilities with heavy export supplies, indicate rather apparent than real comparative advantages in the trade in high-tech goods [2]. (By the way, the indicator "high-technology", inter alia, emerged in the context of debates on the competitiveness of countries and their efforts to maintain or improve their positions in world trade, and, according to Benoit Godin, became a symbol of an "advanced" economy [3]).

At the same time, analysts attribute high-tech production of country with high research and development intensity. The publication OECD Main Science and Technology Indicators provides a set of indicators that, according to experts, "reflect the level and structure of the efforts undertaken by countries". Among other indicators – international trade in R&D-intensive industries (the figures "export market share", "total imports", "total exports", "trade balance" of the three industries: pharmaceutical industry, computer, electronic and optical industry aerospace industry) [4].

Obviously, that in the conditions of the globalization of high-tech production, which had led to diversified sourcing of many important industrial components the scale of trade in high-tech goods can be misleading when one relates gross flows of high-tech exports with competitiveness and technological development of the exporting country [5]. The aim of the article is to deepen understanding on the economic dimensions of high-tech activity, as well as to statistical estimates of international trade flows of high-tech goods (on the example of the EU).

Literature review. Most studies conducted by European scientists are mainly aimed at: studying the mechanism of impact of high-tech internationalization on the process of new company creation [6]; the solution of tasks at evaluating export performance and competitiveness in high-tech sector across the EU [7]; the definition the most competitive country in the EU in reference to the high-tech industry and have identified factors influencing the competitive position of the advanced technology sector in the EU member countries [8]; studying the effects of intellectual property rights and R&D expenditures together with foreign direct investment inflows on high-tech exports of the EU economies [9]; surveys the problems of high-tech sector [10]. At the same time, pressing questions remain: how has the structure of the EU trade in high-tech products changed over the past 10 years, what economic processes have influenced these changes, and what transformations are taking place in the Europe's high-tech industry in the context of the implementation of the new EU industrial policy aimed at reducing external trade dependency.

Results and discussion. EU's global competitiveness depends on a vibrant high-tech industries, that play an important role in the on industrial ecosystems (when it comes to developing processes and products). A healthy high-tech sector is an engine for innovation that can give European companies be sustainable in a highly competitive environment of world market. But as statistics show over the past few years has demonstrated, Europe's high-tech industry has some problems. Between 2011 and 2021 imports of high-tech products increased by 58,1% to €392 billion. The largest categories ware: electronics-telecommunications with €152 billion (38,7%), computers and office machines – €76 billion (19,3%), pharmacy – €60 billion (15,4%), Fig. 1, constructed by data from [11]. Exports of high-tech products increased by 64,5% to €385 billion, resulting in a large trade deficit: according to the results of 2021 – €6,8 billion (€4.5 billion a year earlier); in 2019 (before the outbreak of the pandemic COVID-19) a trade surplus amounted €17,4 billion.

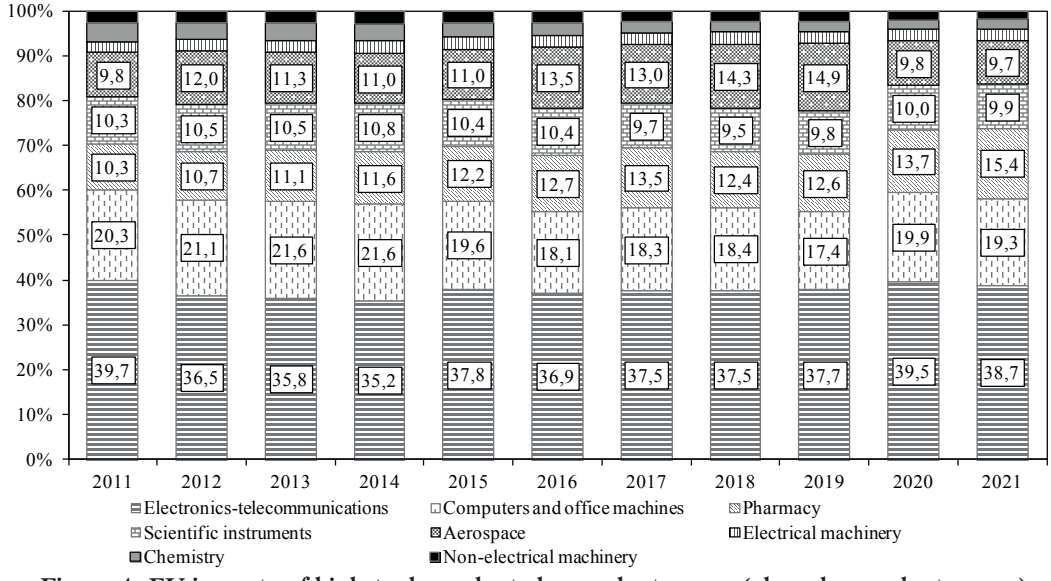

Figure 1. EU imports of high-tech products by product group (share by product group)

Such a negative trend is based on the growing in 2021 trade deficit of electronics-telecommunications (– €70,7 billion) and computers and office machines (– €49,7 billion), Fig. 2, constructed by data from [11]. The EU increased of trade deficit with China to €100,40 billion in 2021. The other partners, with which was in 2021 a trade deficit, are: Vietnam (€12,02 billion), Taiwan (€10,80 billion), Malaysia (€9,95 billion), Switzerland (€5,74 billion), South Korea (€5,07 billion), Thailand (€5,06 billion), Fig. 3, constructed by data from [11].

