Market and Competition Law Review / VOLUME VI / No. 2 / OCTOBER 2022

A Bad Dream Come True: ICT Patent Prosecution against EU Competition Law*

*Niccolò Galli***

ABSTRACT: The article scrutinises patent prosecution practices in the ICT sector under Arts. 101 and 102 TFEU in light of the CJEU case law and economic arguments pointing to their anti- and pro-competitive effects. Although the data on European ICT patent prosecution reveals a 'bad dream' of entry barrier features prone to anti-competitive practices, the article acknowledges the limited scope under the existing jurisprudence for EU competition law intervention to awaken from it. Indeed, the data on the European ICT patent landscape hint at substantial patent prosecution cost and timing, rising patent applications and granted patents owned by a few large ICT undertakings, and rare administrative oppositions, especially between symmetric firms. Despite the competition policy appeal of collusive cross-licensing agreements coordinating the parties' ICT patent prosecution strategies to the detriment of technology competition, their investigation under Art. 101 TFEU is yet to be seen. However, the offered evidence suggesting restrictions of competition in ICT technology markets coupled with the anti-competitive findings of the recent Consumer IoT Sector inquiry might justify a follow-on inquiry limited to ICT cross-licensing agreements. Regarding Art. 102 TFEU, the article concludes that the AstraZeneca jurisprudence on abusive patent prosecution is of a limited application for anti-competitive ICT patenting practices that essentially concern blocking patents. Absent fundamental patent law reforms, EU competition law remains not only a second-best solution to address the depicted bad dream of the ICT patent landscape, but also a very remote one.

KEYWORDS: Antitrust, intellectual property, innovation, patents, patent applications

---

* Date of Reception: 28 June 2022. Date of Acceptance: 20 July 2022.
DOI: https://doi.org/10.34632/mclawreview.2022.11716.

** Research Associate, European University Institute, Florence (Italy). Niccolo.galli@eui.eu. ORCID ID: 0000-0003-1292-0296. All websites are accessed as of August 4, 2022, unless stated differently.

1. Introduction

Patents are intellectual property rights ('IPRs') granted for novel, inventive and industrially applicable inventions upon positive examination of the applications claimed before governmental or intergovernmental organisations, such as the European Patent Office ('EPO'), on which this article focuses.[1] One of their primary functions is to incentivise investments in research and development by granting inventors the right to exclude others from practising the patented invention without their authorisation.[2] As such, patents are an essential instrument of competition in technology-intensive markets: they enable appropriability and dynamic competition by substitution at the expense of static price imitation competition. In so doing, patents tilt the trade-off between the short-term allocation of resources and long-term innovation in favour of the latter.[3] The patent degree of static inefficiency post-invention is well-accepted to foster dynamic competition before any market for the invention exists, especially due to patents' limits in geographic scope, length, and subject matter.[4] In other words, patent protection prevails against competition by imitation.

Nevertheless, in exceptional and context-specific circumstances, patents short-circuit and limit not only competition by imitation but also

---

[1] Note that the stated patentability requirements apply to European patents under Arts. 54, 56 and 57 of the Convention on the Grant of European patents of 5 October 1973. Other jurisdictions adopt different terminologies, such as non-obviousness and usefulness in the US instead of respectively inventive step and industrial application, but in essence the requirements are harmonised internationally; see Sections 101-103 of Title 35 United States Code and Art. 33 of the Patent Cooperation Treaty (PCT) of 19 June 1970. For treatises on patent law, see Richard Davis, Thomas St. Quintin and Guy Tritton, *Tritton on Intellectual Property in Europe* (London: Sweet and Maxwell, 2018), 57-254; Annette Kur and Thomas Dreier, *European Intellectual Property Law: Text, Cases and Materials* (Cheltenham: Edward Elgar, 2013), 84-156.

[2] The literature recognises several other functions of patent rights, such as the disclosure in the public interest of inventions that without the patent exclusivity would remain secret (so-called 'disclosure theory), or the diffusion of technology because of the embodiment of the claimed invention into a property title (so-called 'prospect theory'). For an overview of the role of patents, see Edmund Kitch, "The Nature and Function of the Patent System", *The Journal of Law & Economics* 20, (1977): 265; François Leveque and Yann Ménière, *The Economics of Patents and Copyright* (Berkeley: Berkeley Electronic Press, 2004), 19ff.

[3] Carl Shapiro, "Competition and Innovation: Did Arrow Hit the Bulls' Eye?", in *The Rate and Direction of Inventive Activity Revisited,* eds. Josh Lerner and Scott Stern (University of Chicago Press, 2012), 400-401.

[4] Josef Drexl, "Anticompetitive Stumbling Stones on the Way to a Cleaner World: Protecting Competition in Innovation Without a Market", *Journal of Competition Law & Economics* 8 (2012): 507, 533.

competition by substitution.[5] For instance, exploitative patent licensing demands or disproportionate patent infringement remedies can diminish the markets' overall incentives to innovate. In the quest for innovation, EU competition law, which is this article's context of interest, chips in to remedy the exceptional patent short-circuits that lack objective justifications and unleash at least market-wide static efficiencies and possibly also dynamic ones.[6]

Bearing in mind the clash between patent protection and competition, the whole administrative procedure between patent applicants, the patent attorneys representing them, and patent offices leading to patent grants, is called patent prosecution. Formally, patent prosecution comprises both the activities that precede the patent grant, such as examination and division of patent applications and those that come after it, such as renewal, opposition, and related appeals. According to the functional approach for the identification of the economic activities within reach of EU competition law,[7] patent offices' role in the patent prosecution process bears no antitrust liability.[8] The decision of granting, amending, or revoking a patent is a public activity connected with the exercise of administrative discretion, which does not result in the supply of goods or services in competition with the private sector. Therefore, competition law cannot address patent offices' granting practices as the source of market failures related to the flood of overlapping or dubious quality patents that are in the exclusive realm of patent system design.[9]

---

[5] On the clash between patent protection and competition, see, among many: Herbert Hovenkamp et al., *IP and Antitrust: An Analysis of Antitrust Principles Applied to Intellectual Property Law* (Wolters Kluwer 3rd ed), 1-12; Mariateresa Maggiolino and Laura Zoboli, "The Intersection between Intellectual Property and Antitrust Law", in *Handbook of Intellectual Property Research: Lenses, Methods, and Perspectives*, eds. Irene Calboli and Maria Lillà Montagnani (OUP, 2021), 125-127.

[6] CJEU cases on the interaction between intellectual property and EU competition law, include Judgment of 6 April 1995, *P RTE and IPT v. Commission ('Magill'),* Joined Cases C-241-242/91, EU:C:1995:98; Judgment of 29 April 2004, *IMS Health*, Case C-418/01, EU:C:2004:257; Judgment of 16 July 2015, *Huawei v. ZTE*, C-170/13, EU:C:2015:477.

[7] Judgment of 26 January 2005, *Piau v. Commission*, T-193/02, paragraphs 69-72; Judgment of 19 February 2002, *Wouters and Others*, C-309/99, EU:C:2002:98, paragraph 57; Judgment of 23 April 1991, *Höfner and Eleser v. Macrotron*, C-41/90, EU:C:1991:161, paragraph 21; Judgment of 12 September 200, *Pavlov and Others*, C-180/98, EU:C:2000:428, paragraph 75.

[8] Richard Whish and David Baley, *Competition Law* (Oxford: Oxford University Press, 2021), 83-93; UK Office of Fair Trading, *Public Bodies and Competition Law* (UK OFT, 2011), 7-18.

[9] Actually patent system reforms targeted at eradicating patent-related market failures, such as by raising the patentability bar or increasing prosecution and renewal fees, would minimise anti-competitive risks too. However, such reforms are both unlikely and undesirable. Unlikely because

In contrast, the filing of patent applications, oppositions to patent offices' decisions and lodging of appeals by inventors and their counterparties are economic activities that directly impact the relevant markets where the parties operate. Patent prosecution is just a means to a competitive end. Patent applicants seek legal exclusivity over the claimed invention or, at least, to create prior art impairing rivals' exclusivity. Instead, counterparties opposing granted patents strive to preserve their freedom to operate, removing any prejudicial property right. Nothing in the patent laws prevents undertakings from exploiting patent prosecution in concert or unilaterally to the detriment of competition.[10] Nonetheless, EU competition law has only dealt with deception on the patent office as a unilateral abuse of a dominant position in the landmark *AstraZeneca* judgment so far.[11]

The present paper analyses patent prosecution activities under Arts. 101 and 102 TFEU.[12] Albeit the existence of anti-competitive effects in the EU would justify the extraterritorial application of EU competition law to unlawful patent prosecution activities even before non-EU patent offices,[13] the article concentrates on patent prosecution practices before the EPO. Nonetheless, the EPO is highly reputed for the quality of its patents,[14] which in principle would discourage the anti-competitive use of its services. As a further limitation, the analysis also confines itself to the information communication technologies (ICT) sector. Because patents' practical functions vary by industry and patent prosecution practices differ across sectors, the research findings may not be valid for industries other than the ICT.

Nonetheless, ICT technologies, such as chips, high-performance computing, and wireless connectivity, are the backbone of the digital economy and are vital for Europe's economic strategy, as recognised by the

---

diminishing the number of patents and patent applications would run against patent offices' self-funding mechanism, whereas undesirable because higher patentability bar or patent fees would disincentivise patenting by resource-constrained inventors especially. See David Olson, "Removing the Troll from the Thicket: The Case for Enhancing Patent Maintenance Fees In Relation to the Size of a Patent Owner's Patent Portfolio", *Florida Law Review* 68 (2017): 519, 546-549.

[10] Daniel Rubinfield and Robert Maness, "The Strategic Use of Patents: Implications for Antitrust", in *Antitrust, Patents, and Copyright: EU and US Perspectives*, eds. François Léveque and Howard Shelanski (Cheltenham: Edward Elgar, 2005), 99.

[11] Judgment of 6 December 2012, *AstraZeneca v. Commission*, C-457/10, EU:C:2012:770.

[12] Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union, OJ C-326/1, 26.10.2012, Arts. 101-102.

[13] Judgment of 6 September 2017, *Intel v Commission*, C-413/14, EU:C:2017:632, paragraphs 48-49.

[14] "EPO remains the 'gold standard' for patent quality", *EPO News* 30 November 2021, https://www.epo.org/news-events/news/2021/20211130b.html.

European Commission's 2019-2024 political priorities.[15] In addition, the ICT sector is prone to patent-related market failures, such as patent thickets and infringement jungles.[16] On the one hand, patent thickets constitute entry and expansion barriers that impair technology implementers' freedom to operate in the market due to the cost of complying with overlapping ICT patents, such as standard-essential patents ('SEPs'), owned by different entities.[17] On the other hand, patent infringement jungles diminishing patentees' returns on R&D investments due to the wild, tangled mass of free-riding implementers from diverse sectors, as in the Internet of Things.[18]

Given the limitations, the research question discussed in the paper is whether and under what conditions EU competition rules can proscribe anti-competitive filing of ICT European patent applications and lodging of administrative oppositions against granted ICT European patents. Specifically, the paper assesses such patent prosecution practices in light of the CJEU case law and economic arguments pointing to their anti- and pro-competitive effects. To answer the research question, the remainder of the article is structured as follows. Section 2. introduces the reader to the basics of patent prosecution before the EPO and empirically maps the relevant ICT patent landscape. Overall, the European ICT patent landscape reveals a 'bad dream' of entry barrier features prone to anti-competitive practices. Section 3. scrutinises evidence of coordination before the EPO under Art. 101 TFEU, while section 4. assesses the lawfulness of patent prosecution as a unilateral practice pursuant to Art. 102 TFEU. Together, sections 3. and 4. acknowledge the limited scope of EU competition law intervention against anti-competitive ICT patent prosecution practices under the existing case law. Section 5. recapitulates the research findings and concludes that absent fundamental patent law reforms, EU

---

[15] "6 Commission priorities for 2019-2024: A Europe fit for the digital age". *European Commission*. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en.

