Who Patents in Czech Republic? Analysis of Patent Activity of Czech Enterprises in 1997 – 2017

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Abstract

Purpose of the article Purpose of the article is to analyse trends in patenting activities and reveal the strength of patenting companies in the market.

Methodology/methods Methodology of the research is based on dataset collected from PATSTAT database, supplemented from UPV database, matched with owner's ID numbers using AMADEUS database and extended from financial and legal data retrieved from ORBIS Academic database. The analysed sample consists of 914 companies and their 2925 patents. Aggregated patent data retrieved from Czech Statistical Office were subjected to a graphical trend analysis. The size of a population was derived from the aggregated data as a prerequisite for sampling fraction estimation. The market share was estimated by proportioning sales of the firms in the sample to the sales in a whole respective industry.

Scientific aim Scientific aim is to validate the extensive dataset that covers data since the nineties. Additional aim is to explore the patenting activities of Czech enterprises from novel perspective, namely through estimating the market shares on which these firms operate, considering their size.

Findings Findings show that two thirds of patent owners are SMEs, though they own only one third of patents. Large companies are more likely to build a big patent portfolio. The size of the portfolio for most companies (95 %) does not exceed nine patents. Large firms are gaining higher market shares in industries where they lead in patenting, but also where SMEs predominate in patenting. The market share analysis revealed that patenting firms are leaders in industries, where patenting is rare.

Conclusions The presented findings indicate that large companies are better at benefiting from patent system, however SMEs are more active. The analysis considered only the patent grant and not the patent life. It gives an opportunity for further research based on in depth analysis of patents and determinants of their value.

Keywords: patent, patent application, patent value, european patent application, patent grant, population estimation and sampling fraction, czech enterprises

JEL Classification: G32, O31, O32, O34

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Introduction

Innovations are inseparable part of our everyday lives. They have various forms, from tangible invention to intangible, sometimes even abstract, improvement of products or processes. The tireless efforts to invent pushes mankind constantly forward. Along with innovative activities, there also arise questions about the most appropriate and the most beneficial subsequent protection of the innovation itself, or the future benefits it brings. The history of intellectual property protection is profound. The first industrial patent filing is dated back to 1421 attributing it to Filippo Brunelleschi, a Florence architect who developed a crane system for shipping and transporting marble from the Carrara mountains. The first person on record to have been awarded an English patent was a Flemish glassmaker, it was granted as early as in 1449 by King Henry VI on producing stained glass - a technique that was unknown until that point in England (Kwong, 2014).

Patents, however, are only one part of legal right referred to as intellectual property (IP). These rights are considered to include for instance trademarks, copyright, and trade secrets (Stahl & Fischer, 2010). The choice of form of IP protection is not always straightforward and is driven by various motives (Blind et al. 2006, Torrisi et al., 2016). Patents are costly and the length of pendency period usually counts in years. Despite, the amount of patent applications filed worldwide amounted to 3,2 million in 2019 (WIPO, 2020). Patent gives its owner quasi-monopolistic power in return of which the owner is obliged to disclose the protected technological solution. As every single invention is unique in essence, so are unequal the patents in terms of its quality or value. It is likely therefore, that also the motivation for filing or holding patents are also different. Moreover, Marco et al. (2019) suspect decrease in patent quality over the last decade due to strategic practices in applying for patent protection. It has already been proved in surveys that the size of a company and the technological field are correlated to propensity to patent (Torrisi et al., 2016; Suchý, 2014, 2015). But what else characterize companies that seek for patent protection? The purpose of the paper is to analyse on extensive dataset, that combines patent data with owner's legal and financial data, trends in patenting of Czech companies in their homeland. Firstly, on aggregate data, secondly on data on applicant level. The analysis served as cross-check for collected dataset as well as base for sampling fraction estimation. Furthermore, the dataset provided a decent base for estimation of market share belonging to patent owners. There are plenty of studies and report summarizing the patenting activity with respect to the size of a company in respective industries, however, to the best of author's knowledge, there is none that estimates the share of Czech applicants on their domestic market.

The remainder of this paper is organized as follows. The second section describes patents and provides brief literature review on patent systems, patent value and determinant of propensity to patent. The third section summarize the process of data collection and narrates the methods of research. The fourth section shows and discuss the results and the fifth section concludes the paper.

