

The capacity of absorption of the international technology transfer, its limits and the analysis of the possibilities of production of knowledge in developing countries: The case of Republic of Moldova

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This article is based indirectly on the analysis of the interdependencies between economic development of world states and the technological potential. In this article we set the objective to analyse the interdependence between the capacity of production and generation of modern technologies and the absorption capacity. The appreciation of the possibilities of developing countries to create and disseminate technologies, in which form of organization and financing could that, be done. Determining the obstacles that limit the degree of absorption of technologies, and which are the measures that could open new possibilities in the international technology transfer.

Keywords: Technology transfer, capacity of absorption, knowledge, patents, alliances, intellectual property, intellectual property rights, degree of absorption

Introduction

In recent publications in the sphere of International Technology Transfer frequently are approached the discrepancies between developed and developing countries in this sphere. The innovative performances and the economic growth depend on the superior levels of technological development that some countries have accumulated over time, and that generate a virtuous circle. Together with production and export specialization phenomena are deepened the initial advantages in comparison with states with low technological performances. The main possibility by which the latter can recover the technological discrepancies, that is the most frequently used represents the transfer of technologies from developed countries.

Statistical data show us that the inequalities between countries stand at considerable levels. These differences can be explained in the majority of cases only by the discrepancies regarding the intensity of technological research and development activities, cumulated with barriers in the way of spreading and implementation of new technologies at the world level. The research and development activities are concentrated in a reduced number of states. It is appreciated that the G7 countries (USA, Canada, Germany, Great Britain, France and Italy) hold around 90% of these activities.

Although it was proved that the commercial openness accelerates the spread of technological knowledge, the positive externalities generated by the increase of the stocks of national knowledge are limited by the borders of the country of origin, this hypothesis being assumed by the new theories of endogenous economic growth.

The stock of knowledge can be increased by the investments in technological research and development (TRD), or by the dissemination of existing knowledge in other states. The innovations generated by the own activities of research and “knowledge drain” coming from other economies are as important for the increase of the productivity of firms and the convergence of the levels of development of the world countries. For developing countries, the majority of technological knowledge (80-90%) from the economy comes from external sources. Due to this reason, the technology transfer from developed countries is vital for keeping the pace or for reducing the discrepancies regarding the level of development.

The statistics proves us that the technologies’ flows between developed countries have a much higher level in comparison with the transfer from developed countries towards countries with low or medium level of development. Due to the fact that the majority of innovations are made by the group of industrialized countries, the permanent transfer mainly between them will perpetuate and amplify their supremacy in high-tech industries. This explains to a great extent the divergent trend of the development of the two groups of countries. In this article in first part I showed the interdependence between the absorption capacity and the production of knowledge, the key elements in the chain of transfer of technologies. In the second part is described the capacity of technologies absorption, its limits. The third part analyses the possibility of generation of knowledge by developing countries, its forms.

1. Forms and mechanisms of international technology transfer

In order to understand at which stage in the chain of technological transfer there appear more problems, we tried to describe the component elements of a technological transfer.

1. technological modules, that consist of in central technologies (that are indispensable to a production process, the use of a good or a service) and peripheric technologies (secondary);
2. the permission to use, for fixed payments or a percent of revenues, different technologies or tangible or intangible assets (licenses, franchises etc.);
3. incorporated technologies that can take the form of capital goods, intermediary or final goods;
4. knowledge (non-incorporated technologies) consisting of written documents, projects, schemes, personal communications etc.

The means by which the transfer of these elements is made is divided in their turn in direct and indirect.

The direct technological transfer implies either the creation of technological capacities through foreign direct investments made by multinational companies, either by the acquiring by local firms of new technologies by buying and by different contractual agreements as the ones of licensing, technical and managerial assistance, cooperation between local and foreign firms, professional training courses and other.

Another category is represented by the indirect technological transfer, by the use in the production process of some intermediary goods of high technology (capital goods, material, semi-finished etc.) made outside the respective country. The use of these means, implicitly, the use of foreign technological knowledge incorporated in those, that is profitable to the extent to which the price of the imported goods is lower than the opportunity cost - that includes the production cost and the research and development expenses.

Regardless of the direct or indirect way in which they are transferred, the necessary knowledge to realize the new technologies can be in the majority of cases stocked in electronic format, multiplied to a marginal cost almost zero and transferred anywhere in the world, due to the modern communication systems. Also, non-rivalry in consumption makes them theoretically endless.