[16] Carl Shapiro, "Navigating the Patent Thicket: Cross Licenses, Patent Pools and Standard Setting", in *Innovation Policy and the Economy*, eds. Adam Jaffe, Josh Lerner and Scott Stern (Cambridge MA, MIT Press, 2001), 121; Robin Jacob, "Patent Thickets: A Paper for the European Patent Office Economic and Scientific Advisory Board Meeting", *Journal of Intellectual Property Law & Practice* 8 (2013): 203, 205; Igor Nikolic and Niccolò Galli, "Patent Pools in 5G: The Principles for Facilitating Pool Licensing", *Telecommunications Policy* 46, no. 4 (2022): 102287, 3-4.

[17] Shapiro, "Navigating the Patent Thicket", 121.

[18] Nikolic and Galli, "5G Patent Pools", 3-4.

competition law remains not only a second-best solution to address the depicted bad dream of the ICT patent landscape but also a very remote one.

2. The EPO ICT Patent Prosecution Landscape and its Competition Law Relevance

Although several international treaties since the end of the nineteenth century have significantly harmonised national patent laws worldwide,[19] patents remain territorial rights. Hence, they are valid and enforceable according to the domestic patent law of the country where they have been granted. Nevertheless, inventors can benefit from a centralised regional prosecution regime before the EPO in Europe. Thus, besides filing several patent applications at each respective national patent office, the 1973 European Patent Convention (EPC) allows inventors to obtain patent protection in EPC signatory states by filing a single application at the EPO.[20] The EPO so provides a one-stop shop for prosecuting European Patent applications. According to Article 2 EPC, European Patents, once granted, can then be validated, upon translation if necessary, both in European states and beyond. A European Patent results in a bundle of national patents for those contracting states designated by the applicant.[21]

According to Art. 99 EPC, the EPO also governs the validity challenges against European Patents that any third party may bring within nine months from the date of grant, so-called opposition proceedings. Through oppositions, parties with superior knowledge than the patent examiners

---

[19] Paris Convention for the Protection of Industrial Property 1883; Patent Cooperation Treaty (PCT) 1970; Agreement on Trade-Related Aspects of Intellectual Property Rights, Annex 1C Marrakesh Agreement Establishing the World Trade Organisation.

[20] Convention on the Grant of European patents of 5 October 1973. For a broader picture on the functioning of the EPC, see Davis, Quintin and Tritton, *Tritton on Intellectual Property*, 79-198; Kur and Dreier, *European Intellectual Property*, 90-106.

[21] A European Patent is a bundle of national patents since it qualifies a number of territorially separate and independent exclusive rights that originate from the EPO. Yet, each domestic law regulates the substance of every national patent. Once the EU Unitary Patent Regulations will be in force, European Patents may be converted, within one month from grant, into a single patent with effect for all EU countries except Spain and Croatia. See Regulation of the European Parliament and of the Council 1257/2012 of 17 December 2012 implementing enhanced cooperation in the creation of unitary patent protection [2012] OJ L361/1 (Unitary Patent Regulation); Council Regulation 1260/2012 of 17 December 2012 implementing enhanced cooperation in the creation of unitary patent protection with regard to the applicable translation arrangements [2012] OJ L361/89 (Unitary Patent Translation Regulation).

on the patentability of an invention, such as the inventors' competitors, may disclose their information to the EPO, allowing for better policing of the quality of the patent system as a whole. Under Art. 101 EPC, opposed patents for every designated country can either be maintained as granted, revoked, or maintained in amended form.[22] Within two months, the adversely affected parties can appeal opposition decisions to the Board of Appeal according to Art. 106 EPC. In turn, the Board of Appeal's findings can be challenged on limited legal grounds before the Enlarged Board of Appeal (Art. 112 EPC). Thus, oppositions are a more efficient way to test European Patents validity than country-by-country litigation; they are also a more predictable forum to do so compared to the different contracting states' jurisprudences.[23]

Patent prosecution is a lengthy endeavour. The European examination procedure alone takes about three to five years from the filing date. When examination decisions are opposed, the ensuing proceedings take about two to three years to end, plus a mean of three years more in case of appeals.[24] As a result, patent applications can remain pending for over

---

[22] Opposed patents can be maintained as granted either because the oppositions are rejected, deemed inadmissible or withdrawn. Withdrawn oppositions might underlie settlements between the patent proprietor and the opponent. The EPO has no *ex officio* authority to start oppositions nor to continue withdrawn ones.

[23] Empirical evidence suggests that more valuable or technologically important patents are more likely to be opposed. Moreover, European patents that survive oppositions and appeals are reputed as particularly valuable patents since they passed such additional patentability checks; see Stuart Graham and Dietmar Harhoff, "Can Post-Grant Reviews Improve Patent System Design? A Twin Study of US and European Patents", *GESY Discussion Paper* 38 (2006), accessed June 30, 2022. https://epub.ub.uni-muenchen.de/13510/1/38.pdf, 17; Federico Caviggioli, Giuseppe Scellato and Elisa Ughetto, "International Patent Disputes: Evidence from Oppositions at the European Patent Office", *Research Policy* 42 (2013): 1634, 1640.

[24] "FAQ – Procedure & law". EPO. https://www.epo.org/service-support/faq/procedure-law.html#faq-274. Rapid growth in the number of applications extended patent pendency times. In 1996, the mean EPO patent pendency time was about 24 months and in 2007 it increased to about 45 months. See WIPO, *2011 World Intellectual Property Report: The Changing Face of Innovation* (WIPO Economics & Statistics Series, 2011), 99. An average patent application at the US patent and trademark office (USPTO) takes less than 20 hours of patent examiner time; see Josh Feng and Xavier Jaravel, "Who Feeds the Trolls? Patent Trolls and the Patent Examination Process?", *Harvard University Working Paper* (2016), 1. The 2017 Annual Report of the EPO Boards of Appeal states an average length of 37 months for technical appeal proceedings; see EPO Boards of Appeals, *2017 Annual Report,* (EPO, 2017), 12; Bardehle Pagenberg, *European Patent Opposition Proceedings* (Bardehle Pagenberg, 2021), https://media.bardehle.com/contentdocuments/broschures/European_Patent_Opposition_Proceedings_BARDEHLE_PAGENBERG_IP-Brochure.pdf.

half the twenty-year maximum patent term. This lag is cumbersome not only for patent applicants but also for other market participants as they all face uncertainties regarding the grant or revocation decision, the exact technical scope of the resulting patent, and the market adoption of the patented invention. To overcome these uncertainties, both applicants and their competitors need time and financial resources that raise the costs of participating in patent-intensive industries as market barriers.[25]

On top of time, prosecution before the EPO comports three substantial costs. First, patent applicants pay European Patent attorneys that draft the applications and interact with the EPO. Second, they owe EPO administrative fees upon filing, search, designation of contracting states, examination of applications, grant and renewal of patents. In this sense, patent applicants and patentees are revenue sources for patent offices and the countries behind them. Last, translation costs might be incurred when validating European Patents in those countries where none of the EPO official languages is a national language.[26] In practice, the prosecution costs vary depending on the scope of patent protection sought for the underlying invention. Generally, patent applications cost more if they are long, designate several contracting states, and are renewed for several years. On top of these administrative costs, broad, long-lived, and widely validated European Patents imply higher professional and translation costs too. Consequently, such patents exist only in those large markets with a high-income potential that justifies cumbersome prosecution overheads.[27]

---

[25] Patent uncertainties enable the so-called FUD (Fear, Uncertainty and Doubt) strategy, namely threat of patent litigation in order to pressure competitors without comparable patent portfolios into signing licensing agreements; see Bundeskartellamt, *Bundeskartellamt Clears CPTN Joint Venture for Acquisition of Novell Patents* (Bundeskartellamt News, 20 April 2011), https://www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2011/20_04_2011_CPTN.html.

[26] Davis, Quintin and Tritton, *Tritton on Intellectual Property,* 156-157; Kur and Dreier, *European Intellectual Property*, 99-100. Patent offices' double role as service providers for applicants and garrisons of the public domain is not without conflicts of interests.

[27] Despite increasing maintenance fees at the end of the patent life, electrical engineering patents, on average, live longer than the mean patent, yet they are validated in a lower average number of countries; see Angél Sanchez, Pablo Hortal and David Cuesta, *Patent Costs and Impact on Innovation – International Comparison and Analysis of the Impact of the Exploitation of R&D Results by SMEs, Universities and Public Research Organisations* (European Commission, 2014), 42-43.

Given all these variables, average estimates of how much prosecution costs rely on the ideal model European Patent. In 1999, to obtain a European Patent, validate it in eight states and renew it for ten years caused costs of €29,800, which became €40,350 in 2005, and €42,772 in 2019. Considering the considerable size of ICT patent portfolios, often in the figures of thousands of patents, the estimates suggest that ICT companies sustain patent prosecution costs above six figures.[28] Moreover, their patent-related expenses are even higher since prosecution costs occur after much of the sunk R&D investments. Finally, all patentees might also incur the charges of asserting their exclusive rights in the event of patent infringement, whose amounts significantly vary among legal systems, often depending on the value of the dispute.[29]

Bearing in mind how European Patent prosecution works and its substantial costs and length, the next subsection analyses official EPO statistics on ICT patenting trends.

---

[28] Ten years is the current average lifetime of a European Patent according to the EPO; "Cost of a Unitary Patent". EPO. https://www.epo.org/applying/european/unitary/unitary-patent/cost.html. Out of €29,800, €4,300 were EPO administrative fees, €5,500 professional representation costs, €11,500 translations, and €8,500 renewals. See Dietmar Harhoff *et al.*, *The Strategic Use of Patents and Its Implications for Enterprise and Competition Policies* (European Commission, 2007), 21. The 2005 estimate specified that the European Patent in question contained 24 pages and 15 claims; see Roland Berger Market Research, *Study on the Cost of Patenting* (EPO, 2005), 114. Same numbers of pages and claims are used for 2019; see https://www.epo.org/law-practice/unitary/unitary-patent/cost.html; https://www.patworx.net/en/patent-costs-2/european-patent-costs/. The average size of European Patent applications in terms of pages and claims jumped from 14 pages and 12 claims in 1988, to 30 pages and 21 claims in 2005; see Nicolas van Zeebroeck, Bruno van Pottelsberghe de la Potterie and Dominique Guellec, "Claiming more: The Increased Voluminosity of Patent Applications and its Determinants", *Research Policy* 38, (2009):1006, 1008. In 2021, for example, Huawei reported a portfolio of over 110,000 granted patents worldwide, Ericsson 60,000 patents, and Nokia 20,000 patent families. See Huawei Investment & Holding, *Building a Fully Connected, Intelligent World* (Huawei Annual Report, 2021), 72; Ericsson, *Annual Report 2021*, 5; Nokia, *US Securities and Exchange Commission Form 20-F* (Annual Report, 2021), 21.

[29] Patent infringement litigation, on average, is estimated to cost between €80,000 and 200,000 in Germany, €50,000 - 200,000 in France, €60,000-200,000 in the Netherlands, and €2-4 million in the UK; see Katrin Cremers *et al.*, "Patent Litigation in Europe", *European Journal of Law and Economics* 44 (2017): 1, 14-15. Notwithstanding these considerable amounts, the US is renowned for a much more expensive patent litigation system with costs between US$750,000 and 8 million; see AIPLA, *Report of the Economic Survey* (2019).

