

IPR-intensive industries and economic performance in the European Union

Industry-Level Analysis Report, September 2019
Third edition

A joint project between the European Patent Office
and the European Union Intellectual Property Office





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01 / Foreword

Innovation is a key component of the growth strategy adopted by the European Union (EU) and its Member States, as well as many other countries. The aim is to create a more competitive economy with higher employment. The achievement of this goal depends on several different factors, but an efficient system of intellectual property rights (IPR) undoubtedly ranks among the most important, given IP's capacity to encourage creativity and innovation throughout the economy.

In response to the clear need to provide policymakers and the public with accurate information, the European Union Intellectual Property Office (EUIPO) and the European Patent Office (EPO) joined forces in 2013 to carry out a study that quantified the economic contribution made to the EU economy by IPR-intensive industries.

This study has now been updated for the second time, demonstrating that in the intervening period IPR-intensive industries have become even more integral to GDP, employment and trade in Europe.

Europe already has a long tradition of encouraging creativity and innovation: the Member States of both the EU and the European Patent Organisation have played a major role in shaping a modern and balanced system of IPR which not only guarantees innovators their due reward but also stimulates a competitive market. In today's world of increasingly globalised markets and the knowledge economy, it is vital to ensure that this system remains effective for implementing new innovation policies. To assist us in that task, it is essential that the debate on IP's role in supporting innovation and creativity be based on sound evidence.

The first joint study, carried out in 2013, revealed that IPR-intensive industries accounted for 39% of the EU's economic output and 26% of employment during the period 2008-2010, attesting to the value of IP to the European economy. The study was repeated in 2016, covering the period 2011-2013, and showed that, even during a severe financial crisis and recession in much of Europe, the IPR-intensive sectors coped better with the difficult conditions than did the rest of the economy.

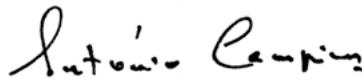
To safeguard the enduring value of the study, the third edition includes new elements which provide a substantially improved overview of the situation of IPR industries in Europe. Firstly, the database matching used to identify IPR-intensive industries has been refreshed, resulting in an updated list of the sectors concerned. Secondly, the report matches the contemporary focus of policymakers in Europe and beyond with a specific chapter on the economic importance of climate change mitigation technologies (CCMTs) and the information technology sectors that are driving the Fourth Industrial Revolution (4IR). Finally, in addition to providing data for the EU Member States, this report also includes information for Iceland, Norway and Switzerland.

This new edition of the report shows that the shares of these industries in EU employment and GDP are higher than in the 2016 study, and confirms the increasing centrality of intellectual assets in modern economies.

These are significant findings that serve to underline further the contribution of IPR-intensive industries to the prosperity and competitiveness of Europe. Equipped with this updated study, it is our hope that readers can draw upon this information to ensure the continuing strength not just of our intellectual property system, but also of the European economy in which it has been found to play such a vital part.



Christian Archambeau
Executive Director, EUIPO



António Campinos
President, EPO

Joint Project Team

EUIPO

Nathan Wajzman, Chief Economist
Michał Kazimierzak, Economist
Carolina Arias Burgos, Economist
Francisco García Valero, Economist

EPO

Yann Ménière, Chief Economist
George Lazaridis, Economist
Ilja Rudyk, Economist
Karin Terzić, Assistant

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02 / About this study

One of the mandates of the EUIPO through its European Observatory on Infringements of Intellectual Property Rights (“the Observatory”)¹ is to provide evidence-based data on the impact, role and public perception of intellectual property in the economy of the European Union (EU). In order to meet that objective, the Observatory is conducting a programme of socio-economic studies.

Similarly, the Strategic Plan 2023 of the European Patent Office (EPO) prioritises the conduct of economic studies to meet the increasing demand among stakeholders for greater awareness of the impact of the European patent system and its development.

The present report, drawn up as a joint project between the EUIPO and the EPO and benefiting from input from other IP offices, European Commission services and international organisations, is the third major study resulting from this collaboration, following a first study published by the two offices in 2013² and an update released in 2016.³ It aims to provide an updated assessment of the combined contribution of industries that make intensive use of the various types of intellectual property rights (IPRs) to the economy of the EU as a whole as well as those of individual European countries. Although this report quantifies the collective contribution of IPR-intensive industries, it does not claim to show **causal** relationships between IP rights and economic variables.

The study covers a broad range of IP rights⁴ – trade marks, patents, designs, copyright, geographical indications (GIs) and plant variety rights (PVRs) – and considers a variety of economic indicators, in particular gross domestic product (GDP), employment, external trade and wages. It makes no policy recommendations, as this is not within its scope. Instead, it is designed to provide evidence that can be used by policymakers in their work, and to serve as a basis for raising IP awareness throughout Europe.

