

TECHNOLOGICAL INNOVATION ACTIVITIES IN THE EU: A NEW PERSPECTIVE

- In many EU countries, a high proportion of local inventions are owned by foreign companies. On the contrary, in few countries the number of patents owned is much higher than the local inventions.
- Companies from Germany and the US are the most frequent foreign owners of patents invented in EU countries.
- Concentration of patents across companies changes largely from one country to the other.
- Differences between local inventions and patent ownership, as well as their concentration within countries matter for Innovation policies aiming at closing the EU gap of knowledge creation and technology diffusion.

1. What's the issue?

One of the weaknesses of the EU innovation ecosystem resides in the difficulty to guarantee widespread benefits from the inventions generated (European Commission, 2012).

The creation of technological knowledge (e.g. inventors' location) and its exploitation can occur in different places (e.g. countries) and be performed by different entities.

Such differences offer a useful insight to analysts and policy-makers in order to monitor innovation diffusion and address possible market failures.

2. What's known?

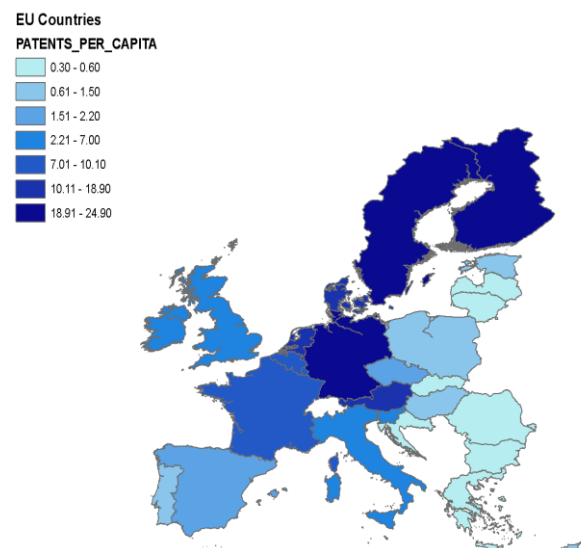
Patents are commonly used to proxy where R&D is performed and knowledge is produced. To this end patents can be assigned to countries/regions on the basis of the inventor residence as reported in the respective document.

It is well-known that there are great differences in patenting activities across industrial sectors and EU countries. In this work we focus on the patenting activities (registered at the European Patent Office, EPO) of the business sector.

The map in Figure 1 shows patents per capita across EU countries. Patents are assigned to countries according to the location of inventors as reported in patent documents. The geography of innovation activities in the EU shows the leadership in technological development of Central and Northern Europe. The distance, in terms of patents per capita, between the leader countries and those at the bottom of the distribution is very large. All-in-all, this reflects

differences in the capabilities and possibilities needed in order to produce frontier technological knowledge as well as differences in industrial specialisation. The differences are so significant that it is unreasonable to expect the gap closing in the short term.

Figure 1 - Patents per capita from the business sector in the EU
(allocated by inventor)



Note: EPO patents per 100,000 inhabitants (period: 2013-2015).
Source: own computation based on Patstat 2018A.

3. What's new?

Thus far, we have considered knowledge generation; to what extent EU countries differ when considering knowledge exploitation instead?

Patents can be also analysed according to the location of the applicants (ownership), which allows

capturing better where the returns from innovation go (Picci, 2010).

3.1 Location differences: applicants versus inventors

The differences between the number of patents owned by local companies and the number of those invented within the respective country are shown in Table 1.

Table 1—Relative difference of patents by applicant vs inventor (EU)

Countries in deficit		Countries balanced		Countries in surplus	
Romania	● -85%	Denmark	● -1%	Ireland	▲ 13%
Croatia	● -69%	France	● 1%	Finland	▲ 14%
Hungary	● -63%	Germany	● 1%	Sweden	▲ 19%
Slovakia	● -49%			Netherlands	▲ 23%
Czech Republic	● -40%			Cyprus	▲ 371%
Poland	● -36%			Luxembourg	▲ 484%
Greece	● -36%			Malta	▲ 968%
Estonia	● -35%				
Lithuania	● -33%				
United Kingdom	● -31%				
Slovenia	● -30%				
Bulgaria	● -30%				
Spain	● -29%				
Italy	● -16%				
Portugal	● -15%				
Belgium	● -13%				
Latvia	● -12%				
Austria	● -7%				

Note: How to read: patents by applicant in Romania are 85% lower than those by inventor (period: 2013-2015)

Source: own computation on Patstat 2018A

In the majority of EU countries, the number of invented patents is much higher than the number of patents owned by local companies. These countries produce more knowledge than what they actually 'own'.

Three European countries show a substantial balance between patents invented and patents owned: Denmark, Germany and France.

Finally, there is a group of countries with a clear surplus in ownership compared to generation of innovation. Among these countries there are Finland and Sweden, top performers also when considering patents invented per capita (see map above); these two countries seem to have a very active and creative business sector.

