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POLICY OF ENDOGENOUS DEVELOPMENT OF PHARMACEUTICALS IN CHINA: LESSONS FOR UKRAINE

This article provides overview of the programs and plans, tools of scientific and technological, innovation and industry policies for new drug discovery. The authors substantiate that China has a government-led integrated approach to protecting and strengthening pharmaceutical sector. Discovered and proved the fact that the Chinese Government is encouraging 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. In addition to government support, there is substantial foreign direct investment in production and R&D, which entails transfer of technology and intensifies endogenous innovations in pharmaceutical manufacturing.

The authors give special attention to the fact that China's Government Procurement provides domestic price preference programme and realizes policies promoting indigenous innovation products and technology transfer. Initiatives to create human resources for pharmaceuticals industry and government aid attract foreign specialists and highly qualified Chinese migrants. Government support has raised the level of production localization, and increased employment and value added in the industry. Among the achievements attained due to the political mechanisms created in this country, are scientific and technological competencies and technology development, and high competitiveness of the domestic pharmaceutical industry, protection of intellectual property rights, access to foreign markets, import substitution and lower dependence on imported technologies, pharmaceutical intermediate goods and end-product, and high consumer quality of manufactured goods.

It is proven that China's state-led innovation and investment development model has supported growth over the last 40 years and produced numerous endogenous innovations in pharmaceutical manufacturing. The article presents the authors' vision of the determinants of success of the Chinese government in building innovation potential of domestic pharmaceuticals

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industry and of the resilience of the industry in the face of crisis caused by COVID-19.

Keywords: *China, pharmaceutical industry, biotechnologies, innovation, government aid, tax incentives, subsidies, public procurement, industrial policy*

The COVID-19 pandemic is leading the world economy to a crisis with significant negative socio-economic consequences, which, according to the IMF, will be much worse than those of the global financial crisis of 2008 [1]. Leaders of the top world countries are looking for ways to help businesses that are suffering from the difficulties caused by the epidemic outbreak, traditionally relying on horizontal support measures [2]. At the same time, China has focused on restoring the stable operation of leading industries that are the "pillars" of this country's national economy, including the pharmaceutics. In 2018, the drugs manufacturers, in terms of "added value" made China the third biggest global producer in the industry[3] and strengthened its position as a supplier of components for other countries' pharmaceutical companies. However, COVID-19 affected the sector's dynamics - in January-March 2020, operating income of Chinese pharmaceuticals fell by 8.9% and total profit - by 15.7% (compared to the same period in previous year). This result was more optimistic than in this country's industry as a whole, where the respective values were 15.1 and 36.7% [4], because in March Chinese pharmaceutical manufacturers managed to almost normalize the situation and restore more than 80% of the sector's capacity. **But what is the reason for China's global leadership in pharmaceuticals, which is traditionally considered a high-tech industry, and what are the reasons for the sector's resilience in the crisis in this country?** Finding answers to these questions is the purpose of our article.

Ukrainian scientists have studied the phenomenon of rapid innovative development of Chinese industry [5, 6], economic problems of drug production and features of the regulation of the corresponding market [7]. At the same time, the mechanisms of state policy, which promoted the transformation of the industry into a high-tech and highly productive segment of Chinese economy and a powerful player in the world market, have so far remained insufficiently studied, and hence controversial.

We analyzed China's regulations, purpose oriented programs and plans (by the sequence of their adoption), which facilitated the transition from exogenously dependent to endogenously oriented strategy of economic development [8, p. 44], and **enabled a technological breakthrough based on national innovation assets** [9, p. 5] and a development of the pharmaceutical industry, which made it possible for China to become one of the countries dominated by innovation factors.

Purposeful and selective industrial policy, focused on the restructuring towards high-tech industries, including pharmaceuticals, has been implemented in China since the 1980s, with Deng Xiaoping's coming to power of [10, p. 237–257]. An impetus for the endogenization of the innovation process was the following decision by the country's leadership: *"We must reform China's science and technology management system step by step in accordance with the strategic principle that the construction of our economy should be based on science and technology, while scientific and technological activities should focus on the needs of economic development"* [11].

