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Research paper

Technological Cooperation Trends Under Conditions of the Modern World Economy

Natalia Anatol'evna Navrotskaia[1], Ekaterina Alexandrovna Kovaleva[2], Elena Vyacheslavovna Zenkina[3], Gozel' Muradovna Kutlyeva[4], Tatyana Vyacheslavovna Bogacheva[5], Nataliya Vital'evna Bondarchuk[6]

1Saint-Petersburg State University
Chaikovskogo st., 62, St.Petersburg, 191123, Russia
2Peoples' Friendship University of Russia (RUDN University)
Miklukho-Maklaya st., 6, Moscow, 117198, Russia
3Russian university of transport (MIIT)
Obraztsova st., 9, Moscow, 127994, Russia
4Peoples' Friendship University of Russia (RUDN University)
Miklukho-Maklaya st., 6, Moscow, 117198, Russia
5Peoples' Friendship University of Russia (RUDN University)
Miklukho-Maklaya st., 6, Moscow, 117198, Russia
6Russian State Social University
Vil'gelma Picka str., 4, Moscow, 129226, Russia

Abstract

The authors emphasized key specific features of technological cooperation under conditions of the modern world economy and analyze modern trends of the world production ties development in high and medium technological economic sectors. They generalized main trends of technological cooperation development in the light of structural changes in the world economy, innovative production process and specific features of regional labor division. It was concluded that structural changes in the world economy, an innovative production process and specific features of regional labor division formed a new location of the world production, an architecture and motivation of technological cooperation in the hi-tech and economic sectors. It was emphasized that an analysis of technological cooperation development for Russia should be performed with account of the mentioned world tendencies and special features of the national economy.

Keywords: *technological cooperation, high and medium technological economic sectors, global production systems, value added chains, reshoring of production.*

1. Introduction

The key trends of global production development today are innovative production cooperation and wider production ties of the world countries. As experience shows, countries with innovative strategies are more successful in economic development, and close cooperation in high and medium technologies can promote scientific, technological, production and resource complementarity of partner countries in consequence of benefits connected with synergism, economy of scale, neighborhood etc. Fast technological development of the leading world countries is provided by development of new branches and overhauling of economy sectors, where new technologies are developed and introduced. According to OECD experts, now economic growth rates are provided by technological progress by 38%, by the end of the century this figure will have increased to 65 %. This factor provides 75 % of labor capacity runup in OECD countries and more than 50% of their national income addition, since it increases a cost value dramatically. According to Bureau of Economic Analysis, in the USA R&D provide 6,6% of GDP growth, one invested in this field dollar brings three [25].

Today use of knowledge, technologies, goods and services is global. The volume of the world trade in the field of intellectual property grows by 12% every year, while rates of world production are 2,5-3% [3]. According to the experts forecasts, an annual volume of hi-tech market can increase from 2,9 to 10-12 trillion US dollars in 15 years to come, while the fuel-power market will grow from 0,7 to 1,2 – 1,4 trillion US dollars [16]. For this very reason, the most developed countries invest lots of money in R&D despite slow economic growth according to OECD statistics [18] (see Table 1).

Table 1:. Expenditures on R&D (% from GDP)

Country	2010	2011	2012	2013	2014	2015
The USA	2,74	2,76	2,70	2,74	2,80	2,82
China	1,73	1,79	1,93	2,01	2,05	2,06
Germany	2,71	2,79	2,87	2,83	2,84	2,86

Sweden	3,22	3,25	3,28	3,31	3,16	3,18
Japan	3,25	3,38	3,34	3,47	3,58	3,57
Republic of Korea	3,47	3,74	4,03	4,15	4,29	4,31

According to the data, expenditures on R&D in such countries as Republic of Korea, Japan and Sweden are more than 3% of GDP, it allows to form the world technological specialization and promotes its further development under new technological modes.

2. Methodology of the Research

Scientific developments and recommendations, building the concept of technological cooperation among countries nowadays, are a theoretical and methodical basis of the research. The authors use the methods, based on general scientific principles, fundamental statements of the economic theory, theories of globalization, regionalization and international integration, practice of economic processes development generally and technological cooperation evolvement particularly. The authors also apply such general scientific methods of research as a system-structural method, scientific abstraction, analysis and synthesis and comparative analysis.

Official data of international economic organization OECD and UNCTAD, research, expert and rating agencies and associations, Internet resources are a statistical basis of the research.

By the end of the 20th century international technological specialization in the hi-tech economic sector had developed to such an extend, that international production ties and technologies exchange on the world market became a separate field of international economic relations and a new market appeared – a market of technologies. A high profitability of a hi-tech sector promotes structural changes in countries' production ties development.

