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Procedia Economics and Finance 8 (2014) 649 – 657

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**Procedia**  
Economics and Finance

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1st International Conference 'Economic Scientific Research - Theoretical, Empirical and Practical Approaches', ESPERA 2013

## Market of R&D results in Romania

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### Abstract

The theoretical and methodological approach, as well as the empirical analysis of the market of R&D face major challenges stemming from the high diversity of determinant factors, functional mechanisms, the dimension and structure of R&D demand and supply on one hand, and the necessity to find a relevant indicators system for the quantitative and qualitative assessment of demand and supply, on the other. Issues such as the public nature of the research results, the specific obstacles in the commercialization the R&D's supply, the operation mode and regulatory mechanisms of this market, intellectual property rights, the degree and forms of state involvement in supporting public and private research are still subject of public debates. This paper aims to contribute to the description of the dimensions and of the tendencies of the market of R&D in Romania and to show imbalances between supply and demand. Outlining the particularities of the science market, in general, and in Romania, in particular, the paper highlights the main determinants that contributed to the current position of the market of science in Romania in European landscape, the main aspects of the knowledge transfer from the institutes of research and development towards industrial companies and the obstacles that blocked the relationship between supplier and users of the scientific results.

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Selection and peer-review under responsibility of the Organizing Committee of ESPERA 2013

*Keywords:* R&D market, R& D demand, R&D supply, intellectual property right, relation between science and market

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## 1. Introduction

In the literature, despite the fact that various facets and features of the market of scientific research results are approached, there is still any coherent conceptualization of this topic that is rather challenging because the R & D market is a particular form of market, entirely different from traditional ones. The theoretical and methodological approaches and empirical analysis of the "market of research results and development" are a challenging and difficult approach, due to the complexity and of the great diversity of the supply and demand components, of their determinants, and of the functional mechanisms of the demand and supply equilibrium. Beyond theoretical differences concerning the nature of the science results, which have been regarded as either "public goods" or having "commercial nature", significant difficulties arise in connection with the evaluation methodology of scientific research results, due to the lack of standardized system of indicators, and, particularly, due to the difficulty to gain data needed to assess both the real dimensions of the demand and supply on this particular market. The aggregated data that can be collected from international databases cover a small number of indicators relevant for an accurate analysis of the size and structure of supply and demand results of the research and development activity. These indicators are usually of quantitative nature, as the qualitative aspects are difficult to differentiate and evaluate. Based on the above theoretical background and on the specific indicators available in international and national databases, the paper has highlighted the trends in production, circulation and using of the results of R & D embedded in publications and patents in Romania compared to other EU countries and, also, to explain the current gaps and possibilities to solve them.

## 2. Literature review

Specific issues that can be considered parts of the theory of the R&D market, such as: the commercialization of R & D, especially when research is funded from public sources, the protection of intellectual property rights, the ways of knowledge transfer from the suppliers of scientific output towards the industrial companies, have been controversial in the literature and in the public debates along the last tens years (SotaroShibayama, 2012). The argumentation concerning "the commercialization of the university R&D results" was triggered by the changing the paradigm regarding the new role of the universities, that is of the knowledge transfer, through various channels, towards the business sector (AISBL, 2012; M.Callon, 1993; OECD, 2003; E Rasmussen et al, 2006). Issues such as : the nature of "public good" of research results, the specific barriers that diminish the marketability of the R & D results, the regulatory mechanisms, the degree and forms of state involvement in supporting public and private R&D have represented, also, subjects of recent debate

"The new role on entrepreneurship "of the universities, supported by an increasing number of experts, especially from the U.S., Canada and from many European countries, has drawn criticism from those who argue that science is a "public good" that requires supportive intervention of the government that would avoid market failures. They argue that the commercialization of the science results leads to losing intellectual property right of public institutions and to the limitation of researchers 'independence, which may increasingly become dependent on the business sector. Moreover, these authors argue that this perspective will lead to the promotion, mainly, of applied research and to the diminishing the attention for the basic research (V.Doronina, 2013; Caufield et al, 2012). Derek Bok (2009) argues that universities faced with the temptations of getting much money in the knowledge-based economy but in this way they are jeopardizing their fundamental mission and can compromise their basic academic values..

