

Risk asymmetries in “open science” concept: university technology transfer perspective

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Abstract: *Purpose* – This paper applies Ahlbrecht and Weber risk asymmetries approach to foundations of Open Science concept. The aim of this study is answering the questions: What are the risk asymmetries in the Open Science evolution process? What are directions of change in Open Science concept?

Design/methodology/approach – The paper is prepared in the historical – empirical mainstream. Methodology used in this research was the critical analysis of the state of knowledge based on literature review.

Findings – Part I of this paper discusses the framework of the concept of Open Science in research policy. Part II concludes with a brief overview of Open Science concept in university technology transfer process and highlights the risk asymmetries. There were identified three risk asymmetries: in the area of assessment of the quality of the research results, “rapid mode” of increasing of research results in science, intellectual property fraud risk for university. The analysis was made with consideration of two coexisting systems – one still based on OS (OSS – Open Science System) and the other characterized by legal norms (intellectual property rights) of research (IPRS – Intellectual Property Rights System). In one system (OS) appears freedom to “openness” and in the other system (IPRS) there is obligatory in the evaluation of scientific achievements measured as citation in the top journals or obtained patents.

Originality/value – The purpose of the study was completed. Open Science considerations were in the context of unprecedented literature. In the study there were used assumptions of Akerlof theory of information asymmetry and Ahlbrecht Weber risk asymmetries, that is as follows: Short-term Long-term asymmetry, Certainty-Risk asymmetry, Gain-Loss asymmetry. There were also proposed Public – Private risks asymmetry.

Keywords: open science, risk, asymmetry, technology, transfer

Introduction

The end of the last century and the beginning of the 21st century witnessed unprecedented changes in the global environment that are influencing the role and mode of operation of tertiary research policies all over the world. Among the most significant dimensions of transformation of the global economy are the increasing importance of knowledge and innovation as drivers of growth and social development, and the information and communication revolution (Goh, 2005; Zweimüller, 2000; World Bank, 2002; OECD, 2015; Salmi, 2015). In the past decade, the high-technology share of manufacturing production and exports has more than doubled, to reach 20–25%. Knowledge-intensive service sectors, are growing even faster. Indeed, it is estimated that more than 50% of Gross Domestic Product (GDP) in

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the major modern economies is now “knowledge-based” (Lee, Wang, 2003; OECD, 1996, p. 3). We are living in a complex and dynamic world, in which research and innovation are occupying a decisive role for economic development and wealth of nations. The economies are increasingly based on knowledge and information. Knowledge generated from research is now recognized as the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance. The ability of a society to generate, adapt and apply science is critical for sustained economic growth and improved living standards. Science has indeed become the most important factor in economic development (World Bank, 1999).

Two related aspects of the recent evolution of tertiary education systems are particularly worth underlining in this context: the rise of multidisciplinary, and the emergence of collaborative modes of research transmission and generation. In the first instance, traditional disciplines and methods characterized by over-specialization and segmentation are increasingly challenged by developments in new scientific and technological fields, the shift toward a problem-based mode of production of knowledge, and the blurring of the distinction between basic and applied research (Gibbons et al., 1994; Gibbons, 1998). Under these conditions, there was an intensification of the Open Science (OS) concept evolution. Activity at the level of the European Commission and the OECD, as well as the internal research policies of the developed countries, are being observed. There is a wide-ranging debate about the OS, and some materializing ideas are beginning to be implemented, for example in the Horizon 2020 research funds policy. In the area of the commercialization of intellectual property in the processes of transferring university technology taking into account asymmetric risks, the issue of OS is definitely worth analyzing.

In the study there were used assumptions of Akerlof (1970) theory of information asymmetry and Ahlbrecht Weber risk asymmetries (Ahlbrecht, Weber, 1997), that is as follows: Short-term Long-term asymmetry, Certainty-risk asymmetry, Gain-Loss asymmetry. The aim of this paper is answering the questions: What are the risk asymmetries in the OS evolution process? What are directions of change in OS concept? Part I of this paper discusses the framework of the concept of OS in research policy. Part II concludes with an overview of OS concept in university technology transfer process and highlights the risk asymmetries. The paper is prepared in the historical – empirical mainstream. Methodology used in this research was the critical analysis of the state of knowledge based on literature review.

1. Framework for the concept of “Open Science”

Recently there has been many debates about OS. Concept that is not well defined and it is often also described as: Science 2.0, Open Research or E-Science. It is also connected to terms like: Open Access, Open Publication, Open Source, Open Data, Big Data, Open Collaboration or Open Software. The debate is about new paradigms shift in science at the

same time. So the bothering questions arise: What does this “openness” means in science? Is this the process that is entering in the new era of scientific history? If so, what would it be main features?

