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# INTERNATIONAL TECHNOLOGY TRANSFER IMPACT ON DEVELOPING COUNTRIES: THE CASE OF RUSSIA AND CHINA

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The main aim of the article is further development of the idea of the key role of international technology transfer in developing countries' policy. This article argues that it is the transferring of knowledge that prompted technological development, which in turn is the basis of overall development.

**Keywords:** Knowledge transfer, Patent, Innovative development.

## Introduction

Technology has become a key factor in maintaining competitiveness in the modern global economy. Socioeconomic development of countries, their economic and political position in the world arena and the welfare of the population are determined largely by the competitiveness of their national economies and the participation in foreign exchange. On the one hand, developed countries go to an increasing separation from the developing world through technological excellence own farms and effective national innovation systems, on the other hand, developing countries are deprived of the possibility of reduction of this gap through the intensification import of technologies that are critical to their development. Formation in the most developed countries of the post-industrial society, with its inherent types of farm characteristics, even more restrict the ability of developing countries to reduce the gap in socio-economic development. In this regard, the importance of international technology transfer (ITT) for economic development is difficult to overestimate. Leaders in innovation development are developed countries with openness to collaboration and sharing knowledge. Many of the "catching up" countries tend to quickly make up for a lack of innovative capacity through implementation of effective scientific policy, often on the basis of derived practical experience from abroad. Developing countries could follow that practice, however, main obstacles for successful technology transfer are lying in domestic environment. Thus, this article focuses more on knowledge transfer as part of ITT.

It is important to underline the fact that despite quite a great number of studies holistic approach to the problem has not been developed yet. ITT as part of national innovation policy is practically not reflected in academic literature. Still there are several studies, which touch upon the problem of ITT in one way or another. Acharya & Keller (2007), Hoekman & Javorcik (2006), Maskus & Saggi (2004) are known to be the authors of such works.

## ITT as a Part of State Technology Policy

Many countries have historically engaged in protectionism nascent industries in more or less latent form. Simultaneously, much evidence suggests that an open trade regime facilitates the dissemination of

knowledge (Saagi, 2002). The company should have access to imported equipment, which embody the foreign knowledge. Nevertheless, in the case of open markets freedom extends to any products, thus increasing the competition between the imported and interior products. At the same time, given that the technology markets are associated with enhanced, imperfect competition and externalities, any arguments against the policy of protectionism are subject to debate.

Technology acquisition as well as its diffusion enhances productivity growth. However, as a rule, innovations are generated in OECD countries while most developing countries rely mainly on imported technologies as sources of new productive knowledge. Nevertheless, significant amounts of cost to create innovation is observed in the latter countries that stimulates technological change (Evenson and Westphal, 1995). In this regard, developing countries implement national policies and international agreements to stimulate ITT. National policy includes the economic programs of wide purpose (e.g. education) and financial mechanisms, such as funding the creation and acquisition of technology, tax incentives for the purchase of capital equipment and intellectual property, thereby creating conditions for the introduction of technological changes (Kiseleva and Kolosnitsina, 2008).

One of the most significant parts of technology policy is licensing and policy of foreign direct investment (FDI). Historically, the limits of trade policy is often supplemented by restrictions on FDI. Thus, Japan, Korea, Taiwan (China) all imposed restrictions on FDI in different moments of time. However, policy is often leans toward the other modes, including trade policies that affect machines and equipment and licensing of foreign technology. In practice, many countries are actively attract foreign investors through advances, subsidies, tax benefits and other transfers (Hoekman, Maskus and Saggi, 2004).

The predominance of conduct "follow the leader" among Transnational corporations (TNCs) provides another potential option to promote FDI. Given the oligopolistic nature of the markets within which FDI occurs, a new participant can attract investments from competitors or suppliers. If so, competition for several stages of production may increase, thereby increasing the efficiency and total production and employment. Often this means that the host country is able to consistently attract FDI from one or two large firms.

Other important element to be considered is Intellectual property rights (IPRs). IPRs can support the markets of technologies, including the international transfer of technology (Arora et al., 2001). Patents and trade secrets provide a legal framework identify patentable technologies for subsidies and licensing, promoting the establishment of licensing contracts. Protection of patents increases flows ITT in the country with the technological capacity, as well as shifts the incentives of investors from FDI to licensing (Correa, 2003).

