The role of European universities in patenting and innovation

A study of academic inventions at the EPO

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Office européen des brevets

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Foreword

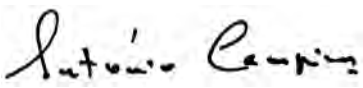
Europe has a long tradition of academic excellence, but we frequently struggle to turn research into commercial success. As recently emphasised in Mario Draghi's landmark report, the commercialisation of academic research should be a priority concern for Europe. Indeed, universities play a vital role in today's innovation ecosystems. They are the source of groundbreaking developments that are needed to maintain Europe's competitiveness as the global race for technology keeps accelerating.

Recognising both the importance of university-based innovation and the role of the patent system in helping funnel it to market, the EPO has maintained longstanding relationships with European universities through our European Patent Academy and its modular IP education framework (MIPEF). The EPO's Observatory on Patents and Technology has defined universities as one of the main stakeholders in fostering exchange and collaboration in the European innovation ecosystem.

Inspired by these relationships and the sector's centrality, and based on the EPO's comprehensive patent data, I am happy to present this pioneering study on the innovation process at European universities. The report, the first comprehensive analysis of its kind, is based on data on European patent applications stemming from more than 1 200 European universities across all EPO member states. In addition to patent applications that are filed directly by universities, the study also looks at applications filed by other entities for inventions developed in those universities. It thereby sheds fresh light on the role of universities as a source of innovation in Europe. Our findings show that the impact of European universities on the European patent system has been steadily increasing over the past two decades. More than 10% of all patent applications filed at the EPO from within Europe in 2019 originated in universities. Importantly, the intellectual property policies of universities have also evolved. Universities now frequently keep the ownership of the patented inventions stemming from their labs, taking responsibility for proactive commercialisation. More than ever, the role of knowledge transfer offices is therefore critical for academic innovation to achieve impact. A few leading European universities are showing the way, with a remarkable contribution to both academic patenting and startup innovation in Europe.

The study also reveals challenges ahead in building a fully-fledged European market for ideas. Data clearly show that university research benefits local ecosystems – small and large firms alike – across all European regions. However, European universities still mostly operate within long-established national institutional frameworks, and evidence of cross-border connections between them remain scant. Further progress in building those connections is needed to achieve the vision laid out by Enrico Letta and Mario Draghi in their recent reports. The entry into force of the Unitary Patent in 2023 is proof that such progress is possible!

Finally, this study is another milestone for the EPO's Observatory, just one year after it was created to enable and foster collaboration with our stakeholders. This publication caps a project that brought together experts from the EPO and 26 national patent offices, namely Albania, Austria, Belgium, Bosnia and Herzegovina, the Czech Republic, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, the Republic of Serbia, Switzerland, Slovakia, Slovenia, Spain, Sweden, Türkiye, and the United Kingdom. It also inaugurates a broader, longer-term programme of activities dedicated to universities, academic inventions, and knowledge transfer, in which we hope to involve an ever-growing circle of partners.



António Campinos
President, European Patent Office

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List of abbreviations

AI	Artificial intelligence
ASTP	Association of European Science and Technology Transfer Professionals
EARTO	European Association of Research and Technology Organisations
EIT	European Institute of Innovation and Technology
EPO	European Patent Office
ERC	European Research Council
FTE	Full-time equivalent
HEI	Higher Education Institution
INDUSAC	Industry-academia collaborations
IP	Intellectual property
IPFs	International patent families
KET	Key enabling technologies
KTOs	Knowledge transfer offices
MNE	Multiple enterprises
NUTS	Nomenclature of Territorial Units for Statistics
PCT	Patent Cooperation Treaty
PROs	Public research organisations
R&D	Research and development
R&I	Research and innovation
SMEs	Small and medium enterprises
TT	Technology transfer
WIPO	World Intellectual Property Organization

List of countries

AL	Albania
AT	Austria
AU	Australia
BA	Bosnia and Herzegovina
BE	Belgium
BG	Bulgaria
BR	Brazil
CH	Switzerland
CN	People's Republic of China
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GR	Greece
HR	Croatia
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
ME	Montenegro
MK	North Macedonia
MT	Malta
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
RoW	Rest of world
RS	Serbia
SE	Sweden
SI	Slovenia
SL	Slovakia
SM	San Marino
TR	Türkiye
UK	United Kingdom
US	United States

Other Europe (countries)
Member states of the European Patent Organisation that are not part of the EU27:
AL, CH, IS, LI, MC, ME, MK, NO, RS, SM, TR, UK.

Executive summary

Technology breakthroughs and innovation are widely recognised as powerful engines of economic growth in developed economies. As a result, research carried out in universities has gained increasing attention as a lever to securing a nation's competitiveness. However, transferring knowledge to the market often remains a challenge for universities, whose primary missions are related to education and academic research.

This challenge is especially acute in the case of European universities. Europe is typically perceived as a world class academic power with top universities and publications. Compared to other advanced economies, however, it often faces difficulties in transforming science into commercial activity. Market and policy fragmentation, a lack of funding in university research ecosystems and an overall sentiment that is risk-averse are often cited among the causes of this "European paradox", which has become a central policy topic in most European countries and at EU level.

The present study was conducted under the aegis of the EPO Observatory on Patents and Technology, as a contribution to the debate on the European paradox. Patents are key instruments for technology transfers, and potent indicators of knowledge diffusion from universities to the market. By using data on European patent applications to track such transfers across a broad variety of channels over a long period of time, the study provides the first ever comprehensive overview of the role European universities play in patenting and innovation on the European scale.

Our findings shed fresh light on the role of universities as a source of innovation in Europe. The **contribution of academic researchers to European patent applications has increased steadily** in recent decades, and now exceeds 10% of all patents filed by European applicants at the EPO. A broad variety of models exist as to how these inventions are protected and eventually transferred to market. Their analysis reveals structural changes in universities' approach to intellectual property, as well as persistent differences between national innovation systems across Europe.

The **distinction between direct and indirect academic patent applications** provides valuable insights into available channels of knowledge diffusion. Indirect applications are typically filed by companies, and thus more likely to respond to industry's immediate needs. In contrast, patents that are directly filed by universities are more likely to be science-based, and they still have to find a path to commercialisation. The significant shift towards the latter observed in many countries was supported by reforms encouraging universities to take more responsibility for technology commercialisation. It reveals both the challenges and opportunities of commercialising advanced scientific research to foster disruptive innovation in Europe.

The stronger emphasis put on patent commercialisation highlights in particular the **strategic importance of the functions performed by knowledge transfer offices (KTOs)** across a wide variety of universities. Some of them have long-established KTOs managing large patent portfolios in advanced scientific fields. These top-tier universities already achieve significant impact via technology transfers, as evidenced by their revenues from IP or the numbers of European startups benefiting of their inventions. On the other end of the spectrum, small universities also achieve impact in their respective ecosystems through local collaborations and patenting by partner companies. The positioning of other universities between these two models largely depends on their research performance and KTO capabilities. It is crucial to take into account this diversity when defining technology transfer strategies and policy.

The **diversity of national models in academic patenting** represents another challenge, as most European universities transfer knowledge to their respective national or regional ecosystems. And they typically do so within specific institutional frameworks of ownership and research collaborations that have been long-established at the national level. This is illustrated, for instance, by the remarkably low rate of university ownership in Nordic countries, or by the high rate of academic patents that are co-filed by universities with other public research organisations in some other countries.

This fragmentation illustrates the effect of distance (geographic, institutional or cultural) as a barrier to knowledge diffusion. It also validates the emphasis put on local ecosystems and smart specialisation in the EU's innovation strategy. Nevertheless, the additional transaction costs tied to multiple national frameworks, and the ability of a few large companies to overcome these barriers by sourcing technology across borders, suggest there is potential for further harmonisation and integration in Europe's markets for academic inventions. Mario Draghi's report on the future of European competitiveness, as well as Enrico Letta's on the future of the Single Market, highlight that this fragmented innovation ecosystem is central to Europe's struggle to translate innovation into commercialisation. Mario Draghi points to the lack of connected innovation clusters across countries and sectors – spanning both private industry and universities – as a key obstacle in the innovation pipeline. The fact that 10% of startups with European academic patents are headquartered in the US highlights the ongoing difficulties in commercialising new technologies within the EU single market. The recent creation of the Unitary Patent marks a concrete step towards addressing these challenges, complementing other EU initiatives to promote industry-academia collaboration and provide financial support for science-based startups.

Key findings

1. The impact of European universities on the European patent system has been steadily increasing over the past two decades. More than 10% of all patents filed at the EPO by European applicants in 2019 originated in universities.

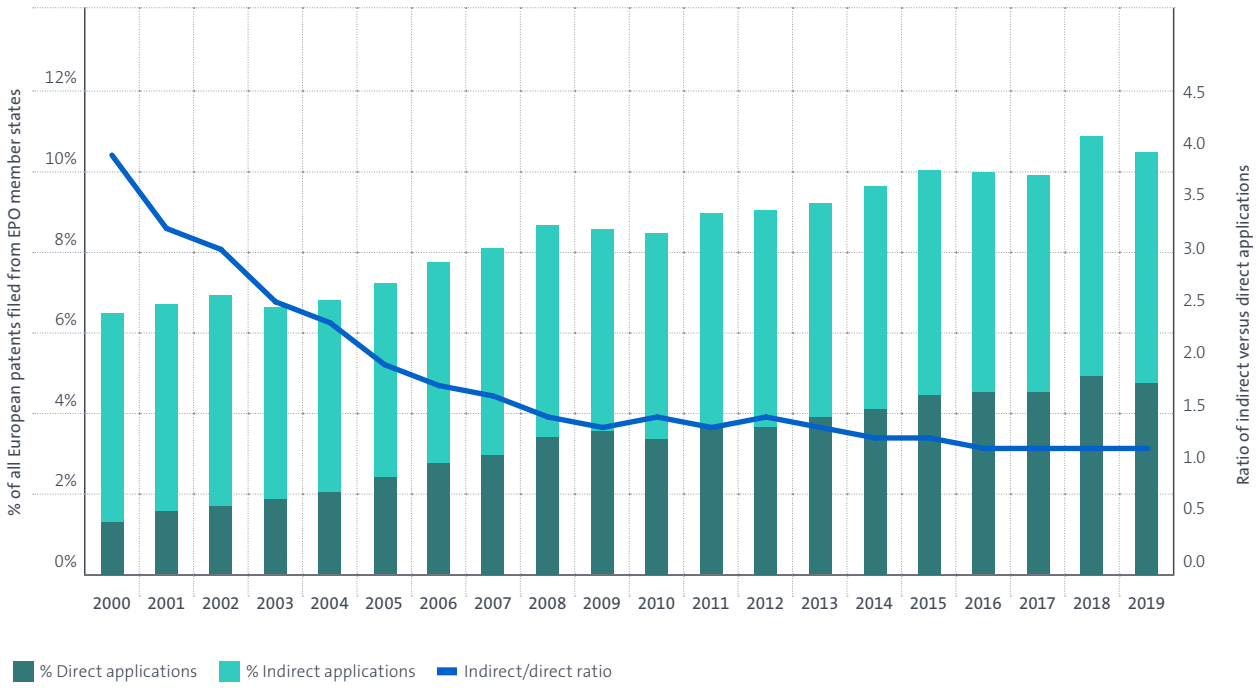
This study uses European patent applications for academic inventions as the reference metric for assessing the patent footprint of European universities. In addition to direct applications filed by the universities themselves ("direct applications"), the data also include patent applications not filed by universities but which include university-affiliated researchers among the inventors listed. These indirect applications are typically filed by companies, as a result of knowledge transfer through research collaborations, entrepreneurship or informal contacts.

The combined weight of direct and indirect patent applications stemming from European universities has increased steadily in recent decades, from 6.2% of all European patent applications in 2000 to 10.2% in 2019 (a share comparable to the total number of applications from Switzerland in 2023).

Looking at this period as a whole, only one-third of academic inventions were patented directly by the inventor's university. However, the IP policy of European universities has been shifting, with a dramatic increase in the proportion of academic inventions filed directly. As a result, direct patent applications represented 45% of academic patents in 2019, up from 24% in 2000.

Figure E1

Academic patents as a share of all European patent applications filed from EPO member states, 2000–2019



Note: Results for 2020 are not reported due to a time truncation of the data for this year.

Source: ETER, EPO - PATSTAT, Elsevier Scopus

2. More than 1 200 European universities have generated patent applications at the EPO, forming a very diverse landscape.

The leading countries in terms of both number of patenting universities and number of academic patents are Germany and France, followed by the UK and Italy. However, smaller countries like Sweden, Switzerland, Denmark, Belgium, Finland, Austria and Belgium show the highest number of academic patents per university on average.

Nearly two-thirds of universities (62%) filed less than one patent application per year on average, accounting for only 8% in total of all European patent applications filed by European universities. These are typically small institutions and tend to focus their applications on technology fields closely related to engineering (e.g. civil engineering, machine tools). Compared with other universities, they are over-represented in Central and Eastern European countries and own a relatively small share of their academic inventions.

By contrast, just 5% of universities account for half of all patent applications, with more than 250 applications each between 2000 and 2020. These institutions are more likely to file direct patent applications for their academic inventions and enjoy significant revenue from IP generated by well-staffed and experienced knowledge transfer offices (KTOs). While their patent portfolios typically span a broad range of technology fields, they are also the only category of universities to show a pattern of specialising in science-based fields, such as audio-visual technologies, telecommunications, nanotechnologies or pharmaceuticals and biotechnology.

Figure E2

Distribution of academic patents by European universities and countries, 2000–2020

Note: The name of the university with the largest number of academic patents in each country is shown in the corresponding cell where possible. For deeper insights into universities by number of academic patents per country, see Annex 2.

Source: ETER, EPO - PATSTAT, Elsevier Scopus

3. Most countries have evolved towards more frequent university ownership of academic inventions, while academic patenting by other applicants has receded. However, major differences between national models persist.

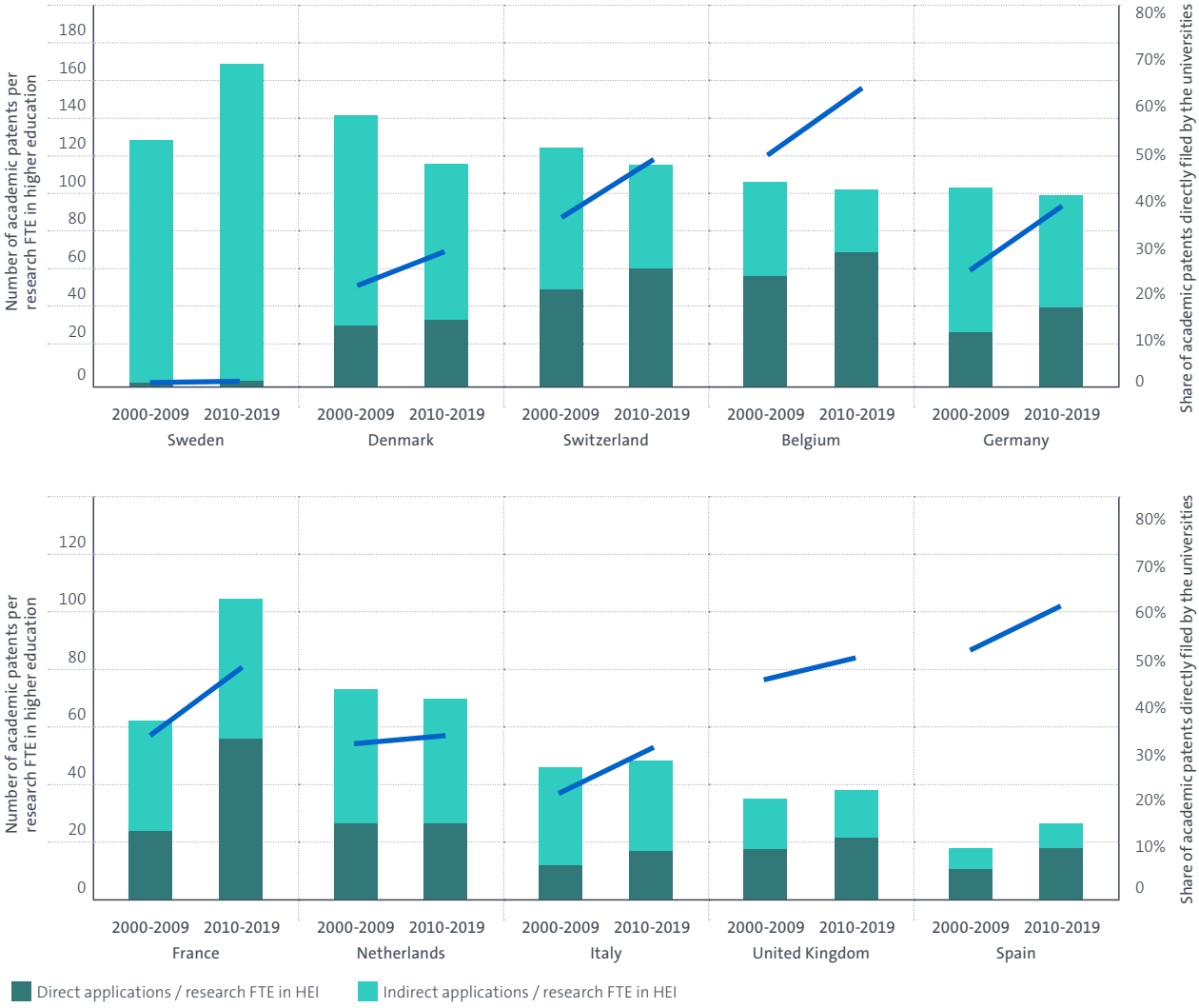
Most countries have seen an increase in the share of direct applications, denoting a systemic shift towards ownership of academic inventions by universities. This trend has been supported by various reforms aiming to foster the commercialisation of academic inventions, such as the abolition of professor's privilege in several countries.[1] However, there are notable differences in the legislation and its application across countries, influenced by the structure of their university systems. Several leading countries (Denmark, Switzerland, Belgium, Germany) show a net decrease in the overall number of academic patents per researcher, in line with other studies that find a general decline in research productivity.

However, important differences between European countries persist. Sweden and other Nordic countries have a different model, with a high number of academic patents per researcher but only a small proportion of (often highly cited) academic patents directly filed by universities. In other countries, such as France and Belgium, universities file most of academic patents, often with large public research organisations as co-applicants.

[1] Professor's privilege, whereby university researchers enjoy full rights to their inventions, was abolished in Denmark, Germany, Austria, Norway and Finland between 2001 and 2007.

Figure E3

Academic patents per research FTE in higher education in the top 10 countries, 2000–2009 versus 2010–2019



Note : The figure is based on counts of European patent applications directly or indirectly generated by universities. The top 10 countries are ranked in the figure by their total number of academic patents over the combined periods 2000–2009 and 2010–2019. The absolute levels of productivity reported by country and time period do not take into account other academic inventions stemming from universities for which patent applications have been filed only at their respective national offices.

Source: EPO - PATSTAT, Elsevier Scopus, Eurostat

4. Co-applications filed by universities with other research partners reveal dense collaboration networks at the country level, in which large research organisations often play a major role.

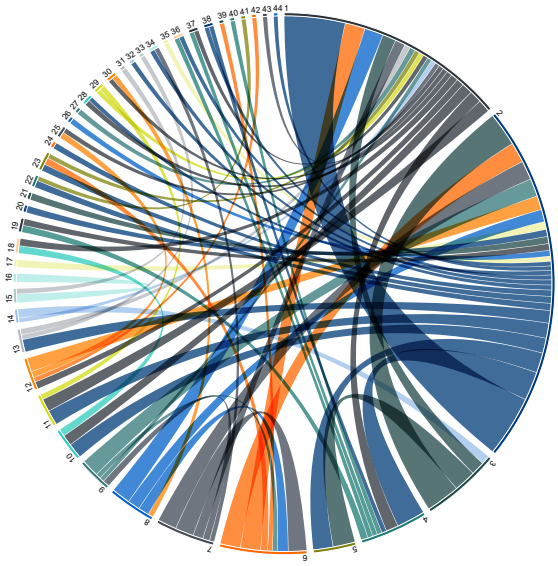
Co-applications signal close research collaborations with elaborate framework agreements governing exploitation of patents. Over the period 2015–2019 they represented 36% of the European patent applications filed by European universities, and mostly involved other research organisations from the same country as co-applicants. France stands out for its very high share of patents filed with a co-applicant (nearly 80%). Belgium (45%) and Italy (39%) are the only other leading countries where more than one-third of direct patent applications have a co-applicant.

The main co-applicants with French universities are large public research organisations (PROs) such as the CNRS and INSERM, with which university laboratories are often affiliated. Because they have a claim on a large share of the inventions produced by most French universities, these PROs occupy a central position in the network of French co-applications. Large PROs are also regular co-applicants with universities in Germany (the Fraunhofer and Max Planck Institutes), Belgium (IMEC, VIB), Spain (CSIC) and Italy (CNR). However, they usually only collaborate with a limited subset of universities. Other organisations such as research hospitals and foundations are also frequent co-applicants with universities across European countries.

Figure E4

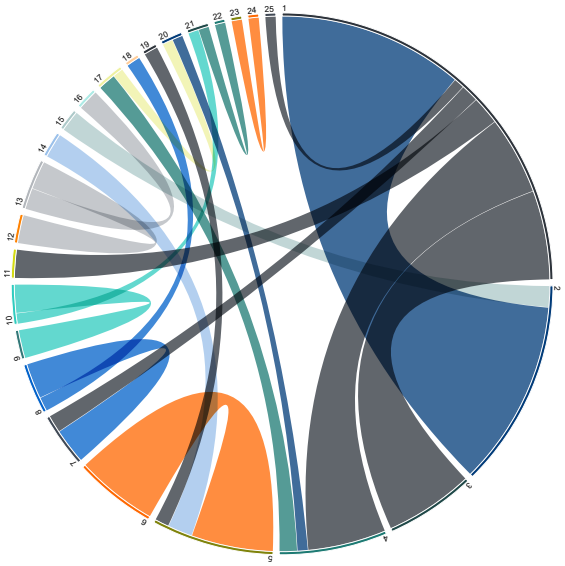
Main pairs of university co-applicants in France and Germany, 2015–2019

France



1 Institut national de la santé et de la recherche médicale (INSERM)
2 Centre national de la recherche scientifique (CNRS)
3 Université de Bordeaux
4 Université Claude Bernard Lyon 1
5 Institut polytechnique de Bordeaux
6 Université Paris Cité
7 Sorbonne Université
8 Assistance publique-hôpitaux de Paris
9 École supérieure de physique et de chimie industrielle de la Ville de Paris (ESPCI)
10 Nantes Université
11 Université de Toulouse
12 Université de Lille
13 Université d'Aix-Marseille
14 Centre Hospitalier Universitaire de Bordeaux
15 Université Grenoble-Alpes
16 Institut polytechnique de Grenoble
17 Commissariat à l'énergie atomique et aux énergies alternatives
18 Centre Hospitalier Universitaire de Nantes
19 École normale supérieure de Lyon
20 Université de Strasbourg
21 Université de Haute-Alsace
22 Université de Montpellier
23 Université Paris-Saclay
24 École normale supérieure (de Paris)
25 Centre Hospitalier Universitaire de Lille

Germany



1 Fraunhofer Gesellschaft
2 Friedrich-Alexander-Universität Erlangen-Nürnberg
3 Technische Universität Dresden
4 Friedrich-Schiller-Universität Jena
5 Deutsches Krebsforschungszentrum (DFKZ)
6 Universität Heidelberg
7 Rheinisch-Westfälische Technische Hochschule Aachen University
8 Forschungszentrum Jülich
9 Ludwig-Maxilillians-Universität München
10 Max-Planck-Gesellschaft
11 Technische Universität Ilmenau
12 Technische Universität Braunschweig
13 Medizinische Hochschule Hannover
14 Eberhard-Karls-Universität Tübingen
15 Uniklinikum Erlangen
16 Leibniz Universität Hannover
17 Leibniz Gemeinschaft
18 Universität Münster
19 Albert-Ludwigs-Universität Freiburg
20 Uniklinikum Jena
21 Technische Universität München
22 Helmholtz Association
23 Philipps-Universität Marburg
24 Justus-Liebig-Universität Giessen
25 Universität Regensburg

Note: The chord diagram for France is based on all pairs of co-applicants that share at least 21 co-applications over the period 2015–2019. The diagram for Germany is based on all pairs of co-applicants that share at least three co-applications during the same period.

Source: EPO - PATSTAT, Elsevier Scopus

5. Three-quarters of applicants for indirect patent applications were based in the same country as the academic inventor's university. Companies generated 80% of these indirect applications, and SMEs alone one-third. Startups filed 12% of all academic patents, either alone or as co-applicants with universities.

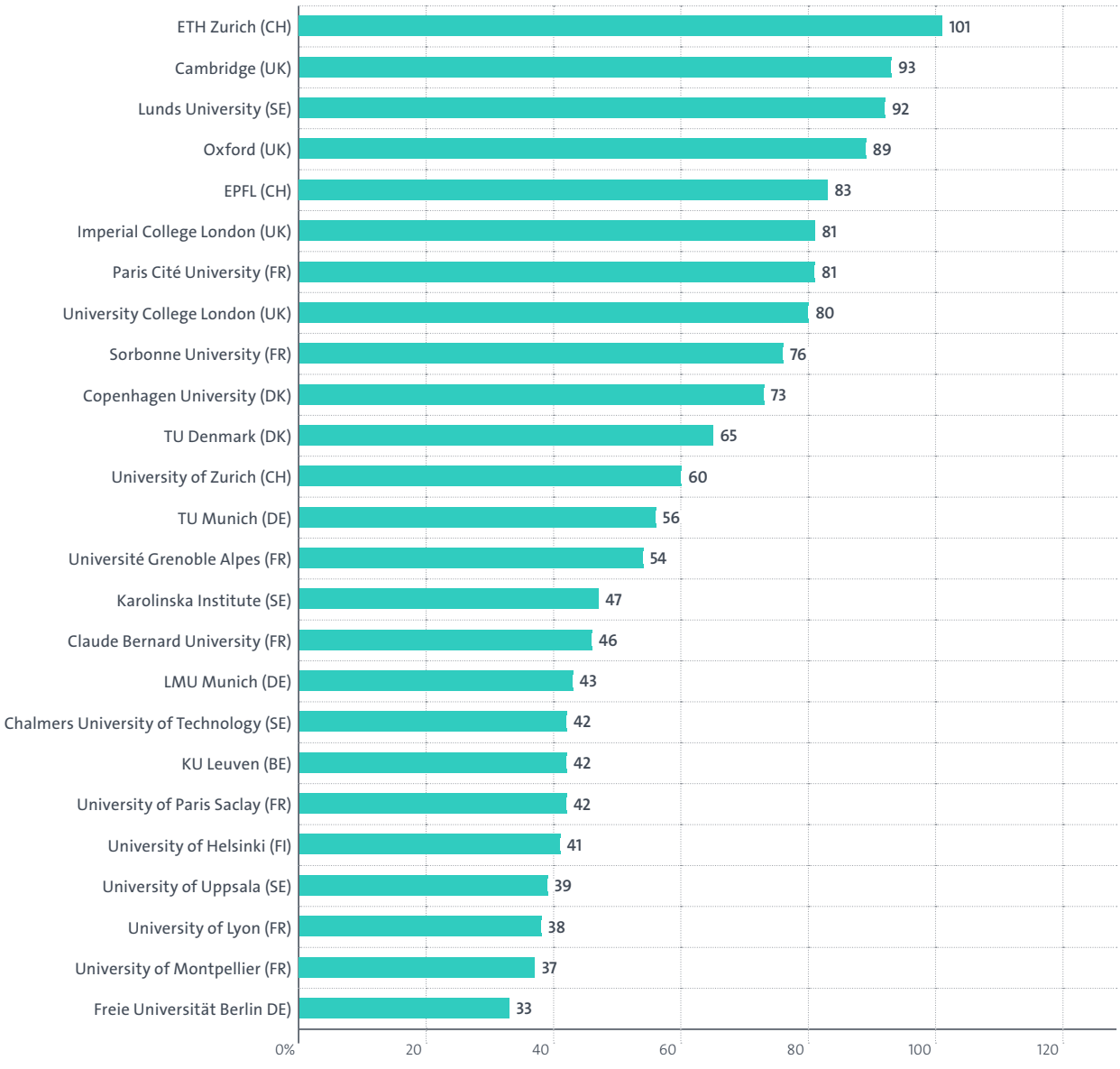
Over the period 2015–2019 indirect applications accounted for between 40% and 70% of all academic patents in most countries. Sweden (2%), Finland (9%), Hungary (7%) and Denmark (29%) stand out as exceptions, with a low propensity for universities to own patent applications on academic inventions. Overall, 76% of applicants for indirect applications were based in the same country as the academic inventor's university, while applicants located in other European countries represented another 15% (11% for the EU27 countries).

About 80% of indirect applications with university-affiliated inventors were filed by companies over the period 2015-2019, and 33% by SMEs. The top 25 co-applicants alone accounted for 32% of academic patents. In addition to six large national PROs they include multinational companies sourcing academic inventions mainly from their headquarter countries. However some, such as Siemens and telecom equipment companies Ericsson, Nokia and Huawei, collaborate with universities across a broader spectrum of European countries.

University research also benefits young companies: 12% of all academic patents were filed by more than 1 500 European startups. Three quarters of these companies sourced their academic inventions from a short list of 25 high-profile European universities.

