World technology market: features and current trends

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Annotation. *The definition of the world technology market is given and its features are characterized. The structure of the world technology market formed by institutional elements is considered. The following segments of the world technology market have been studied: the market of patents and licenses, the market of scientific and technological products, the market of scientific and technological specialists, the market of high-tech capital. According to Ukraine's ratings in the world technology market (2018-2019), the reasons for its lag in it are named. The tendencies of the world market of technologies are substantiated.*
KEYWORDS: HIGH TECHNOLOGIES, PATENTS, LICENSES, SCIENTIFIC AND TECHNOLOGICAL PRODUCTS, SCIENTIFIC AND TECHNOLOGICAL SPECIALISTS, HIGH-TECH CAPITAL.

1. Introduction

In the modern post-industrial economy there is a new paradigm of the world order, in which competition is based on knowledge. The country's ability to create and implement its own innovations and develop high technologies is becoming a key resource for sustainable economic development, financial stability, and competitiveness. This ability determines the place in the world economic space [1].

The world economy demonstrates the focus of national economic systems on the intensive development of high-tech products. A qualitative change in the system of world economic relations was the formation of the world technology market, which today is global in nature.

The formation of the world technology market took place in the second half of the twentieth century, when the volume of international commercial transactions in technology exceeded the scale of national exchange. This made it possible to distinguish international technology exchange into a separate form of international economic relations.

According to the IMF, the number of countries exchanging technologies only during the 60's to 90's of the twentieth century. Increased from 22 to 84 [2]. The volume of annual licensing transactions has significantly expanded. Per unit cost, the currency effect of the sale of technological resources on the world market is much higher than the export of ordinary goods. Technological exchange exceeds traditional international flows of goods, services and capital.

The global technology market is a set of international market relations of entities regarding the commercial use of property rights to its objects (productive technologies, process technologies and management).

The scientific and technical potential of countries, the state of their participation in the international division of labor and international technological exchange gives many advantages, determines the modern picture of the world and its development. This process most fully reflects the model of the world economy "Center - Periphery", according to which the world economy consists of two interconnected and interdependent parts - the center and the periphery, the relationship between which is mainly "dominance - dependence".

Center - countries that are mainly members of the Organization for Economic Cooperation and Development. The periphery is structured and splits into separate "concentric circles" equidistant from the center. Distance is determined by the level of economic and social development on the principle: the farther from the center, the worse. The locations of these countries are defined as follows: East Asia, Eastern Europe, Russia, India, Latin America, African countries and the Arab-Muslim world.

The objective prerequisites for global development and acceleration of technology in modern conditions are:

- formation of information and technological structure of social development;
- increasing priority, compared to the triad of factors of production (capital, labor, natural resources), and today the fourth factor - innovative entrepreneurship, which is simply defined as technological;
- increasing the requirements of the world community to minimize technological and anthropological impact on the environment.

2. Features and structure of the world technology market

The structure of the world technology market is formed by institutional elements that mediate the movement and interaction of world technologies. The institutional elements of the global technology market include:

- objects - products or processes - carriers of technology;
- subjects - legal or natural persons;
- commercial and non-commercial technology transfers. The main forms of commercial technology transfer are: sale of patents; sale of licenses; sale of know-how, leasing; copyright agreements; franchising; provision of knowledge-intensive services. Non-commercial forms of technology transfer include international technological assistance - technological grants (free provision of technology and equipment, consulting and training, etc.); co-financing of projects (part of the costs is covered by the company or the recipient country); use of technologies to obtain a social or environmental effect;
- forms of transfer and legal protection of innovations and technologies (patents, licenses, know-how, leasing, franchising, copyright);
- channels of transfer and diffusion of innovations and technologies (trade in innovative products, licensed trade, scientific-technical and information cooperation, etc.).

The global technology market is heterogeneous in its structure and includes four segments:

1. The market of patents and licenses. The most dynamic segment of the technology market is the market of licenses and patents with an annual growth of over 10%. The leading exporters and importers of the license and patent market are industrialized countries that register patent applications (Table 1).

