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Metadata of Patent Information in the Value Assessment of New Technology Solutions

ABSTRACT

This study aims to discuss the possibility of an aggregated value assessment of a new technology solution on various levels: an entity (organization), specific technology field, regional economy, national economy, the economy of an integration group, and to test that assessment method using a transnational approach. In addition to testing the possibility and purposefulness of an aggregated assessment of new technology solutions in a group of countries, the study is aimed to test the hypothesis on a large technology quality gap between the German economy and those of other member states of the European Union.

To achieve the objective of this study and verify the proposed hypothesis, the nature of invention and potential of patent information in the testing of technology value are discussed, and a taxonomic indicator is devised, suitable for achieving the objective and verifying the hypothesis.

The presented results of an original study show a dramatic difference in the value of new technical solutions between Germany and EU13, but also between

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Germany and EU14. New technical solutions originating from the EU13 region are barely observable to other global R&D centres.

The scope of the research process presented in this article indirectly addresses two issues: using patent information to describe the patterns of technological accumulation and selecting and positioning smart specialization.

KEYWORDS: patent; technology solutions; taxonomic indicator.

INTRODUCTION

Results of research and development work (products of human capital and the process of knowledge accumulation) represent highly valued goods; frequently they give their owners a significant competitive advantage. They affect structural changes in an economy, including the growth dynamics of general welfare.

An example of product of research and development work (R&D) that is highly saturated with knowledge and potentially suitable for industrial use is provided by a new technology solution disclosed in a patent description. Legally, a patent is the right to exclusively use a new technical solution; considered one of the strongest intellectual property rights. Scientifically, it crowns research and development work. Considering the economic aspect, it is a phase of the innovation process. For the entity that owns it, a patent is a resource and potential market value. It offers a relatively high potential of being transformed into a factor of production (Hall & Harhoff, 2012). A good patent is generally one that fulfils the key objectives of the patent system, i.e. to reward and incentivise innovation while enabling diffusion and further technological developments (Guellec & van Pottelsberghe de la Potterie, 2007). Due to the characteristics of a patent description and of the exclusive right as such (a patent strictly understood), patent information forms a bridge between R&D results and their potential economic use (OECD, 2009).

A patent represents a collection of accumulated scientific, technical and technology knowledge, capable of influencing economic processes. A major advantage of time series of patent applications (and granted patents) lies in their suitability for simultaneous use in at least four dimensions: time, space, industrial sector, and value. It has been long argued that the "value" of patented inventions varies widely from patent to patent and that the likelihood to patent inventions of a given quality varies at both firm and industry levels (Scherer, 1965; Lanjouw et al., 1998; Lanjouw & Schankerman, 2004).

This study aims to discuss the possibility of an aggregated value assessment of a new technology solution on various levels: that of an entity (organization), specific technology field, regional economy, national economy, the economy of an integration group, and to test the method of that assessment using a transnational approach. In addition to testing the possibility and purposefulness of an aggregated assessment of new technology solutions in a group of countries, the study is aimed to test the hypothesis on a large technology gap between the economies of Germany and other EU member states.

To achieve the research objective and verify the proposed hypothesis, the nature of invention and potential of patent information in the testing of technology value are discussed, and a taxonomic indicator is proposed, suitable for achieving the objective and verifying the hypothesis. The final section offers a discussion of limitations to the adopted approach.

Invention: Literature review

Invention as a concept is rather vaguely defined. However, it is closely associated with such concepts as a materialized (industrial) idea, a new (product, process) solution, (intellectual) property. Arrow (1962) broadly defines invention as the production of knowledge. This knowledge is incorporated, relational and transformational. An invention is usually subject to a long and

expensive process beginning with pure thought, through a prototype, ending with a final process or product solution. Mutual relations between the actors and phases of the invention process are very complex. They extremely rarely resemble a sequential model.

The dynamics of granted patent rights (regardless of the procedure used) in the recent three decades illustrates an eruption in the "production" of inventions: new solutions. However, the broadly understood quality and value of those rights varies, depending on the legal system wherein they are granted. Most patents represent expansions, continuation or materialization of basic findings achieved by fundamental sciences. In a great majority of cases, results of fundamental research provide inspiration to create new solutions. The findings of Schmookler (1966) in this regard continue to be valid. Freeman (1982, 1987) additionally indicated that fundamental research in chemistry and physics is most intensively exploited in the development of new methods, practices and products. This basic set is being enlarged at present, for example, by biotechnology, biochemistry, biophysics and electronics.