This new theory, that has substantiated the concept of the "entrepreneurial university", was based, on one hand, of the need to find supplementary, private funds for R&D performed in universities, and, on the other hand, of the necessity to spur the increasing of the contribution of the research activity, especially the one financed from public funds, to the sustainable economic growth, to solving stringent problems of the economy and society through new scientifically proven solutions. (Abramo et al., 2012; Geuna A, Nesta L.J.J.2006).

Recently, the debate has intensified (Darrell, 2012). Some authors (Kealey et al., 2013) have argued that the theory of "science as public good is a myth", a dogma unproven by empirical data. These authors have motivated taking into account the contribution of the science supported by the private funds to the greatest discoveries in various fields of research but their opponents have argued that science is a "common good", and its results cannot be traded. They brought also other examples to sustain the contribution of the public research to the challenges of the

present, especially in medicine, molecular biology, environmental protection. The theoretical debates reached on the agenda of international bodies such as the OECD and the European Commission and influenced, more or less, public R & D policies worldwide. In the United States, Canada and the UK, the policy makers have emphasized the need for the strategies that can encourage the commercialization of research and development. In Romania, in the early 1990s, a subject of public debate on the agenda was the privatization of a significant part of public research institutes. This quick and "excessive liberal" decision have had negative consequences for potential R & D from Romania, with consequences on the long term, due to the dismembering of the many strong research teams. In our opinion, the apparent conflict between science as "a public good" and the science for "sale" can be solved by considering of these two segments of the market as being complementary one to another. They can coexist, bringing their own specific contribution to improving of science performance in each country and to solve the acute problems of the economy and society if the decision makers will adopt a clear and coherent vision on ways to maximize their functioning.

### **3. The specific features of the “market of science”**

The “market of science” is a peculiar market. Unlike typical markets, on the "science market" prices are not always the expression of the direct confrontation between supply and demand. Typically, the market price formation requires the availability of the information to buyers, who may assess the value of the supply in relation to the market. This assumption is not always fulfilled on the so-called "market of science.“On the "market of science" it is difficult to analyze the offer in its complexity as well as the potential benefits that could be obtained by purchasing "R&D products”.

The transactions on the "market of science" require buyer’s confidence in the quality of the offer, because there is a significant lag between the moment of the acquisition of the new knowledge, new innovative product or of the new technology and the moment when they proves their performance. These operations may occur outside the market, through the transfer of the results of R&D performed by institutes or universities to new innovative SMEs, (spin offs or spin out), being intermediated by centers of transfer, industrial liaison offices, or incubators. In these cases, a long-term collaboration between the “seller” and "buyer”, mutual trust, compatibility of interests and objectives between sellers and buyers are a prerequisite. The "market of science," requires high specialization, a deep scientific knowledge for both, producers and users, the necessary infrastructure and appropriate skills to carry out transactions and use patents and other types of intangible assets incorporated in the offer (patents, licenses, rights copyright, trademarks, designs, etc.).

The “market of science” is operative only within the National Innovation System, which consists of research and development institutions, be they public or private, of companies from different industrial sectors, but also of other types of organizations that form the infrastructure and knowledge transfer technology (transfer centers , incubators, innovative activity. The transactions on the “market of science" have need specific legislation that should not only stimulate and provide protection to researchers, but encourage interactions between providers of research results (universities, public or private) and users (companies of different sizes and types of property) in order that they cooperate in joint research programs, as well as co-authors, both in publications and in patents, and establish public-private partnerships. On the “market of science “we find both "free goods" (some online publications, indexed in international databases) and tradable goods (patents, licenses, trademarks, designs), each being subject to specific laws and mechanisms for transfer to different users. They are endowed with specific capacity to produce effects in the scientific, economic or social fields.

### **4. Methodology**

There is no standardized indicators and also nor a method for acquiring data needed for the analysis of the market of scientific research results. It is a challenge for the national and international R&D statistics and also for the manuals that contain definitions and methods of data collecting, like the Frascati Manual (R&D statistics) and the Oslo Manual (innovation). In different papers or books , the valuable data are based on the special surveys (Arundel and Bordoy, 2007). An Australian report on the metrics for the commercialization of the scientific research results, requested by the Coordinating Committee on Science and Technology Working Group, has concluded that the

present metrics for commercialisation of publicly funded research need to be extended to reflect a broader understanding of the benefits provided by the commercialization the scientific research results (Working Group.Australia, 2005).

