Eurasian Academy of Sciences
Eurasian Business & Economics Journal
2017 Volume:11 S: 33-44
Published Online October 2017 (http://busecon.eurasianacademy.org)
http://dx.doi.org/10.17740/eas.econ.2017-V11-02

EMERGING TRENDS AND STRUCTURAL CHANGES OF GLOBAL INNOVATION ECOSYSTEMS: EMPIRICAL ANALYSIS OF CHANGING PATENT AND TRADEMARK ACTIVITY OF G7 COUNTRIES AND BRICS COUNTRIES FROM YEARS 1985-2015

Jari Kaivo-oja* & Theresa Lauraeus**

Finland Futures Research Centre, University of Turku, Turku, Finland*

Aalto University, School of Economics, Helsinki, Finland**

E-mail: *jari.kaivo-oja@utu.fi**, *theresa.lauraeus@aalto.fi***

ABSTRACT

Reliable intellectual property (IP) statistics are providing a very important tool in understanding trends in global policy, global business, and technology developments worldwide. Today global innovation ecosystems are in fast transition. Economic analysis has taken an interest in studying the problems associated with technological change. Adequate indicators have been identified, which make it possible to provide a coherent explanation for technological activities and their relationship with economic efficiency and activity. Although the earliest science, technology and innovation studies were focused on analysing the activities of research and development (R&D), at present the focus of analysis has shifted to another type of variable, more oriented towards the gathering of knowledge and capabilities, in which patents and trademarks provide relevant information.

This empirical study analyses three trends of patent and trademark activity in Brazil, the Russian Federation, India, China and South Africa (the BRICS countries) over three decades. The study is based on World Bank data. The study covers years 1985-2015. The study is comparative country study of patent and trademark activity. The study will report the following results: (1) aggregate patent trends of the BRICS and G7 countries, and (2) trademark trends of the BRICS and G7 countries, (3) patent/trademark relationship development of the BRICS and G7 countries and (4) key relational analyses of BRICS and G7 countries. The study elaborates (5) on proportional activity of patent and trademark activity of all BRICS and G7 countries. Some comparative analyses in relation to BRICS and G7 countries are reported in the final section (Section 5). In our analysis, descriptive analysis describes previous long-run events. Descriptive analytics allow us to learn from previous events and trends. We can also use trend analysis to expect how they might affect future behaviour.

Trend analysis of the study includes trend analyses of patent and trademark data, index series analyses of patent and trademark data, yearly changes analyses of patent and trademark data and finally the analysis of most recent data observation in comparison with previous data observation. This kind of basic data analysis will provide interesting insights into emerging trends and structural changes of the global innovation ecosystem.

Keywords:

IPR/Trademark and patent portfolio analysis, Innovation management, Trend analysis of market structure, Innovation policy, global innovation ecosystems, BRICS countries

JEL: O1,O3

1. INTRODUCTION

This article focuses on patent activity and trademark activity. These activities will be analysed by total numbers of patent and trademark applications and by patent and trademark applications in in Brazil, the Russian Federation, India, China and South Africa (the BRICS countries) over three decades. These activities are very important for the growth and employment policy of the BRICS countries. These analyses are also useful when decision–makers assess strategic positions of the BRICS countries' innovation policy in the global setting (see e.g. Nam and Barnett 2011). Changing levels of R&D activity need continuous attention. This critical aspect of technology management has been understood for a long time in the world. Patent claims are linked to priority and productivity claims (see e.g. Little 1981, Griliches 1990, McLeod and Radick 2013) and to IPR policy (Maresch 2016). If decision–makers of the BRICSs want to keep an eye on productivity and employment targets, they must understand the logic of patent and trademark claims and their systemic linkages to productivity claims. The role of the open innovation paradigm is increasing internationally (Ghisetti et al. 2015).

A successful innovation ecosystem depends on knowledge, which can be technological, strategic, and market related. Information and data about patents and trademarks are always results of knowledge management processes. Existing knowledge base and stock contribute directly to the novelty or complexity of new innovations, whether they are technological innovations, business model innovations or social innovations. (Roper and Hewitt–Dundas 2015). From the knowledge management perspective, it is very important to understand how patent applications and trademark applications are submitted and utilised in the BRICS countries. For example, we can make better knowledge investments and knowledge management strategies if we know more about the systemic dynamics of patent and trademark applications and how they interlink with population and economic growth dynamics. Innovation is always linked to the development of the economy. In scientific literature, innovation is often mentioned as one of the key drivers of economic growth, primarily in the sense of raising the level of education, infrastructure, health, the environment, and welfare (see Kuhlmann 2001). Regional innovation systems are regarded as complex systems in which components are strongly dependent on each other. Such relationships can have both a linear and nonlinear character. Innovation contributes to raising the level and quality of social life and thus to levelling social inequalities. A characteristic feature of a modern economy is growing awareness of the role of knowledge and innovation in generating economic progress (Popiel and Jabłońska 2014). Patents and trademarks are important elements of a modern progressive economy.

2. THEORY

There are always changes in innovation activity. In this article, our aim is to analyse long–run changes of innovation activity of the BRICS countries. Innovation activity is in this paper is limited to two key indicators: patents and trademarks. Patents are often used to analyse technological capability (Tong and Frame 1994, Abraham and Moitra 2001, Lee et al 2015). Trademarks are often used to analyse commercial business competences of countries. A trademark is a sign capable of distinguishing between the goods or services of one enterprise from those of other enterprises (Mendonca et al. 2004, Hidalgo and Gabaly 2013). Patents and trademarks are also used as barriers to entry into markets (see e.g. Demsetz 1982). This aspect of market entry is relevant for the BRICS and G7 countries in the global competition. The unique character of products and services is a key issue in global markets. There is also a considerable market value of patents and trademarks (Sandler and Block 2011). In global markets, trademarks are protected by intellectual property rights.

2.1 Trademarks

The first international trademark settlement was reached at the Paris Convention of 1883, whereby the countries involved agreed to provide foreign applicants with the same protection regarding marks as was provided for nationals. In this context, the WIPO eventually emerged as the global coordinating institution promoting the development of IPR laws and facilitating the international registration of trademarks. According to the World Intellectual Property Organisation (WIPO), a trademark is defined as a "*distinctive sign, which identifies certain goods or services as those provided by a specific person or enterprise*" (WIPO 2016, 2017). Like patents, a trademark affords the owner legal protection by granting the exclusive right to use it to identify goods or services, or to licence its use to another entity in return for payment. Rights are granted at a national level but once trademarks are registered, they can be renewed indefinitely on payment of additional fees (see WIPO 2016).

