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*Factors Influencing the Innovativeness of the Global Economy
in the 21st Century*

Czynniki wpływające na innowacyjność gospodarki światowej w XXI w.

Keywords: economic development; innovation; intellectual property protection; R&D

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Introduction

The beginning of the 21st century draws a clear line between changes in the global economy of developing and developed countries. Since that moment, we have witnessed considerable transformations in the areas of work and science. Nowadays, a declining role of industry and agriculture and a growing importance of capital and knowledge are creating an innovative economic model. The emerging economic sectors such as bioinformatics or nanotechnology give new priorities for economic development and shape a different model of entrepreneurship. Research and development (R&D) works together with the increase in the quality of scientific centres to create an efficient environment for development of human capital. Developing new technologies, solutions and inventions and introducing them in the form of ready-made products and services is the main objective of innovative policy. Combining science with the business environment brings about a productive cooperation for the whole economy.

The aim of this study is to identify the most essential factors that have an effect on the innovativeness and economic growth in the 21st century. Setting out determinants that account for the growth of effectiveness of economic activities provides core information on development in its broad meaning and growth at micro and macro levels. The paper presents four key elements of the description of this issue: research and development activities, transformations of production factors, innovativeness and procedures and measures of protection.

1. Research and development activities

Research and development (R&D) works are activities that aim to extend knowledge about people and the surrounding reality. R&D works consist of three pillars [Wysokińska, 2011, p. 111]:

- basic: concerning both theoretical and experimental works. They aim at discovering new information on various phenomena and facts unknown so far;
- industrial: the aim is to search for innovative ways of producing goods and providing services; and
- developmental: concerning shaping, acquiring and integrating obtained knowledge and skills.

The main aim of these activities is to create a new value that will affect the quality of goods produced as well as their formation.

Activities within R&D are presented in the subject literature as the sum of conscious activities of enterprises, research centres and people who invest capital resources in the process of commercialization of inventions, solutions and products. This issue appeared for the first time in the literature in the 1960s. Articles by Richard Nelson and Kenneth Arrow pointed out at the importance of investments and subsidies in research and development activities. According to economists, “financial” means supporting ground-breaking forms of production to determine the level of competition and development of entrepreneurship [Hall, 2006, p. 2].

The discussion of innovative economy within R&D works should be referred to as the macroeconomic world economy. It is worthwhile to analyse the size of investments in R&D in particular countries. Table 1 lists five countries that invested the most into the analysed area in 2017.

Table 1. Expenditure of particular countries for R&D in 2017 (USD billions)

Position	Country	Expenditure
1	United States	527.46
2	China	429.54
3	Japan	173.36
4	Germany	112.49
5	South Korea	83.91

Source: The Statistics Portal.

The largest investments in R&D were made in the United States, which allocated for this purpose almost USD 530 billion. China comes second with spending of USD 100 billion. Then follow Japan and Germany, which invested in innovativeness USD 170 and USD 110 billion, respectively. South Korea spent more than USD 80 billion. It is worth noting that the highest investments were made in the most developed economies. A high level of R&D expenditure in the US, China or Japan is a cause-and-effect relationship of economic innovativeness and efficiency.

R&D activity is connected with creating new product and process innovations by development facilities or acquired from other entities. This type of innovative activity is the first stage of a product's life cycle [Stabryła, 2007, p. 242]. It is essential to present here structural changes in the significance of already existing factors of production to understand the basis for R&D and the changes in the development of entrepreneurship that have taken place recently.

2. Changes in the importance of production factors

Until recently, textbooks on classical economy and other scientific studies have recognized land labour and capital as primary factors of production. At present, this tripartition is supplemented by knowledge. Figure 1 illustrates a new approach towards production factors of the world economy. It is the consequence of changes in the functioning of the global market. At the initial stage of the civilization development, land – as work in fields and farms – was a relevant factor of enrichment. Over time, the share of agriculture has considerably decreased. Until the beginning of the 21st century, industry was a key to the power of many economies, but it has been replaced by a more efficient sector of services.

