JOURNAL
OF EUROPEAN ECONOMY
Vol. 16. № 2 (61). April–June 2017
Publication of Ternopil National Economic University

International Economic Relations of the European Countries

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INTERNATIONALIZATION OF INNOVATION ACTIVITY BY TNCS

Abstract

The article analyses main stages in the internationalization of innovation activity undertaken by transnational companies and offers a generalization of approaches to its various forms.

The analysis of the process of R&D internationalization was carried out based on the roles of subsidiaries in the general structure (network) of TNCs. The study of the evolution of innovation processes was performed in the context of behavioral types and roles of subsidiaries within the TNC networks and the host country environments. The analysis was focused on the main types of local and global linkages in the context of scientific and technical cooperation, with particular attention paid to TNC subsidiaries with a global role in research and development. The findings exposed the impact of TNCs' internationalization of innovations upon host countries, revealed major tendencies in global knowledge spillovers, and corroborated the significance of linkages between structural units of TNCs and their partners in the host countries.

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Key words:

Absorptive capacity, global scientific linkages, global technological linkages, innovation, innovation potential, innovation system, internationalization, local scientific linkages, local technological linkages.

JEL: O30, O32.

1. Actuality of research

The modern world economy is characterized by the emergence of a global model of economic development. Today, the significance of innovation activity continues to rise, exerting influence on competitiveness of both individual enterprises and entire national economies. On the other hand, innovations not only contribute to economic development, but also offer a solution to many social problems, such as environmental protection, healthcare, improvements in the level and quality of human life, etc.

Under globalization, the internationalization of innovation activities attracts major attention, highlighting the importance of transnational corporations (which locate research centers in different countries and invest in research and development (R&D) activity) in generation and dissemination of innovations. Different forms of internationalization influence technological and innovation potential of countries, producing synergetic effects from scientific research for generation of new knowledge creation. Given gradual exhaustion of natural resources, it becomes ever more necessary to intensify the use of the existing knowledge stock. This is particularly true for scientific and technological knowledge, which can increase the efficiency of production.

2. Brief literature review

The problems and challenges of internationalization of innovations were studied and highlighted in the works of many authors. In particular, the role of innovations and their impact on corporate behavior and internationalization of

TNCs' innovation activity were investigated by J. Dunning and S. Lundan (2009), S. Klepper (1996), P. Buckley and M. Casson (1976), E. Chamberlin, E. Greham, J. Johanson, J. Mathews, R. Nelson, while the role of foreign direct investment in this sphere was studied by R. Vernon, W. Kuemmerle (1999), M. Posner, J. Hymer, C. Kindleberger, and others.

3. The objective of this article is to provide theoretical substantiation for the internationalization of innovation activity by TNCs and to subsequently identify its modern tendencies and peculiarities.

To achieve the above set goal, the following tasks were fulfilled: the evolution and development of the internationalization of innovation activity were discussed; the role of TNC subsidiaries in the internationalization of innovation activity was researched; key factors of the country's participation in international innovation projects were analyzed; modern tendencies in the internationalization of innovation activity were identified.

4. Results

Recent research on the drivers of internationalization of corporate innovations revealed that international R&D is a rather heterogeneous process, whereby national companies and affiliated industries play an important and sometimes decisive role in decision-making relating to internationalization of innovations. The development of international innovations in some (small) countries, such as Belgium, the Netherlands and Switzerland, occurs at a faster rate compared to manufacturing, notwithstanding the fact that the latter is highly diversified across these countries. This example underscores the importance of national and regional institutions and linkages. However, there is currently little evidence allowing us to split all the general patterns of R&D internationalization into those driven by sector-specific and those driven by country-specific features.