2. The market of science and technology-intensive products (Table 2). The international exchange of scientific and technical knowledge has an objective character of development. The exchange is an objective necessity, allowing to widely introduce into production the latest achievements of world scientific and technical thought. This leads to the growth of the exchange of scientific and technical knowledge in various forms of interaction and joint efforts of large companies to solve current problems of science.

An important component of the global technology market is the export of high-tech products.

Table 1 *Patent applications (2018-2019)*

Country	2018		2019	
	Value	Place in the ranking	Value	Place in the ranking
Japan	496,46	1	490,35	1
Republic Korea	444,63	3	461,15	2
Taiwan, China	480,33	2	447,42	3
Switzerland	322,48	4	321,65	4
Sweden	271,58	7	256,32	6
Finland	285,97	6	255,31	7
USA	144,09	13	143,99	13
Singapore	121,25	14	118,66	15
Norway	115,24	16	113,69	17

Source: grouped by authors according to data [6].

Table 2 *Scientific publications (2018-2019)*

Country	2018		2019	
	Value	Place in the ranking	Value	Place in the ranking
USA	2002,3	1	2088	1
Great Britain	1235,7	2	1289	2
Germany	1083	3	1131	3
Japan	887,3	6	919,3	6
Switzerland	834	9	867,7	9
Sweden	749,3	98	779,3	11
Finland	545,7	19	571	19
Norway	502,7	20	532,3	20
Singapore	466,7	24	493,7	23

Source: grouped by authors according to data [6].

Leading positions in the export of high-tech products (Table 3) has Germany (10.8% of total world exports of high-tech goods), followed by South Korea, China, the United States and Singapore (they account for 45.05%). The total volume of exports of high-tech goods in 2018 was estimated at about 2 trillion. dollars USA. Exports of high-tech products from developing countries are growing twice as fast as the corresponding exports from developed countries. This indicates the strengthening of the global high-tech market in Asian countries.

Table 3 *World leaders in the volume of exports of high-tech products as at 01.01.2019*

Country	Export volume, million USD
Germany	209,610
South Korea	192,789
SAP Hong Kong, China	161,877
USA	156,365
Singapore	155,446
France	117,814
Japan	111,020
Malaysia	90,395
Netherlands	85,790
Great Britain	76,533

Source: grouped by authors according to data [6].

3. The market of scientific and technological specialists. The creation of a high-tech sector is facilitated by the presence of highly qualified specialists and a large number of high-tech startups. An important characteristic of the labor market is its diversity (Table 4), which means similarities and differences between workers in terms of age, cultural background, physical abilities and disabilities, race, religion, gender and sexual orientation.

Table 4 *Diversity of the workforce (2018-2019)*

Country	2018		2019	
	Value	Place in the ranking	Value	Place in the ranking
Singapore	5,8	2	5,8	1
UAE	5,7	5	5,7	2
Australia	5,6	8	5,7	3
Canada	5,9	1	76,4	5
USA	5,8	3	5,5	7
Qatar	5,4	12	5,5	10
Romania	5	26	5,3	18
Sweden	5,4	13	5,2	20
Switzerland	5,5	11	5,2	21

Source: grouped by authors according to data [6].

4. High-tech capital market.

Industrialized countries account for about 90% of the world technology market, including more than 60% are in the United States, Japan, Britain, Germany and France.

Most of the trade in licenses in the global technology market, of the total volume of commercial transactions, falls on the following industries:

- electrical and electronic industry – 19%;
- general mechanical engineering – 18%;
- chemical industry – 17.4%;
- transport engineering – 10.2%.

The objects of the world technology market are goods classified according to the technological capacity of trade developed by UNCTAD, which is indicated as the ratio of research and development costs to the total cost of production and trade in goods. However, the largest percentage of the state budget for research is spent by Israel and the Republic of Korea (Table 5).

Table 5 R&D expenditures (2018-2019)

Country	2018		2019	
	Value	Place in the ranking	Value	Place in the ranking
Israel	4,3	1	4,3	1
Republic Korea	4,2	2	4,2	2
Switzerland	3	8	3,4	3
Sweden	3,3	4	3,3	4
Japan	3,3	3	3,1	6
Finland	2,9	9	2,7	10
USA	2,8	11	2,7	11
Singapore	2,2	17	2,2	14

Source: grouped by authors according to data [6].

