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Jarosław Mielcarek

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Preface*

The task of surveying the innovation performance of the economy has become one of the biggest challenges facing economists today. The basic growth potential of the Polish economy has nearly reached its end. It is not possible to continue the current model of economic growth which is based on low labour costs and price competitiveness. Innovation should be the main driver of the economy. In the model proposed by R. Solow, exogenous technological progress is the only source of sustainable GDP growth. In endogenous models of economic growth technological progress is an internal force of the economy. Based on these models, *The Global Competitiveness Report 2014/2015*[1] distinguishes 5 groups of countries. 37 countries have been classified as *innovation-driven countries*, which are at the third and highest level of development. Unfortunately, Poland is not in this group.

The problem of breaking out of the middle growth trap, in which the Polish economy has found itself, depends largely on improving innovation. It is only through innovation that sufficiently high GDP growth rates can be achieved in order to overcome accumulated socio-economic problems and catch up with the level of economic development in the "old" EU member states.

The economy is facing challenges of unknown scale and an adequate solution can only be found by solving the problem which can be expressed in the following question: how to steer the process of invention creation and its successful implementation in companies by reforming the institutional framework and playing more active role by state in fostering innovation. This is both a theoretical and practical problem. It is worth noting that having an innovation policy is not only crucial for a state but also for companies. An effective innovation policy re-

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* Preface translated by Grzegorz Grygiel.

[1] World Economic Forum, *The Global Competitiveness Report 2014-2015*, Geneva 2014, pp. 11-13, www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf [access: 20.02.2016].

quires a valid diagnosis of the low level of innovation performance of the Polish economy. It must be accompanied by analyses for different economic sectors to highlight those where implementation of innovation is inhibited by various barriers and other where it is ends in success.

The authors of articles presented in the current issue of the "WSB University in Poznan Research Journal" have addressed the problem of diagnosing the low level of innovation performance of the Polish economy as well as the role of public finance and innovation across sectors. Two articles on public finance concern the impact of public expenditure on R&D, education and health care on innovation and the relationship between public procurement and innovation.

Sectoral analyses are devoted to innovation performance of the services sector in Poland and in the world, the sector of renewable energy sources and the financial sector in Slovakia. One of the authors presents an unconventional view of innovation, describing an innovation strategy which is based on behavioural economics, biology and neurology.

The research problems described in the articles should prove interesting not only to scientists but also to decision makers in the central and local government and to entrepreneurs. They will also be of interest not only to students of economic sciences, since the improvement of innovation performance of the Polish economy will require the mobilization and joint effort of the entire society, not just a narrow group of experts. It can be expected that the present publication will induce a discussion that will motivate authors to implement their existing research plans in this area.

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Instruments Creating Demand for Innovative Public Procurement in Light of Empirical Research*

Abstract. *Public procurement has been, for many years, one of the main instruments of the European Union in creating demand for innovation. Proof of this is seen in numerous strategic documents on this subject, as well as, good practices regarding their use in selected countries. Unfortunately, the use of public procurement in order to create innovation in Poland is a reflection of the low position of our country in the European ranking of the most innovative states. Moreover, the problem is not broadly addressed in Polish literature on the subject. Therefore, the aim of this article is to identify the instruments creating demand for innovative public procurement in Poland. Their characteristics have been enhanced with empirical studies carried out on 165 authorities who were obliged to apply the provisions of the Public Procurement Act, supplemented by data from secondary sources from publications of the Public Procurement Office.*

Keywords: *innovativeness of economy, public procurement, creation of demand*

Introduction

The subject literature sources share a view according to which Polish economy has a high potential for innovation. It consists of a strong entrepreneurship of Poles (according to Eurostat, Poland is one of the most entrepreneurial countries in the world), a success of many industries in creating innovation in spite of the lack of interest of the state in financing their new ideas, as well as greater attention

* The paper translated by Jan Sosnowski.

paid to the development of metropolis, all causing changes in attitude and thinking about innovation.[1] However, using this potential requires an appropriate economic policy of the state and a rational approach to resources and legal solutions. One possibility for an effective action is a consistent use of solutions provided by the public procurement system. The point is to utilize the existing legal provisions and capital in order to create demand for innovative products and services. This problem does not involve any regulatory changes, but more efficient use of available resources to meet social needs, which is the essence of modern economics.

Demand for innovation is a need for new ideas and solutions raised by all potential customers. From the point of view of this article, this demand is understood as the demand for new products reported by public sector entities. It should, however, be noted that the supply of innovations is an offer of new solutions proposed by contractors in procurement procedures. Creating demand for innovation refers to the development by public sector entities of demand for innovative solutions in the economy, which (given their funding) can be used by the whole of society, and the creation of supply may involve all stakeholders of the market. On the other hand, innovative public procurement means a remitted contract concluded between the contracting authority and the contractor, the subject of which is an innovative service, innovative delivery or innovative construction works.

The achievements of theoretical and empirical research on creating demand for innovation through the public procurement system are very modest in global literature. The issue of creating demand for innovation by this system is addressed mainly by the EU strategic documents such as the Lisbon Strategy, for example, while in Poland publications of the Polish Agency for Enterprise Development and the Ministry of Economy. However, they do not include any in-depth research and analysis indicating the possible use of the development potential within public procurement in order to create new solutions in the form of innovative products and services. It should also be noted that the literature related to public procurement is dominated by all kinds of legal publications and the economic issues have not been of particular interest so far.

This fact is surprising, since the public procurement market is one of the fastest growing markets in Poland. Its value in 2013 increased by 8 percentage points over the previous year and amounted to 143,2 billion PLN [UZP 2013: 26]. It undoubtedly points to a significant impact this market has on the entire national economy.

The analysis of creating demand for innovations through public procurement system (and thus the use of the existing potential of this system) is a very important economic problem Polish economy has to face. Despite the lack of empirical

[1] *Go Global! Raport o innowacyjności polskiej gospodarki 2001* [*Go Global! Innovation Report of Polish Economy 2001*], http://polskiwroclaw.pl/upload/Raport_final.pdf [access: 10.12.2014].

achievements in this regard, the examples of highly developed countries show that through the effective use of existing resources and legal status and with solutions used by the public administration, the innovativeness of many economies could be raised.

The purpose of this article is, therefore, to present (against the background of empirical studies and data from secondary sources) the instruments creating demand for innovative public procurement in Poland. The study involved 165 authorities obligated to apply the Public Procurement Act. Purposeful sampling was used primarily to receive professional and real answers, because individuals not participating in public procurement procedures often manifest ignorance of the public procurement system. In order to validate the results and to determine dependencies a test of independence was applied according to the chi-square and the time range of the sample covered the years 2010-2012. The study was conducted among entities throughout the entire country.

1. Instruments creating demand for innovative public procurement

As already mentioned, public procurement may become in the near future one of the main tools to boost competitive position of the Polish economy by creating innovative solutions which would carry economic benefits for many years to come. So let's trace the most important instruments that should determine the demand for innovation in the current legal status. They primarily include the following:

– the use of the so-called pre-commercial procurement,
– technical dialogue between the contracting authority and the contractors,
– the use of competitive dialogue and negotiation modes,
– publication by the contracting authority of initial information notices on procurement,
– the use of the so-called *Value for Money* rule (benefit ratio rule),
– formulating the terms of reference within the terms of the contract,
– admission by the contracting authority of variants and equivalents,
– giving up the lowest price criteria at the expense of the criteria leading to the most economically advantageous tender,
– providing advances to contractors who have submitted the best bid,
– proper drafting of contracts with contractors winning tender procedures and the introduction of appropriate records supporting innovation-oriented solutions,
– professional commitment of the tender committee knowing the criteria for the selection of innovative public procurement (optional involvement of substantive experts).

Pre-commercial procurement processes are related to the provision of innovative public procurement, so that public authorities can control the development of new technology solutions,[2] which are designed to meet the specific needs of the contracting authorities, and in particular in areas where there are no commercial solutions or where they are not sufficient. They refer to tenders for research work and scientific research prior to commercialization. They constitute a modern instrument which facilitates the adjustment of the object of the contract in the best possible way to the needs of the contracting authority.

Pre-commercial public procurement is a potential for a review of various possible solutions before committing to procuring a commercial product. It is worth noting that in the case of pre-commercial procurement, public entity can be composed of contracting authorities from different countries or regions. It diversifies the risk and reduces the financial burden.

Against the background of the basics related to the provision of pre-commercial procurement it is worth considering what is the condition for their use in Poland. Unfortunately, the reality in this area is staggering because as late as the end of 2010 the first and probably the only comprehensive analysis appeared in which the foundations for contracts of this type were laid down. Thus, the existence of disorientation of Polish authorities regarding the concepts and procedures for their implementation. None of the participants of the study on barriers to the implementation of innovative public procurement was able to answer the following question: what is the pre-commercial public procurement. And none of them has ever implemented such procurement nor planned such an implementation.

A good solution prior to the granting of pre-commercial procurement can be the use of **technical dialogue**, because the development of innovation may influence expectations balance between the demand side and the supply side [Movery & Rosenberg 1979: 148]. One needs to keep in mind that public sector employees are generally professionals with regard to the implementation of innovative solutions and technologies, thus by defining their needs they will be forced to consult them with entrepreneurs who are specialists in their respective industries. Therefore, they should be very careful in identifying their needs and then effectively analyze the market of contractors.

Technical dialogue is therefore a tool in the hands of the public entity that enables the exploitation of consulting firms, academics and experts before tender procedures, which should help to correct inaccuracies in the formulation and development of the content of tender specifications. Technical dialogue can be carried out in several ways, e.g. by the following: commissioning of an analysis, development of specifications or testing on the basis of solutions used in other

[2] Draft Preliminary Paper on the Community Law applicable to Pre-commercial Public Procurement, September 2006, Version of 29.09.2006.

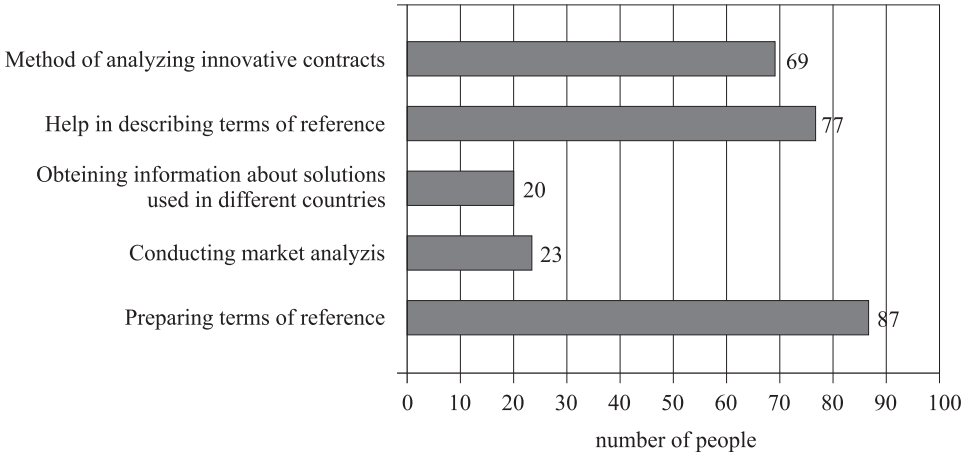
countries. Another method is to conduct interviews with clients, professionals and even potential contractors to obtain knowledge about the existing market solutions and technologies that can be obtained. Finally, another way is to use a tendering mode which allows negotiations [Serbeńska 2011].

It turns out that none of the 165 surveyed persons ever got familiar with the concept of technical dialogue and never introduced it in practice. Few officials (12%) admit, however, that they often consulted with third parties how to prepare tender documentation. But those were never advisory or consulting firms, but above all, direct superiors and colleagues.

Interestingly, more than half of the respondents (55%) see the need for such consultations primarily regarding the preparation of the terms of contract, the terms of reference, and formulating equitable methods for the assessment of contractors participating in tenders. The majority also believes that the use of this approach in the future may contribute to the growth of innovative public procurement in Poland and to create demand for innovation. Chart 1 presents the results of studies related to the demand for the application of technical dialogue at different stages of a tender procedure. Respondents presented their opinions regarding the cases in which the technical dialogue could assist them.

According to the survey, the smallest interest in the field of technical dialogue was enjoyed by the opportunity to obtain information about the solutions used in other countries. This result seems to be disturbing, because Polish economy holds one of the last positions in the European Union in the field of innovation, and the solutions implemented in other countries often seem to be a lot more useful.

Chart 1. Areas indicating the need to use technical dialogue in the opinion of the contracting parties



Source: own study based on test results.

Also, a low interest in performing market analysis is worrying, because only good knowledge of such an analysis is a prerequisite to obtain information about the latest technologies and the most technologically advanced entities. The results do not sum up to the sample size, as respondents had an opportunity to simultaneously identify multiple answers, as well as add all their own proposals. Of these, the most frequently appeared the need to use technical dialogue in terms of cost estimate regarding construction works, as well as the conditions of contract.

Another tool for contracting authorities to create demand for innovative supplies, services and works is the use of a competitive dialogue or negotiation as a mode of public procurement. These modes are undoubtedly suitable as the best of the eight created by the legislature to test and verify new ideas. In accordance with the applicable regulations the **competitive dialogue** is a procurement procedure in which, after the public announcement of public procurement, the contracting authority shall pursue a dialog with selected contractors, and then invite them to tender. Due to its design, this mode enables a wide range of innovative products and services. As pointed out by Paweł Granecki [2007: 201] in his commentary on the Public Procurement Act, it enables the provision of complex contracts often associated with ICT, infrastructure projects, or projects regarding funding processes. It seems that this mode is also suitable for projects financed in the form of public-private partnership, as in this case it is the hardest to describe an innovative project.

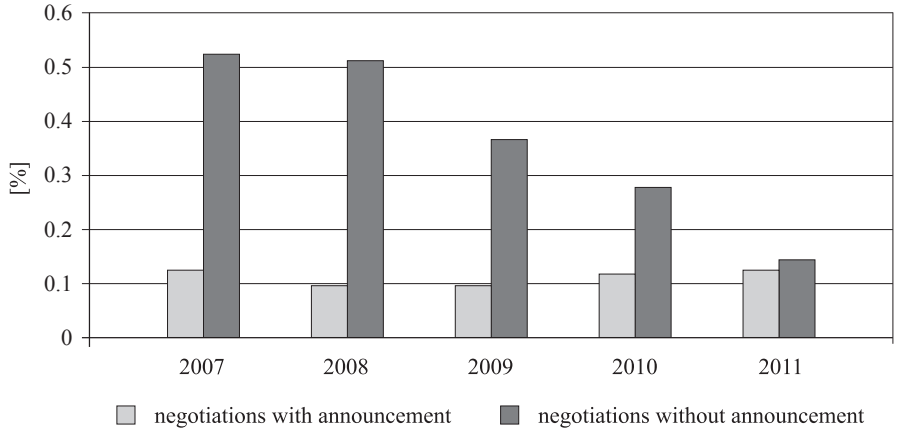
Unfortunately, in Poland the competitive dialogue is virtually never used. Of all the respondents, none has ever used this mode in practice, and none has even known any provisions or conditions concerning its application.

Among the reasons put forward by respondents with regard to the reluctance in the use of this mode the uncertainty of obtaining a contract dominates. Concerns are often raised about the participation in the dialogue, because no one wants to sell their ideas before implementing them in practice. Hence, it is essential to reward potential contractors participating in the dialogue, which would encourage them to participate in it even further. The possibility of such remuneration is given to authorities by the PPL Act.

A solution similar to competitive dialogue is a negotiation procurement mode. Polish Public Procurement Act among such modes includes negotiations with announcement and without announcement. **Negotiations with announcement** are a mode in which, after the public announcement of a contract, the contracting authority invites contractors authorized to participate in the proceedings to submit initial bids not containing prices, leads negotiations with them, and then invites them to re-tender. On the other hand, **negotiations without announcement** are a mode where the contracting authority negotiates the terms contract with contractors of its choice and then invites them to tender.

Unfortunately, in this respect, as in the case of the competitive dialogue, the capacity of its utilization is low. The data of Public Procurement Office on this subject is shown in Chart 2.

Chart 2. The proportion of the use of modes of negotiation in 2007-2011 among Polish contracting authorities



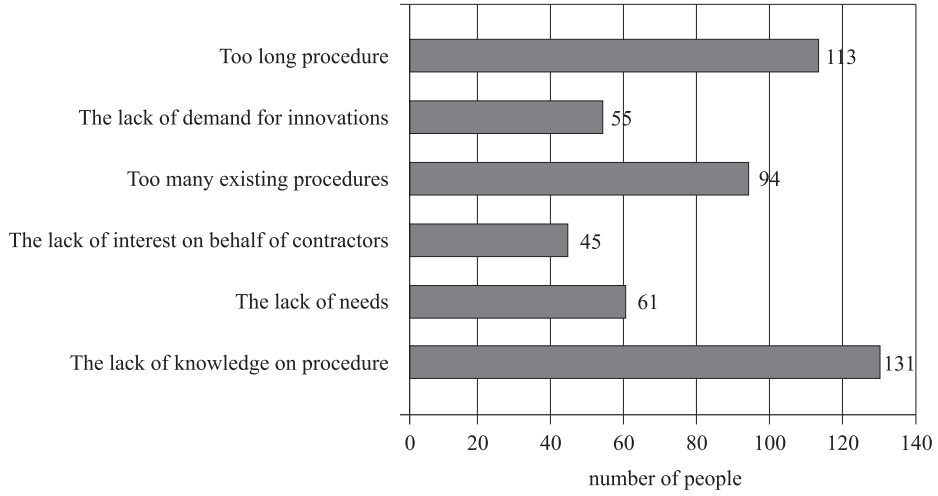
Source: own study based on data from the Public Procurement Office.

Chart 2 shows a large downward trend in the use of negotiation modes by Polish authorities, as well as a very low percentage compared to other modes of public procurement. As in the case of competitive dialogue, the use of these modes requires the fulfillment of statutory requirements and is not always possible. Chart 3 shows the most important barriers to the use of negotiation modes.

Among the most important barriers stemming from the research on the use of negotiation procedures, it is worth to mention primarily those associated with long-term durability and procedure difficulty. Very often contracting authorities are not interested in procedures, which are time-consuming and rarely lead to the expected results. At the same time too many possible solutions also result in the resignation from harder modes and preference of the easier ones and thus shorter lasting in time.

Discussing the negotiation modes one needs to mention one more procedure relating to the award of public contracts, namely **contest**. The associated procedure also allows the presentation and selection of innovative solutions. It is important, however, for the contest works to be actions which are in fact pieces, since it is desired that the subject of the competition was protected and the rights were transferred to the contractor [Starzyńska 2011]. As shown by many specialists in the field of public procurement, a contest is an excellent platform for the

Chart 3. The barriers to the use of negotiation modes
in the opinion of contracting authorities



Source: own study based on test results.

exchange of experiences and presenting innovative solutions by the private sector. The problem linked to its use, however, lies primarily in the fact that it is not a mandatory procedure and is not on the list of modes provided for by law. Therefore, the proportion of proceedings conducted by the authorities on a contest basis is similar to the modes of negotiation.

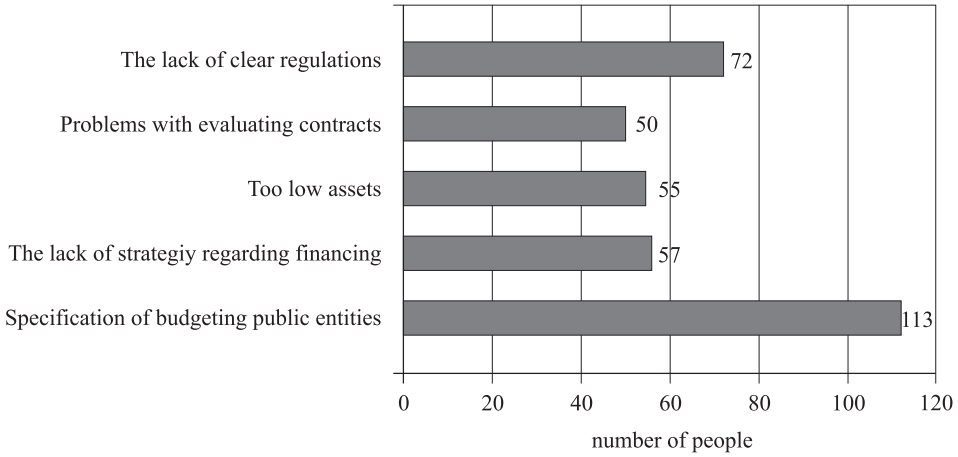
Another solution favorable to the creation of demand for innovations by the contracting authorities is to publish their pre-information notice for procurements. Early **planning of public procurement of innovative** character is decisive when it comes to obtaining a solution that would meet the requirements of the customer. Therefore, in order to effectively create demand for innovation, a public sector entity must articulate its needs well in advance regarding what it wants to purchase, and how it wants to carry out the contract.

A very important element in this respect should be an evaluation committee appointed by the contracting authority. It should begin its work at the stage of preparing specific procedures, because – if it begins to work too late – it will not be able to implement solutions leading to an innovative subject of the contract. Members of this committee should also benefit from a broad support of other organizational units or internal entities to describe the object of contract characterized by innovativeness and a specialized nature. It is also recommended for the committee members to be people who are the end users of products or services. In the case of contracts for a totally unknown object, it is also worth considering the

use of an external professional company, which will be able to the highest extent to take advantage of the possibilities offered by legal provisions.

Unfortunately, despite the benefits stemming from obtaining innovative solutions (resulting from quick planning of customer's needs), the process is not fully exploited by public institutions. Reasons related to the lack of effective planning of public procurement diagnosed in the course of the study are shown in Chart 4.

Chart 4. The reasons for the lack of effective planning of public procurement in the opinion of authorities



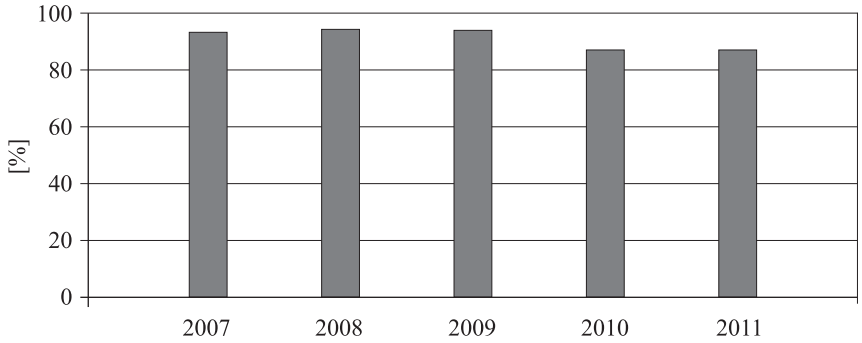
Source: own study based on test results.

The reason for the lack of effective planning of expenses related to the award of public contracts in the opinion of most authorities is the nature of public budgeting. It is hardly surprising that the ordering authorities approach any plans in a skeptical and careful way as they do not know the amount of funding they would receive from the regulatory authorities in the next financial year. They often point to the fact that the amount of funds obtained by them in subsequent years undergoes major changes, and especially in the case of construction works, investment planning is often irrelevant.

One solution to create demand for innovation is the use of the so-called *Value for Money* index. It is achieved by the time they reach the widest possible benefits in terms of their existing resources and capabilities. Obtaining the said index involves primarily an analysis of criteria for selection of the best bid, because – as it turns out – the contracting authorities, while deciding upon tendering procedures, are guided by the most current purchase cost, not further costs of operating, maintenance or repair. It may turn out that a higher cost of purchase when selecting the most advantageous and innovative solutions can result in greater savings in the op-

eration phase. It is worth pointing to additional aspects, so that additional savings may arise such as: lower consumption of electricity or water, longer product life cycle or cheaper materials associated with the operation or exchange. Chart 5 shows the percentage of procurement procedures in 2007-2011 in which the contracting authorities were solely guided by the lowest price when choosing the best bid.

Chart 5. The percentage of procedures in which the contracting authorities were guided by the sole criterion of price in 2007-2011



Source: own study based on UZP data.

As can be seen from the presented data the contracting authorities are in any proceedings always guided by the principle of the lowest price. The ratio of the number of proceedings where it is the only criterion for selection oscillates in the range of 90% and indicates that Polish authorities do not take into account that a more expensive offer may be more favorable. It is impossible, therefore, in this case to talk about Polish officials making purchases in any reasonable manner. Application of the *Value for Money* principle provides a possibility of linking limited financial resources with an innovative effect. Unfortunately, this concept is unknown among Polish authorities. None of the interviewed authorities could identify what it is, or point out to innovative procurement in other countries, which in the long run helped to generate financial savings.

Therefore, Polish authorities should be encouraged to apply such criteria, which are a combination of both price and object criteria, and which allow the selection of the most economically advantageous tender. These criteria may include the following: term of the contract, technical performance, cost of ownership, quality of service, functional characteristics, material quality, after sales service and technical support [Trepte 2004: 202]. What is important, the weight of each of these criteria can be consciously and with great freedom shaped by the contracting authority.

The effective use of the *Value for Money* index is also linked to an appropriate (and consistent with legal provisions) **terms of reference**. Unfortunately, in this respect, the contracting authorities are guided chiefly by means of descriptions of technical standards, well-known in the market, solutions, moving away from defining the functional requirements defining products and services planned for purchase. Only the creation of opportunities for a flexible approach to offer preparation by contractors creates a possibility of preparing a bid for innovative supplies, services or works. As many as 96% of respondents admitted that at the time of describing the object of the contract they only pay attention to descriptions and technical specifications of products that are already available on the market, or those for which they have already filed a request. Often they also declare that the terms of reference is a duplication of previous or turnkey solution found online. This approach is unfortunately quite worrying and does not prognosticate well for the use of functional requirements, which leads (as already mentioned) to more innovative solutions.