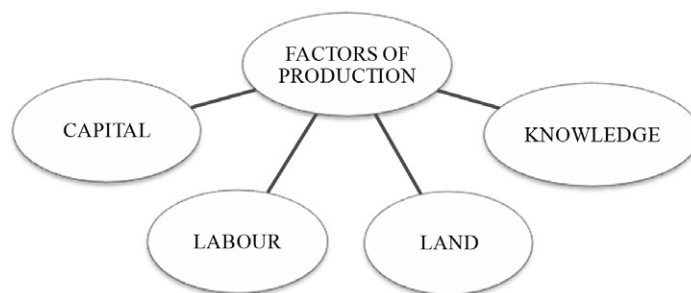


Figure 1. Factors of production

Source: Milewski [2015, p. 20].

Since the beginning of the 21st century, the process of financialization has also become more intense, which is presented as capital in Figure 1. This process means the growing importance of finances in the economy. The instruments of the capital

and money markets start to generate higher and higher revenues in comparison to the industry sector [Davis, Kim, 2015, p. 205]. Knowledge deemed as a factor of productivity is expressed in a number of activities that lead to creating innovative solutions that affect production of new goods or improving the quality of already existing ones.

Economy based on knowledge provides a model in which economic development depends on two elements. One covers investments in human capital, inventions and any kind of innovations. The other is based on the analysis and observations of trends in the world economy. Expenditure on human capital, a whole range of research, that develops works or innovative technologies brings about a positive effect on the economy, making it more developed, open and innovative. In the context of development and transformations in the world economy, one can state that knowledge and innovations account for a unique substitute for farm work and natural resources because they constitute values that do not run out and the potential for the increase in efficiency has no limits [Konopko, 2009, p. 78]. Human capital as an added value arising from knowledge, information and intellect is the starting point for any development activities. Knowledge, if put to good use, permeates the services and production sectors [Beyer, 2015, p. 127].

The rapid growth of industry in the 20th century and considerable technological advances glorified to a large extent the work of machines, various devices and robots. Nowadays, a reverse trend can be observed. Clearly, mechatronics or other forms of technological solutions contribute significantly to the improvement of machine efficiency. However, they are underpinned by human knowledge, intelligence and creativity.

Economy based on knowledge influences many aspects of life. Not only does it develop a sphere of entrepreneurship, but also other areas of life such as medical care, insurance education, administration and construction. The shift from non-renewable production factors to limitless resources such as knowledge or skills develops productivity of entities' operations and allows for their constant growth in efficiency [Morris, 2006, pp. 60–61]. Moreover, knowledge multiplies opportunities to create new structures of entrepreneurship by creating innovative sectors of labour [Tocan, 2012, p. 2]. All the described dependencies and co-operations between knowledge, development, human capital and investments make the economy less susceptible to constraints.

While presenting structural changes in production factors, it is important to describe the elements connected with cutting-edge solutions responsible for rapid growth of the economy. Innovative activities are the basis of novelty, experiments, inventions and the newest technologies.

3. Innovativeness

Innovativeness (*innovatio*, from the Latin), i.e. renewal, is a chain of activities that aim primarily to create innovative or improved goods, services, technological processes or economic systems. This notion concerns producing new quality goods

Based on the assumption of the classical economics theory outlined by Schumpeter, innovativeness is an effective combination of capital and work that includes the elements of five essential areas [Schumpeter, 1960, p. 104]:

- introducing;
- implementing new methods of production of a good;
- looking for new markets;
- managing new raw materials and semi-products necessary to create own solutions; and
- reorganization of an economic sector.

The process of increasing innovative activities is useful for the whole economy. The appearance of unique solutions increases market competition and leads to the improvement of quality in production and services. Information resources coming from the market provide the basis for further cutting-edge solutions [Śnieżek, 2016, p. 17].

The system of innovativeness creation might be presented by a number of elements that, due to mutual cooperation, create strong relationships. Figure 2 presents the model of a national process of innovativeness.