[3] According to Science & Engineering Indicators [3], the value added generated in China's pharmaceutical industry in 2018 is 162527 million USD, being this figure in USA 181800 million USD, and in EU - 183542 million USD.

Guided by this guideline, in 1986 the government launched the *Program "863"*[4], among whose priorities are biotechnologies, in particular, in the interests of pharmaceuticals. Research and development (R&D) projects were maximally approached to the industry's needs. In 1988, the *Torch Program*[5] was launched and China's high-tech industrial development zones, both national and regional, began to develop to accelerate the commercialization of scientific achievements of the Program 863. An example is **the Benxi High-Tech Industry Development Zone** in Liaoning Province (本溪 高新技术 产业 开发区), followed by the Benxi Zone[6], which specializes in pharmaceuticals [12].

Back in 2006, the provincial government, relying on only four drug manufacturers, began to build a 25-square-kilometer city cluster on the principle of "four in one" (industry, science, technology, universities). Today, the Benxi Zone is called the medical capital of China, because the country's top 100 pharmaceutical companies have located their production facilities there. The development of technological innovations of the enterprises located in the Benxi Zone takes place via the implementation of projects financed from the state budget based on public-private partnership within the Program "863" and the Program "973"[7]. Thanks to state support, as of 2017, 140 new drugs completed preclinical and clinical trials; and revenue from the sale of pharmaceutical goods, works and services in the Benxi Zone exceeded 7.5 billion Yuan.

This success is due to the effective measures by the Benxi High-Tech Industrial Development Zone Management Committee (hereinafter referred to as the Committee). This is an authority in the governing body of the city of Benxi, authorized to apply public policy instruments, for which it is fully responsible. The activities of the Committee are funded by the municipal budget: in 2018, the allocation was 436 million Yuan.

Benxi Venture Capital Management Co., Ltd. was established in Benxi in the early 2000s to expand the financial capacity of manufacturing companies (the Committee owns 100% of its shares), which was entrusted with operation and management of assets and projects. In 2006, it founded Liaoning Yaodu Development Co., Ltd. to raise capital for the Benxi Zone. One of the ways to obtain additional (in addition to government's) resources was the issuance of corporate bonds. In 2019, they were issued in the amount of 1 billion Yuan: 600 million Yuan for the first phase of construction of a plant for the production of pharmaceuticals, 100 million Yuan - for the first stage of a project with biopharmaceutical R&D in the Benxi Zone, and 300 million Yuan - to replenish the working capital [13].

In order to give a new impetus to the development of new drugs, in 2019 the Committee expanded the mechanisms of state support. Now they function at all stages of the innovation process, in particular: in the form of subsidies - for the creation of university science parks, and for conducting research and technological innovation, for participation in large special scientific and technological projects and management of these projects, and for obtaining intellectual property rights; and, in the form of partial reimbursement of costs - for the introduction of research results in production and in the establishment of new enterprises.

In addition to incentives for R&D and innovation, the Committee introduced a number of preferences for investors in the Benxi Zone, including: lease benefits for land under industrial

[4] Program "863" – Government plan of research and development of high technologies.
[5] The "Torch" program - a guideline for the development of high-tech industries.
[6] The official launch of the Benxi Zone took place in 2010 based on the Benxi Economic and Technological Development Zone (本溪经济技术开发区), set up in 1993.
[7] Program "973" – the National Key Plan for Basic Research and Development, launched by China's government in 1997.

facilities, income tax and VAT benefits for start-ups, financial assistance for the purchase of productive equipment, and its leasing. There are also incentives to attract professionals and young specialists to the enterprises and institutions in the Benxi Zone - they are provided with subsidies for housing purchase, as well as financial assistance. In addition, pharmaceutical companies located in the Benxi Zone receive "bonuses" related to infrastructure, including access to electricity, water and other utilities, as well as to recycling and disposal of general waste. More than 40 high-tech industry development zones in China specialize in the development and launch of new drugs on a similar basis.