The concept of "invention" is not used by the Statistical Office of the European Communities as a statistical category in data acquisition, processing and presentation. The World Bank does not include this category in its repository, either. Similarly, invention does not appear in the statistical databases of the Organisation for Economic Co-operation and Development as a standalone concept but only in combination with such categories as patent or more broadly: intellectual property, licensing, technology. This rule is also observed in other national and international repositories of primary statistical data.

However, the concept is precisely defined at the level of systemic legal protection of intellectual property assets. Here, the concept of invention is principally associated with technology, and as the subject of augmented legal protection (exceeding con-

tractual regulations) may include amorphous or spatially formed material products or those relating to the technical influence on matter. Four principal categories of inventions can be distinguished in the legislation on intellectual property (Nowicka et al., 2010): products, devices, methods, and applications.

The patent monopoly as an economic category has been addressed in scientific discourse since the dawn of economics. However, in the 18th and the first half of the 19th century, views on the patent were expressed on the margin of principal debates in political economy. The following two or three decades of the 19th century saw a distinct development of economic studies dedicated to exclusive property rights and to producing arguments for and against a patent monopoly. The debate principally focused on four constructs, i.e. natural law, reasons for a temporary monopoly, encouraging further creative thought and reward for publicizing knowledge (Machlup, 1958).

A cautious but also very general conclusion can be drawn from that debate – about the reached consent to a temporary monopoly. This view was more or less firmly supported by: A. Smith, J. Betham, J. S. Mill, J. H. G. Justi, L. H. Jakob, or J. F. E. Lotz. A clearly opposite position was taken, for example, by Simonde de Sismondi. It cannot be compellingly argued that the views proposed by the economists of that time provided a significant reason for work initiated in Paris in 1873 on the international convention for the protection of industrial property. The industrial, political and legal communities were especially interested in the development and international unification of the patent law. However, the fact also materially affected the dynamics of research into a patent monopoly in the community of economists over following decades. The structure of the patent system was discussed by representatives of different economic schools, who also addressed the topics of monopoly, territorial and temporal limitations, economic value, while the system dynamically

developed, generating a series of external effects (with distinctly growing adverse consequences).

To summarize, it can be stated that a patent has two principal functions: (1) protection associated with the disputable concept of legal monopoly; and (2) distribution of knowledge by (structured) collections of patent literature. For this reason, a patent (patent description) can also be understood as a scientific and technical publication resembling a paper in a scientific journal. The attributes of an invention description contained in a patent description can be used to evaluate the invention, to assess its value on various scales: micro-, meso- and macroeconomic, and international.

Patent information in research into technology value

The accumulation of capabilities and possibilities of technology development embodied in ownership titles to new technical solutions has accelerated in recent decades through dramatic changes in the approaches to and methods of managing production processes that are increasingly based on intangible resources. However, it should be expressly stated that the accumulation process varies in its dynamics and nature depending on cultural or institutional conditions. Gomułka (1998) argues that "a reasonable assumption can be adopted that the interrelation between a technology change and cultural and institutional features of a nation represents one of the most important causes of observed differences in invention and economic growth indicators between various countries."

The average annual number of patent applications (irrespective of the application procedure) was stable until 1970s. In the 1980s, international patent applications originated predominantly from Japan, the Soviet Union and the United States; in the 1990s, they came from Japan, the United States, Germany and South Korea. China joined the group in the first decade of the 21st century, to rise to the third place globally in 2010. The

years 2010–2020 saw China's hegemony in the number of new technical solutions filed. Their number consistently exceeded 2.5 million annually in the PCT procedure in 2015–2020.[1] In the same period, the second-ranked country, the US, had about 1 million applications annually, Germany about 350 thousand annually on average, while Poland 12.5 thousand – more than any other country in Central Europe (see: WIPO IP Statistics Data Center, https://www3.wipo.int/ipstats/ipslinechart).

The principal factors stimulating that trend include: (1) possible multiplication of the application for patent protection of technical solutions contained within a single invention, (2) a growing productivity of research and development activity encouraged by the pressure on applicability of research results, (3) the emergence of new or/and more intensely explored existing fields of technology development, (4) the growing awareness of the importance of formal protection of intellectual capital.