Objects presented in an intangible form are the result of intellectual activity and are intangible carriers of various types of technology. Such objects can be classified by internal integrity into:

- non-market (information arrays, knowledge, experience and skills acquired during research and can be transferred through training, internships, exchanges and migration of specialists);
- potential market (patents, know-how, scientific and technical documentation, management consulting);

- market (patent and non-patent licenses, engineering, leasing, franchising, research services, staff training).

In the world market of technologies there are subjects of all structural levels:

- micro level - universities, research institutions, business centers, venture firms, individual innovators;

- meso level - TNCs, national companies, science and technology complexes (technology and research parks, which are the leading implementers and patenters of innovations);

- macro level - state and national scientific and technical systems that ensure the functioning and development of the global technology market;

- mega-level - interstate formations and integration groups, within which efforts are focused on certain areas of STP;

- metalevel - international organizations, including the United Nations, which provide technical assistance to countries that develop and shape the world market for economically safe technologies.

The most important role in all segments of the global technology market is played by the following countries: USA, Japan, Great Britain, Germany, France.

They account for 60% of international technological exchange. In general, industrialized countries account for about 90% of the global technology market, and developing countries - 10%.

For the former socialist countries and republics of the Soviet Union, the share of high-tech exports is much smaller. This is a consequence of the landslide deindustrialization of the former USSR and Eastern European countries in the 1990s. Only the Czech Republic and Poland stand out in a positive way. Thus, Ukraine in this area belongs to the periphery of the technology market and has the following ratings (Table 6).

Table 6 Ratings of Ukraine in the world technology market (2018-2019)

Country	2018		2019	
	Value	Place in the ranking	Value	Place in the ranking
Diversity of the workforce	4,5	62	4,6	59
Scientific publications	215,7	50	229,3	50
Patent applications	1,41	62	1,56	62
R&D costs	0,6	56	0,4	67
Trademark applications	653,88	60	744,49	59
Quality of research institutions	0,04	44	0,04	44
Cooperation with many stakeholders	3,7	56	3,8	58
International joint inventions	0,5	56	0,53	55
The state of cluster development	3,2	106	3,5	96

Source: grouped by authors according to data [6].

Modern processes of globalization have affected the structure of the global technology market and identified a number of its features, namely:

• the world market of technologies contributes to the intellectualization of the world economy in general [3];

• the main actors are TNCs, which share the results of research and development by parent and subsidiary companies, as a result of which the global technology market is better developed than the national [4]. 2/3 of the world's technological exchange is accounted for by intra-firm exchange of TNCs. More than 60% of licensed revenues of industrialized countries account for the share of intra-corporate revenues (in the US - 80%) [5];

• the largest TNCs concentrate research on themselves and contribute to the monopolization of the world technology market (the level of monopolistic control is 89–90%) [3];

• technological gap between different groups of countries causes a multi-stage structure of the global technology market;

• the global technology market has a specific regulatory framework (International Code of Conduct on Technology Transfer), as well as international regulators (World Trade Organization Agreement on Intellectual Property Rights) (TRIPS), the UN Conference on Technology Transfer Committee and Development (UNCTAD), the World Intellectual Property Organization (WIPO), the Export Control Coordinating Committee (COCOM), the Technology Security Expert Meeting (STEM)).

3. Trends in the global technology market

The trends of the world market of high technologies include:

- a high degree of monopolization of the world technology market. This is due to the fact that the implementation of research and development requires significant costs, which can only be done by the largest companies or countries;

- stable dominance in the world market of technologies of industrialized countries, whose share in the international scientific and technological exchange is almost 90%. Exports of high-tech products account for the five most developed countries in the world: the United States, Japan, Britain, Germany and France. In Europe, technology exchange takes place mainly within the EU, most often inter-firm exchange;

- formation of a two-tier structure of the market of high-tech goods and services by relocating production to countries with lower labor costs and widespread use of outsourcing. This applies to the countries of Southeast Asia. Leaders in outsourcing are India and China);

- high level of monopolization of the world market of high-tech products (over 90%) (due to the unique properties of high-tech goods and the transformation of multinational corporations into major market players). Concentration of scientific and technical developments in transnational corporations, joint use of R&D results by parent and subsidiary companies contribute to the development of the global technology market, allows the establishment of monopolistically high prices for patented products and control over the market as a whole;

- an increase in the number of small and medium-sized venture firms (corporations transfer to them the risk of research and development, development of new products, testing of innovations).