The business of branding products has long been part of ordinary economic life. Trademarks are the outcome of establishing recognisable designs and symbols for goods and services, as well as firms' identities. They play a crucial role in the process of marketing innovations, being instrumental in differentiating between the attributes of goods and services in the marketplace. These characteristics make trademarks a potential indicator of product innovation and sectoral change (see e.g. Mendonca et al. 2004). Mendonca, Pereira and Godinho (2004) argued that trademark-based indicators provide a partial measure of the innovative output of profit-oriented organisations. In its most simple formulation, innovation can be understood as the introduction into the market of a new idea, product or production process (Mendonca et al. 2004).

2.2 Why are trademark-based indicators important?

Trademark-based indicators show promise for advancing research agendas concerned with (1) the rates and directions of product innovations in different industrial sectors, (2) international patterns of specialisation, (3) links between technological and marketing activities; and (4) the evolution of economic organisations and structures. When technological disruption can change market conditions and competition in markets (see Kaivo-oja, and Lauraeus 2017a, 2017b) in a short time, it is important to have tools to understand market dynamics of trademarks and patents.

A successful innovation ecosystem depends on knowledge, which can be technological, strategic, and market related. Information and data about patents and trademarks are always the result of knowledge management processes. Existing knowledge base and stock contribute directly to the novelty or complexity of new innovations, whether they are technological innovations, business model innovations or social innovations. (Roper and Hewitt–Dundas 2015, Roth et al 2017). From a knowledge management perspective, it is very important to understand, how patent applications and trademark applications are submitted and utilised. For example, we can make better knowledge investments and knowledge management strategies, if we know more about the systemic dynamics of patent and trademark applications and how they interlink with population and economic growth dynamics. It is very important to know, how patents and trademarks are registered in the global setting (see e.g. Kaivo-oja 2016).

Innovation is always linked to the developments of science, the economy and society. In scientific literature, innovation is often mentioned as one of the key drivers of economic growth, primarily in the sense of raising the level of education, infrastructure, health, the environment, and welfare (see Kuhlmann 2001, Kaivo-oja and Santonen 2016).

2.3 Patent – definition and usefulness

Patents are regarded as one of the most useful indicators of an innovative activity. Patents are by definition inventions and therefore represent technological change and development. In addition, patents are used in economic research due to the availability of data as it is systematically collected, covers long time series, is electronically available, and is classified into technologically specific categories. Patents are complementary to other innovation indicators such as R&D expenditures. These indicators measure mostly innovation input and are often macro-level data. Patents, on the other hand, allow innovation-related questions to be approached with both macro - and micro - level data (Nikulainen et al. 2008).

The usefulness of patent data in innovation studies is based on the information in the patent documents. Each patent publication produces a structured public document containing detailed information on the invention itself, the technological area to which it belongs, the inventors (e.g. their geographic location), and the organisation (i.e. assignee) to which the inventors assign the patent rights at the time of the publication of the patent document (Nikulainen et al. 2008). A patent is a document, issued by an authorised governmental agency, granting the right to exclude anyone else from the production or use of a specific new device, apparatus, or process for a stated number of years (Griliches 1998).

There are three types of patents: (The United States Patent and Trademark Office (USPTO) (1) **Utility patents** may be granted to anyone who invents or discovers any new and useful process, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof; (2) **Design patents** may be granted to anyone who invents a new, original, and ornamental design for an article of manufacture; and (3) **Plant patents** may be granted to anyone who invents or discovers and asexually reproduces any distinct and new variety of plant. Patents and patent portfolios are valuable assets. Companies need a conceptual structure to assess the value of their patent portfolio. Crimaldi et al. examines the main methodological issues in assessing

patent portfolio value. They developed a practical and reproducible framework, which can be used for strategic planning and strategic technology management.

2.4 Patent – advantages and disadvantages

Patents have several advantages when measuring innovative output, but they also have some disadvantages that need to be addressed. In the following, the advantages are weighed up against the disadvantages commonly discussed in literature (Griliches, 1990; and in Finland Nikulainen et al. 2005).

The advantages of patent data are mostly related to their availability and rich content. A patent is a publicly available document and can be accessed electronically either through the Internet or databases. Although most databases are either cumbersome or costly to use, the availability of worldwide patent data makes it compelling. The detailed information provided in the patent documents enables researchers to compare companies, nations, inventors etc. The patent information comprises dates, description/IPC class, assignee, inventors, designated states, citations, legal information etc. The data covers almost every field of technology, and detailed disaggregating is possible. Patent data allows the use of long time series that start as early as the 18th century (Nikulainen et al. 2008).

Nikulainen, Hermans and Kulvi 2008 analyses the validity of so-far untested indicators of patent value to enhance the quality of patent assessments using indicators at a corporate level. The article expands the theory by eliciting patent solicitors' filing rationales to maximise profits from protecting intellectual property. The disadvantages of patent data are related to its use as an indicator of innovative activity. The patentability of technologies varies (e.g. software and genetically modified substances are not as readily patentable in all countries), and hence this problem needs to be recognised in comparisons across different technological fields, industries or companies. Patenting is also a strategic option, depending on the specific strategies that companies choose in protecting their intellectual property. This is especially true for process inventions and inventions with short lifecycles, which rely on other means of protection, such as secrecy or lead time. Furthermore, inventions can build on several patents; only a part of the invention might be patented, or a single patent can build on several inventions. Hence, the technological meaning of a patent can be somewhat blurred. Therefore, we use patent family data that resolves part of this dilemma by pooling all the patent documents related to a single invention (Nikulainen et al. 2008).

In conclusion, it could be said that patents provide an intermediate output indicator of innovative activity. Balancing between the advantages and disadvantages is to some degree a question of different trade-offs in research. Once careful consideration of the special features of patent data is taken into account, patents provide the only readily available (intermediate) output indicators of innovative activity (Nikulainen et al. 2008).