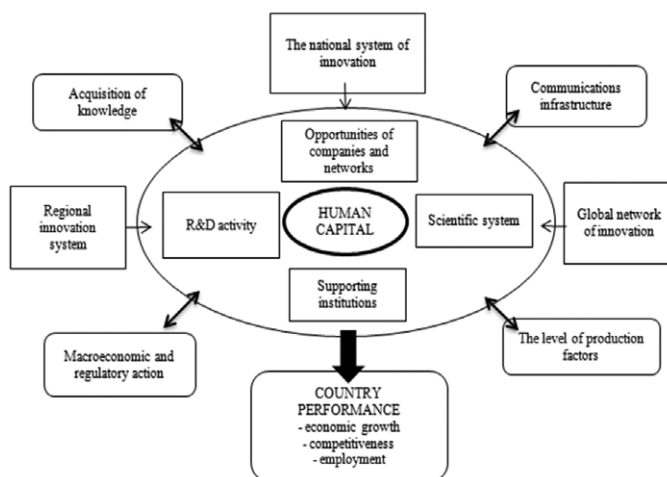


Figure 2. Interdependence model in the national system of innovativeness

Source: Own study based on National Science Board [2012, p. 3].

These are people who are at the centre of creating innovative solutions, in the literature often referred to as human capital. Neither machines nor devices are behind the intellectual potential that can create cutting-edge solutions, inventions or revolutionary ideas. The level of intellectual capital is affected by many matters. One of the most important is an educational system. The whole scientific infrastructure depends on the level of an educational system, schools, universities and educational programs. Significant components in economic development are innovativeness systems at the regional, national and global levels. Such programs help economic units implement innovative solutions. The components presented in Figure 2 as determinants of human capital are different institutions. These are entities that through their operations or their expenditure support development of research projects. They may include development programs or strategies created by business groups or organizations. The notion of supporting institutions also covers those business entities or organizations for which development of science in some specific areas may appear useful and profitable. Attention should also be paid to external factors connected with human capital. Utilization of land capital or human work creates strong interaction between intellectual potential and the environment. One important element in the external environment of innovative development is communication infrastructure. Exchange of information, data and research findings between universities and scientific and research centres is of intrinsic importance. R&D works are a separate element supporting the innovation process. In turn, social capital affects the quality and efficiency of research and development activities. Another element in the analysed structure is macroeconomic policy. Decisions taken by governments in relationship to an educational system, its nature and financial support are very relevant. Equally important are regulations on entrepreneurship, running market entities, special economic zones, tax laws or tax relief for enterprises. All these elements and processes create a monolithic structure that through mutual cooperation is able to generate an added value directly influencing the economic efficiency of a given country. It is likely to be observed in economic growth, decreasing unemployment or increasing competition in the domestic and global markets.

When investing in innovative and pioneering activities, it is essential that they are protected. The next section of this paper will describe protective activity.

4. Protection

Creating new products and services on the basis of new technologies or innovative solutions is a key factor of innovative entrepreneurship. However, the protection of the goods created is a more essential element. Knowledge on intellectual property protection appears to be indispensable.

Economic entities may protect their own solutions by:

1. Industrial property law – utility models, patents, trademarks, geographical indications and plant variety rights;
2. Copyrights that include genuine artistic and literary works, musical works, databases, multimedia and advertising; and
3. Commercial strategies – confidentiality contracts, fast manufacturing and trade secrets.

When it comes to activities concerning the protection of unique and pioneering solutions or products, patents play a significant role in the world economy. In the context of international trade, this protection instrument is worth noticing. A patent, a document issued by the patent office, gives the owner of a given solution an exclusive right to use a created solution, idea or invention. Patents are one of the most efficient protectors of intellectual property rights. They constitute a formal right given administratively by a regional or national patent office [Okoń-Horodyńska et al., 2012, p. 11]. Table 2 presents the number of patent applications by country.

Table 2. Patent applications by country in 2017

Position	Country	Number
1	China	968,252
2	United States	288,335
3	Japan	258,839
4	South Korea	167,275
5	Germany	47,384

Source: World Intellectual Property Organization.