The 2013 study covered the period 2008-2010, and the 2016 update the period 2011-2013. The present study looks at the period 2014-2016. In order to ensure comparability between the three studies, the same methodology has been used as before. However, a number of improvements have been made as regards the underlying data and the methodology. In particular, the matching exercise used to identify IPR-intensive industries has been updated to ensure that the selection reflects recent developments. In addition, to complement the data for the EU member states, Iceland, Norway and Switzerland have been included in this study.

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- 1 The Observatory was transferred to the Office for Harmonization in the Internal Market (OHIM) under Regulation (EU) No 386/2012 of the European Parliament and of the Council of 19 April 2012, which entered into force on 5 June 2012. OHIM was renamed the European Union Intellectual Property Office (EUIPO) following the entry into force of Regulation (EU) 2015/2424 on 23 March 2016. Except in bibliographical references, its new name is used throughout this report.
 - 2 OHIM/EPO: „Intellectual property rights intensive industries: contribution to economic performance and employment in the European Union“, September 2013.
 - 3 EPO/EUIPO: „Intellectual property rights intensive industries and economic performance in the European Union“, October 2016.
 - 4 „IP“ is usually, but not always, a result of innovation. However, it is a broader term than „IPR“, as it includes other types of knowledge, such as trade secrets and business methods. In this study, „IPR“ is used to refer to the six rights included in the analysis: patents, trade marks, registered designs, copyright, geographical indications and plant variety rights.

Given the increasing focus of policymakers and business leaders in Europe and beyond on developing technologies to deal with climate change, a chapter on the economic importance of climate change mitigation technologies (CCMTs) was added in the 2016 study and has been updated for the present edition. In this chapter, the economic weight of industries engaged in the development of those technologies is analysed in greater detail, based on data on patent filings at the EPO. In addition, a new section on the Fourth Industrial Revolution (4IR), also based on patent data, has been introduced in the present report to account for the deep impact of digital transformation in a large array of industries.

03 / Executive Summary

3.1 Main findings

- There are now 353 IPR-intensive industries in the EU economy, compared with the 342 identified in the previous (2016) study. Approximately two thirds of these industries are intensive in respect of more than one IP right.
- IPR-intensive industries generated 29.2% of all jobs in the EU during the period 2014-2016. On average over this period, they employed almost 63 million people in the EU. In addition, another 21 million jobs were generated in industries that supply goods and services to IPR-intensive industries. Taking indirect jobs into account, the total number of IPR-dependent jobs rises to 83.8 million (38.9%).
- Over the same period, IPR-intensive industries generated almost 45% of total economic activity (GDP) in the EU, worth €6.6 trillion. They also accounted for most of the EU's trade with the rest of the world and generated a trade surplus, thus helping to keep the EU's external trade broadly balanced.
- IPR-intensive industries pay significantly higher wages than other industries, with a wage premium of 47% over other industries. This is consistent with the fact that the value added per worker is higher in IPR-intensive industries than elsewhere in the economy.
- A comparison of the results of this study with those of the 2016 edition reveals that the relative contribution of IPR-intensive industries to the EU economy has increased between the two periods 2011-2013 (2016 study) and 2014-2016 (the present study), even after taking into account the change in the number of IPR-intensive industries.
- Among IPR-intensive industries, the economic weight of industries engaged in the development of climate change mitigation technologies (CCMTs) and those related to the Fourth Industrial Revolution (4IR) has increased in recent years. CCMT industries accounted for 2.5% of employment and 4.7% of GDP in the EU in 2014-2016, while the 4IR sectors made up 1.9% of employment and 3.9% of GDP during the same period.
- For the first time, comparable results on the contribution of IPR-intensive industries to GDP and employment are also shown for Iceland, Norway and Switzerland. The contribution of IPR-intensive industries to GDP was above the EU average in Norway and below it in Iceland and Switzerland. The contribution to employment was at or above the EU average in Iceland and Switzerland, but below it in Norway.

3.2 IPR-intensive industries in the EU economy

IPR-intensive industries are defined⁵ as those having an above-average ownership⁶ of IPRs per employee, as compared with other IPR-using industries. In principle, this means that an industry is identified as IPR-intensive in the EU if for at least one of the IP rights under consideration, the number of those IPRs per employee exceeds the average of all EU industries that make use of that same IP right. As is shown in Chapters 6 and 7, these industries are concentrated in the manufacturing, technology and business services sectors.

