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## RESEARCH ARTICLE

### DETERMINANTS FOR THE TRANSFER OF KNOWLEDGE AND TECHNOLOGY IN BUSINESS AND ECONOMY

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#### ABSTRACT

A specific factor ensuring economic development is knowledge, which is a resource that, in principle, does not run out. On the contrary, its creation and distribution increases its importance, and the economic benefits gained from its use are constantly growing. Thus, knowledge is increasingly important in the production process in the modern economy. The ability to create and transform knowledge into new technologies, products and services, affect the market success of companies, and thus the development of the entire economy. The purpose of this article is to show the mechanism for the transfer of knowledge and technology in the business and economic environments. Moreover, the author attempts to demonstrate how the technology transfer process can increase the efficiency of the use of knowledge as a factor of development.

#### INTRODUCTION

European Union strategies assume that expenditure on research and development activities should be around 3% of GDP, with two thirds of the amount coming from companies. To a large extent, social and economic growth is dependent on the level and development of R & D activities and the use of research results in practice. R & D institutions that function efficiently affect the degree of innovativeness in enterprises and in the whole economy. Entrepreneurs often encounter obstacles that impede them from conducting innovative activities. The biggest barriers include economic factors, and above all insufficient funds and excessive cost of introducing innovation. Lack of financial resources from external sources is also a barrier indicated relatively often by entrepreneurs. A strong commitment to decreasing the development gap in Europe can be seen in the case of Estonia. Rapidly increasing expenditures on research and development activities, and the growing importance of business entities in R & D funding, is reflected in the increase of the number of innovative companies. Research and development activities, financed by the business sector, are a driving force for innovation in Estonia.

#### MATERIALS AND METHODS

Currently, little research and analysis has focused on the problems of mechanisms of knowledge and technology transfer in business and economic environments.

Moreover, there is a lack of analyses dealing specifically with systemic approaches to economic and business processes. It is rather surprising, considering the fact that if we take any economic phenomenon or object, regardless of their nature and scale, almost everywhere we come into contact with the flow of knowledge and technology from many areas of economic activity. Given the above gap in research and analyses, the author of this publication has set a target to fill, at least partially, this gap. The subject of consideration in this article is the analysis of the mechanisms of knowledge and technology transfer in the economy. Furthermore, an objective of this study is to show selected fragments of economic reality in the context of mechanisms of knowledge and technology transfer. The basic thesis of this work is that the transfer of knowledge and technology in the sphere of business is a major factor in the market success of enterprises, and therefore it fosters the development of the entire economy.

The method of descriptive analysis, based on extensive literature studies, was used in this paper. The theoretical achievements cited are mainly English-language literature concerning mechanisms of knowledge and technology transfer in business and economic environments.

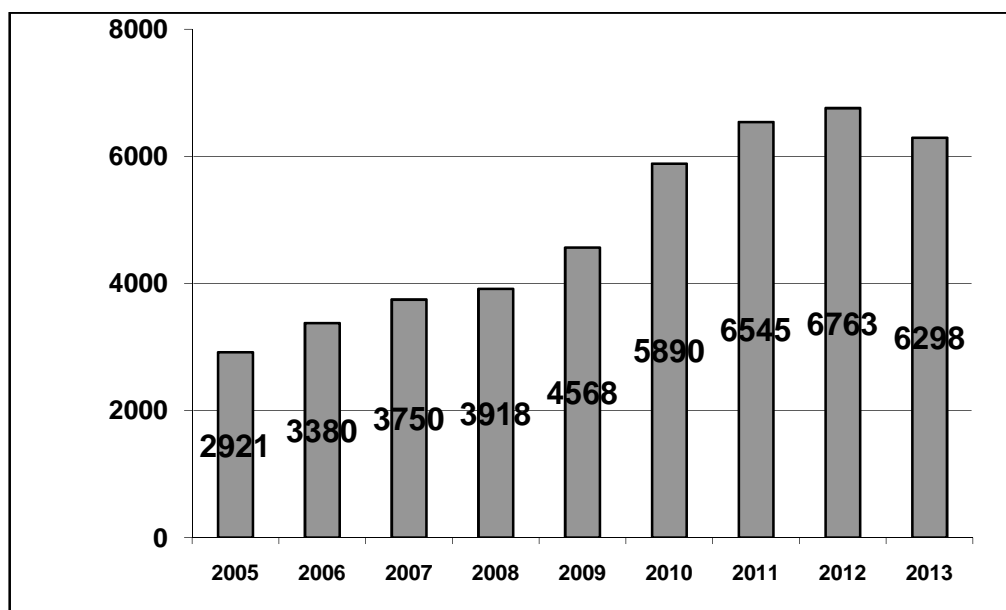
#### Legitimacy of expenditures for innovative purposes