3. METHOD

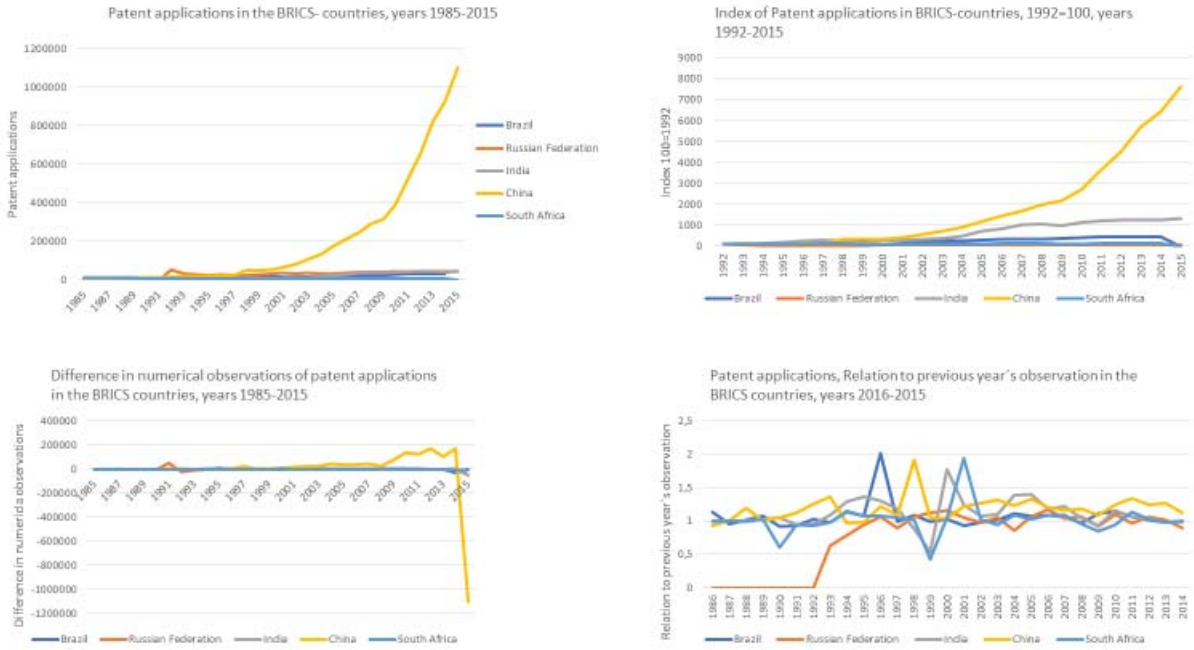
The study is about comparative statistical analysis and provides a clear picture of global IPR issues of trademarks and patents. The study is based on World Bank data (2017). The study covers years 1985-2015. This empirical study analyses three trends of patent and trademark activity in Brazil, the Russian Federation, India, China and South Africa (the BRICS countries) and in the G7 countries in three decades. Trend analysis of the study includes trend analyses of patent and trademark data, index series analyses of patent and trademark data, yearly changes analyses of patent and trademark data and finally the analysis of the most recent data observation to previous data observation. This kind of basic descriptive statistical data analysis will provide interesting insights into emerging trends and structural changes of the global innovation ecosystem.

4. RESULTS

The study will report the following results: (1) aggregate patent trends of the BRICS and G7 countries, and (2) trademark trends of the BRICS and G7 countries, (3) the patent/trademark relationship development of the BRICS and G7 countries and (4) key relational analyses of BRICS and G7 countries. The study elaborates on (5) proportional activity of patent and trademark activity of all BRICS and G7 countries. Some comparative analyses in relation to BRICS and G7 countries are reported in the final section (Section 5). In our analysis, descriptive analysis describes previous long-run events. Descriptive analytics allow us to learn from the previous events and trends. We can also use trend analysis to expect how they might affect future behaviour.

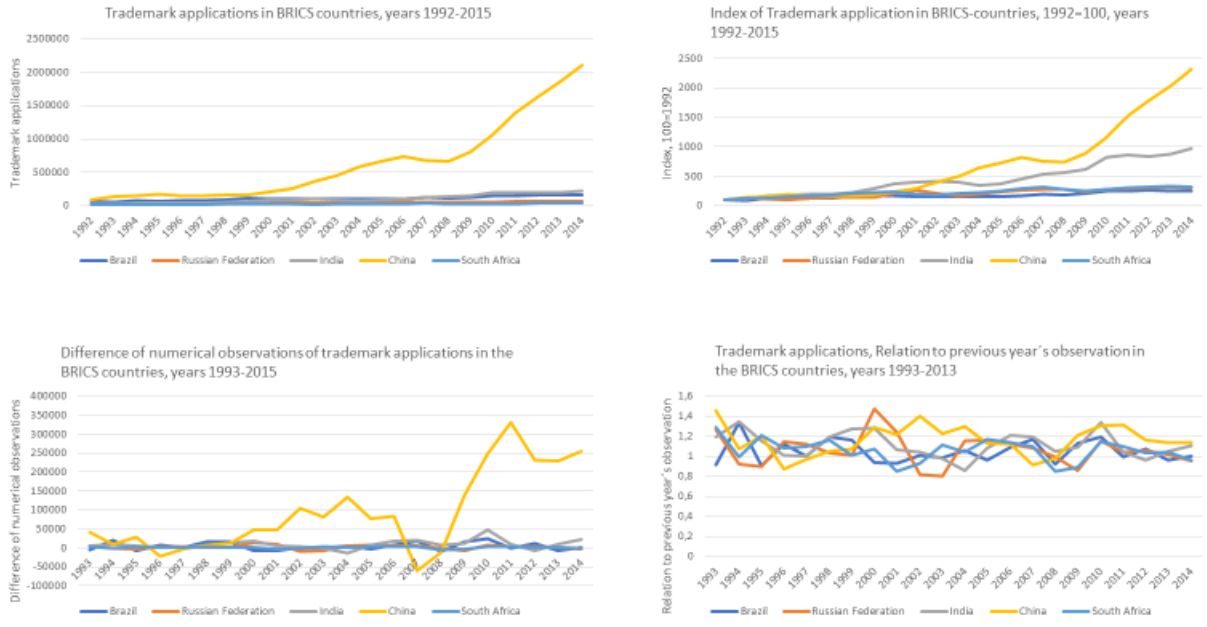
First, we figure out the trends of patent applications in the BRICS countries (Fig. 1).

Figure 1. Patent applications of the BRICS countries. Four statistical aspects of trend analysis.