It should be emphasised, however, that most industries use IP rights, often in combination, to some extent. By focusing exclusively on IPR-intensive industries, this study covers that part of the European economy in which IP rights are most prominent.⁷

The contribution of IPR-intensive industries to the two principal economic indicators – employment and output – is summarised in Tables 1 and 2.^{8,9}

IPR-intensive industries are shown to have generated 29.2% of all jobs in the EU during the period 2014-2016, with 22% in trade mark-intensive industries, 14% in design-intensive industries, 11% in patent-intensive industries, 5.5% in copyright-intensive industries, and smaller proportions in GI-intensive and PVR-intensive industries.¹⁰ On average over this period, nearly 63 million Europeans were employed by IPR-intensive industries, out of a total employment figure of approximately 216 million. In addition to their direct employment contribution, IPR-intensive industries also generate employment in other, non-IPR-intensive industries which supply them with goods and services as inputs to their production processes. Using the EU input-output tables¹¹ published by Eurostat, it is possible to calculate this indirect effect on employment in non-IPR-intensive industries. Taking this indirect effect into account, the total number of IPR-dependent jobs rises to almost 84 million (38.9%).

The results are summarised in Table 1, which shows a breakdown by direct and indirect employment.

5 See Chapter 5 on methodology. Due to the particular nature of copyright, GIs and PVRs, different approaches had to be applied to them.

6 In this report, the expressions „use of IPRs“ and „ownership of IPRs“ are used interchangeably and should be understood to refer to ownership of IPRs in all cases.

7 The industries identified as IPR-intensive in this report accounted for 73% of the European Union Trade Marks (EUTMs), 83% of the Registered Community designs (RCDs), 86% of the European patents and 96% of the Community Plant Variety Rights registered during the period covered.

8 In order to minimise the impact of data gaps in the economic statistics and avoid attaching undue importance to a particular year, the economic indicators were calculated as an average for the years 2014-2016.

9 It should be noted that the shares in GDP and employment shown do not necessarily reflect the degree to which a country is innovative, but rather the importance of these industries in its economy.

10 The total contribution of IPR-intensive industries is less than the sum of the individual contributions of trade mark-intensive, patent-intensive, design-intensive, copyright-intensive, PVR-intensive and GI-intensive industries because many industries are intensive in respect of more than one IP right. However, the study methodology ensures that there is no double-counting of industry contributions.

11 Input-output tables show the flow of goods and services between all industries in the economy.

Table 1:
Direct and indirect contribution of IPR-intensive industries to
employment, 2014-2016 average

IPR-intensive industries	Employment (direct)	Share of total employment (direct)	Employment (direct+indirect)	Share of total employment (direct+indirect)
Trade mark-intensive	46,700,950	21.7%	65,047,936	30.2%
Design-intensive	30,711,322	14.2%	45,073,288	20.9%
Patent-intensive	23,571,234	10.9%	34,740,674	16.1%
Copyright-intensive	11,821,456	5.5%	15,358,044	7.1%
GI-intensive	n/a	n/a	399,324	0.2%
PVR-intensive	1,736,407	0.8%	2,618,502	1.2%
All IPR-intensive	62,962,766	29.2%	83,807,505	38.9%
Total EU employment			215,520,333	

Note: Due to overlapping use of IP rights, the sum of the figures for the individual IPRs exceeds the total figure for IPR-intensive industries.

Besides employment, IPR-intensive industries contribute to economic output, as measured by gross domestic product (GDP). Table 2 shows that, overall, almost 45% of EU GDP is generated in IPR-intensive industries, with trade mark-intensive industries accounting for 37%, design-intensive industries 16%, patent-intensive industries 16%, copyright-intensive industries 7% and GI-intensive and PVR-intensive industries for smaller percentages. Chapter 7 provides a more detailed breakdown of these industries' contributions to the national economies of the EU Member States as well as the three non-EU member countries included in this study.

Table 2:
Contribution of IPR-intensive industries to GDP, 2014-2016 average

IPR-intensive industries	Value added / GDP (€ million)	Share of total EU GDP
Trade mark-intensive	5,447,857	37.3%
Design-intensive	2,371,282	16.2%
Patent-intensive	2,353,560	16.1%
Copyright-intensive	1,008,383	6.9%
GI-intensive	20,155	0.1%
PVR-intensive	181,570	1.2%
All IPR-intensive	6,551,768	44.8%
Total EU GDP	14,621,518	

Note: Due to overlapping use of IP rights, the sum of the figures for the individual IPRs exceeds the total figure for IPR-intensive industries.

A comparison of the results of this study with those of the 2016 edition reveals that the contribution of IPR-intensive industries to the EU economy was higher in the 2014-2016 period than in 2011-2013. However, the comparison is complicated by the fact that certain key components of the European system of national and regional accounts (ESA) used by Eurostat were updated between these two periods. In addition, in order to ensure that this study reflects the current structure of the EU

economy, the matching exercise used to identify IPR-intensive industries was updated, resulting in an increase of the number of these industries from 342 in the 2016 study to 353 in the present one. These updates had the effect of increasing the contribution to GDP and employment of IPR-intensive industries. In Table 3, the 2011-2013 figures have been re-calculated using the new definitions so as to illustrate the impact of these changes.