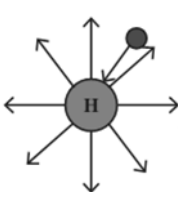
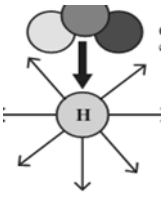
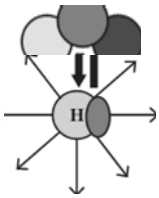
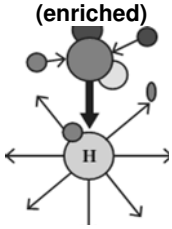
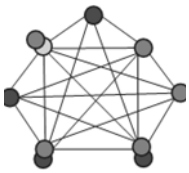
According to Klepper (1996), the life cycle of a particular product is reflected in the country-specific features. New products satisfy local (national) needs and will be exported primarily to countries with similar needs, preferences and incomes. This is one of the regularities of the internationalization of innovation activity.

Over the recent decades, the internationalization of corporate R&D, the importance of research on national and sectoral factors and the significance of foreign R&D investment have noticeably grown.

From a corporate viewpoint, the study of the company's factors of external environment allows to single out two groups of motives for international R&D. The first group, also called «adaptive product R&D», focuses on exploiting the TNCs' domestic business opportunities abroad (Figure 1). For TNCs, the attractiveness of a host country is determined by the competitiveness of its R&D personnel and the size of its market (main dimensions: GDP, GDP per capita, population density).

Figure 1

The global innovation process: Stages of transformation

Traditional	Reverse	Frugal	Reverse (enriched)	Global
				
«Home»-centric	«Host»-centric	«Host»-centric	«Host» - centric	Polycentric networks
Ethnocentric	Challenges to innovate: • performance; • cost	Significant breakthrough in cost reduction	Market insights and technological contributions from multiple sources	Markets and competences from all over the world
«Project» innovations into the world (export, invest, license) Transnational: multiple homes, but traditional model	Reversing the knowledge flow	Interactive knowledge exchange	Knowledge attractor in host country	

Source: Mahmoud-Jouini et al., 2015.

Since 1990s, however, the second type of international R&D has become increasingly popular. This type of R&D is targeted at acquiring new knowledge and competences. This is very important for TNCs, which strive to protect their global competitive positions. In its turn, this encourages companies to transfer

their R&D to countries that have advantages in certain areas. This R&D type is labeled «technology-oriented». The quality and nature of the national innovation system will thus will be instrumental for this type of strategy.

The tendencies to centralization and internationalization of R&D are unevenly distributed among industries.

The decision-making process regarding the internationalization of R&D largely depends on the ability of sectors to reproduce technological knowledge. Technological regimes are instrumental in defining the interrelationship between industry specifics and spatial agglomeration. The research of the features of sector-specific innovation activity and industrial dynamics provided a possibility to introduce categories that group sectors based on the attributes of the processes through which companies perform their innovation activity (Mahmoud-Jouini et al., 2015). All products and services are forms of embodied knowledge. Sectors vary in terms of R&D implementation since production of different goods (services) requires different inputs of codified and non-codified knowledge. Some sectors are shaped by high degree of knowledge cumulativeness, and thus, are highly competitive. In such a case, knowledge is accumulated mainly from the sources located within the sector (for example, in developed countries), whereas industrial dynamics is characterized by low stock and persistently high geographic concentration. On the other hand, when new opportunities are generated by sources from outside the sector (scientific research, general and non-systemic knowledge, etc.), then high stock and low geographic concentration will most likely prevail.

These conditions influence the creation and diffusion of technological knowledge, which is of crucial importance for outcomes of corporate research internationalization, as it is the development of tacit knowledge that stimulates TNCs to seek access to this knowledge. The location of innovation-related technological knowledge in a particular geographical area stimulates foreign subsidiaries to accumulate assets and activities through knowledge spillovers from industrial concentration and innovation activity taking place within particular regional or national clusters (Mahmoud-Jouini et al., 2015).

From the geographical viewpoint, the marginal cost of transferring non-codified (tacit) knowledge (as opposed to codified knowledge) will increase with distance. Institutional and cultural factors also affect knowledge transfer. The significance of spatial factor in reducing the barriers and costs of knowledge exchange will depend on basic properties of knowledge and learning, their degree of complexity and «tacitness». This can lead to clustering of innovation activity, in particular at the early stage of the life cycle, when non-codified knowledge is of crucial importance.