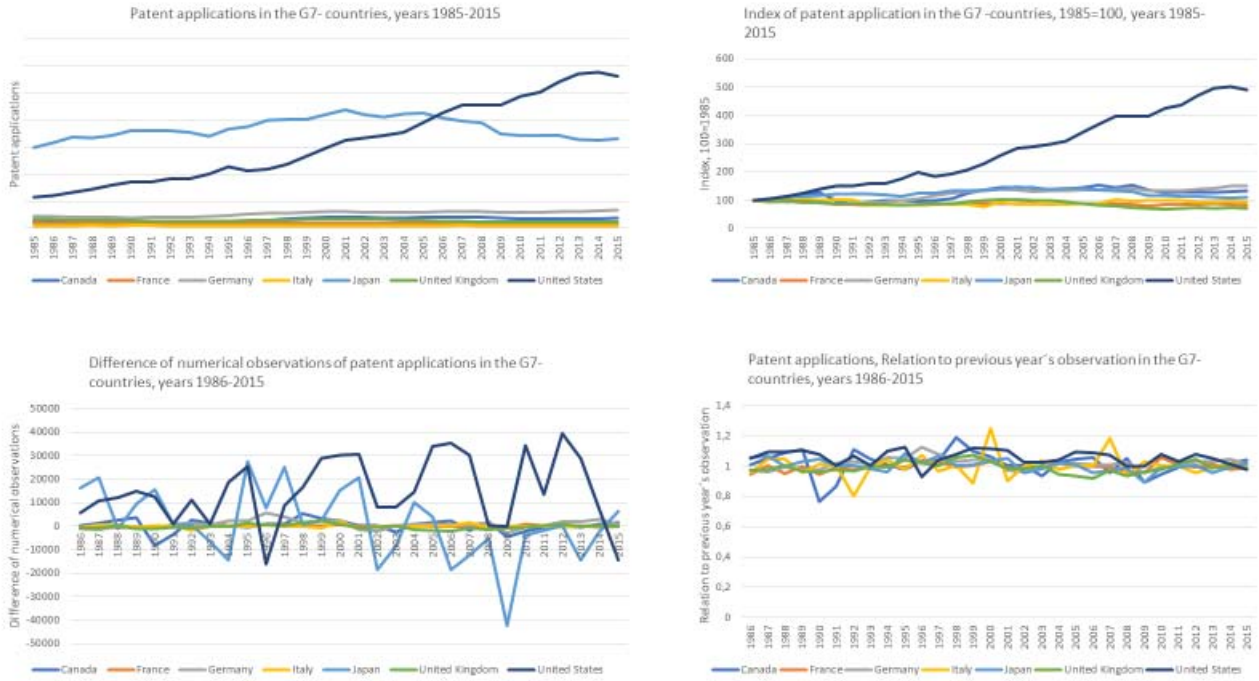
Secondly, we figure out the trends of trademark applications in the BRICS countries (Fig. 2).

Figure 2. Trademark applications of the BRICS countries. Four statistical aspects of trend analysis.



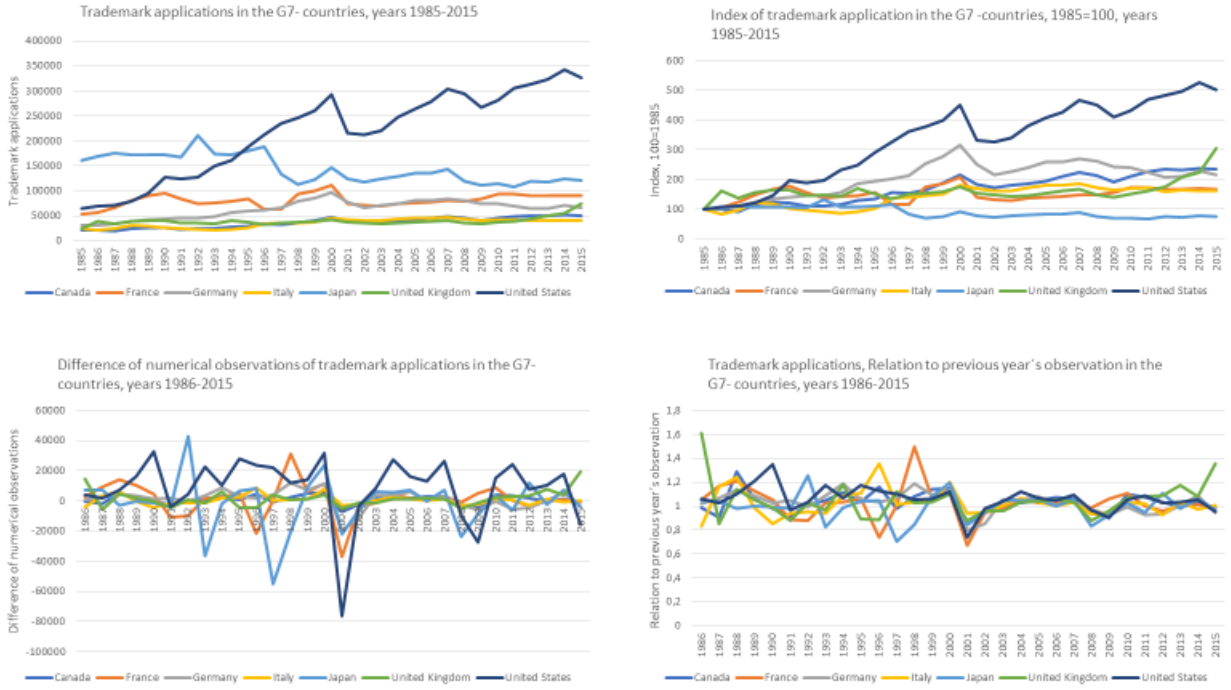
Thirdly, we figure out the trends of patent applications in the G7 countries (Fig. 3).

Figure 3. Patent applications of the G7 countries. Four statistical aspects of trend analysis.



Fourthly, we figure out the trends of trademark applications in the G7 countries (Fig. 4).

Figure 4. Trademark applications for the G7 countries. Four statistical aspects of trend analysis.



4.1 Patent and Trademark Trends of the BRICS and G7 countries

We can make a summary of findings about our trend analyses of BRICSs and G7 countries:

1. Among the BRICS countries, China and India have increased their patent activity since the year 2000, which was a turning point of the patent activity trend. In particular, China nowadays is experiencing 70 times more patent applications than in 1992 and India has been experiencing about 10 times more patent applications than in 1992. The trends of patent activity in other BRICS countries have been quite

stable. Only the Russian Federation has showed some instability in the early 1990s in patent registrations activity, but in recent years this indicator has been quite stable.

2. Among the BRICS countries, China and India have increased their trademark registration activity since the year 2000, which was a turning point of the trademark activity trend. In particular, China nowadays is experiencing 22.5 times more patent applications than in the year 1992, and India is experiencing about 10 times more patent application than in 1992. Our statistical analysis reveals that China had a boom in trademark applications from 2008-2011, but also had small recessions from 2004-2007 and from 2012-2014. The trend of trademark applications has not been fully linear.
3. Both in China and India, patent registrations have had a higher volume compared to trademark applications from 1992-2014.
4. Among the G7 countries, Japan has been very important for patent applications. In 2006, the number of patent application registrations in the USA increased to the level of the Japanese economy. The number of Japanese patent applications has been decreasing since 2005. Other G7 countries have shown stable activity in patent applications while other G7 countries' variations in patent applications have been stable.
5. The USA is dominating trademark applications. Since 1985, the number of trademark applications in the USA has increased significantly and trademark activity is five times higher than in 1985. The trademark activity of the United Kingdom is three times higher and the trademark activity of Germany is two times higher than in 1985. Among G7 countries, Canada's number of trademark applications has decreased and Canada is the only G-7 country where this is the case.