We can see oncoming flows of increasing investments in R&D and new technologies, it builds a new trend in the world economy – neoindustrialization [15, 21]. Some countries, oriented to bio – and nanotechnologies, gene engineering, membrane and quantum technologies, integrated photonics, micromechanics, fusion energy etc., are creating a basis for groundbreaking innovations, for example, artificial intellect, additive technologies, providing a principally new level of a state government and economy management.

Together with this trend the role of hi-tech suppliers is changing dramatically. Till 2000 companies from the USA, Japan and other developed countries were leaders in the field, they controlled 80% of the world hi-tech market, since they had 46 in 50 key macrotechnologies [12], which are the basis of modern telecommunication, computer programming, atomic power, aircraft engineering, shipbuilding and missilery. For the last 20 years the number of knowledge – intensive products suppliers has increased dramatically, primary at the expense of China, India, Brazil, Mexico and other countries of Eastern Asia, Latin America and Africa [11] (see Table 2).

Table 2:. Hi-tech exports (% from manufactured exports) in 2015

No	Country	%	No	Country	%
1	The Philippines	68	9	The USA	20
2	Malaysia	45	10	Japan	18
3	China	37	11	Hong Cong	16
4	Coria	29	12	Germany	13
5	Cyprus	27	13	Finland	11
6	France	25	14	Romania	10
7	The Netherlands	21	15	Belorussia	10
8	Great Britain	21	16	Russia	9

For example, China worked out a strategy of scientific-technological development, it plans an increased number of R&D projects, especially fundamental researches, national scientific laboratories constructing, scientists and engineers training, boost of biological, informational, space and power technologies acquisition [26]. Today China is a leader of the hi-tech export, it is the largest exporter of informational – communication technologies [27] (see Fig. 1).

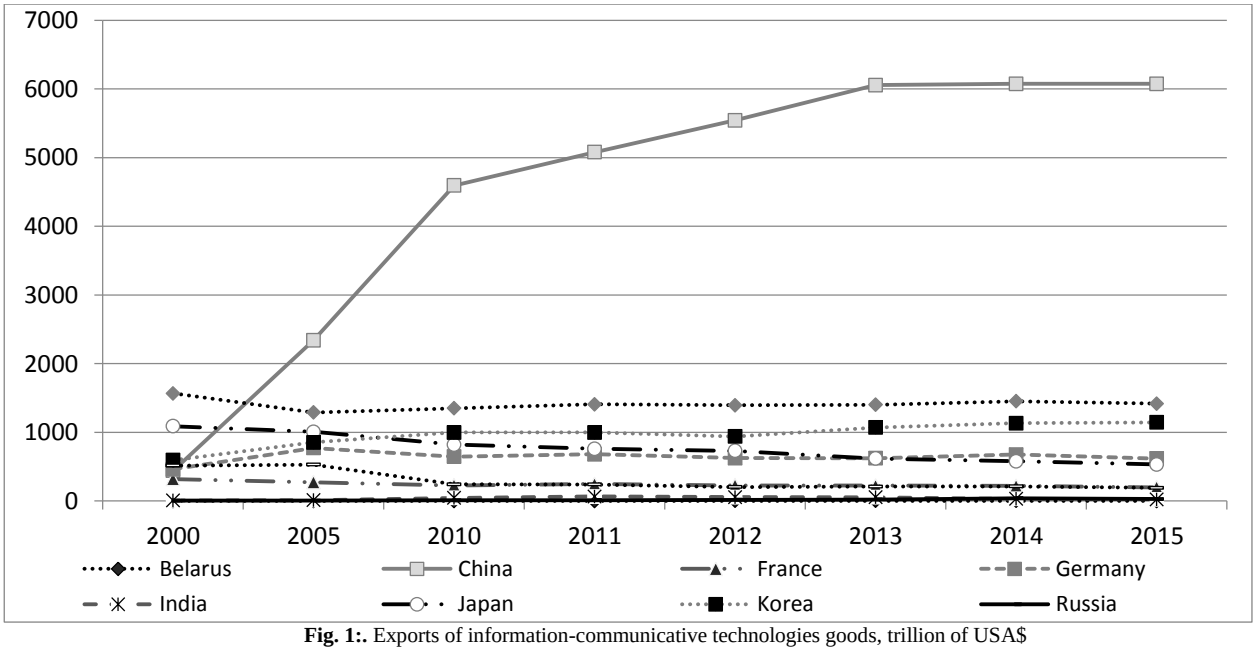

Fig. 1:. Exports of information-communicative technologies goods, trillion of USA$

India is also being involved into the processes of the hi-tech export very fast, it exports biochemical and medical goods, software and informational services [13].