Undoubtedly, the 863 and Torch Programs laid a foundation for building Chinese pharmaceuticals based on advanced technology. But the cornerstone of the development of this industry and "technological breakthrough on the basis of national innovation", in our opinion, was **the State Program of long-term and medium-term planning of science and technology for 2006-2020** [14] (hereinafter - the State Program), which focused further government measures on endogenous innovations[8]. "*We need to recognize endogenous innovation as a national strategy, implement it in all aspects of modernization and implement it in all industries,"* the document says. Although the State Program notes that there has been a breakthrough in drug development over the past 15 years, it emphasizes the need for new major projects to improve the economy's ability to develop important pharmaceutical items, speed up their development in the industrial scale, and ensure the development of advanced technologies, and establish the production of machinery and equipment for the production processes in the pharmaceutical industry.

To implement the State Program, the government introduced **the scientific and technological special project on "Creation of new important drugs"** (hereinafter - the Special Project) [15], aimed at solving the problems of major diseases, improving the national drug supply system and reducing the dependence on foreign technologies and pharmaceutical items. The special project guides the researchers to follow the instructions set by the Chinese government on the "triple" principle of innovative positioning: creating new products, meeting important needs and solving the key societal problems.

The Special Project Fund, created from the state budget, amounts to 12.8 billion Yuan. The direct economic gain of the first five years of its implementation reached 160 billion Yuan. As of July 2019, 139 development projects received certificates for new drugs, and out of them - 44 certificates for new drugs of the 1st category, which is eight times more than before the launch of the Special Project [16].

In 2019, a directive of the relevant ministry improved the guidelines for the implementation of the Special Project: priority is now given to the development of endogenous innovative drugs with new clinical value, as well as to generics and biopharmaceuticals, which are in urgent need in clinical practice and have good market prospects.

The requirements stipulate that: the applicants may be companies, research institutes and universities registered in mainland China for at least one year, which have the capabilities, conditions and experience to conduct R&D; the project manager must have a doctorate in relevant research for more than two years; the working time during which such a manager will be employed in the project must be at least six months a year; the date of birth of the

[8] In the original, the phrase自主 创新 (zizhu chuangxin) is used. Scholars in China have not reached a consensus on the appropriate translation of this term. The most commonly used translations are: "endogenous innovations" (from the point of view of neoclassical economics, as well as growth theory); "radical innovations" (from the point of view of evolutionary economy, and also the resource concept); other translations - "independent innovations"; "self-determined innovations"; "self-oriented innovations"; "independent innovation". This study uses the term "**endogenous innovation**".

project manager must not be earlier than December 31, 1959; the subject of the project must correspond to the priorities of the "863" and "973" Programs. The mechanism of state financial aid depends on the project category.

Category 1. *"Basic development projects of innovative drugs"*. Support is provided for R&D aimed at developing new drugs based on chemical and biological technologies, as well as traditional Chinese medicines. The result should be the obtaining of a new drug certificate or the completion of all clinical trials and application for and registering of a new medicinal product and receipt of the corresponding confirmation. The financing method used is the government's pre-project subsidy in the ratio of no less than 1:1 to the project applicant's investments. The project applicant must have a clear plan of his own investment and himself make an initial contribution to the project's R&D fund.

Category 2. *"Internationally approved endogenous innovative drugs"*. Since 2008, when the mechanism was launched, a number of drug developers have created new drugs based on endogenous innovations and received permission to sell them in the US, Japan or EU countries, but as they did not use any government aid under the Special Project, they can claim coverage of their project-related costs. The financing method used is post-project subsidy.

The coordinator of the government's initiatives for the development of high-tech industries and, in particular, in the pharmaceuticals sector is the Ministry of Industry and Information Technology (hereinafter - the Ministry of Industry). Its functions include the development and implementation of plans and programs for the development of industries, their monitoring, and introduction of standards, and promotion of the creation of new technologies and endogenous innovations on their basis. In 2015, at the request of the Ministry of Industry, the government approved the Program for the development of high-tech industries "**Made in China 2025**" [17]. 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 endogenous innovation, attaining self-sufficiency and reducing the dependence of the Chinese economy on foreign advanced technologies and high-tech goods.