5. CONCLUSIONS

5.1 Global Trends of Patent and Trademark Applications

In this section, we provide some final analyses of patent and trademark data. First, we report the summary figures of patent applications for the BRICS countries.

Figure 5. Patent applications for the BRICS countries of the total world patent application from 1992-2015 (%).

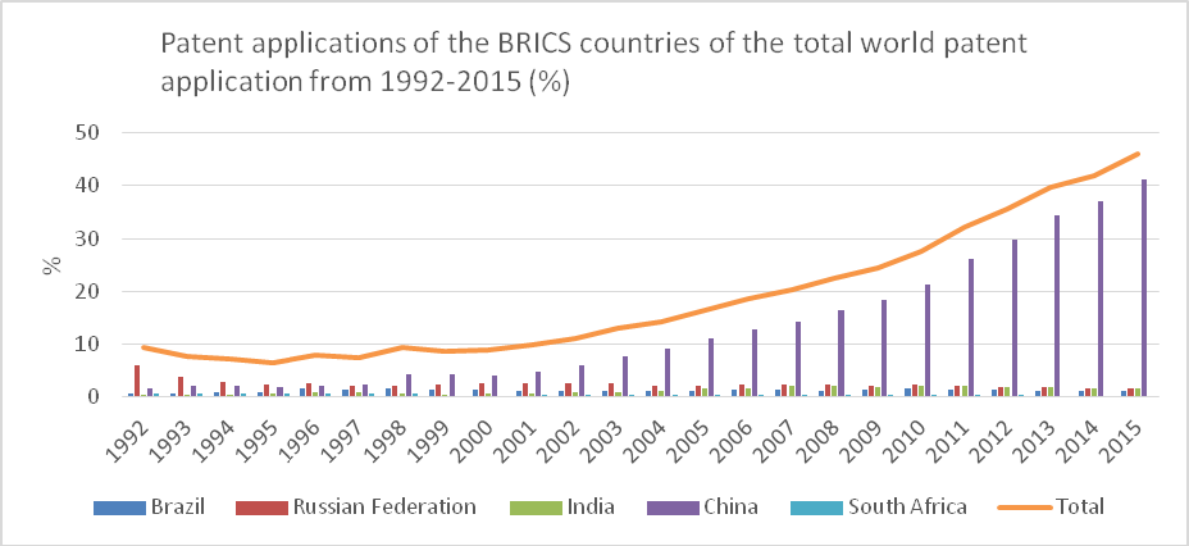


Fig. 5 shows that the percentage of the BRICS countries' patent applications of the world's patent applications has increased, in a considerable way, to about 40%. This dramatic change has happened mostly due to increased Chinese activity for patent applications.

Figure 6. Patent applications for the BRICS countries of the total BRICS patent applications from 1992-2015 (%).

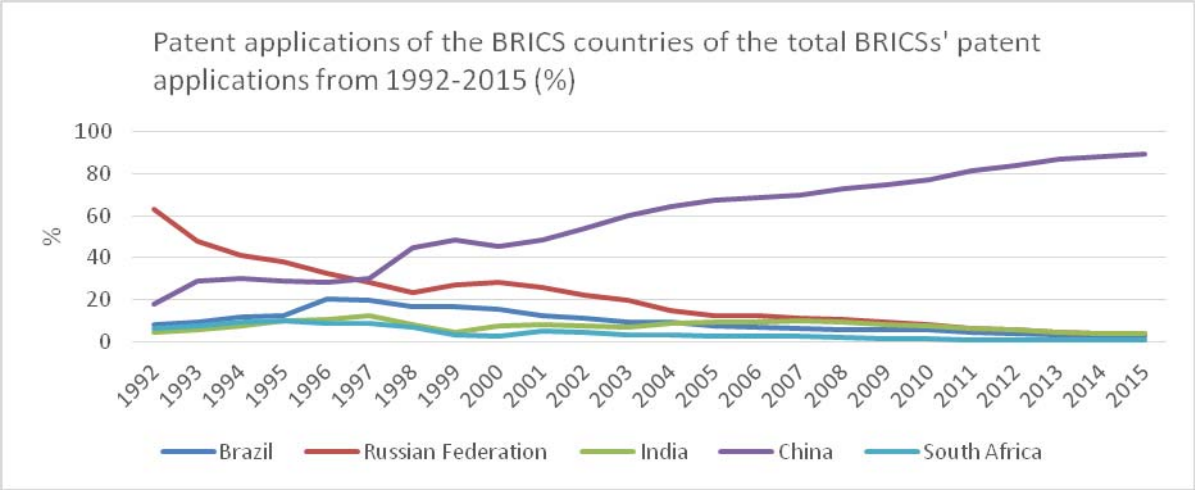


Fig. 6 visualises the dominance of Chinese patent applications among the BRICS country group. All other countries show decreasing percentages of the total BRICS patent applications. In 2015, China represented 90% of all BRICS patent applications.

Figure 7. Patent applications for the G7 countries of the total world patent applications from 1985-2015 (%).