Figure E5

Top 25 universities by number of startups with academic patent applications at the EPO, 2000–2020



Source: EPO - PATSTAT, Elsevier Scopus, Dealroom

6. The patent footprint of universities depends heavily on local industry ecosystems.

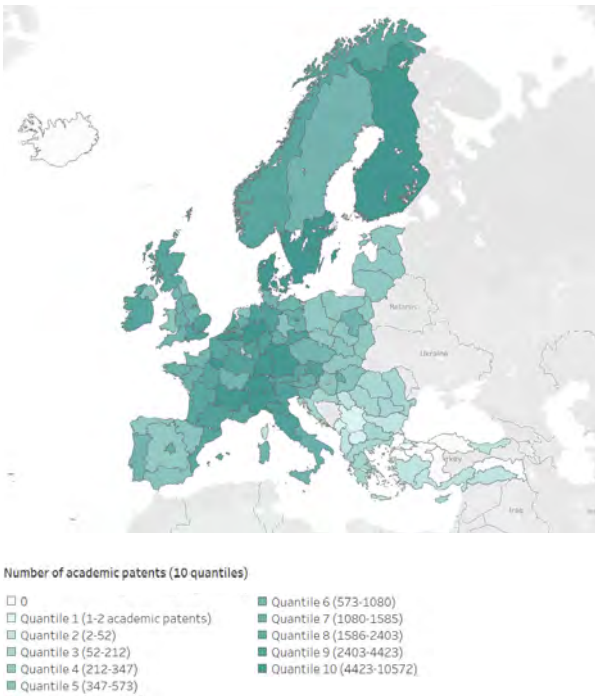
The number of academic patents generated by universities is larger in the more industrialised regions of Europe where opportunities for collaboration and technology transfers with industry are greatest. These regions also contain most of the universities that filed a large number of patent applications with the EPO over the period 2000–2019. However, academic patents represent only a relatively small share of all patents filed from these regions, due to the large number filed by local industry.

By contrast, universities in regions with lower GDP per capita, especially in Central and Eastern Europe, are mostly occasional applicants at the EPO, and generate relatively small numbers of academic patents. However, they account for a large proportion of local patent applications, which are frequently filed by partner companies rather than the universities themselves. They are essential components of innovation ecosystems in these regions and a key to development and smart specialisation.

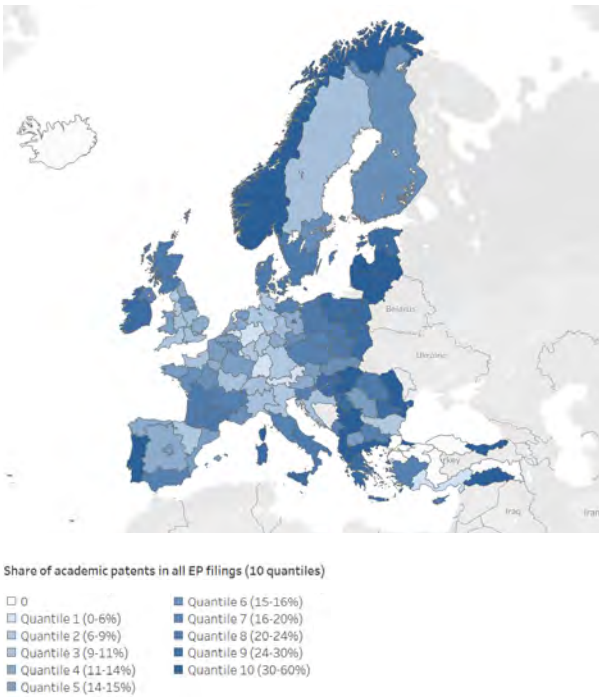
Figure E6

Academic patenting by European regions: number of European patents by NUTS 1 region, 2000–2020

Number of academic patents filed at the EPO by NUTS 1 region



Academic patents as a share of total patent filings at the EPO by NUTS 1 region



Note: Location is based on the applicant's address. The colour coding is based on 12.5% quantiles.
The darker the colour, the larger the plotted value.

Source: EPO - PATSTAT, Elsevier Scopus

1. Introduction

Technology breakthroughs and innovation are widely recognised as powerful engines of economic growth in developed economies. As a result, research carried out in universities has gained attention as a potential lever to securing a nation's competitiveness and long-term sustainability. However, transferring knowledge to the market is often a challenge for universities, whose primary missions are related to education and academic research. The question of how to better support universities in this endeavour has become ever more essential in innovation policy and economics.

The EPO is contributing to this debate by conducting this study under the aegis of the EPO Observatory on Patents and Technology. Patents are a key instrument for transferring inventions from universities to the market, and a potent indicator of the impact of universities. By systematically tracking European patent applications stemming from EPO member states' universities, the study provides a first comprehensive analysis of that impact on a pan-European scale.

1.1 The role of universities in innovation

Research by universities is essential for developing breakthrough innovations, technologies and processes. Inventions like the polio vaccine, the 3D printer, laser technologies and artificial intelligence would not have been possible without the basic and applied research that takes place in universities. Along with research and education, universities are tasked with developing applied innovation, participating in the development and economic growth of their regions. This is what is commonly referred to as the "third mission of universities", one which has flourished since the development of the knowledge economy (Schmoch, 2011; Taieb, 2024). This makes the role of IP management in universities essential – it is through IP that research in universities is transferred and later applied in industry.

Universities use IP to disseminate the knowledge they produce and create market and social value through technology transfer (TT), including licensing, research contracts, spin-out companies and other collaborative research projects. They are also at the heart of local innovation networks, acting as a catalyst for the creation and dissemination of knowledge in the public and private sectors (Jaffe, 1989; Reichert, 2019)

Global economic and technology trends suggest the role of universities will grow in importance in future. Finding new ideas and inventions is becoming harder, requiring teamwork among extremely specialised researchers (Bloom et al., 2020; OECD, 2019). At the same time, large firms have been defunding some of their large in-house R&D programmes and now depend more on acquisitions of startups (sometimes university spin-outs) and research contracts with universities to develop new inventions. Universities hire highly specialised scientists and are becoming steadily more open to industry, making them more crucial for patenting and innovation than ever before. Likewise, new open innovation practices are bringing about more contract-based relationships with universities, and hence more demand for patents (Rafols et al., 2014; Schoellman and Smirnyagin, 2021).[2]

In practice, however, the great expansion universities have made into innovation systems has coincided with a productivity slowdown in most industries. Some studies even suggest that the traditional model of big business-led science might be more effective in boosting productivity and commercialisation than the newer university-led approach (Arora et al., 2023). This might be because university research is different to corporate research. Spin-offs, startups and university licensing offices do not transfer knowledge and technology to industry the same way corporate research labs do.

Research in business possesses several key attributes that are highly beneficial for science-based innovation. Large corporations have access to extensive resources, can seamlessly integrate diverse streams of knowledge and focus their research on solving specific practical problems. This increases the likelihood of producing commercially viable applications. University research is often driven by curiosity, rather than specific missions. It prioritises gaining insights over finding solutions to particular issues, which means it often requires further integration and transformation to become economically useful.

[2] These conclusions coincide with the findings of previous studies by the EPO, including Patents and innovation against cancer (EPO, 2024), where we note that the international patent families (IPFs) of universities and PROs have increased over recent years, while those of established firms have stagnated.

1.2 Intellectual property and technology transfer

IP is fundamental in translating academic inventions into commercially viable ones. TT mechanisms such as licensing, research contracts, spin-out companies, science parks and incubator spaces, and other collaborative research projects with private organisations allow universities to leverage IP to disseminate their knowledge and generate social value. Universities serve as central hubs in local innovation networks, acting as a driver for creating and disseminating knowledge across both public and private sectors. They support technology transfer from research to industry, provide a framework for collaborative research with industry partners and afford the necessary protection to enable the private investments typically needed to bring inventions from universities to the market (Jaffe, 1989; Schoellman and Smirnyagin, 2021; Ertugrul et al., 2024).

Although European universities and PROs filed only 8% of all European patent applications in 2023 , IP remains a key asset for revenue generation for academia and collaboration with industry. According to the latest annual survey from the ASTP, Europe's association of knowledge transfer professionals, in 2021 alone over 1 100 IP contracts such as licences, options and contracts were recorded by KTOs from universities and PROs. This amounted to revenue of over EUR 800 million just from direct IP contracts, a number that has been growing since the ASTP started their surveys in 2014. IP is also the basis for knowledge exchange between institutions, through contract research agreements, consultancy projects and other collaborations between industry and academia. A total of EUR 2.4 billion of income was generated in 2021 by developing business agreements supported by IP rights held (ASTP, 2023).

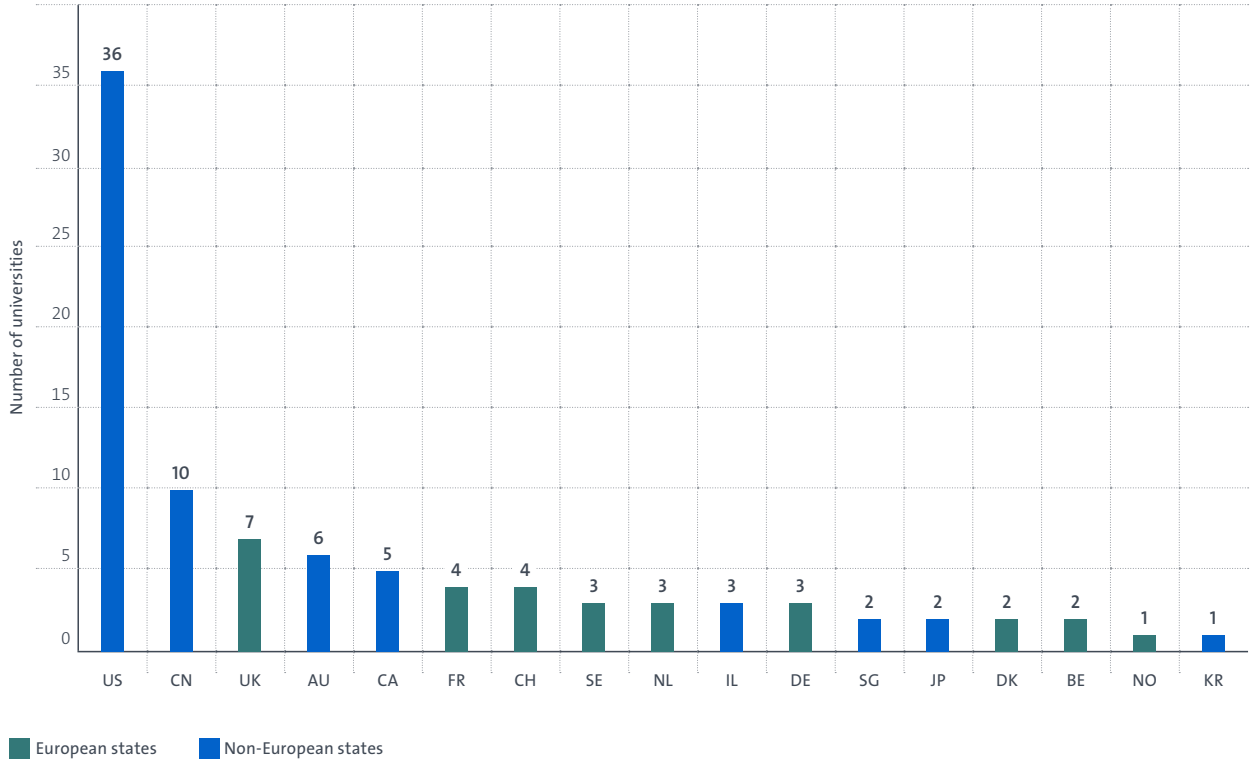
[3] See EPO's Patent Index 2023

1.3 A "European paradox" in university innovation?

Europe is typically perceived as a world class academic power, with top universities and publications. Of the top 100 universities in the Shanghai Rankings, 29 come from EPO member states (Shanghai Rankings, 2023). Likewise, in academic publications per capita Europe remains a world leader.

Figure 1.3.1

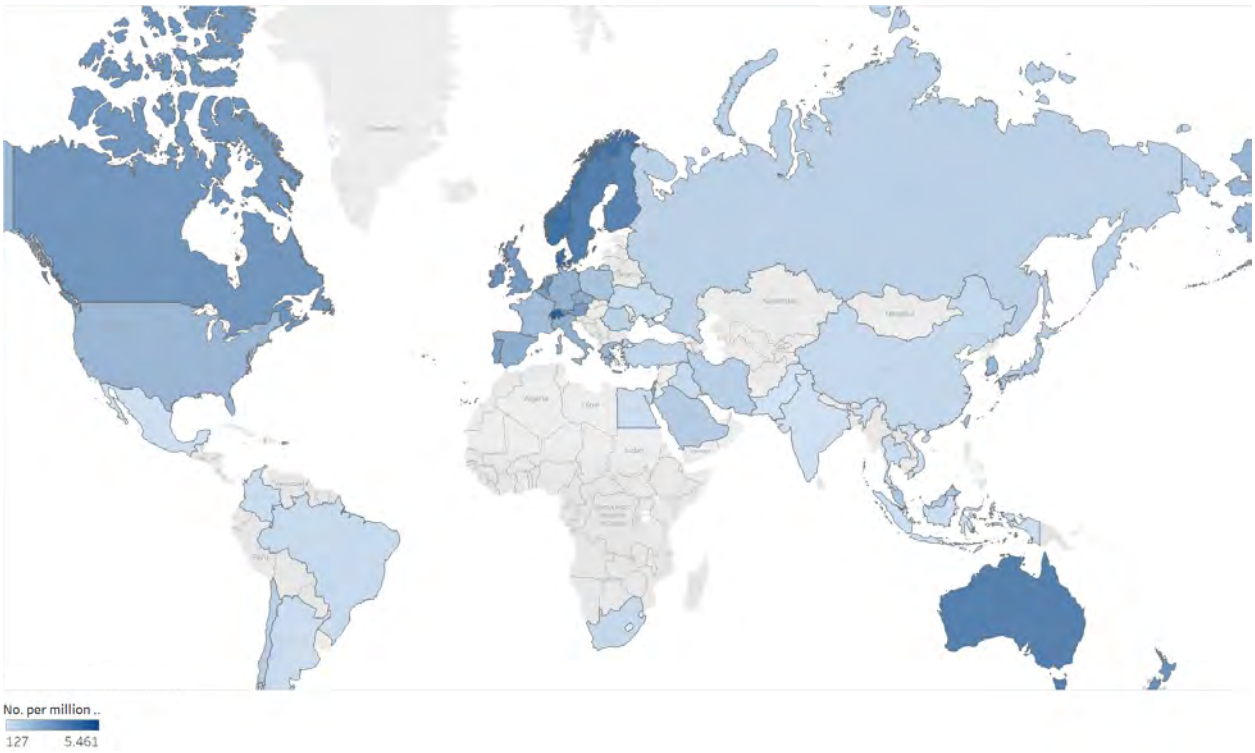
Number of universities in top 100 Shanghai Rankings (2023)



Source: Shanghai Rankings, 2023

Figure 1.3.2

Academic publications per million people (2022)



Source: Scopus, 2022

Nevertheless, this European advantage in academic research has not been necessarily converted into applied technological and economic performance, compared to other advanced economies. This is what is referred to as the "European paradox": the difficulties of transforming science into commercialisation in Europe, despite the global leadership of European universities (Agyropoulou et al., 2019). This concept of paradox has been used frequently by European policymakers since it was popularised by the European Commission in 1995. However, the validity of the conjecture remains contested in the academic community, where concerns have been raised about the assertion of European leadership in global universities. Similarly, the view of innovation as a linear pipeline from academic to applied research is challenged in favour of a more complex open innovation model (Dosi et al., 2006, Rodríguez-Navarro and Narin, 2018 and Argyropoulouet al., 2019).

Despite this debate, most empirical analysis seems to indicate that Europe lacks entrepreneurial capacity in its university systems compared to economies like the US. Different regulations in European countries, fragmentation in the research market, a lack of funding in university research ecosystems and an overall sentiment that is risk-averse are named as the most relevant pain points holding back the commercialisation of university-based research in Europe (Reillon, 2016; Atomico , 2021). Major European funding programmes like the European Research Council, which provides funds for pioneering research in European universities, have been found to lead to a large number of high-quality patents. However, a recent study by Nagar et al. (2024) underlines that these patents seem to have been commercialised not only by European companies, but also by spin-offs and companies operating in the US, which may be due to its dynamic startup landscape. Overall, findings suggest that European-funded science continues to face challenges associated with the "European paradox", where excellent European science cannot always be successfully commercialised at home. (Nagar et al., 2024).

The EPO examined this issue in a survey of European universities that applied for European patents, as part of its study Valorisation of scientific results (EPO, 2020). This found that over 20% of the patents included had no exploitation planned and were consequently left unused. The finding raises the question of how to better bridge the gap between science and commercialisation and the need for further study, not just on the extent of European universities' involvement in innovation systems, but also the ways in which they participate, particularly through patenting. In Mario Draghi's recent report for the European Commission, "The Future of European Competitiveness", the commercialisation of fundamental research is highlighted as a key challenge for the future of Europe's economy (Draghi, 2024). This is largely due to weak links between higher education and industry, as well as limited incentives for researchers to spin out their academic inventions and pursue entrepreneurial ventures.

The policy responses in Europe to this phenomenon have been numerous. Collaboration between industry and academia has been set as one of the priorities in the EU's Horizon Europe research and innovation policy, and is also included as one of the main visions in the European Education Area programme. Universities receive 25% of Horizon Europe funds through the "Excellence Science" pillar, which includes the ERC and the Marie Skłodowska-Curie Actions supporting collaboration between universities and industry (European Commission, 2021). As part of Horizon Europe the European Commission has also recently activated a collaboration programme across academic institutions called INDUSAC, to develop and validate industry-academia collaboration models in Europe, particularly by widening it to countries associated to the EU (EIT Manufacturing, 2022)

Horizon Europe also encompasses the European Innovation Council (EIC), which has a budget of EUR 10.1 billion to support breakthrough innovations in the move from early-stage research to market scale-up. This is crucial for university-based inventions, as it provides funding for technology transfer and development, facilitating the path to commercialisation. The European Institute of Innovation and Technology (EIT), also led from the European Commission and focused on education and innovation, has developed the HEI Initiative: Innovation Capacity Building for Higher Education, which targets universities across Europe. It serves as the learning platform for European universities on industry-academia collaboration, under the patronage of the European Commission.

The UK published the first comprehensive review of university spin-out companies in a European country. Spin-outs and universities are a key priority in UK innovation policy (Department for Science, Innovation and Technology, 2023). The study triggered a British government response announcing billions of pounds of public money for targeted spin-out projects (Coe, 2023). Germany, in its annual EFI report on innovation and research, set international collaboration between German universities and industry on key topics like AI and sustainable technologies as one of its four key priorities for 2024.

European legislation has also seen a recent rise in interest in this issue. In March 2024 the European Commission published Recommendation 2024/774 on the principles of knowledge valorisation. This states that industry-academia co-creation through IP transfer, among other TTs, is key. It also "recommends providing incentives for all stages in industry and in academia to participate", including training on IP management (European Commission, 2024). The role of IP, and especially patents, is seen by European policy makers as essential in translating these investments in academic research into commercially viable inventions.

1.4 Measuring university innovation output with academic patents

Due to differences in the ownership models of patents in European universities, studying the output of universities only looking at patent filings is challenging. They are a valuable metric, but an imperfect measure of impact. Overemphasis on filings can lead to a competitive race that prioritises quantity over quality and the follow-up necessary for technology transfer to succeed. Focusing instead on the concept of "academic patents" offers a more nuanced understanding of universities' innovation footprints, as well as their technology transfer models (Meyer, 2003; Lissoni, 2008). This is the approach adopted for the purpose of this study.

Academic patents are defined as those whose inventors work or study as researchers in universities, including patents directly filed by the universities themselves, but also ones filed by other entities. These methods have been used in studies in Europe for over a decade (Perkmann et al., 2013). Methods for accounting for academic patents typically involve a series of matching exercises and algorithms. The processes align the names of inventors on patent documents with the names of researchers in academic publications. Academic patents are therefore a way to assess the impact universities and academic researchers have on innovation, regardless of the university or national policies in place for IP ownership.

Another limitation in absolute patent rankings is the focus on top universities, which does not fully capture the complexity and diversity of the European university landscape. For instance, the top 20 European universities, often featured in global rankings, account for only 30% of EPO patent filings by European universities. This narrow focus overlooks the contributions made by numerous other institutions across member states, ignoring their unique ecosystems and technological advancements. Smaller and younger universities may in fact contribute a great deal as active players in their local environment and shape regional innovation systems (Villani and Lechner, 2021). To accurately assess the impact of university research, it is essential to delve deeper into the diverse and fragmented landscape of European higher education, which is what this study seeks to do.

1.5 Structure of the report

The main purpose of the study is to assess the patent impact of European universities by systematically identifying applications filed at the EPO for academic inventions. The report addresses key questions on the profiles of universities that generate academic patents, the balance they strike between direct ownership and third-part party ownership of academic inventions, and the external partners involved in developing and exploiting these inventions. In doing so, the analysis necessarily dives into the specifics of national university systems, their structure and performance, and the impact of policy reforms implemented since the turn of the century.

The report is organised into three main parts. Section 2 provides a general overview of academic patenting in Europe, highlighting general trends and the diversity of universities that generate academic patents. Section 3 offers a benchmarking of national models, while section 4 focuses on the corporate and institutional applicants involved in academic patenting. Section 5 concludes.

Case study: Atlantic Therapeutics

Company:	Atlantic Therapeutics
Headquarters:	Galway, Ireland
Founded:	2017
Products:	Wearable device to strengthen the pelvic floor muscles
Full case study:	https://link.epo.org/elearning/technology_transfer_case_study_atlantic_therapeutics_en.pdf

"IP management processes can benefit the smooth passage of a research project."
Brian Caulfield, Inventor and Professor of Physiotherapy, University College Dublin

The collaboration between University College Dublin (UCD) and Bio-Medical Research (BMR) led to the development of wearable shorts to treat stress urinary incontinence (SUI). Prior to the launch of the product, UCD and BMR had built a strong patent portfolio and negotiated a mutually beneficial licensing agreement. This enabled them to secure funding, commercialise the product and later establish Atlantic Therapeutics, a spin-out targeting the US market.

A stimulating environment

Based in Galway, Ireland, BMR is a privately owned company with over 50 years experience in the design, manufacturing and marketing of medical-grade products based on electrical muscle stimulation (EMS). In the early 2000s BMR collaborated with UCD physiotherapist Brian Caulfield to explore the commercial potential of Multipath technology, an innovative approach to electrical stimulation. With funding from Enterprise Ireland, the Irish government's enterprise development agency, BMR and UCD undertook two research projects to investigate numerous Multipath applications, focusing on conditions like obesity, SUI, lower back pain, spinal cord injury and chronic obstructive pulmonary disease.

Caulfield's team shifted its focus to SUI shortly after physical therapist Ruth Maher joined in 2008. Clinicians had long used EMS as a non-invasive and cost-effective alternative to surgery. However, Caulfield and Maher observed that Multipath EMS technology targeted deeper tissues, allowing for stronger muscle contractions. This effectively re-educates the pelvic floor muscles to control bladder function in a pain-free manner. BMR's clinical trials had also demonstrated the effectiveness of the Multipath EMS technology in significantly reducing symptoms of SUI compared to conventional treatments. With solid research and promising study results, the project team initiated a patenting process through the university's KTO.

The team first filed an Irish patent application, followed by an international Patent Cooperation Treaty (PCT) application, in 2010, aiming at protecting the invention in Europe, the US and several other countries. Under the terms of the collaboration agreement, UCD granted BMR an exclusive licence to the patented technology. This allowed BMR to further develop, validate and commercialise the technology. The KTO ensured that the licensing agreement was fair and reflective of industry standards, incorporating provisions for milestone payments, royalties and BMR's responsibility for the ongoing prosecution and maintenance of the patents. These strategic decisions ensured that the IP was protected and commercially viable.

Crossing the Atlantic

In 2014 BMR launched the technology under the brand name Vital Compact, initially relying on sales referrals from urologists and gynaecologists. Encouraged by sales success in Germany, Ireland, the UK and the Middle East, the company next targeted the US. BMR established Atlantic Therapeutics as a spin-out in 2017 to meet increasing consumer demand for non-invasive and user-friendly medical devices, and to become more attractive for investors. The newly formed company inherited the exclusive licence from BMR.

The early patent claims anticipated the integration of the technology into clothing. Under Atlantic Therapeutics, the device evolved from Vital Compact into INNOVO shorts, a wearable product utilising the patented Multipath technology for SUI treatment. By 2018 the wearable device had become the first transcutaneous electrical stimulator to be approved by the FDA for SUI treatment. Shortly thereafter the company was able to raise EUR 28 million to support its expansion efforts.

Caldera Medical acquired Atlantic Therapeutics in 2023, aiming to bolster its product lineup that focuses on women's health. The company will maintain an innovation centre in Galway and intends to scale up production of the INNOVO line.

2. Academic patenting in Europe: an overview

2.1 Universities with European patent applications

The reference population of the study consists of a set of 1 203 European universities located in EPO member states that filed at least one European patent application at the EPO in the period 2000–2020 (Figure 2.1.1).[4]

These represent about one-third of all higher education institutions listed in the ETER database. They are distributed between 37 countries, with more than half concentrated in just four: France (18%), Germany (16%), UK (11%) and Italy (7%).

Figure 2.1.1

ETER universities covered by the study by country, 2000–2020

Note: The figure shows the number of universities in each country identified as being at the origin of at least one European patent application with a priority year in the period 2000–2020, either as the applicant or the university of affiliation of one of the inventors listed in the application.

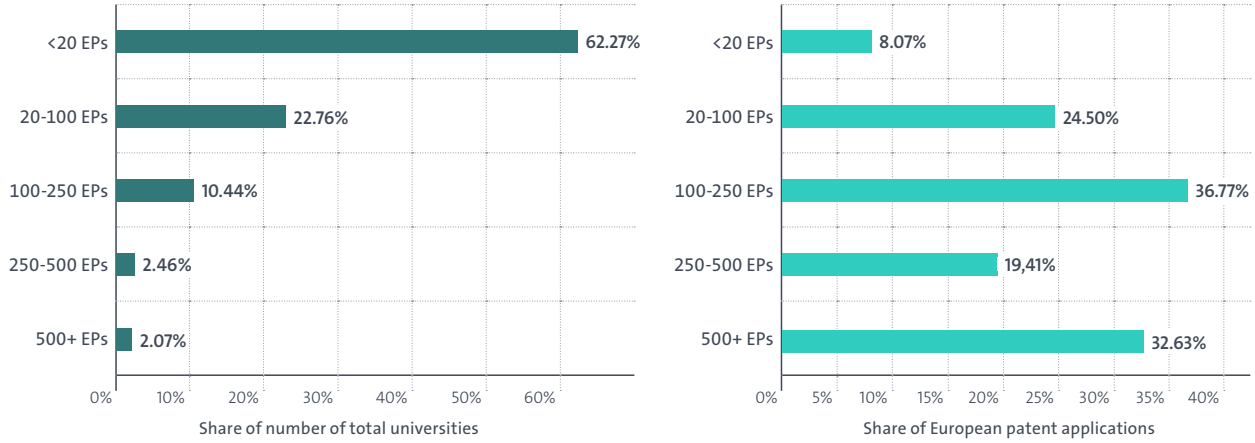
Source: ETER, EPO - PATSTAT

[4] More precisely, the period 2000–2020 is defined by the priority dates of the family. Due to time lags in the production of PATSTAT data, 2020 is truncated, with some applications missing in the dataset used.

There is wide diversity in the number of European patent applications filed over the period 2000–2020 (Figure 2.1.2). Nearly two-thirds of universities (63%) filed less than one patent application per year on average, accounting in total for only 8% of all European patent applications filed by European universities. These occasional university applicants are over-represented in Eastern and Central European countries, where they account for 84% of all universities that have been filing European patent applications (and up to 100% in Bulgaria, Romania, Slovakia, Croatia and Serbia). Universities that filed between 20 and 250 applications over the period represent another third (33%) of all patenting universities. The remaining 5% are leading university applicants with the EPO, accounting alone for more than half (52%) of the patent applications originating from European universities in the period 2000–2020.