However, in this group we also find countries not performing particularly well in terms of patents invented. Among these countries, in Cyprus, Luxembourg and Malta the number of patent owned is between 4 and 10 times higher than those invented. Three countries – Ireland, Luxembourg and The Netherlands – host many company headquarters for tax or takeover-protection reasons and this can substantially affect the figures as can the existence of 'patent box' legislation (Alstadsæter et al., 2018).

3.2 Inventorship-Ownership patterns in EU countries

Who owns the patents invented in EU countries? The information about inventor and applicant location provide also insights to reply to this question.

For each EU Member State the proportion of patent invented locally are allocated over the corresponding top three applicant countries in Table 2. In other words, the table shows the top three countries (by column) in term of patent ownership and their share of the overall patent portfolio invented in a country (by row).

The majority of patents from the business sector in the EU are owned by a company located in the country where inventors reside. Romania, where German companies own about 51% of the patents invented there, is the only exception. The share of home ownership varies greatly: from 27% in Croatia to 88% in Finland.

Companies from Croatia, Hungary, Ireland and Slovakia (and Romania) own less than 50% of patents invented there. Particularly interesting is the case of Ireland, where the majority of patents invented there is owned by foreign companies (table 2), but for which the total number of patent owned is still larger than that of those invented (table 1).

Among the second country in terms of patent ownership (reported in the second column of the table) Germany and US appear as the most frequent ones (10 and 8 times, respectively). In some countries more than one quarter of patents invented there are owned by companies located in a single foreign country: Cyprus (UK, 25%), Slovakia (DE, 26%), Luxembourg (US, 31%), Hungary (DE, 27%).

Finally, in the last column we report the third country in terms of patent ownership. The US and Germany appear frequently in this column as well (8 and 5 times, respectively). Switzerland based companies also own significant shares of patents invented in the EU countries (it appears 4 times in the second column and 5 times in the third). In many cases the third country in terms of ownership still holds more than 10% of patents. This points to the fact that, for a number of countries, patent ownership is rather geographically concentrated.

Finally, a look at the first three owners at company level (Hernández *et al.*, 2018) provides insights of the concentration of patenting activity within the business sector for each EU-28 country.

Table 2 – Country ownership of EU invented patents (2013-2015)

Inventor Country	First applicant country		Second applicant country		Tird applicant country	
	Country	Patent share	Country	Patent share	Country	Patent share
Austria	Austria	76%	Germany	11%	Switzerland	4%
Belgium	Belgium	62%	USA	12%	France	11%
Bulgaria	Bulgaria	55%	USA	12%	Germany	11%
Cyprus	Cyprus	67%	United Kingdom	25%	Japan	5%
Czechia	Czechia	53%	Germany	16%	Switzerland	11%
Germany	Germany	87%	USA	3%	Switzerland	3%
Denmark	Denmark	81%	Germany	8%	USA	4%
Estonia	Estonia	63%	Germany	8%	Virgin Islands	7%
Spain	Spain	70%	Germany	10%	USA	9%
Finland	Finland	88%	Switzerland	3%	Sweden	2%
France	France	82%	Switzerland	5%	Germany	3%
United Kingdom	United Kingdom	63%	USA	11%	Netherlands	5%
Greece	Greece	61%	USA	14%	Germany	6%
Croatia	Croatia	27%	United Kingdom	18%	Denmark	14%
Hungary	Hungary	31%	Germany	27%	Sweden	16%
Ireland	Ireland	42%	USA	21%	France	20%
Italy	Italy	80%	Sweden	4%	USA	4%
Lithuania	Lithuania	56%	Germany	23%	USA	8%
Luxembourg	Luxembourg	55%	USA	31%	Switzerland	6%
Latvia	Latvia	59%	Finland	14%	Germany	10%
Malta	Malta	63%	Luxembourg	15%	Belgium	5%
Netherlands	Netherlands	86%	USA	4%	Germany	3%
Poland	Poland	60%	Switzerland	12%	USA	11%
Portugal	Portugal	76%	Germany	8%	USA	3%
Romania	Germany	51%	Romania	14%	USA	13%
Sweden	Sweden	79%	Switzerland	6%	Japan	4%
Slovenia	Slovenia	65%	Germany	15%	Switzerland	6%
Slovakia	Slovakia	40%	Germany	26%	USA	7%

Note: in the second and third column shares greater than 10% are highlighted.

Source: own computation on Patstat 2018A.

In particular, the combined share of patents owned by the top 3 companies over the patent portfolio invented in a country shows that the concentration of patents across private actors can be very high. For example, in Romania 60% of patents invented there are owned by only three companies. Other countries showing very high shares are Lithuania (51%) and The Netherlands (44%). In the latter, Philips is by far the first actor in term of patenting activities, filing about 40% of the patent invented there. In other countries the concentration among companies is very low (e.g. Italy, 5% and United Kingdom, 9%).