The General trend is that poor countries are unlikely to benefit from strong IPRs (McCalman, 2001). Strong patent right may be expected to significantly enhancing the gains earned by international firms as IPR becomes more valuable, obliging developing countries to pay more on average for internal flows of protected technology. This means that in poor countries, policies should be aimed at reducing the cost of imports on intellectual goods and technologies, and to increase the capacity to absorb and adapt technologies.

Subsidies is also a vital element of technological policy. A significant proportion of the benefits of research and development (R&D) may concentrate within the limited space and the company that leads to the emergence of clusters of innovative activity, often around academic research centers (Audretsch and Feldman, 1994). This may cause the R&D associated with the subsidies and support of fundamental research and training to expand the potential application of funds in the country. Many studies indicate that the absorptive capacity in the host country is crucial for obtaining significant external impact of trade and FDI. Without adequate human capital and R&D investments, a chain reaction may simply be impossible. This leads to the conclusion that trade liberalization and open FDI policy should be complemented by policies in the field of education, R & D and human capital accumulation for countries to take full advantage of ITT.

In this context, training subsidies assume great importance, incentives for the purchase of technology. For example, Amsden (1989) argues that political intervention, including explicit and implicit

subsidies, underlie the economic "miracle" in Korea and Taiwan (China). The matter is that targeted subsidies have enabled governments to promote the key sectors, which became effective in its own sphere and gave positive results. It is important to differentiate sectoral subsidies and General policy to promote the training and development of the enterprise. In a recent retrospective of the experience of the East Asian development, analyzed in the work of Noland and Pack (2003) shows that the sectoral policy itself has not led to high growth rates of the overall performance of the enterprises. The overall orientation of the state policy consists in the selection of priority sectors and state support, including innovation, education, transport infrastructure and other similar public goods. The same is true for policies aimed at promoting socially useful activities.

For the effective use of the policy of «support», it is necessary that the government correctly defined the cases that justify intervention and ensure the implementation of measures accordingly. Among the potential problems can be identified: some subsidies can maintain inefficient projects; that firms can manipulate to win subsidies; and that subsidies can lead to corruption, poor corporate governance and rent-seeking behavior.

Irrespective of the channel, a decisive criterion of TT is whether it promotes further innovative development in the country-recipient. 'Technological distance' plays a curtail role in the efficiency of absorbing purchased technology. In other words the greater this distance, the more difficult to implement it into production. Countries with local R&D programs, own private and public research laboratories, sound base of technical skills and human resources create the prerequisites for more rapid international technology acquire (Evstigneeva and Kiseleva, 2015).

**The Case of Russia and China**

The first thing to be consider is the nature of scientific knowledge since it so different in Chinese culture. A classic work of Chinese way of thinking policies of the late XIX century Zhang Chidon wrote that "the Chinese seek to explore the essence of things, while Western civilization is subordinate to the idea of the practical application of knowledge". Despite strong cultural specifics, Chinese innovation business loyalty to the established system of values is often combined successfully with Western management practices. Saxenian (Saxenian, 2002) notes that the combination of elements of different cultures enables Chinese companies to establish an effective chain of businesses, which leads to the formation of international clusters linking Silicon valley and Hsinchu and Shanghai. Even in the end of XX centures, political leaders of People Republic of China had realised the fact that the process of technology transfer is not always followed by transfer of "know-how". For example, in the late 1980s many scientific laboratories were equipped with contemporary tooling, however, much of that equipment were standing unused (SSTC, 1996). For that reason, PRC's policy was focused on ITT very closely. Government controlled that process and executed a policy that encouraged assimilation of soft technology and learning the details. That policy restriction was aimed at maintaining the situation when Chinese industries would be able to produce innovation themselves.