2. The capacity of absorption, its limits

The economic growth requires not only the development of new technologies by innovation, but also their distribution and efficient use in the economy. Also, for the firms from developing countries is extremely important the capacity to absorb and use the knowledge provided by external sources. The simple existence of technological externalities generated by the stocks of knowledge of other states isn't enough, it is required that the destination-country possesses the ability to absorb and implement the new technologies in the national economy.

This ability is called the absorption capacity, consisting mainly of human capital and technological capacities capable of integrating the new technologies that will allow in their turn a more efficient use of the resources and implicitly, a higher rhythm of economic growth.

The absorption capacity itself doesn't have a direct influence on the productivity. It helps just to the efficient assimilation and exploitation of the knowledge flows incorporated in intermediary and capital goods, foreign direct investments and others described earlier.

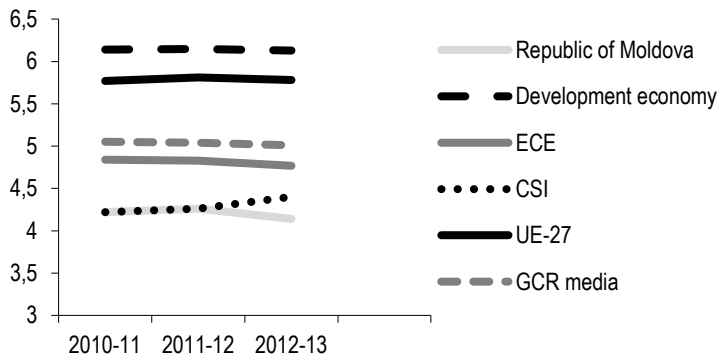
There are significant differences between countries regarding the degree of success in adopting foreign technologies. As a result appeared the question: which are the main determinants of successful assimilation of new technologies?

The acquiring of knowledge is made firstly by the contribution of firms that hold (must hold) the majority of research and development activity, contributing at the same time to the increase of the degree of qualification of employees. These led further to the obtaining of superior technological capacities, respectively, to the accumulation of human capital that in its turn, facilitates the absorption of new technologies in the production process. The lack of technological capacities and the human capital reduce considerably the possibilities of assimilation of knowledge generated by external sources from two reasons. In the first place, a major part of knowledge has a tacit character, specific to the firms that generated them. This component cannot be de-codified in the absence of the two mentioned elements. In the second place, the absorption of knowledge that comes from external sources by different ways requires a minimum level of the national stock of knowledge.

If we analyze the case of Republic of Moldova regarding the availability of latest technologies, then as we see in the Figure nr. 1, the performance by groups of countries is very different. The average world score is pretty high. In the top, much higher than the world average, of course are the developed countries, where companies have wide access to the newest technologies. In the European Union, analyzed as a single group, the level of the index is lower, being influenced to a great extent by the "performance" of the new members of the EU. The score of the countries from the Central and Eastern Europe is under the world average, but well in advance of the scores of the ex soviet countries. The data show that at the world level prevails the same trend and, mainly, of stagnation or weak decrease of the obtained score. Nevertheless, the CIS countries register in the last period a pretty evident positive trend. Although, Republic of Moldova is a part of this structure and until 2011 the obtained score was the same with the performance of the whole group, in the next period the situation changed. Besides the fact that the position of Republic of Moldova is far below the world average, registering currently the 118 position, the results of the analysis show that the access of the companies to new technologies is decreasing, that constitutes a negative factor for the economic development of the country.

The differences between countries regarding the technological level are still at high levels due to the fact that there exist at least 3 main elements that limit the uniform distribution of knowledge at the world level: 1) the disagreement of inventors, that is stated by the enforcement of intellectual property rights; 2) the tacit character, non-coding of an important part of knowledge; 3) the incapacity of some states to absorb, to assimilate the new technologies into the economy.

FIGURE 1. THE AVAILABILITY OF LATEST TECHNOLOGIES



Source: Elaborated on the basis of World Economic Forum data.

Also, the transactions with advanced technologies on the international market are relatively limited by some imperfections of the mechanisms of the market, due to incomplete internalization of the benefits and the impossibility to keep the exclusivity on the property and use of innovations.