Table 3:
Comparison of the main results: 2016 vs. 2019 study

Contribution of IPR-intensive industries	2016 study (original)	2016 study (new national account calculations, new IPR-intensive industries)	2019 study (new national account calculations, new IPR-intensive industries)
Employment (direct)	27.8%	28.6%	29.2%
GDP	42.3%	44.0%	44.8%
Total trade in goods	89.3%	88.8%	92.5%
Total trade in goods and services	not calculated	78.1%	81.0%

The first column contains the results reported in the 2016 study for the period 2011-2013. The second column re-calculates the 2016 results for the same period, taking into account the new national accounting calculations and the new list of IPR-intensive industries. The third column shows the results of the present study (for the period 2014-2016) and is therefore directly comparable with the second column.

Thus, even after the effects of the statistical revisions have been taken into account, the contribution of IPR-intensive industries has increased between the two periods 2011-2013 (2016 study) and 2014-2016 (2019 study).

There are also indications that during the difficult economic conditions that prevailed in 2014-2016, employment in IPR-intensive industries held up significantly better than overall employment. Total employment in the EU declined slightly from 215.8 million in 2011-2013 to 215.5 million in 2014-2016, a fall of 0.1%, while employment in the 353 IPR-intensive industries rose from 61.7 million to 63 million (+1%).

Given that 44.8% of GDP (value added) in the economy and 29.2% of employment is generated in IPR-intensive industries, the value added *per employee* is higher in IPR-intensive industries than in the rest of the economy. Economic theory suggests that, all else being equal, industries in which the average worker produces more value added can be expected to pay their workers higher wages than other industries. It is therefore interesting to examine whether this higher value added is reflected in wages in IPR-intensive industries.

As shown in Table 4, wages in IPR-intensive industries are indeed higher than in non-IPR-intensive industries. The average weekly wage in IPR-intensive industries is €801, compared with €544 in non-IPR-intensive industries – a difference of 47%. This “wage premium” is 29% in GI-intensive industries, 40% in design-intensive industries, 48% in trade mark-intensive industries, 59% in copyright-intensive industries and 72% in patent-intensive industries.

Table 4:
Average personnel costs in IPR-intensive industries, 2016

IPR-intensive industries	Average personnel costs (€ per week)	Premium (compared with non-IPR- intensive industries)
Trade mark-intensive	805	48%
Design-intensive	761	40%
Patent-intensive	934	72%
Copyright-intensive	867	59%
GI-intensive	705	29%
PVR-intensive*	n/a	n/a
All IPR-intensive industries	801	47%
Non-IPR-intensive industries	544	
All industries (included in SBS**)	654	

*Not calculated because of lack of wage statistics for agriculture.

**Structural Business Statistics published by Eurostat.

Compared with the situation in 2013 (re-calculated using the new set of IPR-intensive industries), the wage premium has increased slightly from 45% to 47%, reflecting particularly strong increases in wage premiums for patent-intensive and design-intensive industries.

The role played by IPR-intensive industries in the EU's external trade is also examined. In the 2016 report, only trade in goods was reported. Since then, Eurostat has begun to provide data on trade in services as well, so in the present report the two types of trade are treated separately. The bulk of EU trade is in IPR-intensive industries. It may be somewhat surprising at first glance that such a high share of trade is IPR-intensive. This is because even some industries producing commodities such as energy are IPR-intensive,¹² while on the other hand, many non-IPR-intensive activities are also non-tradable.¹³ For that reason, 89% of EU goods imports consist of products of IPR-intensive industries. However, an even higher share of EU goods exports – 96% – is accounted for by IPR-intensive industries. In the case of trade in services, the share of IPR-intensive industries is lower, with imports accounting for 57.4% of total services imports, and exports at 53.7% of total services exports. Taking both goods and services trade into account, in 2016 80% of EU imports and 82% of EU exports were generated by IPR-intensive industries.

The EU as a whole had an overall trade surplus in 2016 of approximately €166 billion, or 1.1% of GDP. The trade surplus in IPR-intensive industries was even greater, at €182 billion, thus counterbalancing a small deficit in non-IPR-intensive trade.

Table 5 summarises trade volumes in IPR-intensive industries based on data from 2016.¹⁴

12 NACE class 0610 (Extraction of crude petroleum) is patent-intensive.

13 For example, service industries such as those included in NACE divisions 86 (*Human health activities*) and 96 (*Other personal service activities*). Such services are generally consumed at the point of production.

14 As with the employment and GDP calculations, the figures for the individual IP rights do not add up to the overall figure for IPR-intensive industries due to the fact that many industries are intensive in more than one IP right. However, the study methodology ensures that there is no double-counting of industry contributions.