Due to various country- and sector-specific features, countries exhibit major differences in R&D internationalization. Moreover, R&D inputs reflect comparative advantages of the country in different sectors, especially at the early

stage of the industry life cycle, when non-codified knowledge is of major importance.

In order to successfully identify the above mentioned regularities, we need a comprehensive database on TNCs' internationalization of R&D. So far, the so-called «boards of corporate innovations» are used. TNCs use patents as measures of their invention activity. Patents represent a heterogeneous set of inventions in technologies, programs and processes. As such, patents do not always provide a complete and accurate reflection of innovations, since different sectors and countries adopt different patenting requirements and procedures. Besides, patented inventions differ in terms of quality and economic significance. Patents that were registered in more than one country are considered to be more valuable inventions of global significance. However, patents as a target indicator are a good demonstration of the country's inventive activity. Nevertheless, patents have one major drawback – the institutional bias (patenting rules can be significantly different: the costs of applying, level of invention, the need or even possibility of patenting for some types of inventions).

The activity of TNCs in the developing countries is quite often viewed primarily as a tendency towards growing technological dependence and falling regional technological capabilities, but not as a contribution to these countries' economic and technological development. Generally, the literature emphasizes the search for knowledge, which does not always promote innovative development of the host country. The two alternative approaches that are not constrained by national borders include the concepts of «sectoral innovation systems» and «technological systems». Both of them are different from national innovation systems. The sectoral systems approach concentrates on the dynamics of competitive selection of technological systems. The technological systems approach, in its turn, investigates how the system can discover, absorb and seize global technological opportunities, as well as studies the network of agents, which interact within the framework of specific technology in a particular institutional environment and participate in generation, diffusion and use of technologies.

The concept of technological systems postulates that innovations are generated within networks (buyers, suppliers, science and research institutions, etc.), which can surpass national borders. Examples are technological systems based on «competences» or «solutions» or even «informal networks». Thus, economies where TNCs are dominant players tend to view the R&D activity of foreign subsidiaries as an important link between the innovator host country and the global R&D network, as a platform for diffusion of new knowledge and technology. TNC subsidiaries act as major players in the process of technology diffusion in the host countries, although evidence on their real impact is scarce. The nature, level and scale of effects produced by TNCs' internationalization of R&D are diverse. For the internationalization of innovation processes to produce benefits for the TNCs, it is important that two conditions are met: (1) technology transfer; and (2) adequate level of absorptive capacity (see Table 1, Figure 2) (United Nations,

2014). Consequently, the benefits for subsidiary companies will differ depending on the country of origin (e.g. there are essential differences in the operations of American, Japanese and European companies, whose management systems are also very different). In addition, the length of presence in the foreign country and experience are also important determinants of success.

Table 1

Innovation potential and absorptive capacity: indicators, descriptions and measures

Indicator	Description	Values / measures
Innovation Potential		
Innovation input	Total efforts and investments put by each country into research and development of innovation activity	Aggregate R&D expenditure, in percent to GDP Government R&D spending, in percent to GDP
Scientific output	Reflects the results of research and innovation activity performed by the public science and technology system (e.g. scientific and technical publications)	Number of scientific and technical journals per million people
Technological output	Total output of technological and innovation activities generated by private firms (e.g. patents, new products)	Number of registered patents and trademarks per million people
Absorptive Capacity		
International trade	Denotes the openness of the national system – the more open the system the higher the ability to imitate foreign leading knowledge	Openness: (exports + imports) / GDP High-technology exports, in percent to GDP
Human capital	The key determinant of absorptive capacity emphasized by technological gap models	Higher education: enrolment rate Secondary education: enrolment rate
Infrastructure	A higher level and quality of infrastructure (e.g. networks, transport, distribution) enhances the country's ability to absorb, imitate and implement leading technologies from abroad	Electricity: number of kilowatts of electricity consumed per hour per capita Telephony: number of fixed-line and mobile phone subscriptions per