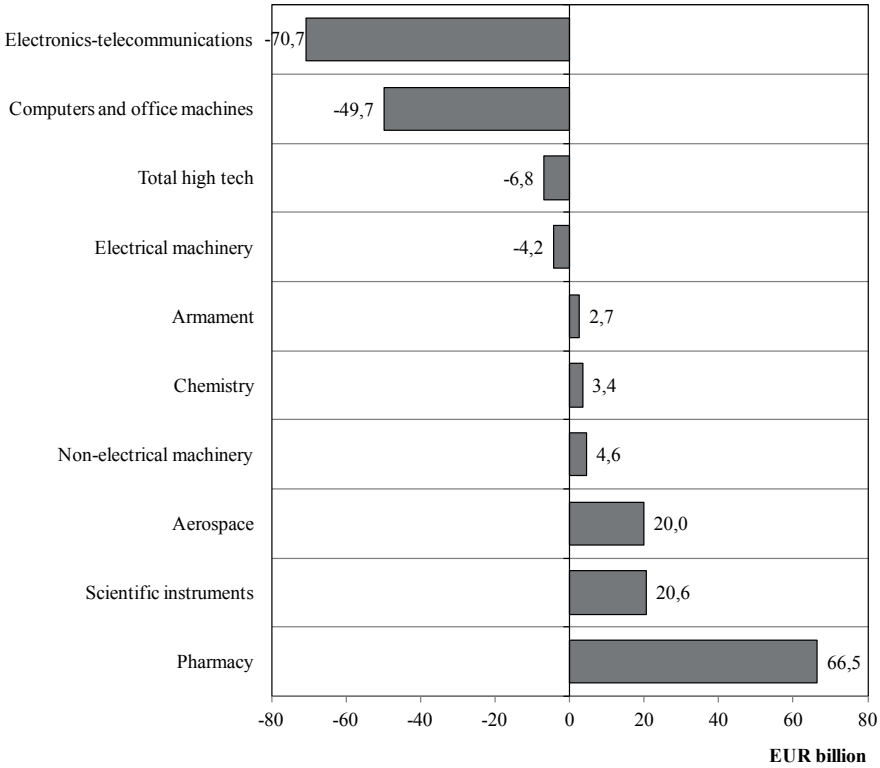

Figure 2. EU trade balance of high-tech products by product group, 2021

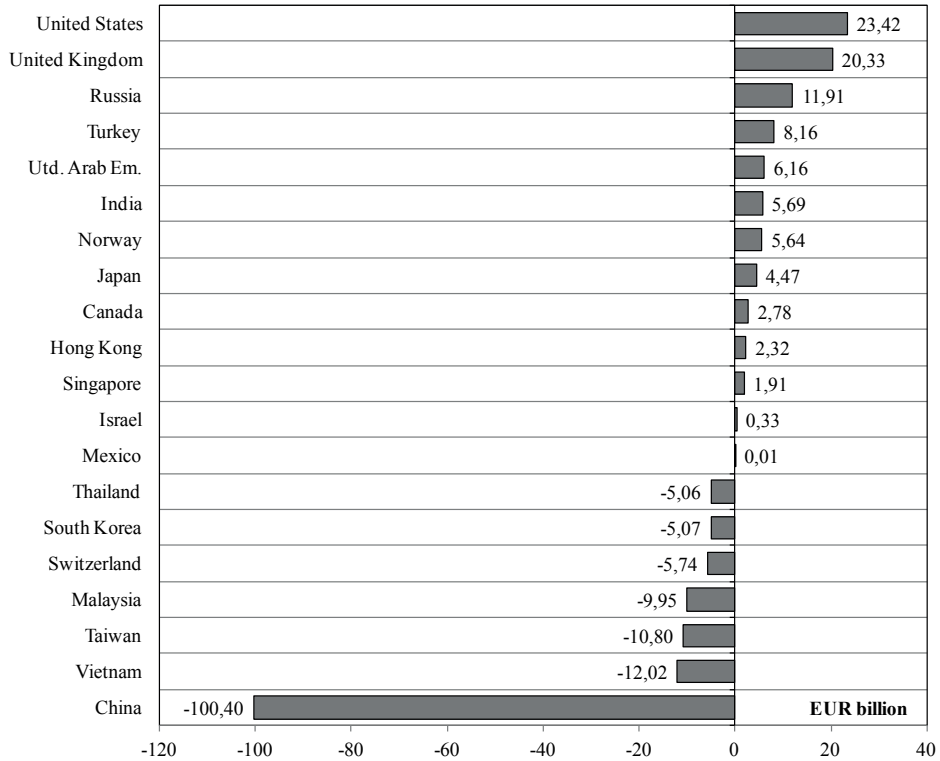

Figure 3. EU trade balance of high-tech products for top 20 partners, 2021

According to the results of 2021 the largest share of the EU imports of high-tech products from non-EU is in the China – 38% (in 2011 – 33%). Over a 10-year period imports from China increased the most in absolute terms, from €82 billion to €148 billion. China dominates imports of items such as computers and office machines – 69%, electronics-telecommunications – 50%, electrical machinery – 47% (Table 1, constructed by data from [11]).

Table 1

EU imports of high-tech products by product group, top 5 trading partners

(%)

Product group	Extra EU	China	United States	Switzerland	United Kingdom	Taiwan	Other
Electronics-telecommunications	100	50	6	1	2	7	35
Scientific instruments	100	17	31	11	9	1	30
Pharmacy	100	10	34	36	4	0	16
Aerospace	100	2	66	2	11	1	18
Non-electrical machinery	100	14	30	14	7	2	32
Computers and office machines	100	69	4	0	2	5	19
Chemistry	100	11	12	4	12	1	60
Electrical machinery	100	47	9	2	5	4	33
Armament	100	6	30	17	6	5	36
Total high tech	100	38	19	8	4	4	27

High-tech pharmaceutical goods – the largest export item (33%). Between 2011 and 2021 these exports increased from €35 billion to €127 billion, equivalent to an annual average growth rate of 13,8%, Fig. 4, 5, constructed by data from [11].).