Table 5:
EU external trade in IPR-intensive industries, 2016

IPR-intensive industries	Exports (€ million)	Imports (€ million)	Net exports (€ million)
Trade mark-intensive	1,613,366	1,600,703	12,663
Design-intensive	1,261,774	1,194,885	66,889
Patent-intensive	1,438,117	1,307,850	130,267
Copyright-intensive	294,856	202,738	92,119
GI-intensive*	12,490	1,360	11,130
PVR-intensive*	7,552	3,885	3,667
Total IPR-intensive	2,122,465	1,940,510	181,955
TOTAL EU TRADE	2,590,889	2,425,202	165,687

Note: Due to overlapping use of IP rights, the sum of the figures for the individual IPRs exceeds the total figure for IPR-intensive industries.
*Goods only.

Patent-intensive industries have the highest trade surplus, followed by the copyright-intensive and design-intensive sectors.

A closer look at the activity of IPR-intensive industries within the EU Single Market reveals a division of labour between EU Member States. Countries such as Austria, Denmark, Finland, Germany, Luxembourg, Malta and Sweden are above the EU average in terms of IPR creation per employee. IPR-intensive industries in other EU member states, such as Romania, Slovakia, Hungary and the Czech Republic, have the highest proportion of jobs that are attributed to companies based in other countries. As shown in Table 6, overall, 22.7% of EU jobs in IPR-intensive industries are generated in subsidiaries of foreign companies, a majority of which originate from another EU member state. Only in Estonia, the Netherlands, Great Britain and Ireland do non-EU companies create more jobs than companies from other EU member states.

Table 6:
Share of employment in IPR-intensive industries attributed to foreign companies 2014-2016, EU average

IPR-intensive industries	EU share	Non-EU share	Total non-domestic share
Trade mark-intensive	11.5%	9.2%	20.6%
Design-intensive	13.0%	9.8%	22.8%
Patent-intensive	14.5%	12.0%	26.5%
All IPR-intensive	12.9%	9.8%	22.7%

Note: "Foreign" companies are companies whose headquarters are located in another country.

Finally, patent data are used to identify IPR-intensive industries that are active in climate change mitigation technologies (CCMTs) aimed at reducing or preventing the emission of greenhouse gases¹⁵, and Fourth Industrial Revolution technologies (4IR), both of which are pervasive to many sectors and of particular importance for the EU economy. Overall, 9.4% of the total European patents considered in 2010-2014 related to CCMTs, while 1.9% related to 4IR technologies.

The 25 CCMT-intensive industries are of particular interest, since CCMTs will play an important role in achieving the goals set out in the Paris Agreement on Climate Change, and European companies are among the world leaders in many of those technologies. These sectors account for 2.5% of employment and 4.7% of economic output in the EU, and have seen their contribution increase since the period 2011-2013. Employees in those industries also receive a far higher remuneration than those in other industries. At 93.3% compared with non-IPR-intensive industries, the "wage premium" in CCMT industries is almost double that of IPR-intensive industries in general (47%).

Driven by the emergence of the Internet of Things, 4IR encompasses a number of other technologies, such as cloud computing and artificial intelligence (AI). The 16 4IR-intensive industries (concentrated in advanced manufacturing sectors) account for 1.9% of EU employment and 3.9% of EU GDP, and have also seen their contribution increase since the period 2011-2013. The wage premium in 4IR industries is even higher than in CCMT industries, at 104.3% (compared with non-IPR-intensive industries).

These figures are a subset of the patent-intensive industries and are thus already included in the overall figures in Tables 1-5.

15 The CCMT identification is based on the EPO's Y02/Y04S tagging scheme, which is part of the Cooperative Patent Classification (CPC). It covers selected technologies which control, reduce or prevent anthropogenic emissions of greenhouse gases [GHG] within the framework of the Kyoto Protocol and the Paris Agreement. For example, it includes technologies that help reduce greenhouse gas emissions related to energy generation, transmission or distribution and technologies that allow the capture, storage, sequestration or disposal of greenhouse gases, as well as information and communication technologies aimed at reducing their own energy use.

3.3 IPR-intensive industries in the economies of Iceland, Norway and Switzerland

In addition to the 28 EU Member States, the study also includes basic results for the EFTA countries Iceland, Norway and Switzerland.¹⁶ The contribution to employment and GDP of IPR-intensive industries in those countries is shown in Table 7. The EU average is included for reference purposes.

Table 7:

Contribution of IPR-intensive industries to employment and GDP in EFTA countries, 2014-2016 average

IPR-intensive industries	Employment (direct)	Share of total employment (direct)	GDP (€ million)	Share of GDP
Trade mark-intensive				
IS	40,029	23.0%	5,267	33.1%
NO	477,143	18.8%	150,312	42.5%
CH	1,023,493	23.4%	200,892	34.4%
Design-intensive				
IS	14,542	8.3%	1,060	6.7%
NO	256,256	10.1%	83,443	23.6%
CH	657,143	15.0%	114,456	19.6%
Patent-intensive				
IS	11,561	6.6%	1,499	9.4%
NO	284,366	11.2%	100,543	28.4%
CH	583,563	13.5%	123,513	21.1%
Copyright-intensive				
IS	13,547	7.8%	1,017	6.4%
NO	146,977	5.8%	18,210	5.1%
CH	252,252	5.8%	37,902	6.5%
All IPR-intensive				
IS	50,939	29.2%	6,294	39.6%
NO	669,540	26.3%	173,460	49.1%
CH	1,341,482	30.7%	241,518	41.3%
All IPR-intensive (EU)	62,962,766	29.2%	6,551,768	44.8%

Note: Due to overlapping use of IP rights, the sum of the figures for the individual IPRs exceeds the total figure for IPR-intensive industries.