2.1. EPO Annual Reports: The Electronics European Patent Thicket and Its 'Shrubs'

Every year between 2004 and 2018, the EPO published the Annual Report on the activities carried out in the previous year. Besides information on international affairs, internal staff and financial matters, these reports include a statistics section that indicates, *inter alia,* the numbers of patent applications received, oppositions decided, and patents granted. The remainder of this section analyses the self-made collection of EPO data until 2018. It is worth stressing that although the patent prosecution data is secondary, its aggregation directly from the Annual Reports is original. Furthermore, the dataset in Excel format is available upon request, which may be more accessible than the EPO PATSTAT service for lawyers like the author.

The Reports document a rising number of European Patent applications and grants across all fields of technology, as shown in Figure 1. below. The worldwide patent surge is well documented and signals the growing importance that intangible assets play in the modern economy.[30] Accepted explanations for this phenomenon are increased R&D investments, expanded applications for information technologies due to the advent of the IoT and Artificial Intelligence, extended patentable subject matters, more comprehensive patenting strategies brought by the open innovation paradigm, and growth of subsequent filings to protect inventions abroad because of globalised markets.[31]

---

[30] The patent propensity of firms exploded around 1984 in the US and 1995 in the EU; see Harhoff *et al.*, *The Strategic Use of Patents*, 65; Dominique Guellec, Thierry Madiès and Jean-Claude Prager, *Les Marchés des Brevets Dans l´Économie de la Connaissance,* (Conseil d'Analyse Économique, 2010), 11; Elise Mellon, *Patents, Competition Law and Open Innovation: A Study of 'Global Patent Warming'*, (College of Europe, 2012), 3-5; Kur and Dreier, *European Intellectual Property*, 95.

[31] See Jerry Sheelan, Catalina Martinez and Dominique Guellec, "Understanding Business Patenting and Licensing; Results of a Survey", in *Patents, Innovation and Economic Performance* (OECD, 2004), 84; Knut Blind *et al.*, 'Motives to Patent: Empirical Evidence from Germany', Research Policy 35, 5 (2006):655, 655-656; WIPO, *"The Changing Face of Innovation"*, 54-56; Carsteen Fink, Mosahid Khan and Hao Zou, "Exploring the Worldwide Patent Surge", WIPO Economic Research Working Paper 12 (2013), 5-9.

Figure 1. 1980-2018 Overview of European Patent Applications and Patents

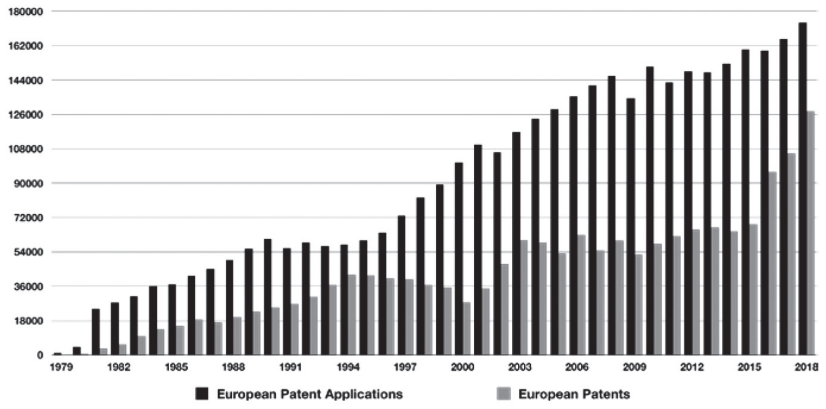

Figure edited by the author upon EPO data.

Notwithstanding the overall surge in patent applications and grants, opposition proceedings did not rise comparably, as indicated in Figure 2.

Figure 2. 1980-2018 EPO Grants and Oppositions

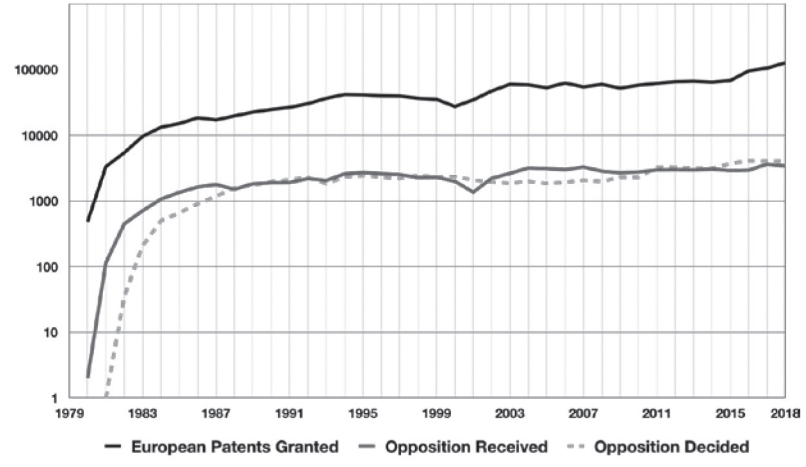

Figure edited by the author upon EPO data.

Of all European Patents granted, about 5% have been opposed up to 2018. From 2000 to 2018, a mean of 2,842 oppositions started each year, whereas 2,710 were decided on average. Considering the last three years' grants pikes, opposition rates for those years have been the lowest since

1981, when 3.4% of the 3,346 granted patents had been opposed. Low opposition rates signal low degrees of technological rivalry, whereby firms are generally not interested in preventing each other from patenting. This is especially the case in the ICT sector, whose cumulative innovation processes rely on patent portfolio-wide licenses and cross-licenses rather than patent-by-patent licensing or invalidating and designing around rivals' patents.[32]

Albeit with a gap between 2010 and 2012, the opposition outcomes are available. From 1997 to 2009, annually, a mean of 35.5% of opposed patents was revoked, 34.5% maintained in amended form, and 30% of the oppositions rejected. Since 2013, these trends have changed in favour of patentees. In fact, between 2013 and 2018, a mean of 29% of opposed patents was revoked, 40% was maintained in amended form, and in 31% of the cases, oppositions were rejected. Strikingly, such a few patents are challenged, although opposition proceedings are the opportunity to test their validity and possibly invalidate them at once and for all designated states. Not only are oppositions more cost-efficient than validity litigation in each country, but less than one-third of opposed patents survive unscathed such a test, too.

Data in line with the WIPO-IPC Technology Concordance classification dates back to 2001 and allows us to set out the electrical engineering technologies as a proxy of the ICT sector of interest for this paper.[33] Much of the growth in EPO patenting is due to the electrical engineering technologies, as can be taken from Figures 3. and 4. This is a natural consequence of the core-role ICT innovations have across all economic sectors, especially in light of the IoT.[34]

---

[32] Between 1980 and 2003, the opposition rate per electrical engineering European patents granted was below the average of the other technological areas. In addition, smaller applicants are likely to face more oppositions than larger patentees within concentrated technology areas where patent portfolio races occur; Harhoff *et al*., *The Strategic Use of Patents,* 141-147 and 251-252.

[33] The electrical engineering sector, according to the WIPO Technology Classification for Country Comparisons, comprises electrical machinery, audio-visual technology, telecommunication, digital communication, computer technology, information technology methods for management, and semiconductors. Sometimes, information communication technology (ICT) is used as synonymous with electrical engineering, yet more correctly the latter contains the first in a genus-species relation. See Ulrich Schmoch, *Concept of a Technology Classification for Country Comparisons* (WIPO Report, 2008), 5.

[34] In this sense, see Harhoff *et al*., *The Strategic Use of Patents,* 131; Guellec, Madiès and Prager, *Les Marchés des Brevets*, 7 and 11. On the IoT, see Informatics Team, *Eight Great Technologies: The Internet of Things: A Patent Overview* (UKIPO, 2014); European Commission, *Report from the*

Figure 3. 2001-2018 European Patent Applications per Technology Field

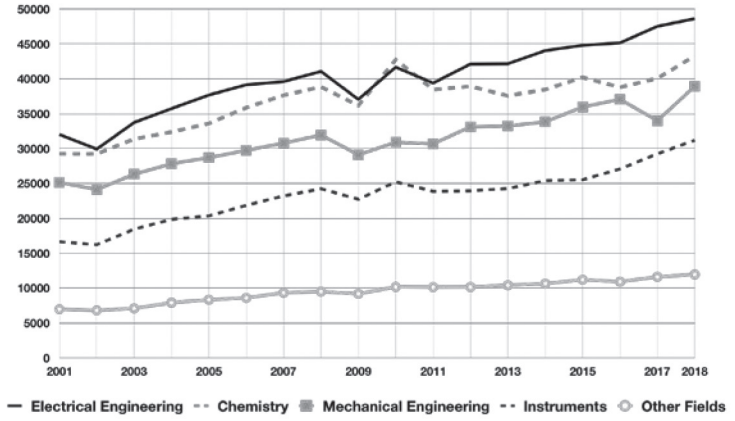

Figure edited by the author upon EPO data.

Figure 4. 2001-2018 European Patents Granted per Technology Field

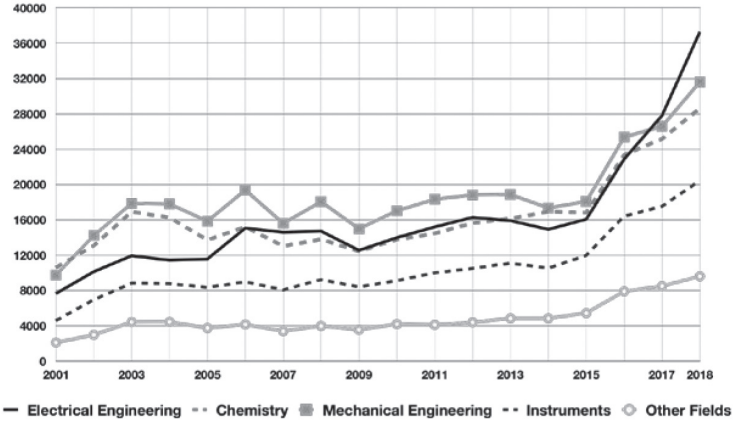

Figure edited by the author upon EPO data.

Commission to the Council and the European Parliament – Final report – sector inquiry into consumer Internet of Things (COM(2022) 19 final), 3. For a seminal appraisal of the patent and competition law implications of the IoT, see Beatriz Conde Gallego and Josef Drexl, "IoT Connectivity Standards: How Adaptive is the Current SEP Regulatory Framework?", International Review of Intellectual Property and Competition Law 59, (2019):135; Rupprecht Podszun, "Standard Essential Patents and Antitrust Law in the Age of Standardisation and the Internet of Things: Shifting Paradigms", International Review of Intellectual Property and Competition Law 50, (2019):720, 730ff.

However, electronics patents are less likely to be granted than patents for other technology sectors. Or at least it was so until the 2016 surge in patenting, evidenced by Figure 5.

Figure 5. 2001-2018 Electrical Engineering EPO Patenting Trends

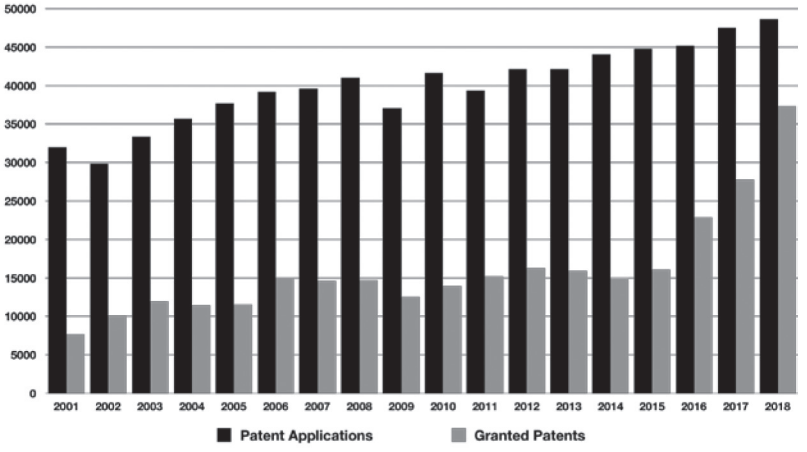

Figure edited by the author upon EPO data.