1 Patents, Value and Patent Strategy

Patents are legally protected exclusive rights to an invention for a given period, usually twenty years starting from application date. Patents, by definition, are granted for inventions that are novel, result from inventive actions, and are industrially applicable. Patents are territorial in nature and thus valid only in the jurisdiction that grants them. It means that the same invention may be protected in one jurisdiction, but not in another (Hall & Helmers, 2019). Patents award its holder a right to exclude competitors from using their innovation even if the competitors' inventions are developed independently. Moreover, patent holder is not obliged to commercialize the invention, and no matter the decision on utilization is, it has no effect on his right to seek compensation in case of infringement (Stahl & Fisher, 2010).

The main social function of the patent system is to strengthen private incentives for innovation by granting temporary monopoly power to inventors. In return for exclusivity, the patent owner is required to make the invention public rather than keeping it secret. The potential negative consequences for market due to the temporary monopoly are counterbalanced by the disclosure of the technical solution (Blind et al., 2006; Hall et al., 2009). However, the monopoly power is questionable. Wanetick (2010) objects that competitors are free to design around by producing another technology which yields the same effect and defines patents rather as a license to exclude anyone else from reproducing the same effect by applying a specified process while the patent is in force accompanied by the right to sue alleged infringers. Similarly, Stahl and Fischer (2010) describe patent as a contract between the inventor and the public, under which the public grants the inventor a limited period during which it has the right to sue others to prevent them from exploiting that invention in certain ways, in exchange for the inventor's disclosing the invention to the public.

Patents serves as valuable source of information for research as well. On macroeconomic level, they are often employed as indicator of innovation (e.g. Khalili et al., 2016; Kotabe, 1992; Saini & Jain, 2011), or they are used to examine the knowledge spillover (e.g. Goel & Saunoris, 2017; Maurseth & Verspagen, 2002). Along with approximation innovations with patents statistics there are widely discussed their strengths and weaknesses (e.g. Crosby, 2000; Griliches, 1990; Kleinknecht et al., 2002). In short, the most advantageous is the availability of patent data. There are various types of patent databases, mainly national but also international (e.g. Espacenet, Patentscope) search databases, that contain complex data on patents. European Patent Office provides statistical database PATSTAT, which contains bibliographical, legal status data and other information about patents, their owners, inventors, field of technology etc. The PATSTAT also provide references on patent family members, or its antecedent or descendant, alternatively citing or cited patents documents.

The major disadvantage of patent statistics, however, is that patents may differ in terms of their significance or value, commonly referred to as varying patent quality. What is also important and often left out is the need, stressed out by (Ernst et al. 2010), to distinguish between the value of patent as intellectual property right and the value of invention under the patent protection. The value of patent as IP right is being examined in literature using variables referred to as indicators or determinants of the value or patent quality (e.g. Putnam, 1996; Ernst & Omland, 2011; Chang S.H. et al., 2018) comprehensive overview of which provide van Zeebroeck and van Pottelsberghe de la Potterie (2011). In empirical studies, authors usually apply one of three approaches. The first approach is identification of determinants having the strongest impact on economical or strategical value of patent itself (e.g. Suzuki, 2011; Gambardella et al., 2008; Hedge & Sampat, 2009; Fischer & Leidinger, 2014). The second approach is through the impact of patents on the business value or business performance according to the patent characteristics (e.g. Hall et al., 2005; Patel & Ward, 2011; Harrigan et al., 2018). The third approach is proposing an index to evaluate the patent or patent portfolio compiled by assigning weights to selected value determinants (e.g. Lanjouw & Schankerman, 2004; Ernst & Omland, 2011; van Zeebroeck, 2011; Grimaldi et al., 2018).

Besides the traditional role of patent as a mechanism that provides exclusivity to its owner, literature has also examined the motives to patent. Companies usually protect those technological solutions, which are considered as bearer of the competitive advantage. The technological solution does not necessarily need to cover the whole product. It's quite common nowadays that company's single product is protected by several patents (Stahl & Fischer, 2010) to hamper competitors. The strategy of building a patent wall around a product is referred to as clustering. Similar competitive strategy worth mention is so-called bracketing when a company uses patents to hem in competitor's initial market (Rivette & Kline, 2000). Undoubtedly, patents earn to its owner some competitive advantage. The invention under patent protection may be a breakthrough in its category, so its owner may gain higher market share, or it can become a basis of a whole new industry. The patent ownership, or ownership of properly protected intangible assets in general, may also lead to advantageous partnerships (Rivette & Kline, 2000).