Figure 2.1.2

ETER universities by number of European patent applications filed by each university, 2000–2020

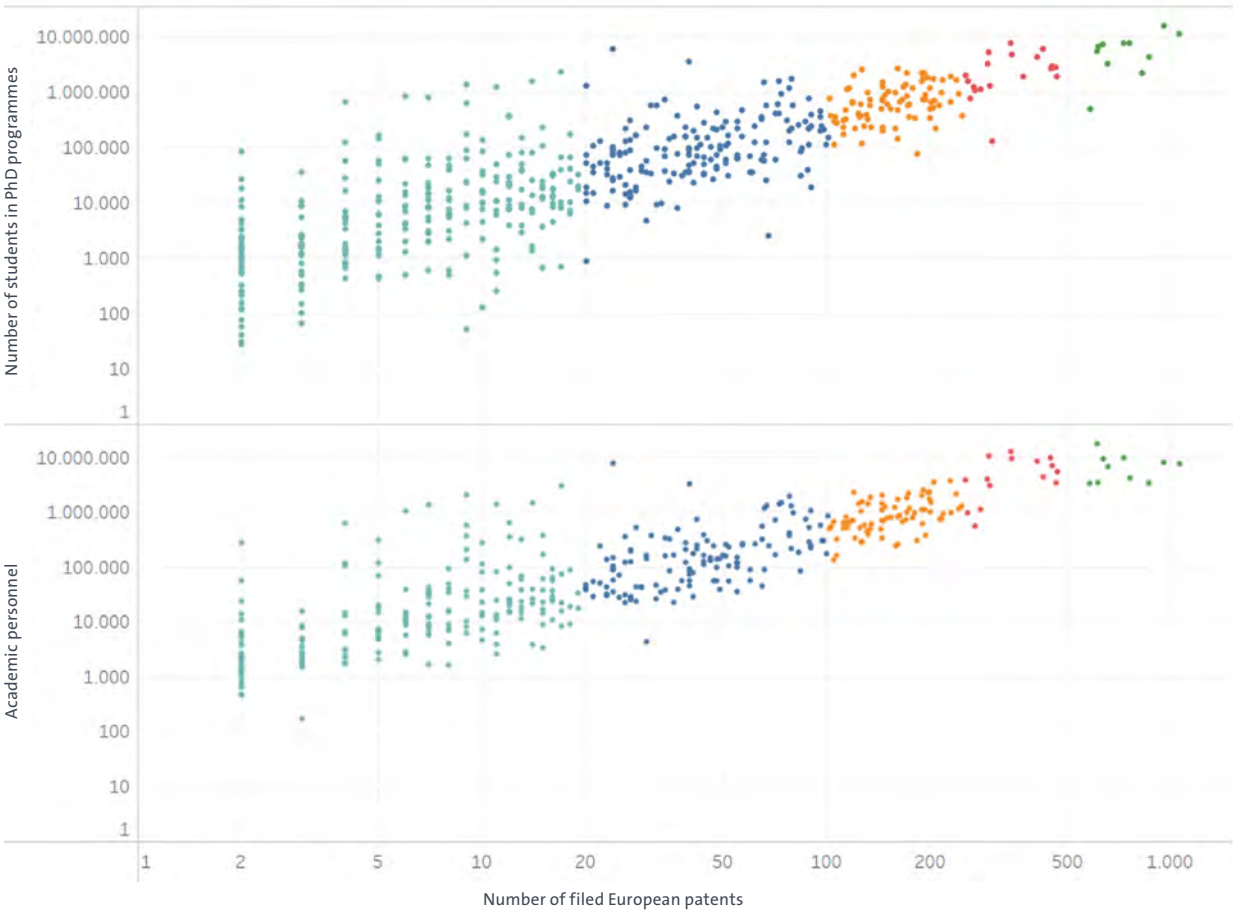


Note: The figure shows the number of universities in each country identified as being at the origin of at least one European patent application with a priority year in the period 2000–2020, either as the applicant or the university of affiliation of one of the inventors listed in the application.

Sources: ETER, EPO - PATSTAT, Elsevier Scopus.

Figure 2.1.3

Total PhD students and academic personnel of European universities by their European patent portfolio



Note: Logarithmic scale. The colours indicate the classification of European universities by European patent portfolio, as defined in Figure 2.1.2. Universities with at least 20 EP applications are indicated in light green, 20–100 in blue, 100–250 in orange, 250–500 in red and more than 500 in dark green.

Source: ETER, EPO - PATSTAT

To a large extent these differences reflect the different sizes of European universities. Using information from the ETER database, Figure 2.1.3 shows a robust correlation between the number of European patent applications filed by universities and the student body enrolled in PhD programmes, as well as academic personnel. Additional results from the ASTP survey suggest in turn that the universities that are the most active applicants (as measured by number of active patent families managed by the KTO) also have larger and more experienced KTOs. The same universities generate more revenues and license a larger share of their patent families than other universities.

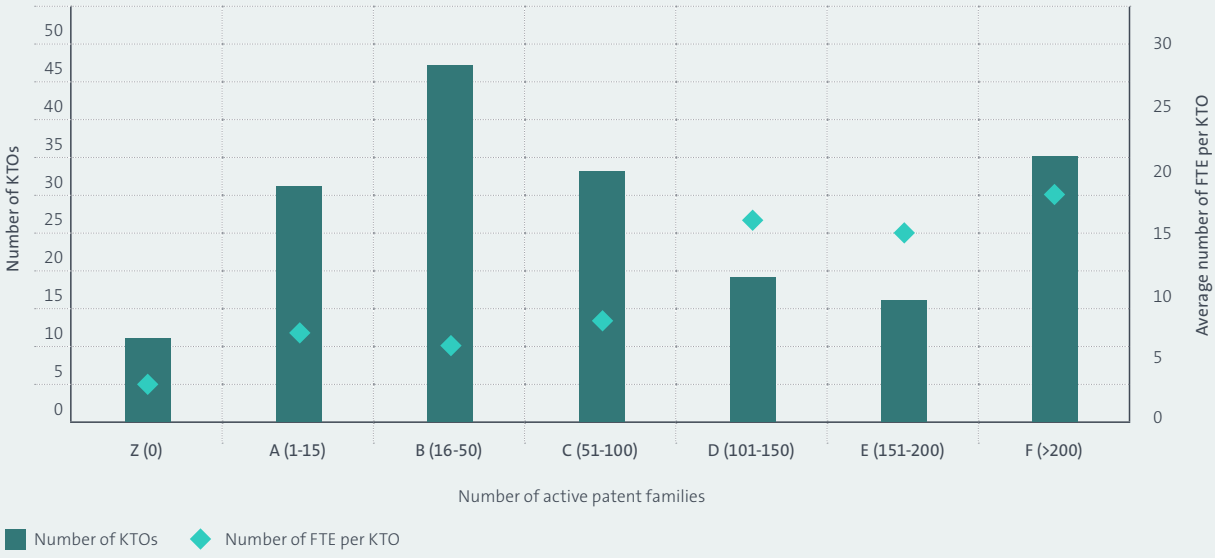
Technology transfer activities in European universities: insights from the ASTP 2023 Annual European Survey

The ASTP is the pan-European association of knowledge transfer (KT) professionals, with a core mission to share best practices and develop competencies among KT professionals. Part of this role involves undertaking an annual survey of KT activities. Some of the results have been shared by the ASTP for the purpose of this study to help document the knowledge transfer resources and activities of European universities.

The ASTP survey covers a sample of 235 universities, with patent portfolios ranging from no active patent family to more than 200 active patent families. Figure 2.1.4 shows the number of KTOs (bars) and average number of FTE per KTO (diamonds) broken down by the number of active patent families in portfolio (categories A to F). As such, it covers the different types of universities identified in this study. However, universities with very large portfolios (>200 active families) are over-represented among the respondents. By contrast, KTOs with few or no active patent families tend to be under-represented compared to Figure 2.1.2.

Figure 2.1.4

Number and average staffing of KTOs by number of active patent families



Base: 192 respondents

Source: ASTP Annual European Survey, 2023

As reported in Figure 2.1.4, most KTOs have between 6 and 18 full-time-equivalent staff, with slightly larger teams in KTOs managing larger patent portfolios.

Overall, the main functions performed by the KTOs include commercialisation (27% of the KTO staffing) and research support (22%), followed by entrepreneurship support (10%) and business development (5%). The average creation year of the surveyed KTOs is 2000, but KTOs with a larger portfolio of active patent families tend to be older than this average, while those with a smaller portfolio tend to be younger.

Figure 2.1.5

Licensing of active patent families

Base: 109 respondents

Source: ASTP Annual European Survey, 2023

KTOs that manage relatively large portfolios report a higher impact in terms of technology transfer. Figure 2.1.5 shows a strong correlation between the size of the portfolios and the number of active families that are licensed by the university. However, the proportion of families that are licensed is relatively stable – in the range of 13% to 23% – whatever the size of the university's portfolio.

Collaborative research is the main source of revenue for all categories of KTOs. Figure 2.1.6 shows that KTOs with more than a hundred active families in their portfolio are also the ones that generate significantly higher average income from industry contracts. This fact does not necessarily denote a causal relationship, but rather by the fact that KTOs with a large portfolio are more staffed.

Typically factors associated with larger KTOs staffing include:

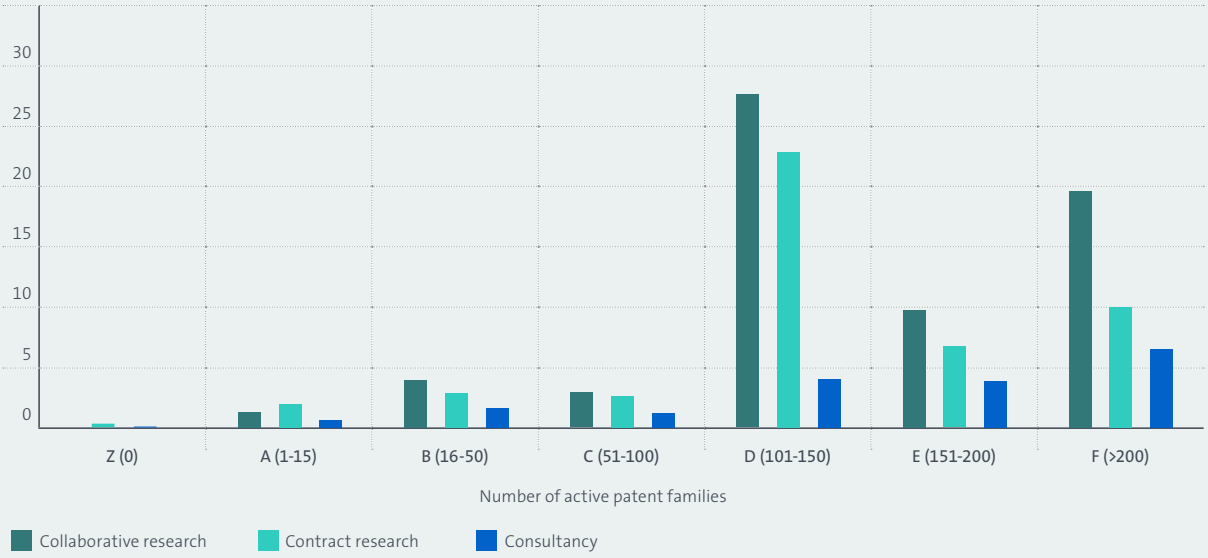
– the number of researchers of the university or PRO. More researchers generate more research results, and thus more opportunities of collaborations with companies, more contracts and more income.

– the research disciplines. Universities that are focused on research in humanities and social disciplines typically file fewer patents. Nevertheless, they may generate significant numbers of spin-outs, licences and industrial collaborations.

– the age of the university.

Figure 2.1.6

Average income from industry contracts (€M)



Base: 70 respondents

Source: ASTP Annual European Survey, 2023

2.2 Measuring the patent footprint of European universities

The number of patents filed directly by universities does not fully capture the influence of higher education institutions within the innovation ecosystem. As a result of varying regulations across countries, many technologies developed in universities are patented by partner businesses, PROs or other collaborating institutions. For instance, in some European nations "professor's privilege" has historically allowed university staff to retain ownership of patents, rather than the university itself. Additionally, when research is partially or fully funded by external entities such as private companies, patent rights are often negotiated, frequently resulting in universities not being listed as patent applicants (Geuna and Rossi, 2011). This means a significant portion of patents originating from university research is registered under the names of companies, individuals or PROs, with university staff listed only as inventors – a detail often overlooked in statistics that count only patents directly filed by universities.

The approach used in this study addresses these limitations by matching the names of scientific authors (university staff active in research) from the Scopus bibliometric database with inventor names from patent databases (Dornbusch et al., 2014).[5] This method, successfully applied in several studies of national data (Dornbusch and Neuhäusler, 2015; Neuhäusler et al., 2019), considers both the "applicants' perspective" and the "inventors' perspective." Together, these provide a more comprehensive statistical measure of patents from universities, or "academic patents" as popularised in the economic literature (Lissoni et al., 2008).

[5] Two primary methods have been used to identify university-affiliated patents. The first involves searching in official documents for academic titles like professor which, although not legally part of the name, can help identify patents where professors have mentioned their title (e.g. Schmoch, 2007). However, this method is limited to countries where the title is commonly indicated and those inventors who explicitly declare it, thereby excluding other university staff. The second approach involves matching university staff lists with the names of inventors listed on patents. This method has been employed in the US by Haeussler et al. (2009) and in France, Italy and Sweden by Lissoni and colleagues (Lissoni et al., 2008) as part of the KEINS project (Knowledge-based Entrepreneurship: Innovation, Networks and Systems). However, this approach faces limitations, as many countries do not maintain comprehensive and up-to-date lists of university staff, and lists often include only tenured professors, risking the omission of other inventors.

Box 1: Definition and economic role of academic patents

In this report we use the concept of academic patents to define all European patent applications originating in universities, whether they are owned or filed by universities or not. For this, academic patents are defined as all European patent applications filed directly by universities or that have inventors who are academic researchers at a university. Academic patents are therefore the sum of two mutually exclusive subcategories:[6]

- **Direct academic patents:** all European patent applications that have at least one applicant recognised as a European university in the reference population of the study. Direct patent applications can also be co-filed with other institutions, such as companies or other research organisations.
- **Indirect academic patents:** all European patent applications that have at least one inventor matched to a European university and have not been filed by one of the universities that constitute the reference population of this study.

Direct and indirect academic patents may be associated with different possible channels for universities to transfer knowledge and generate revenue. Being owned and controlled by the universities, patents that are directly filed by universities can be exploited through licensing, sold to third parties or transferred to startups and spin-outs in exchange for a share of equity. Indirect applications may be an outcome of collaborations between universities and external partners – especially in industry – with the partner contractually entitled to the results of the collaboration. However, they may also proceed from more informal channels, where university researchers independently collaborate with industry partners or launch their own business venture (Lissoni, 2010).

Results from the annual survey carried out by the ASTP among its members in 2023 provide orders of magnitude of the revenue generated by these different channels at European universities in 2021. They reveal an aggregate total of EUR 822m in commercial revenues from IP reported by a total of 477 respondents. A subset of 311 respondents also reported aggregate revenue of EUR 379m from patent licences specifically. This compares with a total of EUR 2.4bn of income generated by active agreements with industry, highlighting the importance of such agreements as channels of revenue and knowledge transfer for European universities.

Table 2.2.1

Revenue of European universities by knowledge transfer channel, 2021

	Income 2021 (mEUR)	Nb of respondents
Total commercial revenue from IP	822	477
Gross revenue from patent licences	379	311
Gross revenue from cash-in equity	108	344
Total revenue from industry agreements	2 384	
Collaborative research agreements	744	80
Contract research agreements	1 234	289
Consultancy agreements	406	286

Source: ASTP annual survey, 2023

[6] In both cases, university names have been normalised following the European Tertiary Education Register (ETER), a comprehensive repository of European universities. This was enriched by further collaboration with national patent offices (NPOs), adjusting the university names to better reflect the current institutional landscape of universities in each country.

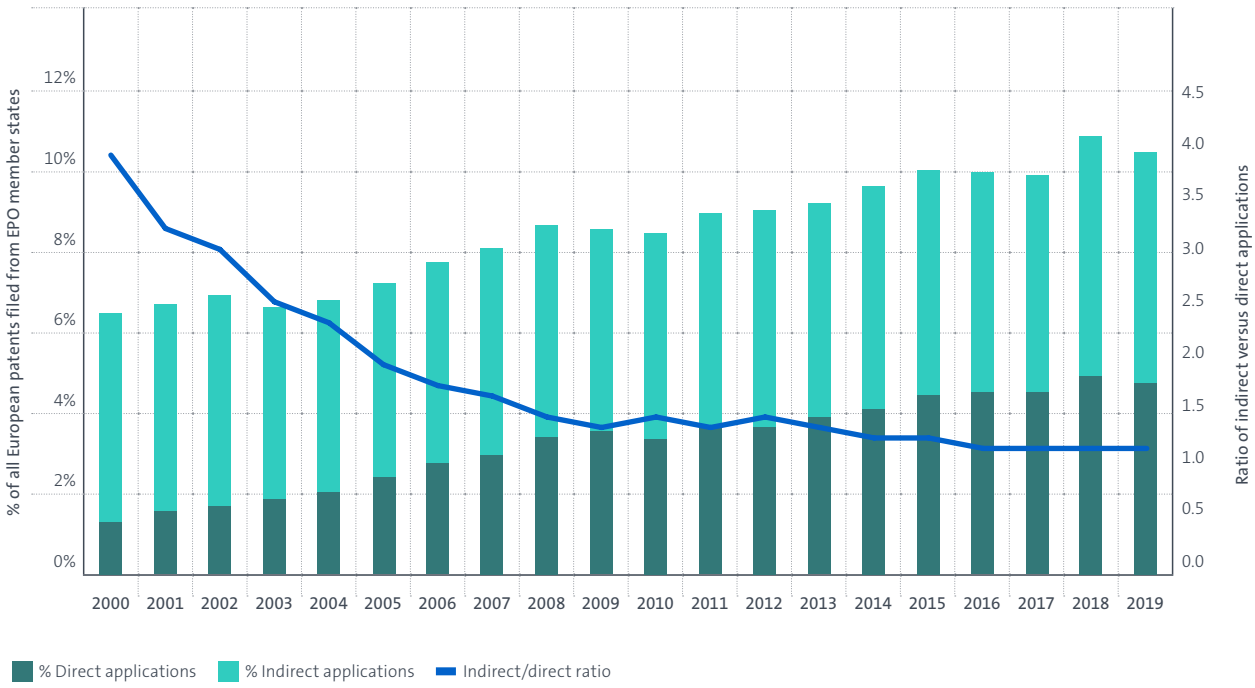
This methodology makes it possible to identify European patent applications that were not filed by universities but include one or more inventors who are affiliated to a university identified as a patent applicant for the purpose of this study. It dramatically changes the perception of the patent footprint of these universities. The number of indirect patent applications originating from European universities actually exceeds the number of the patent applications filed directly by those universities (Figure 2.2.1). Over the whole period 2000–2019 the number of indirect patent applications was about twice that of direct ones.

Adding up both indicators provides a comprehensive measure of the patent footprint of European universities. In 2019 direct and indirect patent applications accounted for 4.75% and 5.72% of all European patent applications filed at the EPO by European applicants respectively, resulting in a combined university footprint of about 10% of all European patents. Interestingly, this combined footprint has been steadily increasing over the period, up from 6.4% in 2000, denoting the growing influence of universities on European innovation ecosystems.

The overall growth of the patent footprint of universities has been driven by an increase in both direct and indirect patent applications. However, the compound annual growth rate of indirect applications over the period 2000–2019 (1.8%) was significantly lower than that of direct applications (8.4%). As a result, direct patent applications represent an increasing proportion of the patent footprint of European universities: up from 20% in 2000 to 45% in 2019. This points to a significant shift in the patent filing behaviour of European universities and an evolution in the way they interact with their innovation ecosystems, which will be further explored in the following sections of this report.

Figure 2.2.1

Academic patents as a share of all European patent applications filed from EPO member states, 2000–2019



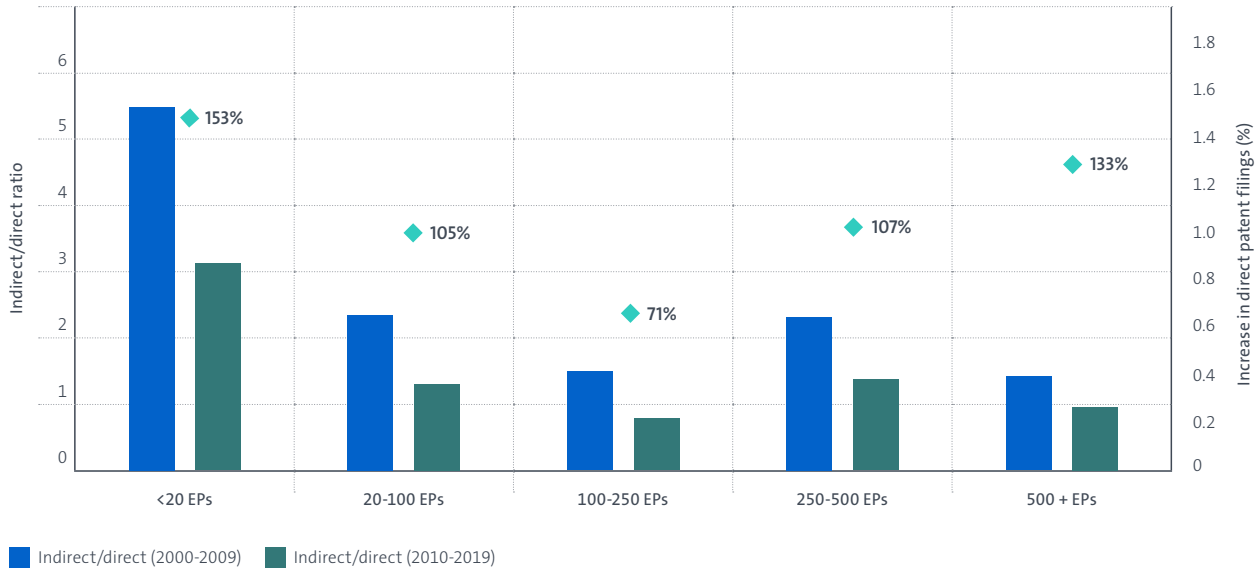
Note: Results for 2020 are not reported due to a time truncation of the data for this year.

Source: ETER, EPO - PATSTAT, Elsevier Scopus

As shown in Figure 2.2.2, this general trend can be observed for all categories of universities, but with different degrees of magnitude. Between 2000–2009 and 2010–2019 the total number of European patent applications filed by universities more than doubled in all categories of university except the median one, in which it nevertheless grew 71%. It increased the fastest in the largest universities (+133%) and the smallest ones (+153%), though from a very low starting point for the latter. At the same time the average number of indirect applications per direct application dropped in all categories, suggesting a substitution effect. The ratio was close to one in most categories in the period 2010–2019. The smallest universities were the only exception. Despite a drop from the previous period, they nevertheless show a much higher ratio of three indirect applications for one application filed in 2010–2019, suggesting that small universities rely more on knowledge transfer channels allowing external stakeholders to appropriate the ownership of academic patents.

Figure 2.2.2

Growth of patent applications by universities and ratio of indirect patent applications to direct patent applications by size of university portfolio, 2000–2009 versus 2010-2019



Note: The bars reported in the chart indicate the ratio of indirect patent applications to direct patent applications in the periods 2000-2009 and 2020-2019 respectively, for each subcategory of university.

Source: ETER, EPO - PATSTAT, Elsevier Scopus

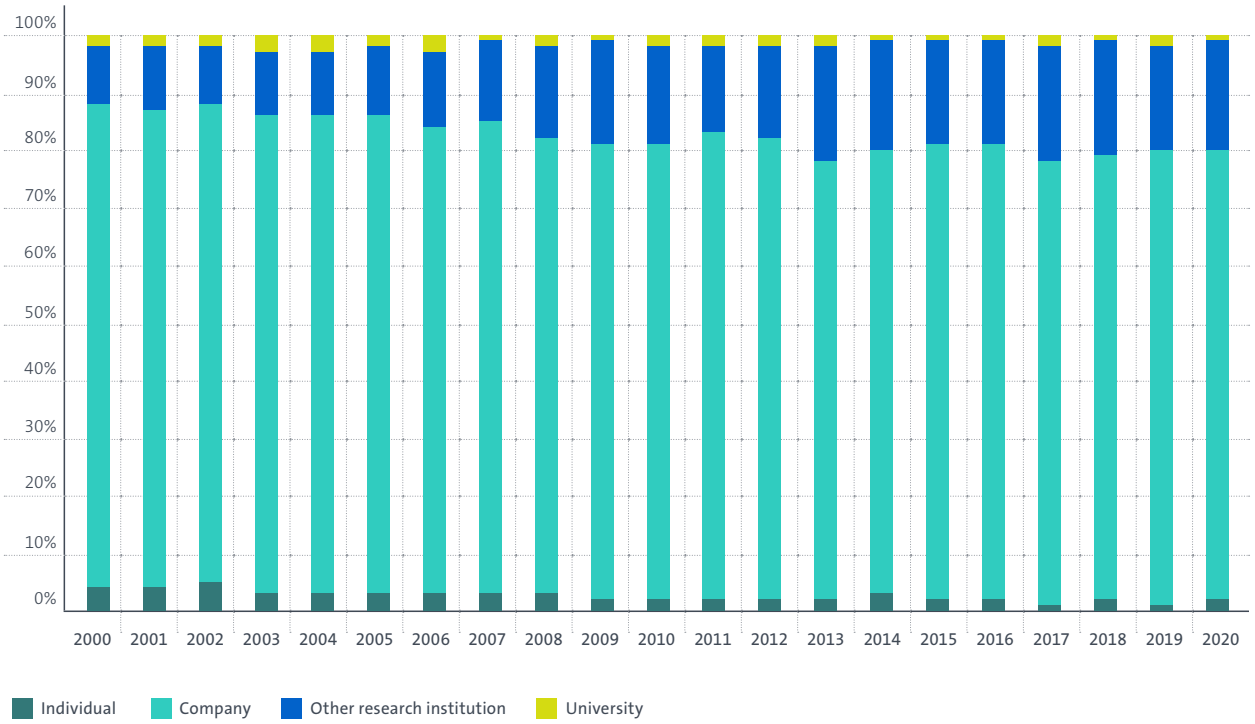
2.3 Profile of indirect patent applications on academic inventions

Because they are filed by entities other than the inventors' university, indirect patent applications provide valuable information on the economic actors university researchers collaborate with, and thus on the channels through which universities impact innovation ecosystems. As shown in Figure 2.3.1, a very large majority (80%) of indirect applications are actually filed by corporate applicants. Other applicants may in some cases be the inventors themselves (as signalled by the "individual" category). They also include universities in other (non-European) countries and other research organisations, typically as a result of the professional mobility of the academic inventors.

The high proportion of corporate applicants illustrates the relevance of indirect patent applications as a measure of the impact university innovation has on industry through channels such as collaborative and contractual research and the job mobility of academic researchers. However, the growing proportion of those applications filed by other research organisations and foreign universities is also worthy of attention, as it suggests a trend towards increasing mobility of research staff between higher education and research institutions.

Figure 2.3.1

Applicant profiles of indirect academic patent applications



Source: ETER, EPO - PATSTAT, Elsevier Scopus

The patent quality indicators reported in Table 2.3.1 provide yet another illustration of the interest of indirect patent applications as an impact metric for universities. The first two rows of the table highlight qualitative differences between ordinary and academic patents. Despite having a lower grant rate, academic patents in general have larger family sizes and more forward citations on average, indicating higher economic value and impact. The last two rows show in turn that these differences are chiefly driven by indirect applications that stem from academic inventors but have been filed by other applicants. The family size and citation metrics are highest in the case of indirect applications, whereas direct applications alone do not appear to be qualitatively superior to ordinary patents. As a matter of fact, they appear to be qualitatively inferior, as measured by the number of patent citations[7]

Table 2.3.1

Qualitative benchmarking of academic patents

	Grant rate	Av. family size	Av. number of citations	% with forward citations	Weighted citation score
All EPC member patents	64.2%	5.57	4.1	62.5%	1.45
All academic patents, of which:	59.5%	5.81	5.6	71.9%	1.72
Indirect applications	*60.3%*	*5.89*	*5.9*	*73.0%*	*1.78*
Direct applications	*56.7%*	*5.29*	*4.6*	*68.9%*	*1.34*

Source: ETER, EPO - PATSTAT, Elsevier Scopus

[7] The lower number of citations received by direct patent applications may reflect recent findings suggesting that patent citations are highly concentrated and mostly originate from business partners (Fadeev, 2023). From this perspective, indirect patent applications filed by companies with well-established networks of customers and partners would likely attract more citations than those filed directly by universities.

2.4 Technology fields of academic patents

Using the World Intellectual Property Organization's classification of technology fields and sectors (Schmoch, 2008), Figure 2.4.1 shows the distribution of academic patents[8] across 35 broad technological fields, along with the relative specialisation index for each field compared to total EP filings (a value over one, indicated in blue, signifies that academic patents are over-represented in that field). Academic patents appear to be over-represented in the medicine and biology sectors, such as biotechnology, optics, pharmaceuticals and medical technology, as well as semiconductors, digital communication and computer technologies, and measurement. In contrast, universities are relatively less active applicants in more engineering-focused sectors like transport or electrical machinery compared to overall European patent applications.

Figure 2.4.1

Distribution by technology field in EP academic patents, 2000–2020

Note: The colour of the boxes show the relative specialisation index, which is calculated as the share of EP applications identified as academic patents in that particular field relative to the share of the overall EP applications in that particular field. Technology fields in which universities show a relative specialisation are coloured in blue. Technology fields in which universities show a relative lack of specialisation are coloured in green. Technology fields where universities show a similar specialisation as the overall EP patents are shown in white.

Source: ETER, EPO - PATSTAT, Elsevier Scopus

[8] The distribution of academic patents between technology sectors is very similar when considering indirect and direct applications separately.

Box 2: Innovation in basic research

While applied research is essential for bringing innovations to market, it is basic research that expands the knowledge base needed for breakthroughs. The development of COVID-19 vaccines is a good example, where decades of accumulated academic knowledge enabled the rapid development of mRNA technologies to fight the pandemic. This illustrates how basic research, though not tied to specific products or countries, spreads widely and remains relevant for longer periods.