Two trends dominate the literature on the analysis of government expenditures on innovative activities (Makkonen, 2013). The first trend is of a pro-cyclical nature, where expenditures on innovative activities are reduced with the collapse of the economy, and reallocation of rather slim

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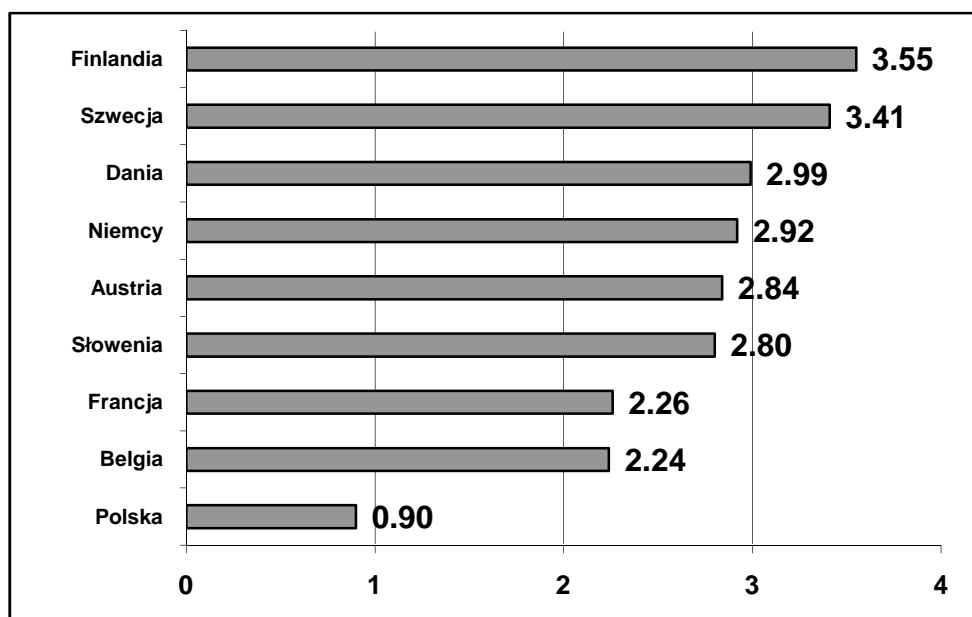
financial resources occurs. The second trend is of an anti-cyclical nature, where a crisis is perceived as the perfect opportunity to increase expenditure on innovative solutions. This latter approach can be explained by the conviction that in this way, the state tries to regain lost competitive advantage, and above all, to survive in difficult macroeconomic situations.

agency of the Ministry of Science and Higher Education that is responsible for the organization of competitions in the field of basic research. Information about domestic expenditure on research and development, which is one of the determinants of economic growth, is published every year (Figure 2).



Source: own research based on data from the Ministry of Science and Higher Education

**Figure 1.** The amount of budget expenditure on science in 2005-2013 in Poland (in millions w PLN)



Note: GERD - Gross Domestic Expenditure on R&D Index determines the total domestic expenditure on research and development, carried out within the country in the reporting year.

Source: own research based on: *Gross Domestic Expenditure on R&D*, Eurostat, <http://epp.eurostat.ec.europa.eu> [access: 10.11.2014].

**Figure 2.** The GERD Index (in %) in selected European countries in 2012

There has been an observed increase in the budget expenditure on education in Poland in recent years (Figure 1). A time of particularly important growth (compared to the previous year) occurred in 2011, which was connected, among others, with the establishment of the National Science Centre - an executive

In 2012, the highest expenditures on research and development was recorded in: Finland - 3.55%, Sweden - 3.41%, Denmark - 2.99%, Germany - 2.92%, Austria - 2.84% and Slovenia - 2.80%. Poland, with a rate of 0.9%, has a low position,

occupying 18<sup>th</sup> place within European Union (out of 28 EU countries).