Torrisi et al. (2016) presented survey study addressing the actual ways of patent utilization and strategic patenting. Their results suggest that 24 % of companies are not utilizing patents for strategical reason in order to block their competitors. Their results imply that the strategic intentions can be dependent, along with the field, on the size of a company, since the portion of firms that strategically do not use their patents is higher in case of large companies. In Czech Republic was the question about motives to patent or not to patent addressed by Suchý (2014, 2015). He identified significant correlation between the intensity of patent activity and the size of a firm. Namely, small companies having less then 50 employees prefer rather informal protection. On the other hand, larger firms are much more prone to patenting.

Suchý (2014, 2015) find out that the propensity to patent in Czech enterprises is driven mainly by aspiration for profit from direct use of patent or licencing, image improvement, and litigation prevention. On the other hand, companies that do not patent are doing so mainly because of high costs of patenting, the territorially limited validity of patent, the knowledge disclosure, or because of fast innovation cycle.

Since there are many factors causing vast inequalities among patents like different fields of technology, different patent strategies, or differences between national patent systems or applicants' practices, this question surely deserves to be addressed in more detail on national level. Interestingly, the accession of Czech Republic to European Patent Cooperation did not distinctly change the patenting behaviour of residents (Hall & Helmers, 2019). Therefore, it seems worth to find out, who are the domestic companies that patent their inventions in Czech Republic.

2 Methodology

The analysis of patent activity of Czech enterprises is based on dataset collected and combined from several sources. Detailed patent data were retrieved from European Patent Office (EPO) World Patent Statistical Database PATSTAT (version Autumn 2018). The focus was pointed on patent grants which were applied for in years between 1993 to 2016 by Czech enterprises having only one applicant. The data from PATSTAT about patents and their owners were combined with business information retrieved from Amadeus database. Amadeus played crucial role in matching patents to their owner`s national ID numbers, which are essential unique identifiers. Further, the dataset was verified and supplemented with additional data retrieved from patent database provided by Industrial Property Office of the Czech Republic (UPV). However, Amadeus included only the last known owner and the owner in some cases did not correspond to the owner claimed in the UPV database. More frequently, the ID number did not match to the owner`s name. Therefore, the data were thoroughly verified and corrected if needed using public register on justice.cz. Afterwards, the dataset was enhanced with financial and legal information retrieved from Orbis Academic database due to its historical reach.

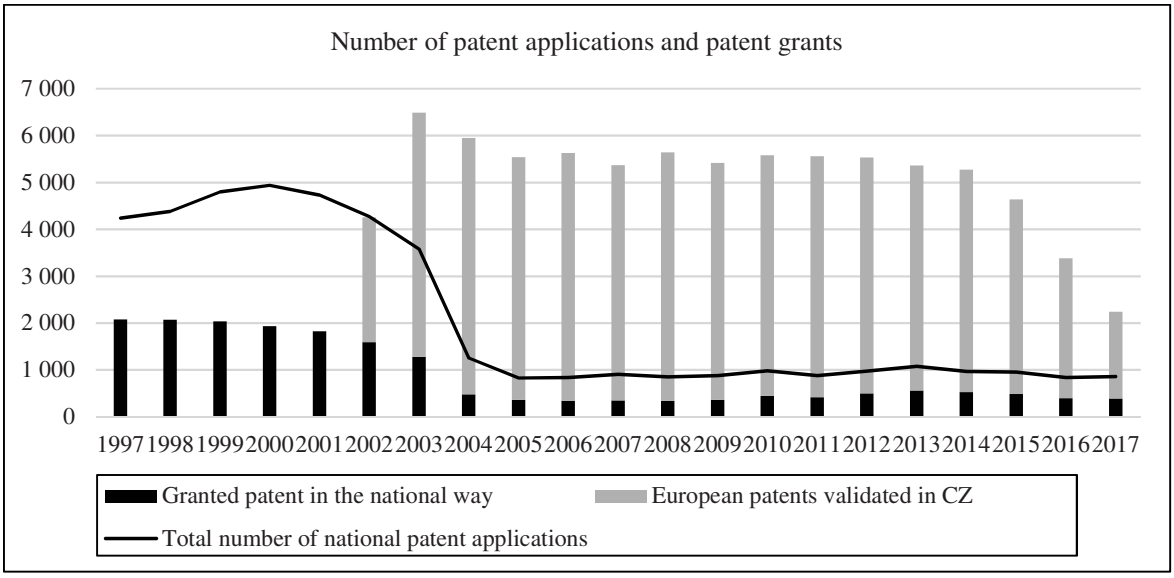
The dataset created by combining data from various sources provides rich information about the patents, inventors as well as legal and financial information about owners. The data were collected for the purpose of research of value of Czech patents and business value of their owners. The richness, however, does not necessarily guarantee validity and reliability of respective dataset. The cross-check of the dataset and further analysis of patenting activities of Czech enterprises is also based on patent statistics annually published by Czech Statistical Office (CSO). Since the analysis, results of which are presented in next section, was mostly focused on the applicants, it does not consider the patent life, i.e. for the purposes of the analysis was relevant that the patent was granted and not for how long it was valid.