Another important feature of China's economic and social and political system is preserving the leading role of personal relationships and acquaintances (so-called "guanxi" 关系) in business practices and scientific and professional career. In the modern scientific and innovative system of China are both endogenous and introduced elements exists. Many traditional principles and values continue to influence the formation of scientific knowledge and the educational system. However, changes of the last two centuries has led to massive borrowing practices of management in scientific activities abroad: as from Western Europe and the United States. As Li, Gao and Wu (Li, Gao, Wu 2006) noted, the modern innovative business China prefers to combine traditional values Confucian culture with modern Western management practices by enterprises.

Over the past 20 years the infrastructure contributing to the development of innovative business and increase of scientific power of the country by increasing the speed of knowledge transfer and information exchange was created. In an effort to incentive domestic technological innovation and to diffuse applied

technologies across government, industry, scientific, and academic communities, China has established numerous National Engineering Research Centers (NERCs) across the country. These centers play a key role in China's strategy to reform its science and technology research system. The highly regarded Chinese Academy of Sciences (CAS) has also established over 500 commercial enterprises in the high-tech sector as part of a government program to develop "technical enterprises" as subsidiaries of existing research institutes.

China has no shortage of well-trained scientists, engineers, mathematicians, or other technical experts in contrast to Russia (fig. 1). Chinese scholars educated abroad over the last decade reportedly make up more than half of the top scientific researchers now working on key research projects and receiving priority in conducting this research. Development of scientific community of China also supported due to the return of scientists and specialists educated abroad (mainly in the USA).

In 2010-2011, approximately 620,000 Chinese students have left to study abroad, which amounted to more than a quarter of the total number of Chinese who moved to study abroad since 1978. Scholarship Council of China provides support to the Chinese students and scholars seeking to work with the best foreign research groups, while Thousands of talents" provides unprecedented financial support to scientists returning from work in the developed countries. It provides not only a high salary, but the latest scientific equipment and payment for work of laboratory assistants to research of the world level. As a result, it attracts a growing number of Chinese graduates of foreign universities who now prefer to go back to China and not to pursue a career in other countries (Table. 1). The main partner who stimulated modernization in China is unsurprisingly The USA.

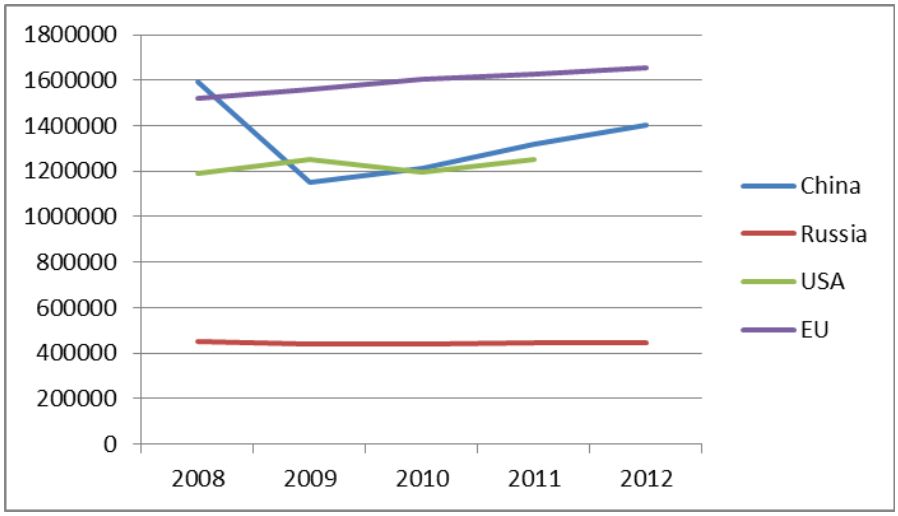


**Figure 1.** Total number of researchers in full-time equivalent
*Source:* OECD, Main Science and Technology Indicators, Volume 2013 Issue 2