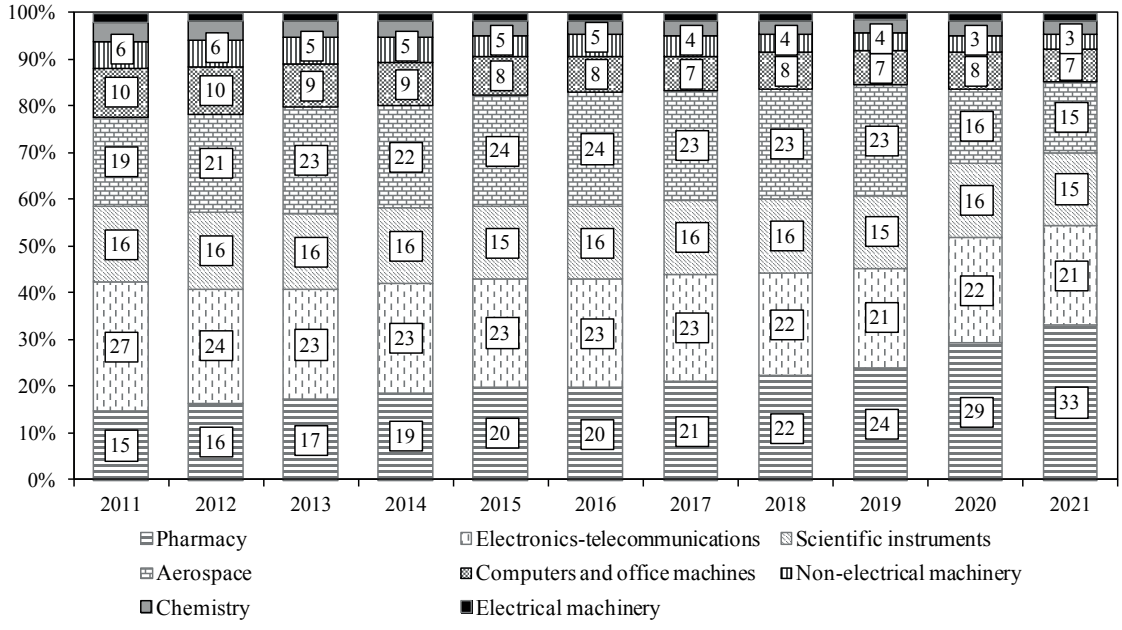

Figure 4. EU export of high-tech products by product group (share by product group)

As a result of positive dynamics, high-tech pharmaceutical goods became the greatest category in the exports of high-tech goods in 2021 with a volume of €127 billion and a trade surplus €66.5 billion (see Fig. 3).

As in previous years, the production and export capabilities of pharmaceutical industries of countries such as Belgium, Ireland, Germany, Netherlands and France contributed to solid performance of EU (Table 2, constructed by data from [11]). However, it

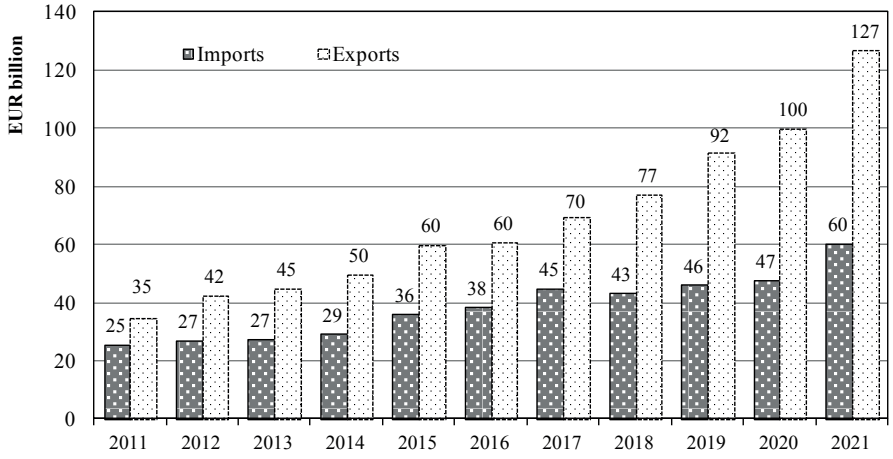

Figure 5. EU trade in high-tech products by product group Pharmacy

should be noted that these countries have their own particularities of local pharmaceutical production: different institutional histories, endowments and capacities, which determine the prospects for further development of the industry.

Table 2

EU exports of high-tech products by product group Pharmacy for top 5 exprters Extra-EU27 (from 2020)

(EUR billion)

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Belgium	9,15	8,57	10,49	11,42	11,51	10,76	11,92	15,15	17,50	33,17
Ireland	2,15	2,59	2,90	5,48	6,96	12,93	18,34	23,65	25,60	28,80
Germany	10,73	12,05	14,17	16,14	15,86	15,93	15,71	17,70	19,22	25,59
Netherlands	4,54	3,85	3,45	4,54	3,18	5,95	7,10	8,06	9,50	10,70
France	4,77	5,56	5,94	7,56	7,69	7,80	7,78	7,99	7,61	7,68

According to the results of 2021, Belgium exported goods of high-tech group "Pharmacy" to Extra-EU27 worth €33,17 billion, making it the first largest exporter of this group in the EU. First of all, this is due to the fact that Belgium has become one of Europe´s largest producers and a major export hub of Covid-19 vaccines (in Puurs, in Belgium with the efforts of BioNTech-Pfizer started the production of mRNA vaccines), which led to a whopping 83% pharmaceuticals value added output increase in 2021, while pharmaceuticals exports accounted for 15% of total Belgian exports [12]. The most common destination for the exports of high-tech group "Pharmacy" of Belgium are: United States and United Kingdom.

Ireland is the second largest exporter of high-tech group "Pharmacy" from EU. In 2021, country exported €28,80 billion high-tech pharmaceutical goods to Extra-EU27. Since 2018, for exports of high-tech pharmaceutical products, Ireland outstrips Germany – global pharmaceutical leader. But it's not about increasing the benefits of science and innovation – indicator R&D – intensity of industry (It is calculated as the ratio of R&D costs to value added) of Ireland in 2018 – 1,3%, Germany – 25,6% [13]. The pharmaceutical industry of Ireland has benefited from high foreign investment and technologies. Other factors also played a significant role: a stable business environment, a robust talent pipeline, strong government support. Ireland also is known for its regulatory stability and pro-business policies that have been maintained across successive governments [14].