The analysis is limited to time span from 1997 to 2017 and covers more than 3 thousand patents and their owners. Firstly, the graphical analysis of trends in patent applications and grants was performed on aggregated patent data retrieved from CSO. The aggregated data were then narrowed to data relating to Czech enterprises and compare to the created dataset described above. Based on the comparison, the sampling fraction have been estimated. After this point, the analysis continued at applicant level.

Based on the sample, the patent frequency per applicant during the analysed period have been calculated according to their size. Further, the estimation of market share of sample companies within their industry was made. The market share was estimated by comparing annually aggregated sales achieved by analysed companies during a period from 2007 to 2017 with the sales in whole industry presented by Ministry of Industry and Trade (MPO) and further analysed with respect to the industry and company size.

3 Results and Discussion

Figure 1 shows trends in filing national patent applications supplemented by the number of patent grants according to the application year. After the significant fall in application filing between the years 2002 and 2004, the patenting activity in Czech Republic is relatively steady with minimum of 830 national application in 2005 and maximum of 1080 national applications in 2013.



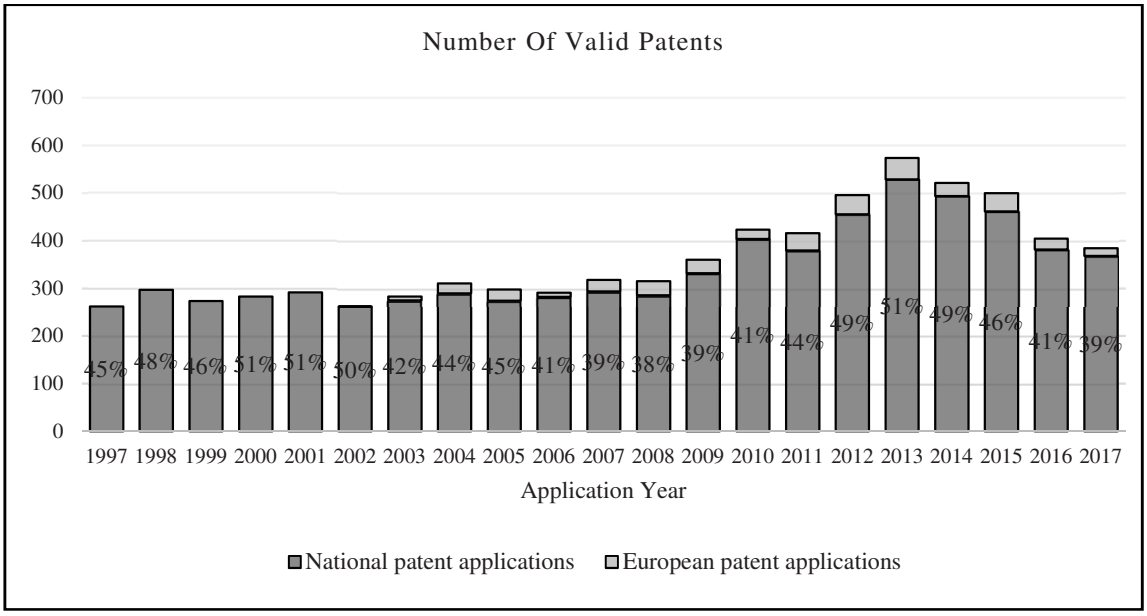
Source: author, according to the data of the Czech Statistical Office