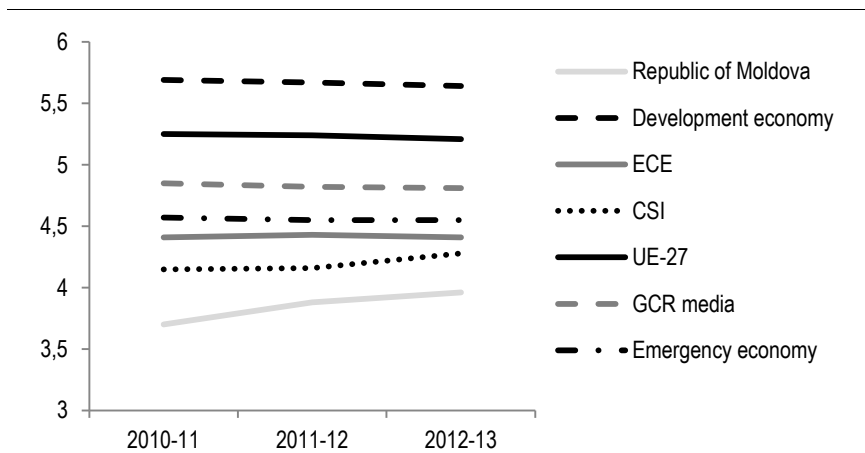
The opinions regarding the way in which can be corrected the fails of the market are different in developed and developing countries. The ones from the first category that as a rule represent the suppliers of technology, are interested in the reduction of costs of transaction and the maintenance of the monopoly on the knowledge obtained by research and development. It is obvious that the inventor would not allow the spread of his achievements, and would spend additional resources in order to keep the exclusivity of the benefits brought by new knowledge that he holds. In this respect, obtaining the intellectual property rights (IPR) is the most efficient way, although it doesn't completely prevent the spread of knowledge, but rather the use and commercialization of products it incorporates.

Developed countries argue that the efficient protection of IPR will increase the confidence of multinational companies to transfer the technologies in developing countries, thus helping them to increase their level of development. The last are interested in obtaining technological knowledge with lower costs, from here being derived their reluctance towards the restrictions imposed by DC and the critics brought to WTO agreements in the Uruguay round. The lack of legal protection of Intellectual Property Rights can constitute an advantage for this group of states, because it allows them to transfer technologies by other means than the formal one, the market.

Finally, one of the most important aspects that limit the technology transfer represents the reduced efficiency of Developing countries of absorbing the technological knowledge. The increase of productivity of developing countries depends to a great extent on the ability to take and adjust to own economy the knowledge developed by other states. A reduced level of absorption capacity is generally associated with the non-availability of human capital and technological capacity that have a decisive role in the integration of new technologies. That is why, if in the case of the first two types of obstacles the developing countries can't do anything to remove them, regarding the absorption capacity, the role of governmental policies is very important because both mentioned elements that determine it are a result of investments in education, research and technological development.

Although, regarding the latest technologies availability Republic of Moldova is declining, still it is registering an increase of the absorption capacity at the company level, registering an increase together with CIS. It is registered an increase of the technological absorption at the company level (figure 2). From the graph below it can be seen that for the analysed period, the score obtained by all the groups of countries, except teh CIS was relatively stable. The position of the developed countries as a whole and of EU in particular is far above the world average. The active implication of the emerging economies in the catching-up process determined a better performance of this group in comparison with the CEE countries. At the CIS level can be observed an increase of the enterprises' capacity to value the new technologies. The results registered by the Republic of Moldova are modest, but have a positive trend (place 133).

FIGURE 2. TECHNOLOGICAL ABSORPTION AT THE COMPANY LEVEL

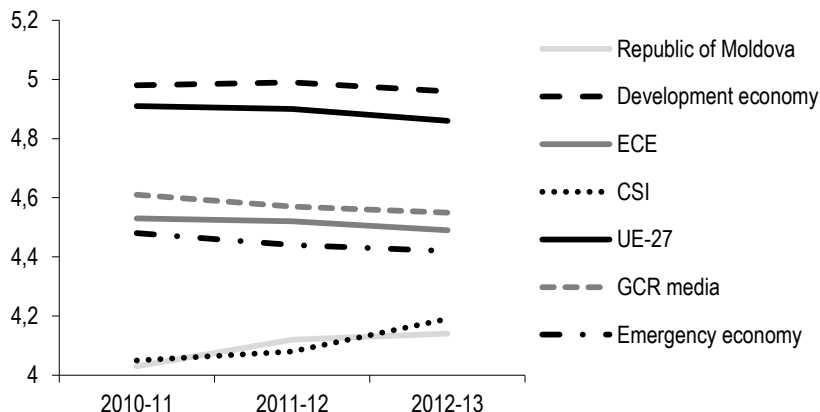


Source: Elaborated on the basis of World Economic Forum data.