Pharma companies that operate in Ireland have access to several financial supports and incentives. Ireland's headline corporation tax rate is 12.5, attracting both investment and the re-domiciliation of multinational pharma companies and contract manufacturing organisations (CMOs). However, foreign multinationals pay an aggregate Effective tax rate of 2.2–4.5 on global profits shifted to Ireland, via Ireland's global network of bilateral tax treaties. These lower effective tax rates are achieved by a complex set of Irish base erosion and profit shifting (BEPS) tools which handle the largest BEPS flows in the world. Ireland's main Multinational tax schemes use "intellectual property" accounting to affect the BEPS movement, which is much of foreign multinationals in Ireland are from the industries with substantial IP, such as life sciences [15]. As a result, more than 85 global pharmaceutical companies in the country (including nine of the top ten) own

more than 100 businesses due to the tax policies that have effectively turned the country into an offshore. Today, the key role in the Irish pharmaceutical industry belongs to American companies. Over the past 20 years, U.S. pharmaceutical companies have progressively outsourced and offshored the manufacture of prescription medicines, generic drugs, and over-the-counter medications. Among the main markets for them is the United States [16]. US advanced technology trade demonstrates that the America's Biotechnology sector (focuses on advances in genetics applied to the development of new drugs, hormones and other therapeutic items), previously in surplus, but from 2015 the country has increased a deficit (from –$0.1 billion in 2015 to –$31.6 billion in 2020) [17], as US drug manufacture continues to be offshored. Nevertheless, the US's pharmaceutical creates the highest added value –$182,4 billion in 2019. However, the positive dynamics in the EU exports of high-tech pharmaceutical products, (on the eve of the crisis COVID-19 pandemic) the figure Value added of pharmaceuticals industry of EU fell by 4,1 in 2019 comparison with the past year, in doing so the indicator United States increased by 10,2, China – by 3,6 (Fig. 6, constructed by data from [18]).

The COVID-19 pandemic and its aftermath highlighted the consequences of build capacity of the pharmaceutical industry in China and raised the issue of dependency of EU' industrial ecosystems on key goods and technologies. As it turned out, pharmaceutical production in European countries depends on pharmaceutical intermediates (ingredients) of foreign origin.The loss of European independence in this sector is linked to the relocation of production, with the result that 60% to 80% of chemical active pharmaceutical ingredients (APIs) are manufactured outside the EU, mainly in China and India; whereas this proportion was 20% 30 years ago. It is noted that as a result of globalization and offshoring, the European pharmaceutical industry has developed "component dependency" [19], which was manifested in the context of the COVID-19 pandemic due to failures in value-added chains and the supply of raw materials and APIs.

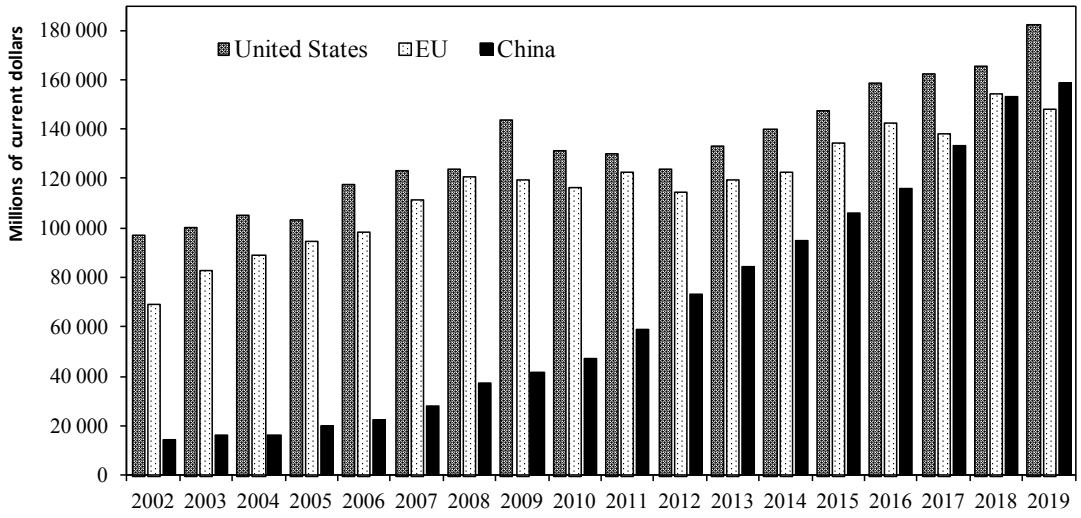

Figure 6. Value added of pharmaceuticals industry

The current dependence of the EU on Chinese producers and suppliers of chemical raw materials, starting materials and APIs has several reasons, but there are three key ones – strategies of transnational companies (TNCs), government policies of both TNCs home countries and host countries.

By implementing market-seeking and resource-seeking strategies to enter the developing markets and access their resources at lower prices, large pharmaceutical companies started establishing production units in these countries since the 1950s. The fact is, most of European pharmaceutical giant companies were aimed at cost reduction and in the early 2000s, the process of offshoring and outsourcing to third countries intensified. Many offshore contract development and manufacturing organizations (CDMOs) had started offering more high levels of product quality, flexible scale, efficient processes, specific technologies and capabilities all designed to optimize pharmaceutical manufacture. In addition to the move to offshore manufacturers, TNCs have also been outsourcing more complex APIs and drug products to specialized contract manufacturing organizations [20]. It is clear that the process of offshoring and outsourcing pharmaceutical companies allows to minimize investment not only in the construction of laboratories, but also in the development of new drugs, as well as to increase net profit and cash flow, reduce the cost and speed up research, and increase the efficiency of production processes, which helps redistribute resources and direct them to other areas, such as marketing. It also helps facilitate compliance with the regulators' standards and requirements in different countries.

European pharmaceutical companies appear to have "contributed" to the growth of the Chinese industry – some gave China the specifications for making their generic drugs including antibiotics.

The governments of European countries have set high environmental standards for the purchase, treatment and disposal of toxic chemicals, which has led to increased direct costs of chemical and pharmaceutical production. The growing cost of labour, infrastructure and transportation, even with increased productivity in European pharmaceutical companies through automation of production and the use of advanced technologies, could not offset the effect of low labour costs of third countries. Legally established practice of budget procurement, that relies primarily on the lowest price criterion rather than the origin of goods, prompted health facilities with budget constraints (as the main buyers of drugs and health products) to give preference to cheaper offers. This encouraged European companies to outsource production to third countries [19].