The current metrics comprise the commercialization of the intellectual property (IP), especially through patents, licenses and spin-out company formation. These data are referring to a portion of the scientific results transferred from the publicly funded research sector towards private enterprise. This is the reason for which there are various proposals, in the literature, for expanding the metrics used in this field, adding indicators related to research consultancies and contracts, and also, indicators regarding contribution of the universities and public research institutes to the development and deployment of appropriate skills in business companies. There are, also, different opinions regarding the identification of the appropriate indicators for evaluating the supply and the demand of R&D results.

Among the most commonly used indicators for the science' commercialization we may mention: granted patents and patent applications, licensing deals and income from licensing, number of spin-off companies and indicators of their development (turnover, number of employees etc.), the number and characteristics of the technology transfer offices , the funds coming from the business sector and are spent within the R&D units from the public sector. The International comparisons are difficult to make due to a lack of common definitions and methodology for collecting data for different indicators (Gulbrandsen and Rasmussen, 2008) .

The EUROSTAT database, the most accessible and used database for international comparisons in the framework of the UE, provides macro data about the patent applications (supply of patents) but not for patent exploitation by different users. Also, there are available data regarding the number of the publications but it is difficult to know how much people are interested of their content and ideas. To collect such kind of data for a more accurate measure of the R&D demand, one needs to resort to some wide scope surveys addressed to enterprises, universities or other research units to find out if they read and found publications useful, or if they acquired and implemented the patents elaborated by the Romanian researchers or they used the ideas from the scientific publication in order to develop new products or new technologies. This is the major reason for that we used the proxy indicators to express demand for the results of R&D activity in Romania. We consider that the content of the scientific articles may provide interesting ideas, knowledge and data that may further beget to other innovative ideas and can develop the innovative and entrepreneurial spirit. The supply is much easier to be delineated and to be measured, and most of the available data and indicators are related to the publications, applications for patents or patents granted. As for the estimation of the demand , the optimal approach should be that mentioned above, that is to resorting to wide scope surveys among enterprises in order to identify if they found how many publications has been accessed and inspired them for the future patents.

In order to depict the relations between demand and supply of R&D results in Romania, in the absence of standardized methodology and indicators, we used some indicators and data from European data base and from the last Union Innovation Scoreboard that are referring to the relationships between public research sector and business sector (Innovation Union Survey, 2013); from the Community Innovation Survey 2010. Thus, in our analysis we relied on the following indicators, for which there are available data:

1. The number of citable documents, as a measure of the offer on the market of the free goods, using the SCImago Journal and Country Rank, based on indexed journals in SCOPUS database , that could expresses, among other meanings, the interest level of the users for scientific publications, let say a proxy indicator for "the demand" of publications.

3. The number of public-private co-publications which depicts the level of cooperation and partnership between the researchers from universities and research institutes and of those from business sector, facilitating thus the correlation between demand and offer.

4. The number of patents – provided by Eurostat database, for the analysis of the marketable results of R&D

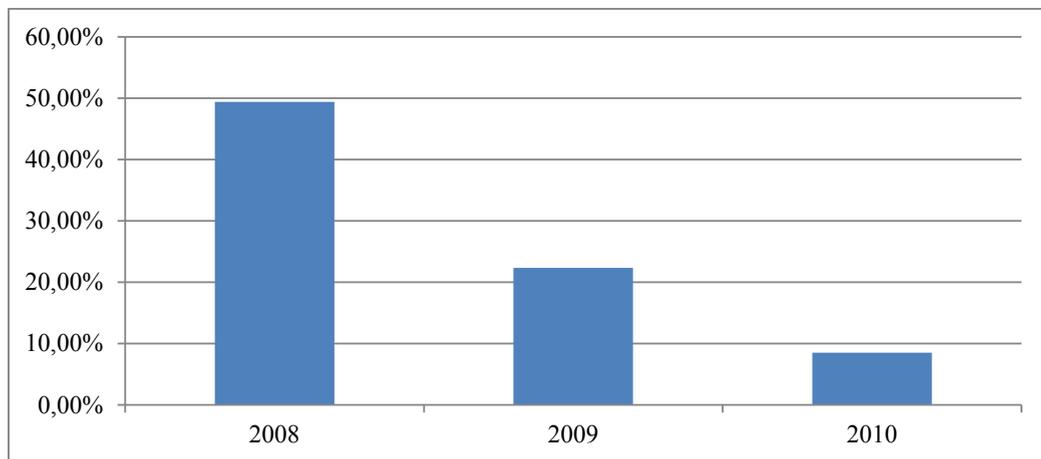
5.Data regarding the interest of the companies for the research results, based on the Community Innovation Survey