In 2017, most patents were filed by China, which came up with nearly one million solutions and inventions. The US presented 300,000 projects in this area, and Japan presented over 250,000 solutions. South Korea came fourth with 170,000 patent filings. Germany is ranked fifth with 50,000 patents. It is not coincidental that the first three positions in this ranking are taken by the countries with the highest GDPs. The relationships between innovative policy and economic growth are significant, similarly to the comparison of expenditure on R&D (Table 1). Obviously, a patent filing does not mean a positive opinion issued by the patent office; policy plays a key role here based on the most effective attempts to apply for protection of created solutions. Such efforts made to reserve one’s own solutions are relevant because they allow accruing benefits from this for some period of time with no risk of the work being copied by competitors. These activities help maximize the profit of a business entity in the first stage of the product’s life cycle, i.e. at the moment of introducing a particular product into the market [Zieliński, 2013, p. 12]. The impossibility of competitors copying particular inventions or products gives the pioneer a privileged position that may make it possible for him or her to realize a strategy called “cream-skimming” for some time. Such a situation occurs when an enterprise is not threatened by competition, consumers are not much sensitive to prices and

the market is limited [Mruk, 2012, p. 214]. The described dependencies and effects give rationale for the need to use patent policy as well as other activities aimed at reserving created solutions.

Summary

Investments in R&D have become an inseparable element of the innovation policy of the most developed economies. Expenditure on R&D is a very profitable investment that affects the potential of entities in a country. There are actions through which the process of producing new goods and services becomes very creative and unique. Creation of an environment in which human capital will have the most favourable conditions for development is the foundation of the increase in work efficiency in the 21st century. Such a situation leads to increased competitiveness and efficiency of the global market, allowing it to continually develop. The cooperation of business and science can be a high-performance connection that currently creates the competitiveness of the global economy. A protection policy based on patents or proprietary rights must form the foundation of innovative actions that can be easily subject to theft or replicas without protection.

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Czynniki wpływające na innowacyjność gospodarki światowej w XXI w.

Inwestycje w prace badawczo-rozwojowe stały się nieodłącznym elementem polityki innowacyjnej najbardziej rozwiniętych gospodarek. Nakłady na prace badawczo-rozwojowe są bardzo rentowną inwestycją, która wpływa na potencjał podmiotów w danym kraju. Stanowią one działania, dzięki którym proces wytwarzania nowych dóbr i usług staje się bardzo kreatywny i twórczy. Rozwój kapitału ludzkiego i tworzenie środowiska, w którym będzie miał najdogodniejsze warunki do rozwoju, stanowi fundament wzrostu efektywności pracy w XXI w. Coraz większa innowacyjność podmiotów gospodarczych wpływa na tworzenie nowatorskich produktów o lepszej jakości i użyteczności. Taka sytuacja doprowadza do wzrostu konkurencyjności i wydajności rynku światowego, pozwalając mu na ustawiczny rozwój gospodarczy. Kooperacja świata biznesu z nauką może stanowić wysokowydajne połączenie, które obecnie kształtuje konkurencyjność gospodarki światowej. Polityka ochronna oparta na patentach czy prawach własnościowych musi zatem stanowić fundament innowacyjnych działań, które bez zabezpieczenia mogą stać się przedmiotem kradzieży czy repliki.

Factors Influencing the Innovativeness of the Global Economy in the 21st Century

Investments in research and development (R&D) have become an inseparable element of the innovation policy of the most developed economies. Expenditure on R&D is a very profitable investment that affects the potential of entities in a country. There are actions through which the process of producing new goods and services becomes very creative and unique. Creation of an environment in which human capital will have the most favourable conditions for development is the foundation of the increase in work efficiency in the 21st century. Such a situation leads to increased competitiveness and efficiency of the global market, allowing it to continually develop. The cooperation of business and science can be a high-performance connection that currently creates the competitiveness of the global economy. A protection policy based on patents or proprietary rights must form the foundation of innovative actions that can be easily subject to theft or replicas without protection.