Figure 1 The Total Number of National Patent Applications and the Number of Patents Granted (in National Way) or Validated (EPs) in Czech Republic According to Application Year

The fall was because the Czech Republic became a member of the European Patent Organization in 2002, which is an intergovernmental organization set up on the basis of the European Patent Convention (EPC). The Industrial Property Office became a recipient of European patent applications, which resulted in a significant decrease of national patent applications. The data shows significant shift in the portion of foreign applications filed in national way since the 2004, from approximately 50 % to 7,66 % in 2017. This kind of decline is common also in other countries that accessed EPC (Hall & Helmers, 2019). Since the decline is the matter of non-residential patent applications, it does not affect the further analysis, which is focused on the patent activity of Czech residents.

Figure 2 depicts the number of valid patents with respect to the way of application filing according to the application year. It also shows the rate of patent grant, i.e., the proportion of application that resulted in patent grant according to the year of application. In case of Czech applicant, the rate at which a patent application resulted in grant is approximately 45 % on average. The rate of grant accounts also for European patents granted to Czech applicants.

Interestingly, less than half of patent applications filed by Czech residents is filed by enterprises. The share of applications filed by Czech companies in analysed period was 42,2% on average with the lowest share 35,3% in 2008 and highest share 49,3% in 2004.



Source: author, according to the data of the Czech Statistical Office

Figure 2 Number of Valid Patents Filed by Czech Applicants According to Application Year, Supplemented by the Grant Rate According to Application Year

There was granted 3663 patents during the analysed period to Czech companies, according to data presented by the Czech Statistical Office, 3068 patents out of them were successfully matched to their owners` ID number. It is important to point out that the sample collection was focused on patents with only one applicant. It implies that vast majority of granted patents have a single owner. Furthermore, there was identified a thousand unique ID numbers. Put in other words, those more than three thousand patents are owned by one thousand companies. The sample was further narrowed to patents owners which were matched with Orbis Academic database. Table 1 presents in more detail the size of population estimated using patent statistics published by CSO and size of the sample.

Table 1 Estimation of sampling fraction.

Year	Total number of granted patents – population	Number of patents in sample (matched with ID number)	Number of unique ID numbers	Number of unique ID numbers from Orbis	Number of patents matched with Orbis	Sampling fraction
1997	153	105	74	54	84	54,90%
1998	170	132	78	63	102	60,18%
1999	136	107	75	64	96	70,67%
2000	151	126	75	64	109	72,15%
2001	137	113	76	67	101	73,86%
2002	124	111	66	62	106	85,48%
2003	144	124	79	74	118	81,76%
2004	150	132	89	81	124	82,67%
2005	197	186	126	121	181	91,88%
2006	154	141	88	81	132	85,53%
2007	132	124	68	66	122	92,31%
2008	156	146	82	78	142	91,03%
2009	209	179	95	93	177	84,49%
2010	127	104	63	63	104	81,89%
2011	125	106	64	64	106	84,48%

2012	169	142	85	83	139	82,21%
2013	169	135	89	89	135	80,09%
2014	212	175	109	107	173	81,78%
2015	250	207	128	127	206	82,47%
2016	310	245	150	147	241	77,75%
2017	288	228	138	137	227	78,87%

Source: author

Almost half of the population is in hands of very large companies, i.e., companies with 250 and more employees. On the other hand, companies having less than 50 employees owns only 30 % of patents granted during the analysed time span. These results are in line with finding of previous studies (Torrisi et al., 2016; Suchý, 2014, 2015). Further analysis is focused on the sample. The most active in patenting are companies operating in manufacturing (C section in NACE classification) since they are responsible for 65 % of valid patents in the sample. The next considerable field in terms of patent activity is in M section in NACE classification, which is described as professional, scientific, and technical activities. Companies operating in this field holds 14 % of patents in the sample.

Table 2 depicts a list of companies having more than forty patents in their portfolio applied for during the analysed time span. Having large patent portfolio is, however, rather rare since less than 5 % of companies owns ten or more patents. Interestingly, one small company, namely Preciosa, a. s., also reached to the top six companies.