In the latest ranking on innovation, based on data from the years 2009 to 2012, prepared by the European Commission in 2014, Poland is a "moderate innovator" that generates innovation at approximately 50 to 90% of the EU average (unfortunately Poland ranks closer to the lower value). Innovation leaders are the Nordic countries (Finland, Sweden, Denmark) and Germany (**Innovation Union Scoreboard, 2014**). Perhaps a recipe for the improvement of this situation in Poland would be to strengthen the mutual cooperation of academic centers with the business sector. The experience of countries that achieved measurable successes in R&D activities indicate the need to appoint appropriate organizational structures (e.g. in the form of companies, foundations and associations), whose task would be, among others, to stimulate the process of the absorption of developed solutions into business practice (**Best, 2005**). This refers to, among others, technological parks or technology transfer offices. The scope of support offered by such institutions varies (usually it includes trainings, legal or accounting counseling, financial support in various forms), and depends primarily on the needs reported by the environment (**Dolan et al., 2006**).

An indispensable way to stimulate innovation is to search for cooperation with foreign partners through the Enterprise Europe Network, whose aim is, among others, to support SMEs to develop their innovative potential (**Enterprise Europe Network, 2014**). The problem does not lie in the establishment of new institutions, but in ensuring that those already established have proper conditions for the effective distribution of developed innovative solutions among stakeholders.

### **Transfer of technology and knowledge in the business environment**

Technology transfer can be carried out in a horizontal manner (between interested companies) or in a vertical manner (knowledge is transferred from research units to the business sector). Knowledge transfer, with the aim to develop a specific innovation, is made between its bidder (an academic or research institution), and the entity which requested it (i.e. a company). The effectiveness of this flow depends on a number of factors, such as:

1. The institution offering knowledge or technology must constantly adapt its "product" to the requirements of its customers.
2. Companies using such services should have a relatively high level of innovation and technological absorption to be ready to receive specialized solutions.
3. In the course of the evolution of the process of knowledge transfer, the following instruments are increasingly being used: initiation of common research and development projects; internships for students, graduates or PhD students in selected branches of companies; universities postgraduate studies or training courses for specific companies; as well as the establishment of competence centers.

With increased expenditures on basic research funding, national governments can expand access to permanent informational resources which influence the development of the economy (**Salter and Martin, 2001**). However, we cannot forget that sometimes this knowledge is so called "tacit knowledge", comprehensible for only a specific group/network of scientists, who are able to find a practical use for it. Research shows that the benefits from funding are directly translated into the development of new technological solutions (**Beis and Stahl, 1999**). This occurs most often in the pharmaceutical, petroleum, chemical and food industries. The concept of open innovation was initially the domain of large, international companies. At present, experience shows that small and medium-sized enterprises should also take advantage of such opportunities. The evidence for this is that, on a global scale, small and medium-sized enterprises are rapidly growing. The source of their competitive advantage is the protection and utilization of their intellectual property through the opening of the innovation process (**Keupp and Gassmann, 2007**).

External commercialization of technology is at the core of fast growing companies. As pointed out by O. Gassmann, E. Enkel and H. Chesbrough, the creation of the open innovation model is still in its early stages. It still requires much more work on the part of researchers, practitioners and politicians (**Gassmann, Enkel and Chesbrough, 2010**). The process of creating new solutions occurs within a system of connections, which include: networks of enterprises, research and development units, various public initiatives, as well as non-governmental institutions and public administration institutions. Mutual exchange of information and penetration of ideas facilitates the development process. Companies, in the era of globalization and intense technological changes, in seeking new solutions and increasing the competitiveness of their units, should use a variety of solutions for achieving their goals (**Gabriel, 2008**).

An analysis taking into account the size of companies showed that bigger companies use innovation more often (**Gupta and Lehmann, 2005**). This is due to the fact that they have greater financial possibilities as well as greater potential to lead innovation activities. It is indicated that large enterprises usually operate on more demanding markets, competing with other large foreign companies (**Łapi ski, 2010**). This competition somehow forces large companies to behave in an innovative way. On the other hand, small and medium-sized enterprises are characterized by a smaller range of activities, often limiting their activity to the local market; they have in their offer fewer products than larger entities. Therefore, their chances for innovation are relatively smaller.

### **Research as a factor of economic development**

Financing basic research from public resources exerts a significant impact on economic development by:

- Increasing the resources of useful knowledge,
- Training talented graduates,
- Creating new sets of scientific instruments and research methodologies,

- Setting up networks and stimulating social contacts,
- Increasing possibilities for solving problems of scientific and technological nature,
- Establishing new companies ([martin salter, 1996](#)).