A flexible approach to the formulation of the terms of reference, which would be pro-innovative, allows for a variant or an equivalent offer. If the contracting authority admits **variant offers**, it allows the selection of the contractor who will meet the object of the contract, as well as the technology of its implementation. Variant offers allow different proposals from those indicated in the terms of the contract, for example in the field of technical solutions or the type of material used. Such offers facilitate process innovations, because as a result of their submission a product should be comparable with respect to its description made by the contracting authority. Thus they relate to the various methods of performing the contract. It should also be emphasized that the possibility of such offers exists only if the price is not the only criterion of selection. However, this leads to an increase in contractor's responsibility for the design, technology, technical or organizational solutions, which is reflected in innovative effects and desired operating parameters.

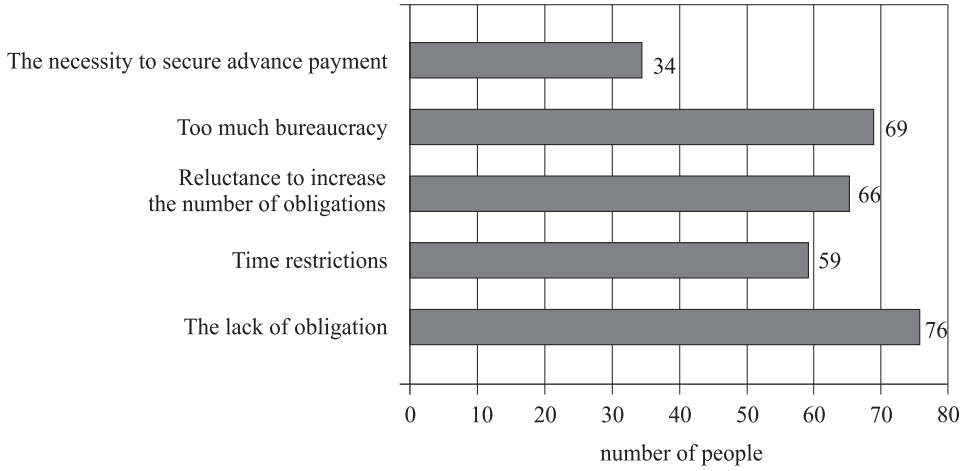
The results of studies on the use of variant offers are quite disturbing. It turns out that only 3% of the surveyed officials applied this solution in their work, and only 7% were familiar with the rules relating to its application. This may prove, on the one hand, that there is a shortage of knowledge and skills associated with the practice, while on the other, the lack of awareness of the implications of this solution for creating more innovative products.

An interesting solution introduced by the amendment of the Public Procurement Act of 2009 is the possibility of granting **advances** to contractors who submit the lowest bid. It seems that this is a very favorable settlement, especially for the efficient implementation of public tasks. It should encourage the especially innovative small and medium-sized enterprises to become more involved in tender

procedures. Such a situation, from the point of view of competition, would favor the probability of appearance of innovative solutions submitted by contractors in the market, as well as real financial support at the stage of contract implementation, which normally (especially in the case of an innovative projects) would cause large strain for budgets of companies.

In the case of Polish authorities, as shown by the results of the study, pre-financing of contracts is not of particular interest. The reasons for this unwillingness are shown in Chart 6.

Chart 6. Causes related to the reluctance of authorities to grant advances in public tender procedures



Source: own study based on research results.

According to the research, the lack of a statutory obligation to provide advances by the authorities is the most common reason for discontinued activities in this area. In combination with an excess of bureaucracy caused by the extra load time, it is hardly surprising that only in the case of 35% of the respondents it was possible to apply this type of solution in the course of the contract. They agree, however, in the majority (78%) that pre-financing of supplies of particularly complex and sophisticated (in terms of technology) items and services not easily available on the market is linked to advance payments for contractors.

Demand for innovative solutions can also be created by appropriately constructed **terms of reference**. Efforts should be made to reach such provisions of the contract, that after the public procurement procedure there still are further opportunities to develop innovative solutions during the term of the contract, which is particularly important in terms of appropriate regulation of copyright. It is all

about preventing public finance entities from condemning citizens to use products and services that would not keep pace with new trends or changes in the market. However, as the results show, only 4% of contracting authorities declare the introduction of pro-innovation content in the contract records. Introduction of such records in the case of certain sectors should become obligatory. This applies especially to computer equipment that depreciates rapidly, high-tech industries and services, and medical equipment.

From the viewpoint of improving the conditions for creating demand for innovation, it is worth forming a **professional procurement committee** or a group of professionals who know how to properly analyze the risks associated with the implementation of innovative solutions. This is not only about the ability to determine the probability of a contract gaining public approval, but above all, a proper diversification of financial risk between the contracting authority and the contractor whose offer proves to be the most advantageous.

Conclusion

Polish economy lacks positive examples indicating the correct and sensible application of the Public Procurement Act in order to ensure greater demand for innovative supplies, services and construction works. Thus, it is worth emphasizing the importance of public entities in promoting innovation through public procurement.

It seems that one of the main barriers to the development of innovativeness is the human factor. As a result, it is worth considering model training programs for the formulation of the terms of reference, to define its functions as well as to determine the evaluation criteria. Such trainings are worth propagating, so the public procurement system attracts employees who are competent, able to interpret the law and apply it in order to create demand for innovation.

In terms of training and promotion policy, the support should focus on such solutions in the procurement process that would lead to the use of negotiated procurement modes, especially the competitive dialogue. The ordering authorities should also see the benefits from advisory services before the initiation of the public procurement procedures i.e. technical dialogue and training on the use of this tool.

The public procurement procedures should abandon the lowest price criteria, at the expense of greater use of the most economically advantageous tender, as well as the possibility of variants. It is well known that the lowest price does not necessarily mean the best solution, and the benefit ratio analysis leads to the conclusion that it often requires more resources and money in the later phase of the contract.

In order to implement pro-innovative public procurement it is necessary to plan well in advance the conduct designed to serve the private sector. Informing the market in advance about the needs of government can contribute to a better and more professional preparation of potential contractors. As part of a comprehensive innovation policy, the contracting authorities should also establish a dialogue with key stakeholders, legal practitioners and experts.

It seems absolutely necessary to develop model contracts that would allow for the acquisition and development of innovative solutions. It is important to fully respect the copyright of the owners. In any proceedings of innovative potential the contracting authorities should also analyze the feasibility of pre-commercial procurement in accordance with applicable regulations.

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Instrumenty kreowania popytu na innowacyjne zamówienia publiczne w świetle badań empirycznych

Streszczenie. *Zamówienia publiczne od wielu lat są jednym z podstawowych instrumentów Unii Europejskiej związanych z kreowaniem popytu na innowacje. Mogą o tym świadczyć liczne dokumenty strategiczne poświęcone temu zagadnieniu, jak również dobre praktyki w zakresie ich stosowania w wybranych krajach. Niestety stosowanie zamówień publicznych w celu tworzenia innowacji w Polsce jest odzwierciedleniem niskiej pozycji naszego kraju w europejskim rankingu najbardziej innowacyjnych państw, a ponadto problem ten nie znajduje w polskiej literaturze przedmiotu sze-*

rokiej reprezentacji. W związku z tym celem artykułu jest przedstawienie instrumentów kreowania popytu na innowacyjne zamówienia publiczne w Polsce. Ich charakterystyka została wzbogacona badaniami empirycznymi przeprowadzonymi na 165 zamawiających zobowiązanych do stosowania przepisów ustawy Prawo zamówień publicznych oraz uzupełniona o dane ze źródeł wtórnych pochodzące z publikacji Urzędu Zamówień Publicznych.

Słowa kluczowe: *innowacyjność gospodarki, zamówienia publiczne, kreowanie popytu*

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Innovation: An Unconventional Perspective

Abstract. *Innovation as a means of gaining competitive economic advantage has garnered a great deal of recent scientific and popular interest in both the United States and in Poland. For example, a January 19, 2015, exploration of the Google Scholar search engine for the term "Economic Innovation" turned up 2,250,000 hits for the United States and 16,700 for Poland. This paper intends to offer its readers an unconventional perspective on the subject of innovation that is grounded in both business and psychology. It will offer some innovation strategies that are rooted in the fields of behavioral economics, biology, and neuroscience. The focus will primarily be on innovation strategies pursued by creative individuals and organizations in the United States and offer some parallels to innovation approaches currently being pursued in Poland and in the European Union.*

Keywords: *innovation, design-driven innovation, innovation strategy, biomimicry*

1. Why Innovation?

Renowned management thinker and author Peter Drucker once defined innovation as "change that creates a new dimension of performance" [Hesselbein, Goldsmith & Sommerville 2002, p. 1]. Current international management experts Fons Trompenaars and Charles Hampden-Turner [2010, p. 1] have since raised the issue "Is innovation a phenomenon of boom times?" Today's organizations face daunting challenges in managing the precarious balance between survival in the present and success in the future. What can we offer organizational leaders such that it will enable them to more positively survive and thrive in increasingly cha-

otic environments? As long ago as the early 1940s economist Joseph Schumpeter [1943] suggested that capitalistic economies were driven by gales of "creative destruction." Is there a stance through which individuals and organizations can gain a useful purchase between the extremes of doing nothing and over-reacting to Schumpeter's inevitable destructive waves? Perhaps exploring the concept of Innovation in non-traditional ways can provide some useful guidance that can be of service to economies and organizations wrestling with difficult times.

2. Innovation Strategies

Rather than being a monolithic concept, Higgins [1995, p. 47] has proposed at least four different varieties of innovation: product, process, marketing, and management. Product innovation relates to a physical product or service. Process innovation concerns a means for improving efficiency or effectiveness. Marketing innovation connects to new marketing concepts or actions. Management innovation conveys a new way of managing.

Strategies are typically concerned with approaches that can be used to accomplish desired future ends. Innovation strategies begin with the use of individual and group creativity to identify new ideas for thinking and solving problems. The essence of innovation is the translation of the best creative ideas into the practical reality of new or enhanced products, services, and processes. This transformation of ideas involves finding new possibilities, assessing their potential worth, trying them out, and then further investing in those that show the most promise.

In particular, after reviewing the state of innovation strategies in the United States, this paper will look at three unconventional strategies that may offer unusual innovation potential: use of metaphor, design-driven innovation, and bio-emulation innovation.

3. Innovation Strategies in the United States

Harvard professor Clayton Christensen [2000, 2003] has written extensively on innovation strategy. His basic premise relates to a perceived innovation paradox: good business practices can ultimately weaken a dominant firm. Great firms can become vulnerable to visionary upstarts, who court an unorthodox group of customers, who are initially viewed as non-threats, and who usually enter markets at the low end of profitability.

Christensen suggests that the most effective strategies are developed as the consequence of radical changes in technology or market structure. These changes are disruptive in that they interrupt or disturb an existing order among established players in an industry or economic sector. Christensen, Anthony and Roth [2004]

have also been advocates for using theories of innovation to predict industry change. They recommend the use of analytical models and tools such that decision makers can: spot innovative firms well in advance of major change actually being recognized within an industry, predict competitive winners and losers, and evaluate how an individual firm's choices can affect its chances of success in the marketplace.

Recently, Ariely [2012] has complied some of the most intriguing new American innovations identified by leaders in their fields. He has organized their innovations into categories of: bacteria/microorganisms, animals, humans, society and environment, and technology. Many of these innovations are the direct result of cooperative and synergistic arrangements between individuals, teams, and organizations,

Soliciting member engagement has been another major innovation theme among companies in the USA. Janov [1994] addressed the notion of organizations as inventive systems and promoted the idea of employee innovation at work. Using examples of companies such as Johnson & Johnson, Xerox, and Ford, Janov explains how these enterprises are seeking to make the transition to high performance inventive organizations. In particular, Janov notes how the use of task teams and suggestion systems has become popular as a means for capitalizing on discretionary worker effort. Companies such as W.L. Gore (the maker of Gore-tex fabric) have experimented with increased worker autonomy, decision-making discretion, and flattened bureaucratic hierarchies. Additionally, corporations such as 3M and Google offer employees the incentive of paid time off to work on their own innovative projects.

Psychiatrist, musician, management professor and leading expert on innovation John Kao believes that America is losing its innovation edge. Kao [2007] infers that the United States is being overtaken by innovation centers such as those in Denmark, China, Finland, and Singapore. He suggests that the United States in in the middle of a reverse brain drain where foreign professionals trained in US universities and companies are returning to their native countries to start competitive enterprises. Kao also suggests the United States does have the capacity to regain its prominence as an innovative country. He proposed that change should begin with a new national narrative around innovation.

4. Polish Parallels

Researching the origins of organizational creativity and innovation, management professor Barton Kunstler [2004] uncovered the influence of "creative hothouses" throughout history. The rise of several of these hothouses was attributed to the intellectual ferment of the European Renaissance. These innovative com-

munities acted as gestational vehicles for the spread of new, out-of-the-ordinary ideas that led to innovations like the printing press that eventually transcended cultures and nations.

In a similar vein, writer and entrepreneur Frans Johansson [2004] has proposed a "Medici Effect" named after the creative explosion in Renaissance Italy that was supported by funds from the Medici banking family. Johanasson suggests that innovators change the world by developing breakthrough insights through exploiting the intersection where different ideas, concepts and cultures intertwine.

More recently, Szabo and Herman [2012] have investigated innovative entrepreneurship for economic development within the European Union. Their work provides a short review of the literature on the relevance and role of innovation and leadership as related to economic growth and development. Additionally, Fagerberg, Feldman, and Shorde [2011] drew comparisons between U.S. states and European nations in the areas of technological dynamics and social capability. More specifically, Miller, Mroczkowski, and Healy [2014] have enquired into Poland's basic innovation strategy of smart specialization.

5. Metaphor as an Innovation Strategy

Clegg [1999, p. 55] has suggested that innovation works best in a culture of creativity that affords free communication and access to information. Additionally, to foster innovation successfully within a culture, risk-taking is to be encouraged, failing is allowable, and there are explicit rewards to be earned for being innovative. One model for the use of creativity that leads to innovation is via the thoughtful application of metaphor. Metaphor being defined as a thing that is representative of something else. The following is an example of the deliberate mining of metaphorical insights derived from a review of a selected work of world-class literature.

British author Lewis Carroll [1993, 1999] in his classic works of literature, *Alice's Adventures in Wonderland* and *Through the Looking Glass* described a world turned topsy-turvy. Carroll's central character is the brave and innocent young girl Alice. Dissatisfied with her current life's circumstances, Alice's inherent curiosity led her to spontaneously follow a furtive, oddly behaving, fast-moving, but intriguing figure. In her own garden, focused and in hot pursuit, Alice unexpectedly tripped and fell down into a well camouflaged hole.

Thus began a series of adventures for Alice in a new and exotic world, one she had never encountered before. Entry into this strange environment of the unusual and different as gained by passing through a looking glass. This magical mirror had the exceptional ability to both shatter and transform reality.

The inherent craziness of this enchanted realm was epitomized by the person of the White Rabbit. It was the rabbit that Alice had initially followed in her garden. The White Rabbit had an aura of authority about him and appeared to be in perpetual motion. Fashionably dressed, and carrying a large pocket watch, which he frequently and anxiously checked, the White rabbit scurried frenetically and randomly about.

In Alice's mixed-up world of talking animals, nothing was as it seemed on the surface. The usual clues the orient human beings to their surroundings were missing. Prior experience of reality was misleading. Little could be taken for granted. Adjustments had to be made to fit the changing circumstances.

Increasingly life in the world of contemporary organizations seems to reflect Carroll's fictional fantasy. Everything seems to be in fast, crazy, and simultaneous motion. Many of the old rules don't seem to work well anymore. The complexity and the chaos in the external environment also finds its mirror reflection in the interior of our institutions. In a manner analogous to punitive Queen of Hearts croquet game with Alice where the hoops move, the mallets are alive, the balls have minds of their own, the rules constantly change, and losing can cost you your head; organizations must regularly cope with risky and unpredictable conditions.

Paradoxically, along with death and taxes, constant disruptive change appears to have been added to the mantra of what's for certain in organizations. Externally, the internationalization of the marketplace, technological acceleration, the triumph of capitalism, and the growth of technology as expressed in the internet are some of the factors that have led to the current situation. Inside organizations, many institutional leaders must now cope with rapid turnover of staff, a growing lack of employee trust, increased pressures for conformance via regulatory bodies, more active and militant boards of directors, heightened threats of job dislocation and loss, fewer middle manager opportunities for promotion as result of down-sized organizational structures, and vocal concerns about lessened opportunities for continued regular employment.

So, what are the innovation strategy lessons to be derived from the *Alice in Wonderland* fictional metaphor? One lesson is that fictional literature is a rich and potentially untapped source of innovation approaches. Here, temporarily adopting the naivety and openness to new experiences of an Alice may uncover new world wonderlands of innovation possibility. A second lesson is that selected innovation should consider capitalizing on opportunities inherent in a chaotic world. The Chinese written character for crises represents this well, since it can be interpreted as a "dangerous opportunity."

As a third metaphorical message, when given the choice, humans generally prefer the avoidance of negative outcomes to the possible gain of positive outcomes. Numerous studies by Behavioral Economists show that the propensity to

weigh the potential for negative outcomes occurs at a much higher level (some think that the ratio may be about two to one) than that of a positive payoff. This tendency to be risk adverse appears to have been selected for as a way to enhance the survival of our species. Additionally, the pressure to react right away to a perceived threat can interfere with a rational appraisal of the longer term likelihood for success from an innovation.

And, as a final lesson, that the risks of innovation can be obscured by apparently well-meaning individuals with a personal agenda. These persons may offer an upbeat and one-sided perspective of future possibilities to enhance their own personal gain. Today's business environment appears to feature many consultants and change advocates (the White Rabbits of the Alice fantasy) eager to sell their own particular brand of innovational wares to needy institutions and organizations.

One idea relating to innovation that is presently gaining acceptance is that deliberately going slow now will enable going much faster later. This permits the rational-reflective human System Two decision process, as expressed by Nobel Prize in Economics winner Daniel Kahnenman, to override the more intuitive and subconscious System One process. Kahneman [2011] described System One thinking as mostly driven by below conscious awareness brain processes that make blink-of-an-eye judgments based on emotion and impulse. Alternatively, System Two thinking depends primarily on consciously aware brain processes that use reason, logic, and deliberation to weigh options.

6. Design-Driven Innovation

Pioneered by Italian professor of management innovation Roberto Verganti, Design-Driven Innovation attempts to change the rules of competition by radically altering what things mean. Verganti suggests that previous studies of innovation have emphasized radical innovation impelled by technology or incremental innovation driven by markets. He proposes that significant innovations do not necessarily come from market need nor from the invention of new technologies but from the engineering of radical new human meanings.

Using examples such as Nintento's Wii, Apple's iPod, Bang and Olufsen's consumer electronics products, Verganti advocates going beyond customers and users. He advocates the utilization of external "interpreters" as a principal means to support successful innovation. Interpreters are defined as knowledgeable individuals such as artists, technology suppliers, anthropologists, members of cultural organizations, and design school faculty. These experienced, well-connected individuals are available to assist companies in understanding and influencing how people derive meaning from the things they use.

Verganti [2009, p. 236] contrasts typical innovation design policies of organizations that support incremental innovation of meanings and those that promote radical innovation of meanings. Incremental supporters tend to: center on collaborations, encourage local collaborations, focus on collaboration between firms and designers, and educate designers on business. Radical innovation promoters: center on how to collaborate and with whom, encourage global collaborations, focus on collaborations between firms and multiple interpreters, and educate business leaders on design.

Another proponent of design-based innovation is Tom Kelley, general manager of the innovative design consultancy, IDEO. Kelley, author of the business classic *The Art of Innovation* [2001] and *The Ten Faces of Innovation* [2005], is a world authority on innovation. In the IDEO innovation process ten roles are utilized to foster new ideas and innovation. Representative roles include: the Anthropologist who goes into the field to see how products and services are actually used by customers; the Cross-Pollinator who combines ideas, technology, and people to create better new ideas; and the Experience Architect who sets the stage for positive encounters with participating organizations.

Marcia Giudice and Christopher Ireland [2014] further expand the innovative designer idea into the field of leadership. In their book *Rise of the DEO* the authors suggest that in advanced parts of today's world the Information Age is being already being superseded by the Conceptual Age. In this nascent era employees are more highly skilled. They are highly networked and seek challenge and growth over security and predictability in their work assignments. DEOs, or Design Executive Officers, are seen as the next evolutionary step as logical replacements for present CEOs or Chief Executive Officers. The DEO utilizes design thinking as a problem solving skill that seeks to innovate new products, processes and opportunities. DEOs are envisioned as being more aspirational, systems thinking, experimental in outlook, disruption permitting, adaptive, comfortable with ambiguity, and open to new experience than the typical CEO.

7. Bio-Emulation Innovation

Venture capitalist Geoffrey Moore has noted that great companies appear to innovate at every phase of their evolution. Using an extensive analysis of Cisco Systems as a case example, he employs Darwinian concepts of biological evolution to explain technological innovation. Moore [2005, p. 14] has proposed biology-based Category-Maturity and Technology-Adoption Life Cycles as well as various Technology-Adoption strategies.

Dyer, Gregersen and Christensen [2011] further the connection between biology and innovation by relating it to DNA. These university-based professors and

authors researched the behaviors of some of the world's most innovative executives and entrepreneurs including leaders at Amazon, Apple, Google, Skype and the Virgin Group. Their research identified five distinguishing behaviors of successful innovators: associating, questioning, observing, networking and experimenting.

Originally espoused by biologist Janine Benyus [2002], Biomimicry is strategy for innovation that parallels and leverages nature. According to author Jay Harman [2014, p. 2]: "Whether finding inspiration on hippos to reduce skin cancer or developing better road systems by studying the tracks made by slime molds seeking food, biomimicry, or bio-inspiration as some call it, very simply means applying lessons learned from nature to solve human problems." Passino [2005] and Baumeister and Smithy [2014] have also made contributions to realizing the innovative potential of the field of Biomimicry.

8. Some conclusions

Neuroscientist Elkhonon Goldberg [2001, p. 70] has advocated that the frontal cortex in human beings is the equivalent of an organization's Chief Executive Officer. He has also proposed that the right cerebral hemisphere of the brain is specialized to process novelty whereas the left hemisphere is primarily concerned with routine and stability. If so, innovation appears to first require processing novelty (something new and different) and then stabilizing and transforming it into a product or service that can be of use to others.

Currently, a variety of organizations appear metaphorically to be like mountaineers clinging precariously to the sheer side of a mountain rock face in a storm while they struggle to reach the top. These institutions operate in a perceived world where they are hanging on for dear life battered by seemingly unrelenting and uncontrollable external and internal elemental forces. For them, existing and working in the midst of substantial organizational chaos is an immutable daily fact of life.

Unyielding change pressures act to alter and distort the leader's reality. On the positive side, innovation strategies and techniques are available to assist leaders in adapting and even thriving in a chaotic world. The artful application of thoughtful questions, reflective listening, the insights of neuroscience, understandings from biology, and the use of helpful tools such as success stories and metaphors are available to assist in the identification and choice of innovation strategies.

9. Summary

The spur of chaotic times, with its implicit need for adaptive changes, can also offer organizations the chance to unlock from historically-based themes of

thought and non-helpful habitual behaviors. The impetus of operating on the edge of chaos can unfreeze paralyzing patterns and encourage experimentation with new and different innovational forms. The use of metaphors and analogies to characterize and organization's circumstances may free them to come up with creative approaches to employ in the future.

For many leaders it is their strong beliefs, personal values, and direct engagement with the organizational mission that helps them sort through the often conflicting and ambiguous messages about innovation that constantly compete for their attention. Psychologists tell us that our beliefs filter what we see, reinforcing some aspects of reality and diminishing or blocking others. It appears that in today's brave new world of accelerated change, what leaders tend to believe conditions what they actually sense and remember. The good news and the bad news is that the act of believing alters what is observed and what is expected including economic innovation.

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Innowacja – niekonwencjonalne spojrzenie

Streszczenie. *Innowacja jako sposób na zyskanie gospodarczej przewagi konkurencyjnej przyciąga ostatnio uwagę wielu naukowców, i nie tylko naukowców, zarówno w Stanach Zjednoczonych, jak i w Polsce. Ilustruje to choćby fakt, że 19 stycznia 2015 r. na zapytanie o „Economic Innovation" wyszukiwarka Google Scholar podawała 2 250 000 trafień w USA i 16 700 w Polsce. Niniejszy artykuł ma na celu przedstawienie niekonwencjonalnego spojrzenia na temat innowacji – pojęcia, które zakorzenione jest równie mocno w biznesie jak w psychologii. Przedstawione zostaną strategie innowacyjności ukształtowane w takich dziedzinach, jak ekonomia behawioralna, biologia i neuronauka. Najwięcej uwagi poświęcone zostanie strategiom innowacyjności stosowanym przez twórcze jednostki i organizacje w Stanach Zjednoczonych, przy czym ukazane zostaną analogie do podejść stosowanych obecnie w Polsce i w Unii Europejskiej.*

Słowa kluczowe: *innowacja, innowacyjność, innowacje napędzane wzornictwem, strategia innowacyjności, biomimetyka*

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The Influence of Market and Policy on Revenues in the Polish Biomass Energy Sector – Experiences from SME*

Abstract. *The aim of the study is to examine some of the factors that are crucial for revenue generation in the Polish industry of producing renewable energy from biomass. What is essential for the biomass energy sector is an adequate public policy, especially regulations which concern financial aspects. In addition, the market mechanisms which determine a company's revenue are also important aspect here. However, it is difficult to decide which of the two factors, public policy or market mechanisms, is a higher priority. The research will help define revenue volatility resulting from biomass energy production. Furthermore, a better understanding of the conditions of the Polish biomass sector will be useful in the process of policy adjustments and fostering the development of renewable energy. This study is one of the first attempts to investigate the issues concerning the financial performance of renewable energy companies on the Polish market. It will be based on a case study of small and medium-sized enterprises.*

Keywords: *renewable energy sources, biomass energy sector, solid biomass, innovative technologies, market mechanism, market regulation*

Introduction

Not only does renewable energy use up in its entire life cycle but it also releases relatively very few harmful substances and greenhouse gases. Therefore, as the only one among other energy technologies, it complies with ecological

* The paper translated by Małgorzata Bączyńska.

principles of sustainable development. According to most recent Eurostat data [2013], the share of energy derived from renewable energy sources (RES) in gross final energy consumption within the EU amounted to 13.0% in 2011. This share should amount to 20% in 2020. For some time the dynamic development of RES worldwide has been the result of adopting different energy strategies in particular countries and in the groups they constitute such as the EU. However, it should be remembered that in many countries RES are the only media of energy available there, therefore the idea of energy safety is based completely on them. Additionally, the development of RES sector is also driven by: technological progress and increasing awareness of the society which can see more and more benefits generated from the RES development for itself and the environment.