Academic patents often reflect the basic research found in academic papers and are direct evidence of the main developments in university labs. According to most linear innovation models, technology development cycles often begin with "science-pushed" innovations, followed by a surge in applied research driven by market needs. This cyclical nature, combined with feedback loops, means that the impact of basic research can span several decades, laying the groundwork for future patent growth and business developments. This sort of innovation path, driven by basic science and technology, has been found using patent data, academic publications, trademark applications and trade results in technology sectors as different as robotics (Schmoch, 2008), IT (Häring et al., 2007) and energy (Bradke et al., 2007).

The European Commission has identified key enabling technologies (KETs) – critical sectors that drive growth in other fields, including areas like nanotechnology, photonics and advanced materials. KETs typically follow a science-driven technology path, where innovations originating from scientific research in universities are crucial for market development and growth (Frietsch et al., 2022). Similarly, research using complexity estimators has demonstrated that academic basic research is often more complex and more closely linked to future growth than applied or business-driven innovation (Hausmann et al., 2024).

Table 2.4.1 shows in turn the relative specialisation of European universities – grouped by range of their number of academic patents – in selected technology fields. Blue cells indicate that the proportion of academic patents in a field is smaller than the total distribution, while green cells point to a higher concentration of academic patents in the field. Cells in white indicate that that group of universities showcase the same levels of specialisation in the field than the average university.

Table 2.4.1

Relative specialisation by range of universities' numbers of academic patents in selected technology fields, 2000–2020

Technology field	No. of academic patents	Universities by number of academic patents: <20	20–100	100–250	250–500	>500
Furniture, games	576					
IT methods for management	533					
Machine tools	1 476					
Civil engineering	1 220					
Control	2 087					
Food chemistry	2 748					
Environmental technology	2 056					
Transport	2 569					
Mechanical elements	1 547					
Measurement	10 837					
Electrical machinery, apparatus, energy	6 459					
Telecommunications	3 511					
Micro-structural and nano-technology	1 641					
Analysis of biological materials	8 832					
Pharmaceuticals	24 944					
Biotechnology	22 870					
Audio-visual technology	2 786					
Semiconductors	4 728					

Note: Technology field groups in which a group of universities shows a higher than average specialisation rate are shown in blue; those in which a group of universities show a lower than average specialisation are shown in green. White indicates that the group of universities have a similar specialisation rate than the average.

Source: ETER, EPO - PATSTAT, Elsevier Scopus

The heat map reveals that universities which file relatively few patent applications tend to focus on a number of fields such as machine tools, civil engineering and furniture that are closer to engineering than to basic science. By contrast, universities that are amongst the most active applicants tend to be less specialised due to their large size. Nevertheless, they show (often exclusive) patterns of specialisation in fields that are more science-based, such as audio-visual technologies, telecommunications, nanotechnologies, pharmaceuticals and biotechnology.

Case study: fos4X

Company:	fos4X
Headquarters:	Munich, Germany
Founded:	2010
Products:	Fibre optic measurement technology and measurement solutions for wind turbines
Full case study:	https://link.epo.org/elearning/technology_transfer_case_study_fos4x_en.pdf

"I encourage all my research students to think about IP protection from the outset. Six successful startups are living proof of how important this is!"
Alexander Koch, co-inventor, professor at the Technical University of Munich and European patent attorney

A group of young researchers had been exploring applications for optical sensors across various industries, guided by their professor, who is also a European patent attorney. They founded fos4X and decided to focus their attention on wind turbine applications. Their strong IP portfolio was crucial in demonstrating professionalism and competitiveness to large companies and played a key role in fos4X's eventual acquisition by a large wind power equipment supplier.

The right team for the job

Lars Hoffmann, Mathias Müller, Thorbjörn Buck, Rolf Wojtech and Markus Schmid were PhD students at the Institute for Measurement Systems and Sensor Technology at the Technical University of Munich (TUM) under Professor Alexander Koch. Together, they researched the potential of optical sensors in several industries and developed sensors for detecting lightning strikes on wind turbines.

While the young team had thought of starting a company, securing investors was challenging during the financial crisis in 2008 and given the new and untested nature of their technology. Lars Hoffmann had completed his studies and was at a management consultancy, but continued to meet his former colleagues to work on the project. Professor Koch encouraged the team to focus on intellectual property from the start, leading to their first patent application in 2009.

Finding funding

In 2010 they secured an EXIST Business Start-up Grant,[9] which was conditional on them having a business-savvy partner and access to the university's IP. Lars Hoffmann joined fos4X full-time, meeting the first condition.

The company signed a contract with the university, securing rights to its IP through an exclusive licensing agreement, which was important for investors. fos4X continued its research, participated in startup competitions and maintained access to university facilities even after moving to their own premises in 2012. Their first major contract was with Nordex, supplying systems for active load reduction in wind turbines. By 2016, fos4X's sensors were installed on existing turbines, primarily for ice detection and vibration measurement, generating additional income through related projects.

Shifting ambitions

fos4X expanded its patent portfolio as new technologies emerged, protecting its inventions in Europe, the US, and other key markets such as China. Initially aiming to develop a platform technology with wide-reaching applications, the company shifted its focus to wind energy by developing durable fibre optic sensors for rotor blades to overcome the limitations of traditional sensors. This strategic focus allowed fos4X to scale up and produce high-quality, competitively priced products.

Despite regulatory challenges, fos4X continued to secure funding for growth. In 2016 the company sold a non-core patent, providing a critical financial boost at a time when some co-founders had left, making it difficult to secure additional investor funding. This sale was pivotal in maintaining the company's momentum. fos4X raised EUR 8.5 million in Series B funding in 2018, and by 2020 had grown to around 100 employees and achieved revenue of EUR 11 million.

In the same year the company was acquired by PolyTech, a Danish firm specialising in products and systems for the wind power industry. The acquisition was driven by fos4X's innovative technology and comprehensive IP portfolio, which included nearly 200 patents across approximately 80 patent families at that time. The integration included incorporating fos4X's IP and innovation management system into PolyTech, allowing the continued development of intelligent sensors and software solutions, and demonstrating the enduring value of a well-managed IP strategy.

[9] For more information see the website of the Federal Ministry for Economic Affairs and Climate Action.

3. Academic patents in European countries

This section documents trends in academic patenting at the level of European countries. It first analyses geographic distribution across countries and regions. Building on the indicators introduced in the previous section, it then explores and benchmarks patterns of academic patenting between countries, highlighting common trends and persistent differences across a diversity of national academic systems.

3.1 Academic patenting across European countries and regions

Figure 3.1.1 and Table 3.1.1 summarise the distribution of universities and related academic patents (pooling both indirect patent applications and direct patent applications) across European countries.

Figure 3.1.1

Distribution of academic patents by European universities and countries, 2000–2020

Note: The name of the university with the largest number of academic patents in each country is shown in the corresponding cell where possible. For deeper insights into universities by number of academic patents per country, see Annex 2.

Source: ETER, EPO - PATSTAT, Elsevier Scopus

While France ranks first in terms of number of universities with patent applications at the EPO, Germany is the leader by number of academic patents generated by domestic universities. Both countries have a larger share of academic patents than patenting universities, denoting the presence of universities with large patent footprints (Figure 3.1.1). However, there is hardly any difference in the case of France (17.87% versus 17.97%), but the difference is very important in the case of Germany (15.79% versus 24.09%).

More generally, countries like Belgium, Switzerland, Denmark, Finland, the Netherlands and Sweden show a share of all academic patents that significantly exceeds their share of all universities. This seems largely correlated with the presence of large university applicants (>250 applications) in these countries. In contrast, relatively small countries without a large university tend to have a lower share of all academic patents.

Table 3.1.1

Distribution of universities and academic patents between European countries, 2000–2020

	Universities with one or more direct European patent applications		Academic patents		Av. number of academic patents per university	Universities with at least 250 direct patent applications	Academic patents as a % of all European patents filed by domestic applicants
Country	Total	%	Total	%			
AL	1	0.08%	2	0.00%	2.0		16.7%
AT	33	2.74%	3 215	3.00%	97.4	1	10.2%
BE	26	2.16%	4 736	4.42%	182.2	6	16.6%
BG	13	1.08%	163	0.15%	12.5	-	36.9%
CH	25	2.08%	6 103	5.69%	244.1	3	6.0%
CY	7	0.58%	45	0.04%	6.4	-	5.9%
CZ	19	1.58%	704	0.66%	37.1	-	23.3%
DE	190	15.79%	25 822	24.09%	135.9	12	5.8%
DK	19	1.58%	4 394	4.10%	231.3	2	17.6%
EE	5	0.42%	190	0.18%	38.0	-	36.0%
ES	75	6.23%	3 460	3.23%	46.1	-	14.6%
FI	24	2.00%	3 350	3.13%	139.6	-	10.0%
FR	215	17.87%	19 265	17.97%	89.6	15	10.9%
GR	18	1.50%	340	0.32%	18.9	-	20.9%
HR	4	0.33%	57	0.05%	14.3	-	14.8%
HU	22	1.83%	833	0.78%	37.9	-	43.0%
IE	18	1.50%	1 715	1.60%	95.3	1	16.7%
IS	2	0.17%	8	0.01%	4.0	-	1.1%
IT	79	6.57%	7 088	6.61%	89.7	1	8.6%
LT	9	0.75%	212	0.20%	23.6	-	4.8%
LU	1	0.08%	70	0.07%	70.0	-	17.8%
LV	8	0.67%	174	0.16%	21.8	-	2.7%
MT	1	0.08%	16	0.01%	16.0	-	2.2%
NL	20	1.66%	4 898	4.57%	244.9	1	5.5%
NO	19	1.58%	994	0.93%	52.3	-	10.9%
PL	71	5.90%	1 341	1.25%	18.9	-	25.2%
PT	39	3.24%	818	0.76%	21.0	-	34.2%
RO	19	1.58%	191	0.18%	10.1	-	43.1%
RS	1	0.08%	7	0.01%	7.0	-	5.6%
SE	35	2.91%	6 356	5.93%	181.6	-	10.0%
SI	6	0.50%	315	0.29%	52.5	-	16.8%
SK	8	0.67%	92	0.09%	11.5	-	15.4%
TR	40	3.33%	456	0.43%	11.4	-	6.3%
UK	131	10.89%	13 144	12.26%	100.3	4	13.9%
Total	**1 203**		**107 198**		**89.1**	**45**	**8.7%**

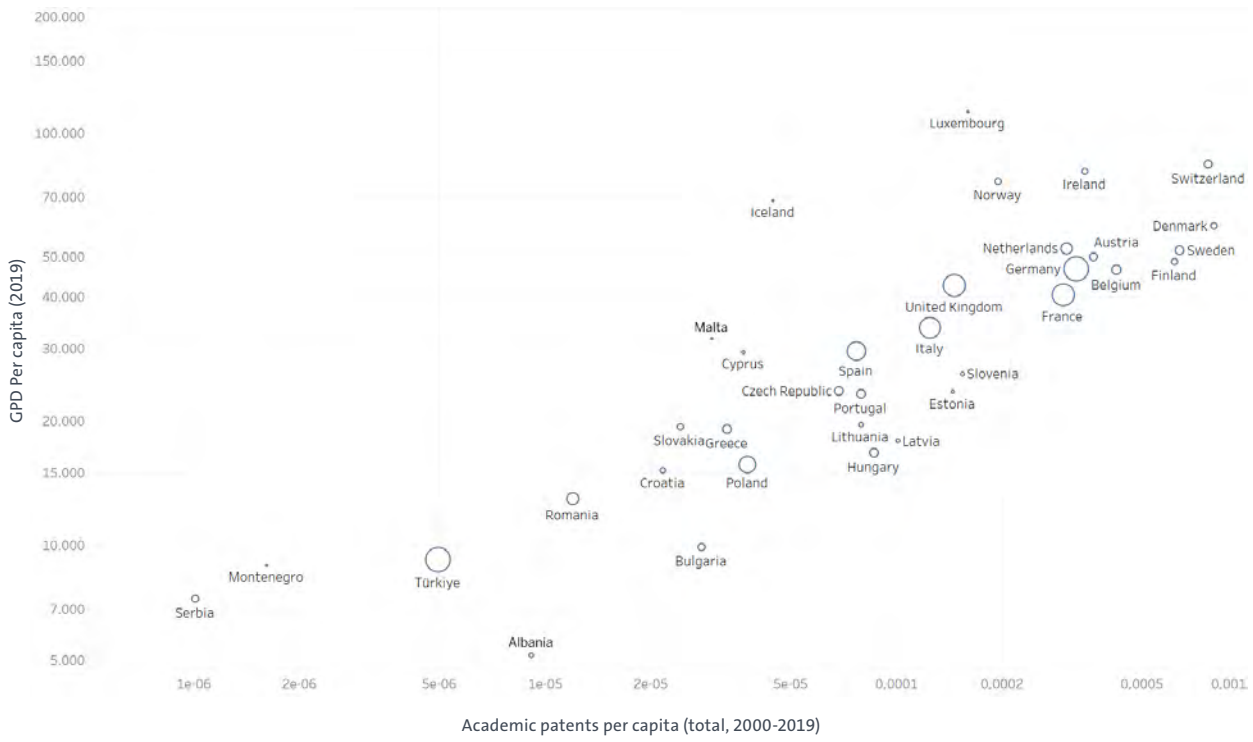
Source: ETER, EPO - PATSTAT, Elsevier Scopus

However, important exceptions can also be observed. Apart from France, the presence of large university applicants does not appear to significantly increase the share of all academic patents in Austria, Italy and UK. Conversely, Sweden and Finland perform particularly well in terms of share of academic patents but have no large university applicant.

Figure 3.1.2 offers a different perspective by casting the number of academic patents per capita in each country against GDP per capita. The number of academic patents per capita provides a measure of the relative impact of academic patenting in each country, independently of its size. It reveals a strong performance by relatively small European countries, including Switzerland, Denmark, Sweden, Finland, Belgium and Austria, followed by the larger Germany and France, on a par with the Netherlands.

Figure 3.1.2

Academic patenting versus GDP and population in European countries, 2000–2020



Note: The size of the plots shows the population size of each country; both variables are shown on a logarithmic scale.

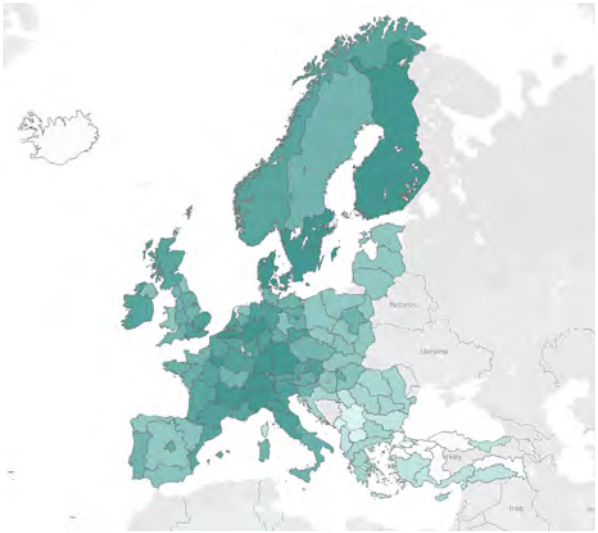
Source: EPO, World Bank Indicators

A closer analysis at the regional level confirms this finding, with a strong concentration in the most economically developed regions of Europe (Figure 3.1.3). The number of academic patents within EPO countries is displayed across NUTS-1 regions in Figure 3.1.2. Central European countries along a North-South axis, plus the United Kingdom, file the largest number of academic patents. There are also significant contributions from the Northern European countries and Northern Italy; the absolute number of academic patents from Central and Eastern European countries is considerably smaller, at least when focusing on EPO filings.

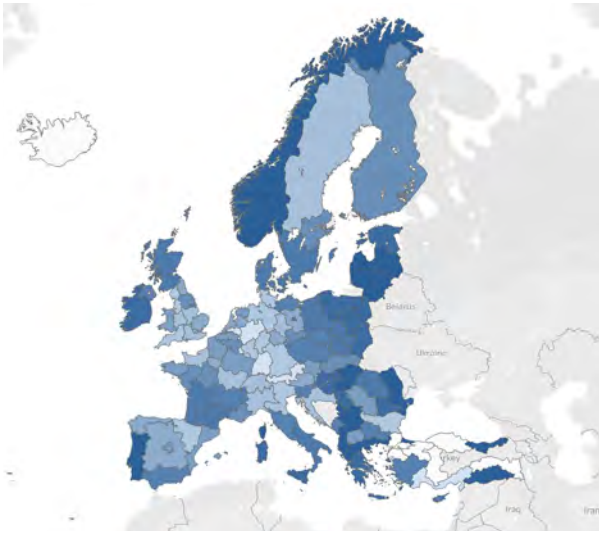
Figure 3.1.3

Academic patenting by European regions: number of European patents by NUTS 1 region, 2000–2020

Number of academic patents filed at the EPO by NUTS 1 region



Academic patents as a share of total patent filings at the EPO by NUTS 1 region



Notes: The darker the colour, the larger the plotted value. This map only shows regions from EPO member states with registered European patent applications from 2000 to 2020 as a priority year. In map 1, regions are shown in colour by 10 quantiles (10%) of total academic patents per region.

Source: EPO - PATSTAT, Elsevier Scopus

This picture changes when we focus on shares of academic patents in total patent filings rather than absolute filing numbers. Figure 3.1.3. shows that universities are key pillars of local innovation ecosystems in less economically developed regions. The countries with the largest share of academic patents in their total patent portfolio are in Central and Eastern Europe: Hungary, Romania and Lithuania are at the top of the list. In these countries, the share of academic patents exceeds 40%, i.e. more than 40% of these countries' patent filings are either filed by a university or a university member is listed as an inventor on the patent filing. This share is much smaller for the larger countries, despite higher absolute numbers of academic patents, because an even larger number of patent applications are filed by industry applicants in these countries. Germany for example has a share of 5.8% (below average), while the United Kingdom and France have shares of 10.9% and 13.9%, respectively (above average).

3.2 Different national models of academic patent ownership

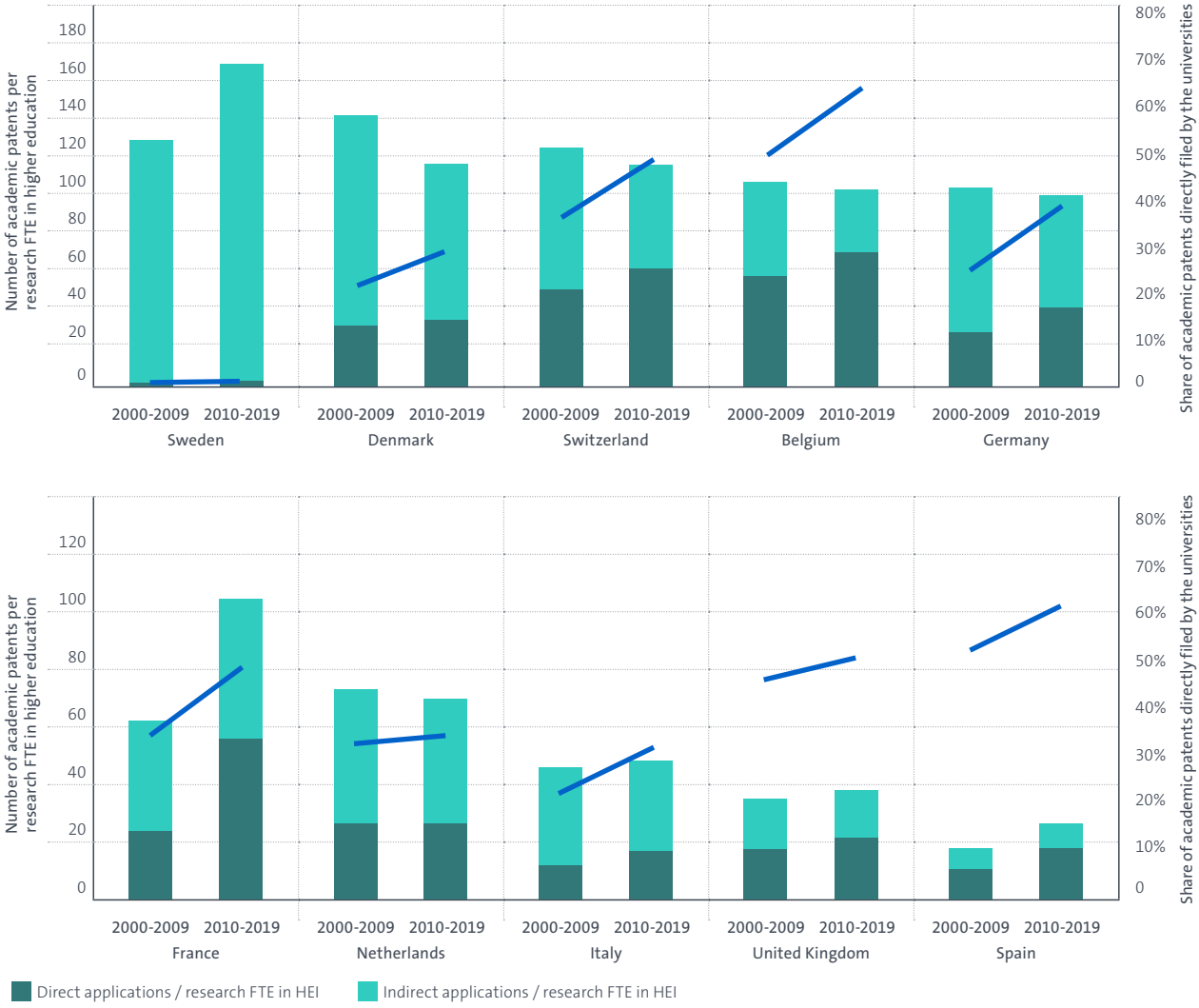
To compare the productivity of universities between countries, we consider an ad hoc productivity index defined as the ratio of total number of academic patents to number of FTE staff employed for research activities in higher education institutions. This indicator is reported in Figure 3.2.1 for the periods 2000–2009 and 2010–2019 in the ten countries with the highest absolute numbers of academic patents. It is then further decomposed into direct and indirect patent applications, making it possible to keep track of the proportion of each subcategory in the country's overall score.

The country ranking resulting from this indicator is very close to that obtained with academic patents per capita (see Figure 3.1.2). Sweden, Denmark and Switzerland are in the leading positions, with the highest numbers of academic patents per FTE. They are followed by Belgium, Germany, France and the Netherlands with roughly similar productivity scores. Italy, the United Kingdom and Spain complete the ranking, with relatively low numbers of academic patents per employee.

While Sweden, France, and to a lesser extent Italy experienced an increase in their productivity index from one period to the next, five of the ten countries listed (including four of the most productive ones) show a decrease in academic patent productivity between 2000–2009 and 2010–2019. This apparent decline in university research productivity is consistent with a broader, secular decline in research productivity observed in recent studies (Bloom et al., 2020). The causes are not further explored in this study.

Figure 3.2.1

Academic patents per research FTE in higher education in the top 10 countries, 2000–2009 versus 2010–2019



Note : The figure is based on counts of European patent applications directly or indirectly generated by universities. The top 10 countries are ranked in the figure by their total number of academic patents over the combined periods 2000–2009 and 2010–2019. The absolute levels of productivity reported by country and time period do not take into account other academic inventions stemming from universities for which patent applications have been filed only at their respective national offices.

Source: EPO - PATSTAT, Elsevier Scopus, Eurostat

The distinction between direct and indirect patent applications offers a number of valuable insights into these trends, highlighting the specificities of the underlying national institutional models. Sweden stands out as a country in which university researchers have a particularly high patent footprint, despite hardly filing any of these patents. It is the only country where the professor's privilege which allows university researchers to enjoy full rights to their inventions is fully in force.

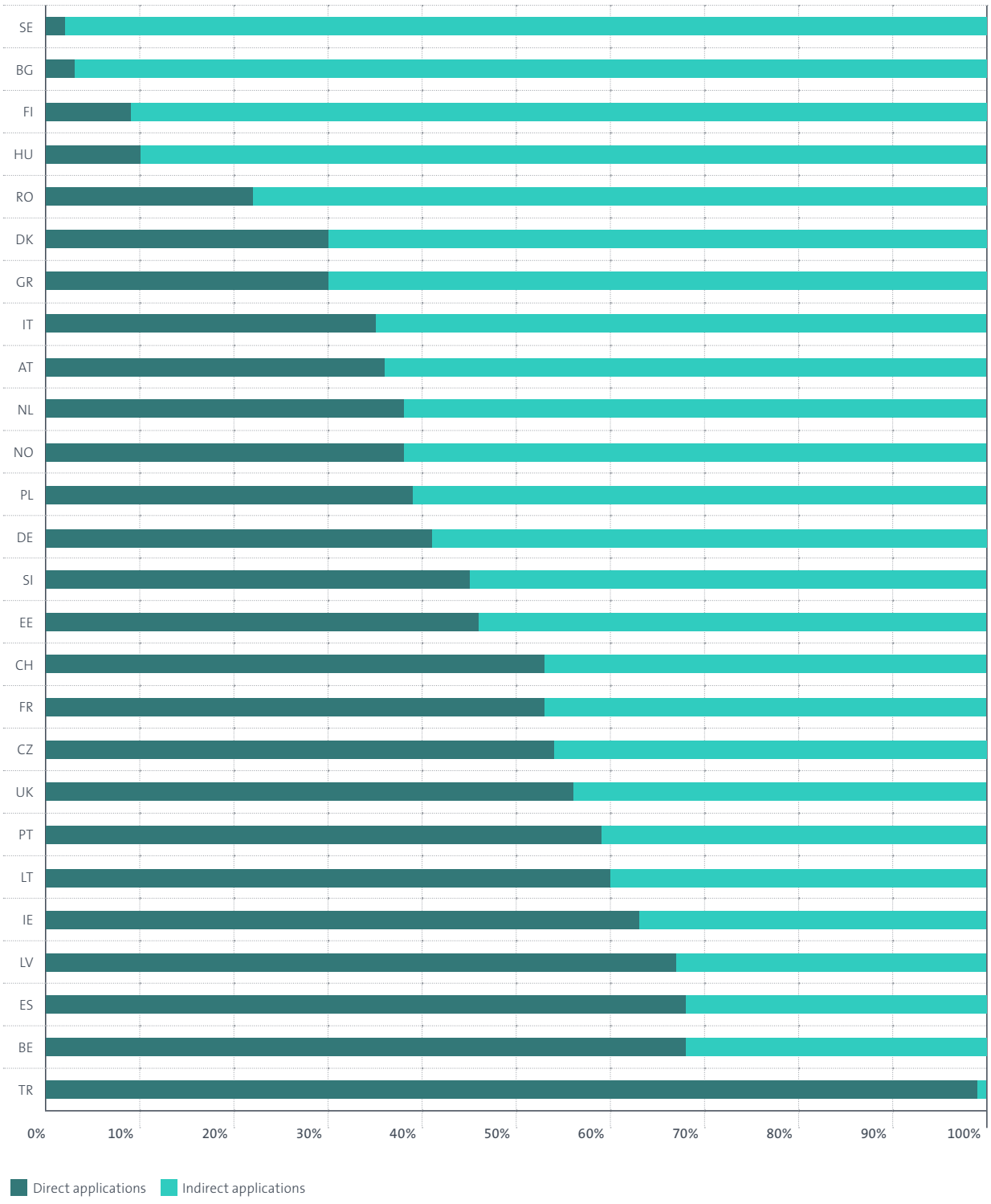
By contrast, other countries have either abolished the professor's privilege regarding patent ownership (Denmark in 2000, Germany in 2002, Norway in 2003), or never had it in the first place, and have gradually strengthened institutional ownership controls to make commercialisation and technology transfer one of their principal missions (Iversen et al., 2007; Martinez and Sterzi, 2020). This is apparent in Figure 3.2.1: eight of the ten countries (Germany, France, the UK, Italy, Switzerland, Belgium, Denmark and Spain) show a significant increase of the share of academic patents directly filed by universities. Besides a larger number of direct applications per FTE, this trend often goes along with a decrease or stagnation in the number of indirect applications per FTE – suggesting a substitution effect between the two types of academic patents. The net effect on the overall number of academic patents per FTE appears to be negative in five countries (Denmark, Switzerland, Belgium, Germany and the Netherlands), whereas a net increase can be observed only in Sweden and France.

While there is a general trend towards more frequent ownership of academic patents by universities, Figure 3.2.1 reveals persistent heterogenity among the ten largest European countries. Countries differ significantly in terms of both levels of academic patenting per FTE and the share of those patents filed directly by the universities. This observation is equally valid for other European countries.

Figure 3.2.2 shows for instance that the share of academic patents filed by universities in the period 2010–2019 varies even more widely when all EPO member states are taken into account. The figure ranges from 99% in Türkiye and 68% in Belgium and Spain, to 9% in Finland, 3% in Bulgaria and 2% in Sweden. Such heterogeneity highlights the persistent fragmentation of the institutional framework of European university systems, despite the converging steps undertaken since 2000 to foster university ownership of academic inventions.

Figure 3.2.2

Proportion of direct patent applications and indirect patent applications in selected European countries, 2010–2019



Note: Chart shows European countries with at least 100 academic patents identified over the period 2010–2019.