It is important to emphasize that beginning with 2000s more and more applied researches and developments, especially connected with specific features of local demand and production, are being shifted to the home countries. Puga nad Trefler called such innovations incremental [22].

Nowadays the location of research and designer departments in production chains is changing, since China and India could provide fast training of engineers. For example, India specializes in services, most of which (offshore programming) is connected with increment innovations. Lately research centers have created more than 300 multinational corporations in this country, 125 of them belong to the largest American companies. The key reasons for these processes are centers of fundamental researches, intellectual property protection, cheap labor force, highly-qualified scientists and engineers, getting their education in the USA and other countries and returning back home. Multinational corporations have invested in R&D in India more than1,3 trillion US dollars for the last 15 years, it has provided an employment status for 23 thousand researchers [20].

A key trend in international production ties development is foreign offshoring and outsourcing, leading to overhauling of national economic sectors, first of all, OECD, it also promoted creation of global production systems [17]. Development of global production systems on the basis of global added value chains (GAVC) is connected with involving of developing countries in the process [2, 9].

As experience shows, successful technological development does not always require inhouse technologies. It is possible to cooperate with a technological leader. Some developing countries could modernize their economies very effectively and fast, using foreign investments, technologies and equipment. Such countries as South Coria, Singapore and Taiwan are serious rivals for the leading developed countries. The Philippines and Malaysia are being involved into the global production systems very fast.

At the same time, we can see slower process of GAVC development high and medium technological sectors. According to OECD research, long and wide diversified chains are rather vulnerable because of such various factors as calamities, political storms etc., a problem in one small link can stop work of the whole chain of deliveries [2]. To diversify risks companies, plan additional alternative variants of deliveries, it makes the chains odd and nonoptimal. So, to make the chains more reliable, companies make them shorter and production closer to the consumers' market. These processes influence the location of production, make it more concentrated around the regional centers both in the developed and developing economic systems.

Together with the mentioned trends, that can be characterized as internationalisation of production ties, an opposite tendency is becoming stronger – relocation of production from developing countries to the countries of parent bodies. These tendencies are called reshoring or backshoring in the scientific literature. Reshoring is relocation of a manufacturing industry back to the country of a parent body [6], or any other change of production location in relation to a former offshore country [7]. Backshoring is concentration of a part of foreign production operations, creating a value [10, 14].

The USA has been losing 220 thousand of working places annually for the last ten years because it shifted production abroad [23]. In 2014-2015 the country reached a parity rate between offshoring and reshoring working places, in 2016 it had a runup of working places. According to the experts estimations, American companies have 3-4 million working places abroad, this is a huge potential for further development of inner production under the reshoring conditions [23].

Higher labour productivity, lower energy and materials consumption, cheaper energy in the developed countries allowed to decrease a cost value of some productions and to increase their concentration in the home country or near countries.

There is one more trend of production localization change – nearshoring – it's shifting of production processes to the near countries, closer to national boards. We can see nearshoring of American foreign productions from Asia to Mexico or Canada. For example, export of accessories from Mexico to the USA is 40 %, whereas export from China is 5 % [23]. The most widespread branches for reshoring and nearshoring are hi-tech manufacturing, production of transport and home equipment, medium technological productions. Mexico has been the most attractive region for automobile companies reshoring from Asia and Europe [24].

Analysis of production shifting in Europe shows that backshoring is common in hi-tech sectors [4].

Motivation of reshoring is connected with dramatic changes of production expenditures in various world countries. As a result of higher life standards in some Asian countries, first of all, in China, these countries have almost lost advantages connected with cheap labor force in the high and medium technological economic sectors. An average earnings per hour increases by 15-20% annually, whereas in the developed countries it grows only by 2% [28]. The countries that have advantages of cheap labor force don't have developed infrastructure, there are also some other factors that prevent from involving these countries into the global production processes. Besides development of digital economy and artificial intellect automates production and minimizes labor force use, these factors depreciate living labor as a competitive advantage.

The factor, stimulating reshoring, is common problems with quality of goods, produced abroad, and lower production flexibility, especially in hi-tech sectors. Expenditures on earnings play a minor role [5]. Possible reasons for reshoring are pour protection of intellectual property in some developing countries, it promotes development of possible competing productions in these countries.

However, these reshoring tendencies are not conclusive. We would like to emphasize that backshoring is possible only under economic expediency, if a production value together with additional investments in home country is not higher, even lower than in the countries, where the production already works.