## **5. The analysis of the supply of publications and patents on the R&D market**

When we are talking about market of R&D in Romania we cannot ignore how this market functioned decades before 1990. This period left a hard heritage for the R&D system, influencing strongly its current dysfunctions, its

weaknesses and imbalances that still persist on the Romanian R & D market. Market imbalances of the R&D are now quite visible, but we must keep in mind that unlike developed countries, where the national research and innovation systems that operate today efficiently, were formed and strengthened over centuries, in Romania, the frequent changes that had took place in the last 24 years, regarding both the institutional mechanisms and also financing and organization, at macro and micro level, have brought many imbalances into R&D market. We cannot claim R & D & I system in Romania, which is a relatively new in terms of operation according to market mechanisms, the performance of the research and innovation markets from developed countries. Therefore, international comparisons should be considered with caution, especially when we have in view funding R&D from private sources. The R&D market, which had benefited from the principles of planned management for decades, was abruptly left, after 1990, at the discretion of the market laws. The R&D institutes, some with a large number of researchers and auxiliary staff, that had been specially created to serve specific industries, thus having both state funding through the so-called "Fund for New technique" and also a planned demand, suddenly found themselves without financial support and without a secure demand for their results - as many industrial firms were in a state of uncertainty - on a free market that was, itself, at its very beginning.

Thus, the R&D market has passed from an excessively centralized state to a new one, excessively liberal. Without the public support, although most of them were still state owned, the R&D institutes have been driven only by market forces. Consequently, according to the juridical laws in force at that time, a part of the R&D industrial institutes became commercial companies, and others have remained with an uncertain, "hybrid" status from the ownership point of view. In the first hectic years after 1990, large research institutes had to adapt to new conditions, either through privatization or through dramatic decrease in the number of researchers, either by changing the object of activity by adding commercial activities. Subsequently, through the publicly funded national research programs based on competition, research institutes, regardless of ownership, had access to these funds and were able to revive research on other bases. Unfortunately, although public funds were theoretically allocated according to certain priorities, practically most institutes replicated, under new labels, from their previous research activity, according to the old specialization of that institute. Therefore, we can say that the applied research market was "supply driven" not "demand driven". Under an survey conducted by IRECSON - Romania, regarding the Development of the capacity of the National Agency for Scientific Research to develop the public policies in the field of innovation and technology transfer, financed by an European program, the managers of R&D units have appreciated that the degree of applicability of their scientific results between 2008-2010 have been only of 22,33 % but of the patents was only 8, 58% (fig. no.1))



Source: NACE, Analysis of the present situation of the modalities of reporting of the performances in the fields of the R&D, innovation and technology transfer , 2011, p.35