As a consequence, huge sets of structured data and information (fact databases) are accumulated. In combination with a rapid development in the area of IT infrastructure of data repositories and new methods and techniques used to explore data (data mining), new opportunities open to: (1) reveal previously unknown relations and connections between data, (2) project processes, also economic ones, (3) determine rules governing those processes, or finally (4) propose general statements regarding their development, depending on the factors that determine their environment.

[1] The Patent Cooperation Treaty (PCT) is an international agreement that facilitates application for a patent or protection right in a utility model in multiple states or regions using a single international procedure (single application). The administrative procedure is held before an international intellectual property office (such as the World Intellectual Property Organization), and initiated by an application (filing) for a patent/utility certificate for the described asset to be protected (e.g. an invention). The international procedures are usually designed to obtain protection in several (multiple) states in various regions of the world using a single, uniform application.

An important advantage offered by patents and patent information sets (databases) is their availability over a long period (as long as decades). The contents of patent databases and long time series describing them facilitate data aggregation on any scale (micro-, meso- and macroeconomic, and international). Already decades ago, Griliches (1990) and Schmookler (1966) argued that patent data provides a valuable source of knowledge not only of stimuli, trends in and structure of innovation processes, but also its relation to economic growth and development (OECD, 2017).

The information currently contained in patent document collections can be divided into five principal areas:

1) information about the technical domain to which the solution belongs, determined using various classifications systems;
2) information used to identify and recognize the entities involved in the creation process of new technologies (by analysing e.g. the structure of the invention-creating team and their affiliations, the structure and type of applicants, progress in the development of patent families, including the "triadic family"[2]);
3) information revealing the history of application using dates disclosed in the documents, such as the application date, publication date, denial or withdrawal date, patent granting date, end date of the monopoly right;

[2] The "triadic patent family" refers to an invention that was simultaneously reported using the following procedures: (1) EPO (European Patent Office, an executive body of the European Patent Organisation, responsible for granting European patents), (2) JPO (Japan Patent Office, a government body in Japan responsible for granting and maintaining validity of industrial property rights; one of the three world's largest patent offices, (3) USPTO (United States Patent and Trademark Office, a patent office reporting to the US Department of Commerce, granting patents and registering trade marks), and obtained a patent in the group of the most economically developed states in the world. The concept is based on the assumption of an above-average technical and economic importance of this industrial property right.

4) information used to establish the legal status of invention (a patent in force, an invalidated patent); and
5) information used to determine the potential value of a new solution, based e.g. on the number of citations, number or licences granted, the process of changes in the patent right holder due to market transactions, the number of years of the patent monopoly maintained in force, the geographic extent of protection.

The documents included in the patent literature require a standardized bibliographic description of their contents (due to formal and pragmatic reasons). The data contained in the patent literature is collected considering objectives and typology characteristic of a classification used. The rules of bibliographic description recommended by the World Intellectual Property Organization are contained in **Standard ST.9.**[3] The basic components of that standard include: identification of the patent document, data concerning the application for a patent, technical information about the patent, references to the patent and scientific literature, identification of parties concerned with the patent, and other.

The principal objective of unification of patent description attributes based on WIPO ST. 9 is to improve the efficiency of a search in the patent literature. A uniform method of data organization aims to facilitate data aggregation on any level, the identification of interrelations between data, rules, trends, the forecasting of development directions of technology processes, development and diffusion of specialist engineering knowledge, and structural changes occurring in an economy. Simultaneously, a dynamic development is observed in the area of IT infrastructure of data repositories.

[3] WIPO (2013). STANDARD ST.9. Recommendation concerning bibliographic data on and relating to patents and SPCS. http://www.wipo.int/export/sites/www/standards/en/pdf/03-09-01.pdf

Considering the value assessment of a specific technical solution, the patent documents can be used to analyse the following aspects (see also Squicciarini et al., 2013):

1) the scope of patent family (e.g., the number and importance of patent offices, geographic extent of protection) in a defined technology domain recognized as a priority in the country;
2) the number of citations in other patent descriptions (as a manifestation of the patent value, applicability of scientific research results);
3) the period of maintaining patent protection in force (paying fees) divided into sectors and technology domains as an indicator of the actual, market value of inventions;
4) the opposition procedure initiated;
5) the number and type of licences granted under the exclusive right (as a manifestation of the implementation effect and technology accumulation that finally materializes industrially, affecting changes in the capital-labour ratio and technical development).