To implement the program, the Chinese government has adopted the **"Guide to Planning the Development of the Pharmaceutical Industry"** (hereinafter - the Guide) [18]. We will present this document in more detail, as it most clearly reflects the contents of the aggressive policy of the Chinese government in speeding up the endogenous innovative development of the national pharmaceutical industry.

In particular, the Guide 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,*" and

for expanding equipment producing capacities for the pharmaceutical industry for comprehensive solution of the issues.

Separately, the Leadership emphasizes the strengthening of mechanisms for financial and tax support for the development of pharmaceuticals, whose implementation is considered in the context of the State Program and the Special Project. Emphasis is placed on the following three instruments: *tax credit for R&D, income tax exemptions for high-tech enterprises, and accelerated depreciation of fixed assets*. At the same time, the Leadership points to the need to develop venture capital funds and equity funds, improve the policy of export credits and their insurance, expand debt financing tools etc. To encourage the demand for pharmaceutical products, it is recommended to improve the policy of *public procurement* via supporting endogenous innovations, and in terms of establishing *quality standards* of purchased drugs.

In the context of the implementation of the Guidelines in 2016, the Chinese government specified the **list of high-tech industries for targeted state support** [20]. Now it includes the category "Biotechnology and new pharmaceutical technologies", which covers the following industries: biopharmaceuticals; Chinese medicine, natural medicine; chemical pharmaceuticals; new dosages and technologies of drug manufacture, etc. Within each industry, there is a detailed list of top sub-industries that are top priority for the state. Business entities working in these industries have the opportunity to receive preferences, but subject to the **high-tech enterprise certificate** (the main points in the approach to its provision are stated in [10, pp. 111-112].

In 2016, the criteria for identifying high-tech enterprises were adjusted, in particular, it was clarified that: for enterprises with revenue of less than 50 million Yuan per year, R&D expenditures should be at least 5% of total sales; for those with an income of less than 200 million Yuan - no less than 4%; and for those with an income of more than 200 million Yuan - no less than 3%. Besides, at least 60% of the company's R&D must be conducted in mainland China. Volume of the sales of high-tech based products (services) must exceed 60% of the company's total income for the reporting period.

Manufacturers of pharmaceutical products who meet the established criteria and have received certificate will receive a number of preferences. According to China's Income Tax Act, in particular, Chapter IV, which defines tax exemptions for certain business categories, "*high-tech enterprises, to which the state gives priority, pay a 15%income.*" For all other business entities, the rate is 25%.

In the work "Does the policy of certification of high-tech enterprises promote innovation in China?" [21], based on ten years of experience in implementing this policy, it is proved that such an approach has significant positive effects on innovation activities of the manufacturers of high-tech items, including medicines[9].

[9] Back in 2007, one of the authors substantiated the need to introduce a selective approach to the implementation of state policy for the development of high-tech industries in Ukraine, and proposed a methodological approach to identifying high-tech industrial enterprises to "optimize the process of granting state preferences to those industrial enterprises, which constitute the basis of the competitiveness of the national economy "[22, p.133]. Approbation of the author's tools based on 7639 domestic economic entities (coverage ratio - 85%) allowed to conclude that "there are significant differences in the parameters of economic entities in Ukraine [in terms of technological level of production processes and products. – Ed. Note] within a certain type of activity "[23, p. 21], and therefore in the conditions of limited resources the justified step should be not support of "high-tech" branches as a whole, but "*creation of the State register of Ukraine's high-tech industrial companies that will allow to carry out: the address approach in granting the state preferences - fiscal exemptions, state grants, loans, subsidies, donations, government orders, and preferential lending conditions to encourage the development*

To enhance endogenous innovations, the government in 2018 issued the "Notice of increase in the coefficient of deduction for the taxation of research and development costs", which raised the size of the R&D tax credit from 50 to 75% [24]. Companies conducting research in other countries also received tax exemptions - part of their expenditures on R&D abroad, unless it exceeds two-thirds of their R&D expenditures in China, can be deducted before paying corporate tax.