In fact, between 2001 and 2018, the relative majority of granted patents per year were mechanical engineering ones, followed by chemistry, then electrical engineering. Looking in particular at the electronics field, in 2001, there were 32,020 applications and 7,656 European Patents, which became 41,055 and 14,719 in 2008, and 48,612 (+51% in 2001 and +18% on 2008) and 37,292 in 2018 (+387% in 2001 and +153% on 2008). Hence, while applications raised steadily, the resulting patents almost quadrupled. If patent thicket issues in the ICT sector ever existed, the EPO granting tendency might only be exacerbating them. Nevertheless, the 'shrubs' of the patent thicket differ within the ICT sector since certain electrical engineering technologies account for many more applications than others, as depicted in Figure 6.

Figure 6. 2001-2018 European Electrical Engineering Patent Applications

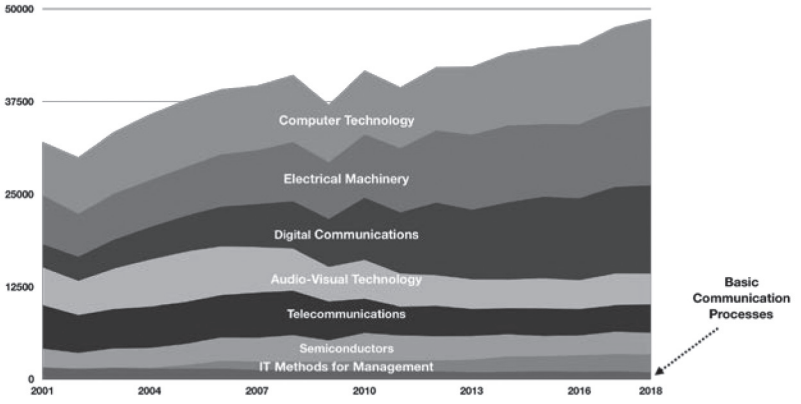

Figure edited by the author upon EPO data.

From 2001 to 2018, annual applications on computer technology represent a mean of 23% of all electrical engineering patent applications, followed by 20% electrical machinery ones, 18% digital communication, 13% audio-visual, 12% telecommunications, 8% semiconductors, while IT methods for management and basic communication processes applications are each 3% of the total.[35] However, Figure 7. shows that the resulting grants do not mirror the distribution of applications.

Of all electronics patents granted on average each year, a mean of 25% is electrical machinery patents, 18% computer technology ones, 17% telecommunications, 16% digital communication, 13% audio-visual, 10% semiconductors, 5% basic communication processes, and about 0,2% IT management methods.[36] The reasons why patent applications in different technology classes fare differently in meeting the patentability requirements might also hint at patent shrubs of various sizes within the thicket. Overlapping inventions that read on each other and form patent thickets

[35] Regarding the mean yearly change in applications filed between 2001 and 2018, electrical machinery applications grew by 3%, digital communication 9%, computer technology 3%, IT methods for management 53%, audio-visual technology -1%, semiconductors 2%, telecommunications -2%, and basic communication processes -3%.

[36] Regarding the mean yearly change in patents granted between 2001 and 2018, electrical machinery grants grew by 11%, digital communication 26%, computer technology 10%, IT methods for management 329%, audio-visual technology 5%, semiconductors 11%, telecommunications 10%, and basic communication processes 4%.

might as well easily lack novelty or inventiveness and therefore fail the patentability exam.[37]

Figure 7. 2001-2018 European Electrical Engineering Patents Granted

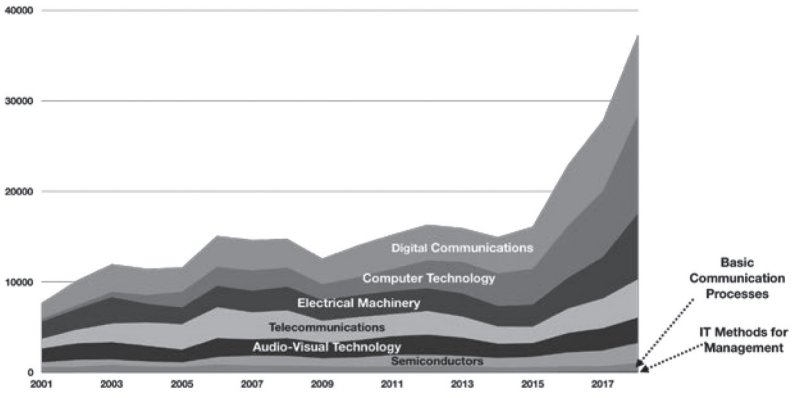

Figure edited by the author upon EPO data.

In light of the growth of general and electrical engineering-specific EPO patenting, it is interesting to identify the principal responsible undertakings. Since 2004, the EPO has published its overall largest applicants.[38] The ranking entries and exits, rises and falls mirror the contestability of technology-intensive markets and, especially, of the electronics one.[39] From 2004 to 2018, all top five EPO applicants, except for BASF, have always been companies active in the electronics industries.[40] Every year, an average of 20 out of 25 top applicants are electronics firms.[41] Thus, a large share of patent applications in the electronics field is concentrated in the hands

[37] See Bronwyn Hall *et al., A Study of Patent Thickets,* (UKIPO 23, 2013), 7-11.

[38] The EPO lists for 2004 and 2005 the 25 largest applicants, while since 2006 the one hundred largest ones.

[39] Electronics firms have been found to be the fastest growing patent applicants between 1989 and 2003; Harhoff *et al.*, *The Strategic Use of Patents*, 204.

[40] These are Siemens, Philips, Samsung, Huawei, LG, General Electric, Qualcomm, United Technologies, Matsushita/Panasonic, and Bosch.

[41] Since 2007, the EPO has also published the largest European patent recipients. Thirteen different electronics firms fill the annual top five positions. Every year, an average of 19 out of 25 top recipients operate in electrical engineering industries. The annual top five European Patents recipients between 2007 and 2017 include Siemens, Bosch, Matsushita/Panasonic, Philips, Alcatel-Lucent, Samsung, Ericsson, Sony, Honda, Panasonic, LG, Huawei, and Qualcomm. Given all the EPO prosecution fees, the top applicants and patentees represent EPO's main funders.

of a few applicants. At the same time, the concentration has dropped in other technological sectors, such as chemistry.[42]

In the ICT sector, digital communications and computer technologies are often associated with controversial patent practices, such as sham litigation by patent assertion entities.[43] Interestingly, fewer firms filed most of the patent applications in these fields than in other technological sectors. For example, between 2014 and 2018, the top-ten digital communications EPO applicants filed a mean of 51% of all applications, while the top-ten computer technologies a mean of 30% of all annual applications.[44] In contrast, the top-ten pharmaceutical and biotechnology EPO applicants respectively accounted for means of 13% and 19% of all yearly applications. Figures 8. and 9. visualise the trends for digital communication and computer technology top-ten EPO applicants.[45]

Figure 8. 2014-2018 Digital Communication Top 10 Applicants

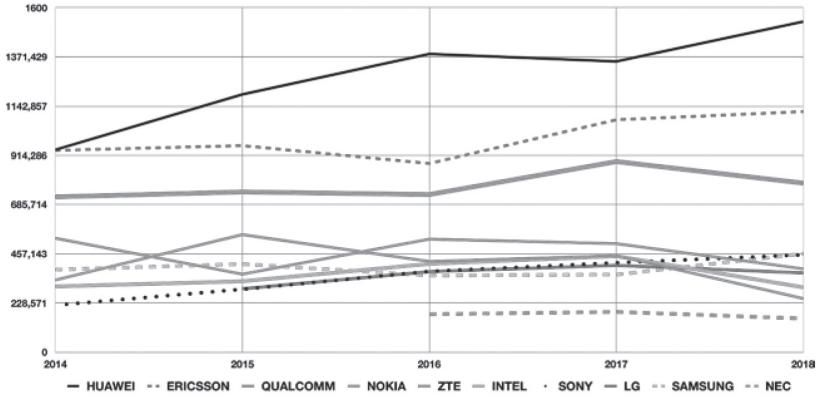

Figure edited by the author upon EPO data.

[42] In this sense, see Harhoff *et al.*, *The Strategic Use of Patents*, 147.

[43] See US Federal Trade Commission, *Patent Assertion Entity Activity: An FTC Study* (2016), 113-114; Nikolaus Thumm and Garry Gabison (eds), *Patent Assertion Entities in Europe – Their Impact on Innovation and Knowledge Transfer in ICT Markets* (JRC, 2016), 6; Dominique Christ, Niccolò Galli and Cornelia Peuser, "Patent Aggregation: More Than Patent Trolls", *Les Nouvelles* 54, no. 4 (2019): 238, 241.

[44] During the same years, top-ten mechanical engineering EPO applicants filed a mean of 27% of all yearly applications.

[45] Figure 9. misses the entry in 2018 of NTT Docomo with 241 digital communication applications, whereas Figure 10. misses the entry in 2018 of Oppo with 155 computer technology applications.

Figure 9. 2014-2018 Computer Technology Top 10 EPO Applicants

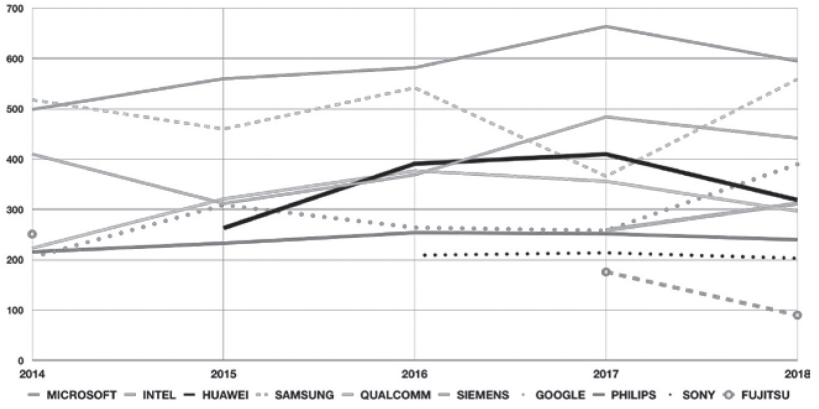

Figure edited by the author upon EPO data.

From all these statistics, the European ICT patent landscape seems crowded with patent applications compared to other technological fields. At the same time, fewer electronics applications become patents than applications from other technologies. Nevertheless, even if eventually refused, lapsed or withdrawn, patent applications yield strategic benefits to applicants, such as raising risks for competitors by creating market and technology uncertainties or as creating prior art to secure freedom to operate.[46]

Moreover, electrical engineering firms are usually the most active European Patent applicants and recipients. The ten largest filers in the electronics subfields of computer and digital communication technologies account for a larger share of all annual applications than the largest filers in other technological classes. In other words, electrical engineering applications and the likely resulting patents are concentrated in the

[46] Patent applications yield especially strong benefits in Germany, where the applicant can defer their examination up to seven years from the date of filing pursuant to Section 44 of the German Patent Act. Before the EPO, applicants must file the request for examination and pay the corresponding fee before by six months after the date on which the European Patent Bulletin mentions the publications of the search report pursuant to Article 94(2) EPC and Rule 70 of the EPC Implementing Regulations. The rationale for the time lag between filing and examination is to give time to applicants for evaluating if a patent is worth its costs. On the strategical implications of deferred examination systems, see Florian Jell, *Patent Filing Strategies and Patent Management: An Empirical Study* (Berlin: Springer, 2012).

hands of fewer big firms than in other technology-intensive industries.[47] High patenting patterns of whatsoever R&D achievement might be due to low marginal costs for applicants when applying for an additional patent, which overcome any market consideration.[48] However, despite the concentration of most electronics patents and applications between a few large firms, electronics products are complex and rely upon fragmentary pools of complementary technologies. Empirical evidence shows that firms prosecute more aggressively than otherwise predicted when markets for technological inputs are highly fragmented.[49] As a result, the EPO electrical engineering patenting trends confirm patent thickets entry barrier concerns: rising patent grants and even more rising patent applications concentrated in the hands of large firms that rarely oppose each other's patents. That is this article's bad dream.