Norway has an above-EU average contribution to its GDP from IPR-intensive industries, while Switzerland lies above the EU average when it comes to the employment contribution of those industries.

¹⁶ In calculating the contribution of IPR-intensive industries in those countries, it was assumed that industries that are IPR-intensive in the EU28 are also IPR-intensive in these three countries. In addition, due to lack of data coverage, it was not possible to calculate the contribution of GI-intensive and PVR-intensive industries for these three countries.

3.4 Methodology and data

The basic methodology of this study is the same as that used in the previous studies. Nevertheless, to make this report self-contained, a large part of it, specifically Chapter 5 and Appendix 11, is devoted to documenting this methodology. There are two main reasons for this:

1. Given the complexity of dealing with a large amount of data from 28 Member States, contained in several large databases, a novel and sophisticated data matching methodology was needed.
2. In the interests of transparency, it was important to provide as thorough a description of the methodology as possible.

Another distinguishing feature of this study is the wide variety of databases and other data sources used to determine which industries are IPR-intensive and to assess the contribution of these industries to employment, GDP and other economic indicators. A full list is given in Chapter 5.

In addition, industry-specific third-country data was used where needed, in particular in connection with the estimate of trade in GI products.

In order to determine which industries are IPR-intensive, the register databases of the EUIPO, EPO and CPVO were matched with the commercial database ORBIS.¹⁷ The resulting matched database contains data on approximately 345,000 companies, including the number of EU trade marks, registered Community designs, patents and CPVRs applied for by each company and subsequently granted, along with the industry classification and various financial and economic variables for each one, providing a set of data that can be used in future, more detailed studies.

Using this database, the number of trade marks, designs, patents and PVRs per employee was calculated for each industry, and the industries which were above average according to this measure were considered to be IPR-intensive. This calculation was performed at EU level, no account being taken of national filings by the companies in the database. This approach, made necessary in part by data limitations, is nevertheless justified by the assumption that an industry which is defined as IPR-intensive based on its registration of EU-level IP rights would also be deemed IPR-intensive if national IP rights per employee were included as well.

The matching methodology was improved and automated for this study, and new data from ORBIS was used. In addition, the method for identifying PVR-intensive industries was modified, resulting in the identification of three additional such sectors. As a result, 353 IPR-intensive industries were identified, compared with 342 in the previous study. For copyright and GIs, the same industries were considered intensive as in the earlier study.

¹⁷ ORBIS is a database of financial information on European companies, provided by Bureau van Dijk and based on data obtained from company filings in company registers or similar records in the various countries. It includes data on all companies, whether listed on a stock exchange or not (the latter being typically the case for SMEs).

A fundamental assumption behind the methodology is that the degree to which an industry is IPR-intensive is an intrinsic characteristic of that industry, regardless of where it is located.¹⁸ In assessing the contribution of each industry to the economy, what is being measured are the jobs and GDP generated by that industry in each Member State and in the EU, and not the origin of the underlying IPR.

For example, if a car company based in country A builds an assembly plant in country B, then the jobs and value added created as a result accrue to the economy of country B. Therefore, no conclusions as to how innovative a particular country is can be drawn on the basis of the country-level contributions of IPR-incentive industries alone. In the above example, the higher contribution of patent-intensive industries in country B is the result of decisions on where to site the production of vehicles, but the underlying R&D could have been performed in country A or indeed another country altogether.

To shed some light on this issue, Chapter 8 shows which countries the patents, trade marks, designs and PVRs in the database used for this study originate in and presents statistics on the proportion of jobs in IPR-intensive industries in each Member State that are created in companies based in other Member States or outside the EU.