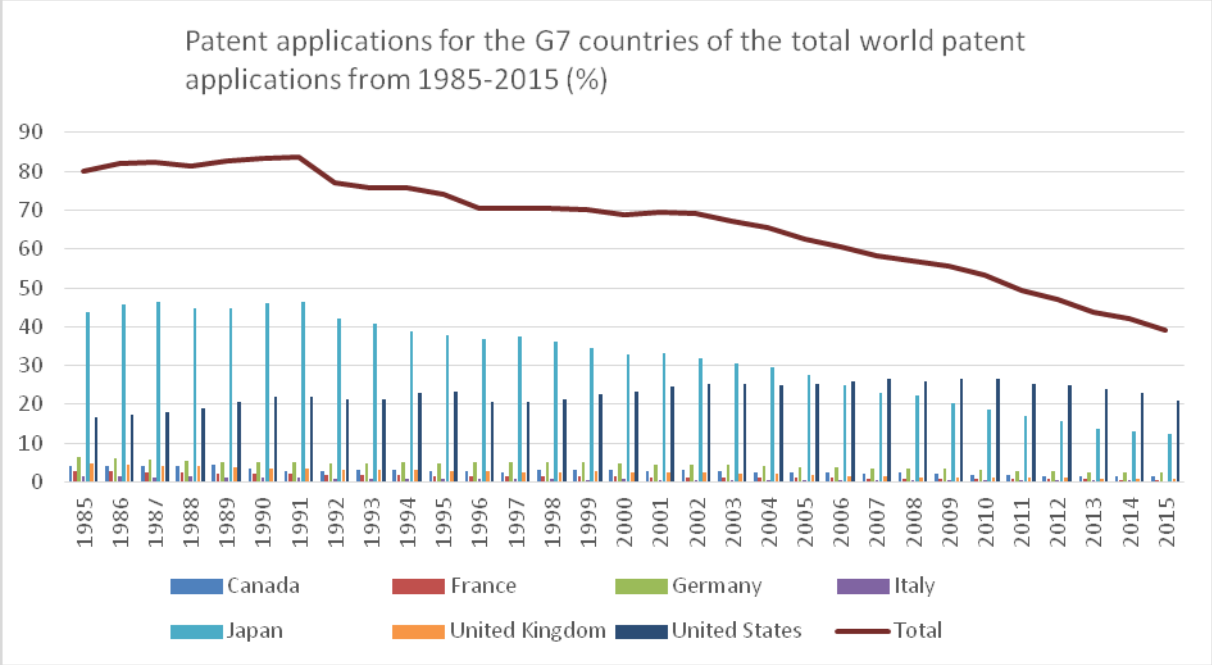


Fig. 7 visualises patent applications for the G7 countries of the total world patent applications (%) from 1985-2015. This figure reports a dramatic change in the patent activity trend in the global innovation ecosystem. In 1985, percentage was 80%, but in 2015, it is only 40%. This change has happened due to decreasing share of the Japanese economy's patent activity.

Figure 8. Patent applications for the G7 countries of the total G7 countries' patent applications from 1985-2015 (%).

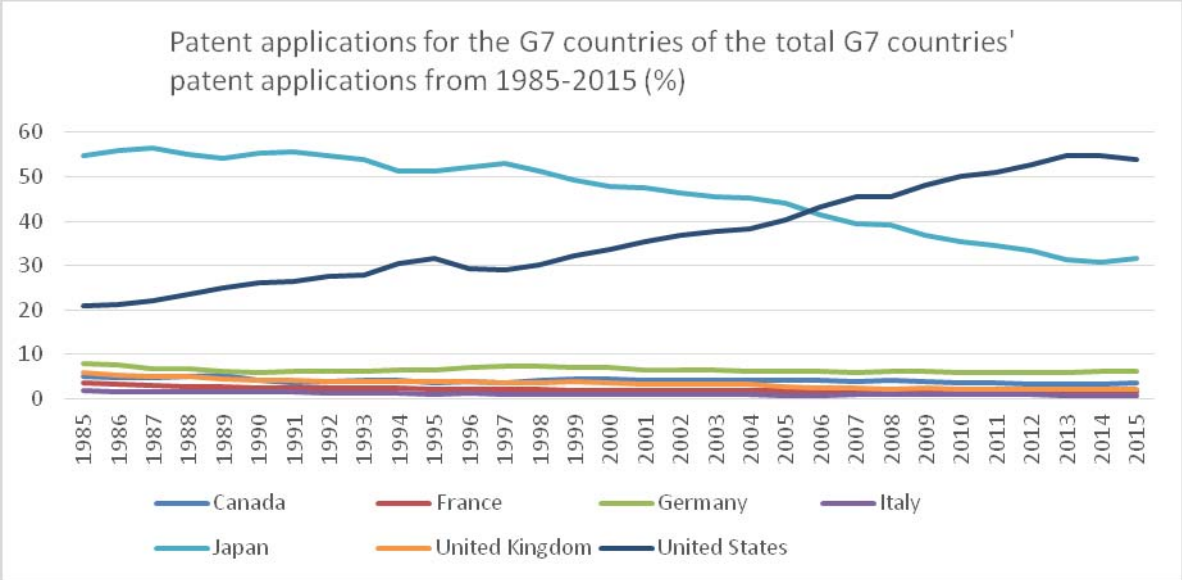
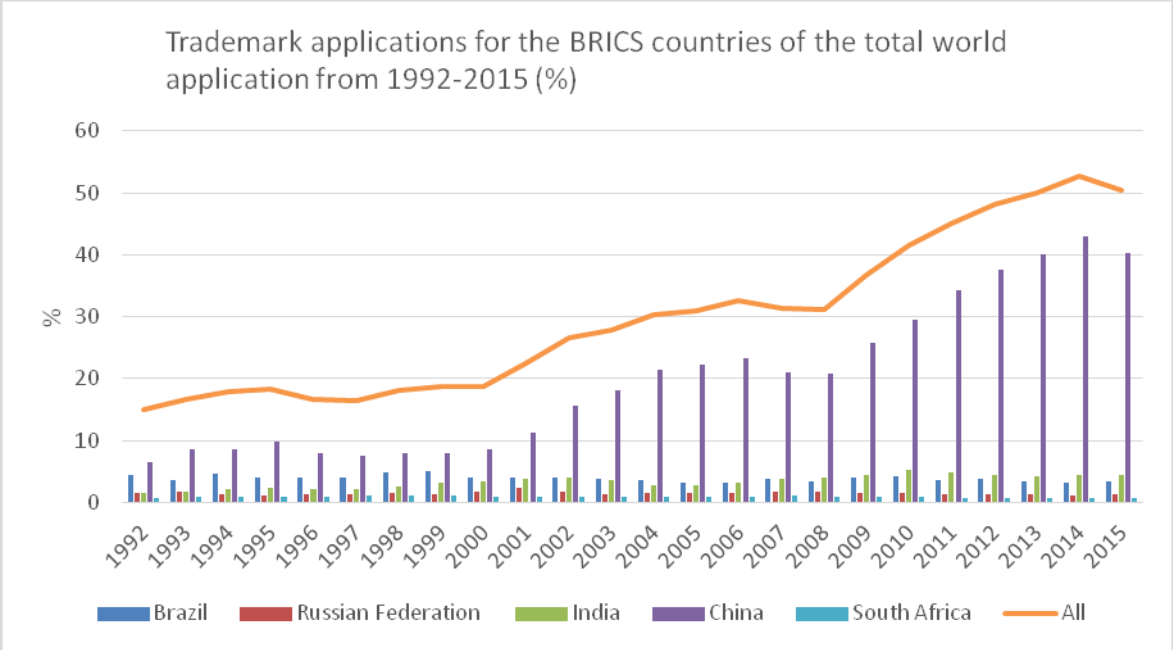


Fig. 8 reports this phenomenon too and shows that the USA economy has increased its percentage and the Japanese economy has decreased its percentage. The percentages of other G7 countries have been stable in the long-run statistical analysis.

Figure 9. Trademark applications for the BRICS countries of the total world application from 1992-2015 (%).



In Figures 9 and 10, trademark applications for the BRICS countries of the total world application from 1992-2015 (%) (Fig. 9) and Trademark applications for the BRICS countries of the total BRICS applications from 1992-2015 (%) (Fig. 10) are reported.