According to the information provided lately by Polish Ministry of Economy, the share of RES in the country's use of electrical energy exceeded 10.5% in 2012.[1] Until 2020 the share of energy obtained from RES in gross final energy consumption is to achieve the level of 15%. A special role in the process of transition into more environmentally friendly solutions is ascribed to the energy sector using biomass. Specialists emphasize that Poland has a very big potential as far as the majority of resources used in the bioenergy sector is concerned [Baum, Wajszczuk, Pepliński & Wawrzynowicz 2013; Burczy, Mirowski, Kalawa & Sajdak 2010]. They simultaneously indicate that in a short-term perspective there exists a wide spectrum of possible use of only a part of such resources. Rogulska, Oniszk-Popławska and Pisarek [2005] enumerate here the following types of biomass:

– timber, tree saplings, horticultural waste, short rotation coppices,
– straw and other side products and/or agricultural production waste,
– liquid/manure used in methane fermentation,
– esters obtained from processed seeds used as biodiesel; potatoes, crops and other plants or waste converted into ethanol.

The scope of this paper comprises only the energy obtained from solid biomass. It is due to the production specification of a chosen enterprise whose many years of business experience in the RES sector will be the groundwork for further analysis using a case study method.

Summarizing the terminology discussion hereabove, once again the terms used by GUS should be applied here, i.e. solid biomass understood as: "[...] organic, non-fossil fuel of biological origin which may be used as fuel to produce heat and electrical energy". The main solid fuel obtained from biomass is forest biomass (fuel wood) and forestry waste such as timber of non-standard size as well as waste generated by wood and paper industries. Another group consists of

[1] *W 2012 r. wzrosła produkcja energii elektrycznej z OZE*, www.bankier.pl/wiadomosc/W-2012-r-wzrosla-produkcja-energii-elektrycznej-z-OZE-2786202.html [access: 24.08.2013].

fuels generated from agricultural biomass obtained from plantations meant for energetic purposes and organic waste from agriculture and gardening. The last selected biomass solid fuel also includes charcoal.

The share of obtained "green energy" (Table 1) as well as the suitable classification from previous years illustrate well a clear dominance of biomass among RES available in Poland. The share of solid biomass is especially important, though in recent years this tendency has been said to decline slightly. Quite similar data is observable in the Baltic states excluding Sweden.

Table 1. The share of renewable commodities in the total obtaining energy from renewable sources in 2013 in Poland (2013) and in the EU-28 (2012) (in %)

Source of energy	Poland	EU-27
Solid biomass	80.03	47.19
Solar energy	0.18	5.13
Water energy	2.46	16.24
Wind energy	6.05	9.97
Biogas	2.12	6.81
Bio-fuel	8.20	6.50
Geothermal energy	0.22	3.21
Others	0.74	4.95

Sources: own analysis based on GUS 2013.

The main objective of the research is to analyze the influence of the prices for property rights ("Green Certificates") and the scope of the state support on the structure and volume of the revenues for a selected enterprise. The following research questions will be answered:

1. How does the volatility of market prices for "Green Certificates" influence the volume of revenues assuming that the state support will achieve 1:1 proportion, *ceteris paribus*.

2. How does the volatility of charcoal prices influence the structure and volume of the revenues.

1. Theoretical background: literature review

It seems that at least two clear tendencies may be distinguished among currently carried out research within which the conditions are strongly emphasized. The first research tendency focuses on the barriers and driving forces (stimulants and destimulants) for RES or its particular segments development. Such an approach is aimed at possibly complete identification of diversified developmental factors and their clear arrangement. The results may be quite general, though. The second tendency tries to diagnose the situation at its source. Therefore, businesses

and their environment have become the subject of a detailed analysis. The results here may, however, be somehow stigmatized with the peculiarity of analyzed subjects, which may impede the generalization of formulated conclusions.

According to White, Lunnan, Nybakk and Kulisic [2013], "the most important role of the government in the RSE market is to provide an environment through rules and regulations". Public authorities should ensure the system for market development, that will not require government intervention while maximizing social welfare. These regulations could lead companies toward achieving the government's aims for the RES. Later in the study, the authors focused on importance of policy consistency. They stated, that "policy inconsistencies cause problems for the industry in both the short and long term. Profitable businesses can rapidly be made unprofitable, and investments in the future development of the industry can become more difficult to obtain". Finally, they stressed the compatibility of these findings with basic economic theory, which states that uncertainty will have a negative impact on investment.

The role of public policy was also examined by Erlend Nybakk et al. [2011]. They found out, on the basis of a study of fourteen European companies operating in the wood bioenergy sector, that policy measures played an important role in the innovations of the companies. In previous studies [2009], Nybakk emphasized the importance of risk in innovation of SME.

As far as Polish publications discussing the conditions for the development of Polish RES are concerned, the article by Stanisław Bielski [2011] should be mentioned here. Not only did he focus on presenting economic and legal conditions but he also introduced technological conditions for processing biomass. In conclusion, he noticed that the introduction of legal regulations in Poland concerning RES was mainly the consequence of adjusting the state's law to the EU requirements. Due to the general character of EU directives, state solutions could be modified with a relative freedom. Bielski also assumed that in future the importance of forests as a source of biomass would be diminished and the importance of the sources possible to be obtained from agriculture would increase. He noticed that this process might also pose some dilemmas. For instance, due to limited biomass resources, there is a risk of much more intensified competition with the food production sector and, as a result, the increase of food prices.

A very interesting conclusion referring to the formulation of public policy in terms of RES was introduced by Gawlik, Mokrzycki and Ney [2007]. They stated that renewable energy sources in Poland are strictly connected with local societies. Therefore, the development of RES should be adjusted to the conditions dominating in a given region. In this sense, there is no justification for the same scale or pace of RES development in the whole country.

Igliński, Iglińska, Kujawski, Buczkowski and Cichosz [2011] conducted a series of a dozen or so interviews with the producers from different RES areas

operating in Poland. Unfortunately, there is no room left for presenting all the conclusions drawn in the article, however, having imposed some limits and selecting only those mentioned by the authors in the conclusion, it is worth mentioning the following:

– high costs of investment in RES technologies and preparing investment against running costs;

– no precisely determined economic and tax mechanisms (no financial policy for RES);

– no defined strategies, programs and schedule of spending money from ecological and par budget funds (difficulties for the sector to develop with lowest costs);

– insufficient support from the authorities as well as no training and workshops for bioenergy producers.

– despite difficulties, bioenergy producers in Poland are planning to increase their activity in the forthcoming years.

Jarosław Mielcarek [2014] presented the economic aspect of the profitability of investment in wind farms. He said that under the conditions prevailing in 2013 in Poland, to build wind farms do not meet the criteria for acceptance.

Concluding the theoretical aspect of the study, it should be mentioned that the problem of RES development as well as bioenergy has been enjoying recently an increasing interest of the Polish scientific environment. However, it does not mean that the research area has been fully analyzed. The further part of this paper may confirm the assumption made hereabove since the study will touch upon the analysis of one of these economic factors which has been omitted so far, at least in Polish publications. It concerns the risk of revenue volatility in a company whose production is based on solid biomass. In particular, it will be crucial to determine the influence of this risk on the shape of the revenues structure. It should be mentioned that the selected company obtains revenue from selling four, very different in many aspects, 'products' (Figure 1 and Tables 2-5).

2. Data and method

To identify the case, secondary information were investigated, including data from Polish Power Exchange and primary data from in-depth interviews. Descriptive analysis and sensitivity analysis were selected as the primary tool for answers to research questions.

The company generating its revenue from wood biomass has been analyzed here. Figure 1 presents the revenues structure. The data which constitute market and regulated prices of dry wood distillation products, i.e. charcoal and coal dust (which is used to produce briquette) as well as electrical energy were analyzed

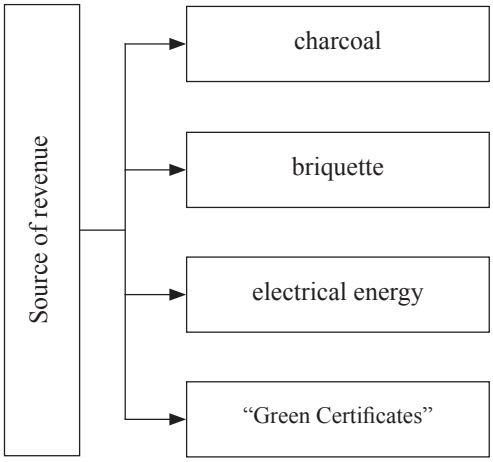

Figure 1. Revenue structure

Sources: own analysis.

Table 2. Adopted prices of effects of dry wood distillation (average prices within 2012/2013) and the prices of electrical energy and "Green Certificates" in one-year-period

Revenue source	Regulated prices	Contract prices (market)
Charcoal*	–	487 EUR/ton
Briquette	–	410 EUR/ton
Electrical energy	PLN 192.35 MWh	–
Property rights ("Green Certificates")	PLN 100-180 per MWh (minimal and maximum price on the energy market in 1H2013) adopted price – PLN 160**. Contract prices PLN 240 and 280 per MWh on the basis of long-term contracts.	

* The prices of coal dust in this model were not analyzed due to their little share. It is assumed that 90% of dust coal is used to produce briquette.

** It is an average price as of August 2013.

Glossary: Charcoal – the coal price is the market price and depends mainly on the market position of a company. Briquette – the briquette price is mainly a derivative of the coal price. Electrical energy – the price of so called 'black energy' is a regulated price. Green certificates – belong to the mechanisms supporting 'green energy' but also are influenced by a market mechanism.

Sources: own analysis based on Polish Power Exchange data.

as well. Also one supporting element was taken into account, namely the price of "Green Certificates" (Table 2).

We assumed that technological efficiency of the presented model equals 100% within the entire production process, i.e. 350 days (15 days in a year are devoted to a technological break). In practice, it is extremely difficult to maintain production continuously since there happen unplanned breaks resulting from e.g. imperfection of the raw material. The analysis was conducted in a one-year-period assuming continuous work of two technological lines used to produce dry wood distillation products. Electrical energy is produced by means of a Siemens tribune

Table 3. Sources and risk characteristics of revenue volatility

Revenue	Risk level	Risk description
Charcoal	high	Price volatility risk. The price depends on the market position of the producer and production possibilities.
Briquette	low	Price volatility risk. Saturated market and strongly competitive.
Electrical energy	low	Regulation risk – prices are regulated. The risk of price volatility is low.
Property rights ("Green Certificates")	high	Regulated risk, price volatility risk – market prices; the possibility to sign long-term contracts to protect oneself against price volatility.

Sources: own analysis.

of the declared power of 7.23 MW and is a derivative of supplied steam from two heat recovery steam generators from coal lines in the amount of 8.5 t/h each, and from a biomass boiler in the amount of 14 t/h. The daily production of dry wood distillation products is estimated at the level of 30 t from one technological line (the analysis was conducted on two technological lines L1, L2) which equals the annual production of 21 thousand tons of products out of which coal amounts to 14 thousand tons and dust coal equals 7 thousand tons. Table 3 shows the level and description of risk for products of dry wood distillation as well as for electrical energy and "Green Certificates".

3. Results

Sensitivity analysis of particular revenue elements was conducted. Technological efficiency is implied directly by the level of charcoal and dust coal produc-

Table 4. Annual production values obtained from wood biomass

Revenue sources	Daily production for L1, L2	Annual production for L1, L2	Type of dry wood distillation products	
Dry wood distillation products	30 t × 2 = 60 t	350 × 60 t = = 21 000 t	charcoal	14 000 t
			coal dust	7000 t = 6600 t briquette
Electrical energy	–	For sale × 49 453.7 MWh	–	–
Property rights ("Green Certificates")	–	60 373.7 MWh	–	–

* The amount of energy for sale is lower than the produced one. It is due to the fact that the company uses a part of this energy for its own purposes.

Sources: own analysis based on the data obtained from the company.

Table 5. The volume and structure of revenue for the base figures

Revenue	Unit price	Sale volume	Total (1 × 2)	PLN 3(WD,BR) × 4.2323	Share in %
Charcoal (WD)	487 EUR/t	14 000 t	6 818 000 EUR	28 855 821.4	48.5
Briquette (BR)	410 EUR/t	6 600 t	2 706 000 EUR	11 452 603.8	19.3
Electrical energy (EE)	192.35 PLN/MWh	49 456 MWh	PLN 9 512 865	9 512 865.0	15.9
Property rights "Green Certificates" (GC)	PLN 160 per MWh	60 373.7 MWh	PLN 9 659 789	9 659 789.0	16.2

Sources: author's own analysis based on Polish Power Exchange and company's data.

tion as well as dust coal, electrical energy and the number of green certificates. Table 4 presents annual values of obtained products. Below, Table 5 contains the volume and structure of revenues for the adopted model taking into consideration average market prices on the Polish market. Since part of the production is sold in a foreign currency, an average euro exchange rate was assumed, announced by the National Bank of Poland on the 23 day of August 2013.

The first analyzed element is charcoal which influences operational profitability most strongly. An average price on the Polish market amounts to 487 euros/t, however, higher prices are also possible as for example the prices on developed markets. For instance, companies with a solid position on the European market reach prices at the level of 800 euros/t.

The price of briquette is directly connected with wood price and its share in the revenues structure equals about 19.3% in the assumed model. The market is relatively competitive and there exists little space for price fluctuations.

The price of electrical energy is regulated by the law. The average weighted price of electrical energy equals almost PLN 193 per 1 MWh.

The price of "Green Certificates" is a market price and the volume of revenues from this source depends on the amount of produced electrical energy and market price. In the analyzed model the revenue from this source equals 16.2% in the company's revenues structure. Most European countries support renewable sources by the Feed-in-Tariff system, which means that renewable power station is guaranteed a price for which energy is sold to the network.

Additionally, the prices of "Green Certificates" are the element of a market game. For years they have been maintained within the cost of compensatory payment[2] but in 2012 they started decreasing. The market reality showed that the

[2] After receiving a certificate of origin, the entities are obliged to submit this certificate to the president of the Energy Regulatory Office for redemption otherwise they should transfer a compensatory payment to the bank account of the National Fund for Environmental Protection and Water Management (Pol. NFOŚiGW). The fee for green energy in 2007 was PLN 242.40 per MWh, for red

prices started to reflect a growing excessive supply. In February 2012 the market price of a green certificate fell to the record lowest level of PLN 100 per MWh. The price reached its maximum, i.e. PLN 180 per MWh after the Ministry of Economy announced the decrease of excessive supply and returned market balance. Currently, the excessive supply of green certificates is still huge. Its volume is estimated at about 7 TWh, which means more or less a half of the amount of green energy produced last year.

The revenues in the event of unit price changes were presented in Table 6. The analyzed example assumed: three price variants of charcoal sale, one variant for briquettes and electrical energy as well as five variants for "Green Certificates" (all of them refer to the price leap). It is due to the risk analysis for particular revenues presented in Table 6.

Table 6. The revenues in the event of unit price leap

Revenue		Unit price	Sale volume	Total (A-E, 1 × 2)	PLN 3(A, B, C, D) ×4.2323 PLN 1 × 3(E-M)
Charcoal (Ch)	A	800 EUR/t	14 000 t	11 200 000.0 EUR	47 401 760.0
	B	600 EUR/t	14 000 t	8 400 000.0 EUR	35 551 320.0
	C	487 EUR/t	14 000 t	6 818 000.0 EUR	28 855 821.4
Briquettes (BR)	D	410 EUR/t	6 600 t	2 706 000.0 EUR	11 452 603.8
Electrical energy (EE)	E	192.35 PLN/ MWh	49 456 MWh	9 512 865.0 PLN	9 512 865.0
Property rights "Green Certificates" (GC)	F	160 PLN MWh	60 373.7 MWh 1:1	60 373.7 MWh	9 659 792.0
	G	100 PLN MWh	60 373.7 MWh 1:1	60 373.7 MWh	6 037 370.0
	H	180 PLN MWh	60 373.7 MWh 1:1	60 373.7 MWh	10 867 266.0
	I	240 PLN MWh	60 373,7 MWh 1:1	60 373.7 MWh	14 489 688.0
	J	280 PLN MWh	60 373,1 MWh 1:1	60 373.7 MWh	16 904 636.0

Sources: author's own analysis.

All possible combinations were analyzed for the adopted parameters and the results were presented as the structure of revenues level for particular combinations (Table 7). The widest spectrum of changes takes place in the case of the revenues obtained from green certificates within <8.1%; 25.33%>. The second element of the revenues, also of high changeability level, is charcoal with <43.25%; 63.7%>. The prices of charcoal are market prices, whereas the prices of "Green Certificates" depend on market price.

energy PLN 17.96 per MWh and for yellow energy PLN 117 per MWh. In the case of 'green' energy the value of the payment is indexed every year by the inflation rate, whereas the value of payment for 'red' and 'yellow' energies is settled by the president of the Energy Regulatory Office every year.

Table 7. The structure of revenues depending on the assumed scenario

Group	Ch	BR	EE	GC
A	A 60.8% A 63.7% A 59.8% A 57.2% A 55.6%	D 14.6% D 15.4% D 14.4% D 13.8% D 13.4%	E 12.2% E 12.8% E 12.0% E 11.5% E 11.2%	F 12.4% G 8.1% H 13.8% I 17.5% J 19.8%
B	B 53.7% B 56.9% B 52.8% B 50.03% B 48.42%	D 17.3% D 18.3% D 16.9% D 16.13% D 15.60%	E 14.4% E 15.2% E 14.1% E 13.40% E 12.96%	F 14.6% G 9.6% H 16.2% I 20.41% J 23.02%
C	C 48.5% C 51.6% C 47.5% C 44.87% C 43.25%	D 19.3% D 20.5% D 18.9% D 17.81% D 17.16%	E 15.9% E 17.0% E 15.7% E 14.79% E 14.26%	I 16.2% J 10.8% K 17.9% L 22.53% M 25.33%

Sources: author's own analysis.

Finally, Table 8 presents the volume of revenues within three selected groups distinguished on the basis of charcoal prices. Each group has adopted five scenarios depending on the level of market price of green certificates. The potential volume of revenues, depending on the adopted assumptions, is very high. It may fluctuate between PLN 55.9 and 85.2 million annually. The highest volume refers to group C and the lowest to group A.

The main lesson which may be learned from the analysis is as follows: "Green Certificates" are the key source of revenue volatility. Further analytical research

Table 8. The volume of revenues according to the adopted groups and scenarios

Group	The volume of revenue for the entire sample A-C in PLN million (in %)	The volume of revenue in particular groups: A, B, C in PLN million (in %)
A	55.9-85.2 (52.4%)	74.4-85.2 (14.5%)
B		62.5-73.4 (17.4%)
C		55.9-66.7 (19.3%)

Sources: the author's own analysis.

concerning this revenue component should be aimed at preparing a proper supporting model for energy obtained from biomass which will optimize the state's policy towards the production of this type.

Conclusions

The obligation to increase significantly the RES share in the total sale of energy is one of the priority challenges for the Polish public authorities until 2020. The so far development of this part of the country's energy sector is characterized by a relatively high growth dynamics. However, there are a lot of factors suggesting that the pace of growth may turn out to be insufficient to reach the level required by the European Union. In this case, some action should be taken which may facilitate and accelerate the transition into energy using renewable sources of energy to a much greater extend.

The preparation of an effective support model for RES should be based upon former identification of the key developmental factors. Such an identification should not discuss RES as a whole, but should be rather directed to particular RES segments. Unfortunately, Polish publications do not fulfill such needs sufficiently, which sets an interesting direction for future research.

One of the important economic factors, identified for the needs of this study in the company whose production is based on biomass, is the risk of revenue volatility. The conducted analysis clearly indicates that the implementation of this risk may have a crucial influence on the shape of the company's revenue structure, and "Green Certificates" seem to be the key factor for revenue volatility.

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Wpływ polityki rynkowej na przychody polskiego sektora energetycznego biomasy – doświadczenia MSP

Streszczenie. *Celem niniejszej pracy jest zbadanie czynników, które mają kluczowe znaczenie dla generowania dochodów w polskim przemyśle pozyskiwania energii odnawialnej z biomasy. Istotna dla sektora energetycznego biomasy jest odpowiednia polityka publiczna, zwłaszcza przepisy dotyczące aspektów finansowych. Równie ważne są mechanizmy rynkowe, które określają przychody spółki. Trudno jednak rozsądzić, które z czynników – porządek publiczny czy mechanizmy rynkowe – są ważniejsze. Badania pomogą zdefiniować zmienność przychodów wynikających z produkcji energii z biomasy, a lepsze zrozumienie warunków funkcjonowania polskiego sektora biomasy będzie przydatne w dostosowywaniu polityki do wspierania rozwoju odnawialnych źródeł energii. Badanie to jest jedną z pierwszych prób oceny kwestii dotyczących wyników finansowych sektora energii odnawialnej na polskim rynku.*

Słowa kluczowe: *odnawialne źródła energii, sektor energii z biomasy, innowacyjne technologie, mechanizm rynkowy, regulacje rynkowe, wyniki finansowe*

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On the Need to Continue Diagnosing Low Innovation Performance of the Polish Economy*

Abstract. *The aim of the article is to analyse one of the most well-known reports on the innovation performance of the Polish economy conducted by M. Kleiber. The research tool used in this paper was presented definition of innovation by the author and described innovation models. Selected macro and microeconomic indicators were used to assess the economy innovation performance. During the period of the fourth financial framework (2007-2013 – Barrosso's package) the gap between the innovation performance of the Polish economy and economies of other EU countries increased. Kleiber's report "Wise Poland" provides an exhaustive description of weaknesses of the state, of the system of research and education and the low level of relations with the international economy. The state was de facto absent from areas recognized as crucial in fostering innovative economy. Doubts raised by this diagnosis do not concern the description of the low innovativeness of the economy, but the lack of sufficient explanations of its causes. For this reason and given a failure to address relevant research problems resulting from the presented definition of innovation as well as that the lack of transition from the stage of diagnosis to the implementation phase was not explained, there is the need to continue diagnosing the low innovation performance of the Polish economy.*

Keywords: *definition of innovation, innovation models, target costing, financial success, invention*

Introduction

Given the fact of the almost depletion of simple sources of economic growth, Poland's ability to achieve sufficiently high GDP growth rates in order to reduce

* The paper translated by Grzegorz Grygiel.

unemployment and equalizing the level of development compared to the "old" EU member states (EU-15) is crucially dependent on the innovation performance of the economy. A higher rate of economic growth is also essential for halting the growing public debt, or at least keeping its growth below that of the GDP, which is the prerequisite for the stability of public finance.

New possibilities of financing innovation, connected with the financial framework 2007-2013, including, among others, the Innovative Economy Operational Programme (IE OP), have raised the question whether the Polish economy is innovative enough to absorb the funds available under IE OP, which amount to approximately 40 billion PLN and whether the funds will be used effectively. A synthetic answer to this question will be given on the basis of selected macro and micro-economic indicators of innovativeness.

A complete diagnosis of the low innovation performance of the Polish economy should include four knowledge elements. Firstly, it is necessary to describe the actual situation, i.e. the facts (*know-what*). Secondly, an explanation must be provided, i.e. an answer to the question why things are the way they are, which identifies causes or intentions and goals (*know-why*). Thirdly, one needs to present normative knowledge about how things should be and what should be done to achieve the desired state of things (*know-how*). Fourthly, it is necessary to specify who or what institution responsible for a given sphere of life should do it (*know-who*) [Bernaert & Poels 2011]. An analysis of a particular diagnosis should indicate what type of knowledge has been presented in it.

The preparation of a diagnosis is also closely connected with knowledge management. The presented understanding of knowledge management is based on the process-based approach [Davenport & Prusak 1998]. According to this approach, there are three main process of knowledge management:

– the process of knowledge creation,
– the process of knowledge dissemination,
– the process of knowledge using.

The process of knowledge creation involves the creation of the four kinds of knowledge mentioned earlier. The process of disseminating knowledge contained in a given innovation report depends, on the one hand, on the willingness and possibilities of the authors, and on the other hand, on the attitude and support of the state and the media. The process of knowledge using should consist in moving from the diagnosis stage to implementation. From a practical point of view, it is a crucial problem, for if, despite its urgency, such a transition does not occur, it becomes necessary to present additional diagnosis to answer the question why such a transition from the diagnosis to implementation has not taken place.

The purpose of the article is a critical analysis of one of the most well-known reports on the innovation performance of the Polish economy and the statement on this basis of whether there is still a need to diagnose low level of innovative-

ness of the Polish economy. Undertaking of this second problem results from the J. Hausner's idea [Hausner 2012], that it is time to move from diagnosis to implementation. Without absolutely denying the need for such a transition, the question arises whether it is accurate idea contained in this statement, that economy innovativeness is already sufficiently diagnosed.. For purposes of this specific analysis, which focuses on the *know-what* knowledge, the author has selected the report prepared by M. Kleiber [2011]. Its choice was dictated by the fact that this is so far the most comprehensive and versatile of the important reports that have arisen during the fourth financial perspective (2007-2013). Probably for this reason, Kleiber gave it a subtitle: A *Decalogue for a society of knowledge, skills and entrepreneurship.* The *know-why* knowledge it contains is also very valuable. Including all these reasons this report suited to examine whether there is further need for the diagnosis of low innovativeness of the Polish economy.