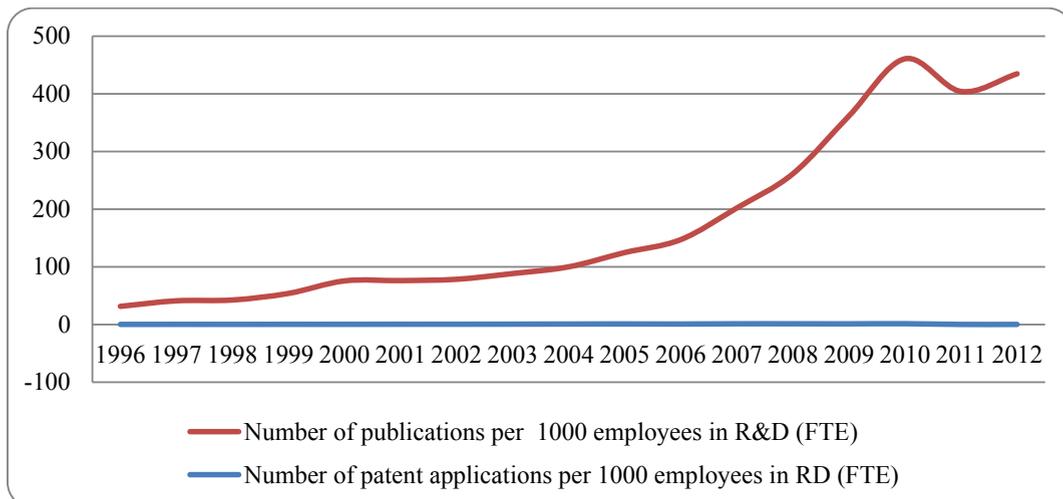
Fig.nr.1 Valorization of the R&D results in the period 2008-2010

In terms of the results of scientific research on the "free goods market", reflected in scientific publications indexed in international databases, Romania is still at a disadvantage compared to other countries, despite significant progress along the recent years. On one hand, there is a large number of scientific publications and citations in journals with a long tradition, especially in scientific fields such as chemistry, biology, mathematics, while, on the other hand, there are still fewer publications in the areas that no had journals indexed in international databases before 1990, and in new areas – interdisciplinary or borderline – which have only recently benefited from internationally accessible scientific publications.

While, before 1990, the number of Romanian journals was extremely low, at present there are the scientific journals covering almost all research areas, most of which are indexed in international databases and in ISI Thompson database. Therefore, the number of documents in the period 1996-2012 published in Romanian journals indexed in SCOPUS database, increased more than 5 times, from 1860 to 9955.

The research communities in other central and European countries had more possibilities for mobility and write in international journals during the communist regime; they enjoyed a somewhat higher freedom to publish and to benefit from international visibility.

Some authors (Crespi et al, 2008) have found a positive relation between publication activity and patenting, considering that they are complementary activities. We can see also in the case of Romania, a common tendency for publications and for patents ( fig nr.2).



Source: SCImago Journal & Country Rank, <http://www.scimagojr.com/countrysearch.php?country=RO>, Eurostat database, file code: pat\_ep\_ntot  
Fig .2 Evolution of the patent applications and publications in Romania

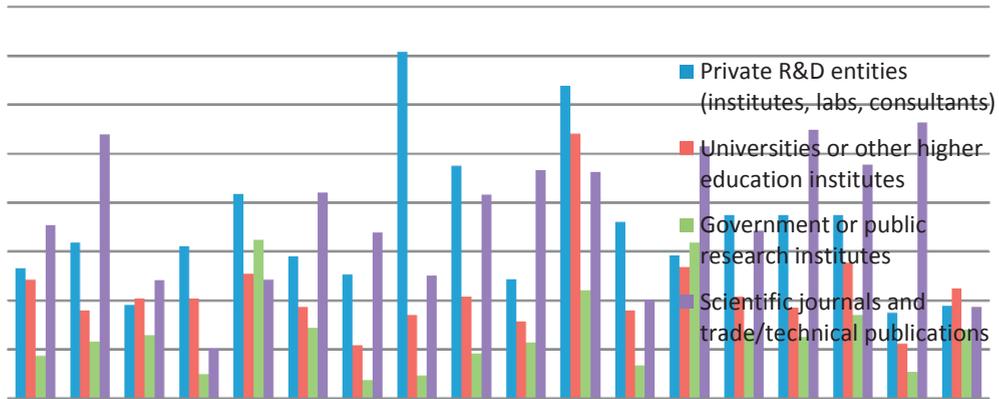
But the favorable trend couldn't cover much of the gap between Romania and the European average regarding patent applications (see table no. 1). In Romania, the number of patent applications per bill euro (PPS) of GDP is by more than 6 times lower than the EU average.

Romanian companies display an increasing interest for scientific research output resulted in private or public R&D institutes, in universities or other higher education institutions, in public research institutions, as well as for technical publications and scientific literature. According to figure no.2, the share of innovative enterprises for which the scientific research results represent an important source of innovation significantly varies between countries, regarding both the share of interested enterprises as well as the structure of scientific information sources. In Romania, it is apparent that the scientific and technical publications are of a higher interest to the private sector than the research results provided by the public R&D institutions.