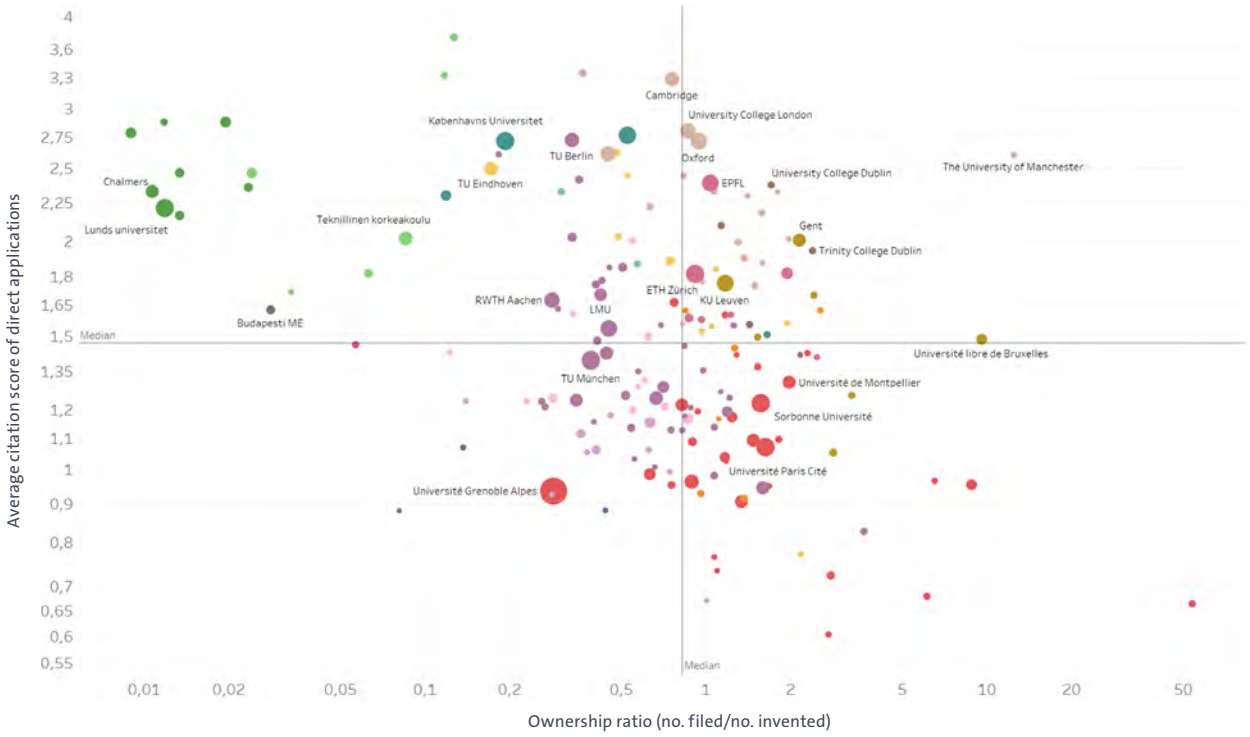
Source: ETER, EPO - PATSTAT, Elsevier Scopus

Figures 3.2.3 and 3.2.4 provide further insights into cross-country differences in universities' patenting behaviour during the period 2010–2019. Both figures map academic patents generated by national universities against an ownership ratio (measuring the universities' propensity to file academic patents directly) on the X axis and a normalised citation index[10] for direct patent applications (as a proxy for their impact on subsequent innovations) on the Y axis.

Figures 3.2.3 focuses on the largest universities (with a track record of at least 100 academic patents) – each represented by a bubble, the size of which is proportional to the number of academic patents stemming from the university. The distribution across quadrants suggests a negative correlation between universities' propensity to own academic patents and the average citation impact of the patents filed by those universities. In other words, universities that file only a small share of their staff's inventions tend to select high potential inventions that are more likely to be cited later on. In contrast, the patent portfolios of universities that file patent applications for most of their academic inventions are more likely to include patents with lower citation impact.

Figure 3.2.3

Top university applicants: share and citation score of direct applications filed by universities, 2010–2019



Note: Logarithmic scales. The size of the circles is proportional to the number of academic European patents originating in each university in the period 2010–2019. Only universities with at least 100 academic patents recorded in the period are shown.
The country colours are aligned with those of figure 3.2.4

Source: EPO - PATSTAT, Elsevier Scopus

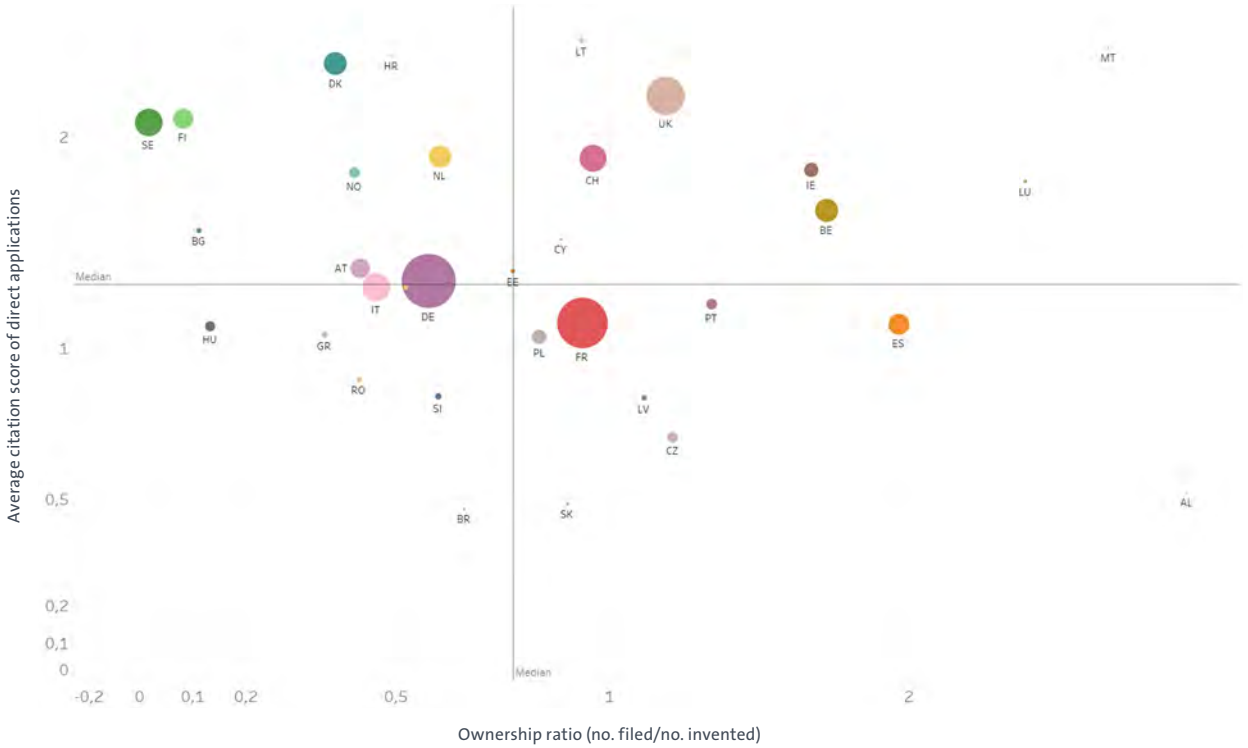
[10] The index attributes a citation score to each patent application, taking into account its age (priority date) and technical field, with a view to enabling sound comparisons between different age cohorts and technical fields.

The colour codes used to identify universities' countries in turn reveal a consistent pattern of national models. On the one hand, those in Sweden (where professor's privilege is in force) and other Nordic countries (Finland, Denmark) are located in the top left quadrant, denoting a consistent model of selective appropriation of a small share of high-value inventions. On the other hand, French and Spanish universities show the highest ownership ratio but relatively low average citation scores. Most other European universities are located within a relatively narrow range for the ownership ratio, with a slightly higher propensity to own academic patents among those in Germany, the Netherlands and Austria. However they significantly diverge with respect to citation scores: UK and Danish universities show the highest average citation impact, followed by Swiss, Dutch, Belgian and Irish ones.

Figure 3.2.4 displays similar results aggregating all academic patents at country level. Covering all universities now, it confirms the position of Sweden, Finland, Denmark, Norway and Hungary as the countries with the lowest ownership ratios and highest citation score for patent applications directly filed by universities. At the opposite end of the scale, Spain, France, Portugal, the Czech Republic, Latvia and Slovakia show the highest ownership ratios and lowest citation score of direct applications. UK, Belgian, Irish and Swiss universities combine relatively high ownership ratios with high citation scores. Germany, Italy and Austria are in a median position with respect to both indicators, with the Netherlands showing a similar ownership ratio but a higher average citation impact.

Figure 3.2.4

University profiles at the country level: share and citation score of direct applications filed by universities in different EPO member states, 2010–2019



Note: Logarithmic scales. The size of the circles is proportional to the number of academic European patents originating in each country in the period 2010–2019. Türkiye is an outlier, with an ownership ratio of 91 and a citation score of 0.6929, and not shown.

Source: EPO - PATSTAT, Elsevier Scopus

Box 3: Academic patent ownership and professor's privilege

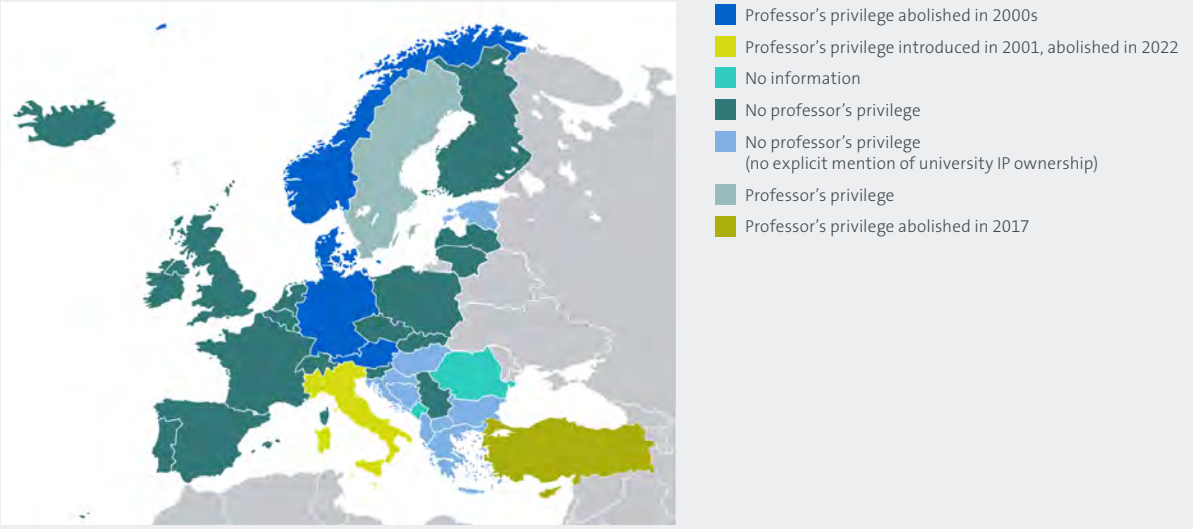
Among the many factors influencing the processes of knowledge transfer through universities, a crucial aspect shared across all legal systems is ownership of IP rights to research outcomes. According to the patent law, the right to the invention is for the inventor. However, since the early 2000s many European countries have shifted away from a model where inventors retain ownership of patent rights, opting instead for frameworks that emphasise university ownership. Inventor ownership, often referred to as "professor's privilege," occurs when researchers hold the rights to inventions produced through publicly funded research, rather than the institutions where the research is conducted. In contrast, university ownership assigns these rights to the institution where the researcher is employed or studying (Geuna and Rossi, 2012).

Historically the concept of professor's privilege was prevalent in German-speaking and Nordic countries. Inventions by scientists working in public research facilities or private industry were typically owned by their employers. Denmark was the first to abolish professor's privilege, in 2000, favouring university ownership, followed by Germany, Austria, Norway and Finland between 2001 and 2007. Italy is an exception, having introduced professor's privilege in 2001 to address the perceived failure of universities to effectively commercialise academic inventions (Boni, 2023), but then abolished it in late 2023, following the general European trend. Sweden retains professor's privilege and has no plans for abolition (ibid.; Geuna and Rossi, 2011; Martinez and Sterzi, 2020).

The map below shows reforms and current legislation with regards to academic patenting in European countries. National legislation on professor's privilege is broadly uniform, with countries preferring to abolish it or to maintain systems where university ownership is preferred. However, application of professor's privilege varies across countries, influenced by the structure of their university systems and the degree of flexibility and autonomy granted to universities in national frameworks. A survey conducted by the EPO in collaboration with 19 national patent offices and distributed to 134 universities in European countries reveals that universities often have their own internal policies regarding IP assets.[11] These may allow implementation of professor's privilege in specific cases or permit joint ownership between university and researcher, even in countries where privilege is not enacted at the national level. This practice is observed in certain universities in France, Türkiye, Portugal, Greece and Slovakia; final ownership can be decided by agreement between researcher and university in specific cases.

Figure 3.2.5

Countries in Europe according to the current national legislation on ownership of academic IP (professor's privilege)



Note: For further details, see Annex 4.

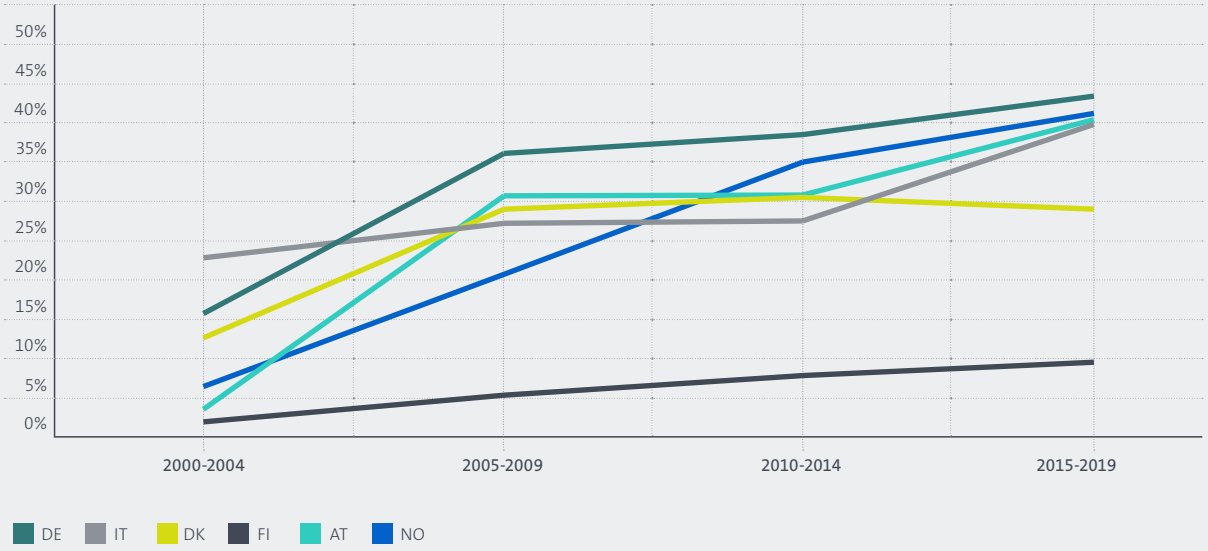
Source: EPO

[11] For more information on the EPO survey including questions and overview of main results, Annex 3.

As shown in Figure 3.2.6, reforms towards abolishing professor's privilege led to a strong increase in the share of academic patents directly filed by universities in Germany, Austria and Norway, where it converged towards 40% in 2015–2019. There was only a small effect in Finland, with a modest increase to just 10% in 2015–2019. Denmark shows a singular trajectory, with a plateau at about 30% after an initial increase following the reform of 2000. In Italy, although professor's privilege was established in 2001, the legislation proved unpopular and professors were unwilling to own and invest in the IP assets of their research output (Mundell, 2022), as can be seen in the graph below. The legislation was made more flexible in 2005, and finally abolished in 2023.

Figure 3.2.6

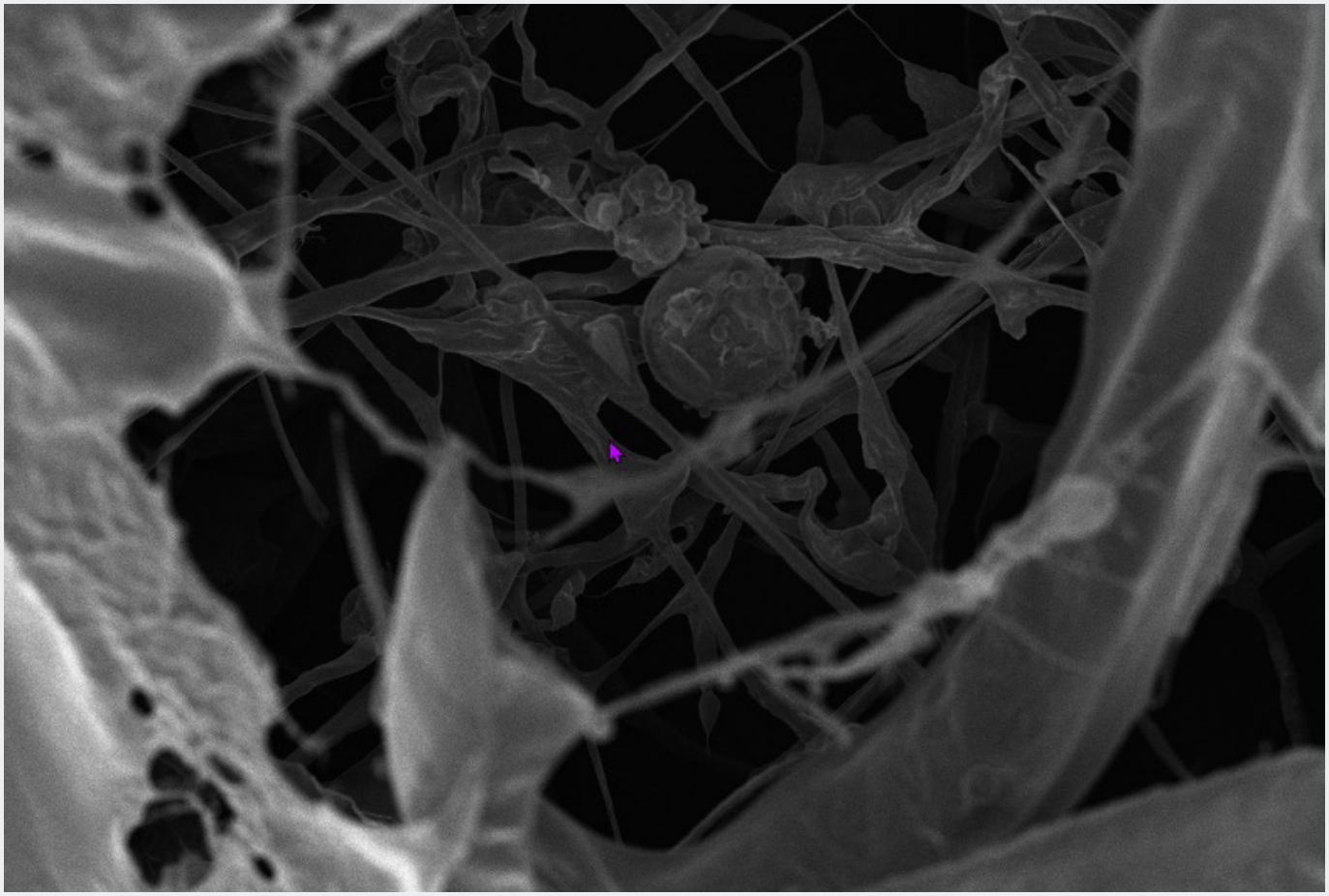
Share of academic patents directly filed by universities in countries that abolished professor's privilege (5-year averages 2000–2020)



Source: EPO - PATSTAT, Elsevier Scopus

In countries like France, the UK, Spain, Switzerland and Türkiye, where university ownership was already established as a general practice, universities were prompted to more actively assert these rights by developing KTOs to help commercialise university-based inventions.

These changes were largely inspired by the US experience, where the Bayh-Dole Act of 1980 allowed universities to hold patent rights for inventions arising from government-funded research.



Case study: Dermis Pharma

Company:	Dermis Pharma
Headquarters:	İzmir, Türkiye
Founded:	2016
Products:	Bioactive wound dressing for fast and effective treatment of diabetic wounds and bedsores
Full case study:	https://link.epo.org/elearning/technology_transfer_case_study_dermalix_en.pdf

"A patent is like a birth certificate in the healthcare industry. If the product does not have patent protection, you may lose most of your competitive advantage in the market. If there were no patents, we would not even have a chance to get in contact or co-operate with companies."
Evren Homan Gökçe, Sakine Tuncay Tanrıverdi, Özgen Özer and İpek Eroğlu
Inventors and founders, Dermis Pharma

Four women inventors at a Turkish university developed a ground-breaking product to treat open wounds. Despite securing early IP protection, their initial licensing attempts failed. Undeterred, the team pursued other routes and founded Dermis Pharma through a startup acceleration programme. With strong IP, the startup secured venture capital for clinical trials and product development. A deal with a major Turkish pharma company then accelerated commercialisation through a corporate partnership.

Recognising an urgent need

In 2012 a research team from Ege University including Professors Özgen Özer, Evren Homan Gökçe, Sakine Tuncay Tanrıverdi and İpek Eroğlu began investigating materials that could be integrated into microparticles and scaffolds for treating chronic wounds. They wanted to create biocompatible and biodegradable matrices targeting the global challenge of chronic wounds. With nearly 400 million people worldwide living with diabetes, 10% of them experiencing debilitating foot ulcers, the team recognised an urgent need for innovative wound-healing solutions.

Their research led to the development of a wound dressing that accelerates healing by forming a new tissue layer, reducing infection and scarring. Experiments demonstrated that a single dosage could achieve full wound recovery within two weeks, and as the patch was prepared with natural components, no adverse effects were observed.

Transferring technology and knowledge

At the time, academics in Türkiye were expected to file their own patent applications due to professor's privilege, which was abolished in 2017. The team decided to reach out to the university's KTO for help. After a comprehensive assessment by the IP Commercialisation Committee, the university took over the patenting process and developed a robust IP strategy for global protection.

Setbacks and success

The KTO used the Turkish priority application to file an international application under the PCT, aiming to secure protection in multiple countries. Initially they wanted to license the technology to pharmaceutical companies, as they thought it would be too risky to spin-out and start a company. However, these licensing efforts faltered due to concerns about the technology's readiness.

Attempts to partner with Turkish and global pharmaceutical companies also failed; the "not-invented-here" mindset and the effort required to make the technology market-ready were significant obstacles, despite favourable initial test results. The inventors shifted their focus to establishing Dermis Pharma after receiving an award from a startup acceleration programme. With funding and business development training from the national programme, the team were poised to take their invention further.

Ege University became a shareholder in the spin-out by transferring its patent rights in exchange for equity – a pioneering move in Türkiye's emerging tech-transfer ecosystem. This partnership allowed the KTO to continue supporting the inventors on their entrepreneurial journey. Dermis Pharma's next step was securing venture capital to fund clinical trials and develop its patent portfolio.

After extensive due diligence the company successfully negotiated a deal with the Turkish pharmaceutical leader Abdi İbrahim, which included an IP assignment agreement. This partnership allowed Dermis Pharma to retain its autonomy. The company continued its research and development on the technology, while Abdi İbrahim took on production and marketing. Finally, with CE certification[12] for the European market, the Dermalix wound dressing was launched in Türkiye in 2021 and plans for international expansion are underway.

[12] CE marking indicates that a product has been assessed by the manufacturer and deemed to meet EU safety, health and environmental protection requirements.

4. Academic patents beyond universities

By revealing the partners with which universities and academic inventors carry out inventive activities, academic patents shed light on the channels through which the results of university research are transferred to market. Two main channels are explored in this section. Co-applications between universities and other categories of applicants are a first indicator of universities' propensity to engage in collaborative research with close partners. The analysis of the profile of applicants for indirect academic patent applications sheds light on the broader impact of universities in their respective innovation ecosystems.

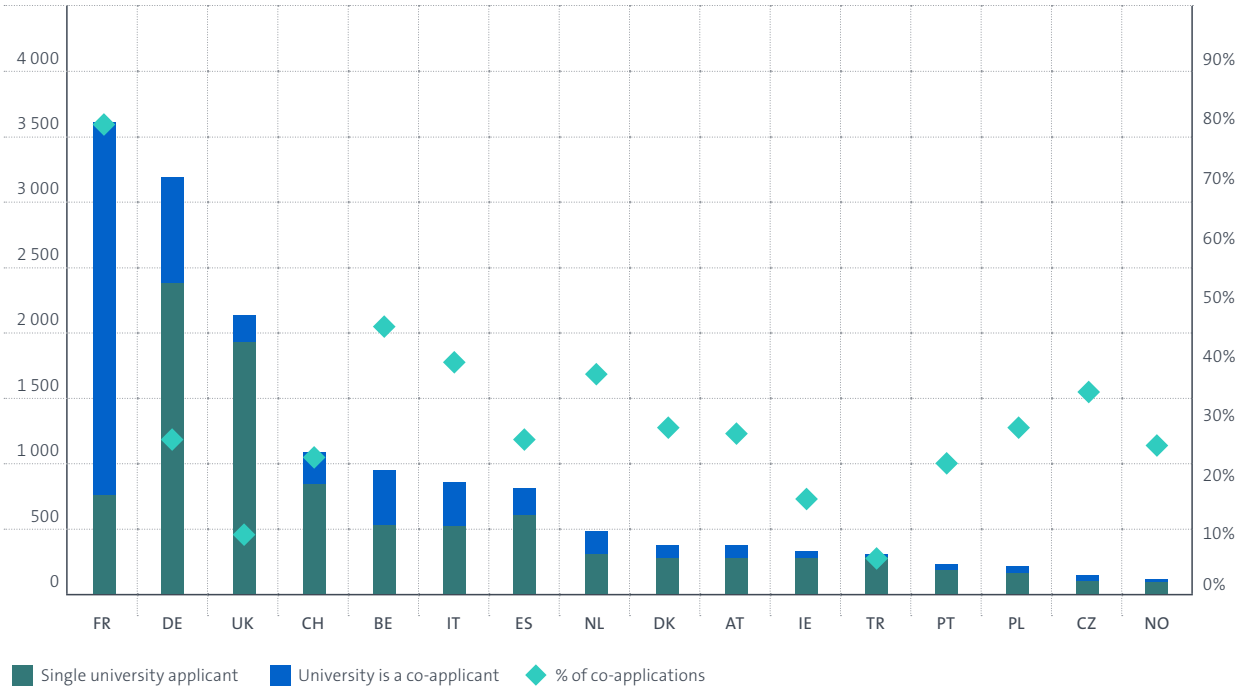
4.1 Universities' co-applicants: the weight of PROs

While patent applications are usually filed by a single person, several entities may also jointly file an application, usually as a result of collaborative innovation. Such co-applications are of particular relevance to EU-funded programmes, joint ventures and more generally to any research project involving co-development of intellectual property. They are especially relevant when the outcome is jointly developed by several partners and their respective contributions to the final work cannot be separated or traced. The management of co-owned patents also raises specific issues whenever decisions on patent prosecution, litigation or licensing have to be made, for example. Co-applicants should therefore agree on the terms of the resulting joint ownership beforehand in a separate framework agreement.[13]

[13] For more information and guidance on these topics, see for instance the Fact Sheet on IPR ownership of the EU IPR Helpdesk (2015).

Figure 4.1.1

Number of direct applications by universities and share of co-application in selected countries, 2015–2019



Note: The selected countries are all EPO member states with at least 100 direct patent applications involving co-applicants in the period 2015–2019.

Source: EPO - PATSTAT, Elsevier Scopus

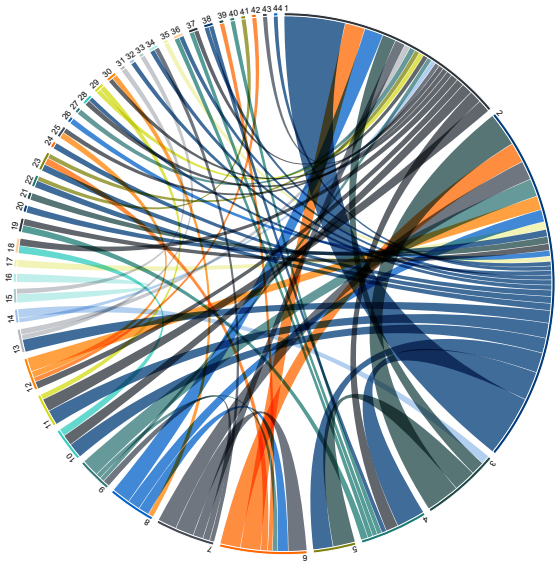
Co-applications by universities and their research partners represented 17% of all academic patents and 36% of the European patent applications directly filed by universities in the period 2015–2019. Since they involve joint research undertakings and elaborate framework agreements, they are a good signal of close collaborations between regular partners. They also provide insights into the institutional frameworks in which universities develop research collaborations.

As shown in Figure 4.1.1, the share of European patent applications filed by universities that are co-applications lies in a range of 20% to 40% in most of the top ten countries in terms of direct patent applications in the period 2015–2019. However, French universities clearly stand out with a very high share of co-applications (79%), thanks to which France also ranks first in terms of applications filed by universities. By contrast, Turkish universities (6%) and British and Irish universities (10% and 16% respectively) make co-applications much less frequently than their European counterparts.