The expected outcomes of evaluation using the above attributes are:

– an aggregated image of changes in the value of technical knowledge accumulated by enterprises (in a country or region) in a specific technology domain,
– an aggregated image of changes in the value of a specific technical solution owned by an enterprise,
– an aggregated image of changes in the value of accumulated technical knowledge owned by residents and non-residents,
– an aggregated image of changes in the value of accumulated technical knowledge owned by individual sectors of the national economy.

Various forms of citations contained in patent descriptions can be used as an important component in an analysis of the value of technical knowledge (Hall et al., 2001a, 2001b, 2005; Harhoff et al., 2003; Alcacer & Gittelman, 2006; Criscuolo & Verspagen, 2008).

A study into citations of a technical solution opens new possibilities of analysing the development of a domain of technology in time but also its diffusion into other domains. Citations form a kind of network combining works in a specific domain into an aggregate, an area of technology development. Each new solution is inspired by other prior solutions. In turn, it frequently provides a starting point for future solutions. References, comparisons with other technical solutions, exemplify technical progress. Kuhn (1973) argued that changes in citations from the specialist [patent] literature can be considered as a possible symptom of scientific [technical] revolution. The authors propose that an analysis of frequently cited patent descriptions, of a change in co-citation "sockets", the geographic affiliation of a cited patent description as selected attributes (variables), opens a new promising research perspective in economics.

Purposefully designed quantification of information streams can be used to discern the following advantages of an analysis of citations of patent descriptions compared to other methods employed in social research into technical development:

1) using patent statistics, including their citation statistics, reveals an image of the entire technical development system in its various dimensions; any other study will be relatively far more fragmented, and its presented results will not reflect the complete image of a domain, process, etc.;
2) the discussed approach offers the possibility to explore a huge, usually complete set of objects, giving the opportunity to employ various methods of analysis;
3) unlike other methods and techniques used to access primary data (such as a survey questionnaire or in-depth interview), research into citations of technical solution descriptions reveals the first phase of concept materialization;
4) a patent description represents an unbiased material that passed through a restrictive "quality" control.

The statistics of citations is useful in revealing trends in the development of technology, determining its pace and identifying possible breakthroughs in technology evolution.

MATERIALS AND METHOD

Patent information is published using various methods. The following list indicates major patent databases operated and made available by international organizations: (1) Espacenet – an international patent document database kept by the European Patent Office (https://worldwide.espacenet.com); (2) PATENTSCOPE – an international patent document database kept by the World Intellectual Property Organization (https://patentscope.wipo.int); (3) DEPATISnet – a database and information service operated by the German Patent Office (https://www.dpma.de); or (4) USPTO – a full-text document database of applications and patents granted in the USA (https://www.uspto.gov). This analysis uses the patent information sets accumulated in 2006–2022 in the Espacenet database maintained by the European Patent Office.

The entity applying for patent protection covering a new technical solution can select an application procedure. The procedures may be divided into national, regional and international ones. The use of one procedure does not exclude the simultaneous use of another.

The European patent application procedure provides an example of obtaining regional protection. Its formal basis is defined in the European Patent Convention, ratified by 38 European countries (as of the end of 2013). A European patent application may be filed by every natural or legal person, or any body equivalent to a legal person, irrespective of nationality, place of residence or business. A European patent application may be filed by joint applicants designating different Convention contracting states (as the area of patent protection). The applicant may file the applica-

tion directly with the European Patent Office or with the patent office of a European Patent Convention contracting state.

The party that has obtained a European patent, indicating e.g. Poland as the area of protection, acquires similar rights as enjoyed under a patent granted in accordance with national industrial property law, i.e. the holder of patent rights may prevent third parties from using the invention for profit or professional purposes without the holder's consent.

A patent application filed using this procedure has to be validated in each state indicated by the applicant as a territory of future protection. The national patent office collects periodic fees for protecting the invention covered by the European patent. The holders of European patents pay fees for maintaining their patents to the competent patent offices of the states in which their patents are validated, at the rates applicable in those states.