The term “open science” was presented by economist Paul David in an attempt to describe the properties of scientific goods generated by the public sector and in opposition to the perceived extension of intellectual property rights into the area of information goods. Economists consider scientific knowledge generated by public research as a public good, which means that everyone can make use of that knowledge at no additional cost once it is made public, generating higher social returns (David, 2003). But foundations for the ongoing debate on OS has been attributed to Merton.

In 1942, Robert King Merton, an American sociologist of science, described a set of ideals that characterised modern science framework. First and foremost is the notion of “common ownership” of scientific discoveries, according to which the substantive findings of science are seen as a product of social collaboration and are assigned to the community. Scientists’ claims to intellectual property are limited to recognition and esteem (Merton, 1973). According to David (1991) the world of “open science” expresses the ideas of free pursuit and open disclosure of knowledge accompanied by a reputational reward and resource allocation system based on validated claims to priority in discovery or invention. This is justified in the observed changes that occur around the way of practicing science.

Research creation has increased exponentially in the past decades, and collaborative research activities have followed the same pattern. We can identify trends illustrating the evolution of co-authored articles, revealing a faster growth of multiple author articles than single author ones. While the number of articles published over the past decade went from 1.3 million in 2003 to 2.4 million in 2013, the number of authorships has increased at a far greater rate from 4.6 million in 2003 to 10 million in 2013 (Plume, van Weijin, 2014).

The “Mertonian norms” represent of course idealized model of diffusion of research results. Eternal ownership plays a key role in science policy and system generating scientific results. It establishes a competitiveness for scientific discoveries and it acts as a mechanism to diffusion of new findings. This approach has also been criticized. Latour (1987) has portrayed the “Mertonian norms” as apologetic ideology: self-serving “myths about cooperative” disinterested science. From the other side it was glorified. As argued in Dasgupta and David (1994), OS is a remarkable social innovation for its faculty to separate “moral property” and “physical possession”, i.e., for making compatible the provision of incentives to researchers (“winning the race”) with the organization of quick and broad dissemination of the new findings. In David (1991) it is argued that the norms are prescriptive, and that beliefs that are instilled in scientists as part of the “culture of science” have an effect on their behavior - making it easier to form cooperative networks where it is in their mutual interest (and that of society at large) to organize research cooperatively.

Scientists and academics are not the only stakeholders that can benefit from OS. The demand from the business sector and individual citizens to access research results is

significant. For example, usage data from PubMed Central (the online repository of the US National Institutes of Health) show that 25% of the daily unique users are from universities, 17% from companies, 40% are individual citizens and the rest are from government or in other categories (UNESCO, 2012). Key actors in OS (OECD, 2015) are: Researchers, Government ministries, Research funding agencies, universities and public research institutes, Libraries, repositories and data centers, Private non-profit organisations and foundations, Private scientific publishers, Businesses, supra-national entities.

According to OECD (2015) there can be identified rationales for OS such as:

1. *Improving efficiency in science* – OS efforts can increase the effectiveness and productivity of the research system, by a) reducing duplication and the costs of creating, transferring and reusing data; b) allowing more research from the same data; c) multiplying opportunities for domestic and global participation in the research process.
2. *Increasing transparency and quality* in the research validation process, by allowing a greater extent of replication and validation of scientific results.
3. *Speeding the transfer of knowledge* – OS can reduce delays in the re-use of the results of scientific research including articles and data sets and promote a swifter path from research to innovation.
4. *Increasing knowledge spillovers to the economy* – Increasing access to the results of publicly funded research can foster spillovers and boost innovation across the economy as well as increase awareness and conscious choices among consumers.
5. *Addressing global challenges more effectively* – Global challenges require coordinated international actions.