Since productions return is connected with additional investments, industrialization, local labor force attraction, it requires serious overhauling of a postindustrial economic system. High taxes, especially in European countries, an insurance and other expenditures slow down reshoring. So, reshoring is possible only on the level of modern technologies, requiring minimal labour force in the sectors with a high added value – in high and medium technological economic sectors.

3. Discussion

So, development of international technological cooperation is conditioned by the following trends of international production:

- deeper international specialization in the high and medium technological economic sectors, a stronger "novelty monopoly" and more oncoming flows of production ties;
- fast involving of developing countries in the high and medium technological economic sectors;
- development of increment innovative- investment processes, based on technological investments of foreign business-partners and cooperation with them;

- development of value added global chains with a large number of participants from developing countries in high and medium technological economic sectors;
- transformation of global production systems, optimization of value added global chains;
- change of territorial division of labor, reshoring and nearshoring of productions;
- regional concentration of high and medium technological productions.

These tendencies form a new location of the world production, an architecture and motivation of technological cooperation in hi-tech and economic sectors. An analysis of technological cooperation development for Russia should be performed with account of the mentioned world tendencies and special features of the national economy.

Russian link in global production systems is rather weak, since labor force is rather expensive. Production ties of such a nature are fragmentary and connected with construction of assembly facilities, producing goods for local markets.

International production cooperation process, where Russia plays the role of an initiator of production ties, also is rather slow, since new products are regional, not global. It promotes production ties with regional business-partners mostly, so neither reshoring nor nearshoring is essential for Russia.

There are some high and medium technological economic sectors where Russia has serious competitive advantages – energetics, atomic power engineering, defense industry, missilery, aircraft engineering etc. These sectors have been developing under the conditions of a closed economy, they are based on a native development and production potential.

However, new "global" products make international cooperation successful. An example of such a cooperation is an aircraft Sukhoi Superjet 100 (SSJ-100), characterized by the best achievements of the world aircraft engineering - inhibitory systems, aviation electronics, wheel trains, electric systems, etc. – the producers of all these things were the world leaders in this sector. Russian scientific development and production center "Saturn" and French company "Snecma" created a joint venture to built an engine.

The cooperation among Russia, China and India is developing very fast, the countries have signed 50 inter-governmental agreements [1]. Initially the cooperation is connected with development of a wide-body aircraft and a civil advanced heavy helicopter (Chinese company "Avicopter" and Russian holding "Helicopters of Russia").

Russian-Indian ties are developing in the field of military aircraft engineering. Indian company "Hindustan Aeronautics Limited" (HAL) and Russian experimental design bureau named after Sukhoi are developing an attack jet of the 5th generation FGFA– an export version of a Russian fighter aircraft T-50.

4. Conclusions

Having analyzed the world trends of technological cooperation development, we came to the conclusions about these processes in Russia. "Global" products are rather rare for Russia, so regional productions development is long-range for the country, as the world trend of regional concentration of production shows, it can be in the hedges of regional innovative clusters.

Such clusters creation was being discussed at the Eurasian Economic Commission (EEC). It was decided to promote trans-border production clusters to make both "regional" and "global" goods (including new technologies as a kind of a product), to take on new market sectors, increasing competitive abilities of business conditions in the countries [19].

The advantages of the EEC will allow to use synergism of a sci-tech, resource and production potential for the technological progress, to form common institutes and infrastructure of innovative and technological development and to upgrade the economies. An integration potential unlocking with participants from the third countries can promote effective production ties in the hedges of a production life cycle.