**Table 1.** The number of Chinese students studying abroad and returned to China

| Year | studing abroad | The number of students returned to China | Share of returned students in all students studying abroad |
|---|---|---|---|
| 1997 | 22410 | 7130 | 31,82 |
| 1998 | 17622 | 7379 | 41,87 |
| 1999 | 23749 | 7748 | 32,62 |
| 2000 | 38989 | 9121 | 23,39 |
| 2001 | 83973 | 12243 | 14,58 |

| | | | |
|---|---|---|---|
| 2002 | 125179 | 17945 | 14,34 |
| 2003 | 117307 | 20152 | 17,18 |
| 2004 | 114682 | 24726 | 21,56 |
| 2005 | 118515 | 34987 | 29,52 |
| 2006 | 134000 | 42000 | 31,34 |
| 2007 | 144000 | 44000 | 30,56 |
| 2008 | 179800 | 69300 | 38,54 |
| 2009 | 229300 | 108300 | 47,23 |

*Source:* Own calculation based on Statistical Yearbook of China

Meanwhile, the scientists, who returned to China, continue to maintain close ties with foreign partners that provides seamless integration of the country into the world science and facilitating technological development (Jonkers and Tijssen, 2008). Some researchers point to the important role of these scientists in the development of innovative business. For example, students returning from abroad, founded more than 2,100 companies in the technology Park Zhong - guangchun (Cao, 2004).

Patent activity plays a major role in assessing the level of country's innovation development. In the light of ITT channels and transferring knowledge, it is important to analyse the share of foreign patent holders. As far as Russia is concerned, it remained virtually stable from 1995 to 2002. Then it significantly rises and reaches a peak of 34% in 2006, followed by sharp decrease to the level of 1992 year. This could be explained by consequences of global crisis. Another crucial element is how patents implements (fig. 2, 3). Contrary to the commercialized patent, the number of used inventions is moderately surge (fig. 4). That might be explained by the improvement of patent legislation. In 1992 it was launched on the preparation of special legislative acts on the regulation of copyright relations. The first was the Law of the RF "On legal protection of computer programs and databases" of September 23, 1992, entered into force the Law of the Russian Federation "On copyright and allied rights" of July 9, 1993. In 2006, the Patent law of the Russian Federation has lost its action and instead entered into force 4th part of the Civil code of the Russian Federation. This Chapter of the Code is devoted to the rights for inventions, utility models and industrial designs.

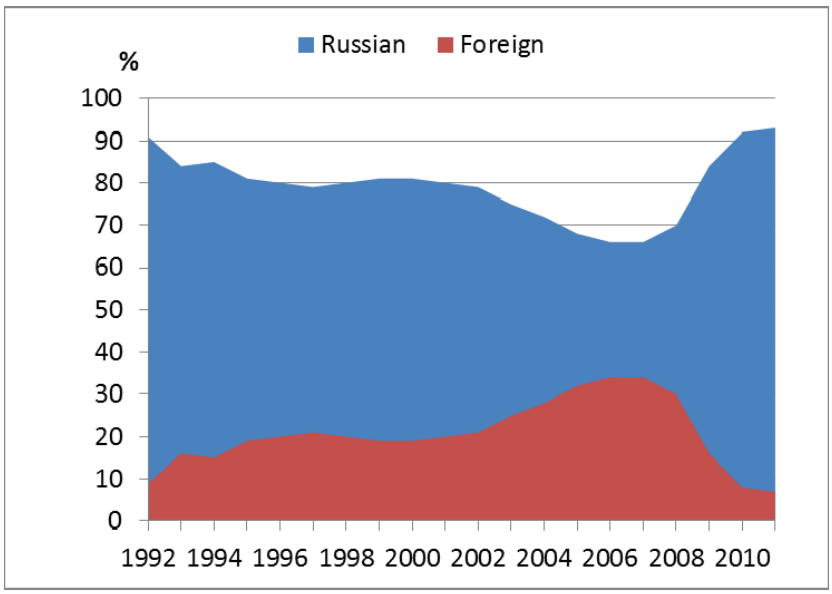


**Figure 2.** The share of Russian and foreign patent owners in the Russian patent Fund
*Source:* Russian Federal Statistics Service