But at the same time, the Chinese Government began to actively develop R&D in the pharmaceutical sector, with special attention to the biotechnologies and is providing substantial support in the form of subsidies, tax incentives and establishment of special high-tech zones to encourage the production of new products and processes in the pharmaceutical sector [21]. The government of China has launched measures to attract pharmaceutical TNCs in production and R&D, which entails transfer of technology and intensifies endogenous innovations in pharmaceutical manufacturing. Low prices, attractive business conditions and growing global demand for pharmaceuticals have led to a concentration of APIs production in China. In 2015 the government approved the Program for the development of high-tech industries "Made in China 2025". The Program's priorities include pharmaceuticals and, in particular, the development of new drugs, and the development of machinery and equipment for the industry's modernization. The program aims at attaining self-sufficiency and reducing the dependence of the Chinese economy on foreign advanced technologies and high-tech goods. China's government has introduced the Guide to Planning the Development of the Pharmaceutical Industry (hereinafter – the Guide), [22]. This document calls on all stakeholders: "Take advantage of this country's opportunities in implementing the One Belt, One Road initiative, make a full use of international resources to strengthen technologies and attract talents to promote the development of pharmaceutical companies and raise their international competitiveness". In the context of the implementation of the internationalization strategy, the Leadership points to the priority of "supporting enterprises in purchasing or investing in the construction abroad of production bases of chemical raw materials, drugs and traditional Chinese medicines, promoting international cooperation in the use of production capacities and foreign environmental resources and expanding the presence in the local market"; and encourages "mergers and acquisitions and investments in promising facilities" to access foreign technologies and perform international registration of pharmaceutical items, create new sales channels and develop Chinese brands in foreign markets. To attract foreign capital and technologies for industry development, the Guide calls for "encouraging foreign companies to establish research and industrial bases in China to conduct contract based clinical trials of new drugs and their contract-based production" [22], and for expanding equipment producing capacities for the pharmaceutical industry for comprehensive solution of the issues.

In 2021 China has adopted the "Implementation Plan on Promoting the High-quality Development of the API Industry" [23], proposing to focuc on innovation-driven and accelerate the construction of a new development pattern for the APIs industry. The Implementation Plan proposes to implement a major project for the development of APIs, promote the integration of production, education and research, accelerate the development of advanced production technology and equipment, and improve the production efficiency and quality control of APIs. Also, the Implementation Plan emphasizes of strategic significance of chemical APIs and aimes at further strengthening China's global position.

Understanding the threat of Chinese domination on the world market of APIs, the European Fine Chemicals Group, expressing concern at the potential threat of the dependency on Asian countries for APIs, made the following recommendations to prevent them: "Launching a 5- to 10-year investment plan to bring critical off-shore technology back to Europe and develop Research and Development into critical raw materials or technologies produced in Europe" [24].

Committee on the Environment, Public Health and Food Safety of European Parliament pointed to the need to return to health sovereignty: "Above all, this calls for relocation back to the European Union of plants producing active ingredients and medicinal end products of strategic importance for health". The European Parliament prioritises the return to the EU of plants producing APIs and finished medicines that are of strategic importance [25]. With this goal in mind, it has been recommended that efforts be made to ensure the following major steps should be taken:

1. Introduce measures to stimulate relocation and provide state aid (tax incentives and financing) to encourage the industry to locate its operations in Europe, from the establishment of complex production to packaging and distribution, with the precise location of possible production sites in the European map.

2. Recognise reliability of supplies as a priority criterion in tender procedures.

3. Create one or more European non-profit pharmaceutical undertakings capable of producing certain medicines that are of strategic importance for health care in cases of emergency (with regards to the production of an ingredient that is difficult and/or unprofitable to manufacture for pharmaceutical companies).

Having regard to the above considerations, the European Commission has adopted Pharmaceutical Strategy for Europe (hereinafter the Pharmaceutical Strategy). The document seeks to increase the stability of pharmaceutical supply chains through the EU's strategic autonomy in the pharmaceutical sector by diversifying production and supply, as well as increasing investment and production of medicines and components in Europe. The Pharmaceutical Strategy is in line with the priorities of A New Industrial Strategy for Europe (hereinafter the Industrial Strategy), adopted in 2020. The latter was updated in 2021 to include the new challenges of the COVID-19 pandemic, with a focus on removing the external strategic trade dependencies of industrial ecosystems. Accompanying the updated Strategy, the Commission carried out a comprehensive assessment of the EU's strategic dependencies and capacities in six strategic areas (raw materials, APIs, li-ion batteries, clean hydrogen, semiconductors and cloud and edge computing), that affect the development of manufacturing including high-tech industries.

In essence, the guidelines for both pharmaceutical and industrial strategies direct the EU members' governments towards implementing policies to address the effects of delocalisation strategies and reduce dependencies on offshore production of APIs, and medicines by: 1) expanding the product portfolio of existing companies; 2) creating new enterprises from scratch; 3) reshoring production facilities of pharmaceutical industry to the territory of the European Union or other European countries. These guidelines are already being implemented through the state aid mechanism. During the COVID-19 crisis, the European Commission approved multiple measures compatible with the internal market, including aid to facilitate the development of certain economic activities or of certain economic areas (Article 107 (3) c TFEU). In particular, the EU leadership has introduced an investment aid for the production of COVID-19 relevant products. Aid intensity is up to 80% of project costs.

Today, many European countries have launched appropriate national programs. For example, for implementation of the tasks set by strategies and under their mechanisms, the French government on 2020 has introduced an action plan for the relocation of pharmaceutical industries within the French borders. As part of this action plan, the first 6 projects have been selected to share €78 million budget, in order to cover various therapeutic strategies (vaccines, antivirals, etc.) and technological approaches (chemistry, biotechnologies, etc.) [25]. At the same time, Bpifrance (Public Investment Bank) launched "The call for Expression of Interest (AMI): Capacity Building" aiming to finance the creation of new production capacities. AMI "Capacity building" in 2021 selected the 25 new winning projects, which are represent an industrial investment of around €585 million (have benefited from a total amount of Government aid of nearly €365 million, i.e. an aid rate of over 60%, paid in the form of repayable advances). If the objectives of the projects are achieved, nearly 50% of the aid paid can be converted into grants [26].

The first example of this approach undertaken by the government is the relocation of the production of paracetamol active ingredients within three years. It is noteworthy that Europe's paracetamol producer Rhodia closed in 2008 the region's last manufacturing facility in Roussillon, southern France. Rhodia, which had been the world's second largest producer of the painkiller sold under the Panadol and Tylenol brands, had left the market as a result of increased competition from producers in China and India. SEQENS has officially launched the project to build a new paracetamol production unit, in partnership with Sanofi and UPSA and with the support of the France Recovery program (on four of APIs and pharmaceutical intermediates production sites). Innovative, competitive and environmentally friendly, the unit will have a capacity of 10,000 tonnes of paracetamol per year, will be built on the Roussillon platform and will be commissioned in 2023 [27].