4. Why is this important for Europe?

Patent valorisation through technology development and commercialisation may favour further investment in innovation, knowledge diffusion and, finally contribute to a sustainable economic growth.

On one hand, exploiting the patented technology can be profitable for a patent owner and create multiplying effects on the economy. The latter can be favoured by a shared exploitation of the technology underlying the invention. This should be guaranteed

by reasonable and non-discriminatory licensing fees and is particularly relevant for patents essential for technology standards (SEPs).

On the other hand, certain countries or regions face structural difficulties to grasp the opportunities that patented inventions may offer. Indeed, while the generation of new technologies may create knowledge spillovers in the economy, this does not guarantee that benefits will remain within the country.

Finally, specificities in the industrial base and the characteristics of the business sector in a country may lead to different ownership patterns of intellectual property.

EU policies should take these facts into account in order to design effective EU industrial and innovation policies. These should be flexible to address the specific needs of each country's innovation ecosystem. Favouring the flows of private R&D to "less advanced" countries is a first step but sustainable growth might require more.



Read more

More information, including activities and publications, is available at:

- <http://iri.jrc.ec.europa.eu/>
- <http://ec.europa.eu/research/>
- <https://ec.europa.eu/jrc>
- <http://iri.jrc.ec.europa.eu/policy-briefs.html>

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Hernández, H., Grassano, N., Tübke, A., Potters, L., Gkotsis, P., and Vezzani, A. (2018). "The 2018 EU Industrial R&D Investment Scoreboard"; EUR 29450 EN; Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97293-5, doi:10.2760/131813, JRC113807.

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Methodological Annex

For 14 years, the EU Industrial R&D Investment Scoreboard (Scoreboard) has monitored the activities of the top corporate R&D investors worldwide. Despite efforts to increase its coverage of R&D activities in European countries, a number of countries are still not represented in the Scoreboard. Considering the top 1000 EU companies, eight EU Member States are not yet represented, while for a number of other countries the R&D activities financed by the business sector are hardly captured (see table A1). This is mainly due to two reasons, either R&D performers in such countries are too small to be included in the Scoreboard sample, or they are subsidiaries of foreign Scoreboard companies and thus their R&D is consolidated and attributed to the country where the headquarters of the parent company is located.

Therefore, Scoreboard figures are not directly comparable with Eurostat ones. Indeed, due to size and corporate group consolidation, Scoreboard figures can be higher or lower than the Eurostat figures of R&D financed by the business enterprise sector, the BES-R&D (see column 2 of table A1). For the sake of clarity, the BES-R&D is different from BERD; the latter captures the R&D performed in the business enterprise sector, but that can be financed by different

entities. In general, BERD tends to be higher than BES-R&D (see column 3 of table 6.1).

To close this information gap we have used the full sample of patents filed at the European Patent Office (EPO) and provided evidence on the patenting activities of the business sector in the EU Member States. We do so using a field in the Patstat database that allows identifying those patents for which the applicant operates in the business sector. In order to control for multiple filing of the same invention at different Patent Offices, applications were matched via INPADOC (International Patent Documentation) families (<http://www.epo.org/searching/essentials/patent-families/inpadoc.html>).

This allows tackling the need for better coverage of technological activities in the business sector in the EU countries with a focus on inventorship-ownership patterns across countries and companies.

Table A1 - Comparing Scoreboard R&D with BES-R&D and BERD in EU

Country	Companies in the 2018 EU1000 Scoreboard	SB-R&D/ BES-R&D	BERD/ BES-R&D	BES-R&D (R&D funded by business enterprise sector)
Germany	219	1.22	1.05	58,239
France	111	1.06	1.17	27,203
UK	275	1.40	1.35	21,333
Italy	39	1.12	1.16	11,077
Sweden	77	1.20	1.22	8,396
The Netherlands	53	2.15	1.15	6,663
Austria	32	0.24	1.44	5,222
Belgium	34	0.41	1.19	5,929
Spain	20	0.79	1.15	6,039
Denmark	42	0.93	1.08	4,771
Finland	36	1.18	1.22	3,325
Ireland	27	5.83	1.47	1,516
Poland	4	0.01	1.19	1,684
Czech Republic	2	0.05	1.57	1,122
Hungary	1	0.15	1.48	751
Portugal	4	0.14	1.09	953
Slovenia	2	0.24	1.10	590
Greece	3	0.26	1.05	535
Romania			1.18	292
Luxembourg	18	2.18	1.10	312
Bulgaria			2.06	155
Slovakia			1.12	232
Croatia			1.10	175
Estonia			1.12	124
Lithuania			0.96	111
Latvia			1.23	31
Malta	1	0.93	1.13	33
Cyprus			1.14	17

Note: BES-R&D reported in €million.

Source: own computation on the Industrial Research and Innovation Scoreboard 2016 and Eurostat (R&D figures refer to 2015).

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