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The demand for scientific results can be estimated taking into account the indicator regarding the share of enterprises for which research results are a highly important source of innovation. According to figure no.2, the share of innovative enterprises for which the scientific research results represent an important source of innovation significantly varies between countries, regarding both the share of interested enterprises as well as the structure of scientific information sources. In Romania, it is apparent that the priority source of innovation for private sector is the scientific and technical publications than the research results provided by the public R&D institutions.



Source: CIS 2010, Eurostat database, file code: inn\_cis7\_sou

Figure no.3. Share of enterprises for which research results are a highly important source of innovation, by source of information (% of total innovative enterprises)

Public-private co-publications may also represent an important indicator for the relationship between the providers and users of scientific papers, with beneficial impact on companies' innovativeness. The EU average is almost four times higher than the figures reported by Romania( see table nr1)

Tabel nr.1. The gap between Romania and EU27 average in the innovation field

Indicators	Romania	EU27
Venture capital investment (% in GDP)	0.033	0.094
SMEs innovating in house(% of total SMEs)	10.75	31.83
Innovative SMEs collaborating with others(% total SMEs)	2.93	11.69
Public-private co-publications/1 million population	8.3	52.80
PCT patent applications/1billion GDP in PPPeuro	0.18	3.90
SMEs introducing product or process innovation(% of total SMEs)	13.17	38.44

Source: Union Innovation Scoreboard, 2013, p72

## 6. Research limitations and future research directions.

Our research work on this topic, although provocative, has been limited by the lack of a proper conceptualization in the literature regarding the market of R&D. The use of proxy indicators is a limitation and also an opportunity to conduct in the future a survey among managers of research institutes and universities, on the one hand, and for some

specialized companies in the same area of interest in order to obtain data that could reflect directly size of demand and supply outcomes of R & D.

## Conclusions

1. The Romanian research market is still dominated by a R&D offer consisting in publications, patents, technical documentations, which is not correlated with the demand for this kind of scientific output;
2. The excessive fragmentation of the national RDI system led to the dissipation of critical mass needed for a high-quality research activity, with higher applicability in industry and economy;
3. The low intensity of the national research "in-house", and also a low interest from the private sector, dominated by foreign companies, for R&D output provided by the national research institutions – especially the public ones. The innovative companies seem to search for other sources of knowledge;
4. The lack of incentives of increasing demand for Romanian research results, in the context of deindustrialization and of the foreign capital domination, uninterested in doing research within Romanian branches have, led to a major unbalance between the offer and demand of scientific research output;
5. The relationships between science suppliers and users are still scarce, as suggested by the small number of public-private co-publications.
6. Considering the lack of public policies targeted to the elimination of the aforementioned drawbacks, the disequilibrium will persist and accentuate, with negative impact on the Romanian R&D potential.