A useful research tool used in the analysis of Kleiber's report will be correct definition of innovation. With this definition and in particular with the clarification of the term "financial success of the company" by means of Target Costing will result conclusions regarding the most important issues that should be taken in the diagnosis of low innovativeness of the Polish economy.

Another research tool used in the analysis will be models of innovation described in the literature. They will be used to determine to what extent Kleiber drew on the existing knowledge to prepare his diagnosis of innovation performance. This is expected to contribute to a better understanding of the diagnosis.

A preliminary assessment of the innovativeness of the Polish economy in the financial framework 2007-2013 as an introduction to the study report Kleiber will be made on the basis of selected macro- and micro-economic indicators.

Used in the title the term "low level of innovativeness" of the Polish economy results from the comparisons with other EU countries.

1. Preliminary assessment of innovation performance

1.1. Selected macro-economic indicators

Despite the use of funds under IE OP, the innovation performance of the Polish economy has not improved, and, compared to EU-15 countries, has even deteriorated. After the completion of IE OP, Poland has found itself in the group of the four least innovative countries, next to Latvia, Bulgaria and Romania [European Commission 2014, p. 92]. In Table 1 are given data on innovativeness of the Polish economy and the EU. The average annual rate of growth of innovation index in the years 2006-2013 was approximately 2 times less than the size of the EU. This led to a decline in the share of the Polish innovation index from 0.53 in 2006 to 0.5 in 2013 that is a decrease of 5.6%.

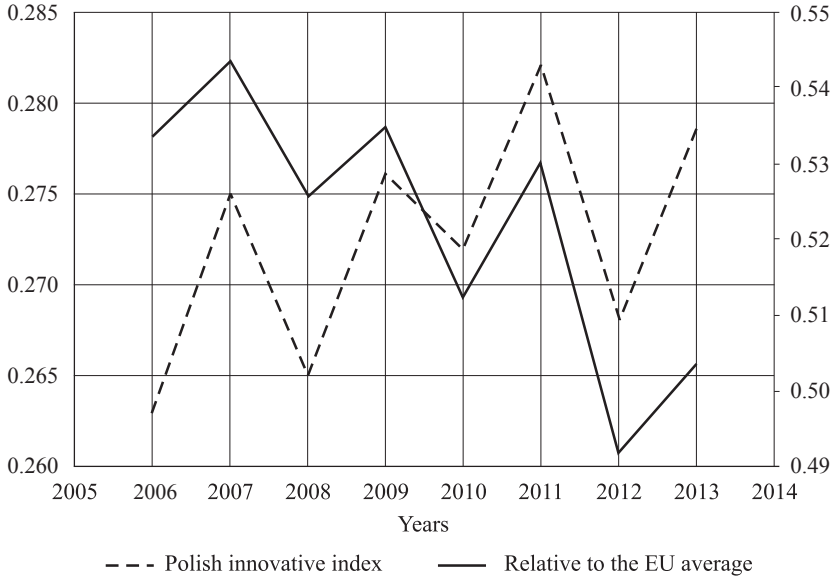
Table 1. Innovation index and its relation to the EU average for Poland in the years 2006-2013

Years	Poland	EU	Relative to the EU average
2006	0.263	0.493	0.533
2007	0.275	0.506	0.543
2008	0.265	0.504	0.526
2009	0.276	0.516	0.535
2010	0.272	0.531	0.512
2011	0.282	0.532	0.530
2012	0.268	0.545	0.492
2013	0.279	0.554	0.504
The average annual growth rate	0.76%	1.55%	–

Source: European Commission 2014, *Innovation Union Scoreboard 2014*, p. 92, https://bookshop.europa.eu/en/innovation-union-scoreboard-2014-pbNBAY14001/?CatalogCategoryID=Gj0KABst5F4AAAEjsZAY4e5L [access: 5.12.2016].

Chart 1 illustrates shaping innovation index and its relation to the EU average for Poland in the years 2006-2013.

Chart 1. The innovation index for Poland (left axis) and its relation to the EU average (right axis)



Source: European Commission 2014, *Innovation Union Scoreboard 2014*, p. 92, https://bookshop.europa.eu/en/innovation-union-scoreboard-2014-pbNBAY14001/?CatalogCategoryID=Gj0KABst5F4AAAEjsZAY4e5L [access: 5.12.2016].

According to the trend lines in Chart 1 innovation measured by the innovation index, which has been calculated on the basis of 25 indicators improved somewhat from the level exceeding 0.26 in 2006 to 0.28 in 2013. Innovation in relation to the EU average, unfortunately, has significantly deteriorated by about 5.6% during the same period. Rather than to catch up the distance to the EU, it has increased.

Table 2 presents data about innovation performance in the countries of Central and Eastern Europe in terms of the Global Innovation Index 2014.

Table 2. Ranking of countries in Central and Eastern Europe by innovation performance (July 2013)

Position	Country	Index	Relative to the Switzerland index
1	Switzerland	64.8	1.00
24	Estonia	51.5	0.84
26	The Czech Republic	50.2	0.82
28	Slovenia	47.2	0.81
34	Latvia	44.8	0.77
35	Hungary	44.6	0.76
37	Slovakia	41.9	0.75
39	Lithuania	41.0	0.73
42	Croatia	40.7	0.71
44	Bulgaria	40.7	0.70
45	Poland	40.6	0.69
55	Romania	38.1	0.62
58	Belarus	37.1	0.60
63	Ukraine	36.3	0.56

Source: *The Global Innovation Index 2014: The Human Factor in Innovation*, 2014, Fontainebleau – Ithaca – Geneva: Cornell University, INSEAD, and WIPO, pp. XXIV-XXV, www.globalinnovationindex.org/userfiles/file/reportpdf/GII-2014-v5.pdf [access: 25.08.2014].

Poland is ranked 45th in the world and in the group of EU countries is only ahead of Romania. Macroeconomic indicators contained in Tables 1 and 2 point to the low efficiency in the use of funds for innovation. These data, taking into account the size of the innovation index in comparison with the EU in Table 1 and with other countries in Table 2 are the basis for the formulation of the conclusion that the Polish economy is characterized by a low level of innovativeness.

1.2. Selected micro-economic indicators

Selected indicators of innovation performance of companies, provided by the Central Statistical Office (GUS) for the period 2006-2013 (GUS) are shown in Table 3.

Table 3. Selected indicators of innovation performance of companies for 2006-2013 (in %)

Item	2006	2007	2008	2009	2010	2011	2012	2013	% change 2013/2006
Share of innovative companies in the total number of manufacturing companies	23.7	–	21.4	18.1	17.1	16.1	16.5	17.1	–27.8
Share of innovative companies in the total number of manufacturing companies – new or significantly improved products	16.1	–	15.6	12.7	12.1	11.2	11.2	11.0	–31.7
Share of innovative companies in the total number of manufacturing companies – new or significantly improved products to the market	7.8	–	9.4	7.0	6.8	6.1	5.6	5.7	–26.9
Share of innovative companies in the total number of companies in the services sector	21.2	–	16.1	14.0	12.8	11.6	12.4	12.8	–39.6
Share of innovative companies in the total number of companies in the services sector – new or significantly improved products	13.2	–	10.7	8.0	7.9	6.4	7.0	5.8	–56.1
Share of innovative companies in the total number of companies in the services sector – new or significantly improved products to the market	7.2	–	6.5	4.4	4.3	3.4	3.4	2.8	–61.1
Share of net revenues from the sale of innovative products in net revenues from total sales of manufacturing companies (from the industrial processing section)	13.5	–	12.4	10.6	11.3	8.9	11.5	10.7	–20.7
Share of manufacturing companies (employing 50 or more persons) which invested in innovation	37.3	31.8	16.9	29.6	29.6	29.8	28.8	29.6	–20.6
Share of manufacturing companies which cooperated in the area of innovation*	11.3	–	8.5	6.4	6.1	5.5	6.0	5.2	–54.0

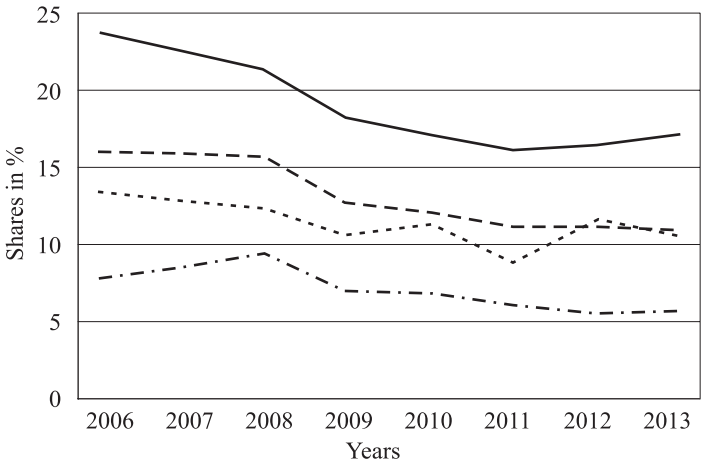
* Cooperation in the area of innovation refers to a company's participation in joint projects together with other companies or non-commercial institutions (suppliers, customers, competitors, consultants, laboratories, private R&D institutions, Polish Academy of Sciences centres, research institutes, foreign public R&D, universities).

Source: GUS, the Statistical Office in Szczecin, 2015, *Działalność innowacyjna przedsiębiorstw w latach 2012-2014*, http://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/nauka-i-technika/dzialalnosc-innowacyjna-przedsiebiorstw-w-latach-2012-2014,2,13.html [access: 20.04.2016].

Data presented in Table 3 suggest that access to European funds under IE OP not only did not improve innovation indicators, but actually contributed to their deterioration compared with 2006. All of the growth rate for this period have a negative sign. A particularly dramatic decrease can be observed in the services sector, which is the biggest sector in a typical market economy. Extremely harmful phenomenon is the 46.5% decrease in the proportion of industrial enterprises which cooperated in the field of innovation. Similarly, a decline in net revenues from the sale of innovative products is indicative of a low effectiveness of innovation performance, which is measured in terms of market success achieved by companies.

Chart 2 illustrates the falling trends in innovation indicators for manufacturing companies. There you can see, among others a fall in the share of innovative enterprises in the total number of industrial enterprises from 23.7% in 2006 to 17.1% in 2013, an decrease of 27.8%. There was a particularly worrying decline in the share of innovative companies (new products or significantly improved for the

Chart 2. Selected indicators of innovation performance of manufacturing companies



Share of innovative companies in the total number of manufacturing companies

Share of innovative companies in the total number of manufacturing companies – new or significantly improved products

Share of innovative companies in the total number of manufacturing companies – new or significantly improved products to the market

Share of net revenues from the sale of innovative products in net revenues from total sales of manufacturing companies (from the industrial processing section)

Source: GUS, the Statistical Office in w Szczecin, 2015, *Działalność innowacyjna przedsiębiorstw w latach 2012-2014*, http://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/nauka-i-technika/dzialalnosc-innowacyjna-przedsiebiorstw-w-latach-2012-2014,2,13.html [access: 20.04.2016].

market) in the total number of manufacturing companies – from the already low level in 2006 of 7.8% to a mere 5.7% in 2013, which corresponds to a decrease of 26.9%, indicating that despite increasing investments in innovation, society is gaining diminishing returns in the form of consumer goods. Evolution of indicators of innovation performance of manufacturing companies, as shown in Chart 2 suggests that innovation funds have not been used effectively.

2. Research tools used to analize Kleiber's report

Low innovativeness of Polish economy was a subject of the scientific debate and reflection in academia for a long time. The result was, among other things publication, from 2011 onwards a number of reports, of whom three can be counted towards the most well-known [Kleiber 2011; Geodecki et al. 2012; Rybiński 2013]. The following analysis focuses on the report prepared by Kleiber.

2.1. Definition of innovation

We will start our analysis of the Kleiber's report about the innovation performance of the Polish economy by reviewing definitions of innovation that can be found in the literature of the subject. This is important since the choice of a particular definition and one or more innovation models developed in the literature will prejudge the perception and analysis of innovation processes.

The well-known definition is provided in the Oslo Manual [Oslo Manual 2008, pp. 48-52]. Stated in it that the minimum requirement for an innovation is that the product, process, marketing method or organizational were new (or significantly improved) to the company. This is the definition in the sense of results incomplete, since that product is to be a novelty is a necessary condition, but not sufficient one for its recognition as innovation.

To provide a more adequate definition of innovation, let us quote the definition proposed by Mckeown which emphasizes the novelties usefulness [Mckeown 2008, p. 2]: "Innovation is new stuff that is made useful." Another definition of innovation from an organizational perspective proposed by R. Luecke and R. Katz [2003, p. 2], which can help us to formulate the definition adopted in this article: "Innovation [...] is generally understood as the successful implementation of a new thing or method [...]." The explanation of the meaning of "successful implementation" of a new thing or method can be found in Mckeown's general definition: it is its usefulness. Luecke and Katz used an imprecise term "successful implementation." It is therefore necessary to explain it by specifying what it involves and what criterion should be used to assess whether an implementation has been successful. Based on the definitions provided above, a new definition

has been formulated by the author of this paper: innovation in a company is an implemented invention, which may be a new or improved product, technological process, raw material, market niche, distribution channel, or an organisational change providing manufacturing, market and financial success.[1] This is the definition that combines the modified results and process approach.

Of course, this raises the question of how to exactly determine whether the criteria of manufacturing, market and financial success, mentioned in the definition of innovation have been met.In other words, the point is to present operational definition, which is the exact description of how to measure these successes of the company. The answer to this question will be represented by the target costing (TC) with its fundamental theorem. [Mielcarek 2013b, pp. 395-396; 2014a, p. 409].

If the real unit cost of a product k_r after implementing an invention does not exceed the target cost [Mielcarek 2015, pp. 347-348; 2016, p. 295]:

$$k_r \leq k_d \tag{1}$$

where:

$$k_d = p_d - p_d ROS_{me} \tag{2}$$

p_d – projected product price

and the real demand P_r is not lower than the projected demand

$$P_r \leq P_d \tag{3}$$

and the real market price is not lower than the projected price

$$p_r \leq p_d \tag{4}$$

then the real return on sales ROS_r is not lower than the minimum value

$$ROS_r \geq ROS_{me} \tag{5}$$

where [Mielcarek 2016: p. 294]:

$$ROS_{me} = \frac{I_0 + W_0 + \sum_{i=1}^{n} \frac{\Delta W_i + I_b - t(A_i + I_i)}{(1+r)^i} - \frac{Z}{(1+r)^n}}{\sum_{i=1}^{n} \frac{(1-t)\, S_i}{(1+r)^i}} \tag{6}$$

[1] This definition is an expansion of the definition of innovation used in the context of management accounting [Mielcarek 2014a, p. 213].

ROS_{me} – minimum return on sales $EBITDA_m$,
I_0 – initial capital investment,
W_0 – initial working capital investment,
S_i – sales revenue over period i,
ΔW_i – change in working capital over period i,
I_{bi} – gross investment over period i,
A_i – depreciation over period i,
I_i – interest over period i,
Z – terminal-year cash flow at the end of the project's life,
t – income tax rate,
r – discount rate,
and the investment meets the acceptance criteria:

$$NPV_r \geq 0 \tag{7}$$

$$IRR_r \geq r \tag{8}$$

i.e. the net present value (*NPV*) is equal to or greater than zero, and Internal Rate of Return (*IRR*) is equal to or greater than the bank rate, which is considered to be a minimal, accepted rate of return by investors.

The above formulation presents the necessary and sufficient conditions to regard a given invention as an innovation at the planning stage and in the implementation stage. Condition (1) defines manufacturing success, conditions (3) and (4) determine market success, conditions (5) and (7) need to be satisfied to ensure manufacturing and market success and, finally, condition (8) is crucial for financial success. The last two conditions sum up all of the other conditions for success. In the light of the above definition, the incomplete perception of innovation as an activity combining science, technology, production and market is successfully overcome.

The complete set of these conditions describes an investment which is attractive for investors irrespective of the economic situation. The list includes both the traditional conditions of financial success – the real rate of return on sales is equal to or greater than the minimum return on sales, and the investment criteria used in capital budgeting – *NPV* is equal to or greater than zero and the Internal Rate of Return (*IRR*) is equal to or greater than the discount rate. The adoption of the definition of innovation which refers to target costing in the context of discount cash flow [Mielcarek 2016, pp. 290-303] makes it possible to distinguish between an invention and an innovation, which is not possible when using the definition provided in the Oslo Manual. Whether or not a given invention is an innovation, can only be determined *ex post*, since it is only after implementing it in an organisation will it be possible to see if the implementation was successful. It follows that the

implementation of inventions in companies is an activity fraught with high risk and in most cases ends in failure.

The above definition highlights five fundamental and frequently underestimated or even overlooked aspects of innovation:

– there is no innovation without inventions, which raises the question of whether a given economy has the necessary conditions that facilitate and stimulate inventiveness;

– the number of attractive business ventures involving the implementation of inventions in a company, in other words, those that meet the conditions of success described by the rule of target costing, depends on the economic situation in a given country, which raises the next question: does the country's economic policy stimulate the economic situation or perhaps there is no economic policy and the country's economy is stuck in the middle income trap;

– the implementation of inventions is fraught with high risk, since one can only know whether the conditions of manufacturing, market and financial success have been satisfied through *ex post* assessment, which raises the following question: does the state undertake actions aimed at reducing the perception of this risk by inventors and companies;

– the implementation of an invention by a company, without checking whether the conditions of manufacturing, market and financial success are satisfied at the planning (pre-production) stage is like jumping into a pool without checking whether or not it contains any water, which raises the next question: does the state offer assistance to inventors who do not have the necessary skills or capital to conduct essential target costing analyses, in particular manufacturing analyses and market projections when they are planning to implement inventions in their own small and medium-sized companies or in companies they cooperate with;

– there are types of market (capitalist) economies which inhibit or even block the creation and implementation of inventions [Baumol 2002; Baumol, Litan & Schramm 2007], which raises the question whether the Polish economy is driven by an economic necessity to innovate and whether it provides positive incentives to implement inventions, and whether inventors and companies want and have to innovate.

Kleiber does not provide an explicit definition of innovation but it can be inferred on the basis of some of his statements. He talks about a system of implementing innovation or introducing innovations in the market [Kleiber 2011, p. 8]. On this basis one can draw a general conclusion that he does not distinguish between inventions and innovations, which means that his perception and analysis of reality is significantly limited in his report. It also affects his ability to recognise and take in the report presented the five main problems with economy innovativeness.

2.2. Innovation models

Reports on innovativeness of the Polish economy were not created in a science vacuum. There are many models of innovation in the literature:

– the supply model – it is a linear model (innovation pushed by technology) in which R&D work takes place outside companies, above all at universities and in other research units which are sources of innovation. It is classified as the first generation innovation model [OECD 1994, p. 13; Rothwell 1994, p. 8; Smith 2010, p. 105];

– the demand model – it is a linear model (innovation pulled by a market need) in which it is assumed that new products are created as a reaction to a market need or changes in demand and the appearance of a new innovation generates additional stream of revenue and causes another change of demand, which stimulates further innovation. It is classified as the second generation model of innovation. The idea of linearity is associated with the fact that innovation occurs as a result of a linear sequence of events, leading from fundamental research to the commercialization phase in the first generation model and from a market need to the launch of a new product in the second generation model [Schmookler 1965, p. 338; Rothwell 1994, p. 9; Kleinknecht & Verspagen 1990, p. 394];

– the coupling model (chain-linked model), which recognises interactions and feedback loops between elements involved in the creation of innovation; on the one hand, the model accounts for idea generator as the initial step for research, design and development, on other hand, it recognises the needs of the market. The model combines the supply and the demand models by accounting for interactions and feedback loops between their elements and the needs of society and the state of technological development. It was classified as the third generation model of innovation [Kline & Rosenberg 1986, p. 290; Rothwel 1994, pp. 9-10; Fisher 1999, pp. 11-27];

– the integrated model, according to which the company's project team takes advantage of both internal connections (between different departments) and external connections (with suppliers) at different stages of the innovation process, particularly in order to facilitate the exchange and use of information. It is classified as the fourth generation model of innovation [Rothwell 1994, p. 12; Smith 2010, p. 127];

– the network model [Rothwell 1994, p. 27; Smith 2010, p. 119] which is the sum of the fourth-generation model and the additional essential feature consisting in the speed of implementing innovations to market. Rothwell [1994, p. 13] stresses this aspect: "Being a 'fast innovator' is seen increasingly as an important factor determining the company's competitiveness, especially in areas where rates of technological change are high and product cycles are short." He identifies 24 factors affecting the development speed and efficiency [Rothwell 1994, pp. 15-22],

– the open innovation model [Chesbrough 2003a; 2003b; 2006; Trott 2005, p. 28] – the central idea behind open innovation is that a company develops and implements innovation in the existing or new market by relying on free or cheap internal knowledge as well as external knowledge, which is available in the domestic or foreign market and by cooperating with domestic and foreign companies;

– the innovation system model, which represents an approach focusing on the institutional structure of innovation systems at the global and national level [Niosi, Saviotti, Bellon & Crow 1993; Niosi & Bellon 1994], at the regional level [Amin 1999] or at the sectoral level [Breschi & Malerba 1997; Malerba 2002], and emphasises the role of knowledge and learning as an interactive process, which takes place inside an organisation and in interactions with external entities [Lundvall & Johnson 1994; Cooke 2001].

The above models are characterized by a transition from simple approach to increasingly complex ones, and their development to a large extent are based on an analysis of historical process. Leaving unresolved the question of whether the models explain the process of creating and commercialising inventions in the most developed countries and whether some of the models can be treated as normative when applied as an analytic tool to the Polish economy, there are two questions that need to be answered. First, do the models represent the specific characteristics of the Polish economy and can they be used to explain the problem of its low innovation performance and, secondly, whether they are normative models that provide useful tips on how to form in Poland an efficient system of creation and implementation of inventions.

Kleiber makes an explicit reference to the open innovation model [Kleiber 2011, pp. 12-13], and indirectly to the innovation system model. In this way, his emphasis is placed on weaknesses of the state, the system of scientific research and education and few connections between the Polish and international economy. Speaking of the specific character of the Polish economy, Kleiber argues that our model of development, owing to the distinctiveness of civilizational development makes it impossible to copy solutions used in other countries. It is necessary to create the Polish own model. Such a model has not been created yet and, in particular, coherent model of commercialising innovations in Poland does not exist. [Kleiber 2011, p. 8].

3. Manifestations of state weakness

The 10 points of the Kleiber's report describe how things should be. In the meantime, their text contains harsh criticism that things are not as they should be. The report is largely focused on describing symptoms of state weakness.

The first point [Kleiber 2011, pp. 2-3] is devoted to such general areas as imprudent government, ineffective and overregulated legislation, lack of modern infrastructure and strict fiscal discipline. The main weaknesses include:

– lack of a strategic vision of development,
– uncontrolled growth of administration and legislation,
– lack of a modern vision of public administration,
– inconveniences for small and medium-sized businesses,
– a weak health care system,
– lack of measures to counteract economic emigration,
– no increase in spending on modernisation activities
– lack of measures to counteract demographic problems.

The main state weakness is the lack of a strategic vision of development supported by a matching level of expenditure on modernisation.

In the second point [Kleiber 2011, pp. 3-4], which focuses on the scope and manner of public discourse, the author points out that there is no system of making rational decisions that are broadly accepted by society. This would require a broad involvement of society in the transformation processes. The current state of affairs could be overcome by introducing the principles of deliberative democracy. Unfortunately, in the absence of such a system, the Polish society, administration and economy are characterised by a low culture of innovation.

The third point [Kleiber 2011, pp. 4-5] deals with the lack of a cross-sectoral, anticipatory strategy of development, in other words, the lack of visionary leadership. This is manifested by the lack of essential coordination at the government level, where the strategy of research development is the task of the Ministry of Science and Higher Education, innovation is the responsibility of the Ministry of Economy, computerisation and e-government are to be implemented by the Ministry of Internal Affairs and Administration, and the distribution of the biggest share of modernisation funds is the responsibility of the Ministry of Regional Development. A cross-sectoral development policy is a necessity, which remains unaddressed in the absence of a national centre for strategic studies.

In the fourth point [Kleiber 2011, pp. 5-7] the author draws attention to the low level of human and social capital. Unfortunately, it cannot be increased given the lack of sufficient measures and funding, which should be considered a priority development investment.

The sixth point [Kleiber 2011, pp. 8-10] concerns the lack of a system of introducing innovations. According to Kleiber, this is first due to the lack of knowledge about (failure to understand) the complexity of the phenomenon, which is described in the most comprehensive way in the innovation system model, and secondly, due to the spread of harmful stereotypes about innovation activity. As a result, the state is incapable of creating a cross-sectoral policy. To illustrate the scale of state weakness in this respect Kleiber poses a rhetorical question: "Is

there anything that prevents us from adopting solutions tested in other countries, the so-called good practices in the area of innovation, such as the methodology of creating a national innovation strategy and a system of education oriented towards international cooperation which exists in Sweden, France's research tax credit, the Japanese system of intellectual property laws, methods of stimulating the venture capital market, ways of setting development priorities and the creation of knowledge clusters in Finland, public procurement of innovation in the UK, or the novel approach to public-private partnership in Austria" [Kleiber 2011, p. 9].

The Kleiber's report states, so far the way for effective funding of innovative projects in pre-production phase has not been found. The same is true of the implementation phase in a company. Without solving this problem it will not be possible to create an effective model of implementing innovation.