French pharmaceutical heavyweight Sanofi also announced plans to establish a new manufacturer of APIs. The project announced by Sanofi consists of creating a standalone company – EUROAPI which will combine Sanofi's API commercial and development activities with six of its European production sites: Brindisi (Italy), Frankfurt Chemistry (Germany), Haverhill (UK), St Aubin les Elbeuf (France), Újpest (Hungary) and Vertolaye (France). With around 3.350 employees, EUROAPI posted sales of about €900 million in 2021. By now the company represents the "made in Europe" API state-of-the-art industrial capabilities and technologies (including a broad portfolio of 200 APIs) [28]. Other European countries also started realizing programs to increase contract manufacturing of APIs and intermediates in EU, that promotes private investment.

It is obvious that the above-mentioned policy measures of the EU and member states, as well as business decisions on the implementation of investment and innovation projects in the EU will form new capacities, contribute to increasing gross output, creating high added value, increasing exports of countries, forming their specialization and

advantages in pharmaceutical production. This in turn puts forward new demands on official statistics.

Pascal Lamy – the Director-General of the WTO (2005–2013), in his speech to the French Senate in Paris on 15 October 2010, said: "When the needs of economic and social policy change, statistics must follow along" [29]. He asked for a new way to look at trade statistics, noting that the country of origin of goods has gradually become obsolete as various operations, from design to manufacture of components and assembly, have spread across the world. At the time, the global finance crisis 2008–2009, revived analysts' interest in improving the statistical instruments in responding to globalization processe and changes of high-tech manufacruring (caused by fragmentation across economiesin a production chain between resident and non-resident firms) and stimulated the solution searching process for these challenges. The increased demand for statistics on global value chains to understand the specialization and comparative advantages led to the creation and the development statistics on trade in value added [30]. While this system isn't perfect yet and does not provide the full story about the operation of global high-tech production networks.

The work for performance assessment of high-tech industries in the contextof globalization [5] proposed new approaches to determining international comparative advantages, which was the first one topropose a weighted coefficient to be used in calculatingthe high-tech component in the country's exports ofgoods and to introduce new indicators of comparativeadvantages based on the specialization criterion. These indicators include: Revealed Specializationof Production (RSP); Comparative Advantage in Value Added Activity (CAVA); Revealed EffectiveExport (REX). O. Krekhivskyi deepened this tool: based on the data of statistics of foreign trade on value added (in particular using the indicator of domestic value added in gross exports), he suggests using new indicator – coefficient of Comparative Advantage in Embodying Domestic Value Added in Exports (EVA) and provides a formula for its calculation [31].

However, the world economy led to increasingly globalized of high-tech manufacruring (particularly the pharmaceutical industry) in the past decade. It is clear that the process of offshoring and outsourcing pharmaceutical companies allows to minimize investment not only in the construction of laboratories, but also in the development of new drugs, as well as to increase net profit and cash flow, reduce the cost and speed up research, and increase the efficiency of production processes, which helps redistribute resources and direct them to other areas, such as marketing. But the current trend of pharmaceutical companies transferring production activities to contract manufacturing organisations in other countries changes have resulted in the development of two-way trade (very often within the framework of intra-industry trade or subcontracting agreements). At the same time, though traditional statistics of international trade in high-tech products and does not give all the necessary data about value chains [32], but, nevertheless, it can shed light on on territorial location of high-tech production and its changes under the influence of global processes on the one hand and on the other – to identify failures of the policy (that can give the right impetus for practical changes).

Conclusions. As the study showed, the trend of TNCs transferring part of activities to contract manufacturing organisations in other countries have resulted in the development of two-way trade in high-tech products (very often within the framework of intra-industry trade or subcontracting agreements). But nevertheless the statistics continue to be based on the idea of an inventory of what is "resident" and "non resident" to constantly monitor of foreign trade in high-tech products and implementation of comparative assessments of high-tech industries of different countries. In case high glibalisation of high-tech production (particularly the pharmaceutical industry, electronics-telecommunications industry, computers and office machines industry) standard methods of statistics analysis of export do not allow to obtain an objective assessment of technological level and global competitive advantages of domestic industry. Statistics on Trade in Value Added does provide more meaningful measures of local inputs in global advanced technology sector. But measuring trade in value added relates to industries' activity rather than to products, as in conventional trade statistics. Therefore it is expedient to use in addition to traditional statistics on international trade in high-tech goods.

The global COVID-19 pandemic, which has led to a shortage of finished and intermediate goods in strategic industrial ecosystems, has prompted the EU leadership to search for effective mechanisms to stimulate the expansion of production by providing preferences for the relocation of certain industries in the EU countries. The speed at which international high-tech production and trade practices are changing (under the influence of globalization and offshoring, and as a response – new EU industrial policy aimed at reducing external trade dependency in strategic ecosystems), is testing the international statistical system's, its ability to objectively evaluate developments occurring, leads to search for new approaches and indicators and also requires new analytical tools. The approach and indicators (RSP – the coefficient of Revealed Specialization of Production, CAVA – the coefficient of Comparative Advantage in Value Added Activity of the country), proposed by the author, also new indicator – coefficient of Comparative Advantage in Embodying Domestic Value Added in Exports (EVA), suggested by O. Krekhivskyi, could be used as a method (in addition

to existing) for study the changes of global leaders in high-tech production and international trade.

At the same time, could be improved Eurostat's product approach to high-tech statistics. As a diraction for further research it is proposed to expand and deepen of the statistical toolkit for the study of globalization trends of high-tech production through monitoring and analysis of foreign trade based on the differentiation of high-tech products by functional purpose (capital goods, intermediate goods, consumer goods), which is the result of a combination of Classification by Broad Economic Categories Rev.4 and the Aggregation of products by SITC Rev.4 (123 nomenclature items are assigned to high-tech capital goods, 126 to intermediate high-tech goods, and 59 to consumer goods were identified author [5]). The development of new statistical information systems of monitoring and analysis of production and international trade in high-tech must be considered as a common undertaking of statisticians and political decision-makers, since the latter its use to guide their choices of policy tools.