Whereas calculating the economic value of research publications and data is challenging Houghton and Sheehan (2009) analysed the effects of increasing accessibility to public sector research outputs in Australia (increased accessibility generates a return of approximately AUD 9 billion over 20 years). Houghton, Rasmussen and Sheehan (2010) claim that a public access policy mandate for US federal research agencies over a period of 30 years may be worth around USD 1.6 billion and up to USD 1.75 billion. One of the more interesting statements is that these figures would be significantly higher than the estimated cost of implementing open access archiving. Even more interesting research results come from JISC – Joint Information Systems Committee (2014) which conducted a study on the economic impact of three UK data centers: the Economic and Social Data Service, the Archaeology Data Service and the British Atmospheric Data Centre. JISC estimated that the returns on investment of each of these three centers could be between approximately twofold and tenfold over 30 years (JISC, 2014). There are also available research results evidencing the need for greater openness of science. For example in Denmark Houghton found that 48% of SMEs (Small and Medium Enterprises) consider research outcomes very important for their business activities, and more than two-thirds reported difficulties in accessing research material (Houghton et al., 2011). Whereas results of the survey on UK SMEs indicate that the equivalent of 10% to 20% of articles were not easily accessible for the survey respondents

(Ware, 2009). There is also no opinion about that making research data publicly available (open) may promote public understanding of science, evidence-based practices, and citizen-science initiatives (Kowalczyk, Shankar, 2010).

However, in development of OS concept very significant risks occurred like risk of incorrect use data/information. It has to do with the ethical, legal and social implications of information and knowledge generated in a scientific collaboration. As scientists generates new knowledge in areas that directly influence the quality of human life, new ethical dilemmas appear, which require appropriate legislation. The best example of this is “The Human Genome Project”, where the availability of detailed genetic information has momentous implications, positive and negative, in terms of possible genetic reengineering to deal with genetically determined diseases or potential health conditions. In addition, there is a need to limit the commercial use of private data collected during research. The protection of private citizen data used in collaborative research projects is now also a critical dimension (Salmi, 2015).

From the economic point of view one serious dilemma occurs. In knowledge based economy with internet technology, universities generating research results funded by public money should naturally become public, what should stimulate OS. There are many arguments that confirm the validity of developing the OS concept in research policy, what should cause increased efficiency and diffusion of research results, increasing transparency and quality in the research validation process, speeding the transfer of knowledge, increasing knowledge spillovers to the economy, addressing global challenges more effectively. This all value added in economy coming from OS perfectly incorporates with Schumpeterian perspective of innovation. For example Caballero and Jaffe (1993) developed a new methodology for measuring research productivity through innovation. They assessed the extent of Schumpeterian creative destruction, knowledge obsolescence, and knowledge spillovers in the endogenous growth process using US data on patents and patent citations. In the economy the vast majority of innovations is generated by private companies, but there is part of innovations generated from relation science-business incorporated in university technology transfer process.

2. OS concept and risk asymmetries in University Technology Transfer process

According to European Commission OS movement is challenging conventional approaches on best to promote research and development activities in an effective manner. OS represents a novel approach to scientific development, based on cooperative work and information distribution through networks using advanced technologies and collaborative tools. Rather than restricting the “ownership” of discoveries and scientific advances, OS seeks to facilitate knowledge acquisition through collaborative networks and encourage the generation of solutions based on openness and sharing (Salmi, 2015).

On the one hand today universities are transferring technology in accordance with the law mainly under patent licenses. Intellectual property protection in patent system is one of the basic economic laws. In this area there is a contradiction with OS concept. Without intellectual property rights, technological (and not only) knowledge would be public property (what is crucial for the OS concept). The inventors' competitors would be able to imitate the idea without penalty and claim the new knowledge to be their own. If companies want to make production of technological knowledge available not entirely free of charge, they must invoke their temporary monopolistic right accorded by patenting. The intellectual property rights or "rights of free disposal" (Grupp, 2007, p. 507).

On the other hand today's intellectual property foundations represented by patent system is becoming less and less effective as evidenced by numerous disputes over the background of the patent claims and from companies so-called NPE (Non Performing Entities) or PAE (Patent Assertion Entities) (Simonton, 2010; Lemley, 2012; Scotchmer, 2005; Magliocca, 2007; Lemley, Melamed, 2013; Bessen, Meurer, 2012; Bessen et al., 2011; Chien 2009). According to Dasgupta and David (1994) university research is experiencing the degradation of the openness convention through the penetration of market-driven rivalry. Behaviors like patenting activities, delayed access, non-release of data and strategies regarding knowledge disclosure and sharing are now emerging. Nowadays two systems are, thus, coexisting – one based on OS (OSS – Open Science System) and the other still characterized by legal norms (intellectual property rights) of research (IPRS – Intellectual Property Rights System). In one system (OS) appears freedom to "openness" and in the other system (IPRS) there is obligatoriness in the evaluation of scientific achievements measured as citation in the top journals or obtained patents. At the interface between those two systems, there are many risks occurs because these two systems are strongly interrelated since the same stakeholders, agents and entities can operate within. There is a risk of binary choices with externalities: each stakeholder must decide whether to work in a complete OSS or in a system characterized by a compromise between openness and some legal norms of research. This coexisting of two systems generates risk asymmetries deriving from incomplete information.