Considering the coherence and comparability of research results, the following attributes are important, and also provide a criterion for choosing a specific procedure used to obtain the patent monopoly: (1) a uniform application form, (2) a single patent-granting procedure, and (3) a uniform scope of protection.

A taxonomic indicator was devised to achieve the objective of this study and verify the hypothesis proposed. Taxonomic methods facilitate a classification of countries by their allocation to types using metrics. The metrics transform an n-dimensional space of variables describing the level of analysed phenomenon into a one-dimensional real space. The principal reason for using taxonomic measures is the absence of a total order in n-dimensional spaces ($n \geq 2$), preventing a comparison of freely chosen vectors of attributes.

Synthetic variables are suitable for (first) organizing and comparing countries and (second) classifying countries to obtain groups characterized by a similar degree. In this study, the authors used synthetic variables to classify countries in quintile groups. Stimulants and destimulants are distinguished in the set

of diagnostic variables in the subsequent phase; only stimulants occur in the study below.

A stimulant is understood as a variable whose high values are desirable considering the characteristics of analysed structure while its low values are undesirable. A destimulant is a variable whose high values cause undesirable condition of the analysed structure; also an increase in the value of such a variable aggravates that condition.

The stimulants were normalized to units, through dividing the value of *j*-th stimulant by its maximum value, to exclude their dimensions:

$$\bar{s}_{jt}^{i} = \frac{s_{jt}^{i}}{\max_{it}\left(s_{jt}^{i}\right)} \tag{1}$$

Where $\bar{s}_{jt}^{i}$ represents the standardized stimulant. The values of $\bar{s}_{jt}^{i}$ are also not greater than 1 and not less than 0, making comparable freely chosen values of standardized stimulants. Additionally, the value of stimulant equal 1 is interpreted so that in *i*-th country in the year t, the *j*-th stimulant assumed its maximum value in the group of analysed countries.

The taxonomic approach adopted in this study is based on the greatest value of total of Pearson correlation coefficients between the taxonomic indicator (SK_t^i) and standardized stimulants (see Dykas at. al. 2013).

Let $D = [d_{ij}]$ be a matrix of variables representing stimulants, where d_{ij} equals the value of *j*-th stimulant in country number *k*, where $i = k(modulo)$ 28, thus

$$i = k + p \cdot r$$

(r = 0 for the year 2006, r = 1 for the year 2007, … , r = 15 for the year 2021 and p = 28).

Let X be a normalized matrix D, where normalization is done using the following transformation:[4]

$$X_{\bullet,j} = \frac{D_{\bullet,j}}{max\left(D_{\bullet,j}\right)}$$

where the j-th column of matrix D is a stimulant, and

$$X_{\bullet,j} = 1 - \frac{D_{\bullet,j}}{max\left(D_{\bullet,j}\right)}$$

where the j-th column of matrix D is a destimulant.

The taxonomic indicator SK_i of development of the k-th ($i = k(modulo)\ 28$) country is given by the following linear combination of normalized attributes:

$$SK_i = \omega_1 \cdot X_{i,1} + \omega_2 \cdot X_{i,2} + \omega_3 \cdot X_{i,3} + \omega_4 \cdot X_{i,4}$$

where the vector of weights $\omega = (\omega_1, \omega_2, \omega_3, \omega_4)$ is an argument for which function[5]

$$F(\omega) = \sum_{j=1}^{4} \mathrm{cor}(X_{\bullet,j}, X * \omega) \tag{2}$$

assumes the greatest value.

The indicators SK_i (for $i = 1, 2, \ldots, 28$) are interpreted so that the closer to (farther from) 1 is their value, the more (less) developed is country i. The vector of weights ω was determined using distributed evolutionary algorithms. Vector coordinates $\omega = \omega_1, \ldots, \omega_n$ belong to the range (0,1) and sum up to unity. The maximum value of the function F is determined on an n-dimensional cube with an edge of length 1. The algorithm divides each edge into m

[4] For matrix $M = [m_{ij}]$, the notation $M_{\bullet,j}$ means the j-th column of the matrix.