Figure 4.1.2

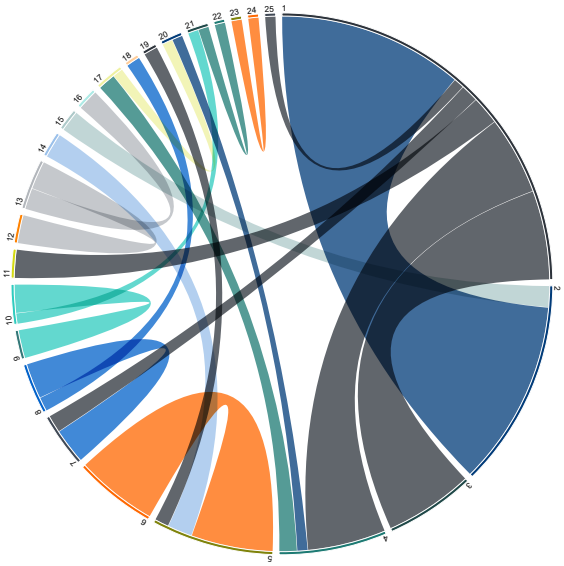
Main pairs of university co-applicants in France and Germany, 2015–2019

France



1 Institut national de la santé et de la recherche médicale (INSERM)
2 Centre national de la recherche scientifique (CNRS)
3 Université de Bordeaux
4 Université Claude Bernard Lyon 1
5 Institut polytechnique de Bordeaux
6 Université Paris Cité
7 Sorbonne Université
8 Assistance publique-hôpitaux de Paris
9 École supérieure de physique et de chimie industrielle de la Ville de Paris (ESPCI)
10 Nantes Université
11 Université de Toulouse
12 Université de Lille
13 Université d'Aix-Marseille
14 Centre Hospitalier Universitaire de Bordeaux
15 Université Grenoble-Alpes
16 Institut polytechnique de Grenoble
17 Commissariat à l'énergie atomique et aux énergies alternatives
18 Centre Hospitalier Universitaire de Nantes
19 École normale supérieure de Lyon
20 Université de Strasbourg
21 Université de Haute-Alsace
22 Université de Montpellier
23 Université Paris-Saclay
24 École normale supérieure (de Paris)
25 Centre Hospitalier Universitaire de Lille

Germany



1 Fraunhofer Gesellschaft
2 Friedrich-Alexander-Universität Erlangen-Nürnberg
3 Technische Universität Dresden
4 Friedrich-Schiller-Universität Jena
5 Deutsches Krebsforschungszentrum (DFKZ)
6 Universität Heidelberg
7 Rheinisch-Westfälische Technische Hochschule Aachen University
8 Forschungszentrum Jülich
9 Ludwig-Maxilillians-Universität München
10 Max-Planck-Gesellschaft
11 Technische Universität Ilmenau
12 Technische Universität Braunschweig
13 Medizinische Hochschule Hannover
14 Eberhard-Karls-Universität Tübingen
15 Uniklinikum Erlangen
16 Leibniz Universität Hannover
17 Leibniz Gemeinschaft
18 Universität Münster
19 Albert-Ludwigs-Universität Freiburg
20 Uniklinikum Jena
21 Technische Universität München
22 Helmholtz Association
23 Philipps-Universität Marburg
24 Justus-Liebig-Universität Giessen
25 Universität Regensburg

Note: The chord diagram for France is based on all pairs of co-applicants that share at least 21 co-applications over the period 2015–2019.
The diagram for Germany is based on all pairs of co-applicants that share at least three co-applications during the same period.

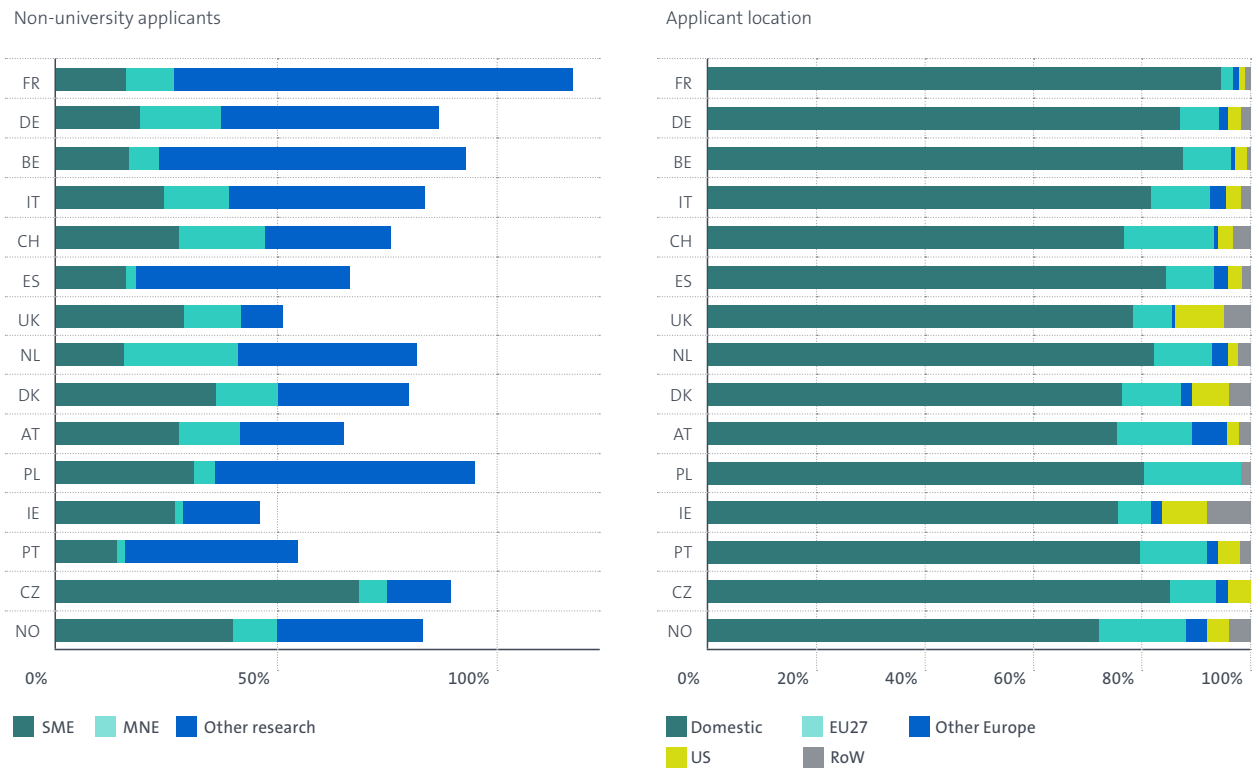
Source: EPO - PATSTAT, Elsevier Scopus

The remarkably high proportion of co-applications filed by French universities is related to the prominent role played by large PROs such as the CNRS, INSERM, INRAE and INRIA in the French university system. These work as research catalysts in their respective specialisation domains, and the best university laboratories are usually co-affiliated with one or more of them. As a consequence, they also have a claim on the inventions produced by these laboratories, along with the university. Their impact is illustrated in the left-hand side of Figure 4.1.2, which maps pairs of co-applicants sharing at least 21 academic co-applications in the period 2015–2019. The CNRS has strong connections with 26 different French universities and INSERM with 29, whereas similar connections between universities are relatively scant. In comparison, the right-hand side of the figure shows pairs of German co-applicants sharing at least three academic co-applications in the same period. The Fraunhofer society, a major PRO organised as a relatively decentralised network of research institutes, stands out as a major co-applicant of universities. However, its co-applications stem from collaborations with a limited number of just six universities; other co-applications involve only pairs of universities, with a smaller number of bilateral connections overall.

Figure 4.1.3 provides a more comprehensive picture of the profile and location of universities' co-applicants in selected European countries. As shown on the left-hand side, PROs and other research organisations distinct from universities represent a major category of co-applicants in several countries including especially France (90%), Belgium (70%) and Poland (59%), as well as Germany (50%), Spain (49%), Italy (53%) and the Netherlands (41%).

Figure 4.1.3

Profile of universities' co-applicants in selected countries, 2015–2019



Note: The selected countries are all EPO member states with at least 100 direct patent applications in the period 2015–2019, ranked by number of co-applications. Applicant categories are reported as percentages of all co-applications, and their sum may exceed 100% due to multiple co-applicants for the same patent. The first university applicant of each patent has been excluded from the calculation of the application location.

Source: EPO - PATSTAT, Elsevier Scopus

These research organisations include large national PROs such as the CNRS (with 63% of French universities' co-applications), INSERM (36%), CEA (6%) and INRAE (3%) in France; the Fraunhofer Institutes (18%), the Deutsches Krebsforschungszentrum (6%) and the Max Planck Institutes (4%) in Germany; the CSIC (7%) in Spain; IMEC (30%) and VIB (28%) in Belgium; and the Fondazione Istituto Italiano di Tecnologia (6%) and Consiglio Nazionale delle Ricerche (6%) in Italy. Besides these large organisations, a large number of co-applications involve research hospitals as well as a constellation of foundations and university-related consortia. Companies generally account for one-quarter to one-half of all university co-applications, with a majority or SMEs among them.[14]

As shown on the right-hand side of Figure 4.1.3, a large majority (about 80%) of co-applicants are located in the same countries as their partner universities, with most other co-applicants located in other European countries.[15] This underlines the national orientation of university collaborations involving co-applications, and the importance of country-level institutions in the organisation of university research in Europe.

4.2 Profiles of applicants involved in indirect patent applications

Patent applications that were not directly filed by a university but involve a university-affiliated inventor account for a majority (55%) of academic patents filed at the EPO in the period 2015–2019. They provide valuable insights into the ecosystems of stakeholders with which universities carry out innovative activities and technology transfers through various channels, both formal (e.g. contractual research) or informal (e.g. entrepreneurship).

The share of indirect applications in all academic patents is not uniform across the largest European countries (Figure 4.2.1). Spain (with 32% of indirect patent applications), Belgium (33%), Ireland (37%), the Czech Republic (38%), the UK (44%), Switzerland (44%) and France (45%) show a high propensity of universities to directly file and their own patent applications on academic inventions. Interestingly, France, Belgium and Spain are also countries in which PROs are frequent co-applicants of universities, which may help explain the prioritisation of patent ownership.

In other countries (Germany, Austria, the Netherlands, Poland and Norway) the share of academic patents not directly filed by universities lies around 60%. The share is particularly high in Denmark (71%), Sweden, Finland and Hungary (all above 90%), signalling that university research has a stronger impact on industry through applications filed by other applicants.

[14] The share of SMEs seems especially high in the Czech Republic (69%), Norway (40%), Denmark (36%) and Poland (31%). However, these countries have a relatively low share of co-filed academic patents, and university-filed patents remain the main channels for companies to access academic inventions.

[15] France's CNRS and INSERM rank as by far the largest two foreign co-applicants of universities in other countries.

Figure 4.2.1

Indirect patent applications in selected countries: total and share of all academic patents , 2015–2019

Note: Only countries with at least 100 direct patent applications are shown.

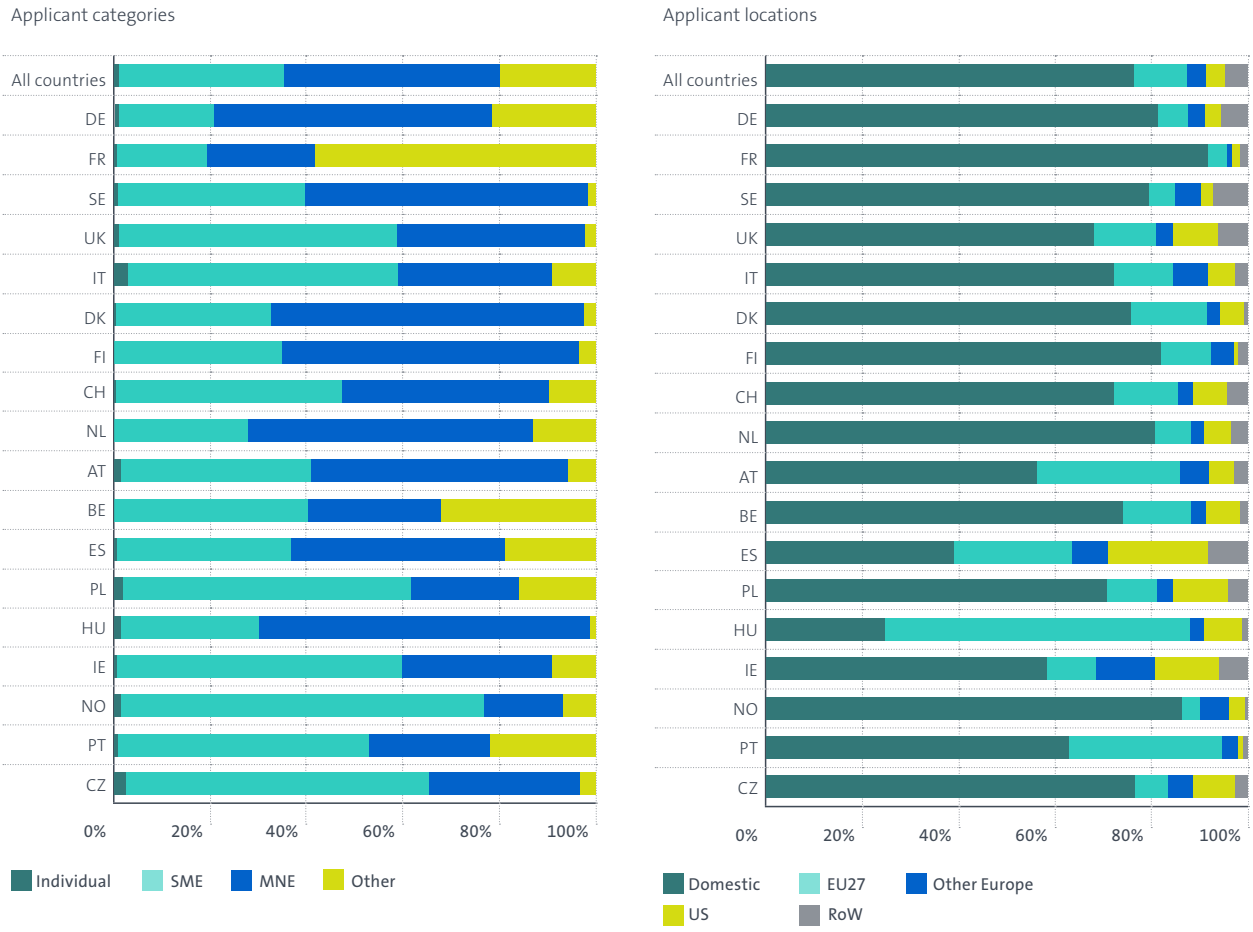
Source: EPO - PATSTAT, Elsevier Scopus

Compared with universities' co-applicants, the private sector plays a more prominent role among applicants for academic inventions. Companies accounted for nearly 80% of indirect applications in Europe in the period 2015–2019. SMEs alone represented about 34% of all indirect applications. A closer analysis, however, shows some differences between countries (Figure 4.2.2). Research organisations other than universities (such as large PROs, hospitals and foundations) account for more than half of indirect applications in France and a third in Belgium. Germany, Sweden, Denmark, Finland, the Netherland and Hungary also stand out, with a more than 50% of indirect patent applications filed by large companies.

About three-quarters (76%) of applicants involved in indirect applications are based in the same country as the academic inventor's university, which confirms the importance of geographic and institutional proximity for collaborations and technology transfers. However, the 24% share of foreign applicants is higher than in the case of co-applications. Applicants located in other European countries account for 15% of the total (11% for EU27 countries), and US-based applicants for another 4%. Interestingly, the proportion of EU-based applicants is particularly high in Hungary (63%), Portugal (32%), Austria (30%) and Spain (24%), pointing to a more advanced integration of their respective universities into broader EU innovation networks.

Figure 4.2.2

Profile of applicants of indirect applications in selected countries, 2015–2019



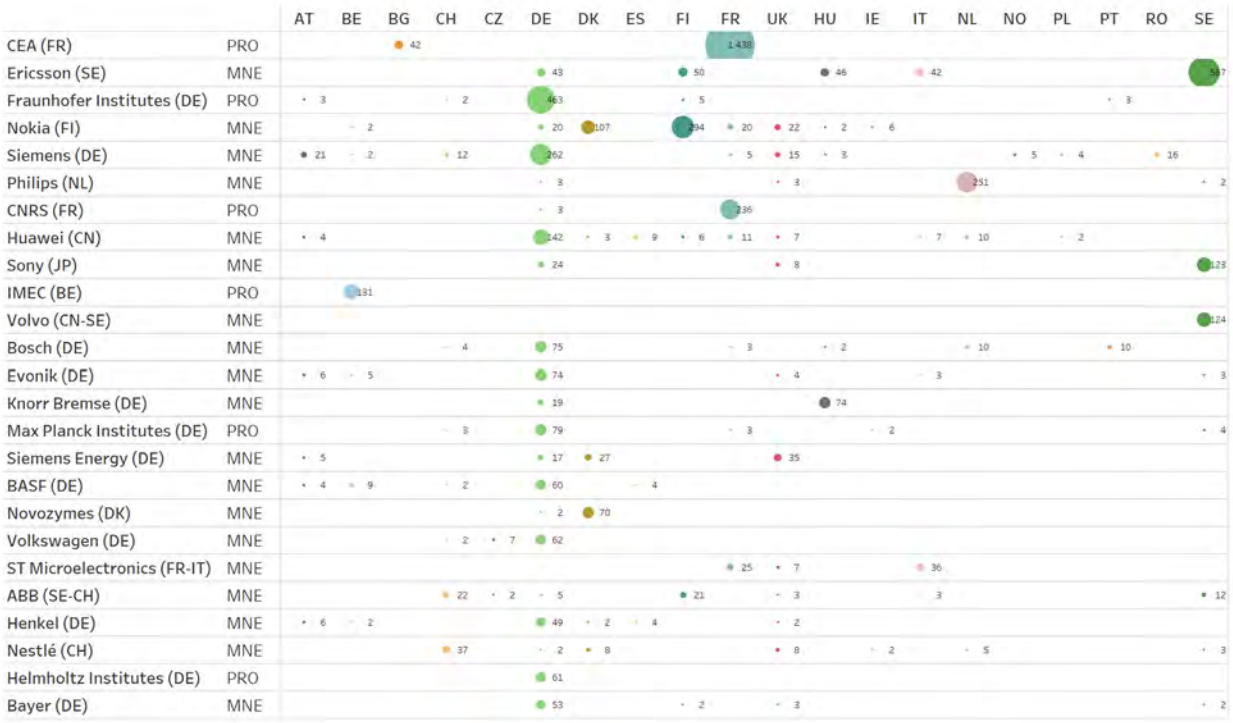
Note: The selected countries are all EPO member states with at least 100 indirect patent applications in the period 2015–2019, ranked by number of invented patents.

Source: EPO - PATSTAT, Elsevier Scopus

The top 25 applicants include six large PROs (the CNRS, the Fraunhofer Institutes, IMEC, the Max Planck Institutes and the Helmholtz Institutes) and 19 large multinational companies (Figure 4.2.3). They alone represent about 32% of all indirect applications in the period 2015–2019, highlighting the weight of such large players in universities' innovation ecosystems. The mapping of their respective portfolios of indirect applications to the country of the inventors' universities indicates that technology transfers through academic patents chiefly take place within national and, to a lesser extent, regional ecosystems. Germany in particular stands out for the large number of major national companies collaborating with university inventors, reaching out to Austrian, Swiss, Belgian and British universities. Some top applicants also appear to collaborate with a broader spectrum of universities across European countries. This concerns especially telecom equipment companies, including Ericsson, Nokia and China's Huawei (the only non-European entity in the ranking, apart from Japan's Sony).

Figure 4.2.3

Top 25 applicants for indirect academic applications by country of inventor's university, 2015–2019



Note: Cases in which a single academic patent is filed by an applicant in a country are not shown.

Source: EPO - PATSTAT, Elsevier Scopus

4.3 Startups and academic patents

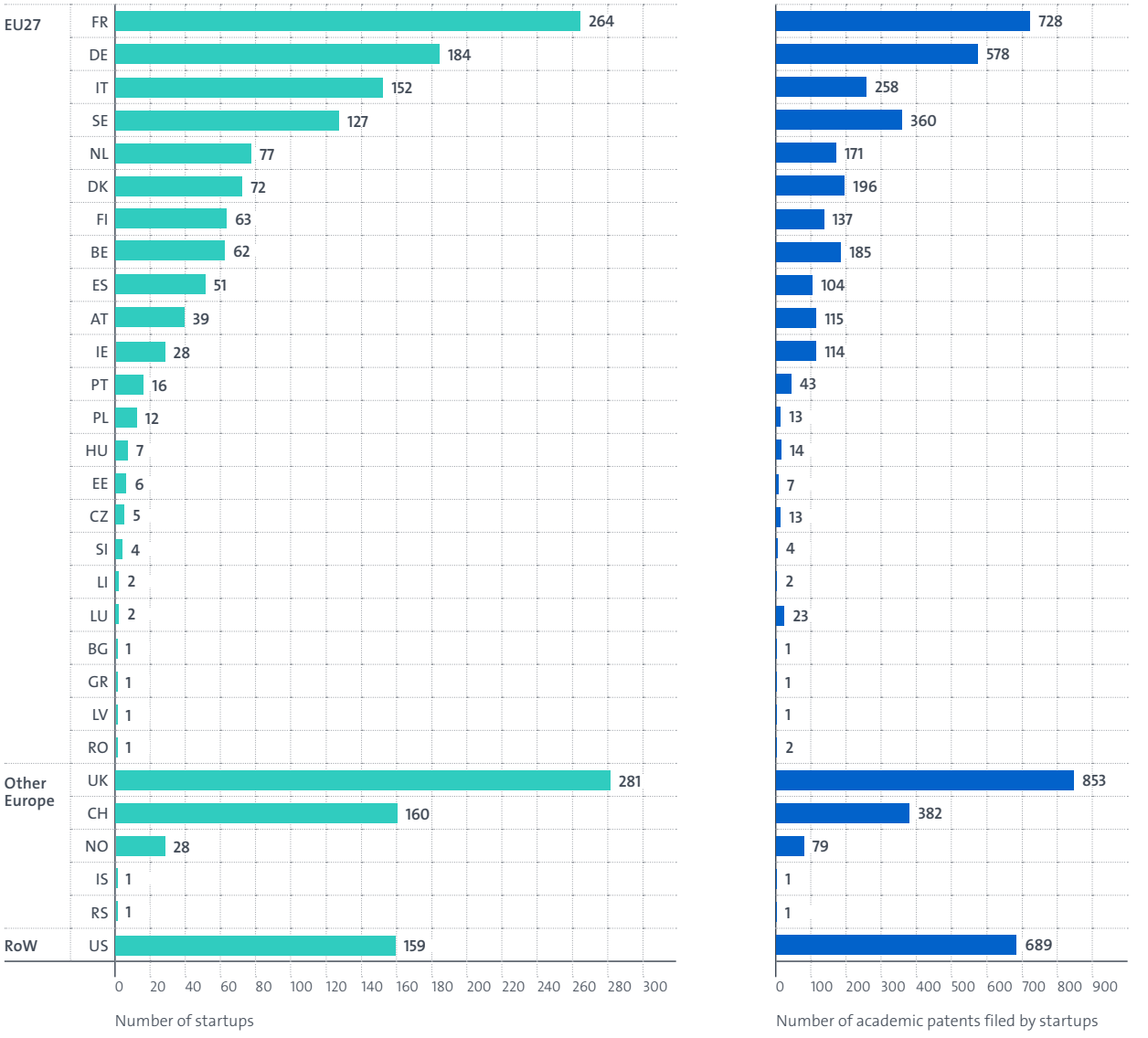
SMEs represent a majority of both company applicants for indirect applications and company co-applicants of universities. Among them, startups are of particular interest as vehicles for technology commercialisation. Using the Dealroom database, a total of 3 077 European startups at the seed, early or late growth stage were identified as applicants for academic patents over the period 2000–2020. In the more recent period 2015–2019, 1 580 of these filed European patent applications on academic inventions, accounting for about 12% of all academic patents over this period. These startups do not include university spin-outs that did not file any application of their own but may license-in patents owned by a university, but they nevertheless provide a valuable measure of the impact of universities on startup ecosystems across Europe.

The distribution of these startups and patents between countries in the period 2015–2019 is shown in Figure 4.3.1. This shows that France (264 startups), Germany (184) and Italy (152) are the leading countries within the EU27, while the UK (281) and Switzerland (160) top the ranking for non-EU countries. It is also noteworthy that 159 of the startups based in the US (or 10% of total) have filed patent applications on academic inventions stemming from European universities, highlighting how attractive European technology ventures are for the US market.

In terms of number of applications filed by startups, France has a short lead over Germany, with averages of 3.1 and 2.8 European patent applications per startup respectively. This is comparable to the UK (3.0), Sweden (2.83) and Switzerland (2.39) but well ahead of Italy (1.7). Among smaller countries, Sweden, the Netherlands, Denmark, Finland, Belgium, Austria and Ireland stand out with sizeable numbers of startups relative to their size, and a relatively large average number of patent applications per startup in the case of Denmark, Belgium and Austria.

Figure 4.3.1

Startups with European patent applications on academic inventions, 2015–2019



Source: EPO - PATSTAT, Elsevier Scopus, Dealroom

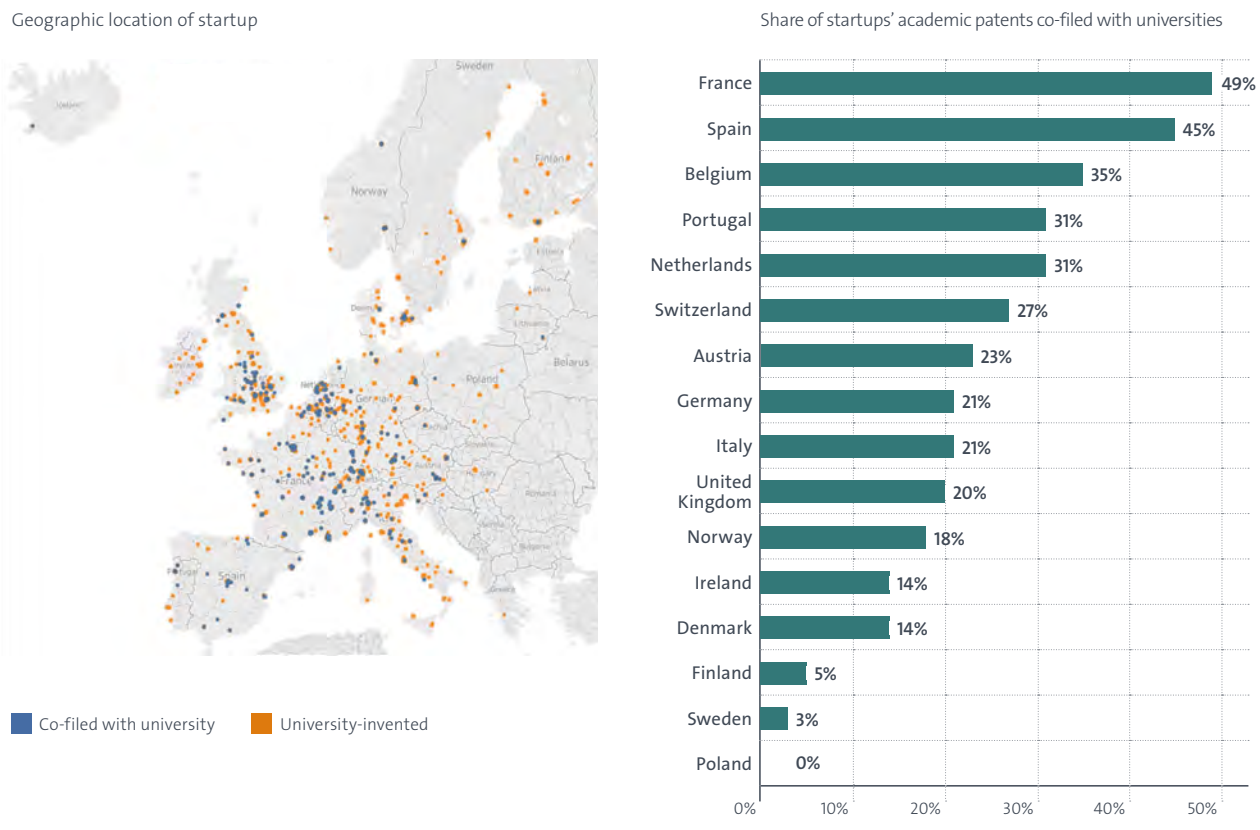
Figure 4.3.2 shows the distribution of the location of these startups on the map of Europe. It highlights the concentration in the most industrialised regions of the continent, in the same regions where universities generate the highest numbers of academic patents (see Figure 3.1.3 above). The concentration is especially visible in Belgium and the lower Rhine valley, the Ruhr region in Germany, around Copenhagen in Denmark, along the Swiss Alps and Grenoble, Greater London and the North of Italy.

The right-hand side of Figure 4.3.2 in turn indicates whether academic patents were filed by the startup only or as a co-application with the university.

Unsurprisingly, the proportion of academic inventions patented only by startups is higher in Nordic countries (Sweden, Finland, Denmark), also in Poland and Ireland. By contrast, the share of startup's academic patents co-filed with universities is highest in France, Spain, Portugal and Belgium, in line with prior findings pointing to universities' stronger propensity to directly appropriate academic inventions in those countries. Other countries are located within a narrow range of 20% to 31%, suggesting closer proximity between academic ownership models.