Incomplete information occurs when one side of the transaction is better informed than the other – that is the so-called information asymmetry (Akerlof, 1970). Decisions related to technology transfer and commercialization will result in licensing research results or patent filing in the patent system only in the context of incomplete information. In some markets, information asymmetry is eliminated by eliminating unfair market participants. Another situation is the commercialization of intellectual property of the university.

First of all, incomplete information in the area of intellectual property concerns both parties to the transaction (e.g. granting a public license to a private entity) by reason of the specific nature of knowledge as such. The university is not entirely sure that knowledge that is commercialized does not occur in the same or similar shape elsewhere in the market. Second, ignorance of knowledge can result in low commercialization potential, which can be considered as one of the parties to the transaction as unsatisfactory.

Asymmetry of information is the subject of many considerations in contemporary literature (Haussler et al., 2014; Heeley et al., 2007; Leung, Kwok, 2012; Long, 2002, Lofgren et al., 2012, Agarwal et al., 2016). Asymmetry of information is the subject of many considerations in contemporary literature (Baxamusa et al., 2015; Choi et al., 2013, Bakarar et al., 2014). Albrecht and Weber in their research tested following asymmetries (Albrecht, Weber, 1997): Short-term Long-term asymmetry; Certainty-Risk asymmetry, Gain-Loss asymmetry. From university the technology transfer point of view one can identify Public-Private risk asymmetry. Technological progress in the economy is mainly generate through research and development activities of private enterprises and public universities. The knowledge and intellectual property of public universities, given the source of funding, can be compared to the public good. It is incontrovertible to assert the equivalence of state priorities to society. This includes priorities such as: National defense, health care, culture, administration or science. The state participates in financing research and development works of universities, among others. By creating scientific research laboratories, grant research funding systems, patent offices, or by supporting academic entrepreneurship by creating the right law. However universities are obligated to intellectual property management under penalty of defrauding of public funds. OS concept in the view of the above is in contradiction. Universities may transfer the technology but accordance with the law they cannot proceed “open transfer” of technology.

Decisions related to intellectual property trading on the market, licensing or patent filing for protection in the patent system are fraught with information. Incomplete information occurs when one side of the transaction is better informed than the other – that is the so-called information asymmetry (Akerlof, 1970). Refraining from reflection on information asymmetry alone and solely to the information itself on the complex and complicated processes of technology transfer from university to economy in today’s market environment seemed to be insufficient. So asymmetric information was isolated in the information asymmetry of risk. Risk asymmetries occurs in following aspects in relation OS versus university technology transfer:

1. OSS can generate public knowledge which can be used free of charge by private companies and stakeholders functioning in IPRS. This part of generated knowledge by OSS can be crucial input for the research working in IPRS or private companies. It causes information asymmetry because results from OSS will not be included in the assessment of the quality of the research results. OS is creating tensions and complications for researches in terms of evaluating criteria. Still high impact factored journals are the base to evaluate researchers work. This corresponds with Ahlbrecht and Weber’s “Gain-Loss asymmetry” and “Certainty-risk asymmetry” and proposed “Public – Private asymmetry”.
2. OSS will generate opportunity to have available scientific knowledge in “rapid mode” (by Open Data and Open Access), this may result increasing the risk of obsolescence of existing knowledge. Asymmetry will occur when results from IPRS will be

recognized as an outdated but the newest results published in OSS will not be implemented in procedures as a scientific achievements. This corresponds with Ahlbrecht and Weber's "Short-term Long-term asymmetry".

3. Priority syndrome functioning in OSS which can be treated as a motivation system can completely block procedures of protecting universities' intellectual property in patent system. This will may cause waste of commercial potential risk. This can lead to sanctions against the university for fraudulent intellectual property. This asymmetry corresponds with Ahlbrecht and Weber's "Gain-Loss asymmetry".

From the university technology transfer perspective the activity of diffusing economically relevant knowledge is not itself a natural one. It is socially constructed through the creation of appropriate institutions and conventions such as intellectual property rights. Risk asymmetries in OS concept are complied with nowadays stronger market incentives for private investment in organized R&D, copyright, patent, and trade secrecy laws are developed which create obstacles to access and restrict the commercial utilization of knowledge. According to David and Foray (1995) it is a "distribution power" of the system of innovation often has been portrayed as a desirable objective that has to be sacrificed to those incentives. There is therefore a persistent tendency in IPRS toward the penetration of market-driven rivalry (generating secrecy and access restriction practices) into domains of university knowledge production where rivalry among researchers or among organizations previously was organized (and restrained) under the non-commercial norms of openness and cooperation (Edquist, 1997). OSS in this conditions seems to be in a lost position.