Table 2 Most Active Companies in Patenting in Czech Republic

Number of Patents	Company Name	Company Size	NACE Main Section
171	LÉČIVA A. S.	Very large company	C - Manufacturing
113	ŠKODA AUTO a.s.	Very large company	C - Manufacturing
113	RIETER ELITEX, A. S.	Large company	C - Manufacturing
55	VÚTS Liberec, a.s.	Large company	M - Professional, scientific, and technical activities
53	PRECIOSA, A. S.	Small company	C - Manufacturing
42	AŽD PRAHA S. R. O.	Very large company	F - Construction

Source: author

Furthermore, the data show that to majority of companies was patent granted only once during the analyzed period, as shown in Table 3. Surprisingly, the data revealed that two thirds of companies in the sample are small or middle-sized companies (further referred to as SMEs), i.e. companies with less than fifty employees (categorization taken from Orbis Academic database). When considering the size of patent portfolio, these companies predominate when the size is three or less patents. More than three patent grants are more frequent for larger companies. These results contradict the findings of Suchý (2015) who concluded from a survey that SMEs are less prone to patenting that large companies. Although, almost two thirds (62 %) of patents in the sample were granted to large or very large company, i.e. company having more than fifty employees. It implies that it is not the size of a company, what determines the propensity to patent in first place.

Table 3 The Frequency of Occurrence of Respective Size of Patent Portfolio in the Sample According to Size of a Company

The Size of Patent Portfolio	1	2	3	4	5	6	7	8	9	10-19	21-49	50-99	>100
Small company	220	42	17	8	2			1	2			1	
Medium sized company	178	47	22	9	7	8	1	3	2	4	3		
Large company	117	36	17	18	12	6	3	5	4	13	6	1	1
Very large company	36	15	8	7	1	2	6	3	3	7	8		2
Total	**551**	**140**	**64**	**42**	**22**	**16**	**10**	**12**	**11**	**24**	**17**	**2**	**3**

Source: author

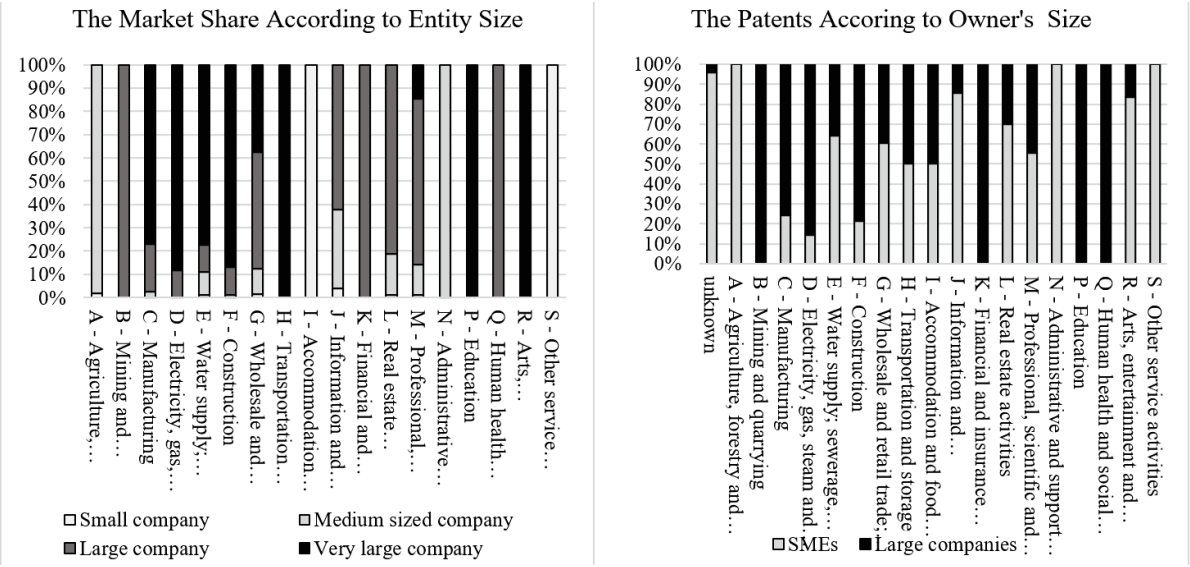
So far, the results pointed out to what industries most of patents belong. But which industries are led by patenting companies? To answer this question, the market share was estimated. The time span for further analysis was narrowed to eleven years from 2007 to 2017. For this period, the sales were aggregated at sample level and were compared to sales in the whole industry defined by NACE Main Section. The results are presented in Table 4 and prove the assumption that patenting plays crucial role in manufacturing and in scientific and technical activities. Moreover, patenting firms seems to be leaders also in Construction, Water supply field and manage also significant share of Mining sector or Wholesale, and retail sector. Furthermore, their market share increased in last few years also in Transportation and Storage section.