Creating new knowledge about occurring phenomena may in the future lead to its direct application in the form of new technological solutions ([Czarniewski, 2015](#)). Many companies attentively observe what kind of projects are realized in research centers. Based on macro- and micro-economical analyses, these enterprises try to predict the potential benefits of the commercialization of scientific work. An important role is played by scientific publications documenting successive phases of conducted studies ([Pomerleano and Shaw, 2005](#)). Through such publications, companies not only gain an opportunity to build contacts, but also have access information which only becomes (valuable) knowledge when its recipients are capable of using it ([Alvesson, 2004](#)). Another benefit associated with the financing of basic research concerns the education of future graduates, who are offered the opportunity to participate in the implementation of research (as their co-contractors). Students can acquire practical skills that will be useful for them in the future, in work environments that are not necessarily connected to research. New challenges associated with conducting basic research force scientists to develop new analytical methods. This allows them to solve emerging problems, to use new research tools or to use laboratory techniques that have not yet been exploited. All this leads to the development of research fields in existing scientific disciplines which have not yet been explored ([Salter and Martin, 2001](#)). It also enables scientists to formulate new solutions to complex technological problems, which often benefit the companies concerned.

The realization of concrete research projects brings about many advantages. For many scientists, there is the possibility of entering into an international community and to actively participate in the process of exchanging ideas that may lead to the design of new technological solutions ([Blatz et al., 2006](#)). Currently, one of the main projects of the European Union is called the Human Brain Project Consortium, which unites 80 institutions from all over the world. The aim of this project is to map out a virtual human brain within the next decade. The economic benefits from the existence of such networks are difficult to estimate, considering the fact that representatives of the industrial sector fight to have access to them. Most of these networks are based on direct contacts. These contacts, in turn, are based on mutual trust, which is an essential component of establishing long-term cooperation ([Sungmin et al., 2008](#)). Institutional openness is becoming an increasingly popular concept in practice and in academic (research) environments, meaning open innovation, open R & D activities and open business models. Entrepreneurs seeking to increase their innovative position may be interested in a concept suggested by H. Chesbrough. According to this concept, in a world of widespread knowledge, companies should use their own ideas, and rely on their own research (on the one hand), but should also use external ideas and acquire licenses, patents and other innovative solutions (on the other hand) ([Chesbrough, 2006](#)). They should also make available the solutions they have not

used to others by selling licenses and creating consortia, in order to generate additional value.

## Conclusion

1. Countries which rank last in the innovativeness of enterprises also do not invest much in R&D. Polish, Slovakian, Lithuanian, Latvian and Bulgarian companies conduct research and development activities only to a small extent, and there is overall low investment on research and development activities. In countries with greater expenditures on R&D, there are also higher shares of innovative enterprises (Germany, Belgium, Finland, Sweden).
2. Thanks to the transfer of knowledge and/or technology, there is a specific combination of two worlds (the theoretical and the practical) where there had been no relationship before. This flow of knowledge does not only go from academic or research centers to industrial hubs. We can also observe the opposite relationship. Scientists, holding internships in enterprises and learning about technological problems, are sometimes able to offer companies concrete solutions. They may also conduct research in such directions that would allow them to eliminate those problems in the future.
3. Ensuring continuity of the innovative processes requires having control over the development of knowledge and its applications at different levels. Hence the crucial role of great organizational systems. The new organization of the modern economy combines the features of free market and control. The country/ state is also involved in the current market economy. Its task is to create macroeconomic conditions that are conducive to developing knowledge and maintaining the continuity of innovation processes.
4. Competitive advantage can be created as a result of innovative activities and more efficient use of resources than the competition. Companies are able to generate a competitive advantage by using their resources more effectively to produce and offer products that are at least comparable to the offer of competitors or provide value for customers at a lower cost (and price), or when the goods are valued higher than the competition at a comparable cost.
5. Key features of competitiveness, as shown in this work, are important in the long term. The skills and experiences of company management can allow for the creation of value that changes over time, which ensures customer retention in the long term, guaranteeing the continuity of the company's existence and its high value. These qualities are the result of competitiveness and a source of future activities in the field of research and development.
6. The basic condition for coming up with scientific breakthroughs and technological solutions is the culmination and development of knowledge. Technological solutions can only be discovered or invented by people who are appropriately trained. They must be part of a modern and well-organized educational system, which contributes to the development of relevant skills.

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