Also, in order to promote the technological transformation of the economy, the policy of accelerated depreciation of companies' fixed assets was improved in six industries, including pharmaceuticals [25]. Accelerated depreciation applies to machinery and equipment used not only in production but also in R&D.

As China's technological gap with developed countries still remains significant, in 2019 the National Development and Reform Commission and the Ministry of Commerce of the PRC presented a new version of the **Catalog of Industries to Encourage Foreign Investment** [26], including the pharmaceutical industry, which included 13 production categories, in particular: production of new complex drugs or drugs with active ingredients; production of amino acids, anticancer drugs, cardiovascular and cerebrovascular drugs, as well as drugs for the nervous system; and drugs using bioengineering and biotechnology; production of medicines of marine origin; new key raw materials for vaccine production, etc.

Investors who invest in the above-mentioned industries are entitled to preferential business practices, in particular, tax exemptions, simplification of the procedure of project consideration and approval, discounts on land lease, and exemption from customs duties. In 2018, the Chinese government expanded preferences for foreign investors by canceling the collection of income tax reinvested in the projects in China (in the areas not prohibited for foreigners), including those related to the construction of new enterprises.

In the context of implementing the Leadership‘s guidelines to facilitate access to China's market for foreign businesses, in particular in the development and production of new drugs, the government launched the **"Pharmaceutical Marketing Authorization Holder"** initiative in ten pilot areas [27]. According to the State Council, as of the end of September 2018, 1,118 applications were cumulatively submitted in the pilot districts, of which 786 - by pharmaceutical producers, and 331 - by the industry's research institutes. The initiative became decisive in the development of the industry of contract based drug manufacturing and contract based R&D in this sector in China.

In parallel with the strengthening of endogenous innovations and the development of national pharmaceutical enterprises, the government is paying attention to capacity building. In particular, Section 10 of the above-mentioned State Program emphasizes the crucial role of talents in the technological progress of economic sectors. For this purpose, the "***National Medium-Term and Long-Term Talent Development Plan for 2006-2020"*** was adopted [28]. The document encourages, on the one hand, to create a large team of highly qualified Chinese professionals capable to developing the key economic sectors; on the other hand, to actively attract high-level foreign talents in the urgently needed specialties, as well as to use foreign educational and training resources for the development of Chinese talents. In the context of the plan's implementation, the "1000 Talents" program was launched with the task to attract Chinese emigrants under the age of 55 with doctoral degrees, professors of well-known educational institutions, experienced corporate executives and businessmen who have partners in the top priority technologies including biopharmaceutical ones. The state decided to allocate 1 million Yuan to each program participant as a subsidy to launch a startup in

and production of high-tech goods" [23, p. 22]. However, despite this argument and the successful similar practice of China [21], the proposed targeted approach in Ukraine has not been initiated so far.

China. At the same time, when hiring such persons, the organization or company provides talented scientists with a housing area of 150-200 square meters and wages equal to or close to what they earned abroad. In 2010, a new requirement was added to the program - "a recruited talent" with a full-time work record in a Chinese institution for at least five years. In return, the researcher receives a 500,000-Yuan subsidy and a research grant of 1-3 million Yuan. In the first five years of this initiative, about 4,100 Chinese emigrants and foreign experts with impeccable recommendations were hired [29, p. 630]. To create similar privileges for Chinese scientists, in 2012 the government launched the national program "10,000 talents".

China has a population of about 1.4 billion people, so the country's domestic **public procurement** market is considered by this country's leadership as a powerful tool to develop national pharmaceutical producers. The interests of the Chinese economy are enshrined in China's Public Procurement Law, adopted in 2002. The amendments to the law, made in 2014, bypassed Article 10, which states [30]:

"Public customers **must purchase domestic goods, equipment and services**, except in one of the following situations:

(1) goods, projects or services to be purchased are not available in China or cannot be obtained on reasonable commercial terms;

(2) purchases are made for use outside China;

(3) other laws and administrative rules providing otherwise.