A very important issue in this context is the creation, observance and application of intellectual property laws. It should be noted that a Polish inventor and innovator is defenceless against large enterprises and multinational corporations. Therefore the goal is not merely to create a legal system that protects intellectual property but also to make sure that the state supports inventors and innovators when their intellectual property rights are violated. The state can no longer afford to remain passive in this area because it will lead to the continuation of the low innovation performance of the Polish economy.

With respect to the importance of activities aimed at protecting industrial property right, Kleiber notes [2011, p. 8] that in terms of the number of patent applications filed at the European Patent Office (per million inhabitants) Poland is in the bottom group of countries included in the European Innovation Scoreboard [European Innovation Scoreboard 2009, pp. 56-57]. The number of Poland is 3.4, against the EU average of 114.8, and 330.4 for the three European leaders (Switzerland, Germany and Sweden). The two indicators are 33.8 and 97.2 times higher, respectively. Can there by a more obvious symptom of state weakness, which is indicative of the state's incapability to create a consistent and effective innovation policy that could establish appropriate conditions for Polish inventors and inventions developed in Polish companies as a result of applying the recommendations set out in the open innovation model?

In the seventh chapter [Kleiber 2011, pp. 11-12] attention is directed to the lack of industrial policy. It should be oriented towards creative specialisation and the development of industrial forms that pursue it. Unfortunately, no such set of technological niches that could be our specialisations has been created. To ensure success in this area the industrial policy would have also to result in the accumulation of people, institutions, competences, equipment and financial resources.

One essential element of an industrial policy, which can be inferred from the innovation system model and the open innovation model are mechanisms of creating clusters. Bringing together in one location enterprises and other organisations

that conduct complementary activities associated with creation and implementation of inventions would make it possible to form conditions for increasing the innovation performance of the Polish economy.

With respect to Kleiber's views on the need to get involved in renewable energy [Kleiber 2011, p. 12], one can point out the state's exceptional weakness in creating financial conditions for the stable functioning of renewable energy sources (RES) [Mielcarek 2014b, pp. 155-172]. The author of this paper can add to Kleiber's considerations that for many years the Polish parliament was not able to adopt a new act on RES in the situation of deteriorating financial condition of the industry. To illustrate this situation, it is worthwhile to quote the alarmist opinion expressed by the Polish Renewable Energy Coordination Council: "The Polish Renewable Energy Coordination Council, representing 19 trade associations and several hundred entrepreneurs hereby informs the public, government agencies and legislative bodies that the growing threat of bankruptcy faced by companies that in recent years have launched investment projects in Polish power industry worth over a dozen billion of PLN, has entered a critical phase!" [Polish Renewable Energy Coordination Council 2013]. Following Kleiber's rhetoric [Kleiber 2011, p. 9], one can ask once again if there is anything that prevents us from adopting solutions used in Germany to create legal conditions which enabled Germany to stimulate a rapid development of wind-generated energy and fast technological progress in the production and assembly of wind turbines [Mielcarek 2014b, pp. 167-168].

4. Weaknesses of the system of scientific research and education

In his report, Kleiber mentions a number of weaknesses of the scientific research system [Kleiber 2011, pp. 7-8]:

– the research sector in Poland does not provide attractive employment prospects for the brightest graduates and is not the source of innovative ideas for the economy,

– ineffective organisation and chronic underfunding of the R&D sector has given rise numerous weaknesses or even pathologies,

– the number of ambitious scientists capable of doing world top-level research has dramatically declined,

– academic entrepreneurship is underdeveloped,

– innovative researchers do not receive a sufficient share of profits from each successful innovation,

– more attention should be paid to chronic under-funding R&D sector.

Analyzing the research system weaknesses Kleiber [2011, p. 8] drew attention to one of the main indicators characterizing the level of innovation in the economy, which is the share of state and companies R&D expenditures in GDP. Kleiber emphasizes [Kleiber 2011, p. 8] that this indicator belongs to the group of the worst for Poland in a set taken into account in the European Innovation Scoreboard report [European Innovation Scoreboard 2009, pp. 56-57]. This issue needs to be analysed more closely. In 2009 the share of GDP spent on R&D by the Polish state was equal to 0.41% compared to the EU-27 average of 0.67%. The corresponding expenditure by companies was 0.19% compared to the EU average of 1.21. A comparison with the three leading countries is even less favourable. The state expenditure in the leading EU countries (Island, Sweden and Finland) accounts for 1.02 of the GDP, which is 2.5 times more than in Poland. The much greater gap exists for the share of companies spending on R&D in GDP. For EU leaders (Sweden, Finland and Denmark), this ratio is 2.48, which is 13 times higher than the rate for Polish companies. Kleiber's analysis of R&D expenditure is summed up with the following statement: "Expecting Polish scientists to make a substantial contribution to the country's development does not appear to be very rational" [Kleiber 2011, p. 8].

M. Kleiber lists the following weaknesses of the educational system [Kleiber 2011, pp. 5-7]:

– the state has failed to create a top league of best universities, comparable to world class universities,

– the popularity of university education and its dynamic development has largely decreased its quality,

– schools of all types are suffering from the instrumentalisation of knowledge,

– the state has not created conditions for general lifelong learning,

– no fundamental changes have been introduced at universities,

– an average university graduate is not able and does not want to keep learning, is not open to new developments and is not aware of their own creativity, is not capable of independent thinking and making a constructive contribution to a team; has not acquired the principles of entrepreneurship, does not have a good command of English or another foreign language,

– a low level of human capital, which is essential for increasing the innovative performance of the economy (its level depends on three factors: the number of educated people, the quality of knowledge they have acquired and the conditions enabling them to use the acquired skills).

Only the first factor is at a satisfying level, though according to some commentators, the number of people with higher education is excessive. Some serious objections are made as to the quality of knowledge acquired by university gradu-

ates, and their mass emigration in recent years is an indication that they have not found favourable conditions to use their skills and knowledge in our country.

5. Limited connections with international economy

The eighth point of the decalogue [Kleiber 2011, pp. 12-13] addresses the lack of a strategic foreign policy in the context of the open innovation model. Kleiber perceives this model, above all, from the international perspective and lists four major weaknesses manifesting the lack of openness to the world, which may indicate the existence of impediments to activities in accordance with the open model:

– low participation of companies in foreign activity,

– extremely low participation of Polish scientists in international research projects,

– very limited and few relations maintained by Polish universities and innovative companies with their counterparts in the US, Canada or Japan,

– surprisingly low enrolment of foreign students in Polish universities.

Under these conditions, activities intended to implement the model of open innovation, without which the innovative performance of the Polish economy cannot be improved, are only marginally important and are not supported by a consistent foreign policy.

Conclusions

It can be concluded that M. Kleiber's report provides a comprehensive description of weaknesses of the state, the scientific research system and the educational system and the low level of relations with international economy, as well as a lack of an appropriate foreign policy in this respect. In this way the report offers *know-what*, which refers to principles of the innovation system model and focuses on institutional factors. The resulting picture of the state is one that is in fact absent from the areas which are generally regarded as crucial for improving the innovative performance of the economy.

This raises the question about the second kind of knowledge to be found in the report, which explains the facts, i.e. *know-why*. Already discussed the reasons for the low level of innovativeness that are listed by Kleiber can be divided into two groups:

1. Causes rooted in the awareness of politicians and society:

– many politicians do not see the need to create a model of pro-development changes in the functioning of the state

– lack of preparedness to face challenges,

– lack of belief in success,

– the existing awareness of decision makers,
– harmful stereotypes concerning innovation processes,
– lack of understanding of the process of introducing innovations in the market,
– low culture of innovation.

2. Causes associated with the lack of essential solutions in this area:
– a convincing model of pro-development changes in the functioning of the state,
– fundamental principles of an innovation strategy of the country's development,
– lack of a consistent, modern vision of the role of administration,
– lack of essential changes as a result of political negligence,
– lack of strong, competent coordination at the government level,
– ineffective organisation and chronic underfunding of the R&D sector, as a result of many years of negligence,
– lack of a consistent model of introducing innovations in the market.

Explanations of this kind are not sufficient. The appeal to the reasons in the sphere of consciousness is rather part of *know-what*, and not part of an explanation of the low level of innovativeness. These kinds of social consciousness also require explanations; for example, one wonders why many politicians do not see the need to create a model of pro-development changes in the functioning of the state or why there is a lack of understanding of the extremely complicated process of introducing innovations in the market. This kind of explanation ran out of the Kleiber's report.

Pointing to the lack of the necessary solutions also not be considered as an explanation. In fact, they are just another manifestation of the low innovative performance of the economy and statements of this kind are part of *know-what,* not *know-why*. They, too, require explanations, such as, for example, answering the question why there is no convincing model of pro-development changes in the functioning of the state or why there is no consistent model of introducing innovations in the market. Failure to provide such explanations is probably the reason for the air of helplessness and pessimism pervading the report.

The definition of innovation provided in the in sub-paragraph 3.1 implies five key research problems. Only one of these problems, formulated as a question whether in a given economy there are conditions facilitating and stimulating inventiveness, was addressed by providing a partial solution. No attention was devoted to the remaining problems, i.e. whether the country's economic policy stimulates the economic situation and thus increases the number of attractive business ventures, including innovation projects; whether the state undertakes actions aimed at reducing the perception of risk by inventors and companies, whether the state offers assistance to inventors and small and medium-sized business who do

not have the necessary skills or capital to conduct essential analyses, in particular manufacturing analyses and market projections and whether the Polish economy is driven by an economic necessity to innovate and whether it provides positive incentives to implement inventions, that is, whether the inventors and companies want and need to implement inventions were not in the report taken. This omission confirms the view that the definition of innovation adopted by Kleiber largely determines the perception of research problems which should be solved.

The process of knowledge management presented in the report also included the process of knowledge application. It should involve the transfer of knowledge from the stage of diagnosis to the stage of implementation. J. Hausner, co-author of another well-known report [Geodecki et al. 2012], states that it is time to move from diagnosing to implementations [Hausner 2012]. This view implies that, firstly, correct diagnosis has been made and, secondly, all that remains to be done is to move on to the implementation phase, which, unfortunately, has not been done. While the second view seems to be basically correct, judging on the basis the innovation indicators presented earlier, one cannot agree that the problems have been correctly diagnosed and there is no need to continue the process of diagnosis. Demonstrated weaknesses of the examined diagnosis do not apply to descriptions of the low innovative performance of the economy, but to the lack of sufficient explanations of its underlying causes. Without this element of knowledge it is impossible (or extremely difficult) to formulate consistent and effective recommendations aimed at bring about a fundamental breakthrough in the innovative performance of the Polish economy.

Undoubtedly, the deterioration of the macroeconomic and microeconomic indicators in the period 2006-2013, despite the large expenditure on innovation in the financial fourth frame should be considered a surprising phenomenon. One possible explanation can be found in the writings of K. Popper, who believes that "the purpose of science is to provide *good explanations* for everything that we believe requires explanation" [Popper 2002a, p. 231]. What, then, requires explanation in social sciences? Popper gives the following answer: "the main task of the theoretical social sciences... is to trace the unintended social repercussions of intentional human actions" [Popper 2002b, p. 460]. In other words, Popper adopts an ontological assumption that intentional human actions lead to unintended social consequences. Kleiber's diagnosis does not seem to be based on this ontological assumption and does not contain any analysis of its consequences, since explanation requires systemic research. It is another argument to support the view that not everything has already been explained.

This view can be further supported by the argument that because the diagnoses were made since 2011 and were not followed by the implementation of their conclusions, the mere absence of such a transition should become one of the key

elements of the diagnosis Unfortunately, this aspect of the low innovation performance of the Polish economy has not been the subject of any studies.

In conclusion, it can be said that in view of the lack of sufficient explanations for the low innovation performance of the Polish economy and the failure to move from the phase of diagnosis to the phase of implementation, as well as the failure to address key research problems resulting from the adopted definition of innovation and take better account of achievements of the literature concerning the innovation models, there is a need to further diagnose low level of innovativeness of the Polish economy. The author of this article personally sees this need and will respond to it conducting further research.

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O potrzebie dalszego diagnozowania niskiej innowacyjności polskiej gospodarki

Streszczenie. *Celem artykułu jest analiza jednego z najbardziej znanych raportów dotyczących innowacyjności polskiej gospodarki, autorstwa M. Kleibera. Narzędziem badawczym były przedstawiona przez autora artykułu definicja innowacji oraz opisane modele innowacji. Wybrane wskaźniki makroekonomiczne i mikroekonomiczne posłużyły do oceny poziomu innowacyjności gospodarki. W okresie czwartej ramy finansowej (2007-2013 – pakiet Barrosso) zwiększył się dystans Polski wobec UE pod względem innowacyjności. Raport Kleibera „Mądra Polska" w sposób wyczerpujący przedstawia przejawy słabości państwa, słabości systemu badań naukowych i edukacyjnego oraz niski poziom powiązań z gospodarką międzynarodową. Państwo de facto nie istniało w obszarach uznawanych za istotne dla kształtowania innowacyjności gospodarki. Wątpliwości co do tej diagnozy nie dotyczą opisów niskiej innowacyjności gospodarki, lecz braku wystarczających wyjaśnień, jakie są tego przyczyny. Wobec tego oraz niepodejmowania istotnych problemów badawczych wynikających z przedstawionej definicji innowacji, a także nieistnienia wyjaśnienia braku przejścia od fazy diagnozy do fazy realizacji zachodzi potrzeba dalszego diagnozowania niskiego poziomu innowacyjności gospodarki.*

Słowa kluczowe: *definicja innowacji, modele innowacji, rachunek kosztów docelowych, sukces finansowy, inwencja*

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Innovations in the Service Sector in Poland and the World*

Abstract. *The paper has carried out empirical research of innovations in the service sector that allow us to draw the following conclusions: 1. Innovations in the service sector are not of marginal importance – as the literature on this subject claims – they are of an ancillary nature, complementary with respect to the industry and the entire manufacturing sector; 2. There is a synergy and feedback between the service and production sectors in creating innovations; 3. Innovativeness of the entire economy and its particular sectors may be measured by the Solow residual, namely the total factor of productivity (TFP), as the TFP causes innovation growth. Moreover, the research on all signs of TFP growth is a basis for looking for sources of innovation growth in all sectors of the national economy.*

Keywords: *innovations, service sector, the Solow residual*

Introduction

F.A. von Hayek in *The Constitution of Liberty* published in 1960 wrote: „most benefits of social life, especially in its more developed forms called „civilization" are derived by a unit using broader knowledge than it is aware of. One may say that civilization begins when striving for the goals, a human being uses more knowledge than they actually acquired and when they go beyond boundaries of their ignorance by using the knowledge they do not have" [Hayek 2006, p. 36].

* The paper translated by Beata Koźmińska.

I have quoted Hayek to raise awareness that a civilization progress, an innovation progress and innovation depend on knowledge and development of science. If it is so, science is an integral part of culture which in turn is part of the service sector and not the sector of industrial production or construction or agriculture.

The Central Statistical Office on its website defines innovation in the following way: "Implementation of a new or improved product (or service) or a process, a new organizational method or a new marketing method to the business practice, a workplace or relations with the environment."[1]

This definition complies with the definition provided by Oslo Manual recommended by OECD in 2008. The definition of innovation quoted shows multiple aspects of this phenomenon and various difficulties with measuring innovation of the economy as well as defining what innovation means.

Generally, according the literature, innovation originates in production activities and service-related innovations are of marginal importance [Miles 2000]. In my opinion this is an incoherent approach towards researching the phenomenon of innovation. On one hand, the literature on the subject "suggests" that the service sector including "science" and "culture" makes use of innovation originated from production activities and on the other hand the most important measures of innovation include: expenditure on scientific research in activities in production companies. We do not need to prove that without scientific research there is not innovation, namely without development of the service sector there will be no innovation in the production activities.

Surely, there is a synergy between production activities and activities of the service sector which leads to a civilization progress and an innovation growth. Schumpeter considers innovation as a creative destruction whereas Hayek thinks that innovation cannot be planned and he wrote: "We are not able to imagine what the civilization will be or may be like in five hundred years or fifty years just like our ancestors or even great-grandparents were not able to predict our present lifestyle" [Hayek 2006, p. 37]. That is, why I think we need to approach the analysis of innovation in the entire national economy in a diversified way. Firstly, we should examine separately innovation processes in production activities and separately in service activities and secondly we should look for innovation synergies between the two types of activities. Certainly, such an approach to innovation will impact changes to measurement of innovation in the economy.

The paper aims to analyse innovativeness of the service sector in Poland and the world and to make an attempt to apply the concept of the Solow residual for the purposes of measuring innovativeness of the service sector. In order to achieve the above objective of the paper I am going to analyse the following issues: 1. Definitions of service activities, services of the service sector, 2. The

[1] http:/old.stat.gov.pl/GUS/definicje_PLK_HTML.htm?id=POJ-7060.htm [access: 3.11.2014].

essence and measurement of innovation; 3. Incentives of innovations in the service sector; 4. Application of the Solow residual to measure innovativeness of the service sector. The paper finishes with recommendations and the conclusion.

1. Service activities, services and the service sector

The literature on economics misses an explicit definition of the notion of a service. The scientific discussion on service was began by J.B. Clark, I. Fisher and J. Fourastié who tried to describe the economy by means of a three-sector economic model where, in simple words:

– sector 1 comprised agriculture, forestry, fishery,
– sector 2 included industry with construction and architecture
– sector 3 consisted of services in their broad understanding.

It is worthwhile paying attention to the fact that in the above approach sector 3, namely the service sector, was obviously a residual sector comprising activities of people which could not have been accounted for in sector 1 or sector 2.

In the literature on the subject, at the beginning of the discussion not about the service sector as Clark, Fisher and Fourastié discussed, but about the essence of the service, there was an opinion that services involved human activities which

Table 1. Enumeration the following features of defining services

Features of services	Implications for a service oriented enterprise and consumers
Immateriality	– services may be evaluated by a potential buyer by means of senses – services cannot be transferred and stored
Simultaneous rendering and consuming processes	– limited availability time of the service to the buyer – limited possibilities of increasing the scale of rendering a service – work of the personnel affects results of the process of rendering a service – no possibility of keeping a production secret as well as protecting patents
Heterogeneity of services	– inability to offer standard products due to the fact that final features are developed by the personnel of a service company, by the customer or other customers – difficulties with calculating costs of rendering services and applying reasonable pricing policy
Impermanence of services	– inability to store services and to produce them to stock – the amount of consumption is limited by the actual capacity of the human and tangible potential engaged in rendering a particular service
No possibility of owning a service	– services rendered cannot by traded again

Source: Flejterski et al. 2005, p. 43.

did not lead to production of material goods [cf. views of Lange, Illeris, Kotler, McLuhan, Marshall and others; Dominiak 2011].

However this „path" of defining a service, in my opinion, is a road to nowhere as most services being of intangible nature lead to production of tangible goods e.g. outcomes of design works, science, commerce, transport etc.

However B. Hollins and S. Shinkins distinguish the following aspects of defining a service.

Table 2. Distinquish the following aspects of defining a service

Dimension of defining a service	Description
Materiality	Most services are of immaterial nature, they cannot be touched e.g. legal advice or a trip though outcomes are visible
Transferability	Most services cannot be transferred from one place to the other and thus they cannot be exported
Storage	Being immaterial services cannot be stored
Contact with the customer	In case of material goods there is not contact with their production process, in case of services, production and consumption are simultaneous and the contact occurs, this gives a possibility of a more comprehensive evaluation of the quality of services.
Quality	In case of material goods the quality can be measured more easily and quantitatively, the evaluation of quality of services is mainly qualitative

Source: Hollins & Shinkins 2006: 8.

Considering the features of defining a service as well as dimensions of describing the category of service, providing a simple definition of a service making its essence precise cannot originate good results. That is, why the category of "service" may be defined in two ways:

a) this is an activity of people accounting for five dimensions (aspects of activities) such as:

- materiality,
- transferability,
- storage,
- contact with the consumer,
- quality,

bears signs of:

- immateriality,
- simultaneous rendering and consuming processes,
- heterogeneity of services,
- impermanence of services,
- no possibility of owning a service.

A service „cannot be dropped on legs" but it can originate a material good e.g.:

– an architectural project may result in a HOUSE

– production technology and plastic materials result in a plastic BUCKET, plastic TOYS as well as plastic tools used for producing material goods.

b) a service is an activity of people which according to the Statistical Classification of Economic Activities in the European Union is considered a service activity namely points G, H, I, J, K, L, M, N, O, P, Q, R & S. NACE comprises:

+ AGRICULTURE, FORESTRY AND FISHING
+ B MINING AND QUARRYING
+ C MANUFACTURING
  + D ELECTRICITY, GAS STEAM AND AIR CONDITIONING SUPPLY
  + E WATER SUPPLY, SEWERAGE, WASTE MANAGEMENT REMEDIATION ACTIVITIES
  + F CONSTRUCTION
  + WHOLESALE AND RETAIL; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES
  + H TRANSPORTING AND STORAGE
  + I ACCOMMODATION AND FOOD SERVICE ACTIVITIES
  + J INFORMATION AND COMMUNICATION
  + K FINANCIAL AND INSURANCE ACTIVITIES
  + L REAL ESTATE ACTIVITIES
  + M PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES
  + N ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES
  + O PUBLIC ADMINISTRATION AND DEFENCE: COMPULSORY SOCIAL SECURITY
  + P EDUCATION
  + Q HUMAN HEALTH AND SOCIAL WORK ACTIVITIES
  + R ARTS, ENTERTAINMENT AND RECREATION
  + S OTHER SERVICE ACTIVITIES
    + T ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS; UNDIFFERENTIATED GOODS- AND SERVICES- PRODUCING ACTIVITIES OF HOUSEHOLDS FOR OWN USE
    + U ACTIVITIES OF EXTRATERRITORIAL ORGANISATIONS AND BODIES.[2]

Moreover I would like to pay attention to two facts:

Firstly, nowadays the division of the economy into three sectors [agriculture, industry and services] has been extended by:

[2] Eurostat, Metadata Combined Nomenclature 2014, RAMON, www.ec.europa.eu/eurostat/ramon/index.cfm?Targeturl=DSP_PUB_WELC [access: 8.11.2014].

– Sector 4 – information or information technology or ICT (Information Communication/Technology),

– Sector 5 – a financial sector connected to finalizing economy on the global scale.

Sectors 4 and 5 are often called modern centres of business services or business services environment.

Secondly, activities of the service sector and its effects are called products by marketing specialists, Theodore Levitt, marketing guru, has developed the concept of the so called augmented product – AP. The AP consists of:

– core product (a pure product),

– actual product expanding the core by a colour and the quality etc.,

– augmenting an actual product with services and guarantees related to consuming the products offer [Levitt 1980].

In the above approach a service does not exist independently and is the same product as other tangible goods e.g. a house or a car. If we are to assume the concept of "total" product, innovation would be researched on the scale of the entire economy. However as I emphasised in the introduction, innovations must be differentiated from the production and service activities. I can see specific features of innovation in service activities in particular. That is why Levitt's concept of the augmented product (AP) is useful but only in marketing management and not only in growth analysis and economic development. When analysing determinants of economic development we need to differentiate functioning:

1. Physical capital:

a) provided by a human being,

b) nature capital or environment wellbeing;

2. Intellectual capital:

a) human capital understood as the knowledge possessed, experience, professional skills of an employee etc.,

b) structural capital (organizational) owned by a company comprising:

- knowledge of an organization,
- organizational culture,
- protected knowledge namely intellectual property,
- inventions, databases, software;

3. Social capital comprising:

a) groups and social networks,

b) trust among people,

c) ability to cooperate,

d) low level of social exclusion,

e) information and communication [Noga 2014: 69-70].

At present innovation of the economy is dependent on intellectual capital and social capital which means that it is the service sector and not the production sec-

tor that powers innovations. Obviously the manufacturing sector may demand innovation however a proper progress depends on the process of satisfying human needs and not techniques and technologies of manufacturing.

2. Innovations and their dimensions

In the introduction to this paper I have quoted the definition of innovation proposed by the Main Statistical Office which is as follows: "Implementation of a new or improved product (or service) or a process, a new organizational method or a new marketing method to the business practice, a workplace or relations with the environment." As I have also emphasised that this definition does not cause any controversies and comprises the following innovations:

– marketing,
– organizational,
– process-oriented,
– product-related,
– benefits for the environment.

The Central Statistical Office also introduces the notion of innovation as: „All scientific, technical, financial and commercial activities which lead to or tend to lead to implementation of innovation. Innovation activities also comprise research and development (R&D) that is not directly related to creating a specific innovation."[3] This differentiation also does not provoke any controversies as innovation is a multidimensional phenomenon that cannot be looked at from the point of linear approach to research activities on launching a new product in the market. We need an approach that will enable to look at the innovation process both in terms of potential determinants as well as achieved results. Such a methodology was proposed by a group of experts working within the project called European Innovation Scoreboard (EIS). This team was appointed in 2000 by the European Commission in order to monitor results of the Lisbon Strategy which explicitly considers innovation as a determinant of competitiveness development. The Summary Innovation Index (SII) elaborated is a mathematical and statistical combination of 25 indicators containing the following ingredients:

– innovation drivers: structural conditions making up innovation capital;
– knowledge creation: investment in research and development activities understood as a key element in creating a knowledge-based economy;
– innovation and entrepreneurship: factors informing about innovation-oriented activities on the level of an enterprise;
– application: information about the impact of innovation on employment and economic results;

[3] http//old.stat.gov.pl/GUS/definicje_PLK_HTML.htm?id=POJ_1477.htm [access: 8.11.2014].

– intellectual property: factors informing about the extent of involvement and the usage of rights protecting intellectual property.[4]

In 2013 Poland ranked 45th in the world achieving the SII = 0,279 and surpasses EU countries:

– Bulgaria 0.188,
– Latvia 0.221,
– Romania 0.237.