Table 4 The Market Share of Patenting Companies According to NACE Main Section (in %)

NACE	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
A					0,55	0,69	0,88	1,01	0,85	0,89	0,94
B	1,28	0,96	1,11	1,09	1,24	1,19	1,39	1,59	1,51	1,67	1,44
C	24,39	24,64	22,66	21,51	17,89	20,84	20,59	16,57	15,66	18,61	14,83
D	0,46	0,39	0,35	0,38	0,36	0,31	0,31	0,33	0,35	0,33	0,27
E	8,48	6,43	7,00	7,25	6,79	6,45	6,17	6,24	6,22	5,80	6,05
F	18,11	18,93	19,71	17,82	19,95	21,76	23,07	23,60	24,67	21,63	21,63
G	1,12	1,11	1,04	0,94	0,95	1,01	1,01	0,96	0,90	0,91	0,90
H	0,04	0,03	0,03	0,01	0,01	3,71	3,49	2,64	2,01	1,71	1,54
I	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
J	0,67	0,68	0,74	0,73	0,54	0,51	0,62	0,69	0,74	0,72	0,66
L	3,80	3,85	8,21	1,40	2,16	2,78	1,43	0,36	0,68	0,63	0,67
M		50,84	44,37	22,28	24,47	23,95	24,11	44,35	39,08	39,56	37,09
N	13,41	8,19	6,10	0,96	0,84	0,75	0,59	0,51	0,21	0,80	0,51

Source: author

The market share was then analyzed in more detail according to the size of a company. Results are depicted in Figure 3. The share of manufacturing industry is almost equally divided between SMEs and large companies in terms of their count; however, vast majority of sales are achieved by large companies. Figure 3 implies that in industries where large firms owns more patents than SMEs, the large firms also operate with higher market share.



Source: author

Figure 3 The Market Share of Companies in the Sample According to the Size of an Entity in 2007–2017 and the Number of Patents According to Owner's Size in 1997–2017

The situation is not so outright in industries, where SMEs predominates in patenting. It seems that even when they own more patents they did not gain as much of the market as the large companies did. For instance, in information and communication field patent more SMEs than large companies, also owns more patents, although large firms have higher sales. The presented results indicate that large companies are better at benefiting from their competitive advantages gained from protection of their intellectual property.

Conclusion

The aim of this paper is to describe the trends in patenting in Czech Republic, mainly from the perspective of domestic enterprises and estimate how big share of Czech market they gained. The graphical trend analysis showed that Czech accession of the European Patent Convention in 2002 had affected mainly patenting behaviour of foreign applicants, what is in line with the conclusion of Hall and Helmers (2019). It was important finding, because for the purpose of further analysis of domestic applicants and their patenting behaviour, the time span did not need to be corrected. During the analysed period, 42 % of all residential patent applications were filed by enterprises and the overall grant rate is 45 %.

It's well known that in manufacturing is patenting a very common practice, therefore, the market share of patenting firms in this industry is significant. Nonetheless, the estimation of market shares also provided a novel perspective in research of patent activities. The results suggest that some industries are led by patenting firms even when patenting in respective industry is rather rare. This is the case of construction or water supply field for instance.

The sample consists of 914 companies and 2925 patents. Two third of companies are SMEs and were granted approximately one third of patents. It means that the patenting is more common for SMEs, however, large firms are more likely to build wide patent portfolio. There arises a question about the strategy of patenting firms and this question might be answer by in depth analysis of the scope and other characteristics of individual patents. Patenting is resource intensive and large firms are usually richer in resources than SMEs, therefore are better equipped to benefit from patent system more. This suggestion is underlined by the further finding that large firms are able to gain higher market share also in industries, where SMEs were granted more patents.

The sample derived from the extensive dataset covers 80 % of the population, which is the number of all patents granted or validated in Czech Republic to Czech enterprises in years from 1997 to 2017. This dataset will serve well for further research of patent value and its contribution to the value of business.

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