Even if a company has access to the newest technologies, this fact doesn't insure its success, unless, the respective technologies can be used by company. Moldova's low performance can be explained by the fact that the human capital, that is necessary for the increase of the absorption capacity, is in the process of exhaustion. The humane capital' characteristics depend on the research and development activity, that is poor in Republic of Moldova. In the figure nr. 3, the Moldovan companies practically don't invest in the research and development activity (place 135). Also, the cooperation between companies and universities in the sphere of research and development is insufficient, much below the world level, and also of the CIS countries (place 140).

In 1998 Borensztein et al., proves that this minimum level is compulsory in order that the spread of the knowledge generated by FDI to contribute to the increase of the productivity of the destination countries. In the figure 3 we analyse to what extent, in some groups of countries and in Republic of Moldova, in particular, the FDI are accompanied by the transfer of new technologies. As we can observe, the world average is decreasing. Far above the average are situated the developed countries and European Union, but with a negative evolution. This can mean that currently the transnational corporations modify their expansion strategies or that appear and evolve new forms of technological transfer. Republic of Moldova is far behind (place 103) at the level of obtaining new technologies by the means of FDI, even in comparison with developing and emerging economies, although in 2010-2011 the evolution was positive.

FIGURE 3. FOREIGN DIRECT INVESTMENTS AND THE TECHNOLOGICAL TRANSFER



Source: Elaborated on the basis of World Economic Forum data.

In this context there is another aspect that we want to mention, mainly, that the reduction of FDI, by opening branches of economic interest would limit the international technological transfer. This should probably be replaced with the strategy of creation of knowledge, not only with its absorption.

Also, frequently FDI are not profitable or difficult to be done, due to the reduced size of the markets and governmental restrictions. In other situations, the company can have a reduced experience in opening branches abroad.

Synthesizing, we can distinguish the following determinant factors of the absorption capacity:

1. Local firms with research and development activities; branches of multinational companies that distribute technological knowledge into the economy,
2. The infrastructure of technological research and development:
 - highly qualified labor force (human capital);
 - universities, mainly the one with technical profile;
 - other institutions of professional formation;
 - research institutions;
3. Institutions that would ensure:
 - the protection of intellectual property rights;
 - the regulation of technical norms and standards;
 - insurance of a competitive economic environment;
 - the promotion of the entrepreneurship;
 - other elements that determine an attractive economic environment for foreign direct investments.

3. The analysis of the potential and capacity of knowledge production

In the majority of the specialized literature is present the idea that for the knowledge production it is necessary to have a given level of absorption capacity, and then after reaching the maximum level it is created a national stock of knowledge that leads to the production of own knowledge (Narula, 2004). We cannot deny this affirmation, but in some cases there are exceptions from this.

Mainly, the absorption capacity of technologies in the economy of RM was limited, by the reduction of FDI, also decreased the availability of latest technologies (that was mentioned earlier). Nevertheless, it increased in comparison with other Eastern European countries, the absorption capacity at the firm level. This proves us that there is a discrepancy between the access to modern technologies and the absorption capacities, that can be explained by the fact that the access to technologies is limited due to decrease of acquisition capacity and exists non-used potential.

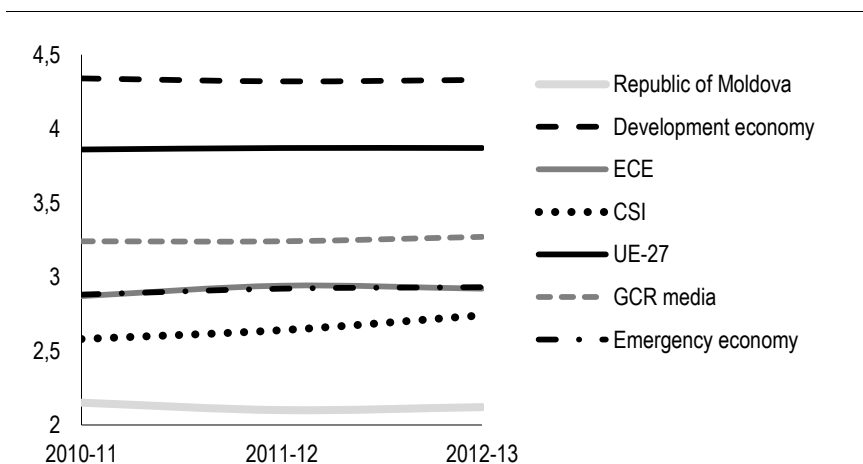
The knowledge production potential also isn't used at the full scale, as an argument in the framework of the Academy of Science of Moldova there are 18 basic scientific institutions, 29 specialized and 45 research laboratories, that create knowledge.