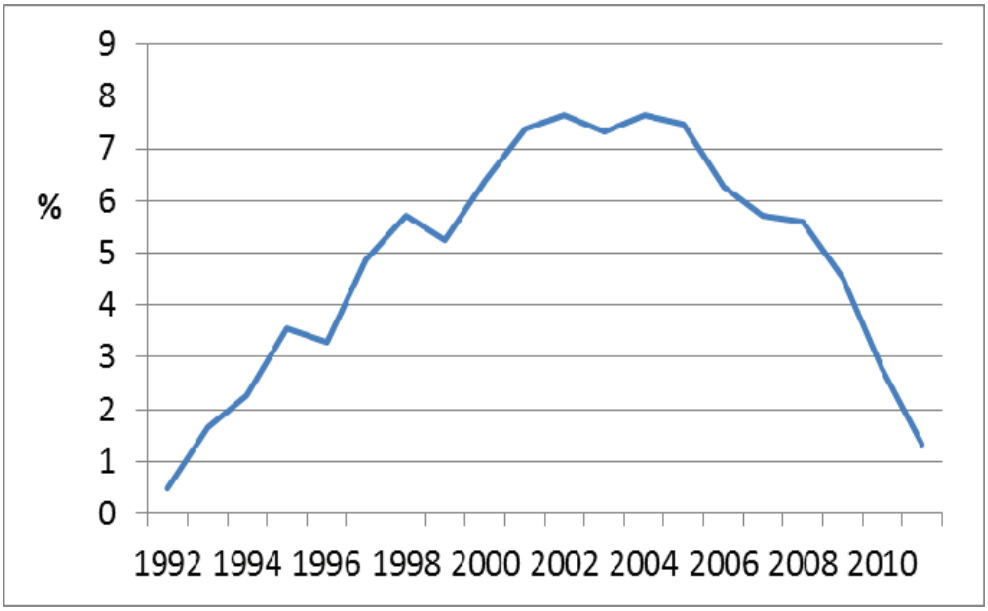


**Figure 3.** The share of commercialized patent in Russia
*Source:* Russian Federal Statistics Service

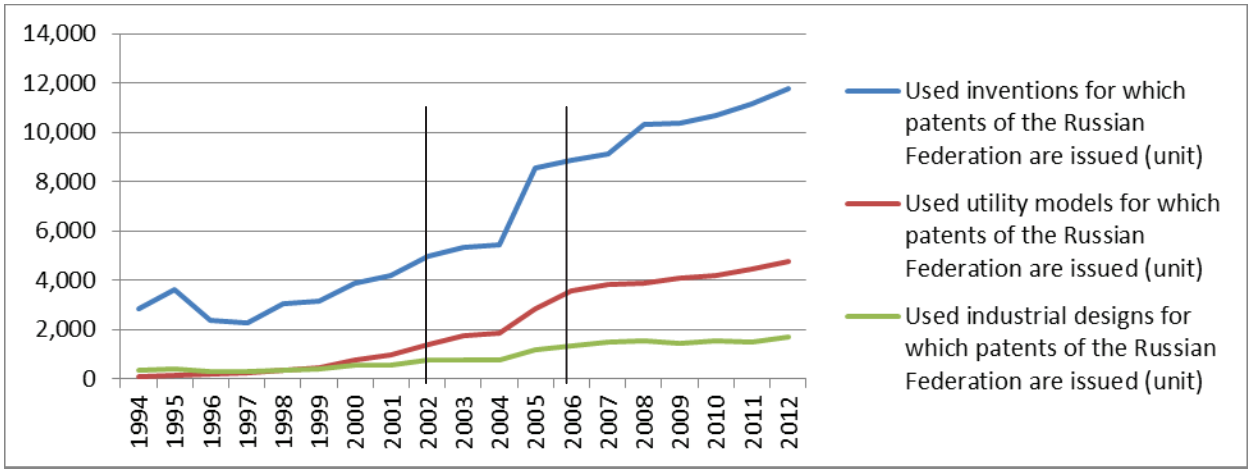


**Figure 4.** The number of used inventions
*Source:* Russian Federal Statistics Service

The number of patent applications filed residents of China increased from 25346 in 2000 to 229096 in 2009 (fig. 5). At the same time some modern scholars suggest that, despite rapid growth in the number of patent applications from China, their quality remains relatively low (Shapira and Wang, 2010). However, a detailed study of Kroll (Kroll, 2011) refutes this criticism: patent activity of the Chinese applicants meet the patenting trends in more developed countries, despite the availability of features connected with the great role of the state and policy in determining the main directions of patent activity. Kroll concludes that data on patent activity of Chinese researchers should be acceptable as one of the indicators of international competitiveness and development of the market of the country, and "although the Chinese system of protection of intellectual property rights may still not functioning at a sufficient level, it is already largely reflects the main features of the national innovation system" (Kroll, 2011).