Indicator	Description	Values / measures
		1000 inhabitants
Quality of institutions and governance	A better and more efficient governance system increases the country's ability to perform upgrading and absorptive capacity	Corruption perceptions index
Social cohesion and economic inequality	National systems with higher social cohesion and lower income inequality within the country have higher degrees of trust and knowledge-sharing, supporting the pace of advanced knowledge diffusion and implementation inside the country	Gini index

Source: United Nations, 2014, p.8.

Internal culture, values and standards leave their mark on the national innovation systems. The R&D activities of TNCs, especially those from the developed countries, tend to be less disparate because, first, TNCs operate in compliance with standards practiced in and set by the developed countries, and second, some of them serve as a so-called «export platform» (development and manufacturing of products for the world market). It has been empirically proven that TNCs of developed countries cooperate with universities and research institutions more actively compared to companies from the developing countries (United Nations, 2014).

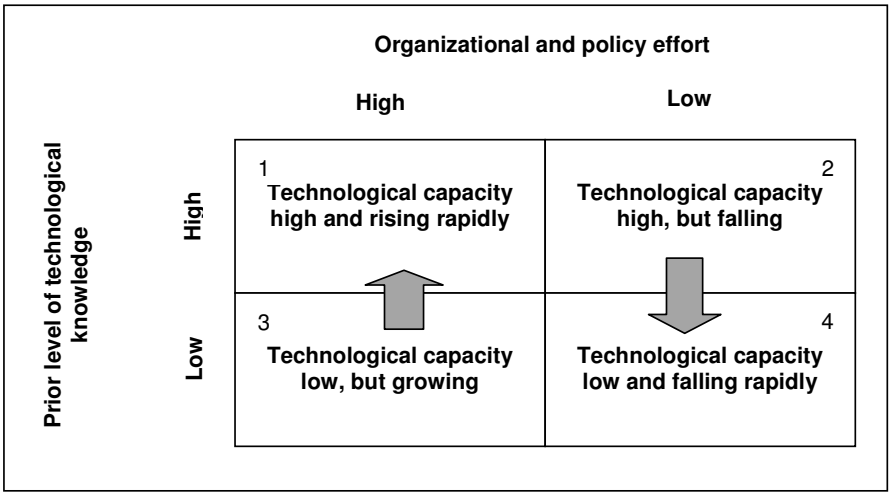
Of fundamental importance is the willingness of a particular TNC subsidiary's management to strive for better positions in the TNC network and take on more complicated roles. This will precondition the level and types of interrelations with local partners and institutions, etc.

Subsidiaries can be assigned different roles.

Local roles are linked with adaptation of product(s) or local authentic R&Ds to the host country market.

Figure 2

Dynamics of technological capacity



Source: United Nations, 2014, p. 23.

Global roles are assigned to subsidiaries which promote the company's global research and development program by accessing leading knowledge and technologies in the host countries, thus creating opportunities within the TNCs. These subsidiaries are also called «centers of excellence» or «competence centers», since they are responsible for the development of the entire product family for the world market (United Nations, 2014, p. 24).

The so-called «global subsidiary mandates» or «world mandates» are linked with strategy coordination across value chain activities (R&D, production, logistics, marketing, etc) for a competitive product family.

As a rule, subsidiaries with global mandates have more connections with external sources of competences in the host country, in particular through buyer-supplier relations.

Local ties allow subsidiaries to reveal and absorb specific external knowledge that is of high importance for the entire TNC, thus globally justifying their «centers of excellence» mandate (United Nations, 2014). As a rule, they closely monitor the scientific and technological systems in their host countries. Moreover, subsidiaries with global R&D mandates and higher decision-making autonomy are believed to positively affect innovations in the host country.

Linkages and cooperation are also differently interpreted in the context of internationalization of innovation activity.