[5] For $M = [m_{ij}]$ and $N = [n_{ij}]$, the symbol $M * N$ represents matrix multiplication.

parts and determines the largest values that the function reaches F, us denote this argument (vector) as ω^1. In the next step, the neighborhood ω^1 (equals $\frac{1}{m}$) is divided into m parts and again the largest value of the function F is selected, while the argument can be denoted as ω^2 and so on. In the last step, we obtain a vector of ω^s for which the value of the F function does not change significantly, while the vector itself is used to determine the taxonomic indices.

Additionally, individual coordinates ω_i (i = 1, 2, 3, 4) had the following values:

1) the number of citations of a patent (patent description) in other patent descriptions indicates the value of that primary description as referred to by other inventors: 0.2255;
2) the number of countries in which the patent is valid: 0.2528;
3) the number of entities holding patent rights (e.g., 3 enterprises; a university + an enterprise): 0.2552;
4) the number of inventors named in the patent description: 0.2665.

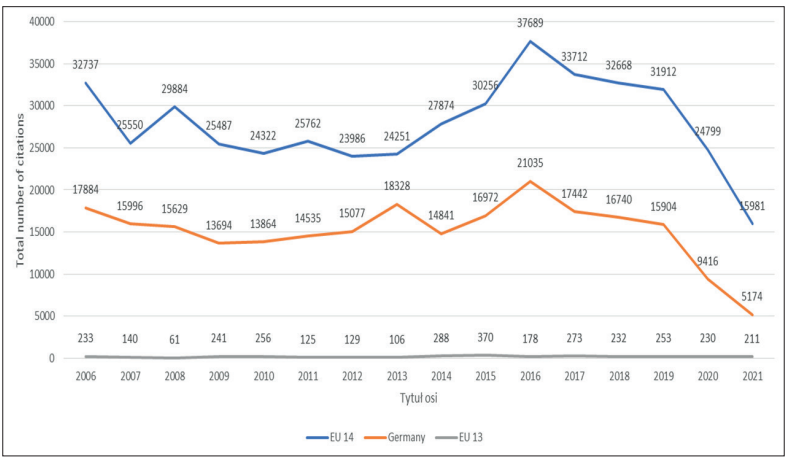
RESULTS

The research results presented below refer to two groups of objects: EU14 (EU member states prior to its enlargement in 2004 excluding Germany), EU13 (countries that joined the EU in 2004) and Germany.

Figure 1 represents accumulated numbers of citations of patent description originating from a group (EU 14, EU 13, Germany) in other patent descriptions. It has to be explained that the figure presents the fact of a patent description being cited in another patent description in any configuration. A French patent cited by another French patent entails award of one citation to the EU14 group; a French patent cited by a Polish patent also entails award of a citation to the EU14 group, and accordingly a French patent

cited by a German patent entails award of a citation to the EU14 group, because France is included in that group.

Fig. 1. The accumulated number of citations of patent descriptions originating from a group (EU 14, EU 13, Germany) in other patent descriptions.



Source: own elaboration.

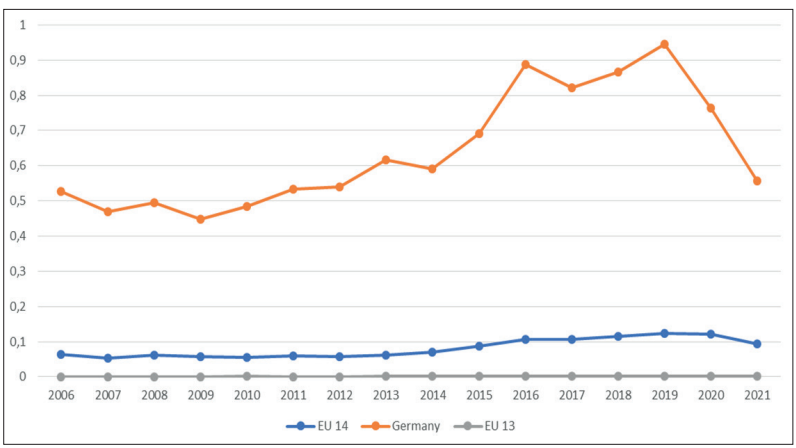
For the 13 countries undergoing an economic transformation (EU13), the European patent application remains a restrictive procedure, considering both expenses and quality (state of the art, legal system, patentability or a patent clearance search). Hence, the set of patents granted using the EPO procedure to entities domiciled in Central and Eastern Europe, covered by our analysis, is regarded as a resource of accumulated technical knowledge representing a high research-based, technology and economic value – from the perspective of those countries (EU13). The number of barriers experienced in the EPO procedure by entities from the countries that still have to build stable foundations of a market economy requires relatively high (financial or competence) outlays compared to the countries with mature market economies. An additional and even more difficult challenge is posed by the

technology development in a domain characterized by intense international competition, with a large number of competing entities that develop scientific and technical knowledge.