Top EU countries:

– Sweden 0.750,
– Denmark 0.728,
– Germany 0.709,
– Finland 0.684,
– Luxemburg 0.646,
– Holland 0.629,
– Belgium 0.627,
– Great Britain 0.613,
– Ireland 0.606,
– Austria 0.599,
– France 0.571.

The average for the EU amounts to 0.554 and the above top exceeds the EU average SII. However the other countries including Poland are below the EU average.[5]

The Summary Innovation Index has been used since 2006 and as I have already said it accounts for innovations of the service sector. Innovation of the service sector may be measured by means of the SII in a multidimensional approach (Performance Stores per Dimension) where out of 8 dimensions 5 may be included in the service sectors namely:

– human resources,
– research systems,
– finance and support,
– linkages and entrepreneurship,
– intellectual assets.

According to the above data from the internet source, 28 EU states achieved the following SII:

– as regards human resources Poland attained results close to the EU average and places us on 18th place,

[4] www.globalinnovationindex.org/userfiles/file/reportpdf/GII-2014-v5.pdf [access: 8.11.2014].

[5] www.ec.europa.eu/enterprises/policies/innovation/files/ius/ius-2014_en.pdf, Annex E: Summary Innovation Index (SII) time series [access: 8.11.2014].

– as regards finance and support we rank 15 among all EU countries. There is no doubt that Polish banking system is one of the most stable systems in the world and not only in the EU.[6]

These two facts confirm that the Polish service sector in on the innovation path.

3. Is the service sector innovative?

J. Dominiak has compared innovations in the industry and services and found out about nine differences, namely:

1. Innovations in services do not require as much R&D support as industry.
2. Service firms are less inclined to invest in fixed assets to support innovations.
3. Service firms spend less money on the purchase of patents and licences.
4. Innovations in services are easier to imitate.
5. Importance of human resources in creating innovations is much higher in services than in industry.
6. In the development of service innovativeness, technology plays a minor role.
7. The chief barrier to the development of service innovativeness is lack of well-educated labour force.
8. Organisational aspects are of key importance.
9. Innovations in services are not restricted to changes in the properties of a product; they also include changes in the process of service provision and contacts with clients [Dominiak 2011].

In my opinion, this way of addressing the scientific problem of differentiating innovativeness in services and production activities does not provoke any controversies.

Creating innovations in services is specific however this process occurs on the basis of known methods of originating ideas such as heuristic methods, spontaneous idea search or methods of coerced contrasting. Table 3 shows how blue ocean ideas are generated as opposed to red ocean.

I think that the blue ocean strategy gives the service sector greater possibilities of designing and implementing innovations. Nevertheless it does not mean that this sector cannot pursue the red ocean strategy.

In my opinion innovativeness including the innovativeness of the service sector may be measures not only by means of the SII but also by the Solow residual [Blanchard 2011: 397-399].

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[6] www.ec.europa.eu/enterprises/policies/innovation/files/ius/ius-2014_en.pdf, Annex E: Summary Innovation Index (SII) time series [access: 8.11.2014].

Table 3. Strategy of red and blue ocean

Red ocean strategy	Blue ocean strategy
Competing in the existing market space	Creating free market space
Fighting with competition	Competition becomes insignificant
Usage of the existing demand	Creating and taking over a new demand
Necessity of finding a compromise between the value and the cost	Overcoming the compulsion of the compromise between the value and the cost
Organizing the entire corporate activities in line with its strategic choice between exceptionality and low costs	Organizing the entire corporate activities in line with its aspirations for exceptionality and low costs

Source: Kin & Mauborgne 2011.

The Solow residual is as follows:

The residual = $g_y - [\alpha\, g_w + (1 - \alpha)\, g_k]$

where:

g_y – observed output growth = $\frac{\Delta Y}{Y}$

$\alpha = \frac{\text{minimum salaries paid}}{\text{nominal output value}}$

$g_N = \frac{\text{growth in labour input}}{\text{labour input}} = \frac{\Delta N}{N}$ = that is a rate of change in the labour input

$g_K = \frac{\text{growth in labour input}}{\text{labour input}}$ that is a rate of change in the capital input

The Solow residual is often called in the literature as the total factor productivity – TFP.

TFP = the Solow residual

$TFP = \alpha \times g_A$

where:

α – as above

TFP – as above

g_A – a rate of technological progress which may be presented as:

$g_A = \frac{TFP}{\alpha}$

Data included in Table 4 is not interesting. If we assume that the rate of technological progress g_a measures innovativeness – which in my opinion is fully justified then: Firstly, in 2010 the pace of technological progress in the entire national economy (g_A) amounted to 5.19 and is almost five times faster than in the service

Table 4. The SOLOW residual for the national economy of Poland (NE) and for the service sector (SS) in 2010 and 2012

No.	Components of the SOLOW residual*	2010		2012	
		NE	SS	NE	SS
1	g_Y	6.32	4.76	3.40	4.60
2	g_N	2.36	0.93	0.00	0.35
3	g_K	6.06	7.52	6.55	7.00
4	α	0.42	0.42	0.55	0.63
5	$1 - \alpha$	0.58	0.58	0.45	0.37
6	TFP (SOLOW RESIDUAL)	2.18	0.46	0.45	1.79
7	g_A (pace of technological progress = innovativeness)	5.19	1.10	0.82	2.84

* symbols as in the examples above.

Source: calculations of one's own based on Yearbooks of the Central Statistical Office GUS 2011 and 2013.

sector where it reached 1.10. Secondly, two years later, namely in 2012, the pace of technological progress (g_A) in the entire national economy was 3.5 times slower than in the service sector.

How can my research results be interpreter? There may be a few conclusions:

1. The service sector plays an ancillary role with respect of the production sector. To enable innovations in the production activities (industry), the service sector must implement innovations and technological progress.

2. In relation to the above, the pace of technological progress and innovations in the industry determines the pace of innovation growth in the service sector. Certainly there is a feedback and a synergy however industry needs of implementing innovations are decisive.

3. The higher the Solow residual namely the total performance of TFP including a higher rate of technological progress and *eo ipso* innovations. That is why, according to my research results TFP should be examined and we should look for determinants of the growth of this measure as they are fundamental for the innovation growth both in the national economy as well as in the service sector.

Remarks

The analysis I carried out as well as empirical research of innovations in the service sector allow us to draw the following conclusions:

1. Innovations in the service sector are not of marginal importance – as the literature on this subject claims- they are of ancillary nature, complementary with respect of the industry and the entire manufacturing sector.

2. There is a synergy and feedback between the service and production sectors in creating innovations.

3. Innovativeness of the entire economy and its particular sectors may be measured by the Solow residual namely the total factor productivity (TFP) as the TFP causes the innovation growth. Moreover, the research on all signs of TFP growth is a basis for looking for sources of innovation growth in all sectors of the national economy.

These conclusions lead to the following recommendations. The growth in innovations in the service sector and the entire national economy is dependent on the increase of expenditure on education. That is why the measure of innovation based on expenditure on the research and development, *eo ipso*, on science result from earlier outlays on education of all levels i.e. development of:

– primary and secondary education,
– higher education,
– technical culture,
– training scientific staff (PhDs, habilitations, professorships),
– training in economic education of the entire Polish society at the level comparable to the American society, Western Europe or Japan. In this respect Poland is delayed e.g. a pupil of Polish secondary school knows where the Congo or Bhutan lie but he/she does not know what a share, a bond or even GDP is whereas a primary school pupil from USA, Germany, France, Norway or Finland knows it though he or she may not know where the Congo is.

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Innowacje w sektorze usług w Polsce i na świecie

***Streszczenie**. W artykule dokonano pomiaru wpływu innowacji w sektorze usług na wzrost gospodarczy w całej gospodarce za pomocą reszty Solowa. Otrzymane wyniki są bardzo interesujące i wskazują na duże znaczenie innowacji w sektorze usług dla całej gospodarki, bowiem działają one na zasadzie forward-looking. Wymaga to jednak prowadzenia dalszych badań.*

***Słowa kluczowe:** innowacje, sektor usług, reszta Solowa*

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Public Finance versus Economic Innovation*

Abstract. *The following paper is a limited attempt to analyse public finances in regard to their influence on the Polish economy when compared with the European Union between the years 2006-2013. In EU countries there are significant differences as far as the levels of development and innovation are concerned, together with the level and the sources of financing research and development activities. Distinct progress in innovation, which is the source of change in product quality and costs of product manufacturing, is the prerequisite sustainable growth for the EU, which implies product and whole economy competitiveness. The most significant determinants of innovation are financial resource accessibility and widely understood human potential. Both these factors are undoubtedly places within the scope of public finance. The following analysis does not exhaust the subject matter, but is sufficient to draw conclusions that with reference to the needs of the Polish economy, the direct public spending on research and development is too low. The decrease in public expenditure (GDP share) on education and health care, when compared with other EU countries, does not support the improvement in the quality of human capital. On the other hand, the results of the following study show that the outlays from public levies on these two mentioned above functions are positively correlated with innovation of the economy.*

Keywords: *innovation, Summary Innovation Index, Global Innovation Index, innovation versus economic growth, GBOARD (Government Budget Outlays and Appropriations for Research and Developments), GERD (Gross Domestic Expenditure on R&D), public expenditure on R&D, Spearman's rank correlation coefficient*

* The paper translated by Krzysztof Sajon.

Introduction

Innovation is most frequently understood as the implementation of a new or a significantly upgraded product, process, organizational or marketing method into the practice of economic activity. Thus, it is an activity which is dynamically and multi-dimensionally determined by not only the economic, social and political factors but also by the historical, sociological and philosophical ones. It is the market itself that plays the crucial role in the process, as it finally verifies all the undertaken actions in terms of innovation. Innovations being the source of shifts and diversification in product quality and manufacturing costs imply the changes in the market potential of particular economies.

Access to the internal and external financial resources and widely understood human resources are among the most significant innovation determinants.

According to the strategic document EU 2020 published by the European Council, one of the major goals of the EU is to reach the level of 3% GDB spent on R&D in 2020. According to the document 1/3 of the outlays on research and development is to be financed with public resources of the member states and 2/3 from the private sources.

The forecast for Poland prepared by the Ministry of Education based on various variants of finance allocation from structural funds in the years 2013-2020 together with the increase in the private outlays on research and development activity from the present 30% to 50% determined the target value of GERD with reference to GDP for Poland at the level of 1.7% assuming the equal participation of public and private sectors.

The purpose of the following paper is the attempt to analyze the influence of public finance onto the increase in innovation of Polish economy when compared with the EU in the years 2006-2013. Moreover, the author attempts to verify two hypotheses:

– the first hypothesis assumes maintaining high differences of innovation in particular EU economies;

– the latter assumes the existence of strong correlation between public financing of research and development activity and real gross domestic product per capita.

1. Innovation of Polish economy when compared with the EU

There is no single measurement of innovation. According to *Frascati Manual* research and development activity is defined as systematically conducted crea-

tive activity undertaken in order to increase the knowledge and the ways of its implementation[1]. Innovation is undoubtedly connected with widely understood knowledge and the expression of this knowledge. Different innovations can reflect different level of knowledge acquired both in the formal education system and from experience. This direct connection between knowledge and innovation is one of the basic criteria differentiating innovation, particularly its significance for the competitiveness of the economy. Different classifications of innovation have been widely discussed in Polish and foreign literature [e.g. Balcerowicz & Wziątek-Kubiak 2009; Kozioł 2007; Francik & Pocztowski 1991]. The measurement of innovation of particular economies is not a simple process. It requires interdisciplinary knowledge and experience.

In Europe SII – *Summary Innovation Index,* published within the annual report *Innovation Union Scoreboard* (IUS) is mainly applied as the measurement of economic innovation. *European Innovation Scoreboard* (EIS) is an annual report assessing innovative achievements of the member states of the EU on the basis of SII. It is calculated as weighted arithmetic mean of 29 partial ratios for 28 EU countries together with Turkey, Island, Norway, Switzerland, the USA and Japan. SII ratio has values from 0 to 1 and the closest its value is to 1 the higher is the level of the given country's innovation. This ratio is created on the basis of partial ratios including both the outlays on innovation and their outcomes.[2] The former are described by means of the ratios referring to financing, education, corporate investment and the infrastructure of their functioning. The latter, on the other hand, mainly concern the economic results of the companies implementing innovations.[3] Differences in the innovation indices in the years 2006-2013 in the European Union are presented graphically in Chart 1.

According to SII index – in accordance with *Innovation Union Scoreboard* – countries were divided into four groups: innovation leaders, followers, moderate innovators and innovators with small results. Poland was included into the third group. In 2011 an increase in the value of the index was observed, unfortunately it did not have a permanent character.

The values of synthetic innovation indices for Poland, means in the EU and the indices of the highest and lowest values in the EU countries in the years 2006-2013 are presented in Table 1.

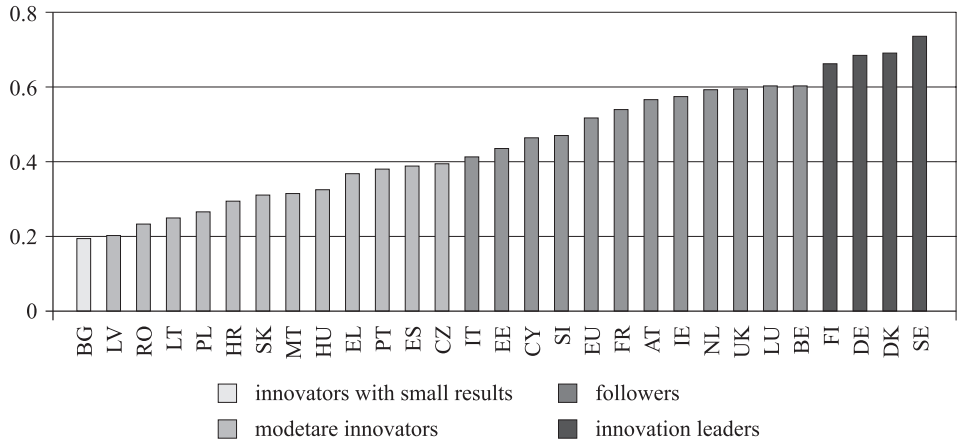
The analysis of the index in the years 2006-2013 indicates that it underwent a number of multi-direction changes. However, the shifts between the highest and

[1] *Frascati Manual* is the very first methodological manual containing guidelines concerning statistical research in science and technology. Cf. www.nauka.gov.pl/g2/oryginal/2013_05/08935db1c9f7adf15c087d07720a984f.pdf [access: 11.11.2014].

[2] The number of indicators in particular reports changed from 22 to 30.

[3] The indicators on the basis of which SII was created are described in detail: Wołodkiewicz-Donimirski 2011.

Chart 1. Average SII indices in EU countries in the years 2006-2013



Source: own work on the basis of Innovation Union Scoreboard 2014.

Table 1. SII for selected EU countries

Specification	2006	2007	2008	2009	2010	2011	2012	2013
EU	0.493	0.506	0.504	0.516	0.531	0.532	0.545	0.554
BG (min in 2013)	0.158	0.168	0.189	0.198	0.216	0.228	0.191	0.188
SE (max in 2013)	0.732	0.729	0.732	0.737	0.739	0.746	0.752	0.750
PL	0.263	0.275	0.265	0.276	0.272	0.282	0.268	0.279

Source: Innovation Union Scoreboard 2014.

lowest values of SII in the two extreme years of the period under examination were relatively small. In 2006 index for Bulgaria was 4.6 times as low as the index for Sweden – the country with the highest SII, in 2013, on the other hand it, was 4 times lower. The change for Poland was even less favorable. In 2013 the value of the index regarding Poland was 2.8 times as low as the index for Sweden, and in the last year it was 2.7 times lower.

The differences in the levels of economic innovation for different EU countries are still very high. Assuming that the average EU index = 100, the relations of the joint innovation index for Poland with relation to three EU countries with the highest and lowest values of the index are presented in Table 2.

The joint shift in the index in the analyzed years shows how different the changes in innovation of particular EU economies measured by means of the accumulated SII increase were; which is presented in Table 3.

The highest change in the values of the innovation index were reported in Estonia, Portugal, Cyprus, Slovenia and Austria, while the lowest values were

Table 2. SII for the selected EU countries with the assumption that EU = 100

Specification	2006	2007	2008	2009	2010	2011	2012	2013
UE	100	100	100	100	100	100	100	100
SE	148	144	145	143	139	140	138	135
DK	139	137	130	130	133	131	132	131
DE	131	130	133	133	132	130	130	128
PL	53	54	53	53	51	53	49	50
BG	32	33	38	38	44	44	35	34
LV	35	37	39	41	41	43	43	40
RO	42	43	48	50	45	48	42	43

Source: own calculations on the basis of Innovation Union Scoreboard 2014.

Table 3. Accumulated increase in the synthetic innovation index in the EU in the years 2007-2013

Specification	SII 2013	Change in SII index
EE	0.502	0.114
PT	0.410	0.096
CY	0.501	0.087
SI	0.513	0.086
AT	0.599	0.083
LU	0.646	0.076
NL	0.629	0.068
DE	0.709	0.063
IT	0.443	0.063
EU	0.554	0.061
FI	0.684	0.054
FR	0.571	0.054
HU	0.351	0.053
CZ	0.422	0.048
LT	0.289	0.048
LV	0.221	0.047
DK	0.728	0.044
MT	0.319	0.041
BE	0.627	0.039
IE	0.606	0.039
ES	0.414	0.039
SK	0.328	0.032
EL	0.384	0.031
BG	0.188	0.030
RO	0.237	0.029
UK	0.613	0.023
SE	0.750	0.018
HR	0.306	0.016
PL	0.279	0.016

Source: own calculation on the basis of Innovation Union Scoreboard 2014.

reported in Poland, Croatia, Sweden, Great Britain and Romania. Thus, both in the upper and the lower part of the table one can find countries exhibiting very different wealth levels measured by means of GDP per capita. Countries with the lowest change in SII in the analyzed seven years exhibit its accumulated change which is nine times as low as in Estonia – the country with the highest level of innovation increase.

While comparing the EU economies with the leading, in terms of innovation, Swiss economy, one can notice even greater differences. Its SII value increased from 0.752 in 2006 to 0.835 in 2013, while the lowest change of the average EU index was from 0.493 to 0.554. Table 4 presents the comparison between the EU countries that are placed at the top three and the lowest three positions together with the innovation of Polish and Swiss economies.

Table 4. SII for selected EU countries assuming that CH = 100

Specification	2006	2007	2008	2009	2010	2011	2012	2013
CH	100	100	100	100	100	100	100	100
SE	97	94	92	92	90	91	89	90
DK	91	90	83	84	86	85	86	87
DE	86	85	85	85	85	84	84	85
PL	35	36	33	34	33	34	32	33
RO	28	28	31	32	29	31	27	28
LV	23	24	25	26	26	28	28	26
BG	21	22	24	25	28	28	23	23

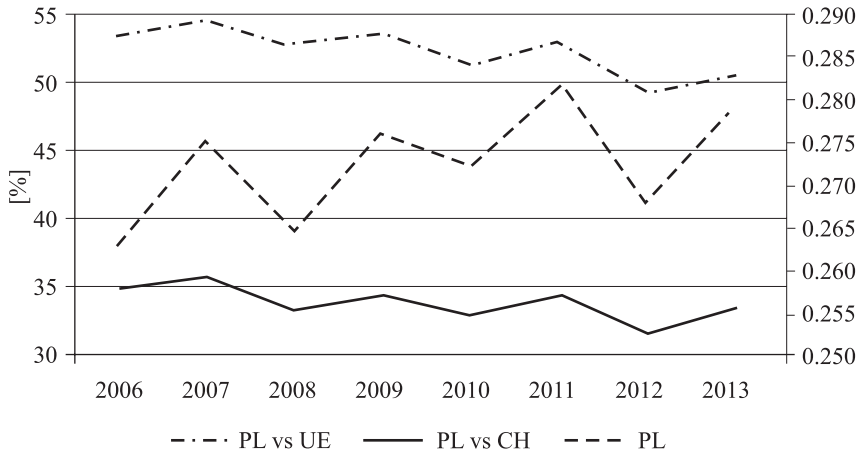
Source: own calculation on the basis of Innovation Union Scoreboard 2014.

In 2013 SII for Sweden accounted for 90% of the Swiss index and the difference between the country with the highest value and the lowest value in the last year under the analysis was 67 points. Synthetic index of Polish economy innovation in 2013 accounted for 50% of the average index for the EU and for only 33% of SII value for the Swiss economy. In 2006 the values of these indices for Poland were higher and accounted for 53% of the EU index (UE = 100) and for 35% of the Swiss index (CH = 100). Relative differences between the values of the indices and their changes are presented in Chart 2.

These negative assessments of Polish economy are also confirmed by GII – *Global Innovation Index* created in 2007.[4] Currently, this index is used as the measurement of innovation of 143 economies worldwide by means of 84 different indicators. The measurements building up this index can be divided into two basic groups:

[4] The Global Innovation Index 2014, The Human Factor in Innovation, Cornell University, INSEAD, WIPO, www.globalinnovationindex.org/userfiles/file/reportpdf/GII-2014-v5.pdf [access: 20.11.2014]

Chart 2. SII for Poland, EU-28 = 100 and CH = 100 in the years 2006-2013
(innovation index – right-hand axis, relation to EU = 100 and CH = 100 left-hand axis)



Source: own calculation on the basis of Innovation Union Scoreboard 2014.

– factors of innovation input comprising: institutions, human potential, ICT and infrastucture, market advancement, business activity advancement;

– results of innovation output, including the results of scientific and creative activity.

It is also Switzerland that holds the top position in this ranking, which results from favorable conditoning influencing both innovation input and output.

Polish economy, apart from accumulated high GDP dynamics, was not accompanied by the adequate increase in innovation. Analyses based on GII place Poland at the lowest places of the ranking list in the region. In 2013 in the Global Innovation Ranking Poland was classified at 45th position, while in 2012 it was palced at 44 position. In comparison with other EU countries, it is only Romania that had a worse result – it was placed at position 55. On the basis of the indicators regarding innovation input Poland was placed at posion 40, ahead of Hungary, Greece, Slovakia, Bulgaria and Romania. While taking into consideration the second criterion – innovation output – Poland was placed at position 48 and it was only Greece that had a lower position.

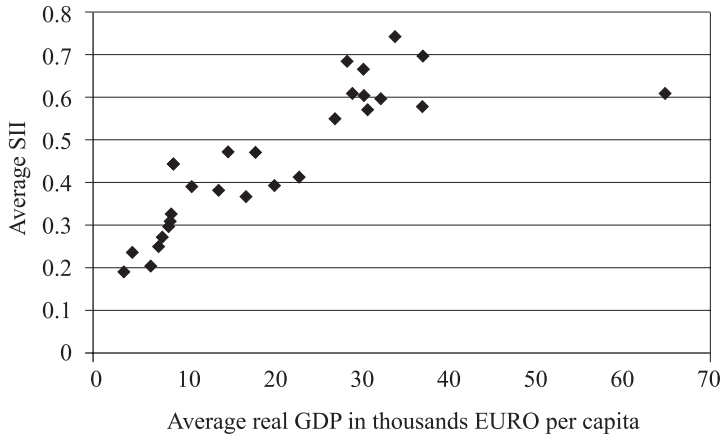
GII methodology made it possible to identify strengths and weaknesses of Poland in terms of particular innovation indicators. Advancement of the business environment, low measurement of trade barriers, relatively favorable conditions of getting credit, and above all, the number of students, are the strengths of our innovation.

Poland's weaknesses in terms of innovation include slim electronic access to public services, very low quality of public infrastructure (ICT and infrastructure), inefficient law and high legal burden (institutions), together with low tendency to cooperate within clusters (business advancement/innovation ecosystem).

2. Innovation versus economic growth

Innovation determining economic competitiveness is one of the major factors determining longterm economic growth. The comparison of the real gross domestic product per capita, which is not free from flaws but, apart from that, is the most often used measurement of the country's wealth, and the average joint innovation index in the years 2006-2013 is presented in Chart 3 [Ziółkowska 2014].

Chart 3. Average real GDP in thousands of EURO per capita and the average SII in the years 2006-2013



Source: own calculation on the basis of Eurostat and Innovation Union Scoreboard 2014.

It indicates that there is a positive correlation between real gross domestic product per capita and synthetic innovation index. The strength of this correlation was calculated by means of Spearman's rank correlation coefficient which confirmed the existence of very strong positive correlation of 0.92 indicating that the increase in innovation is accompanied by the increase in GDP.[5] Simultaneously, one can notice that up to a certain limit innovation index grows at a slower pace

[5] Four-grade assessment scale was adopted: below 0.2 weak correlation, 0.2-0.4 weak correlation, 0.4-0.6 moderate correlation, 0.6-0.8 strong correlation, 0.8-0.9 very strong correlation, 0.9-1.0 nearly complete interdependence.

than GDP, and with its higher values per capita, the increase in innovation exceeds the changes in GDP. Such almost complete interdependence might be, however, infected with the short period under analysis and with the methodological oversimplification that SII cannot be freed from. For Central and Eastern European countries this statistical interdependence was slightly weaker – 0.80.

In Poland in the period under analysis real GDP per capita was 7.9 thousand EURO on average with the innovation index of 0.273. The change in innovation by 0.016 in 2013 in comparison with 2006 was accompanied by the increase in GDP by 1.9 thousand EURO. With reference to GDP per capita Poland was placed in the European Union at position 24 in 2006 and at position 23 in 2013, while with the reference to SII the posions were 24 and 25 respectively.

In Germany the average real GDP per capita (29.2 thousand EURO) was accompanied by the innovation index of 0.684. The increase in innovation in the following years by 0.063 was accompanied by the decrease in GDP by 2.2 thousand EURO, which was definitely due to the economic crisis.

At the same time Swiss economy with the GDP per capita of 34.7 thousand EURO and the innovation index of 0.740 was marked with the increase in the index by 0.018 and in GDP per capita – by 1.3 thousand EURO.