Again, we can observe that the role of China has become much stronger in the field of trademark applications. Fig. 9 reports that the percentage share of global trademark applications is about 40% in 2015 and the share of the BRICSs group is about 50%.

Figure 10: Trademark applications for the BRICS countries of the total BRICS applications from 1992-2015 (%).

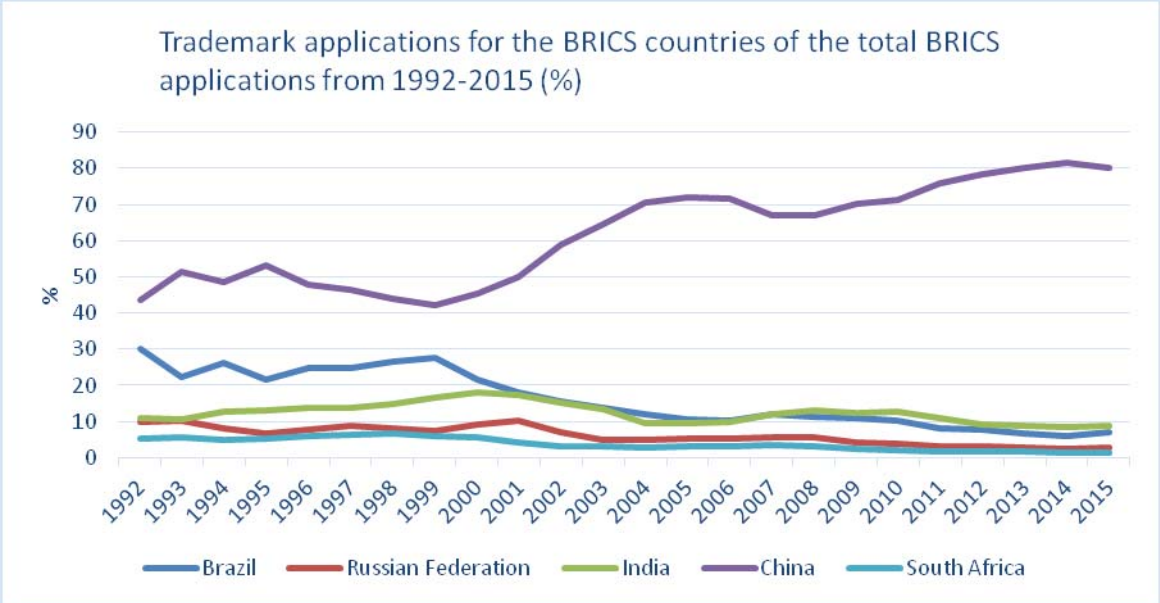


Fig. 10 reports that China's share is about 80% of all the BRICS trademark applications. The other BRICS countries have less than 10% shares.

Figure 11. Trademark applications for the G7 countries of the total world applications from 1985-2015 (%).

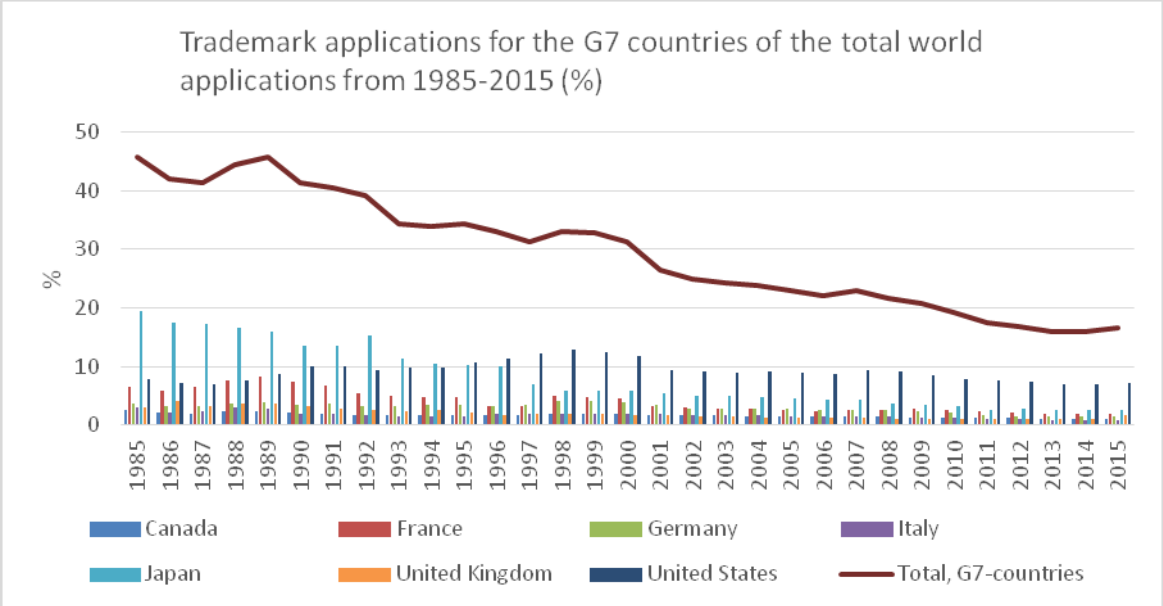


Fig. 11 reports trademark applications from the G7 countries of the total world applications from 1985-2015 (%). The G7 Group's share has decreased from 45% to 18%. The trademark activity of Japanese companies has decreased dramatically.

Figure 12. Trademark applications for the G7 countries of the total G7 countries' applications from 1985-2015 (%).