3. Concerted practices before the Patent Office

The evidence suggests that European electrical engineering patent applications and grants are rising and becoming more concentrated in the hands of a few large patentees. Instead, oppositions before the EPO are declining and exceptionally low in the electrical engineering sector. Low opposition rates disserve the public interest of having patents below the patentability requirements revoked by those parties that can best provide invalidating prior art, namely the applicants' competitors and customers.[50] Moreover, the scarcity of oppositions is particularly obnoxious since economics scholarship finds they have a disciplinary effect. Indeed, after invalidation at the EPO post-grant review process, inventors file fewer applications with validity-threatening prior art (i.e., low-quality), especially in the same field

---

[47] These results are in line with Harhoff *et al*., who also found a moderate increase in complexity of applications in terms of number of claims per patent and a strong increase of divisional applications; see Harhoff *et al*., *The Strategic Use of Patents*, 177. Under Art. 76 EPC, divisional applications split a priority patent application into separate applications for which there is 'unity of invention'. The division of patent applications into one or more divisional patents allows applicants to get early protection for claims that the patent office finds uncontroversial, while leaving the rest for lengthier prosecution. More strategically, the applicant can also use divisionals to draft claims reading on to rivals' products already on the market. See, also, Jacob, "Patent Thickets", 205; Mellon, "*Patents, Competition Law and Open Innovation*", 5-7.

[48] See Neus Palomeras, "Sleeping Patents: Any Reason to Wake Up?", *IESE Working Paper* 506-2003 (2003), https://media.iese.edu/research/pdfs/DI-0506-E.pdf, 22-23.

[49] See Ziedonis, "Don't Fence Me In", 817.

[50] Judgment of 25 February 1986, *Windsurfing International v. Commission*, C-193/83, EU:C:1986:75, paragraphs 91-93.

as the opposed patent.[51] Further, the vast majority of oppositions within specific ICT sub-sectors, such as the telecommunications and information technology ones, involve asymmetrical firms, either small patentees being opposed by large incumbents or vice versa.[52]

The data hint at two coordinated effects raising entry barriers in ICT-related markets. First, symmetric incumbents do not fight each other's patents, let the respective patent portfolios grow and resort to cross-licenses. Second, symmetric incumbents oppose small new entrants' patents that would undermine existing oligopolies in technology markets. In particular, ICT patent cross-licensing, precluding licensors from using patents against one another, does not involve technology transfer, namely the sharing of technical teachings to enable the implementation of patented inventions. Instead, cross-licenses only provide design freedom, they do not fully open innovation but merely facilitate R&D and legal protection against infringement claims.[53] As such, the European Commission's Technology-Transfer Guidelines recognise that cross-licenses between competitors, even as part of settlement agreements, likely infringe Art. 101(1) TFEU if the parties have a significant degree of market power and the license contains restrictions that go beyond freedom-to-operate objectives.[54] Such an anti-competitive restriction could be precisely a clause that coordinates the parties' patent prosecution strategies. For example, a no-challenge clause could insulate the cross-licensors' patent portfolios from each other's oppositions and *de facto* share the relevant technology markets among them: the parties do not contest their technology market

---

[51] Markus Nagler and Stefan Sorg, "The Disciplinary Effect of Post-Grant Review – Causal Evidence from European Patent Opposition", *Research Policy* 49, no. 3 (2020): 1, 11-12.

[52] Andreas Heinemann, "The Contestability of IP-Protected Markets", in *Research Handbook on Intellectual Property and Competition Law*, ed. Josef Drexl (Cheltenham: Edward Elgar, 2008), 64; Chris Forman and Avi Goldfarb, "Concentration and Agglomeration of IT Innovation and Entrepreneurship: Evidence from Patenting", *NBER Working Paper*, No. 27338 (2020), 4-5.

[53] On strategic patent prosecution in ICT industries, Harhoff *et al.* recall the extreme example of PCT priority filing no. WO2005/051444A2 which had several thousand claims per patent application and led to more than 50 USPTO applications and 26 EP applications; see Harhoff *et al.*, *The Strategic Use of Patents*, 259. See also Randolph Beard and David Kaserman, "Patent Thickets, Cross-licensing, and Antitrust", *Antitrust Bulletin* 345, (Summer-Fall 2002), 355.

[54] European Commission, *Guidelines on the application of Article 101 TFEU to technology transfer agreements (Communication)* OJ 2014/C 89/3, paragraphs 240-243; Stefano Barazza, "The Technology Transfer Block Exemption Regulation and Related Guidelines: Competition Law and IP Licensing in the EU", *Journal of Intellectual Property Law & Practice* 9 (2014): 186, 201-203.

positions, while they share the incentive to impair residual technology competition by opposing third parties' patents.

Short of a smoking-gun anti-competitive cross-licensing agreement, whether incumbent electrical engineering patentees coordinate because of an informal common understanding or an individual appreciation of oligopolistic markets is ultimately an uncharted evidentiary problem.[55] Nevertheless, two countermeasures product-market entrants take to overcome patent entry barriers and deal with incumbents' patent portfolios at arms' length are a fact. Both countermeasures, namely patent portfolio acquisitions and patent invalidity services, realise the common saying 'if you can't beat them, join them' and require substantial sunk investment to the prejudice of competition by small companies.[56]

First, ICT product-market entrants externally acquire patent portfolios on technology markets to recreate patent portfolio symmetries and the descending mutually assured destruction ('MAD') settings. In a MAD patent scenario, the threat of retaliatory infringement countersuits between firms holding comparable patent portfolios facilitates their coordination toward peaceful cross-licenses. A prominent example of an ICT patent portfolio acquisition showing the strategic importance of patents to compete in electronic product markets is Google's 2012 acquisition of Motorola for US$12,5 billion, cleared by the European Commission after Google publicly committed to refrain from certain licensing practices.[57] Twice before that, Google tried unsuccessfully to acquire a patent portfolio to react against patent infringement suits by Apple and Microsoft against Android phones original equipment manufacturers and establish a patent equilibrium.[58] Confirming its strategic objective in Motorola's acquisition

---

[55] Judgment of 21 January 2016, *Eturas and Others*, C-74/14, EU:C:2016:42, paragraph 37; judgment of 17 September 2015, *Total Marketing Services v. Commission*, C-634/13 P, EU:C:2015:614, paragraph 26; Whish and Baley, *Competition Law*, 117-120.

[56] See Sri Krishna Sankaran, "Patent Flooding in the United States and Japan", *IDEA* 40 (2000): 393, 417-418.

[57] The entire portfolio, mostly composed by US patents and to a lesser extent by EPO ones, was valued between US$2.5 and 3.5 billion; see https://www.google.com/press/motorola/; Commission Decision of 13 February 2012, Case COMP/M.6381, *Google/Motorola Mobility* (C(2012)1068) OJ C75/1; Thomas Brown and Samuel Zun, "Patent Aggregation: Guidance from the DOJ's Recent Approval Of Three Major Patent Portfolio Acquisitions" *Antitrust* 26 (2012): 60, 60-61.

[58] Google's missed chances were Novell's patent portfolio, acquired in April 2011 by a consortium on behalf of Microsoft, Apple, Oracle and EMC, and Nortel's patent portfolio, acquired by another consortium backed by Microsoft, Apple, EMC, Blackberry and Sony. US Department of Justice, "CPTN Holdings LLC and Novell Inc. Change Deal in Order to Address Department

of deterring patent infringement litigation against Android OEMs, Google quickly sold Motorola's handset manufacturing business to Lenovo while retaining the patents.[59] Another series of exemplary ICT patent portfolio acquisitions involves Facebook. Before its initial public offer in 2012, Facebook bought hundreds of patents from IBM and Microsoft to countersue Yahoo for patent infringement.[60] After the patent acquisitions, Yahoo and Facebook settled their lawsuits by cross-licensing their portfolios quickly.

Second, ICT market entrants started to flood patent offices with applications – at a direct cost of over €40,000 for a European patent validated in eight states and renewed for ten years – whose critical mass cannot be tackled by the technology incumbents' patent-by-patent oppositions. Evidencing that new entrants are playing catch up with incumbents, companies with smaller than average patent portfolios, such as Huawei, Apple, Google, Xiaomi and Oppo, have grown their patent portfolios faster than incumbent undertakings holding bigger ones.[61]

Recently, companies like Unified Patents, Askeladden, RPX and SynPat provide patent implementers with a third option to deal with incumbents' patent portfolios.[62] Namely, they challenge patent validity before the prominent patent offices, like the USPTO or EPO, as a service to subscribing clients. So far, the focus of such patent invalidity service providers has been against patents of firms not competing with subscribing clients on the product market. However, as the patent invalidation business model

---

of Justice's Open Source Concerns" (DoJ Press Release No. 11-491, 20 April 2011), https://www.justice.gov/opa/pr/cptn-holdings-llc-and-novell-inc-change-deal-order-address-department-justices-open-source; Bundeskartellamt, "Bundeskartellamt Clears CPTN Joint Venture"; American Antitrust Institute, "Letter to the US DoJ Ass´n Att. Gen. Re. Rockstar's Bid for Nortel Patent Portfolio 6 July 2011", https://www.antitrustinstitute.org/wp-content/uploads/2018/08/Nortel-letter-to-DOJ.7.6.11.pdf; Cleary Gottlieb, "Nortel in Sale of Residual Patent Assets to Apple Inc. and Rockstar Bidco, LP Through Bankruptcy Auction" (30 June 2011), https://www.clearygottlieb.com/news-and-insights/news-listing/nortel-in-sale-of-residual-patent-assets-to-apple-inc-and-rockstar-bidco-lp-through-bankruptcy-auction50.

[59] Commission Decision of 26 June 2014, Case COMP/M.7202, *Lenovo/Motorola Mobility* (COM 2014 4459 final).

[60] Maurits Dolmans and Daniel Ilan, "European Antitrust and Patent Acquisitions: Trolls in the Patent Thickets", *Competition Law International* 8 (2012): 1, 7; Justin Orr, "Patent Aggregation: Models, Harms, and the Limited Role of Antitrust", *Berkeley Technology Law Journal* 28, (2013): 525, 536-537.

[61] On patent flooding, see Sankaran, "Patent Flooding", 394-399.

[62] See https://www.unifiedpatents.com; https://www.patentqualityinitiative.com; https://www.rpxcorp.com; https://synpat.com.

proves successful, it could turn to the patents of subscribers' competitors, raising hub-and-spoke collusion issues. Despite the competition policy appeal of collusive patent prosecution practices, their investigation, even as part of broader anti-competitive patterns, remains to be seen and would need to overcome prompt efficiency defences by patent invalidity service providers, whose successful paid-for patent revocation initiatives generate significant positive externalities for the public.