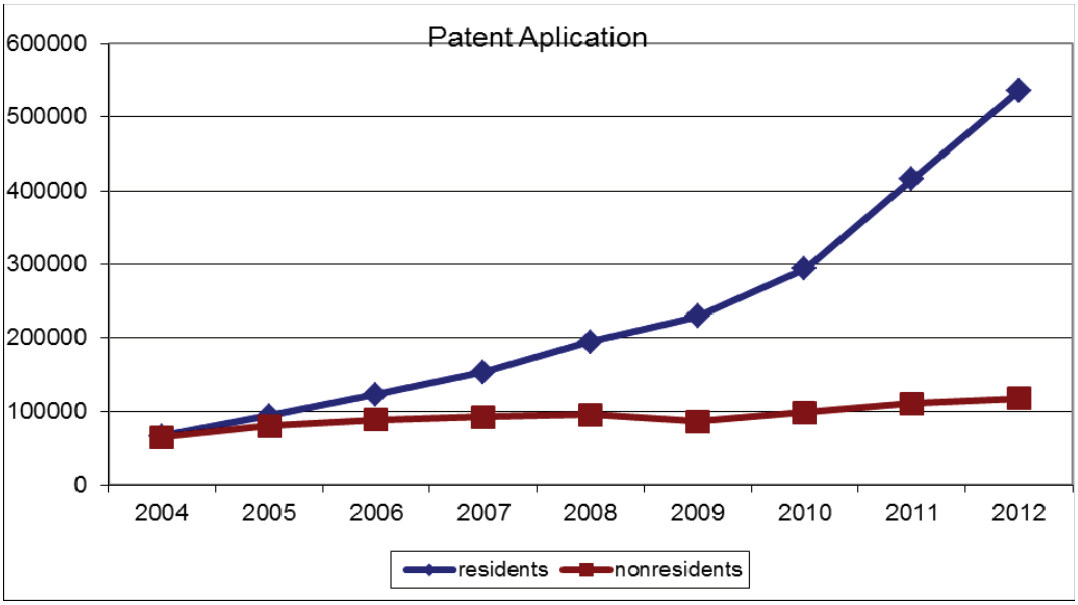


**Figure 5.** Number of residents and nonresidents applied patent, China
*Source:* World bank database

One of the most important features of Chinese foreign trade is a change from import to export of technologies (fig. 6, 7), allowing to develop such progressive sectors as production of software, telecommunications equipment, new materials, biotechnologies. It gives the possibility of China on the basis of the reconstructed enterprises to establish their own production of modern products and ultimately to reach a higher level of technical development. However, the most important role in export growth has played a company with foreign participation.