The United States remains one of the top five countries in terms of both high-tech exports and imports, despite growing competition. Take the lead in the market of telecommunications, computer and information technology, software (the most famous are Apple, Cisco, Hewlett-Packard, IBM, Intel, and Microsoft). The country dominates the export of computer equipment (75%) and software (65%), remains the world leader in innovation (although most research and innovation focuses on products that are produced abroad and then exported back to the United States). The main trends in the high-tech sector are the development of social media platforms and the active introduction of "cloud" technologies.

The threat to the United States is caused by the penetration of Chinese companies into the American market. To reduce the competitiveness of Chinese companies, a ban on the sale of programs used in sensors, drones and satellites to automate the recognition process. In 2020, the US government imposed restrictions on the export of artificial intelligence technologies. But the US high-tech market has a margin of safety, many of the leading high-tech corporations and firms are American; there is no absorption of American companies by European ones, on the contrary, there are reverse processes; higher education is more in line with the needs of the innovative economy, and higher education is more qualified and prestigious; high-tech products meet the high demands of consumers. Concealed protectionism is an instrument of state support for the high-tech sector of the American market.

The European high-tech market is inferior to the following countries: the United States in areas such as telecommunications and electronics; Japan and the newly industrialized countries of Southeast Asia - in the field of mass production of knowledge-intensive goods. The number of European high-tech companies in the domestic market is only 30-40% of their total. With high energy prices and declining sales, big business has reduced its IT spending, and small and medium-sized enterprises cannot afford to invest heavily in this area.

The reasons for the weakness of the European high-tech market are:

- reduction of demand for ICT compared to the rest of the world;
- insufficient funding for research by states;
- lack of qualified personnel and reduction of graduates in engineering, mathematics and information specialties;
- there is an innovation deficit.

According to a study by Euromonitor International, the production of high-tech goods in the EU is expected to triple and reach 16 trillion US dollars in 2030 through the pooling of resources for investment in several high-tech industries, including the development of innovation in the Internet of Things and the creation "Smart" companies. Finland, Denmark, Sweden and Norway are considered to be the most ready for this.

A common feature of the Asian segment is the crucial role of the state in the effective development of advanced technologies. Japan is one of the leaders in the world market for high-tech goods and is one of the largest competitors in the United States. The main driving forces in the development of high-tech industries in the country were political factors, especially active interaction with the United States and external demand and external financial resources. Japan ranks first in the export of electronics and information.

4. Conclusions

1. The world technology market is one of the most important factors in the development of the world economy as a whole.
2. The growth rate of international technology exchange significantly exceeds the growth of traditional world economic flows, including money capital.
3. The growth of the world market of technologies reflects the objective need for the formation of new systems of productive forces, the introduction of new technological components.
4. Technology is becoming the main determinant that affects all areas of individual and social life and the process of transformation of the technological structure of planetary civilization.
5. Leadership in the development of high technology was achieved by those countries that were aimed at producing competitive products based on their own innovative developments and focused primarily on the European market.
6. The main limitations of intensifying the participation of Ukrainian entities in the processes of technology transfer in the foreign market are:

1) the level of a significant number of domestic scientific developments and science-intensive product does not meet the requirements of the modern market;

2) violation of the system of interaction (cooperation) of research institutions and enterprises in the development and commercialization of science-intensive products;

3) shortage of resources (financial, personnel) for the implementation of innovative activities of enterprises on their own, as well as for the acquisition of innovations abroad;

4) lack of mechanisms for implementing the programs and concepts of scientific and technical development declared by the state.

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