Figure 4.3.2

Distribution of startups with European patent applications on academic inventions, 2015–2019



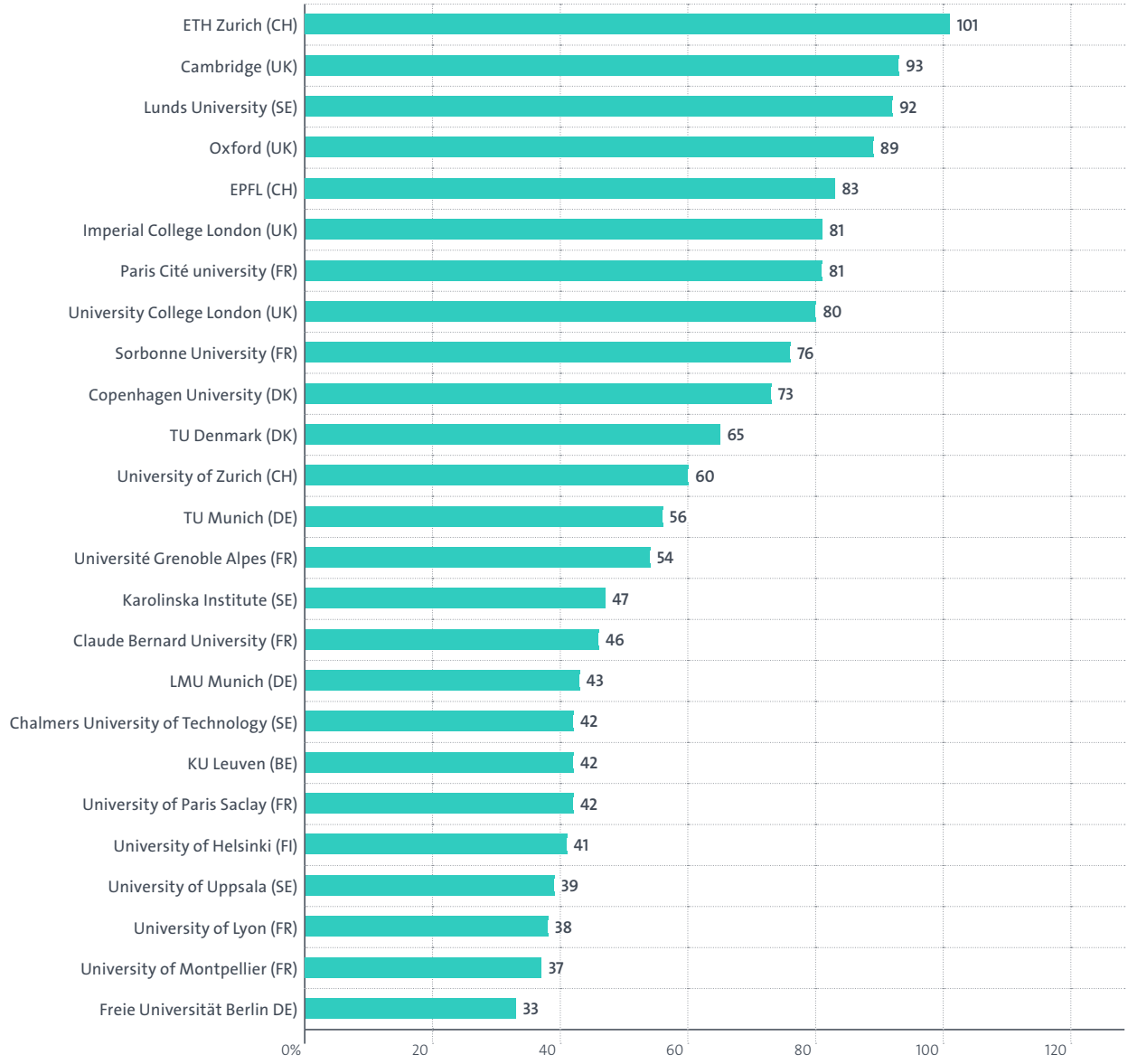
Source: EPO - PATSTAT, Elsevier Scopus, Dealroom

Figure 4.3.3 shows the top 25 European universities by number of startups identified as applicants for their respective academic inventions. All of them belong to the 2% of European universities that filed more than 500 academic applicants in the period 2000–2020.

In total they are related to 4 040 patent applications filed by 1 197 European startups, equivalent to more than three quarters (76%) of all startups with academic patents.

Figure 4.3.3

Top 25 universities by number of startups with academic patent applications at the EPO, 2000–2020



Source: EPO - PATSTAT, Elsevier Scopus, Dealroom

Swiss and UK universities dominate the ranking, with ETH Zurich and EPFL in first and third places, and four UK universities (Cambridge, Oxford, Imperial College and UCL) in the top 8. Including the University of Zurich in twelfth position, non-EU universities represent more than a quarter of the entries in the ranking (7 out of 25).

France has the largest share of the top 25 universities with seven, three of which were recently created as the result of mergers.[16] Germany has three: Technical University of Munich, the Ludwig Maximilian University of Munich and Freie Universität Berlin. Besides Switzerland, relatively small countries are well represented in the ranking, with four in Sweden, two in Denmark, one in Belgium and one in Finland.

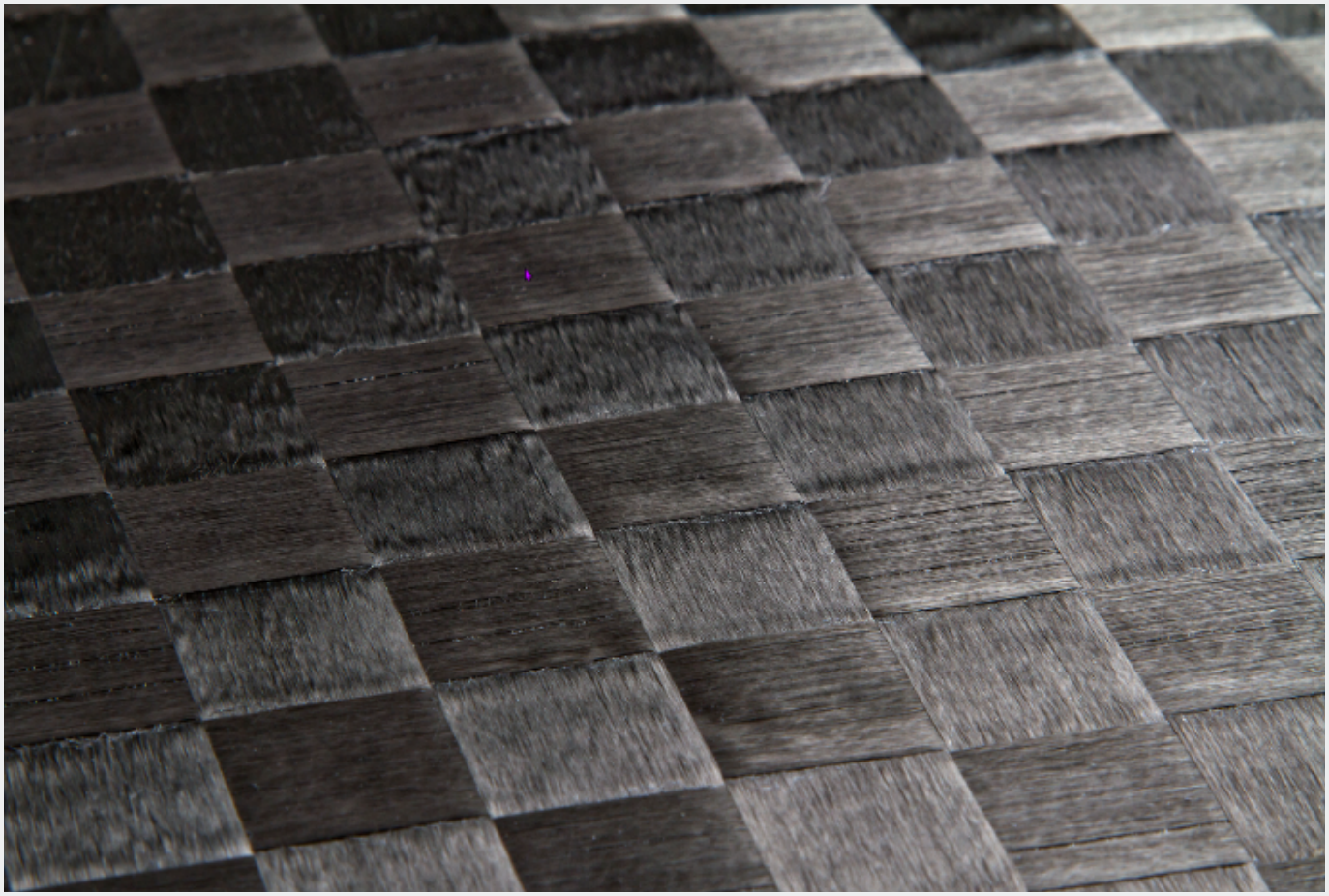
Box 4: Finding European spin-offs with the EPO Deep Tech Finder

The EPO Observatory on Patents and Technology has launched the Deep Tech Finder (DTF), a digital platform designed to make it easier to find and analyse startups in European Patent Organisation member states that have filed European patent applications.

Tailored to companies, investors, researchers and other participants in the innovation ecosystem, this innovative and free tool offers advanced search capabilities based on various industry and technology parameters, enabling users to pinpoint emerging ventures with the potential to launch new technologies on a European scale. The Deep Tech Finder makes it possible to identify spin-offs from European universities. These have been identified using the Dealroom global database and matched to universities, as described in this study (following the ETER classification). The Deep Tech Finder now also provides a way to look for patents filed by universities, mapping all European universities with at least one EPO patent application. Leveraging the EPO's extensive patent information, the tool offers detailed insights into the development of inventions in specific technological fields and their protection using the European patent system.

The Deep Tech Finder can be freely accessed online: epo.org/deep-tech-finder.

[16] Paris Cité university, the Sorbonne university, and the university of Paris-Saclay. For the purpose of the study all academic patents generated by their respective components prior to their creation have been consolidated under the newly created universities.



Case study: Oxeon

Company:	Oxeon AB
Headquarters:	Borås, Sweden
Founded:	2003
Products:	Tape-woven textiles, weaving technologies
Full case study:	https://link.epo.org/elearning/technology_transfer_case_study_oxeon_en.pdf

"Securing patent protection allowed us to have several options when developing our business."
Nandan Khokar, R&D manager and main inventor, Oxeon

Oxeon was founded in 2003 and has revolutionised the textile industry with its innovative weaving technology. Recognised as Sweden's fastest-growing company in 2010, Oxeon's success is rooted in the patented tape weaving technologies that form the basis of their unique tape-woven textiles. These textiles, designed for extreme conditions, have found applications in a wide range of markets and industries including sports, industrial and aerospace sectors.

Revitalising the textile industry

Weaving and textile industries have almost vanished in many advanced economies as these activities are often outsourced to emerging nations. Oxeon emerged from the ashes of the 19th-century Swedish textile capital Borås, developing 21st-century textiles using carbon fibres. The company's unique "spread tow" technologies offer better mechanical performance, very low areal weight and ease of fabric handling. They can employ different types of fibres and tapes in the production process, resulting in a variety of products for different industries. Initially, sports equipment was seen as a good market segment, open to experimentation. This strategy has paid off in the long run – Oxeon's TeXtreme fabric was used to reinforce the rotor blades and other parts on Ingenuity, NASA's first Mars helicopter.

Leveraging the local innovation ecosystem

Dr Nandan Khokar co-founded the company in 2003 under Sweden's "professor's privilege" system, which allows academics full ownership of their research IP. Unlike many start-ups, Oxeon wasn't managed by a university KTO. Instead, it leveraged the Chalmers University innovation ecosystem. With the help of entrepreneur Fredrik Winberg, Dr Khokar secured financing from business angels to patent his tape weaving technologies, initially owned by Biteam and later transferred to Tape Weaving Sweden. This holding company licensed the IP to Oxeon, laying the groundwork for later success.

Chalmers School of Entrepreneurship (CSE) played a crucial role through a pre-incubation project, where students worked with Dr Khokar to refine the business plan and go-to-market strategy. CSE provided business development resources, identified market needs and helped to investigate business models. This flexibility, coupled with access to development tools and working machines, enabled the company to focus on producing fabric reinforcements for composite materials, particularly using carbon fibres. Supported by private investors, Chalmers Ventures and other funds, Oxeon's growth was built on a combination of patented technology, a skilled management team and strategic financial backing.

Portfolio of opportunities

The company has a broad patent portfolio protecting both its production methods and its tape-woven materials. It follows a strategic approach when developing this portfolio, considering the various options, analysing the pros and cons and choosing the most suitable IP rights. In some cases, Oxeon has chosen trade secrets over patenting. This strategy is typically used for some manufacturing processes that are difficult to reverse-engineer from end products and for which infringement is difficult to detect and prove.

Oxeon's business model includes both licensing and product sales in different market segments. Thanks to this hybrid business model, the company has leveraged its patented technologies and supported business growth through several development phases. The early evaluation of machinery sales led to licensing the process technology as a parallel commercial avenue. This early licence agreement became a source of revenue to co-finance technology and business development in the sports and aerospace industries.

5. Concluding remarks

Universities and scientific research are crucial drivers of innovation, providing the foundation for many groundbreaking technologies such as AI, quantum computing, or mRNA technologies. While European universities are ranked among the best globally, their impact on industry and applied innovation has faced scrutiny from policymakers and experts. This disparity between academic excellence and innovation performance has been named the "European Paradox". To address this, various policies, initiatives and plans focusing on IP, innovation and education have been implemented at both national and EU levels. These efforts aim to enhance the competitiveness of European universities in innovation and encourage their active participation in managing intellectual assets. For instance, the European Council has recently issued a recommendation urging universities as key actors in knowledge valorisation to "widen their scope to include intellectual asset management" (European Union, 2022).

In light of the growing interest in policy and IP regulation in universities, the EPO has conducted this study to provide valuable evidence based on patent and economic data. To fully map the impact of European universities, the study identifies all patent applications with university-affiliated inventors that have been filed at the EPO. These "academic patents" include not only patent applications that have been field directly by universities, but also "indirect patent applications" that have been filed by other applicants to protect inventions stemming from university researchers. Their number has been steadily increasing over time, and now exceeds 10% of all European patent applications filed by European applicants.

Patent applications from universities are not only increasing in volume but also evolving in nature. In the past, indirect patent applications – those filed by industry partners, research collaborators, or individual researchers – exceeded those filed directly by universities. However, this trend has shifted. Since the early 2000s, universities in most European countries have increasingly secured ownership rights over IP produced by their researchers. The commercialisation of patents owned by universities is typically the responsibility of knowledge transfer offices (KTO) that aim to facilitate connections to industry. Due to the growing number of university filings, the activity of KTOs in establishing agreements with industry, educating the university community on IP and successfully commercialising inventions is now more crucial than ever for knowledge transfer. Patent data show that larger universities with well-established KTO teams account for a greater share of academic patents and related technology transfers, while many other universities – making up nearly two-thirds of all institutions – file fewer than one patent application per year.

The distribution of academic patents also heavily depends on regional factors. Wealthier, more dynamic industrial and technological regions in Western Europe, often identified as leading innovation clusters, have the highest number of academic patents and host universities with the largest and most science-oriented patent portfolios. Interestingly, those universities contribute relatively little to the overall patent landscape of their respective regions, with firms accounting for the majority of filings. In less dynamic regions, particularly in rural areas and Southern, Eastern, and Central Europe, the total patent output of universities is lower and tends to be focused on applied sciences and engineering universities. However, these universities appear to play an even more central role in the innovation ecosystem, with a large share of local patent applications. Spin-outs, a key measure of knowledge transfer, also show highly unequal distribution. They are primarily generated by universities in large and vibrant innovation ecosystems, with over 75% of start-ups holding academic patents originating from just 25 leading universities.

Effective knowledge transfer, and thus the distribution of academic patents, is heavily influenced by industrial and technology clusters. The role played by universities as innovation actors is partly determined by the presence of established industries, public research organisations (PROs) and the overall business environment. Universities within ecosystems where firms have high research capacity and engage in commercialising advanced technologies are more successful in patenting and bringing to market innovations compared to those in environments where firms lack R&D capabilities. Such results echo with the European Commission's Smart Specialisation Strategies, which focus on leveraging the comparative advantages of European regions and prioritising R&D projects based on local strengths, while underlining the relevance of targeting universities innovation networks.

The relevance of these localised clusters makes it evident that universities continue to operate primarily within local and national ecosystems rather than as a unified European market. Patent data reveals that firms and PROs benefiting from academic inventions are mostly based in the same countries as the universities where the inventions originate. This underlines the critical role of proximity – whether geographic, institutional, or cultural – in successful technology transfers. This can also be explained by the different institutional patterns by countries. While recent national legislation has followed a common European trend to prioritise patent ownership of universities over that of researchers, the way this legislation is materialised in university patenting activities differs across countries and universities. Co-applications with other innovation actors showcase different national models. For example, large PROs dominate in France and Belgium, while major industrial groups in Germany and smaller local companies in Central and Eastern Europe represent the main co-applicants. These variations highlight the national specificity of academic patenting and knowledge transfer.

These findings also point to opportunities for boosting knowledge flows between European countries. The European Single Market, built on the four fundamental freedoms – free movement of goods, services, people, and capital –laid the foundation for economic integration in EU and European Economic Area (EEA) countries. However, to fully harness the potential of global innovation and the knowledge economy, there is growing recognition, as noted in Enrico Letta's Report on the Future of the Single Market (Letta, 2024), that a fifth freedom – the free movement of knowledge – should be added. This study indicates that the single market for science and research is far from complete.

Regulatory harmonisation, like the Unitary Patent system, has enhanced cross-border research collaboration and the harmonisation of technology transfer practices, while improved conditions for commercialising and scaling new technology in the EU single market could significantly boost knowledge transfer across Europe. These points also follow the recommendations of the recently published report by Mario Draghi "The Future of European Competitiveness". The report concludes that a "Research and Innovation Union" should be established to promote the joint formulation of R&I policies and consolidate European academic institutions as global leaders in academic research and knowledge transfer (Draghi, 2024). Without such steps forward, Europe risks losing valuable innovations, as evidenced by the fact that 10% of startups with European academic patents are relocating to the US.

The EPO Observatory on Patents and Technology, driven by expertise to deepen the understanding of future innovation, will keep supporting the European ecosystem by providing evidence-based insights into innovation and technology. Building on the findings of this report, a series of projects will be launched over the next few years to explore the financing of patent-intensive startups, the demographics, professional trajectories and geographic mobility of young scientists in Europe, and the impact of PROs as catalysts of European innovation, as well as the successes and challenges facing European KTOs in bringing academic innovation to market.

ANNEX 1: Note on methodology

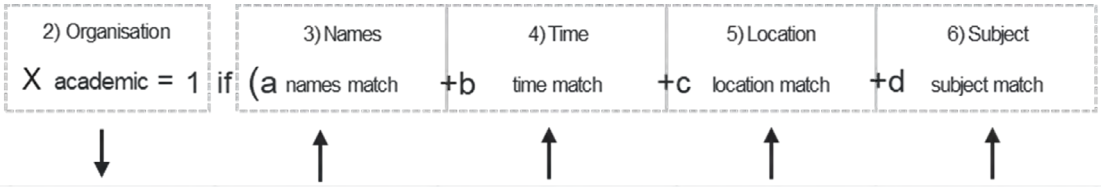
The patent data for this study were extracted from the EPO Worldwide Patent Statistical Database (EPO-PATSTAT), which provides information about published patents collected from more than 80 patent authorities worldwide. The patents are counted according to their year of worldwide first filing, i.e. the priority year. This is the earliest registered date in the patent process and is therefore closest to the date of invention. In this study we use the data for filings at the EPO.

Direct patent applications are identified within the PATSTAT database with the help of a keyword search, including the names of the universities with different spelling variations and languages as well as a search for the names of the respective cities, including spelling variations and languages. In the case of the Technical University of Munich, for example, patents are filed under the names "TECHNICAL UNIVERSITY OF MUNICH", "TECHNISCHE UNIVERSITAET MUENCHEN", or "TU MUENCHEN" etc. Once a keyword has been found in the applicant information, this patent is counted as direct patent application.

The approach to identifying indirect patent applications is based on examining name matches of authors of scientific publications found in the bibliometric database Scopus and inventor names from PATSTAT. Patents do not indicate the employing institution of an inventor, but publications list authors' affiliations and enable us to identify academic inventors and the patents they have contributed to. This allows us to connect these patents to the publications of those university employees, with the limitation that a university employee must have at least one publication listed in Scopus in order to be identifiable by our algorithm. University personnel who have not (yet) published in a journal listed in Scopus cannot be taken into account by our methodology. Once authors from Scopus have been matched to inventors from PATSTAT, the matches are flagged and assigned a unique ID to serve as a link between the patents and publications generated by these individuals. A more detailed description of the matching and how it is validated can be found in Dornbusch et al. (2013).

Figure A.1.1

Selection criteria for academic patents



	Organisation matching	Name matching	Time window matching	Location matching	Classification matching
PATSTAT	?	Full strings of last and first name	Priority year	NUTS 3 codes and distance matrix	IPC classification = WIPO 34
SCOPUS	Author affiliation = university	Full strings of last and first name	Publication year: One year time-lag and time-window	NUTS 3 codes and distance matrix	Scopus classification: fine/coarse grained

Source: Adapted from Dornbusch et al. (2013)

The approach chosen exploits relatively large amounts of data; this raises the danger of erroneous matches, mainly due to increasing numbers of homonyms, i.e. different people with identical names. Additional selection criteria have to be applied to ensure the algorithm matches inventor and author data as precisely as possible.

To identify universities in Scopus, the same keyword search is applied as in the case of PATSTAT. The selection criteria to reduce homonyms were:

– A **time window of one year between a patent publication** and a given publication was chosen to avoid homonyms and make the matching more precise. Likewise, academics often change their affiliations over time—especially when moving into industry. This can lead to incorrect affiliation assignments even if the author matches are accurate. By limiting the time window, we reduce the likelihood of misassignments that could occur due to changes in professional affiliation over a longer period. This approach ensures a more reliable linkage between patents and publications, maintaining the integrity of our analysis. The time widow is therefore of one year between the publication year of the patent and the following year.

– **The inventor address must match location of the university**. The NUTS 3 code is applied. To address the problem of rigid regional definitions, we also worked with a distance matrix, which allows adjacent regions to be taken into account when matching. A standard distance of 20 km was used.

– **To ensure matched documents have related content**, a concordance between technology fields based on the current WIPO35 classification and science fields within Scopus was employed at an aggregated level of five broad fields/technology areas.

Recall and precision analysis were applied to evaluate the algorithm. The combination of full names with location criterion and subject match achieves the best results (F score: 0.83), particularly when giving precision a higher priority over recall.

The final consolidation of names of universities, assigning direct patent applications and indirect patent applications to organisation names (EPO-PATSTAT and Scopus) was carried out using the European Tertiary Education Register (ETER). The ETER data source lists unique IDs for universities, making it possible to create an aggregation of university names in PATSTAT and Scopus for all universities in EPO member states. We limited our matches to the category "Higher Education Institution" (HEI) in ETER, as we are focused on universities in this study. If an author has multiple affiliations at the same time, we count the patent once for each of the organisations.

To further align the university-level dataset with the reality of national university systems, all datasets were reviewed and corrected by participating NPOs of member states. Name changes, consolidation of universities according to recent mergers and reforms were considered in the final dataset, with explicit support from experts of the following NPOs:

– Austria: Austrian Patent Office
– Belgium: Belgian Office for Intellectual Property
– France: French Industrial Property Office
– Germany: German Patent and Trademark Office
– Greece: Hellenic Industrial Property Organisation
– Italy: Italian Patent and Trademark Office
– Lithuania: State Patent Bureau of the Republic of Lithuania
– Netherlands: Netherlands Patent Office
– Poland: Patent Office of the Republic of Poland
– Serbia: Intellectual Property Office of the Republic of Serbia
– Slovakia: Industrial Property Office of the Slovak Republic
– Spain: Spanish Patent and Trademark Office
– Switzerland: Swiss Federal Institute of Intellectual Property
– Türkiye: Turkish Patent and Trademark Office
– United Kingdom: Intellectual Property Office of the United Kingdom

Among them, the support provided by the French Industrial Property Office has proved particularly important to compensate for the limitations of the ETER classification of French universities in the wake of recent reforms and reorganisations of the French university system.

ANNEX 2: Main universities with academic patents in European countries (2000–2020)

The tables below feature the top 10 universities for the top three countries and the top five universities (with at least 25 academic patents) for the remaining countries. The ranking is based on the number of European patent applications filed for academic patents, including both direct applications filed by the universities, and indirect ones filed by other applicants with a university-affiliated researcher listed among the inventors. Because of this definition, the ranking ignores academic inventions for which a patent application may have been filed at another patent office than the EPO.

Table A.2.1

Top universities by country

GERMANY

Rank	University	Academic patents
1	TU München	2 183
2	Friedrich-Alexander-Universität Erlangen-Nürnberg	1 445
3	Freie Universität Berlin	1 392
4	RWTH Aachen	1 345
5	TU Berlin	1 174
6	LMU	1 165
7	Technische Universität Dresden	1 136
8	Ruprecht-Karls-Universität Heidelberg	992
9	Universität Stuttgart	990
10	Karlsruher Institut für Technologie (KIT) - Bereich Hochschule	948

FRANCE

Rank	University	Academic patents
1	Université Grenoble Alpes	3 348
2	Université Paris Cité	1 934
3	Sorbonne Université	1 808
4	Université Paris Saclay	1 136
5	Université Claude Bernard - Lyon 1	1 043
6	Université de Montpellier	1 006
7	Université de Toulouse 3 - Paul Sabatier	967
8	Université de Bordeaux	937
9	Université de Strasbourg	839
10	Grenoble INP	759

UNITED KINGDOM

Rank	University	Academic patents
1	Oxford	1 660
2	Cambridge	1 501
3	Imperial College	1 433
4	University College London	1 360
5	The University of Southampton	425
6	The University of Edinburgh	394
7	The University of Sheffield	385
8	University of Nottingham	347
9	The University of Bristol	324
10	Queen Mary, University of London	302

ITALY

Rank	University	Academic patents
1	Polit. Milano	809
2	Università degli Studi di MILANO	682
3	Università degli Studi di ROMA "La Sapienza"	502
4	Università degli Studi di BOLOGNA	472
5	Politecnico di TORINO	419

SWEDEN

Rank	University	Academic patents
1	Lunds universitet	2 064
2	Chalmers	1 044
3	Uppsala universitet	890
4	Göteborgs universitet	683
5	Linköpings universitet	678

SWITZERLAND

Rank	University	Academic patents
1	ETH Zürich	2 219
2	EPFL	1 697
3	Universität Zürich	930
4	Universität Basel	470
5	Université de Lausanne	363

NETHERLANDS

Rank	University	Academic patents
1	TU Eindhoven	1 404
2	Technische Universiteit Delft	699
3	Universiteit Utrecht	413
4	Universiteit van Amsterdam	380
5	Rijksuniversiteit Groningen	355

BELGIUM

Rank	University	Academic patents
1	KU Leuven	1 772
2	Gent	1 115
3	Université libre de Bruxelles	908
4	Université catholique de Louvain	442
5	Université de Liège	409

DENMARK

Rank	University	Academic patents
1	Københavns Universitet	2 131
2	Danmarks Tekniske Universitet	1 910
3	Aalborg Universitet	635
4	Aarhus Universitet	323
5	Syddansk Universitet	182

SPAIN

Rank	University	Academic patents
1	Universitat de Barcelona	330
2	Universitat Autònoma de Barcelona	328
3	Universitat Politècnica de València	301
4	Universitat Politècnica de Catalunya · BarcelonaTech	298
5	Universidad Politécnica de Madrid	260

FINLAND

Rank	University	Academic patents
1	Aalto University	1 046
2	Helsingin yliopisto	682
3	Tampereen yliopisto	682
4	Oulun yliopisto	374
5	Turun yliopisto	279

AUSTRIA

Rank	University	Academic patents
1	Technische Universität Wien	665
2	Medizinische Universität Wien	600
3	Universität Wien	478
4	Technische Universität Graz	465
5	Universität für Bodenkultur Wien	265

IRELAND

Rank	University	Academic patents
1	Trinity College Dublin	372
2	University College Cork	349
3	University College Dublin	327
4	National University of Ireland	323
5	National University of Ireland, Galway	207

POLAND

Rank	University	Academic patents
1	Warsaw University	274
2	Akademia Górniczo-Hutnicza im. St. Staszica w Krakowie	115
3	Politechnika Warszawska	110
4	Politechnika Poznańska	86
5	Politechnika Wroclawska	85

NORWAY

Rank	University	Academic patents
1	Universitetet i Oslo	401
2	Norges teknisk-naturvitenskapelige universitet	334
3	Universitetet i Bergen	133
4	Norges Informasjonsteknologiske Høgskole	112
5	Norges veterinærhøgskole	30

HUNGARY

Rank	University	Academic patents
1	Budapesti ME	438
2	Semmelweis Egyetem (SE)	217
3	Eötvös Loránd Tudományegyetem (ELTE)	161
4	Debreceni Egyetem (DE)	97
5	Szegedi Tudományegyetem (SZTE)	94