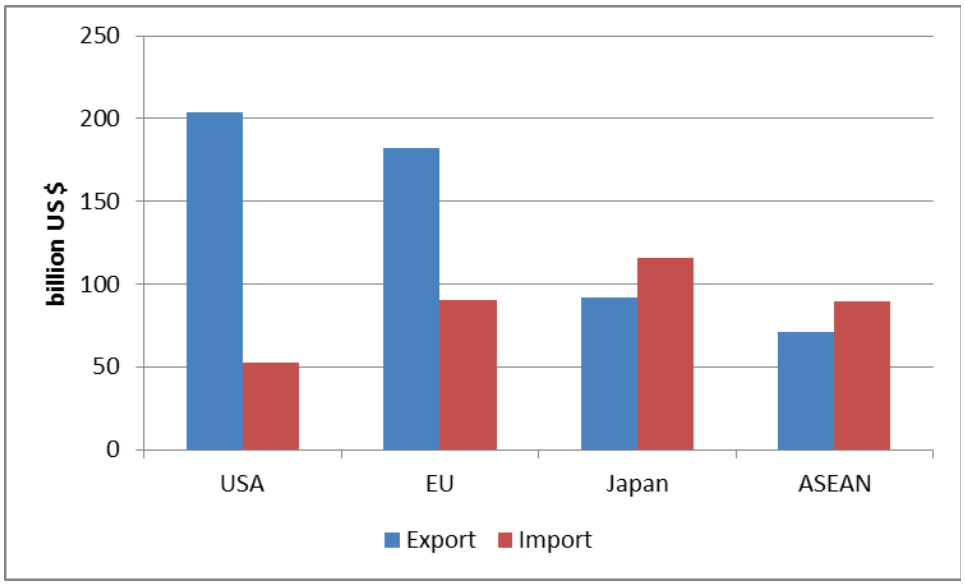


**Figure 6.** Chinese exports and imports of technology structure, 2006
*Source:* World Bank data base

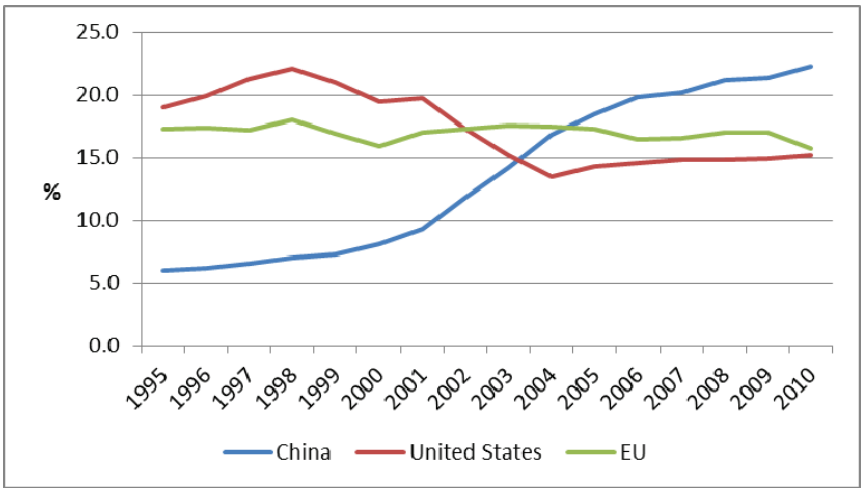


**Figure 7.** Global share of high-technology goods export
*Source:* IHS Global Insight, World Trade Service database (2011).

As a result of the policy China's government executed PRC has a relatively large science and technology system, with great share of state subsides (similar to Russia in this part), which distributed very reasonable. In spite this and regarding China as a success case, there is bias consequences in transferring technology. The motorcar construction seems to achieve desirable ends, but Chinese such industry itself does not; whereas aerospace industry could be taken as a good example for both directions. Considering overall results, China shows far better situation than Russia. The key factor that is accounted for such result is the combination of PRC's legislation and policy of transferring tacit knowledge.

As for Russia, the choice of channels of technology transfer is closely linked to the potential transfer of tacit knowledge, so the acquisition of new technologies abroad depends on their readiness to receive and perceive implicit knowledge associated with their use. This is confirmed also by the fact that the post-Soviet countries are buying technology in Russia, and Russia in the countries, the traditional partners (Germany, France). Analysis of the balance of technology payments by categories of agreements in Russia shows that all categories except for scientific research and development are negative. This can be explained by intensive adaptation of the foreign scientific and technical achievements. Analyzing the structure of export revenues, one can conclude that, the re-orientation of Russia to the markets of developing countries is the main direction (fig. 8). In structure of export of technologies leads Bulgaria, its share is almost one-fifth, followed by the USA and the Netherlands. Germany is one of the fairly major partners, both exports and imports. Slightly larger share in the structure of imports belongs to the United States and the Netherlands. In general, the positive balance in the trade in technologies is achieved with the countries of the CIS, and with the majority of OECD countries this indicator is negative.