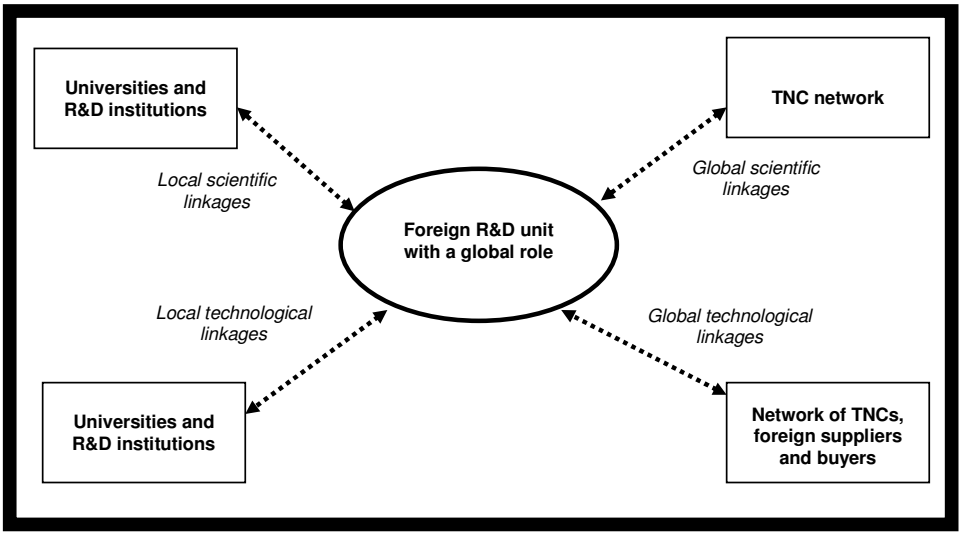
Linkages can take the form of uni- or bi-directional, short-term or long-term, frequent or sporadic relations. In general, the interaction between TNC subsidiaries and local partners entails joint R&D or outsourcing contracts. Joint R&D projects are bi-directional, longer-term initiatives that offer valuable learning opportunities for both partners. In contrast, outsourcing contracts often focus on technological services that can be provided by several mutually substitutable partners. Besides, outsourcing often limits the exchange of know-how (aka «black-box» know-how), while mutual R&D linkages allow mastering technical or scientific knowledge more adequately. Technological knowledge (in particular non-codified (tacit) knowledge) is embedded in specific organizational, cultural and institutional contexts, while scientific knowledge is explicit and universal. Technological knowledge can be acquired by method of trial-and-error, while scientific knowledge can be created through logical inference. The combination or integration of scientific and technological knowledge originates technology. In other words, the technology of technical knowledge is created with the help of scientific methods of methods of scientific discovery, which have been transformed into practical procedures.

Thus, technological progress cannot be a mere derivative of science. Richard Nelson claimed that «strong science provides tools for problem solving, but usually in itself does not solve practical problems» (as cited in Boehe, 2004, p.5). In view of this, companies which are capable of integrating scientific and technological knowledge within the framework of cooperation can implement innovations by creating new technologies. Both types of knowledge can attract partners to cooperation. When these partner relations allow purchasing technological knowledge, they are called «technological linkages»; when they are oriented at scientific knowledge, they are labeled «scientific linkages» (see Figure 3) (Boehe, 2004, p.5). Generally, scientific linkages explain cooperation between companies and R&D institutions or universities, while technological linkages explain product development cooperation with buyers and suppliers. These linkages are fundamental elements of the innovation systems.

Accordingly, TNC subsidiaries which are capable of combining both types of knowledge can create new technology. Subsidiaries can absorb these types of knowledge either from their parent company (headquarters or other foreign subsidiaries) or from external partners, such as universities, research institutions, suppliers, and clients. When subsidiaries receive scientific or technological knowledge via cooperation with other TNC units, the linkages are called «global scientific linkages» and «global technological linkages» respectively. When subsidiaries cooperate with local partners in the host country, these relations are called «local scientific linkages» and «local technological linkages» respectively (Figure 3) (Kuemmerle, 1999).