18 The exception is GI, which is analysed on a country-by-country basis.

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List of abbreviations

4IR	Fourth Industrial Revolution
BvD	Bureau van Dijk
CCMT	Climate change mitigation technology
CPA	Classification of products by activity
CPVO	Community Plant Variety Office
CPVR	Community plant variety right
COMEXT	Eurostat reference database for external trade
DG AGRI	Directorate-General for Agriculture and Rural Development
DG GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
DUO	Domestic ultimate owner
EAA	Economic accounts for agriculture
EBOPS	Extended Balance of Payments Services Classification
EC	European Commission
EFTA	European Free Trade Association
EPC	European Patent Convention
EPO	European Patent Office
EU	European Union
EUIPO	European Union Intellectual Property Office
EUTM	European Union Trade Mark
FATS	Foreign affiliates statistics
GDP	Gross domestic product
GI	Geographical indication
GVA	Gross value added
IP	Intellectual property
IPR	Intellectual property right
LFS	Labour Force Survey
NACE	Nomenclature générale des activités économiques dans les Communautés Européennes (Statistical classification of economic activities in the European Community)
NAICS	North American Industry Classification System
OECD	Organisation for Economic Cooperation and Development
OHIM	Office for Harmonization in the Internal Market (from 23 March 2016: EUIPO)
PATSTAT	Worldwide Patent Statistical Database (EPO)
PDO	Protected designation of origin
PGI	Protected geographical indication
PVR	Plant variety right

R&D	Research and development
RCD	Registered Community design
SBS	Structural business statistics
SMEs	Small and medium-sized enterprises
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
UK IPO	United Kingdom Intellectual Property Office
USPTO	United States Patent and Trademark Office
VA	Value added
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

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Country codes

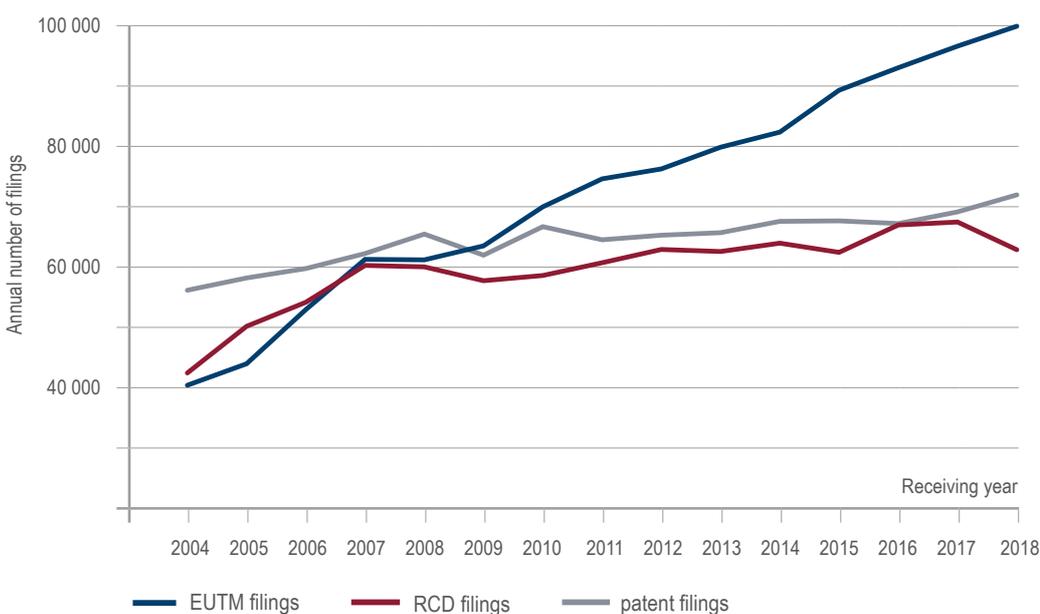
AT	Austria
BE	Belgium
BG	Bulgaria
CH	Switzerland
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FI	Finland
FR	France
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
IS	Iceland
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom
EU-28	28 member states of the European Union
EU-27	27 member states of the European Union (without the UK)

04 / Introduction

Intellectual property (IP) is now widely recognised as a key driver in modern economies. The emergence of the knowledge economy, globalised markets and the growing complexity of products and services have all helped to make IP rights more important. For many companies in advanced economies, their intangible assets are now far more valuable than their physical assets. Empirical evidence suggests that, in their attempt to extract additional value from their innovations, companies consider alternative means of IP protection, often in a complementary way. Looking to the future, most policymakers firmly believe that knowledge-intensive industries will drive growth and prosperity not only in Europe but across the globe.

As shown in Figure 1,¹⁹ filings of European patents, trade marks and designs by European applicants have grown significantly since 2004. Overall, filings of EU trade marks and European patents saw growth over the entire period, with faster growth in the case of trade marks. Growth in EU design filings was comparable to the rate seen in EU trade marks up until 2007, but has been considerably slower since then, and filings stagnated between 2012 and 2015, the years of the global economic crisis, before resuming their growth in 2016. Overall, the resilience of IPR filing activity is yet another indication of the growing importance of IPR.

Figure 1:
Number of EP, EUTM and RCD applications filed by EU applicants between 2004 and 2018



¹⁹ In Figure 1, EP = European patent, EUTM = European Union Trade Mark and RCD = Registered Community Design.

Quantifying IP rights and their economic contribution is tough, as data on them tends to be fragmented and disaggregated, and focuses on individual rights and/or specific industries. In the past, research on the economic impact of IP has concentrated on patents. In recent years, however, several studies have also assessed the impact of trade marks on innovation, growth, employment and wages, but only at a national level.