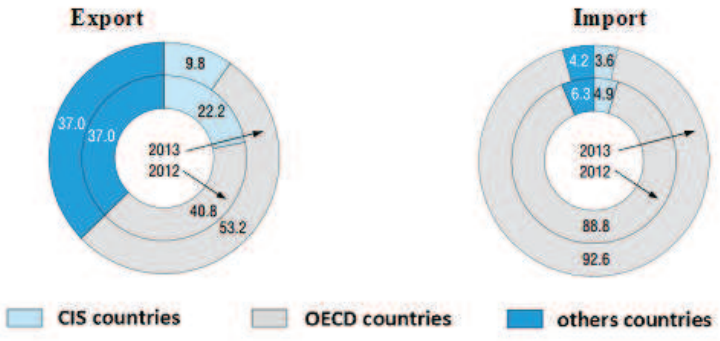


**Figure 8.** Structure of technology export and import in Russia
*Source:* Science Indicators, 2015

Traditionally the high level of research in Russia corresponds to the industries interest in which of the science world is reducing. Russian scientific journals with impact factor greater than 1 are devoted primarily to physical, chemical and mathematical Sciences. Third, high demand for Russian science is limited by a number of factors, due to traditions, organization, and institutional features of Russian science. However, according to Russian Federal Statistics Service, the only type of agreement by which the balance of foreign trade technology payments has a positive balance is scientific R&D. Thus, it still can be argued that the demand for Russian science is maintained at a high level (Kiseleva and Evstigneeva, 2015).

Unfortunately, statistical data reflecting the payments receipts for ITT in Russia is only being formed. In particular, in 2010 193 agreements were concluded on the import of technologies that exceeded the number of export contracts on 19%. Meanwhile the total payments for import amounted to 138 mln. dollars and exceeded the volume of technologies export more than four times. The only case on which export surpassed import was research and development. Transactions related to industrial property, occupied only 2.3% in exports and 14.4 % in import. The major share both in import (75%) and in export (48%) of technologies were found only in a case of transactions for the provision of engineering services, engineering-consulting services on preparation, production and realization of products, on construction and operation of industrial, infrastructural and other objects (Kohno, 2013).

Thus, in technological innovation system, corresponding to the economy of the Russian Federation, in general, there has been a shift towards process innovation, which testifies to the low efficiency of the economy in creating new products, production of different levels technologies differ in the structure of process and product innovation. It is important, that with reduction of the technological level, a growing number of organizations with both types of innovation. Assuming that you create in high-tech industries technology (such as ICT) are a source of innovation for the other activities, it is hoped that there is a tendency to increase the level of innovativeness of the whole economic system. If high-tech production work mainly on themselves, as can be assumed, for example, for the industries working for the defense, the tendency to reduce the level of innovation activity, observed in the last decades, will become sustainable in the long run (Fonotov, 2013) The impact of foreign experience on the technological upgrading of the industry is not enough, because the import of technologies is carried out only in 37 % of the total number of deals on international technology transfer.

## Conclusion

Technology has become a key factor in maintaining competitiveness in the modern global economy. Furthermore with the emergence of new actors (like China, to some extent Russia), international trade in technology is a major instrument for innovation and knowledge globalization. Several ways are existed to transfer technology, in this research, attention was paid only for such channels, which touches upon the aspect of knowledge. This article argued that it is transferring knowledge that prompted technological development, which in turn lies in the basis of overall development.

It is widely acknowledge that the ways of addressing the problems in developing countries are significantly differ from those in the developed world because of economic, social and political reasons. Bearing that in mind the fact that China having plenty similarities with Russia and it is considered to be "success story" in considering sphere, PRC was taken for comparison. Likewise, both country view high technology as the vital element driving its modern economic and industrial development. The key conclusion from that analysis constitutes in the fact that China having realised this problem much earlier was able to build relevant policy to tackle the lag in technological development. China creates such environment that allow to attract qualified specialists and scientists with education and work experience from abroad, including their citizens having received foreign education.

Russian policy for technology transfer have to be carefully introduced into overall national plan since considering problem cannot be regarded separately. This research indicates that Russian potential for more effective transferring policy is very high, especially in R&D sphere. However, it requires

restructing so that increase the number of grants to specified study instead of research universities. At the same time, despite the China's superiority mutual interaction could bring benefits for both parties. That could be especially advantageous in spheres of higher education system and the transformation of universities in scientific and educational research centers, where both countries have already achieved success.

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