Definition of the domestic goods, projects and services is made in accordance with the relevant provisions of the State Council. "

The Procurement Guidelines for Health (Article 4) also state: *"Public procurers shall purchase domestic goods"* [31].

Although the law does not clearly define the concept of "domestic goods" (国 货物), the work "Public procurements in China: the experience of European businesses who compete for government contracts in China" [32, p. 9] states that these are goods in which at least 50% of value added is generated in China. As for "reasonable commercial grounds", these are cases when public customers can purchase foreign products if the domestic equivalent is more than by 20% more expensive than the imported one.

The public procurement system also encourages innovative activities of Chinese pharmaceutical producers. In particular, the document "Measures to assess public procurement of endogenous innovative products" [33] (Articles 13-17) stipulates that endogenous innovative products[10] may be subject to a 5-10% price reduction - if the price is the only determinant factor, and a 4-8% one - in other cases. At the same time, through the public procurement system, the government encourages the involvement of foreign technologies. At the same time, the document "Measures for the administration of state contracts for the purchase of endogenous innovative products" [34] (Article 11) emphasizes: *"When approving the purchase of foreign goods, it is necessary to observe the principles that promote the attraction*

[10] The original uses the phrase 国家 自主 创新 产品 - "national endogenous innovative product" - these are goods and services included in the "Catalog of endogenous innovative products for public procurement", compiled by the Ministry of Finance in cooperation with the Ministry of Industry, the Ministry of Science and Technology and other bodies. The products included in the catalog can be supported by the state in the field of public procurement. One of the authors of an article in 2007 recommended to create a "register of high-tech industrial products of domestic production" [22, p. 133] and substantiated the purpose of such a register [23, p. 22]. However, China's successful practice failed to convince our government officials to start identifying products made in Ukraine with the use of advanced technologies and providing preferences to their manufacturers.

and development of technology, giving preference to contracts concluded with foreign companies who transfer technologies."

Since the launch of the State Program for Long-Term and Medium-Term Science and Technology Development Planning for 2006–2020, Chinese pharmaceutical industry has demonstrated significant qualitative and quantitative growth (Table 1).

Table 1

Selected indicators of China's pharmaceutical industry

Indicator	2006	2018	2018/2016, *times*
Number of enterprises, *units*	5 368	7 581	1,41
Operating income, *100 million Yuan*	4 718,8	24 264,7	5,14
Total profit, *100 million Yuan*	372,6	3 094,2	8,31
Average annual number of employees, *10,000 persons*	130,3	207,5	1,59
Personnel involved in R&D, in full-time equivalent, *person-year*	25 391,0	125 919,0	4,96
R&D expenditures, *100 million Yuan*	52,6	580,9	11,05
Patent applications, *units*	1 475	21 698	14,71
Received patents, *units*	1 965	11 494	5,85
Added value of high-tech pharmaceutical industry, *100 million Yuan*	1 741,5	10 576,4	6,07
Added value of high-tech pharmaceutical industry, *million USD*	22 313,0	162 527,0	7,28
Exports of high-tech pharmaceuticals, *million USD*	5 018,0	6 889,0	1,37
Value added per employee, *USD*	**17 127,0**	**78 326,3**	**4,57**
Share of R&D costs in value added, *%*	**3,02**	**5,49**	**1,82**

Source: calculated by authors based on [3, 35, and 36].

According to the author's calculations presented in Table. 1, in China's pharmaceutical industry, between 2006 and 2018, the number of personnel involved in R&D increased five-fold, R&D expenditures - 11 times, and the number of patent applications - 15 times. The sector's companies of the industry significantly raised the share of R&D expenditures in value added - from 3.0 to 5.5%. However, the most significant indicator, in our opinion, is the value added per employee.

The value of this indicator during 2006-2018 increased almost fivefold and reached 78.3 thousand USD. For comparison, we calculated the value of this indicator for German pharmaceuticals (284.7 thousand USD), Poland - 62.3 thousand USD, and Ukraine - 36.0 thousand USD. As stated in [10], the value of this indicator is not only an indicator of the efficiency of industrial enterprises, but also evidence of increased technological level of their production.