Figure 1 presents a dramatic difference in the value of new technical solutions between Germany and EU13, but also between Germany and EU14. New technical solutions originating from the EU13 region are barely observable to other global R&D centres. The probability that they can become the subject of a market transaction (licence, disposal of industrial property rights) is low. Another distinguishing feature of the EU13 patent portfolio is its significant portion being owned by the science sector (the predominance of public scientific institutions and research and development centres).

Figure 2 presents a change in the value of synthetic taxonomic indicator consisting of (1) the component of citation of patent descriptions, (2) the size of geographic area in which a patent is in force, (3) the number of entities owning the technology solution protected by patent rights, and (4) the number of people (together with their institutional affiliations) who contributed to creating the new technology solution.

Fig. 2. The value of synthetic taxonomic indicator (EU 14, EU 13, Germany).



Source: own elaboration.

The taxonomic indicator structured as described above shows an enormous gap in technology quality between Germany and all other EU member states. This gap distinctly grew in the years 2006–2019.

DISCUSSION AND LIMITATIONS

In practice, accessing the complete set of metadata can be problematic. The authors identified the following barriers to access to complete data sets:

- national patent offices give open access to functionalities and tools suitable for the automated and bulk acquisition of metadata, but to a dramatically limited extent (e.g., a limited number of records that can be exported using generally available browsers for a future analysis);
- data is frequently unavailable on citations in other patent descriptions and scientific literature; the number of years of maintained patent monopoly (information about fees paid); licences granted; changes in patent right holders;
- researchers happen to identify patents using a 1:1 relation (one patent assigned to one protection right), ignoring the topic known as a patent portfolio, and thus arriving at an erroneous interpretation of patent statistics;
- in the case of inventions created by international teams, the risk occurs that the same solution will be counted in multiple analyses – this problem can be solved by using the fractional count method.

The PATSTAT database administered by the European Patent Office gives access to more than 100 million patent documents sent from all over the world. Its special feature is the option to acquire, using SQL, source data in the form of extracts containing even more than 700 thousand records at a time. The source data is supplemented by such items of information as the number of

citations, the size of patent family or references of patent classification to the codes of economic activities (as per NACE Rev 2). Deficiencies in this regard are still considerable, mainly due to the formal aspects of the data acquisition and processing method.

It should be emphasized that, even considering the indicated drawbacks, patent data remains useful in an assessment of the patent quality and value. The patent statistics provide knowledge of the state of the art, profitability of efforts aimed to develop a new solution, options for cooperation with external entities and current invention projects of competitors, that require e.g. that a licence be acquired. In the final process phase, they facilitate the choice of the best strategy aimed to protect exclusive rights and estimate the expenses on possible commercialization of a reserved solution.

CONCLUSION

The international patent application is a non-trivial economic event, especially for entities domiciled in the countries of Central and Eastern Europe. The obtained protection right represents the organization's business resource that can easily evolve into a factor of production.

Patent information metadata provides an information potential pending its efficient use. This situation is principally caused by imperfection of methods that are employed to use patent statistics, and that are far from a holistic approach. The current state of research, and especially its methodology, aimed to assess the usability and possible purposes of patent descriptions and statistics, can be defined as an initial phase in Poland. Despite the reservations signalled in this study, it is emphasized that the strength of patent data lies in its structured form facilitating its comparative analyses on various scales.

The presented results of an original study show a dramatic difference in the value of new technical solutions between Germany and EU13, but also between Germany and EU14. New technical solutions originating from the EU13 region are barely observable to other global R&D centres. The probability that they will become the subject of a market transaction is low.

The value changes in the taxonomic indicator calculated for two analysed groups of countries and for Germany reveal an enormous gap in technology quality between Germany and the other member states of the European Union. This gap grew in the years 2006–2019.

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