References

1. Nagley, J. (2014). Why making engines, not cars, is the real sign of UK manufacturing health. *www.am-online.com*. Retrieved from https://www.am-online.com/news/2014/5/27/why-making-engines-not-cars-is-the-real-sign-of-uk-manufacturing-health/36075/

2. Salikhova, O. B. (2020). Porivnialni perevahy farmatsevtychnykh industrii krain kriz pryzmu novykh indykatoriv [Comparative Advantages of National Pharmaceutical Industries through the Prism of New Indicators]. *Statystyka Ukrainy – Statistics of Ukraine, 2–3,* 48–58. Doi: 10.31767/su.2-3(89-90)2020.02-03.06 [in Ukrainian].

3. Godin, B. (2009). *The making of science, technology and innovation policy: conceptual frameworks as narratives, 1945–2005*. Montreal: Centre – Urbanisation Culture Société de l'Institut national de la recherche scientifique. Retrieved from http://www.csiic.ca/PDF/TheMakingOfScience.pdf

4. OECD (2022). *Main Science and Technology Indicators. Vol. 2021, Issue 2*. Paris: OECD Publishing. https://doi.org/10.1787/a4cf3cb8-en

5. Salikhova, O. B. (2012).*Vysokotekhnolohichni vyrobnytstva: vid metodolohii otsinky do pidnesennia v Ukraini [High-tech production: from the methodology of valuation to uplift in Ukraine].* Kyiv: NAN Ukrainy, Instytut ekonomiky ta prohnozuvannia [in Ukrainian].

6. Gawel, A. (2021). International Trade in the High-Tech Sector – Support or Obstacle to Start-Up Processes at the Macro Level in European Union Countries? *Journal of Theoretical and Applied Electronic Commerce Research, 16,* 1877–1892. Retrieved from https://doi.org/ 10.3390/jtaer16050105

7. Braja, M., & Gemzik-Salwach, A. (2020). Competitiveness of high-tech exports in the EU countries. *Journal of International Studies, 13 (1),* 359–372. doi: 10.14254/2071-8330.2020/13-1/23

8. Juchniewicz, M., & Łada, M. (2020). Diversification of the competitive position of the advanced technology sector in EU. *International Journal of Management and Economics, 56 (1),* 31–41. DOI: 10.2478/ijme-2020-0006

9. Bayar, Y., Remeikienė, R., & Gasparėnienė, L. (2020). Intellectual property rights, R&D expenditures, and high-tech exports in the EU transition economies. *Journal of International Studies, 13 (1),* 143–154. doi:10.14254/2071-8330.2020/13-1/9

10. Rebooting Europe's high-tech industry. (2015). *Kearney.* Retrieved from https://www.kearney.com/communications-media-technology/article/-/insights/rebooting-europes-high-tech-industry

11. Focus on Comext. Eurostat. *ec.europa.eu*. Retrieved June 29, 2022 from https://ec.europa.eu/eurostat/web/international-trade-in-goods/data/focus-on-comext

12. Pharmaceuticals Industry Trends Belgium – 2022. (2022). *Monitor de Mercado*. Retrieved from https://atradius.com.mx/publicaciones/pharmaceuticals-industry-trends-belgium-2022.html

13. Salikhova, O., Honcharenko, D. (2020). Ukraine's pharmaceuticals: from dependence to endogenous development. *Economy and forecasting, 4,* 5–33. Retrieved from https://doi.org/10.15407/econforecast2020.04.005

14. O'Brien, D. (2022). Three Keys to Ireland's Resilient Pharma Industry. *www.pharmexec.com*. Retrieved from https://www.pharmexec.com/view/three-keys-to-ireland-s-resilient-pharma-industry

15. Corporation tax in the Republic of Ireland. *Wikipedia*. Retrieved August 15, 2022 from https://en.wikipedia.org/wiki/Corporation_tax_in_the_Republic_of_Ireland

16. Setser, B. W. (2020). The Irish Shock to U.S. Manufacturing? *www.cfr.org*. Retrieved from https://www.cfr.org/blog/irish-shock-us-manufacturing

17. Setser, B. W. (2020). Advanced Technology Product Code Descriptions. *www.census.gov*. Retrieved from https://www.census.gov/foreign-trade/reference/codes/atp/index.html

18. Science and Engineering Indicators 2022. (2022). *National Science Foundation*. Retrieved from https://nsf.gov/statistics/seind/

19. Salikhova O., Honcharenko, D. (2021). Challenges of the COVID-19 pandemic to pharmaceutical manufacturing: the EU and Ukraine's response. *Ekonomika ta prohnozuvannia – Economy and Forecasting, 3,* 93–117. Retrieved from http://econ-forecast.org.ua/docs/EP_21_3_88_en.pdf

20. Thomas, F. (2020). Securing the Supply Chain. *Pharmaceutical Technology Europe, 32 (6),* 38–40. Retrieved from https://www.pharmtech.com/view/securing-supply-chain-2

21. Salikhova, O., & Honcharenko, D. (2020). Policy of endogenous development of pharmaceuticals in China: lessons for Ukraine. *Ekonomika ta prohnozuvannia – Economy and Forecasting, 2,* 105–119. Retrieved from http://econ-forecast.org.ua/docs/EP_20_2_105_en.pdf

22. Interpretation of "Notices of the Implementation Plan to Promote the Qualitative Development of the API Industry": To Keep Up with the Times and Strive to Create a High Quality and Environmentally Friendly API Industry. (2021). *National Development and Reportr Comission*. Retrieved from https://www.ndrc.gov.cn/xxgk/jd/jd/202111/t20211111_1303758.html?code=&state=123 [in Chinese].