Figure 3

Local and global scientific and technological linkages



Source: Boehe, 2004.

Thus, subsidiary enterprises as R&D divisions can form four types of linkages (Figure 3):

1) global scientific linkages between research laboratories of TNCs and foreign universities, research and development institutions;

2) global technological linkages between sister subsidiaries and foreign external suppliers and buyers;

3) local scientific linkages with universities and R&D institutions of the host country;

4) local technological linkages with suppliers and buyers in the host country (Boehe, 2004, p. 5).

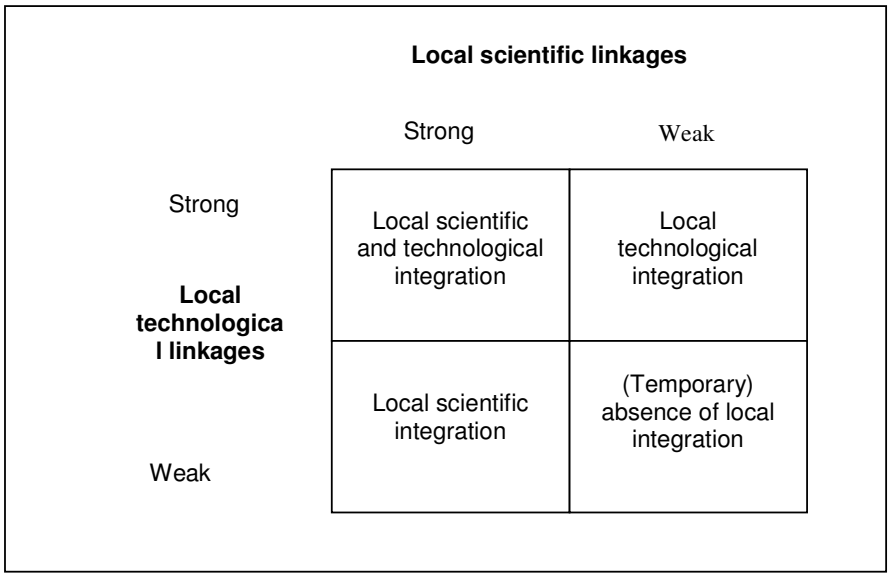
It is R&D subsidiaries that provide connection between the host country's innovation system and the international R&D network or innovation systems of other countries.

The R&D activity of TNC subsidiaries is determined not only by the type of linkages, but also by the strength of these linkages. Strong linkages produce larger effects for TNC subsidiaries in the host country (Figure 4). Accordingly, when

both scientific and technological linkages are in place, then subsidiaries act as «bridges» between the host country's innovation system and the innovation systems of other countries, as well as the global innovation system (knowledge spillovers of the highest level). On the contrary, the absence of local integration (aka «the island of excellence») renders limited opportunities for knowledge acquisition through spillovers to the innovation system of the host country.

Figure 4

Classification of TNC subsidiaries



Source: Boehe, 2004, p.6.

The majority of research in this area relies only on statistical and aggregate data on the links between buyers and suppliers, universities, research institutions, governmental authorities, etc. The advantage of such an approach is the ability to characterize the overall state of the innovation system in a particular country. The properties of separate components are less meticulously analyzed. Thus, this can become a serious drawback, especially when the country under study does not have a mature innovation system. For example, there could be a situation when there is only one large enterprise with high innovation activity and

many SMEs with insufficient innovation activity. Besides, aggregate data do not take into account separate TNC subsidiaries, especially those with massive background in innovation activity and a global mandate in product development. National innovation systems can be analyzed using the micro-, meso- or macro-level approaches (OECD, 1999). Micro-level approach is used at the level of individuals and firms; meso-level approach is used for clusters; macro-level approach is used to study knowledge flows between different economic institutions. In particular, the micro-level approach «is oriented at the firm's internal capabilities and linkages of one or several firms with their environment, and tests their knowledge, relations with other firms and non-market institutions within the innovation system so that to reveal an inadequate (weak) link in the value chain». For TNCs, a combination of the two above-mentioned approaches is used: the micro-level approach and the macro-level approach (Boehe, 2004, p. 6).