PORTUGAL

Rank	University	Academic patents
1	Universidade do Porto	207
2	Universidade Nova de Lisboa	155
3	Universidade de Lisboa	148
4	Universidade do Minho	131
5	Instituto Superior Técnico	115

CZECH REPUBLIC

Rank	University	Academic patents
1	České vysoké učení technické v Praze	168
2	Univerzita Karlova v Praze	155
3	Univerzita Palackého v Olomouci	123
4	Technická univerzita v Liberci	72
5	Vysoké učení technické v Brně	66

TÜRKIYE

Rank	University	Academic patents
1	Yeditepe Üniversitesi	85
2	Sabancı Üniversitesi	67
3	Koç Üniversitesi	48
4	Özyeğin Üniversitesi	37
5	İstanbul Üniversitesi	28

GREECE

Rank	University	Academic patents
1	Aristotle University of Thessaloniki	102
2	National and Kapodistrian University of Athens	86
3	University of Patras	56
4	University of Crete	37
5	National Technical University of Athens	30

SLOVENIA

Rank	University	Academic patents
1	Univerza v Ljubljani	237
2	Univerza v Mariboru	66

LITHUANIA

Rank	University	Academic patents
1	Vilniaus universitetas	132
2	Kauno technologijos universitetas	83
3	Vilniaus Gedimino technikos universitetas	45

ROMANIA

Rank	University	Academic patents
1	Universitatea Politehnica din București	53
2	Universitatea "Transilvania" din Brașov	35

ESTONIA

Rank	University	Academic patents
1	Tartu Ülikool	113
2	Tallinna Tehnikaülikool	79

LATVIA

Rank	University	Academic patents
1	Latvijas Universitate	95
2	Rigas Tehniska universitate	58

BULGARIA

Rank	University	Academic patents
1	University of Security and Economics	115

SLOVAKIA

Rank	University	Academic patents
1	Univerzita Komenského v Bratislave	38

LUXEMBURG

Rank	University	Academic patents
1	Université du Luxembourg	70

CROATIA

Rank	University	Academic patents
1	Sveučilište u Zagrebu	46

CYPRUS

Rank	University	Academic patents
1	University of Cyprus	27

ANNEX 3: Results of the EPO survey of European universities

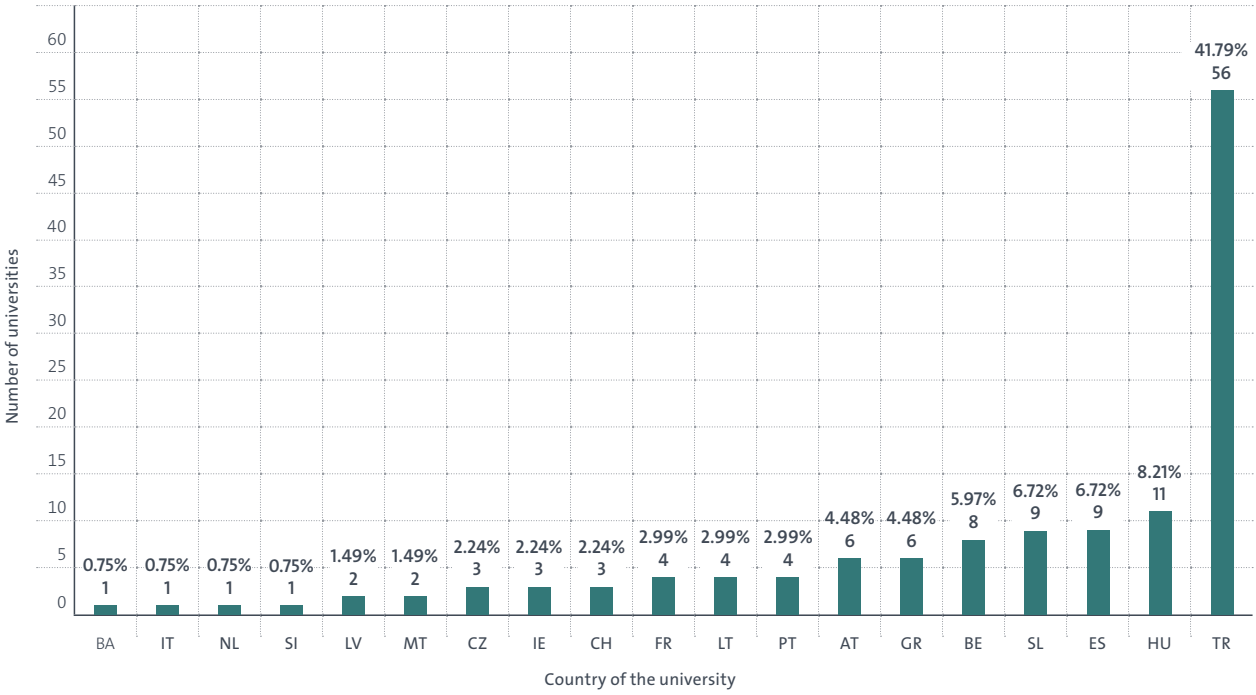
Legal experts at the EPO produced the following survey to be distributed to universities across Europe as a way of better contextualising IP ownership practices in universities. Thanks to the assistance of 19 NPOs, 134 universities replied anonymously. The survey included the following questions:

Name of the university.
Country of the university.
Is there a specific entity responsible for matters of technology transfer for inventions created at your university?
If the answer to question 3 was yes, what kinds of services are provided by this entity?
How many employees does this entity have (approximately)?
Please let us know the name or website of the entity responsible for Technology Transfer
Does the national/county law applicable to your university specifically govern the legal ownership of inventions created by employees or students?
Please indicate the relevant legal instrument if known.
Does your university have an IP policy or statute governing the legal ownership of inventions created by employees or students at the university?
Please provide a link to the university policy if available.
Can the default ownership position established under the law applicable to your university and/or your university's IP policy or statute be deviated from (e.g. through individual employment/student contracts)?
Please indicate in which situations this may occur if possible.
Is ownership of an invention dependant on whether it was created by an employee/student during the performance of their contractual duties/studies or outside of their contractual duties/studies?
Who is by default the owner of an invention created during the performance of contractual duties of an employee/group of employees?
Who is by default the owner of an invention created during the performance of the studies of a student / group of students?
Who is by default the owner of an invention created during the performance of the studies/contractual duties of a student and an employee?
Does the law applicable to your university and/or your university's IP policy or statute govern the ownership of an invention created as a result of research carried out in collaboration between the university/employees/students and an external public or private third-party entity (such as an external researcher, another research institute or an industry or governmental partner)?
Please indicate the specific source of the law or university policy.
If an invention is created in collaboration with an external public or private third-party entity, how does this affect the ownership situation?
Please specify under what conditions this may occur, and the share of ownership if split.
Who is by default the owner of an invention created outside the performance of contractual duties of an employee/group of employees?
Who is by default the owner of an invention created outside the performance of the studies of a student/group of students?

The survey was answered by 134 universities in 19 countries between 15 July and 15 August 2024. As shown in Figure A.3.1, the majority of answers came from Turkish universities. Figure A.3.2. indicates that, according to the universities surveyed, Belgian and French universities have larger KTOs than average.

Figure A.3.1

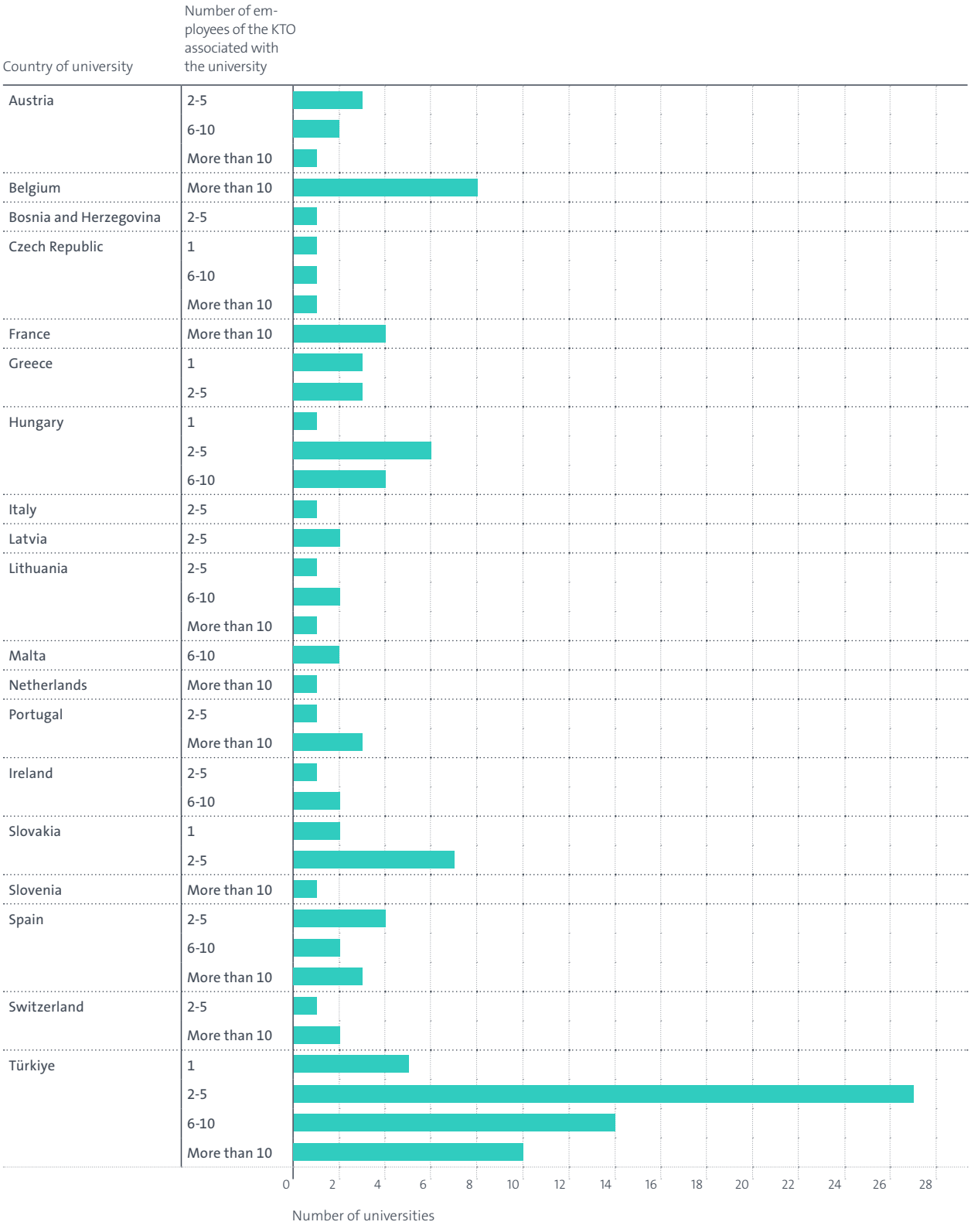
Number of universities surveyed by country



Source: EPO

Figure A.3.2

Number of universities surveyed by number of employees working in the associated KTO, and by country



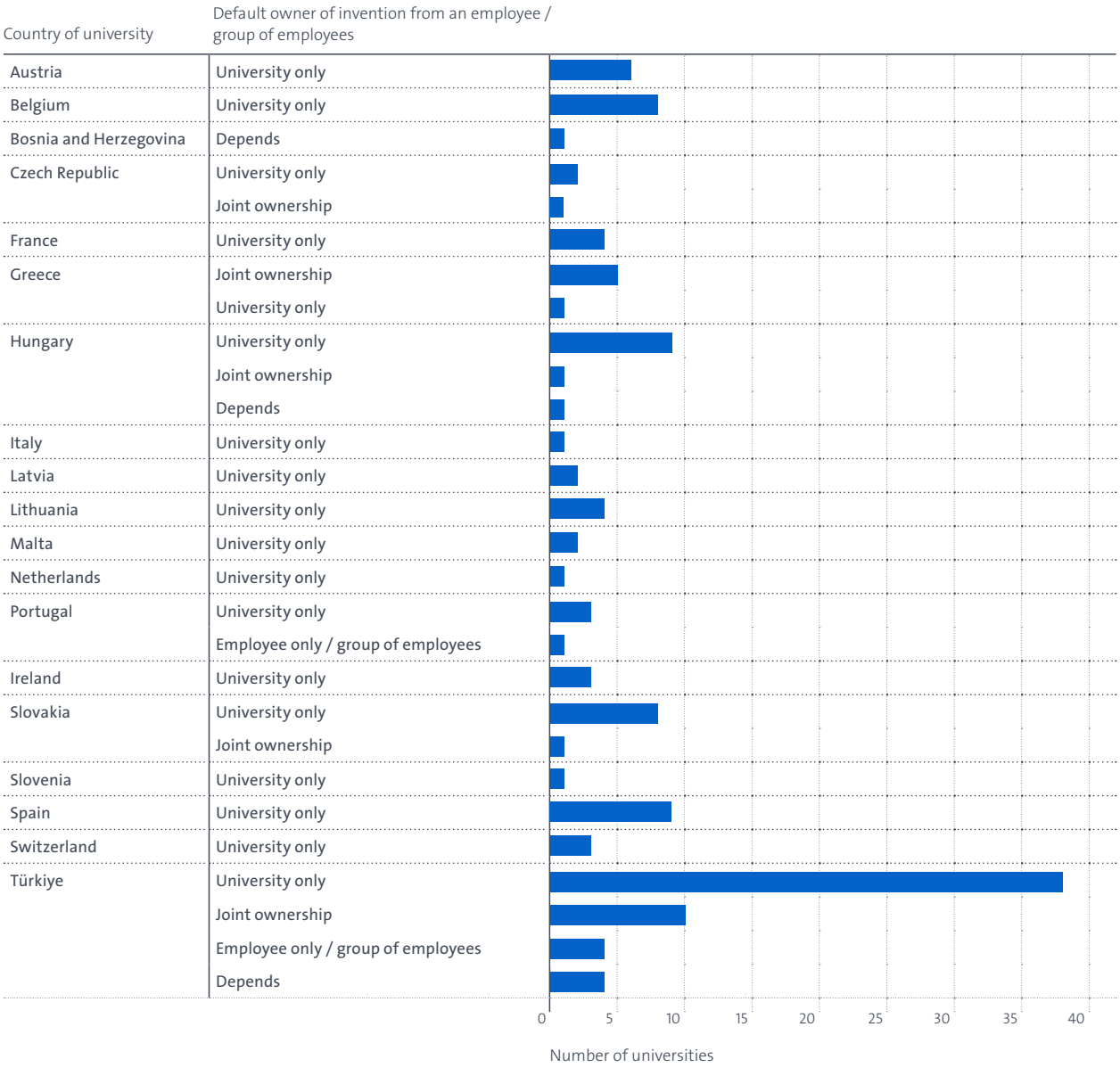
Source: EPO

An overview of selected questions is included here; "Depends" includes answers further developed by the university, mostly including answers where the decision is made on a case-by-case basis and there is no general regulation established in the university.

As shown in Figure A.3.3., universities regulate their IP in different ways, when they come from countries with the same national legislation governing professor's privilege. Some universities might offer "Joint ownership" contracts, as seen in Greece and Türkiye, or full "professor's privilege" regulations, as noted in some universities in Türkiye and Portugal.

Figure A.3.3

Number of universities according to the default owner of an invention from an employee or group of employees by country



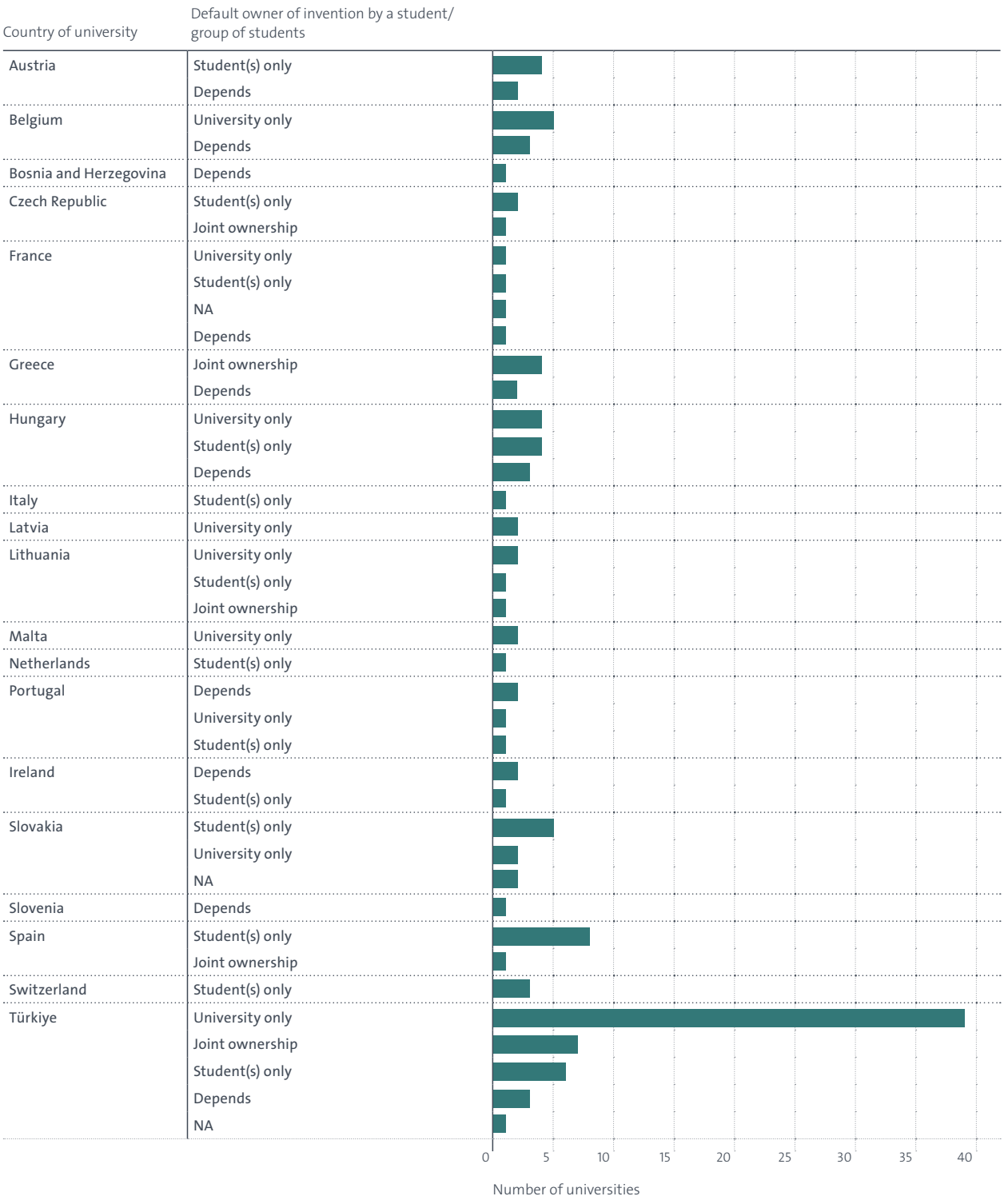
Source: EPO

Figures A.3.4. shows the default owner of an invention by students or groups of students. Figure A.3.5. shows the position for groups comprising students and employees (which differs from the situation with employees alone). In this latter case the situation is more varied, and many universities offer ownership to students.

Other universities, indicated as “Depends”, have ownership arrangements that depend on student status (PhD, graduate or undergraduate), normally granting ownership to undergraduate and graduate students but preserving university ownership for PhDs.

Figure A.3.4

Number of universities according to the default owner of an invention by a student or group of students by country



Source: EPO

Figure A.3.5

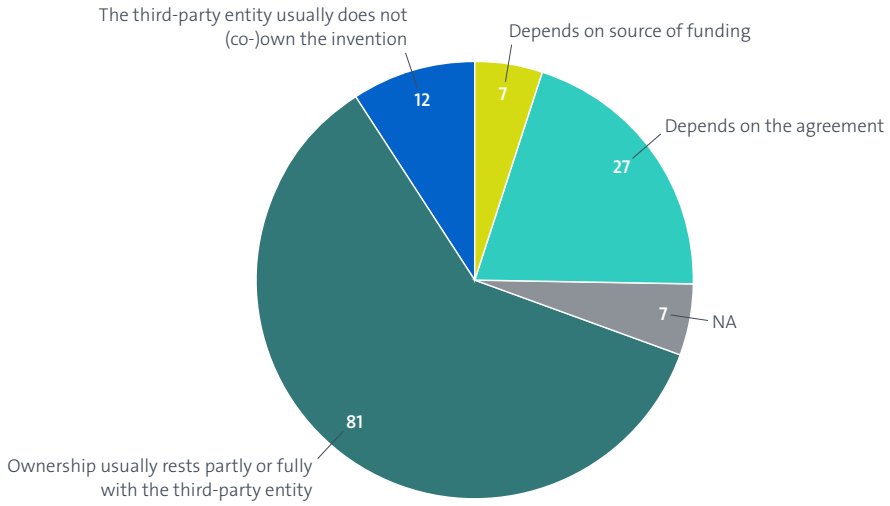
Number of universities according to the default owner of an invention by a group comprising student(s) and employee(s) by country

Source: EPO

Where a third party is involved in the co-creation of the invention (e.g. a PRO or a private organisation), universities often grant co-ownership status. As seen below, this is the case in most universities surveyed and in most countries. Only a slight minority of Turkish, Hungarian and Italian universities say they do not grant ownership to third parties. These numbers justify the methodology used in this study – using direct patent applications only does not make it possible to account for those collaborations from third parties that result in patents filed only by the third party.

Figure A.3.6

Number of universities according to the default owner of an invention co-created with a third party/organisation



Source: EPO

Figure A.3.7

Number of universities according to the default owner of an invention co-created with a third party/organisation by country

Source: EPO

ANNEX 4: Note on Figure 3.2.5

Figure 3.2.5. shows a classification of European countries according to their national legislation governing the ownership of academic patents. This has been compiled by legal experts from the EPO based on the sources mentioned, as well as input from the survey indicated in Annex 3 and sources facilitated by the NPOs of the respective countries.

Country	Type	Explanation
Albania	No professor's privilege (no explicit mention of university IP ownership)	Legal source: Article 15, Law No. 9947 dated 07.07.2008 on Industrial Property. Employer may claim title to inventions created within employment framework.
Austria	Professor's privilege abolished in 2000's	Legal source: §106, Universities Act 2002. Deems universities to be employers under §7 of the Patent Act. Requires academics to disclose inventions to universities, so that title may be claimed within 3 months.
Belgium	No professor's privilege	The abolition of professor's privilege applied in 1997 in Flanders, and 1998 in Wallonia. Based on research from Mejer (2011)
Bosnia and Herzegovina	No professor's privilege (no explicit mention of university IP ownership)	Legal Source: Article 84, Labour Law of the Federation of Bosnia and Herzegovina. Employer claims title to inventions created within employment framework.
Bulgaria	No professor's privilege (no explicit mention of university IP ownership)	Legal source: Article 13, Act on Patents and Registration Utility Models SG 64/06. Assigns right to a patent for an "official invention" under Article 15 to the employer provided an application is filed within three months.
Croatia	No professor's privilege (no explicit mention of university IP ownership)	Legal Source: Article 14(2), Patent Act, NN 173/2003. Grants employers successor in title rights over employee inventions under applicable law or a work contract.
Cyprus	No professor's privilege	Article 11(1) and 11(2) Law No. 16(I)/1998 grants employers the rights to employee inventions. See the Intellectual Property Policy of the University of Cyprus, section 6. The University will generally claim ownership of an invention created by a staff member or student on the basis of Article 11(1) and 11(2) Law No. 16(I)/1998. Equally, see Cyprus University of Technology IP Innovation and Technology Transfer Policy, section 1.4.1.
Czech Republic	No professor's privilege	Legal Source: Section 16, Act on the Support of Research and Development No 130 of 14 March 2002. Regulates ownership of IP results from publicly funded research. Legal Source: Section 9, Act No. 527 / 1990 Coll. on Inventions and Rationalisation Proposals. Employer may claim title to inventions created within employment framework within three months.

Country	Type	Explanation
Denmark	Abolishment of professor's privilege in the 2000s	Legal Source: Article 8 (1) Consolidating Act No 210 on Inventions at Public-Sector Research Institutions of 17 March 2009. Provides for rights in an employee invention to be transferred to the research institution.
Estonia	No professor's privilege (no explicit mention of university IP ownership)	Legal Source: §12, Patents Act 16th March 1994. Ownership of inventions created by employees is governed by the contract or employment contract.
Germany	Abolishment of professor's privilege in the 2000s.	Legal Source: Sections 42, 5, 6 & 7 Employee Inventions Act. Under the Employee Inventions Act, employees are required to disclose service inventions which may be claimed by the employer. Special provisions apply to inventions by university staff.
Finland	No professor's privilege	Legal Source: Act on the Right of Inventions Made at Higher Education Institutions, 19 May 2006, No 369. Finland abolished professor's privilege in 2007 through this act.
France	No professor's privilege	Based in research from Geuna and Rossi (2011)
Greece	No professor's privilege (no explicit mention of university IP ownership)	Legal Source: Article 6, Law 1733/87 on technology transfer, inventions and technological innovation, as amended. Employers own 100% of the rights to service inventions, and 40% of the rights to dependent inventions.
Hungary	No professor's privilege (no explicit mention of university IP ownership)	Legal Source: Article 9 & 10, Law No. XXXIII of 1995 on the Protection of Inventions by Patents. Grants employers the right to a patent for a service invention, and a right of use over other employee inventions.
Iceland	No professor's privilege	Legal Source: Icelandic Act respecting Employees Inventions No 72/2004. Grants employees the rights to their inventions provided no alternative arrangements are in place and their employer does not claim the right to the inventions produced
Ireland	No professor's privilege	Legal Source: Irish Patents Act 1992, s16(1). Universities assert a common law principle of ownership of their employee's inventions.
Italy	Professor's privilege introduced in 2001, abolished in 2023	Legal Source: Article 65, Italian Code of Industrial Property, as amended by Law 102/2023. Abolishes professor's privilege by granting institutional ownership of inventions developed.
Latvia	No professor's privilege	Legal Source: Article 15, Latvian Patent Act 9/1/2022. The employer has the right to a patent if the invention was created by an employee whose work duties included 1) inventive activity and 2) research, design, and construction or preparation of technological development.
Lithuania	No professor's privilege	Legal Source: Article 7, Lithuanian Patent Law, No I-372. Grants ownership of service inventions to the employer. Where an invention is made at an institution carrying out scientific research in contact with a financial client, ownership is determined by contract.
Luxembourg	No professor's privilege	Legal Source: Article 13, Luxembourg Patent Law. Assigns ownership of rights to employee inventions to the employer when an invention is made in the course of the employee's duties. See also the University of Luxembourg IP Policy Article 5.

Country	Type	Explanation
Malta	No professor's privilege	Legal Source: Article 11, Maltese Patents and Designs Act 2000. Inventions created within an employment framework belong to the employer in the absence of contractual provisions to the contrary. IP Policy of the University of Malta confirms that the university asserts ownership based on this provision.
Montenegro	No information found	
Netherlands	No professor's privilege	Legal Source: Article 12(3), Dutch Patent Act 1995. Grants ownership to universities of inventions created by staff.
North Macedonia	No professor's privilege (no explicit mention of university IP ownership)	Legal Source: Article 33(2), North Macedonian Patent Law. "The employer shall be considered to be inventor's successor in title where by virtue of law or employment contract he has the right to acquire patent for invention created under inventor's employment."
Norway	Professor's privilege abolished in the 2000s	Legal Source: Act respecting the Right to Employee's Inventions No 21 of April 17 1970, consolidated version as of 2015.
Poland	No professor's privilege	Legal Source: Article 11(3) Polish Patent Act. Grants employers rights to patents for inventions created within employment framework. IP Policy of the University of Warsaw indicates rights are claimed o the basis of this provision.
Portugal	No professor's privilege	Based on research from Arqué-Castells et al. (2016)
Romania	No Information found	No obvious provision in the Romanian Patent Act governing ownership of academic IP or employee/ employer inventions.
San Marino	No professor's privilege (no explicit mention of university IP ownership)	San Marino Patents Act, Article 7. Rights to employee inventions created within an employment contract belong to the employer.
Serbia	No professor's privilege	Legal Source: Article 122, 123, Serbian Law on Scientific Research and Activity. Results of publicly funded research belong to the accredited scientific research organisations that carried out the research. Legal Source: Article 58, Serbian Patent Act. Grants rights to inventions made in the course of employment to the employer. Confirmed to apply equally to universities.
Slovakia	No professor's privilege	Research by Geuna (2011), suggests an institutional ownership system has been in place since 2000.
Slovenia	No professor's privilege	Legal Source: Employment Related Inventions Act No 45/94. Allows employers to assert claims to employee inventions. University of Ljubljana IP Policy claims all inventions created by staff members within their employment framework.
Spain	No professor's privilege	Legal Source: Article 21. Patent Law 24/2015

Country	Type	Explanation
Sweden	Professor's privilege	Legal Source: Act on the Right to Employees' Inventions (1949:345). Teachers and professors are explicitly exempt from this act. This exemption establishes the Swedish professor's privilege system.
Switzerland	No professor's privilege	Based in research from Chardonnens (2010)
Türkiye	Professor's privilege abolished in 2017	Legal Source: Law No. 6769 of 22 December 2016, on Industrial Property. Entered into force in 2017.
United Kingdom	No professor's privilege	Based in research from Geuna and Rossi (2011).

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