In its Consumer IoT sector inquiry under Art. 17 of Reg. 1/2003, the European Commission missed a golden opportunity to scrutinise the coordinated entry barrier effects descending from the prosecution data on the ICT European patent landscape.[63] Between 2020 and 2021, the Commission gained a better understanding of the consumer IoT sector, mainly digital voice assistants, wearable devices and smart home systems. Although it overlooked patent prosecution data, the Commission identified several potential competitive concerns such as high entry barriers, few vertically integrated technology incumbents with their own IoT ecosystems and lack of interoperability among IoT products.[64] Devoting part of such a sector inquiry, which already touched upon technology standards and SEP licensing issues,[65] to understand better the indications of coordinated entry barriers through patent prosecution and defensive holding of patents would not have been as resource-consuming as launching a standalone sector inquiry over patent-heavy ICT industries such as telecommunications and semiconductors. Moreover, the analysis of impartial patent prosecution data could have likely reinforced the sector inquiry findings and dispelled any doubt on whether consumer IoT product-market entrants need countermeasures to overcome patent entry barriers and deal with incumbents' patent portfolios at arms' length. Nonetheless, the here offered patent data coupled with the potential anti-competitive findings of the Consumer IoT Sector inquiry might be worthy of further scrutiny with a follow-on inquiry limited to cross-licensing agreements between major ICT undertakings.

---

[63] See Commission, Consumer IoT Final Report; European Commission, Commission Staff Working Document Accompanying the document Report from the Commission to the Council and the European Parliament – Final report – sector inquiry into consumer Internet of Things (SWD(2022) 10 final.

[64] Commission, Consumer IoT Final Report, 4; Commission, Consumer IoT Staff Working Document, 46.

[65] Commission, Consumer IoT Final Report, 6-7; Commission, Consumer IoT Staff Working Document, 101 ff.

4. Patent Prosecution as an Abuse of Dominance: The ICT Patent Landscape Misfits AstraZeneca's Theory of Harm

Patents elevate our life standards through technological progress and increased productivity, so the mere prosecution of patents, no matter how many, is inherently desirable and perfectly legal. Accordingly, it would be inconsistent to encourage inventions through the patent system and then penalise the temporary exclusivity by deeming it anti-competitive. Nonetheless, under the CJEU *AstraZeneca* case law, the methods used by a dominant undertaking to obtain patents and other IPRs or to expand their scope may exceptionally violate Art. 102 TFEU, especially if part of a broader foreclosure strategy.[66]

The *AstraZeneca* case, the first and so far only time EU courts dealt with patent prosecution as a dominance abuse, concerns two practices related to Losec, a patented drug for stomach protection marketed by AstraZeneca in Europe in the late 1980s.[67] In 1999, two pharmaceutical companies complained before the European Commission that AstraZeneca had abused its dominant position by foreclosing their generic versions of the drug in several European markets, preventing the patented drug's price from decreasing. For what matters here,[68] the Commission concluded in 2005 that AstraZeneca infringed Art. 102 TFEU by misleading several national patent offices to obtain supplementary protection certificates ('SPC') over Losec that unduly extended its patent protection.[69] The General Court,

---

[66] Judgment of 6 December 2012, *AstraZeneca v. Commission*, C-457/10, EU:C:2012:770. For a national application of the *AstraZeneca* theory of harm, see *Ratiopharm v. Pfizer* Italian Council of State judgement 693 of 12 February 2014. See also Mariateresa Maggiolino and Laura Zoboli, "The Intersection between Intellectual Property and Antitrust Law", in *Handbook of Intellectual Property Research: Lenses, Methods, and Perspectives*, eds. Irene Calboli and Maria Lillà Montagnani (OUP, 2021), 126; Angelika Murer, *Blocking Patents in European Competition Law: The Implications of the Concept of Abuse* (Wolters Kluwer, 2022), 145-151.

[67] Commission Decision of 15 June 2005, Case COMP/A.37507/F3, *AstraZeneca*, C(2005) 1757, paragraphs 1-2.

[68] The other abusive conduct related to an abusive foreclosing strategy through the withdrawal of a dosage form at the end of the patent term; see EC, *AstraZeneca* (2005), paragraphs 848 ff.

[69] In brief, SPCs are *sui generis* intellectual property rights that extend the duration of patent exclusivity on medicinal products compensating for the delays between the patent filing date and the date of first market authorisation up to a maximum of five years. Regulation (EC) 469/2009 of 6 May 2009 concerning the supplementary protection certificate for medicinal products [2009] OJ L152/1, arts. 4, 5 and 13.

the Advocate General and the CJEU all agreed with the Commission's findings.[70]

Under *AstraZeneca*, the anti-competitiveness of patent prosecution arises not merely if the dominant firm applies for a patent that ultimately fails the patentability criteria.[71] In fact, failure to meet the patentability threshold is just a possible outcome of the patent prosecution process. Rather, the dominant firm seeking patent protection breaches Art. 102 TFEU if it engages in a consistent and linear course of deliberate misleading conduct involving the submission to the public authorities of objectively inaccurate or incomplete information liable to lead the authorities into error and enabling the grant of an IPR without a due title.[72] Such conduct, regardless of both any anti-competitive intent and the outcome of the deceived administrative procedure, breaches the dominant firm's special responsibility not to impair residual competition.[73] According to the EC's reasoning in *AstraZeneca*,[74] as confirmed by both the GC and CJEU,[75] dominant firms interacting with public authorities, such as patent offices, must provide them with all relevant information and rectify any error if encountered. Moreover, the fact that the deceitfully obtained IPR does not result in the release on the market of any new product can also show deception on the part of the dominant firm.[76]

---

[70] Judgment of 1 July 2010, *AstraZeneca v. Commission*, T-321/05, EU:T:2010:266; Opinion of AG Mazák of 15 May 2012, *AstraZeneca v. Commission,* C-457/10, EU:C:2012:293.

[71] Josef Drexl, "AstraZeneca and the EU Sector Inquiry: When Do Patent Filings Violate Competition Law?", *MPI for IP and Competition Law Research Paper Series* No. 12-2 (2012), 7-8 and 21-24; Joseph Straus, "Patent Application: Obstacle for Innovation and Abuse of Dominant Position under Article 102 TFEU?", *Journal of European Competition Law & Practice* 1 (2010): 189, 195; Josef Drexl, "Deceptive Conduct in the Patent World – A Case for US Antitrust and EU Competition Law", in *Patents and Technological Progress in a Globalised World*, eds. Wolrad Prinz zu Waldeck und Pyrmont *et al.* (Berlin: Springer, 2009), 147-155.

[72] Andreas Heinemann, "Abusive Filing of IP Rights", in *Research Handbook on Intellectual Property and the Life Sciences*, eds. Matthews Duncan and Zech Herbert (Cheltenham: Edward Elgar, 2017), 470-477; Eugenio Hoss, *Deceptive Conducts Before the Patent Office: Challenges for Patent Law and Competition Law* (Baden Baden: Nomos, 2019), 206-212.

[73] Judgment of 9 November 1983, *Michelin v. Commission*, C-322/81, EU:C:1983:313, paragraph 57; Judgment of 27 March 2012, *Post Danmark I*, C-209/10, EU:C:2012:172, paragraph 23.

[74] EC, *AstraZeneca*, 2005, paragraphs 750-757.

[75] Judgment of 1 July 2010, *AstraZeneca v. Commission*, T-321/05, EU:T:2010:266, paragraphs 478 ff.; Judgment of 6 December 2012, *AstraZeneca v. Commission*, C-457/10, EU:C:2012:770, paragraphs 74 ff.

[76] As Maggiolino and Montagnani also highlight, subjective elements are redundant in antitrust law, which identifies abusive exercises of rights without relying on inquiry into wills and intentions but only eliciting the logic underpinning of behaviours. Competition law prohibits anti-compet-

Patent prosecution provides the dominant firm with an immediate market foreclosure effect arising from the patent application publication that the patent grant and eventual enforcement only reinforce.[77] Pending patent applications, especially if broad (i.e., complicated by many independent claims), create legal uncertainties over the boundaries of the claimed inventions, which already raise market barriers in the form of delayed static competition and diminished dynamic competition. Legal systems accept such an inherent patent foreclosure effect provided applications meet the patentability and disclosure requirements, limiting patent exclusivity for the fundamental benefit of society. Deception implies that the foreclosure effect of patent applications and eventually granted patents is unfounded in patent law and thus unduly excludes legitimate competition against the public interest.[78]

Although dominant patentees better be aware that the manner of obtaining patent protection can infringe Art. 102 TFEU, the relevant theory of harm could hardly apply to the ICT context. On the one hand, the EU and national case law on abuse of dominance through deceptive conduct before patent offices primarily concerns the pharmaceutical industry, whose regulatory dynamics and discrete-product features are very far from the ICT competitive settings. In the pharmaceutical industry, drug originators rely on the product market exclusivity conferred by a few relevant patents and supplementary protection certificates to recoup drug development investments before generics launch imitation competition. In contrast, innovators seek patents as technology expendable bargaining chips in the ICT sector rather than for exclusive product market exploitation.[79] As a result,

---

itive behaviour regardless of intent since it is enough to verify that the conduct does not have any explanation other than the harm to competition; Mariateresa Maggiolino and Maria Lillà Montagnani, "The Abuse of Rights in EU Competition Law and Beyond", in *The Roles of Innovation in Competition Law Analysis,* eds. Paul Nihoul and Pieter Van Cleynenbreugel (Cheltenham: Edward Elgar, 2018), 288 and 296; Jean François Bellis, "IP and Competition", *Journal of European Competition Law & Practice* 5, (2014): 113, 114.

[77] Commission Decision of 9 July 2014, Case AT.39612 – *Perindopril (Servier)*, C(2014) 4955 final, paragraphs 2770-2277; Andreas Heinemann, "Blocking Patents and the Process of Innovation", in *New Developments in Competition Law and Economics*, eds. Klaus Mathis and Avishalom Tor (Berlin: Springer, 2019), 154.

[78] Drexl, "AstraZeneca and the EU Sector Inquiry", 22-23 and 26-28; Maurits Dolmans, "Restrictions on Innovation: An EU Antitrust Approach", *Antitrust Law Journal* 66 (1998): 455, 458.

[79] See Harhoff *et al.*, *The Strategic Use of Patents*, 263; John Barton, "Antitrust Treatment of Oligopolies with Mutually Blocking Patent Portfolios", *Antitrust Law Journal* 69 (2001): 851, 854.

deceptive pharmaceutical patenting extends marginally already existing product market exclusivity against imitation competition. A single or a few deceitfully obtained pharmaceutical patents might prolong national monopolies over drugs worth billions of Euros in sales a year and whose supra-competitive profits originators are even willing to share with potential rivals through reverse-payment settlements.[80] Instead, a single or a few deceitfully obtained ICT patents do not command much deviation over extensive portfolio licensing fees, which account up-front for the fluctuation of the licensed patents because of invalidity findings and new grants.[81]

On the other hand, the theory of harm developed and applied in *AstraZeneca* firmly relates to horizontal foreclosure on downstream patent-implementing markets. Above all, were the deceitfully obtained patents be included in a *de consenso* standard technology, the Huawei/ZTE jurisprudence on FRAND licensing commitments would limit patentees' foreclosure ability just to implementers unwilling to take a FRAND license.[82] FRAND-encumbered SEPs aside, patentees that dominate a relevant technology market miss either the ability or the incentive to foreclose through their deceitfully obtained patents. Because of MAD, a dominant vertically-integrated patentee cannot foreclose access to his patented technology to downstream rivals, knowing that the competitors can retaliate through patents of their own or on other business occasions. In theory, a dominant patentee operating just on the upstream technology market, free from retaliatory constraints, can use a deceitfully obtained patent to foreclose downstream competition. Again, though, it has exclusionary incentives in a market where it does not compete just if it maximises licensing revenue or entertains collusion ties with a vertically integrated sponsor.[83]

EU competition law would have a better case against patentees' anti-competitive prosecution activities if it were to proscribe strategic patenting, whose lawfulness under Art. 102 TFEU the EC *Boehringer Ingelheim*

---

[80] On reverse payment settlements, see Judgment of 25 March 2021, *Lundbeck v. Commission*, Case C-591/16 P, EU:C:2021:243; Pablo Ibanez Colomo, "The Legal Status of Pay-for-Delay Agreements in EU Competition Law: Generics (Paroxetine)", *Common Market Law Review* 57 (2020): 1933.