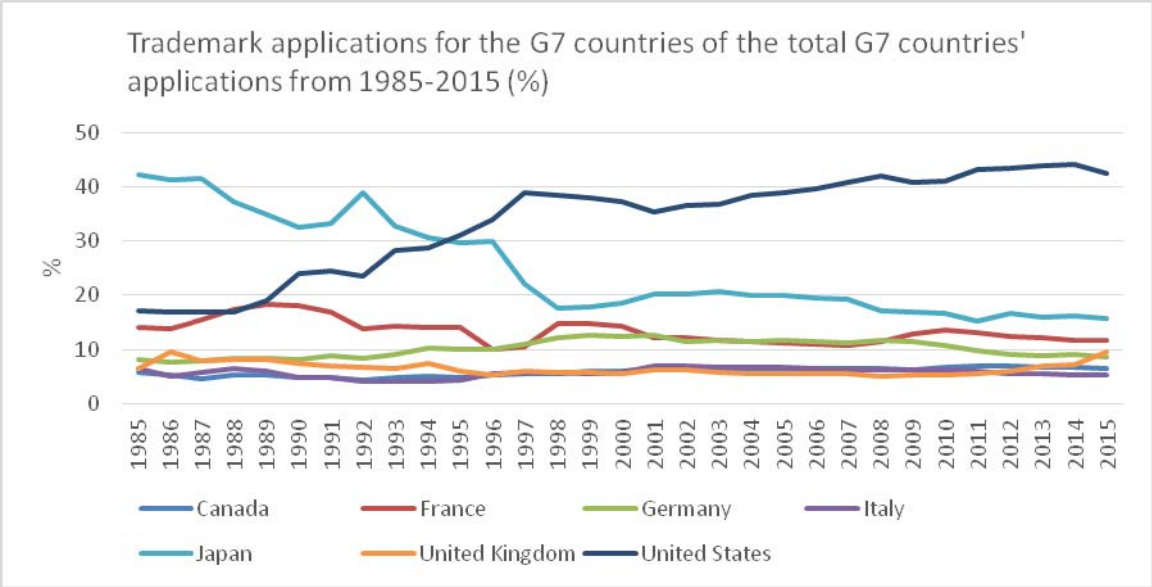


Fig 12 reports Trademark applications for the G7 countries of the total G7 countries' applications from 1985-2015 (%). The biggest trend changes have been: (1) the dramatic decreasing activity of Japan, (2) the dramatic increase of the USA's percentage among G7 countries, (3) the slight increase of Germany´s trademark applications since 1985, and (4) the slight decrease of France´s trademark applications since 1985.

REFERENCES

Abraham, B.P. and Moitra, S.D.2 (2001) Innovation assessment through patent analysis. Technovation, 21(4), 245–252.

Demsetz, H. (1982) Barriers to entry. American Economic Review, 72(1), 47–57.

Griliches, Z. (1990): "Patent Statistics as Economic Indicators: A Survey", Journal of Economic Literature, 28:4 (1661-

Ghisetti, C., Marzucchi, A. and Sandro Montresor, S. (2015) The open eco–innovation mode. An empirical investigation of eleven European countries. Research Policy, 44(5), 1080–1093. http://dx.doi.org/10.1016/j.respol.2014.12.001

Hidalgo, A and Gabaly, S. (2013) Optimization of prediction methods for patents and trademarks in Spain through the use of exogenous variables. World Patent Information, 35, 130–140. http://dx.doi.org/10.1016/j.wpi.2012.12.009

Kaivo-oja, J., 2016, Benchmarking Analysis of Patent and Trademark Applications in the European Union: A Comprehensive Eu Innovation Policy Evaluation for Years 1960–2013, European Integration Studies 2016/10

Kaivo-oja, J. & Santonen, T. (2016) Futures of innovation systems and innovation management. Open innovation paradigm analysed from futures perspective. Chapter 6. In Mention, Anne-Laure & Torkkeli, Marko (2015) *Open Innovation: Bridging Theory and Practice*. Vol. 1. World Scientific, USA, 111–158.

Kaivo-oja, J. & Lauraeus, T. (2017a) Technology disruption and new corporate foresight challenge: The VUCA approach as a possible solution concept for leaders and managers. 5th International Scientific Conference "*Contemporary Issues in Business, Management and Education*". Track 3. Modern Business Management Problems and Perspectives, Vilnius, Lithuania, May 11, 2017 – May 12, 2017. 12 p.

Kaivo-oja, J. & Lauraeus, T. (2017b) Corporate knowledge management foresight tools, primary economically affecting disruptive technologies, corporate technological foresight challenges 2008-2016, and the most important trends for year 2017. *Knowledge Management in Organizations 2017*, Beijing, China. Aug.21 – August 24, 2017, 12 p.

Kuhlmann, S. (2001) Future governance of innovation policy in Europe – three scenarios. Research Policy, Vol. 30, 953–976. http://dx.doi.org/10.1016/S0048–7333(00)00167–0

Lee, C., Kim, J., Kwon, O. and Woo, H–G. (2016) Stochastic technology life cycle analysis using multiple patent indicators. Technological Forecasting and Social Change, 106, 53–64. http://dx.doi.org/10.1016/j.techfore.2016.01.024

Little A, 1981, Strategic Management of Technology. European Management Forum. Davos.

Maresch, D., Fink. M. and Harms, R. (2016) When patents matter: The impact of competition and patent age on the performance contribution of intellectual property rights protection. Technovation. In press.

McLeod, C. and Radick, G. (2013) Claiming ownership in the technosciences: Patents, priority and productivity. Studies in History and Philosophy of Science, 44, 188–201. http://dx.doi.org/10.1016/j.shpsa.2012.11.010

Mendonca, S., Pereira, T.S., Codinco, M.M. (2004) Trademarks as indicator of innovation and industrial change. Research Policy, 33(9), 1385–1404. http://dx.doi.org/10.1016/j.respol.2004.09.005

Nikulainen, T., M. Pajarinen and C. Palmberg (2005): "Patents and Technological Change - A Review with Focus on the FEPOCI Database", ETLA Discussion paper, 984

Nikulainen, T., Hermans, R., And Kulvi,M., 2008, Patent Citations Indicating Present Value Of The Biotechnology Business, *International Journal of Innovation Technoogy Management* **05**, 279 (2008). https://doi.org/10.1142/S0219877008001436

Nam, Y. and Barnett, G.A. (2011) Globalisation of technology. Network analysis of global patents and trademarks. Technological Forecasting and Social Change, 78, 1471–1485. http://dx.doi.org/10.1016/j.techfore.2011.06.005

Popiel, I. and Jabłońska, M. (2014) European Union regional policy with particular emphasis on the area of innovation. Procedia – Social and Behavioral Sciences, 150(15) 1213–1221. http://dx.doi.org/10.1016/j.sbspro.2014.09.137

Roper, S. and Hewitt–Dundas, N. (2015) Knowledge stocks, knowledge flows and innovation: Evidence from matched patents and innovation panel data. Research Policy, 44, 1327–1340. http://dx.doi.org/10.1016/j.respol.2015.03.003

Sandler, P.G. and Block, J. (2011) The market value of R&D, patents and trademarks. Research Policy, 40, 969–985. http://dx.doi.org/10.1016/j.respol.2011.04.004

The United States Patent and Trademark Office (USPTO) https://www.uspto.gov/

Tong, X. and Frame, J.D. (1994) Measuring national technological performance with patent claims data. Research Policy, 23(2), 133–141. http://dx.doi.org/10.1016/0048–7333(94)90050–7

WIPO (2016) Understanding Copyright and Related Rights. Read 18.6.2017. Available at http://www.wipo.int/edocs/pubdocs/en/wipo_pub_909_2016.pdf

WIPO (2017) Summary of the Paris Convention for the Protection of Industrial Property (1883). Read 18.6.2017. Available at http://www.wipo.int/treaties/en/ip/paris/summary_paris.html