## References

- AISBL, 2012, Making Industry-University Partnerships Work. Lesson from successful collaboration, 2012 Science, Business Innovation Board, AISBL
- Arundel, A., Bordoy, C., 2008, Developing internationally comparable indicators for the commercialization of publicly-funded research, UNU MERIT, Working Paper Series, <http://www.merit.unu.edu/publications/wppdf/2008/wp2008-075.pdf>
- Bok Derek, 2004, University in the Marketplace: The commercialization on Higher Education, eBook
- Caulfield, T., Harmon, S., Joly, Y., 2012, Open science versus commercialization: a modern research conflict? In Caulfield et al, *Genome Medicine*, 2012, 4:17, <http://genomemedicine.com/content/4/2/17>
- Cooke, P., 2001, Biotechnology clusters in the UK: Lessons from localisation in the commercialisation of science, in *Small Business Economics* 2001, 17:43-59.
- Crespi Gustavo, 2008, The impact of Academic Patenting on Universities Research and its Transfer, in SPRU electronic Working Papers Series, Paper 178/2008
- Critchley, C., R., Nicol, D., 2011, Understanding the impact of commercialization on public support for scientific research: Is it about the funding source or the organization conducting the research? Public understanding of science, in *Public Understanding of Science* May 2011 vol. 20 no. 3 347-366 <http://pus.sagepub.com/content/20/3/347>
- Dan M.C. (2013), Why Should University and Business Cooperate? A Discussion of Advantages and Disadvantages, in *International Journal of Economic Practices and Theories*, Vol. 3, No. 1, 2013 (January), e-ISSN 2247-7225 [www.ijept.org](http://www.ijept.org)
- David, P., A., 2013, Innovation and the role of universities in commercialization research results, in *Journal of Law, Technology and Policy*, vol 1, <http://illinoisjltlp.com/journal/wp-content/uploads/2013/10/david.pdf>
- Doronina V, 2013. Should Science be for Sale?, *The Scientist*, August 2013
- Fletcher, A.C., Bourne, P.E., 2012, Ten Simple Rules To Commercialize Scientific Research in *PLoS Comput Biol* 8(9): e1002712. doi:10.1371/journal.pcbi.1002712
- Geuna, A., & Nesta, L. J. J. 2006. University patenting and its effects on academic research: The emerging European evidence. *Research Policy*, 35(6), 790-807.; Geuna, A. & L. Nesta 2003, *University Patenting and its Effects on Academic Research*, SPRU Electronic Working Paper Series No. 99 (Brighton, SPRU).
- Guilhon, B., 2004, Market for knowledge: Problems, Scope, and Economic Implications in *Economics of Innovation and New Technology*, volume 13, issue 2, [www.defi-univ.org/IMG/pdf/0201.pdf](http://www.defi-univ.org/IMG/pdf/0201.pdf)
- Gulbrandsen Magnus and Einar Rasmussen, 2008, Indicators for the commercialization of research: what do they tell us? The case of Norway;
- Kealey Terence, 2013, The case against Public Science, <http://www.cato-unbound.org/2013/08/05/terence-kealey/case-against-public-science>
- Kitagawa, F., Wigren, C., 2010, From Basic Research to Innovation: Entrepreneurial Intermediaries for Research Commercialization at Swedish 'Strong Research Environments', Working Paper 2010/02
- Krabel, S., Boente, W., Audretsch, D., 2010, Commercializing of Academic Research – Investigating why individual scientists cooperate with private firms. Paper presented at the Summer Conference 2010 on "Opening Up Innovation: Strategy, Organization and Technology" at Imperial College London Business School, June 16 - 18, 2010, <http://www2.druid.dk/conferences/viewpaper.php?id=501358&cf=43>
- Markman G., D., Siegel, D. S., Wright, M., 2008, Research and Technology Commercialization, in *Journal of Management Studies* 45:8 December 2008 0022-2380
- OECD, 2003, Turning Science Into Business: Patenting and Licensing at Public Research Organizations (Benedicte Callan and Mario Cervantes).

- Peters, B., Roberts, M.J., Vuong, V., A., Fryges, H., 2013, Estimating Dynamic R&D Demand: An Analysis of Costs and Long-Run Benefits, NBER Working Paper No. 19374
- Rasmussen et al, 2006, Initiatives to promote commercialization of university knowledge, *Technovation* 26 (2006), p.518-533
- Sanjay Jain, Gerard George, Mark Maltarich, 2009, Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity, in *Research Policy*, 38(2009), 922-935
- Sotaro, Shibayama, 2012, Conflict between entrepreneurship and open science, and the transition of scientific norms  
Published online: Conflict between entrepreneurship *J Technol Transf* (2012) 37:508–531, DOI 10.1007/s10961-010-9202-7
- West M. Darrell, 2012, Improving University Technology Transfer and Commercialization, in : *Issues in Technology Innovation*, nr.20, December 2012, p.2,4, 8, [http://www.insidepolitics.org/brookingsreports/University\\_Tech\\_Transfer.pdf](http://www.insidepolitics.org/brookingsreports/University_Tech_Transfer.pdf).
- Working Group. 2005, Australian Coordinating Committee on Science and Technology Working Group on the Metrics of Research Commercialisation, *Submission No. 7*, attached report *Metrics for Research Commercialisation: A Report to the Coordination Committee on Science and Technology*, 2005, p. 17).