Thus, subsidiaries are «nodes» between the host country's innovation system and the innovation systems of the countries hosting other TNC units or partner organizations.

TNC subsidiaries affect the host country's innovation dynamics positively by interacting with local partner organizations, such as suppliers, clients, R&D institutions and universities. This contributes to learning and development of innovations. As it was previously mentioned, subsidiaries can play different strategic roles in TNCs with respect to innovation activity and interactions or linkages with partners from their host countries, which in their turn will change depending on the subsidiary's role type.

Let us consider the global R&D mandates for subsidiaries, which develop new products for the world markets or take part in global projects together with other TNC units. The influence of these departments on R&D is significant because of the three reasons:

- first, the departments that have been assigned global mandates usually have more advanced technological capacity compared to units, which are uniquely focused on adapting foreign products to the market of the host country; thus, the learning potential is larger for partner organizations in the host country;
- second, the departments that have higher internal R&D potential generally have high absorptive capacity, which enables them to interact with science and research institutions and universities;
- and third, the departments that have been assigned global mandates can usually satisfy the needs of the market better than partners and competitors from the host county, since competition in global market conditions calls for high quality inputs; thus, these R&D departments can encourage their partners from the host country to modernize their technological processes (Boehe, 2004, p. 5).

The emergence of global roles, such as centers of expertise, and «technological inclusion» of the host country's environment are realized by forming and developing «linkages» between TNC subsidiaries and «local sources of competence». At that, little attention is paid to country-specific features.

Usually, research is based on two-dimensional analysis: (1) TNC subsidiaries and innovation systems of the host countries; (2) governance and focus on strategic roles of subsidiaries.

The linkages between TNC subsidiaries and the country's innovation system are still subject to controversy in what concerns their impact of one upon the other. Innovation systems are often considered at the «national level» in result of evolutionary processes marked by specific historical, cultural and institutional peculiarities of a specific country. That is why the overall activity of TNCs in general and R&D internationalization in particular are immensely affected by national history, culture and institutions.

5. Conclusions

The continuing internationalization of corporate innovations attracts major interest of policy-makers, since innovations are viewed not only as a major driver of growth in labor productivity and national economic development, but also as an important source of solutions to social problems. The policy focuses on potential job loss and economic benefits, losses due to non-competitiveness of national firms, as well as deterioration of local knowledge bases due to increasing volumes of R&D performed by foreign companies and decreasing volumes of R&D performed by national firms. In view of this, the policy of many countries aims to improve the R&D climate and encourage the inflow of FDIs into the R&D sphere (using the advantages of both inflows and outflows of FDIs). It becomes ever more frequent that the policy in this area starts with forming and/or developing competitiveness along with R&D internationalization performed by TNCs.

The challenge for the next decade will be to balance the world development by means of reducing the technological gap, even though it requires that many problems need to be solved – starting from the country's education level and ending with development of the means of labor. Bridging the gap between the developed and developing countries depends upon, first, closing the investment gaps in international science, technology and innovations. In order for countries to exit from the vicious circle of poverty and reach the sustainable development goals set for the post-2015 period, they should set ambitious national minimum target investments for R&D, including special assignations for advancement of fundamental and natural sciences, education and literacy. Since these investments will positively affect the fight against poverty, job creation, re-

duction of inequality, growth of incomes, as well as growth of health and well-being. This, in turn, can help to solve the critical problems, such as access to energy, food and water security, climate change, and loss of biodiversity.

Changes in international business conditions will further affect the development and diversification of the forms of internationalization of innovations performed by TNCs, which will subsequently affect the roles of subsidiaries with respect to international R&D.

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The article was received on April 20, 2017.