Six out of all the years under discussion were marked by economic slowdown for the EU countries or even recession. That is why, together with the discussed above examples, the relationship between the degree of innovation and the pace of development of particular economies in the years 2006-2013 was examined. The correlation between the average synthetic innovation index and the average dynamics of the GDP, although it was positive, was at the same time very weak and did not exceed the first bracket grade from the six-bracket scale. Such result of the study if it comprised longer time series might lead to a quite controversial conclusion that the degree of innovation of a particular economy did not influence its resistence to external shocks and the limitation of the recent global economic and financial and debt crisis results.

Polish economy enters the second twenty-five-year period of building new social and economic order with the innovation index of 0.279 and GDP per capita of 8.7 thousand EURO. Within the twenty-five years the nominal GDP per capita increased from 2.1 billion PLN in 1991 to 42.5 billion PLN in 2013, which enabled to reduce the development distance from highly developed countries. In 2013 GDP per capita measured by means of the spending power parity was 68 with EU = 100 and was higher by 20 points in comparison with 2002. This result is due to the mixture of multiple factors, one of which was undoubtedly the adopted developmental model for Poland based on technology implementation and simple economic, social and organizational patterns adopted from developed countries.

This "immitative" development model according to many theorists and practitioners seems to be currently exhausting its possibilities.[6]

The prerequisite of the continuation of positive developmental tendencies of Polish economy seems to be considering structural policy aimed at economic competitiveness as the top priority. The authors of the mentioned above Report mention the necessity of the shift to the formula of creative diffusion being the creative not just imitative adoption of imported technologies and managerial solutions [Gordecki et al. 2012: 82-96].

That is undoubtedly a rational approach, much more accurate than creating illusions that we can be creators of such innovations that would create totally new markets and could be defined as radical innovations.

Technology import by means of the purchase of machinery and equipment, which was the driving force of increasing our economy's productivity, especially in the first years of transformation, is no longer sufficient to catch up with the western countries. This is indicated by the measurements of Polish economy innovation when compared with other, mainly EU, countries. We will also soon have more limited access to the EU resources. Thus, it is high time to change the main function from "pro-demand" to "pro-supply," which can only be created under the conditions of gradual increase in competitiveness of Polish economy by the increase in its innovation. This process requires a particular activity on the part of the state. The activity which is understood not only as the process of generating financial resources directly contributing to science, reasearch and development by both the public and private sectors but also the whole infrastructure determining the innovative activity of companies. That is in particular broadly understood process of learning, creating thinking, openness towards novelties and risk. The necessity of continuous multidimensional self-education understood not only as the process of achieving particular formal levels but also as the ability to make contacts and to benefit from one's own and somebody elses's experience. The significance of accumulation of human capital in both quantitative and qualitative respect, which is one of the determinants innovation cannot be underestimated but simultaneously is very hard to assess [Balcerowicz & Wziątek-Kubiak 2009].

In order to get out of the trap of "small growth" it is necessary not only to determine the role of the state in terms of innovation but also to demand its fulfillment on the part of the institutions responsible for the process. Public authorities have at their disposal direct and indirect instruments determining innovative processes that should be actively used particularly when companies do not have sufficient resources to conduct costly research actitity [Piekut 2011]. The state can jointly finance research and development not only due to the fact that these

[6] Important and inspiring discussion on the new social and economic development model in Poland is presented in the Report: Gordecki et al. 2012.

outlays are for private subjects too costly and therefore risky, but also due to the fact that direct enaging public resources enables the state to influence the research activity in such a way so that the areas concerned reflect the long-term country's and its citizents interests, such as health or safety. It is always the market that verifies the allocation of both public and private resources into particular areas. Public sector usually gets engaged in financing basic research, which, due to its character, does not bring direct benefits in practice, which is why it is not the area of interest for the private sector. The state can also motivate to get engaged in innovative activity by means of grants, tax reliefs, tax deductions from the tax base or from the tax itself.

3. Public sector outlays on research and development

According to the purpose of the following paper the author examines the progress in Polish economy innovation from the angle of engaging public resources in the process of financing research and development activity.

In order to present the expenditure on research and development activity two measurements were used: GBOARD (*Government Budget Outlays and Appropriations for Research and Developments*) and GERD (*Gross Domestic Expenditure on R&D*) partially financed by the government sector and the sector of higher education disregarding the business sector and non-profit organizations sector. GBOARD data concern the year of allocating budget resources while GERD registers the year in which these resources were really used.

According to Frascati Manual GBOARD presents all the expenses covered by public levies. Therefore GBOARD measurement comprises research and development activity:

– financed by the government and conducted by the institutions subordinate to the government;

– financed by the government in the remaining three domestic sectors (enterprises, higher education, private non-commercial institutions) and „foreign" sector.

Expenditure on research and development activity measured by means of GBOARD in the years 2006-2013 undergo multidimensional changes, which is presented in Table 5.

In 2013 GBOARD expenditure in % GDP in the country with the highest share, that is in Finland, was over seven times as high as in the country with its lowest share in GDP, that is Latvia. In 2006 GBOARD in % GDP in Finland was only four times as high as in Latvia. GBOARD expenditure in % GDP in Poland in 2013 in comparison with 2006 with relation to its average share in the EU slightly improved. It is, however, over twice as low as in the EU.

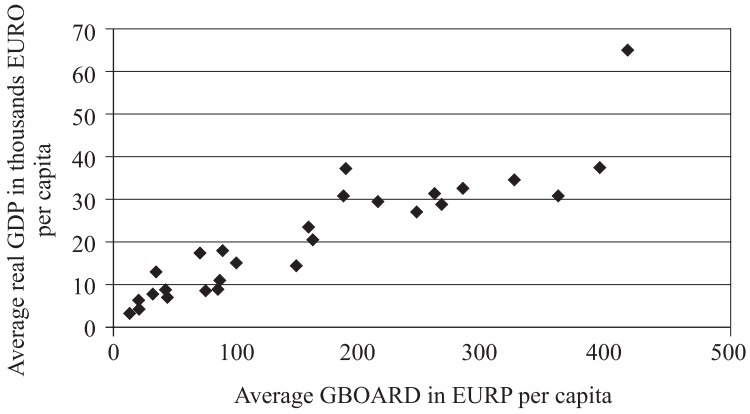
Table 5. GBOARD in % GDP

Specification	2006	2007	2008	2009	2010	2011	2012	2013	Joint change
EU average	0.69	0.68	0.78	0.78	0.75	0.73	0.70	0.69	0.00
LV (min in 2013)	0.27	0.30	0.29	0.21	0.16	0.15	0.15	0.14	–0.13
FI (max in 2013)	1.02	0.97	0.98	1.12	1.16	1.10	1.07	1.03	0.01
PL	0.32	0.32	0.30	0.34	0.37	0.32	0.36	0.37	0.05

Source: own calculation on the basis of Eurostat.

The interdependence between the average GBOARD expenditure in EURO and real average GDP per capita in the EU countries is presented in Chart 4 (correlation scatter chart).

Chart 4. Average real GDP in thousands EURO per capita and average GBOARD in EURO per capita in the years 2006-2013



Source: own calculations on the basis of Eurostat and Innovation Union Scoreboard 2014.

In 2013 in the EU average budgetary outlays per capita in EURO according to GBOARD increased by nearly 10% in comparison with 2006. Moreover, during the economic crisis in the years 2008-2013 they were higher than in the years 2006-2007. In Poland, except for the fact that they increased by almost 66% – in 2013 they were still five times as low as the average outlays in the EU. What is more, although with reference to GDP per capita in EURO the decrease was not observed in any of the years under examination in comparison with the previous year, the dynamics was negative according to GBOARD per capita in 2009 and in 2011.

The highest average budgetary outlays in the EU countries per capita in EURO in the years 2006-2013 were observed in Luxemburg (417.0), Denmark (393.3),

Finland (359.8) and Sweden (324.6), while the lowest were observed in Bulgaria (13.1), Romania (18.3), Latvia (19.5) and in Poland (30.3). While disregarding Luxemburg, the difference in outlays according to GBOARD between the highest and the lowest values in EURO is thirty-fold and significantly exceeds the differences in GDP which is almost eleven times bigger.

The significance of the interdependence between the average GBOARD and GDP outlays per capita in the analyzed period was also examined with the use of Spearman's rank correlation coefficient. A strong positive correlation of 0.94 was observed. Correlation for Eastern and Central Europe countries was also positive, however, its strength was lower but still significant – 0.78 (the third bracket of the scale).

The necessity of engaging the state in both financing and conducting research and development activity is thus undisputable. A more important measurement of outlays on research and development is GERD. According to Frascati Manual, GERD includes internal outlays on research and development only on the territory of a particular country in a particular year. These outlays are divided according to the financing sources into five different sectors: government entities outlays (resources from the state budget and budgets of territorial self-government entities), higher education, enterprises, non-commercial private institutions, and foreign sector. In particular countries the share of these sectors differs significantly. R&D activity is financed as statutory activity and with the use of grants, contracts and subsidies.

Expenditure according to GERD in relation to GDP in Poland, EU averages and the averages in the countries with the minimum and maximum shares are presented in Table 6.

Table 6. GERD in % GDP

Specification	2006	2007	2008	2009	2010	2011	2012	2013	Joint change
EU average	1.78	1.78	1.85	1.94	1.93	1.97	2.01	2.02	0.24
RO (min in 2013)	0.45	0.52	0.57	0.46	0.45	0.49	0.48	0.39	–0.06
FI (max in 2013)	3.34	3.35	3.55	3.75	3.73	3.46	3.43	3.32	–0.02
PL	0.55	0.56	0.60	0.67	0.72	0.75	0.89	0.87	0.32

Source: own calculation on the basis of Eurostat.

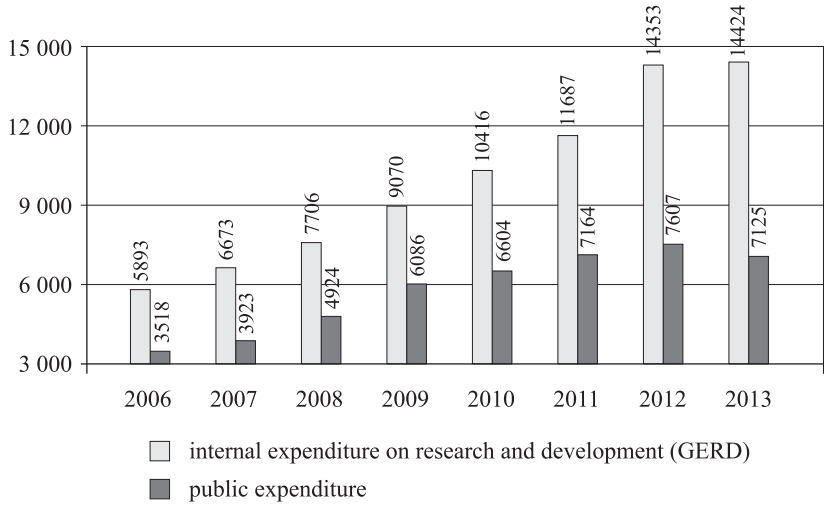
In 2013 maximum GERD share in GDP in Finland was over 8.5 times as high as in Romania. In 2006 this relations was lower – only 7.5 times. In Poland this share in comparison with the EU averages in the two extreme years of the examined period improved. In 2006 it was over 3-times lower, while in 2013 the share of outlays according to GERD in % GDP was over 2 times as low as the EU average.

The expenditure on research and development has significantly increased in Poland in recent years. However, the level of R&D expenditure as % of GDP is still relatively low. In 2013 in Poland it was 0.87% of GDP after a rise to 0.89% of GDP in 2012.

The average value for the EU was 2.02% of GDP in 2013. The European leaders of innovation spent much more on R&D: 3.21% of GDP in the case of Sweden, 3.05% in Denmark, 2.94% of GDP in Germany, 2.81% in Austria.

The amount of internal expenditure on research and development in total and public outlays in the analyzed years in Poland is presented in Chart 5.

Chart 5. GERD in total and public outlays in millions of PLN in the years 2006-2013



Source: The Central Statistical Office, Statistical Office in Szczecin, Szczecin, November 2011, 2012, 2013, 2014.

According to the sources of financing Polish outlays on research and development are characterized by a relatively large, although declining, share of government sector which is presented in Table 7.

Table 7. Government expenditure in % GERD in total

Specification	2006	2007	2008	2009	2010	2011	2012	2013	Joint change
EU average	33.6	33.3	33.8	34.9	34.8	33.3	32.8	31.9	–1.7
FI (min in 2013)	25.1	24.1	21.8	24.0	25.7	25.0	26.7	26.0	0.9
RO (max in 2013)	64.1	67.1	70.1	54.9	54.4	49.1	49.9	52.3	–11.8
PL	57.5	58.6	59.8	60.4	60.9	55.9	51.4	47.3	–10.2

Source: own calculation on the basis of Eurostat.

The analysis of the structure of the financing sources of research and development activity shows that in the countries with the higher share of GERD in GDP it was accompanied with the lower share of government outlays. This interdependence did not refer to the second source of public expenditure – higher education. The highest and still increasing expenditure of this sector, accounting for 4.5 % of expenditure according to GERD in the last year under examination, was observed in Cyprus – the EU averages were five times lower. In Poland the share of higher education accounted for 2.1% of GERD and fluctuated in the years under examination from 6.7% to 0.2%.

A more precise measurement of spending public resources on research and development activity seems to be the expenditure per capita which for Poland when compared with countries with the highest and lowest values are present in Table 8.

Table 8. Public expenditure on R&D in EURO per capita in selected EU countries

Specification	2006	2007	2008	2009	2010	2011	2012	2013
UE	154.8	162.9	171.6	176.2	182.1	184.6	189.9	190.8
DK	342.2	319.6	364.6	381.9	416.8	431.9	461.0	471.4
SE	325.2	342.1	345.3	334.7	396.7	427.7	467.6	462.0
FI	307.6	320.8	326.8	356.7	386.8	384.3	387.0	374.9
BG	11.6	12.6	15.0	17.2	14.2	13.8	13.2	14.1
RO	10.5	17.9	27.4	16.2	17.3	20.7	19.4	19.2
HU	44.5	46.2	47.9	43.6	43.2	43.3	41.6	41.9
PL	27.0	32.1	39.7	39.3	49.9	51.2	55.5	50.0

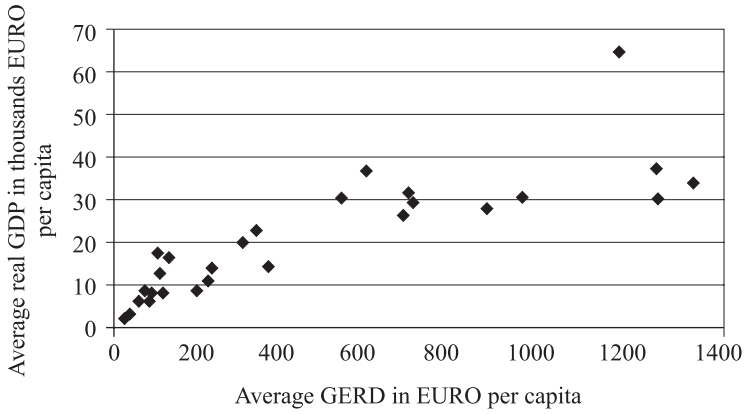
Source: own calculation on the basis of Eurostat and Innovation Union Scoreboard 2014.

The highest, that is exceeding EU averages more than twice, public expenditure according to GERD per capita was incurred in Denmark and Sweden. 13 times lower expenditure was in Bulgaria and about 10 times lower expenditure – in Romania. In Poland this expenditure per capita in comparison with the EU was almost four times lower, but with reference to Denmark this relation was over nine times lower.

The dynamics of public expenditure on R&D per capita also differed with respect to the level and the direction. The highest aggregated increase in the years 2006-2013 was observed in Romania – 101.9%, that is in the country placed at the 27th position in the EU with regard to public spending according to GERD per capita. Simultaneously, Bulgaria, which is placed at the very bottom, exhibited five times lower dynamics of these outlays. Denmark, which is placed at the top ranks with reference to the analyzed expenditure per capita, kept its relatively high increase of 39.1% with the EU average of 21.3%. Similar tendency was observed in Finland – 20.6% and in Sweden – 37.4%. In Poland the aggregated dynamics of public expenditure on R&D was 69.7%.

It is also the interdependence between the average public outlays according to GERD in EURO and the average real GDP per capita in thousands EURO in the years 2006-2013 that was examined. It is presented as correlation scatter chart in Chart 6.

Chart 6. Interdependence between average public expenditure (GERD) and average real GDP per capita in the years 2006-2013 for the UE



Source: own calculation on the basis of Eurostat and Innovation Union Scoreboard 2014.

This figure depicts the positive interdependence between the analyzed variables whose strength, which is calculated by means of Spearman's rank correlation coefficient, turned out to be very high. For the EU countries it was 0.92, while for the Eastern and Central Europe it was 0.60. The same examination conducted with reference to internal expenditure on research and development for all the sectors, not just the public sector, exhibited a very similar significance of positive correlation – 0.93.

Weaker interdependence between the examined variables in the countries that joined the European Union in 2014 and later results, among other things, from the fact that the efficiency of R&D expenditure depends upon the achieved development level measured by means of GDP per capita. This is confirmed by the empirical data from the countries with the top level of innovation, such as: Denmark, Sweden, Finland or Germany. Eastern and Central European countries present a much lower development level. This higher "return" from GERD measured by means of GDP per capita with the higher level of the country's development certainly results from different structures of the economies in question and multiple linked to each other factors. Higher share of private resources in the expenditure on R&D in the countries with the highest GDP per capita whose allocation might be more effective due to stronger motivation and more efficient measurement in-

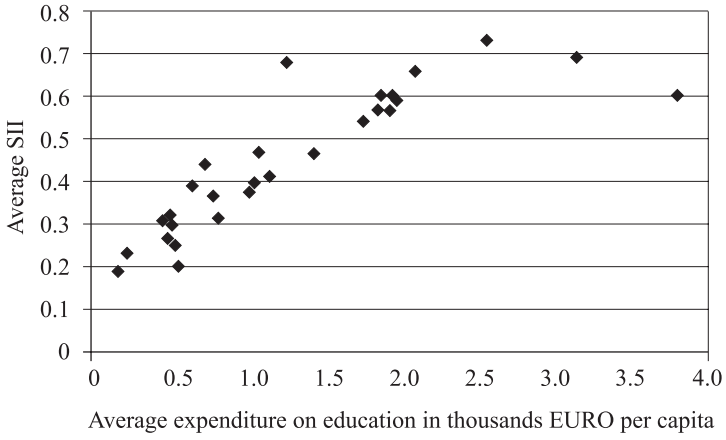
struments is often considered to be one of the causes. However, this explanation does not comply with the fact that Spearman's coefficient in which the variable is the total expenditure according to GERD, is quite similar to the strength of the examined interdependence for public expenditure only, that is 0.93.

Therefore, it might be more important to explain this difference on the basis of the assumption that the policy of public authorities in highly developed economies is more pro-innovative as a rule. Moreover, together with the higher economic development the expenditure on research and development is allocated to more profitable enterprises.

Broadly understood human potential is another determinant of innovation which is as important as financial resources and is related to them. It is human potential that is decisive in terms of efficiency and effectiveness of using private and government expenditure on R&D, which means that it determines the return from the invested into research financial resources. Therefore, the human factor is taken into consideration with respect to all the measurements of innovation. Accumulation of broadly understood human capital cannot be underestimated.

Although it is not analyzed in the following paper, it seems reasonable to pay attention to the existence of very strong (0.93 – the top bracket of the scale) correlation based on Spearman's rank coefficient between SII and public expenditure on education measured in EURO per capita with reference to the whole European Union. Slightly weaker – 0.73, but still significant interdependence between these variables placed at the bottom of the fourth bracket of the 6-bracket scale concerns the countries of Eastern and Central Europe. This interdependence is presented as correlation scatter chart in Chart 7.

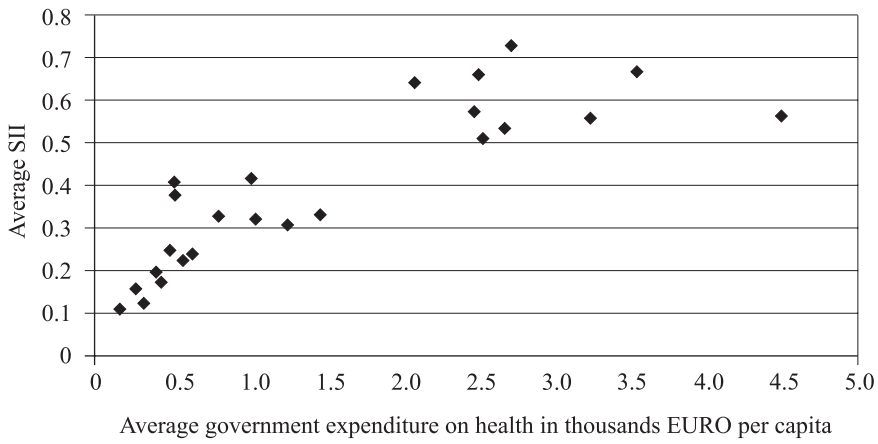
Chart 7. Interdependence between average public expenditure on education in thousands EURO and average SII index in EU in the years 2006-2013



Source: own calculation on the basis of Eurostat and Innovation Union Scoreboard 2014.

It is also the relationship between SII and public expenditure on health which in a particular way determines economy productivity and the quality of life. In this case correlation scatter chart also indicated that there is positive correlation between the examined variables – this is presented in Chart 8.

Chart 8. Relation between average public expenditure on health in thousands EURO per capita and average SII index in the EU in the years 2006-2013



Source: Own calculation on the basis of Eurostat and Innovation Union Scoreboard 2014.

The strength of correlation of these variables is slightly weaker than in the case of outlays on education, but it is still high – 0.89 for the EU countries and 0.60 for the Eastern and Central European countries.

Conclusion

It seems to be obvious that public finance, innovation and the level of economic growth are economic categories which are interrelated. The strength of this interdependence cannot be examined in an simple way leading to unambiguous conclusions. This is due to the fact that these interdependences are conditioned in multifaceted way, some variables are not easily measurable and, moreover, the period of the examination was too short in order to formulate assessments beyond doubt. Thus, the conducted analysis is far from being complete, however, it is possible to draw the following conclusions:

1. The period under analysis (2006-2013) is the period of increasing differences in the levels of EU economies innovation, which, in the context of integration processes within the European Union and differences in the development of particular world regions cannot be the source of optimism.

2. The study conducted with the use of correlation scatter charts and Spearman's rank coefficient proved the existence of very strong and strong, 0.92 for the whole EU and 0.80 for the Eastern and Central European countries, positive significance of correlation between the synthetic innovation index and the average real GDP per capita.

3. Expenditure on research and development activity is among the most significant determinants of innovation. The existence of very strong positive correlation between average expenditure according to GERD in the public part and GBOARD and the value of the real gross domestic product per capita proves the significance of public resources in financing research and development activity. In the case of the first measurement this interdependence was 0.92, and in the case of the second one – 0.94 for the EU, and for the Eastern and Central European countries – 0.60 and 0.78 respectively.

4. The differences in the significance of all the correlations under examination between so called 15 and the new EU members – so called 13, undoubtedly result from the development level of their economies and related differences in the economy structure and adopted developmental strategies. However, one should bear in mind, that the division of the sources of finance into public and private is of limited importance. The basis for such reasoning is the existence of equally strong (0.93) correlation interdependence between GDP and financial outlays in all GERD sectors in EURO per capita.

5. It is not only the direct amount of public outlays on research and development that is significant for the economy's innovation, but also the structure of public expenditure in total, including spending on education and health whose importance for human capital is widely acknowledged. Additional study proved that there is a strong interdependence between public expenditure on education and health and synthetic innovation index.

6. Expenditure on research and development in Poland has increased in recent years, however, its share in GDP remains relatively low and in 2013 it was only 0.87%. Public expenditure according to GERD in 2013 in comparison with 2006 was by almost 70% higher. However, the synthetic innovation index changed in the examined period by only 0.016, which indicates change nine times as low as in the case of Estonia which recorded the highest aggregated change of this index. In 2013 SII for Poland was almost three times as low as the highest value in the EU, that is the value for Sweden. This lower return from internal outlays on R&D in Poland is due to a mixture of different factors.

One of them is the level of economic development measured by means of GDP per capita. However, there are countries with similar Gross Domestic Product per capita in the years 2006-2013 which achieved a significantly higher advancement in economy innovation, for example, Hungary, Estonia, Slovakia, Lithuania and Latvia.

A relatively high share of public expenditure assuming its lower allocation efficiency according to GERD does not seem to be the decisive factor either. There are countries, such as Denmark, Sweden, Finland that have the highest public outlays on R&D per capita and they achieve the highest values of innovation indices.

Therefore, it is the structure of the economy that is of high significance, the adopted model of its development and widely understood aggregated human potential. And although here has been a significant improvement in this area, which can be observed on the basis of qualitative categories that are difficult to measure, but it is inadequate to the needs of Polish economy. Widely publicized successes of Polish scientists and practitioners do not become a permanent tendency.

It seems that with regard to the needs of our economy direct public expenditure on research and development activity is too low. The decrease in the GDP share of public expenditure on education and very low, in comparison with other countries, outlays on health do not support the quality improvement of human capital. As it was proved by the conducted study the outlays from public levies on these two state functions are characterized by a strong positive correlation significance with the economy innovation.