23. Addressing the acute and complex challenge of medicine shortages. (2020). *Position paper. EFCG*. Retrieved from https://efcg.cefic.org/wp-content/uploads/2020/03/Position-Paper-EFCG-Mar-2020.pdf

24. European Parliament resolution of 17 September 2020 on the shortage of medicines – how to address an emerging problem (2020/2071(INI)). (2020). *www.europarl.europa.eu*. Retrieved from https://www.europarl.europa.eu/doceo/document/TA-9-2020-0228_EN.html

25. The relocation of the pharmaceutical industry in France: what are the challenges in the context of COVID-19? (2020). *www.alcimed.com*. Retrieved from https://www.alcimed.com/en/alcim-articles/relocation-of-the-pharmaceutical-industry-in-france-covid-19/

26. Soutien aux industries de santé et renforcement des capacités de production françaises dans la lute contre la COVID-19. (2021). Point d'étape et présentation de 25 nouveaux projets lauréats de l'AMI Capacity Building. *www.economie.gouv.fr*. Retrieved from https://www.economie.gouv.fr/files/files/directions_services/plan-de-relance/DP_20211126_Soutien_industrie_sante_25_nouveaux%20laureats_Capacity_Building.pdf

27. France Relance program: SEQENS new paracetamol production unit. (2021). Press release. *SEQENS*. Retrieved from https://www.seqens.com/en/with-the-support-of-the-france-relance-programme-and-in-partnership-with-sanofi-and-upsa-seqens-has-officially-launched-the-project-to-build-a-new-paracetamol-production-unit/

28. Sanofi to create new industry leading European company to provide active pharmaceutical ingredients (API*). (2020). Press release. *www.sanofi.com*. Retrieved from https://www.sanofi.com/dam/jcr:6cacf1dd-59c3-4b83-a799-7bb78e2bf0fc/2020_02_24_API_EN.pdf

29. Lamy, P. (2010). Lamy says more and more products are "Made in the World". *www.wto.org*. Retrieved from https://www.wto.org/english/news_e/sppl_e/sppl174_e.htm

30. OECD. (2021) Trade in Value Added. *www.oecd.org*. Retrieved from https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm#access

31. Krekhivskyi, O. (2022). Porivnyalni perevahy u vtilenni vnutrishnoi dodanoi vartosti v eksporti [Comparative Advantages in the Domestic Value-Added Exports]. Proceedings from Science. Theory. Practice: *VIII Vseukrainska multydystsyplinarna naukovo-praktychna Internet-konferentsiia (30 zhovtnia 2022) – VIII All-Ukrainian Multidisciplinary Scientific and Practical Internet Conference*. (pp. 108–113). Kyiv: Yarochenko Ya. V. Retrieved from https://webconference.org.ua/wp-content/uploads/2022/11/8_ЗБІРКА_30.10.22.pdf [in Ukrainian].

32. Honcharenko, D. O. (2020). New Approaches to the Assessment of Foreign Trade in High-Tech Pharmaceuticals. *Statystyka Ukrainy – Statistics of Ukraine, 1,* 35–41. Doi: 10.31767/su.1(88)2020.01.04

О. Б. Саліхова,
доктор економічних наук,
провідний науковий співробітник,
відділ моделювання та прогнозування економічного розвитку,
Державна установа
"Інститут економіки та прогнозування НАН України",
E-mail: salikhova_elena@ukr.net
ORCID: https://orcid.org/0000-0002-7669-6601

Зовнішня торгівля високотехнологічною продукцією: економічні та статистичні аспекти

В умовах глобалізації високотехнологічного виробництва, яка призвела до диверсифікації джерел отримання багатьох важливих промислових компонентів, статистичні оцінки обсягу торгівлі високотехнологічними товарами, зокрема експорту, можуть вводити в оману (з погляду кореляції з реальними

показниками місцевого інноваційного та технологічного потенціалів). Водночас хоча традиційна статистика міжнародної торгівлі високотехнологічною продукцією і не дає всіх необхідних даних щодо ланцюжків доданої вартості, проте вона може, з одного боку, пролити світло на територіальну локалізацію високотехнологічних виробництв та зміни їх розміщення під впливом глобальних процесів, а з іншого – виявити провали політики, які часто призводять до негативних наслідків. Ця робота спрямована на поглиблення розуміння економічних аспектів високотехнологічної діяльності, а також на статистичні оцінки міжнародних торгових потоків високотехнологічних товарів (на прикладі ЄС).

Результати дослідження свідчать про зростання дефіциту балансу ЄС у зовнішній торгівлі сфери високих технологій: за підсумками 2021 року – 6,8 млрд євро (до початку пандемії COVID-19 позитивне сальдо торгового балансу становило 17,4 млрд євро). В основі такої негативної тенденції лежить зростання дефіциту торгівлі з Китаєм (за такими групами товарів, як електроніка і телекомунікації та комп'ютери й оргтехніка); також спостерігається стабільне (протягом 10-річного періоду) зростання імпорту високотехнологічної фармацевтичної продукції.

Глобальна пандемія COVID-19, що викликала перебої у поставках та нестачу багатьох проміжних продуктів (включаючи вихідні товари для високотехнологічної промисловості ЄС), показала, що в умовах глобалізації та офшорінгу, а також активної політики урядів третіх країн у ЄС розвинулася залежність від зовнішньої торгівлі, яку можна назвати компонентною залежністю. На прикладі фармацевтики показано, що нові стратегічні документи ЄС, прийняті у відповідь на кризу COVID-19, програми держав-членів ЄС та інвестиційні бізнес-проекти європейських компаній, заклали основу для ліквідації вразливості цієї галузі та нарощування потенціалу виробництва й експорту європейської високотехнологічної промисловості.

Автор доводить, що розробку нових статистичних систем моніторингу й аналізу виробництва та міжнародної торгівлі високотехнологічними товарами слід розглядати як спільне завдання статистиків та осіб, які приймають політичні рішення, оскільки останні використовують отримані дані як керівництво до дії при виборі інструментів політики.

Статистика торгівлі доданою вартістю, запропонована не так давно Організацією економічного співробітництва та розвитку, дає більш вагомі показники місцевого вкладу у глобальний сектор передових технологій, але вимір торгівлі доданою вартістю відбувається у масштабі діяльності галузей, а не окремих товарів. Тому цей підхід доцільно застосовувати у доповнення до традиційної статистики міжнародної торгівлі високотехнологічними товарами.

Ключові слова: *ЄС, зовнішня торгівля, високотехнологічна продукція, фармацевтика, офшоринг, перенесення виробництва.*

Bibliographic description for quoting:

Salikhova, O. B. (2022). Foreign Trade in High-Tech Products: Economic and Statistical Aspects. *Statystyka Ukrainy – Statistics of Ukraine, 3–4,* 78–89. Doi: 10.31767/su.3-4(98-99)2022.03-04.08

Бібліографічний опис для цитування:

Саліхова О. Б. Зовнішня торгівля високотехнологічною продукцією: економічні та статистичні аспекти (публікується англійською мовою). *Статистика України*. 2022. № 3–4. С. 78–89.
Doi: 10.31767/su.3-4(98-99)2022.03-04.08