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References

[1] N. Abdrahmanova, L. Gorodnikova. Nauka. Innovacii. Informacionnoe obshhestvo: 2015: kratkij statisticheskij sbornik [Science. Innovation. Information society: 2015: short statistical book], Moscow: NIU VSHE, 2015, pp. 80.
[2] S. Ahmed, M. Appendino, M. Ruta, Depreciations without Exports? Global value chains and the Exchange Rate Elasticity of Exports. World Bank Research, 2015, pp. 28.
[3] Central Intelligence Agency. The World Factbook (sector composition). Available online: https://www.cia.gov/library/publications/the-worldfactbook/fields/2012.html
[4] B. Dachs, C. Zanker. Backshoring of Production Activities in European Manufacturing, European Manufacturing Survey Bulletin, 3, 2014, pp. 1–8.
[5] K. De Backer, C. Menon, I. Desnoyers-James, L. Moussiegt. Reshoring: Myth or Reality? OECD Publishing, Paris, 2016, pp. 34.
[6] L. Ellram. Off-Shoring, Reshoring and the Manufacturing Location Decision, Journal of Supply Chain Management, 49, 2013, pp. 3–5.
[7] L. Fratocchi, C. Di Mauro. When Manufacturing Moves Back: Concepts and Questions, Journal of Purchasing & Supply Management, 20, 2014, pp. 54–59.
[8] X. Fu, W.T. Woo, J. How. Technological innovation policy in China: the lessons, and the necessary changes ahead, Springer Science+Business Media New York. 2016. DOI 10.1007/s10644-016-9186-x.
[9] G. Gereffi, K. Fernandez-Stark. Global Value Chain Analysis: A Primer. USA, North Carolina: Duke University, 2011, pp. 39.
[10] R. Holz. An Investigation into Off-Shoring in the German Automotive Industry. University of Whales, Swancea, 2009, pp. 352.
[11] INSEAD The Business School for the World. Available online: http://www.insead.edu/home
[12] F. Jansen. Jepoha innovacij [The Epoch of Innovations]. Moscow: INFRA-M, 2002, pp. 308.
[13] M. Kenney, D. Breznitz, M. Murphree. Coming back home after the sun rises: Returnee entrepreneurs and growth of high tech industries, Research Policy, 42(2), 2013, pp. 391–407. https://doi.org/10.1016/j.respol.2012.08.001
[14] S. Kinkel. Future and Impact of Backshoring – Some Conclusions from 15 Years of Research on German Practices, Journal Purchasing & Supply Management, 20, 2014, pp. 63–65.
[15] V.M. Matjushok, V.A. Krasavina. Novye trendy v mirovoj jekonomike (chast' 1) [New trends in the global economy (part 1)]. Finansy. Jekonomika. Strategija. = Finance. Economy. Strategy, 10, 2016, pp. 5–11.
[16] Yu.A. Nazarova, N.Yu. Sopilko, A.F. Orlova, R.Sh. Bolotova, G.V. Gavlovskaya. Evaluation of Development Prospects of Renewable Energy Source for Russia. International Journal of Energy Economics and Policy, 7(3), 2017, pp. 1–6.
[17] OECD Interconnected Economies: Benefitting from Global Value Chains, OECD Publishing, Paris, 2013, pp. 54.
[18] Organisation for EconomicCo-operation and Development. Available online: https://data.oecd.org/
[19] Osnovnye napravleniya ekonomicheskogo razvitiya EAES do 2030 goda [The main directions of economic development of the EAEC by 2030]. Evraziiskaya ekonomicheskaya komissiya = The Eurasian economic Commission. Moscow, 2015, pp. 69.

[20] L.V. Pankova, S.Ju. Kazennov. Prioritety zarubezhnyh NIOKR dvojnogo naznachenija [Priorities for foreign R & D dual-use], Moscow: IMEMO RAN, 2016, pp. 236.
[21] E.A. Pozdnjakova. Neoindustrializacija kak novyj jetap jekonomicheskogo razvitija [Non-industrialization as a new stage of economic development], Zhurnal jekonomicheskoj teorii = Journal of Economic Theory, 1, 2013, pp. 45–60.
[22] D. Puga, D. Trefler. Wake up and Smell the Ginseng: The Rise of Incremental Innovation in Low-Wage Countries, NBER Working Paper, 11571, 2005. Available online: http://www.nber.org/papers/w11571.
[23] Reshoring initiative. Data Report. 2016. Available online: http://www.reshorenow.org/blog/reshoring-initiative-2016-data-report-the-tide-has-turned/.
[24] Reshoring Mexico 2014. CIDAC, Mexico, 2014. Available online: reshoretomexi-co.org/csv/ReshoringMexico2014MexicosReshoringAttractionIndex.pdf
[25] N.Yu. Sopilko, A.A. Kurashova, I.I. Shatalova, T.V. Bogacheva, G.M. Kutlyeva. Modeling the development of trade ties of Russia within the framework of regional integration based on the theory of gravity. Espacios, 38, 2017, pp. 22–34.
[26] A.O. Ul'janov. Osnovnye aspekty innovacionnogo razvitija transnacional'nyh korporacij Kitaja [Main aspects of innovative development of transnational corporations in China] Baykal research journal, 2, 2015, pp. 19–25.
[27] United Nations Conference on Trade and Development. Available online: http://unctad.org/en/Pages/Home.aspx
[28] World Economic Forum 2012. The Future of Manufacturing, Opportunities to Drive Economic Growth, Geneva, 2012, pp. 84.