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Finanse publiczne a innowacyjność gospodarki

Streszczenie. *W artykule podjęto próbę analizy finansów publicznych pod kątem ich wpływu na innowacyjność polskiej gospodarki na tle Unii Europejskiej w latach 2006-2013. W państwach UE występują istotne różnice w poziomie rozwoju i innowacyjności gospodarek oraz wysokości i źródeł finansowania działalności badawczo-rozwojowej. Tymczasem warunkiem zrównoważonego rozwoju UE jest wyraźny postęp w innowacyjności, która jest źródłem zmian jakości produktów oraz kosztów ich wytwarzania, a zarazem konkurencyjności produktów i całych gospodarek. Wśród determinant innowacyjności istotne, jeśli nie najważniejsze, miejsce zajmują dostępność środków finansowych oraz szeroko rozumiany potencjał ludzki. Oba te uwarunkowania mieszczą się w obszarze wpływów finansów publicznych. Analiza nie wyczerpuje tematu, ale upoważnia do wnioskowania, że w stosunku do potrzeb naszej gospodarki bezpośrednie wydatki publiczne na działalność badawczo-rozwojową są zbyt niskie. Poprawie jakościowej kapitału ludzkiego nie sprzyja również spadek udziału w PKB wydatków publicznych na edukację oraz ciągle porównywalnie niskie z innymi krajami nakłady na zdrowie. Tymczasem – jak wykazało przeprowadzone badanie – nakłady z danin publicznych na te dwie funkcje państwa cechuje silna dodatnia istotność korelacyjna z innowacyjnością gospodarki.*

Słowa kluczowe: *innowacje, Summary Innovation Index, Global Innovation Index, innowacje a wzrost gospodarczy, GBOARD, GERD, publiczne wydatki na B+R, współczynnik korelacji rang Spearmana*

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An Innovative Approach to the Evaluation of Efficiency in the Financial Industry – The Case of Slovakia

Abstract. *The financial industry is undergoing a period of rapid change in market share, competition, technology, and the demands of the consumer. The aim of the paper is to answer, how two of the most important fields of the financial industry, commercial banking, and insurance, can meet these challenges by introducing an innovative approach to the evaluation of their efficiency. An efficiency, which reflects the use of less input to maximize possible output, is one of the most important principles of any business. The problem arises in determining the efficiency of the Decision Making Units (DMUs), in our case, the commercial banks and insurances, which have more diverse inputs and outputs. The Data Envelopment Analysis (DEA) allows the analysis of the efficiencies of the observed entities by taking into consideration different combinations of input and output variables. Based on the results of this analysis, it can be determined how inefficient certain observed DMUs are in comparison with efficient ones. Moreover, this analysis can be used to deduce how much a DMU needs to decrease an input and/or increase its output to make the unit efficient. Thus, this paper evaluates the technical efficiency of the Slovak banking and insurance industries by use of the DEA, which reflects the economic theory on the production of banking and insurance services. This innovative approach can also be used as an ex-ante assessment of different policy scenarios. In order to analyse the impact of different strategies and goals of management policy, DEA models with restricted weights can be used.*

Keywords: *production theory, efficiency, banking industry, insurance industry, SBM model, intermediation approach*

Introduction

One of the most important principles of any business is the principle of efficiency, which reflects the use of less input to maximize possible output. The problem arises in the determining the efficiency of the Decision Making Units (DMUs) that have more diverse inputs and outputs. The Data Envelopment Analysis (DEA) allows to analyze the efficiences of observed entities by taking into consideration different combinations of input and output variables. Based on the results of this analysis, it can be determined how inefficient certain observed DMUs are in comparison with efficient ones. Moreover, this analysis can be used to deduce how much a DMU need to decrease an input and/or increase its output to make this unit efficient.

The aim of the contribution is to benchmark individual commercial banking institutions and individual insurance companies in Slovakia with respect to their technical efficiency by the innovative deterministic approach called the data envelopment analysis.

A bank is usualy treated as a financial intermediary that accepts deposits and channels those deposits into lending activities, either directly by loaning or indirectly through capital markets. Other business lines are focussed on raising financial capital by underwriting or acting as the client´s agents in the issuance of securities.

An insurance industry is primarily focussed on a protection which consists of property and liability insurance, financial security, which encompasses life and health insurance, and investment, which is composed of asset management.

In this paper, the technical efficiency and of a homogenious representative sample of the banking and insurance institutions in Slovakia is analysed with the aid of non-radial DEA models of Tone. Two implications of gained results for managerial and regulatory purposes are then drawn. First, the management of the analyzed institutions with the poorest performances should change their managerial procedures and adopt enhanced-incentive policy. Second, the regulatory body should focus its control upon the technically un-efficient financial institutions.

The paper is organized in four sections, the first of which is introductory and the last is concluding. The second section concerns the related literature and the third methodological section is accompanied by the fourth one which presents the results and includes their interpretation.

1. Related literature

There has been intensive research on measuring efficiency of commercial banking institutions and their benchmarking. For example, Stavárek and Řepková

[2012] analyzed the Czech banking sector and its efficiency over the period of 2000 to 2009, Wózniewska [2008] examined the efficiency of the Polish banking sector over the period of 2000 to 2007, and, eventually, Zemanová [2007] in her analysis of the Slovak banking sector covered the short period of 2002 and 2003. Cross-country studies were done by Grigorian and Manole [2002], Kenjegalieva et al. [2009], Stavárek [2006], Tomova [2006] and Vincova [2006].

Table 1. Empirical studies grouped by the Visegrad Group coverage (in the alphabetical order)

Cross-country studies	DEA methodology
Grigorian and Manole [2002]	CCR, BCC
Kenjegalieva et al. [2009]	BCC
Stavárek [2006]	CCR, BCC
Tomova [2006]	BCC
Vincova [2006]	CCR, BCC
Single market studies	DEA methodology
Stavárek and Řepková [2012]	CCR, BCC
Wozniewska [2008]	CCR, BCC
Zemanová [2007]	CCR

"CCR" denotes the model by Charnes et al. [1978], "BCC" stands for the model by Banker et al. [1984].

Source: own elaboration.

The majority of the studies utilized in their quest rudimentary DEA models, the model by Charnes, Cooper and Rhodes [1978] addressed conventionally as the CCR model and the model by Banker, Charnes and Cooper [1984] addressed conventionally as the BCC model. In this paper applies a more advanced DEA model, the slacks-based model by Tone [2001]. This study also deepens research conducted by the author in collaboration [Boďa and Zimková 2013a, 2013b; Boďa, Farkašovský and Zimková 2014; Boďa and Zimková 2014a, 2014b] or by Boďa [2014]. The previous research centered on selected aspects of technical efficiency of the Slovak banking sector and its operating conditions. In their research they applied three main approaches to estimation of efficiency frontier in banking, so called the service-oriented, the intermediation oriented and the profit oriented approach.

There has been considerable research on measuring efficiency of commercial insurances and their benchmarking too. The non-parametric approach of the data envelopment analysis (DEA) was used by Barros et al. [2010], which covered technical efficiency of the insurance sector in Greece, by Diboky and Ubl [2007], which covered X-efficiency of the German insurance sector, and, eventually, Grmanová and Jablonský [2009], which used rudimentary CCR, BCC models to measure technical efficiency and Super-efficiency of the Slovak and Czech insur-

ance sector. Another stream of studies has focused on the production efficiency evaluated by the Malmquist index. For example, Barros and Barroso [2005] researched the production productivity change of the Portugal insurance sector, Cummins et al. [1996] estimated the production productivity change of Italian insurance industry and by following research Cummins et al. [1996, 1998] also the insurance industry of the USA. The insurance industry of Austria was researched by non-parametric DEA approach by Fukuyama [1997] and Mahlberg and Url [2003] devoted their studies to the Austrian insurance industry. Thus, studies currently cover several international insurance markets. However, the Slovak insurance market is researed only by the study of Grmanová and Jablonský [2009].

Table 2. Empirical studies which applied DEA methodology in insurance industry (in the alphabetical order)

Authors	Countries covered	DEA methodology
Barros et al. [2010]	Greece	Bootstrapped DEA
Barros and Barroso [2005]	Portugal	Malmquist index
Cummins et al. [1996]	Italy	DEA input distance function, Malmquist index
Cummins et al. [1998]	USA	DEA deterministic cost function, Malmquist index
Cummins et al. [1999]	USA	DEA input distance function, Malmquist index
Diboky and Ubl [2007]	Germany	X-Efficiency
Grmanová and Jablonský [2009]	Czech Republic, Slovakia	CCR, BCC, Super-efficiency
Fukuyama [1997]	Japan	Malmquist index
Mahlberg and Url [2003]	Austria	Malmquist index

Source: own elaboration.

Traditional literature on efficiency of insurance firms is addressing production approach and intermediation approach [Berger & Humphrey 1997]. The production approach is seeing the insurance firm as manufacturing company. However, especially the use of "claims paid" or "losses incurred" as an output of the production approach has attracted criticism because an unexpected upward change in losses (due to an environmental catastrophe or a terrorist attack) would result in efficiency enhancement of the respective company. Therefore the intermediation approach which treats an insurance company as a financial intermediary and selects inputs and output variables accordingly tries to overcome the shortfalls of the production approach. Diboky and Ubl [2007: 15-17] devide services provided by insurers into risk bearing (assuming risk to decrease potential personal losses), risk pooling (collecting funds from policyholders and redistributing money to those policyholders who incurred losses) and financial intermediation (borrow-

ing funds from policyholder and investing them to financial assets until they are paid back at policy expiration date). They assume the amount of gross premium provided by a company to be a good proxy for these services, since all of them are related to this key figure. As shown below, the framework of Diboky and Ubl [2007: 16] is adopted in this contribution for selecting a combination of output variables. From the shareholder´s point of view, the main objective of an insurer is to achieve a certain profit goal, e.g. a required rate of return. Therefore, the after tax return is selected as output variable as well.

3. Methodology

3.1. Input and output variables

The choice of inputs and outputs is usually a critical part of analysis, as it involves measuring different aspects of the banking firm. Indeed, it is impossible to fully capture the whole range of banking activities, due to their multiproduct nature. Another often discussed issue is the role of deposits, which have both input and output characteristics. So far two main approaches have been developed and used both in theory and practice of *banking,* and these are the intermediation approach and the service-oriented approach. The most commonly used approach in the European banking industry is the intermediation approach which recognizes intermediation as the core activity – banks are not producers of loan and deposit services. Instead, deposits (and other selected variables) are treated as inputs and loans and investments are treated as outputs. In this paper, three inputs and one output is recognized in the study. The input selected under the intermediation approach is total employees, deposits, and fixed assets, while output to be maximized is represented by earning assets.

Consistent with traditional efficiency literature of the *insurance* industry, most decisive inputs are specified: labour, business services and capital. The quantity of labour and business services is defined as total operating costs. They consist of both the costs associated with selling and issuing new policies (acquisition costs) and the costs of maintaining existing policies (maintenance costs). The operating costs of life insurance can be classified broadly into labor-related expenses, capital expenses, and materials consisting of all other expenses [Segal 2000: 4]. Labor is defined as the total number of employees and agents employed by the company. The total cost of employees is the sum of salaries, contributions for benefit plans, payments under non-funded benefit plans and other employee welfare. Capital is defined as the sum of capital expenses: rent, equipment rental, and depreciation. The third input, materials, consists of all other expenses Most of the expense items are directly related to selling new policies and servicing existing policies. The total operating expence in our contribution covers labor-related expenses and ot-

her expences (especially asset and liability management expences), therefore the capital is included as addidional input variable.

In order to determine the technical efficiency of organizational units of the Slovak insurance sector under the intermediation approach, the SBM analysis was applied on the data of fifteen organizational units of the Slovak insurance sector characterizing their performance in 2013.

The data used in the empirical analysis are the yearly data of balance-sheet items disclosed by the fifteen organizational units of the Slovak insurance sector during 2013. Two inputs and two outputs are recognized in the study. The input selected under the intermediation approach is total operating expenses and the capital, while output to be maximized is represented by written premium and after tax result.

3.2. The employment of the SBM model

In this paper, the assumption of variable returns to scale is formed (which, of course includes a specific case of constant returns to scale) and combined with a non-oriented SBM model in evaluating the organizational units of the Slovak insurance sector on a comparative basis.

The disadvantage of the rudimentary DEA models (CCR and BCC model) is that the input or output orientation of the model has to be selected. However, in practice this requirement may sometimes complicate the solution of research problem. Not always it is suitable to determine, whether a production unit should only minimize inputs or only maximize outputs. This drawback is eliminated by SBM (slacks-based measure) model, whose author is Tone [2001].

Properties of SBM model are (1) invariance of measurement units, i.e. the results of model are independent from measurement units of inputs and outputs, (2) negative monotony, rate of efficiency decreases monotonically by increase of each slack in inputs and outputs. SBM can be interpreted as the ratio of average mid inefficiency of inputs and average mid inefficiency of outputs.

In the exact formulation of the SBM model, it is assumed that the data on n production units are available, where any production unit o, $o \in \{1, ..., n\}$, produces s desirable outputs out of m inputs. The values of inputs of production unit o are represented by vector $\mathbf{x}_o = (x_{o1}, ..., x_{om})'$ and the values of outputs by vector $\mathbf{y}_o = (y_{o1}, ..., y_{os})'$. The elements of both vectors are positive. Individual inputs and outputs have corresponding vectors of potential slacks $\mathbf{s}^{\mathbf{x}}_o = (s^{\mathbf{x}}_{o1}, ..., s^{\mathbf{x}}_{om})'$ and $\mathbf{s}^{\mathbf{y}}_o = (s^{\mathbf{y}}_{o1}, ..., s^{\mathbf{y}}_{os})'$, which states how individual inputs and outputs must be improved in order that production unit o become efficient (whereas vector of inputs $\mathbf{x}_o$ need be reduced by $\mathbf{s}^{\mathbf{x}}_o$ and vector of outputs $\mathbf{y}_o$ need be increased by $\mathbf{s}^{\mathbf{y}}_o$). These slacks are to be identified by the DEA and serve as an exclusive basis of efficiency calculation for respective production unit o.

For each production unit o, $o \in \{1, ..., n\}$, it is necessary to solve the following task of linear programming of the non-oriented SBM model under the assumption of variable returns to scale,

$$\rho_o\left(\ddot{\mathbf{e}}, \mathbf{s}^{\mathbf{x}}, \mathbf{s}^{\mathbf{y}}\right) = \frac{1 - \frac{1}{m}\sum_{i=1}^{i=m} s_{oi}^{\mathbf{x}} / x_{oi}}{1 + \frac{1}{s}\sum_{j=1}^{j=s} s_{oj}^{\mathbf{y}} / y_{oj}} = !\min \quad \text{with respect to} \quad \begin{array}{l} \mathbf{s}^{\mathbf{x}} = \mathbf{x}_o - \sum_{i=1}^{i=n} \{\ddot{\mathbf{e}}\}_i \mathbf{x}_i \geq \mathbf{0} \\ \mathbf{s}^{\mathbf{y}} = \mathbf{y}_o - \sum_{i=1}^{i=n} \{\ddot{\mathbf{e}}\}_i \mathbf{y}_i \geq \mathbf{0} \\ \sum_{i=1}^{i=n} \{\ddot{\mathbf{e}}\}_i = 1,\ \ddot{\mathbf{e}} \geq \mathbf{0} \end{array} \quad (1)$$

The symbol „≥“ denotes at a vector that respective elements of this vector are non-negative and at least one element is non-zero.

The restrictions of the optimization task constructs the production possibility set with respect to n production units and their observed inputs $\mathbf{x}_1, ..., \mathbf{x}_n$ and outputs $\mathbf{y}_1, ..., \mathbf{y}_n$ as well as their convex linear combinations in R^m and R^s respectively. The coefficient ρ takes values at interval [0, 1] and it is the SBM score of technical efficiency (in this case of production unit o whose task (1) is subject to optimization. If for some production unit $\rho = 1$ happens to be the case, this production unit is called SBM-efficient, which means that it is technically efficient in the sample of n production units to be evaluated.

In the paper, the role of production units is undertook by individual organizational units in the Slovak banking and insurance sectors in the year 2013.

3.3. The set of production units

In our analysis, the banking sector in the Slovak Republic is represented by 16 banking institutions. Ten banks have the status of foreign banks licensed in the Slovak Republic (Slovenská sporiteľňa, a.s. – denoted as SLSP; Všeobecná úverová banka, a.s. – denoted as VUB; Tatra banka, a.s. – denoted as Tatra banka; Československá obchodná banka, a.s. – denoted as CSOB; UniCredit Bank Slovakia, a.s. – denoted as UniCredit Bank; Poštová banka, a.s. – denoted as Postova banka; Prima banka Slovensko, a.s. – denoted as Prima banka; OTP Banka Slovensko, a.s. – denoted as OTP banka; VOLKSBANK Slovensko, a.s. since 2013 Sberbank Slovensko, a.s. – denoted as Volksbank; Privatbanka, a.s. – denoted as Privatbanka) and six are the branch offices of foreign banks operating in the Slovak Republic (ZUNO BANK AG, branch office of foreign bank – denoted as Zuno Bank AG; ING Bank N. V., branch office of foreign bank – denoted as ING Bank N.V.; Citibank Europe plc, branch office of foreign bank – denoted as City Europe, plc; Oberbank AG, branch office of foreign bank in the Slovak Republic – denoted as Oberbank AG; Komerční banka, a.s., branch office of foreign bank – denoted as Komercni banka; J&T Banka, a.s., branch office of foreign bank – denoted as J&T Banka). This group of the banking institutions concisely represents

the banking sector in the Slovak Republic as it covers more than 95% of the banking assets. Hence the results of this paper can be interpreted as being representative of the total banking sector in Slovakia. To assure consistency of the analysis, building societies and special financial institutions are not under consideration. On the other side, the well-established branch offices of foreign banks are also under consideration, what enables to test the hypothesis that they can be technically efficient too as they benefit from the know-how of the head-quarters. In this case the national regulation body can expect the further outflow of the banks licensed in the Slovakia and their transformation into branch office of a foreign bank. The data used in the empirical analysis are the 2013 yearly data of balance-sheet items disclosed by the TREND Holding, s.r.o., Bratislava.

The dataset of insurance industry comprises the data on 15 organizational units (insurances) operating in the Slovak Republic and it covers the great majority of Slovak insurance industry (as the total of included banks exceeds 80% of the Slovak insurance assets). The organizational units considered in the paper are Allianz – Slovenská Poisťovňa, a.s., Kooperativa, Vienna IG, a.s., Komunalna poisťovňa, Vienna IG, a.s., MetLife Amslico Poisťovňa, a.s., CSOB Poisťovňa, a.s., Poisťovňa Slovenskej sporiteľne, Vienna IG, a.s., QBE Insurance Limited, a.s., HDI Versicherung AG. a.s., Uniqa Poisťovňa, a.s., Union Poisťovňa, a.s., Poisťovňa Poštovej banky, a.s., Poisťovňa Cardif Slovakia, a.s., and AXA Pojisťovna, a.s. Firms not included into our panel typically represent small insurers. In order to assure consistency of the analysis, insurance institutions which concentrate on life insurance only and decision making units with negative input or output data are subject to exclusion. The source of the data is TREND Holding, s.r.o., Bratislava.

4. Results

All DEA computation were done by DEA-Solver learning version 3.0 and the results are listed in Table 3, which presents information about the non-oriented technical efficiency score, ranking each individual banking and insurance institution under the research.

As to the banking industry it appears out that transformation of deposits, human sources and fixed assets into earning assets was successfully achieved by more than half of banking institution under the research: Slovenská sporiteľňa, a.s., Tatra banka, a.s., Poštová banka, a.s., ZUNO BANK AG, branch office of foreign bank, ING Bank N. V., branch office of foreign bank, Citibank Europe plc, branch office of foreign bank, Oberbank AG, branch office of foreign bank in the Slovak Republic, Komerční banka, a.s., branch office of foreign bank, and

Table 3. Technical efficiency scores and slacks of the banking and insurance industries in Slovakia

No.	DMU	Score	DMU	Score
	Banking industry		Insurance industry	
1	SLSP	1	Allianz – Slovenská Poistovňa	1
2	VUB	0.82	Kooperativa, Vienna IG	1
3	Tatra banka	1	Generali Slovensko Poistovňa	0.42
4	CSOB	0.78	Komunálna poisťovňa, Vienna IG	1
5	UniCredit Bank	0.83	MetLife Amslico Poisťovňa	1
6	Postova banka	1	Uniqa Poisťovňa	0.52
7	Prima banka	0.77	CSOB Poisťovňa	1
8	OTP banka	0.47	Wustenrot Poisťovňa	0.43
9	Volksbank	0.54	Poisťovňa Slovenskej sporiteľne, Vienna IG	1
10	Zuno Bank AG	1	Union Poisťovňa	0.28
11	Privatbanka	0.44	Poistovna Cardif Slovakia	0.39
12	ING Bank N.V.	1	QBE Insurance Limited	1
13	Citi Europe plc.	1	AXA Pojisťovna	0.44
14	Oberbank AG	1	Poisťovňa Poštovej banky	0.32
15	Komercni banka	1	HDI Versicherung AG	1
16	J&T Banka	1		

Source: own elaboration.

J&T Banka, a.s., branch office of foreign bank. Among them, three are the foreign banks licensed in the Slovak Republic while six of them have got status of the branch offices of foreign banks operating in the Slovak Republic.

As to the insurance industry, from the gained results it comes out that transformation of total operating costs and equity into premium written and after-tax result was successfully achieved by more than half of insurance institution under the research: Allianz – Slovenská Poisťovňa, a.s., Kooperativa, Vienna IG, a.s., Komunalna poisťovňa, Vienna IG, a.s., MetLife Amslico Poisťovňa, a.s., CSOB Poisťovňa, a.s., Poisťovňa Slovenskej sporiteľne, Vienna IG, a.s., QBE Insurance Limited, a.s., HDI Versicherung AG. a.s. The worst results have got Union Poisťovňa, a.s., Poisťovňa Poštovej banky, a.s., followed by Poisťovňa Cardif Slovakia, a.s. In those cases managers should change their procedures and adopt enhanced-incentive policy. The excess slacks of input variables point how much a technically un-efficient insurance company has to decrease its inputs to become technically efficient. On the contrary the shortage slacks of output variables bring out how much a technically un-efficient insurance company has to increase its outputs to become technically efficient.

Conclusion

Differences in the performance of banks and insurances prompt a number of questions, the answers to which are important to managers (especially those working in the area of bank and insurance strategy) and regulatory bodies. This paper provides answers to the key question: How widely do banks and insurances in Slovakia vary in the technical efficiency with which they use resources and how their benchmark looks like. It was proved that in the case of banking industry and the insurance industry as well, technically efficient units count around half of all decision making units. It is interesting to notice that degree of bank´s in-efficiency is considerably lower than in-efficiency of insurance companies. Changes in the external environment would create growth opportunities for both industries in order to deliver the shareholders' expectations. The financial companies will have to balance between growth, profitability and risk as they go forward. This would entail marked changes in the business strategy and the same would be cascaded to operational decisions related to product design, pricing, channel monitoring, and operational effectiveness. Banks and insurances with a one-dimensional focus on growth or on profitability would lose competitive power either due to strain on capital or due to insignificance of the scale. This would support the trend of overall profitable growth for the financial industry.

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Innowacyjne podejście do oceny efektywności kosztowej w branży finansowej – przypadek Słowacji

Streszczenie. *Sektor finansowy jest w fazie szybkich zmian w zakresie udziałów rynkowych, konkurencji, technologii oraz popytu konsumenckiego. Celem artykułu jest określenie, jak dwa najważniejsze segmenty sektora finansowego: bankowość komercyjna i ubezpieczenia mogą sprostać tym wyzwaniom przez wprowadzenie innowacyjnego podejścia do oceny własnej efektywności kosztowej. Efektywność albo wydajność kosztowa, która polega na maksymalizowaniu efektów i minimalizowaniu nakładów, należy do najważniejszych zasad prowadzenia przedsiębiorstwa. Problem pojawia się, gdy trzeba ustalić efektywność kosztową jednostek decyzyjnych (DMU), w tym przypadku banków komercyjnych i firm ubezpieczeniowych, w których nakłady i efekty cechuje znaczna różnorodność. Pomocna w tym może być metoda Data Envelopment Analysis (DEA), pozwalająca na określenie efektywności obserwowanych podmiotów poprzez badanie różnych kombinacji zmiennych dla nakładów i efektów. Dzięki niej można uchwycić różnice między efektywnymi a nieefektywnymi jednostkami decyzyjnymi, a także określić, o ile dana jednostka decyzyjna musi obniżyć nakłady i/lub zwiększyć efekty, by stać się wydajna. W artykule metodę DEA wykorzystuje się do oceny technicznej wydajności słowackiego sektora bankowego i ubezpieczeniowego, która odzwierciedla teorię ekonomiczną dotyczącą wytwarzania i świadczenia usług bankowych i ubezpieczeniowych. Metoda ta może być także stosowana do oceny ex ante alternatywnych scenariuszy działania, a do analizy wpływu różnych strategii i celów zarządczych – modele DEA z ograniczonymi wagami.*

Słowa kluczowe: *teoria produkcji, wydajność, sektor bankowy, branża ubezpieczeniowa, model SBM, podejście oparte na pośrednictwie*

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P. Pioterek, B. Zieleniecka, *Technika pisania prac dyplomowych*, wyd. 3 zm., Wyd. WSB w Poznaniu, Poznań 2004, s. 9.

♦ praca zbiorowa:

Przemiany we współczesnej gospodarce światowej, red. E. Oziewicz, PWE, Warszawa 2006, s. 20-28.

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A. Michalewicz, *Systemy informacyjne wspomagające logistykę dystrybucji*, w: *Logistyka dystrybucji*, red. K. Rutkowski, Difin, Warszawa 2001, s. 102-123.

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[1] K. Strzyżewska, *Zarządzanie dostawami*, „Logistyka a Jakość" 2008, nr 3-4, s. 31-32.

[2] W. Orłowski, *Wielki wybuch, czyli giełdy w panice*, „Gazeta Wyborcza", 13 października 2008 r., s. 3.

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