[81] See Harhoff *et al.*, *The Strategic Use of Patents*, 75-76; Barton, "Antitrust Treatment of Oligopolies", 854.

[82] Judgment of 16 July 2015, *Huawei v. ZTE,* C-170/13, EU:C:2015:477; Niccolò Galli, "The FRAND Defense Up to Huawei/ZTE", *Bocconi Legal Papers* 7 (2016):155.

[83] See Harhoff *et al.*, *The Strategic Use of Patents*, 89.

investigation questioned in 2007 but ultimately left open in 2011.[84] Irrespective of deception, strategic patent prosecution lawfully seeks to obtain from patent offices blocking patents, namely patents that the patentee does not implement, out-license, nor uses to protect its freedom-to-operate but only hold up third parties' independent or complementary inventions.[85] Numerous patent claims, divisional applications and shared priority applications enable strategic patenting. The effect of blocking patents is just to impair freedom to operate in the relevant technology and implementing-products markets, ultimately decreasing the efficiency of the patentee's actual or potential rivals.[86] The organisational capability competitors need to counter the patentee's blocking patents acts as a market barrier itself.[87]

So far, EU competition law enforcement gives blocking patents a wide berth, although they extend the inherent patent foreclosure effect from static competition-only to dynamic competition-too so denying the patent system pro-innovation function.[88] Any dominant patent applicant could advance objective justifications for its strategic prosecution practices that reject the purely blocking effect of patents lacking direct commercialisation.[89] Patenting substitute or closely-related inventions through divisional and secondary patent applications may serve the legitimate interest of securing exclusivity over a given product and preventing easy design around (so-called patent fences). Without an entrenched patent exclusivity, the patentee or an interested licensee might refrain from investing in the commercialisation of the underlying core invention because of appropriability issues. Further, strategic patenting might serve the defensive function of diminishing the patentee's freedom-to-operate costs through cross-licenses and infringement litigation détentes, which determines

---

[84] See European Commission, "Antitrust: Commission welcomes improved market entry for lung disease treatments" Boehringer Ingelheim (Press Release 6 July 2011); Straus, "Patent Application: Obstacle for Innovation", 201.

[85] Andreas Heinemann, "Blocking Patents", 156-157.

[86] Drexl, "AstraZeneca and the EU Sector Inquiry", 15-18.

[87] See Harhoff et al., *The Strategic Use of Patents*, 260.

[88] Sparse competition cases touch upon strategic patenting issues in Europe plus the authorities' analyses therein are superficial; see European Commission, *Eleventh Report on Competition Policy* (1982) Airam/Osram, 66; French Competition Authority Avis 05-A-20 9 November 2005 *Luk Lamellen v. Valeo*; *Advanced Mass Memories v. Iomega* French Competition Authority Decision 01-D-57 21 September 2001.

[89] Harhoff *et al.*, *The Strategic Use of Patents*, 82; Heinemann, "Blocking Patents", 162; Sankaran, "Patent Flooding", 417-418.

static efficiencies. Last, it may be unclear up-front which innovation among many might succeed so that it is rational to pursue multiple paths in convoy and keep the inventor's freedom to operate.

Unfortunately, without antitrust curbs, blocking patents by any individual company calls for blocking patents in return from all other market participants.[90] The vicious cycle increases both entry barriers in the form of sunk costs needed to build strategic patent portfolios to compete with the incumbents on a level playing field, and the patent arsenal from which ICT patentees can draw.[91] As Harhoff *et al.* put it, the escalation of strategic patenting increases the costs of participating in ICT markets, overloads patent offices, increases examination times and lowers the novelty of granted patents. Hence, society experiences more exclusionary rights on worse inventions.[92]

5. Conclusion

In the dream world, the patent system incentivises innovation and dynamic competition. However, nothing in the patent laws prevents undertakings from exploiting the administrative procedures relating to the grant and revocation of patents that constitute patent prosecution, in concert or unilaterally to the detriment of competition. As in a patent bad dream, the analysis of the European ICT patent landscape reveals entry barrier features prone to anti-competitive practices:

i) substantial patent prosecution cost and timing benefit large undertakings, while they put resource-constrained firms at a competitive disadvantage;
ii) rising patent applications and even more rising patent grants concentrate in the hands of a few large ICT incumbents, which can leverage their technology market power upon a variety of downstream product markets such as the IoT ones;
iii) rare patent oppositions, especially between symmetric firms, protract existing oligopolies in technology markets and disserve the public interest of removing bad quality patents from the market.

Notwithstanding the empirical data hinting at such a bad dream, so far, anti-competitive patent prosecution practices flew under the EU

---

[90] See Harhoff *et al.*, *The Strategic Use of Patents*, 264.

[91] See Erik Hovenkamp and Herbert Hovenkamp, "Buying Monopoly: Antitrust Limits on Damages for Externally Acquired Patents", *Texas Intellectual Property Law Journal* 25 (2017): 39, 55.

[92] See Harhoff *et al.*, *The Strategic Use of Patents*, 264-266.

competition law radar except for the deception of the patent office as a unilateral abuse of a dominant position under the *AstraZeneca* case law.[93]

Without further information on the licensing agreements in place among ICT firms, the research finds that Art. 101 TFEU has a realistically limited application to anti-competitive coordinated patent prosecution. Despite the competition policy appeal of collusive cross-licensing agreements coordinating the parties' ICT patent prosecution strategies to the detriment of technology competition, their investigation, even as part of broader anti-competitive patterns, is yet to come. Whether or not ICT patentees coordinate their patent filings and opposition efforts is ultimately an uncharted evidentiary problem that puts off antitrust watchdogs quickly. The coordinated entry barrier circumstances descending from the ICT patent prosecution data could hardly justify *ad hoc* investigations. However, the here offered data suggesting that ICT technology competition may be restricted coupled with the potential anti-competitive findings of the Consumer IoT Sector inquiry might be worthy of further scrutiny, at least with a follow-on inquiry limited to cross-licensing agreements between major ICT undertakings.

Furthermore, the enforcement case law under Art. 102 TFEU does not have much clout against anti-competitive patent prosecution practices by dominant ICT undertakings too. The inquiry advocates that the case law on abusive patent prosecution, which descends from the CJEU's *AstraZeneca* ruling, is of a limited application when it comes to ICT patent prosecution practices. In fact, such a theory of harm fits regulated pharmaceutical industries, whose discrete-product markets and closed innovation ecosystems are far from the ICT competitive settings of complex electronics products based on interoperable innovations. Further, the jurisprudence at issue firmly relates to horizontal foreclosure on downstream patent-implementing product markets – the ones of the originator drugs – by leveraging patent exclusivity on upstream technology markets. Instead, ICT undertakings seek patents as expendable bargaining chips in the quest for freedom to operate rather than exclusive product market exploitation. Art. 102 TFEU would have a better case against anti-competitive ICT patenting practices if it were to proscribe blocking patents. Primarily, blocking patents impair freedom to operate in the relevant ICT product and technology markets, ultimately decreasing the efficiency of the patentee's actual

[93] Judgment of 6 December 2012, *AstraZeneca v. Commission*, C-457/10, EU:C:2012:770.

or potential rivals.[94] The enforcement problem against blocking patents remains to exclude dominant patentees' many plausible objective justifications that reject their purely blocking effect. Absent fundamental patent law reforms, the application of EU competition law remains not only a second-best solution to address the bad dream of ICT patent prosecution instances that turn out anti-competitive but also a very remote one.

Bibliography

"6 Commission priorities for 2019-2024: A Europe fit for the digital age". *European Commission*. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en.

"Cost of a Unitary Patent". EPO. https://www.epo.org/applying/european/unitary/unitary-patent/cost.html.

"EPO remains the 'gold standard' for patent quality", *EPO News* 30 November 2021, https://www.epo.org/news-events/news/2021/20211130b.html.

"FAQ – Procedure & law". *EPO*. https://www.epo.org/service-support/faq/procedure-law.html#faq-274.

"The 2021 EU Industrial R&D Investment Scoreboard". European Commission. https://iri.jrc.ec.europa.eu/scoreboard/2021-eu-industrial-rd-investment-scoreboard.

Advanced Mass Memories v Iomega French Competition Authority Decision 01-D-57 21 September 2001.

AIPLA, *Report of the Economic Survey* (2019).

American Antitrust Institute, "Letter to the US DoJ Ass'n Att. Gen. Re. Rockstar's Bid for Nortel Patent Portfolio 6 July 2011", https://www.antitrustinstitute.org/wp-content/uploads/2018/08/Nortel-letter-to-DOJ.7.6.11.pdf.

Barazza, Stefano. "The Technology Transfer Block Exemption Regulation and Related Guidelines: Competition Law and IP Licensing in the EU". *Journal of Intellectual Property Law & Practice* 9 (2014): 186.

Bardehle Pagenberg, *European Patent Opposition Proceedings*. Bardehle Pagenberg, 2021, https://media.bardehle.com/contentdocuments/broschures/European_Patent_Opposition_Proceedings_BARDEHLE_PAGENBERG_IP-Brochure.pdf.

Barton, John. "Antitrust Treatment of Oligopolies with Mutually Blocking Patent Portfolios". *Antitrust Law Journal* 69 (2001): 851.

Beard, Randolph and David Kaserman. "Patent Thickets, Cross-licensing, and Antitrust". *Antitrust Bulletin* 345, (Summer-Fall 2002).

---

[94] See European Commission, "Antitrust: Commission welcomes improved market entry for lung disease treatments", Boehringer Ingelheim (Press Release 6 July 2011); Straus, "Patent Application: Obstacle for Innovation", 201.

Bellis, Jean François. "IP and Competition". J*ournal of European Competition Law & Practice* 5 (2014): 113.

Blind, Knut, Jakob Edler, Rainer Frietsch and Ulrich Schmoch. "Motives to Patent: Empirical Evidence from Germany". *Research Policy* 35, 5 (2006): 655.

Brown, Thomas and Samuel Zun. "Patent Aggregation: Guidance from the DOJ's Recent Approval of Three Major Patent Portfolio Acquisitions". *Antitrust* 26 (2012): 60.

Bundeskartellamt, *Bundeskartellamt Clears CPTN Joint Venture for Acquisition of Novell Patents* (Bundeskartellamt News, 20 April 2011), https://www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2011/20_04_2011_CPTN.html.

Caviggioli, Federico, Giuseppe Scellato and Elisa Ughetto. "International Patent Disputes: Evidence from Oppositions at the European Patent Office". *Research Policy* 42 (2013): 1634.

Christ, Dominique, Niccolò Galli and Cornelia Peuser. "Patent Aggregation: More Than Patent Trolls". *Les Nouvelles* 54, no. 4 (2019): 238.

Cleary Gottlieb, "Nortel in Sale of Residual Patent Assets to Apple Inc. and Rockstar Bidco, LP Through Bankruptcy Auction" (30 June 2011), https://www.clearygottlieb.com/news-and-insights/news-listing/nortel-in-sale-of-residual-patent-assets-to-apple-inc-and-rockstar-bidco-lp-through-bankruptcy-auction50.

Commission Decision of 13 February 2012, Case COMP/M.6381, *Google/Motorola Mobility* (C(2012)1068) OJ C75/1.

Commission Decision of 15 June 2005, Case COMP/A.37507/F3, *AstraZeneca*, C(2005) 1757.

Commission Decision of 26 June 2014, Case COMP/M.7202, *Lenovo/Motorola Mobility* (COM 2014 4459 final).