At the time of the outbreak of the COVID-19 pandemic, China's pharmaceutical industry already had strong scientific, technological, innovative and human resources. To stabilize the industry during the pandemic, the Ministry of Industry promptly coordinated the activities of the relevant departments, provinces and cities to ensure the supply of key raw materials and organize the personnel's return to work. In turn, the central bank under its program of re-lending within a framework of measures to combat the epidemic (among which the provision of adequate financial support to pharmaceutical companies was emphasized) decided to provide key industrial companies with a preferential credit support of 300 billion Yuan (about 43 billion USD) with an interest rate of 1.28%. The zones of the development of high-tech industries, in particular pharmaceuticals, used their own support mechanisms to normalize their work - from the creation of special funds to additional subsidies and preferences for companies operating in their territory.

Summarizing the above, we can conclude that the technological breakthrough based on national innovation, and the rise of pharmaceuticals and its stability in crisis are due to the following determinants:

1. Implementation of five-year industry development plans; creation of a proper foundation for achieving the goals through mechanisms of state support of research projects and innovations, and capacity building in the industry's interests; the government's adherence to its chosen priorities for almost 40 years (biotechnology in science and pharmaceuticals in industry helped to avoid "shuffling" and to pass from imitation to endogenous innovation.

2. The intensification of applied research and projects under the 863 Program in combination with the establishment of high-tech industry development zones under the Torch Program expedited the introduction of scientific achievements into production and turned the industry into a global supplier of active pharmaceutical ingredients. Only by creating the cost-effective research and production base, the government introduced the Program "973" for the development of fundamental research, which gave the industry an opportunity to enter to a qualitatively new technological level.

3. Activities of the Ministry of Industry and Information Technology on the coordination of efforts of the National Commission for Development and Reform, the Ministry of Science and Technology, the Ministry of Trade, the National Commission for Health and Family Planning, the State Administration for Food and Drug Administration on the implementation of the government's guidelines for the development of national pharmaceuticals, helped to concentrate resources and prevent scattering of budget funds.

4. The implementation of the "Made in China 2025" Program and guidelines for the development of the pharmaceutical industry allowed to focus on the priority of endogenous innovations, to direct this country's public and private resources to that purpose, and to use the internationalization of production and R&D to attract external resources.

5. The introduction of tax incentives for R&D and for accelerated depreciation of fixed assets, and reduction of income tax for high-tech enterprises contributed to the modernization and increase of the industry's innovative potential.

6. Introduction of the list of high-tech industries for targeted state support; certification of high-tech enterprises to provide tax benefits; catalog of industries to encourage foreign investment; and catalog of endogenous innovative products for public procurement (where a special place belongs to pharmaceutical companies) all helped the Chinese government to implement a targeted approach in supporting those companies who perform innovative and investment activities based of the government's priorities.

7. Providing preferences for foreign investors in China's pharmaceuticals and tax exemptions during the reinvesting of obtained profits made it possible to raise capital and technologies and speed up the potential of this country's pharmaceutical industry.

8. Simplification of the market regulation procedure and launch of pilot projects contributed to the development of contract activities of the world's leading pharmaceutical companies in China in terms of both production and R&D, which provided an additional flow of knowledge.

9. Providing preferences to Chinese goods in general and to endogenous innovative products in particular in the public procurement system made it possible to strengthen the potential of national pharmaceutical producers in the conditions of high competition with foreign companies.

10. Initiatives to create a new generation of talent contributed not only to the return of Chinese scientists from abroad and the involvement of foreign experts in science and pro-

duction, but also to the formation of a class of civil servants with promising vision and competencies needed to formulate and implement the national policy of the development of China's pharmaceutical sector.

In our opinion, these measures by the Chinese government have ensured the involvement, development and dissemination of foreign technologies, which became the basis for building strong local research and production potential and for the transition to endogenous innovations in the pharmaceutical industry.