The main research institutions being: State University of Medicine and Pharmacy "N. Testemitanu"; Technical University of Moldova: Institute of Applied Physics; Institute of Genetics and Plant Physiology; Institute of Energy; Institute of Electronic Engineering and Nanotechnologies "D. Ghitu; Institute of Chemistry -; Institute of Microbiology and Biotechnology and others.

In the case when by the decrease of the level of FDI it is decreased the capacity to use advanced technologies, these discrepancies will lead to the fact that in developing countries in case of economies recessions the situation will become worth (Blomstrom and Sjöholm, 1998). In our opinion, this would not only be beneficial, but vitally necessary for developing countries to participate to the process of knowledge production. Earlier we brought arguments that a major part of developing countries, especially the former socialist one, have a good basis and a good humane potential for knowledge production. As an argument in the favor of this statement we would like to present some data for 2011, presented by the Intellectual Property Agency of Republic of Moldova. During the period of 1993-2011, 6154 patent applications for inventions (5528 applications for PI and 626 applications for STPI) were filed with AGEPI, of which 5440 (88%) came from national applicants, and 714 (12%) – from foreign applicants.

A part of the potential remains non-used due to the reduced levels of companies' investments in research and development. At this chapter, Republic of Moldova remains far behind developed countries.

FIGURE 4. INVESTMENTS OF COMPANIES IN RESEARCH AND DEVELOPMENT



Source: Elaborated on the basis of World Economic Forum data.

The situation that should be changed is concerning the use of the own potential in order to establish a partnership between universities and industries.

In order to develop and keep this potential would be beneficial the alliances between centers, universities or firms in knowledge generation and production.

In the framework of the new economy based on knowledge, the complexity and magnitude of technological knowledge needed for high tech activities, make more and more necessary the alliances/collaborations between big firms that take the practical form of technological transfer.

FIGURE 5. THE COOPERATION UNIVERSITY-INDUSTRY IN RESEARCH AND DEVELOPMENT



Source: Elaborated on the basis of World Economic Forum data.

According to modern theories regarding this way of technological transfer (Cantwell, 1989; Casson, 1987; Teece, 1986), due to the increasing complexity of high technologies, firms tend to develop only central technological capacities (indispensable/strictly related to the firms' main process of production), following to mutually benefit, mainly through these alliances, from complementary technologies. In this way, all the companies of such an alliance win technological supremacy, to which can be added the advantages related to a greater scale of production process, a bigger sales market and other.

Alliances/international cooperation between firms and societies with mixed participation has increased exponentially in the last two decades. It is not needed to prove statistically the fact that big companies from developed states make strategic alliances among them. We will stop however on the developing states with medium level of development, that don't have big firms. For these, an important role is played by small and medium enterprises, for which the cooperation with other firms is a very important one, because they don't possess the necessary resources to have research and development activities of important dimensions. In Republic of Moldova the majority of enterprises are small and medium enterprises, that is why it is necessary to stimulate them through programs of state partnership, or through alliances with big foreign corporations, in order to create conditions for using their potential.

Conclusion

We analyzed in this study the channels of transmission of technological transfer, its limits and the proportions of the capacity of absorption of International Transfer of

Technologies, as well as the possibilities and the capacities of production of knowledge. As a result of this analysis we can make some statements.

The optimum solution for the states at this stage of development is (national and foreign capital), as well as the placement of the national companies on the territory of leading-states, with the hope of getting some benefits as a result of positive technological externalities generated by the their firms. The aim of these strategies is the capture of the newest technologies appeared at the world level, in order to update the national stock of knowledge.

The fact that the more reduced level of development of European peripheric countries negatively influences the absorption capacity contributes to the increase of the difficulties faced by these states in overcoming the technological discrepancies. An important role in solving this problem is given to the state institutions, regarding the investments in technological research and development and human capital, as well as in the stimulation of the entrepreneurship and the insurance of a competitive economic environment that would lead to the increase of firm's inclination to innovation.

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