Commission Decision of 9 July 2014, Case AT.39612 – *Perindopril (Servier)*, C(2014) 4955 final.

Conde Gallego, Beatriz and Josef Drexl. "IoT Connectivity Standards: How Adaptive is the Current SEP Regulatory Framework?". *International Review of Intellectual Property and Competition Law* 59 (2019): 135.

Cremers, Katrin, Max Ernicke, Fabian Gaessler, Dietmar Harhoff, Christian Helmers, Luke McDonagh, Paula Schliessler and Nicolas van Zeebroeck. "Patent Litigation in Europe". *European Journal of Law and Economics* 44 (2017): 1.

Davis, Richard, Thomas St. Quintin and Guy Tritton. *Tritton on Intellectual Property in Europe*. 5th ed. London: Sweet and Maxwell, 2018.

Dolmans, Maurits and Daniel Ilan. "European Antitrust and Patent Acquisitions: Trolls in the Patent Thickets". *Competition Law International* 8 (2012): 1.

Dolmans, Maurits. "Restrictions on Innovation: An EU Antitrust Approach". *Antitrust Law Journal* 66 (1998): 455.

Drexl, Josef. "Anticompetitive Stumbling Stones on the Way to a Cleaner World: Protecting Competition in Innovation Without a Market". *Journal of Competition Law & Economics* 8 (2012): 507.

Drexl, Josef. "AstraZeneca and the EU Sector Inquiry: When Do Patent Filings Violate Competition Law?". *MPI for IP and Competition Law Research Paper Series* No. 12-2 (2012).

Drexl, Josef. "Deceptive Conduct in the Patent World – A Case for US Antitrust and EU Competition Law". In *Patents and Technological Progress in a Globalised World*, edited by Wolrad Prinz zu Waldeck und Pyrmont, Martin Adelman, Robert Brauneis, Josef Drexl and Ralph Nack. Berlin: Springer, 2009.

EPO Boards of Appeals, *2017 Annual Report*. EPO, 2017.

Ericsson, *Annual Report 2021*.

European Commission, "Antitrust: Commission welcomes improved market entry for lung disease treatments". Boehringer Ingelheim (Press Release 6 July 2011).

European Commission, *Commission Staff Working Document Accompanying the document Report from the Commission to the Council and the European Parliament – Final report – sector inquiry into consumer Internet of Things* (SWD(2022) 10 final.

European Commission, *Eleventh Report on Competition Policy* (1982) Airam/Osram.

European Commission, *Guidelines on the application of Article 101 TFEU to technology transfer agreements (Communication)* OJ 2014/C 89/3.

European Commission, *Report from the Commission to the Council and the European Parliament – Final report – sector inquiry into consumer Internet of Things* (COM(2022) 19 final).

Feng, Josh and Xavier Jaravel. "Who Feeds the Trolls? Patent Trolls and the Patent Examination Process?". *Harvard University Working Paper* (2016).

Fink, Carsteen, Mosahid Khan and Hao Zou. "Exploring the Worldwide Patent Surge". *WIPO Economic Research Working Paper* 12 (2013).

Forman, Chris and Avi Goldfarb. "Concentration and Agglomeration of IT Innovation and Entrepreneurship: Evidence from Patenting", *NBER Working Paper* No. 27338 (2020).

French Competition Authority Avis 05-A-20 9 November 2005 *Luk Lamellen v. Valeo*.

Galli, Niccolò. "The FRAND Defense Up to Huawei/ZTE". *Bocconi Legal Papers* 7 (2016): 155.

Graham, Stuart and Dietmar Harhoff. "Can Post-Grant Reviews Improve Patent System Design? A Twin Study of US and European Patents". *GESY Discussion Paper* 38 (2006), accessed June30, 2022. https://epub.ub.uni-muenchen.de/13510/1/38.pdf;

Guellec, Dominique, Thierry Madiès and Jean-Claude Prager. *Les Marchés des Brevets Dans l´Économie de la Connaissance*. Conseil d'Analyse Économique, 2010.

Hall, Bronwyn, Christian Helmers, Georg von Graevenitz and Chiara Rosazza Bondibene. *A Study of Patent Thickets*. UKIPO 23, 2013.

Harhoff, Dietmar, Bronwyn Hall, Georg von Graevenitz, Karin Hoisl and Stefan Wagner. *The Strategic Use of Patents and Its Implications for Enterprise and Competition Policies*. European Commission, 2007.

Heinemann, Andreas. "Abusive Filing of IP Rights". In *Research Handbook on Intellectual Property and the Life Sciences*, edited by Matthews Duncan and Zech Herbert. Cheltenham: Edward Elgar, 2017.

Heinemann, Andreas. "Blocking Patents and the Process of Innovation". In *New Developments in Competition Law and Economics*, edited by Klaus Mathis and Avishalom Tor. Berlin: Springer, 2019.

Heinemann, Andreas. "The Contestability of IP-Protected Markets". In *Research Handbook on Intellectual Property and Competition Law*, edited by Josef Drexl. Cheltenham: Edward Elgar, 2008.

Hoss, Eugenio. *Deceptive Conducts Before the Patent Office: Challenges for Patent Law and Competition Law*. Baden Baden: Nomos, 2019.

Hovenkamp, Erik and Herbert Hovenkamp. "Buying Monopoly: Antitrust Limits on Damages for Externally Acquired Patents", *Texas Intellectual Property Law Journal* 25 (2017): 39.

Hovenkamp, Herbert, Mark Janis, Mark Lemley, Christopher Leslie and Michael Carrier. *IP and Antitrust: An Analysis of Antitrust Principles Applied to Intellectual Property Law*. 3rd ed. Wolters Kluwer, 2019.

Huawei Investment & Holding, *Building a Fully Connected, Intelligent World*. Huawei Annual Report, 2021.

Ibanez Colomo, Pablo. "The Legal Status of Pay-for-Delay Agreements in EU Competition Law: Generics (Paroxetine)". *Common Market Law Review* 57 (2020).

Informatics Team, *Eight Great Technologies: The Internet of Things: A Patent Overview*. UKIPO, 2014.

Jacob, Robin. "Patent Thickets: A Paper for the European Patent Office Economic and Scientific Advisory Board Meeting". *Journal of Intellectual Property Law & Practice* 8 (2013): 203.

Jell, Florian. *Patent Filing Strategies and Patent Management: An Empirical Study*. Berlin: Springer, 2012.

Kitch, Edmund. "The Nature and Function of the Patent System". *The Journal of Law & Economics* 20 (1977): 265.

Kur, Annette and Thomas Dreier. *European Intellectual Property Law: Text, Cases and Materials*. Cheltenham: Edward Elgar, 2013.

Leveque, François and Yann Ménière. *The Economics of Patents and Copyright*. Berkeley: Berkeley Electronic Press, 2004.

Maggiolino, Mariateresa and Laura Zoboli. "The Intersection between Intellectual Property and Antitrust Law". In *Handbook of Intellectual Property Research: Lenses, Methods, and Perspectives*, edited by Irene Calboli and Maria Lillà Montagnani. OUP, 2021,

Maggiolino, Mariateresa and Maria Lillà Montagnani. "The Abuse of Rights in EU Competition Law and Beyond". In *The Roles of Innovation in Competition Law Analysis*, edited by Paul Nihoul and Pieter Van Cleynenbreugel. Cheltenham: Edward Elgar, 2018.

Mellon, Elise. *Patents, Competition Law and Open Innovation: A Study of 'Global Patent Warming'*. College of Europe, 2012.

Murer, Angelika. *Blocking Patents in European Competition Law: The Implications of the Concept of Abuse*. Wolters Kluwer, 2022.

Nagler, Markus and Stefan Sorg. "The Disciplinary Effect of Post-Grant Review – Causal Evidence from European Patent Opposition". *Research Policy* 49, no. 3 (2020): 1.

Nikolic, Igor and Niccolò Galli. "Patent Pools in 5G: The Principles for Facilitating Pool Licensing". *Telecommunications Policy* 46, no. 4 (2022): 102287, 3-4.

Nokia, *US Securities and Exchange Commission Form 20-F* (Annual Report, 2021).

Olson, David. "Removing the Troll From the Thicket: The Case for Enhancing Patent Maintenance Fees In Relation to the Size of a Patent Owner's Patent Portfolio". *Florida Law Review* 68 (2017): 519.

Orr, Justin. "Patent Aggregation: Models, Harms, and the Limited Role of Antitrust", *Berkeley Technology Law Journal* 28 (2013): 525.

Palomeras, Neus. "Sleeping Patents: Any Reason to Wake Up?", *IESE Working Paper* 506-2003 (2003), https://media.iese.edu/research/pdfs/DI-0506-E.pdf.

Podszun, Rupprecht. "Standard Essential Patents and Antitrust Law in the Age of Standardisation and the Internet of Things: Shifting Paradigms". *International Review of Intellectual Property and Competition Law* 50, (2019): 720.

Roland Berger Market Research, *Study on the Cost of Patenting*. EPO, 2005.

Rubinfield, Daniel and Robert Maness. "The Strategic Use of Patents: Implications for Antitrust". In *Antitrust, Patents, and Copyright: EU and US Perspectives*, edited by Francois Léveque and Howard Shelanski. Cheltenham: Edward Elgar, 2005.

Sanchez, Angél, Pablo Hortal and David Cuesta. *Patent Costs and Impact on Innovation – International Comparison and Analysis of the Impact of the Exploitation of R&D Results by SMEs, Universities and Public Research Organisations*. European Commission, 2014.

Sankaran, Sri Krishna. "Patent Flooding in the United States and Japan". *IDEA* 40, (2000): 393.

Shapiro, Carl. "Competition and Innovation: Did Arrow Hit the Bulls' Eye?". In *The Rate and Direction of Inventive Activity Revisited*, edited by Josh Lerner and Scott Stern. University of Chicago Press, 2012.

Shapiro, Carl. "Navigating the Patent Thicket: Cross Licenses, Patent Pools and Standard Setting". In *Innovation Policy and the Economy,* edited by Adam Jaffe, Josh Lerner and Scott Stern. Cambridge MA, MIT Press, 2001.

Sheelan, Jerry, Catalina Martinez and Dominique Guellec. "Understanding Business Patenting and Licensing; Results of a Survey", in *Patents, Innovation and Economic Performance*. OECD, 2004.

Straus, Joseph. "Patent Application: Obstacle for Innovation and Abuse of Dominant Position under Article 102 TFEU?", *Journal of European Competition Law & Practice* 1, (2010): 189.

Thumm, Nikolaus and Garry Gabison eds. *Patent Assertion Entities in Europe – Their Impact on Innovation and Knowledge Transfer in ICT Markets*. JRC, 2016.

UK Office of Fair Trading, *Public Bodies and Competition Law.* UK OFT, 2011.

Ulrich Schmoch, *Concept of a Technology Classification for Country Comparisons*. WIPO Report, 2008.

US Department of Justice, "CPTN Holdings LLC and Novell Inc. Change Deal in Order to Address Department of Justice's Open Source Concerns" (DoJ Press Release No. 11-491, 20 April 2011), https://www.justice.gov/opa/pr/cptn-holdings-llc-and-novell-inc-change-deal-order-address-department-justices-open-source.

US Federal Trade Commission, *Patent Assertion Entity Activity: An FTC Study* (2016).

van Zeebroeck, Nicolas, Bruno van Pottelsberghe de la Potterie and Dominique Guellec. "Claiming more: The Increased Voluminosity of Patent Applications and its Determinants". *Research Policy* 38, (2009):1006.

Whish, Richard and David Baley. *Competition Law.* 10th ed. Oxford: Oxford University Press, 2021.

WIPO, *2011 World Intellectual Property Report: The Changing Face of Innovation*. WIPO Economics & Statistics Series, 2011.