Conclusions

The past two decades have witnessed a radical transformation of knowledge acquisition, production and dissemination modes. OS has brought new approaches that enable communities of researchers to put their ideas and exploratory hypotheses on the web, share the development of joint research projects, involve users in the search of solutions, pool resources, modify the paths and modalities of investigation continuously, and eventually publish jointly (Salmi, 2015).

The biggest problem with OS concept appears between basic and applied research. Or otherwise between results with and without commercial potential. When the research results have commercial potential OS proceedings is practically impossible in the current legal state. There are noncommercial initiatives like: CERN (European Organization for Nuclear Research), Genome bank, PubMed Central, One mind or Polimath Project or other, where commercial potential does not exist. It is impossible to commercialize result like "Higgs Boson Particle" but this result is naturally implemented in OSS. To absorb the IPRS into the OSS, we need to completely change the research paradigm. That kind of radical change requires new standards of evaluating research results, new streams of funding

research (public funding without discipline of public finance), and new ways of measuring impact of research activities.

As a result of the undertaken research occurred answers the questions: What are the risk asymmetries in the OS implementation process? What are directions of change in OS concept? There were identified three risk asymmetries: in the area of assessment of the quality of the research results, “rapid mode” of increasing of research results in science, intellectual property fraud risk for university. Results were compatible with Ahlbrecht and Weber’s risk asymmetries concept.

About directions of change in OS concept two scenarios can be selected. First that OSS and IPRS will function parallel what will cause duality in science policy. This scenario is based on evolution mode around areas of evaluation of the contribution of individual researchers, intellectual property rights, and criteria for the allocation of research funds. Second scenario is based on legal revolutionary decisions which remove obligation of commercialization of intellectual property of universities. This scenario is nowadays unrealistic but still it is a key issue for the university technology transfer process.

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ASYMETRIE RYZYKA W KONCEPCJI „OTWARTEJ NAUKI”: PERSPEKTYWA UNIWERSYTECKIEGO TRANSFERU TECHNOLOGII

Streszczenie: *Cel* – W artykule wykorzystano założenia asymetrii ryzyka Ahlbrechta i Webera w koncepcji Otwartej Nauki. Celem artykułu była odpowiedź na pytanie: Jakie są asymetrie ryzyka w procesie ewolucji koncepcji Otwartej Nauki? oraz Jakie są kierunki zmian koncepcji Otwartej Nauki?

Metodyka badania – Autorzy opracowania dokonali przeglądu literatury przedmiotu w nurcie empirycznym – historycznym. Wykorzystana metodyka badawcza to krytyczna analiza stanu wiedzy.

Wynik – W części pierwszej artykułu przedstawiono założenia koncepcji Otwartej Nauki na tle polityki prowadzenia badań naukowych. W drugiej części opierając się na teorii asymetrii informacji dokonano analizy możliwości funkcjonowania koncepcji Otwartej Nauki w procesach uniwersyteckiego transferu technologii. Zidentyfikowano trzy asymetrie ryzyka: w obszarze oceny jakości wyników badań naukowych, w intensywnym tempie przyrostu wiedzy i wyników naukowych, ryzyka defraudacji środków publicznych. Analiza skutkowała wyodrębnieniem dwóch funkcjonujących systemów. Systemu Otwartej Nauki oraz Systemu opartego na Własności Intelktualnej. Zidentyfikowano różnice pojawiające się pomiędzy tymi systemami.

Oryginalność/wartość – W artykule autorzy odpowiedzieli na zadane w celu pytania. Rozważania na temat koncepcji Otwartej Nauki prowadzone były na bazie teorii asymetrii informacji Akerlofa oraz asymetrii ryzyka Ahlbrechta i Webera co jest niespotykane jak dotąd w literaturze przedmiotu. Zaproponowano podział asymetrii ryzyka w obszarze Otwartej Nauki z perspektywy transferu technologii takie jak: krótkoterminowa długoterminowa asymetria, asymetria pewności i ryzyka, asymetria straty i korzyści oraz zaproponowano autorską asymetrię publiczno-prywatną.

Słowa kluczowe: otwarta nauka, ryzyko, asymetria, transfer, technologia

Citation

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