Given the authors' above stated conclusions, in order to speed up the endogenization of economic development in Ukraine through the development of national high-tech pharmaceutical industries, the following is recommended:

1. The current "Strategy for the development of innovation for the period up to 2030" needs to be amended as to defining priorities, which should include technologies on which new drugs are based (product innovations) and technologies of pharmaceutical production (process innovations).

2. To develop a Strategy for the Development of Ukraine's Industry on an innovative basis until 2030, which would include the sectoral priorities, among which should be pharmaceuticals. In the action plan, along with regional and horizontal instruments of industrial policy, to identify sectoral programs for the development of industries-engines of economic growth, including pharmaceutical production. For the Strategy's implementation, to develop a Strategy for the Development of Ukraine's Pharmaceutical Industry until 2030 and a relevant five-year program, and to specify the action plan, and the necessary amount and sources of funding.

3. To introduce certification of high-tech enterprises in Ukraine and certification of high-tech goods created based on the national innovative assets.

4. To develop a draft Law of Ukraine "On Amendments to the Law of Ukraine "On Public Procurement "" in terms of: (a) introduction of the "innovation partnership" procedure defined in Article 31 of Directive 2014/24 / EU, to be implemented under the Association Agreement between Ukraine and the European Union; (b) reduction of the share of the price criterion from the current 70% to 60% and strengthening the quality criteria, and social, environmental and innovation aspects; (c) introduction of price preferences for purchases of high-tech goods that receive the certificate (in accordance with paragraph 3).

The implementation of the above recommendations and the introduction of effective mechanisms of state aid, incentives and healthy protectionism following the example of China require, on the one hand, the development of corresponding methodological principles and methodological tools, and on the other - political will, executive discipline and monitoring.

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ПОЛІТИКА ЕНДОГЕННОГО РОЗВИТКУ ФАРМАЦЕВТИКИ В КИТАЇ: УРОКИ ДЛЯ УКРАЇНИ

Представлено огляд програм, планів, інструментів науково-технологічної, інноваційної та промислової політики, спрямованої на створення і випуск нових лікарських препаратів; обґрунтовано, що уряд Китаю використовує комплексний підхід щодо реалізації механізмів захисту та зростання фармацевтики, особливу увагу приділяє біотехнологічним розробкам в інтересах галузі. Продемонстровано, що в країні запроваджено політичні механізми, спрямовані на підтримку бізнесу у вигляді субсидій, податкових пільг, створення спеціальних зон розвитку високотехнологічної промисловості, що сприяє залученню прямих іноземних інвестицій у контрактне виробництво та дослідження і розробки, які супроводжуються трансфером технологій; через систему публічних закупівель реалізується програма розвитку ендогенних інновацій за допомогою надання цінових преференцій, а також залучаються передові іноземні технології. Значне місце займають ініціативи зі створення кадрового ресурсу, залучення іноземних фахівців і повернення висококваліфікованих китайських мігрантів.

Зроблено наголос на тому, що державна підтримка забезпечила нарощування рівня локалізації виробництва і збільшення числа робочих місць, імпортозаміщення і зниження залежності від імпорту технологій, зростання доданої вартості фармацевтичної промисловості і конкурентоспроможності її продукції. Сформовані науково-технічні компетенції та розвиток технологій сприяли створенню об'єктів прав інтелектуальної власності, поліпшенню споживчих якостей лікарських засобів, виходу фармацевтичних проміжних товарів і кінцевих продуктів на нові зарубіжні ринки. Обґрунтовано, що китайська модель інвестиційно-інноваційного розвитку, що підтримує економічне зростання протягом останніх 40 років, надала можливість сформувати високотехнологічний фармацевтичний сектор на засадах національних інноваційних надбань.

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У статті викладено авторське бачення визначальних чинників успіху уряду Китаю у нарощуванні інноваційного потенціалу місцевої фармацевтичної промисловості та стійкості галузі в умовах кризи, викликаної COVID-19[13].

Ключові слова: *Китай, фармацевтична промисловість, технології, інновації, державна допомога, податкові пільги, субсидії, публічні закупівлі, промислова політика*

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