Like our 2016 report, this study offers a comprehensive assessment of how IPR-intensive industries contribute to the European economy, with a focus on gross domestic product (GDP), employment and external trade.²⁰ Of course, IP also affects the economy in other ways that are not quantified in our study, including, for example, technology transfer, the long-run effects on innovation and growth, and externalities related to the creation and use of IP that are not monetised through market transactions.²¹

This study looks at trade marks, patents, designs, copyright, geographical indications (GIs) and plant variety rights (PVRs). It identifies those EU industries with above-average use of those rights in relation to the size of their workforce. It quantifies the weight of those industries in the economy of the EU as a whole and that of each member state. It also includes information for Iceland, Norway and Switzerland.

While this report quantifies the collective contribution of IP rights to the economy, its results do not reveal **causal** relationships between IP and economic variables. It does not feature any comparative analysis of the effects of different types of IP protection either. The various IP rights serve different purposes, are used in different sectors of the economy and have different scope. Nor does the study analyse the value of IPRs for individual companies, but rather is concerned with their contribution at the level of industries and Member States. Within any industry, some companies use IPRs more intensively than others and the report does not reflect these. Such variations are not captured in this report. Similarly, companies have adopted different IP protection strategies. For example, some companies prefer to keep trade secrets rather than file for patents, or work with unregistered rather than registered designs. In other words, a number of key forms of IP are not included in this study.

This report defines IPR intensity as the number of IP rights divided by the number of employees in an industry. This means that there could be industries with a relatively small number of valuable IP rights, but a large number of employees. Such industries would not be identified as IPR-intensive according to this methodology.

A firm-level analysis published by the EUIPO in 2015 compares individual IPR-intensive firms with non-IPR-intensive firms in the same industries to assess whether the IPR-intensive firms perform better on indicators like employment or wages.²² Another study published by the EUIPO and EPO in 2019 focuses on the growth performance of European SMEs that use registered IP rights.²³ Both of these firm-level studies indicate a relationship between IPR activity and financial performance of the firm.

20 The 2016 study is available at www.epo.org/ipr-intensive-industries. A similar study on the US economy was published by the USPTO in 2016. See <https://www.uspto.gov/learning-and-resources/ip-motion/intellectual-property-and-us-economy>.

21 Copyright/cultural industries can also affect the economy through the mechanisms of exceptions and limitations. However, these types of contribution are not included in this study.

22 "Intellectual property rights and firm performance in Europe: an economic analysis." Available at https://euiipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/observatory/documents/IPContributionStudy/phase2/OHIM_study_report_en.pdf.

23 „High-growth firms and intellectual property rights: the IPR profile of high-potential SMEs in Europe.“ Available at www.epo.org/high-growth.

This report offers a brief overview of the IP rights covered and their economic function. It features a chapter on the methodology of the study explaining how data was compiled and its analytical treatment. There are two chapters on the results of the industry-level analyses for each of the six IP rights covered, at both EU and individual country level. The most IPR-intensive industries are also discussed in greater detail. The closing chapters of the study look at the origin of the IP rights covered and present an additional analysis of industries patenting inventions in climate change mitigation technologies and 4IR.

4.1 IP rights and their function in the economy

The growing importance of intellectual assets in today's competitive markets has led to the publication in recent years of a wealth of economic and management literature dealing with IPRs. The rising number of scientific publications (and the parallel increase in IPR coverage by management press and newspapers) mirrors the steep increase in the number of patents, trade marks and registered designs worldwide over the past two decades and their usage as output indicators for observing economic phenomena.

Legal protection of intellectual property encourages individuals and organisations to be creative and innovative by granting them exclusive legal rights to the fruits of their work. This section briefly introduces the six forms of IPRs studied in this report: patents, trade marks, registered designs, copyright, GIs and PVRs. It specifies relevant subject-matter, the criteria that need to be met to gain protection and the principal rights conferred. It also provides a brief outline of the economic rationale behind each IP right.

4.1.1 Overview of patents

Patent protection is available for inventions that aim to offer new solutions to technical problems. To be patentable, inventions must be new, non-obvious (i.e. include an inventive step) and industrially applicable. The novelty requirement means that, at the filing date, the invention must not be known to the public anywhere. To satisfy the inventive step requirement, the invention must not be obvious to a person who has ordinary skills in the applicable field. Finally, the invention must be susceptible of an industrial application. Only patents granted by a patent authority are fully valid and enforceable. Patent authorities examine patent applications and ensure that the invention satisfies all legal requirements for patenting. Once granted, the patent confers on its owner the right to prevent any other entity from commercially exploiting the invention. This exclusive right is only granted for a limited time period. Typically, patent protection lasts 20 years from the date of the application, subject to the payment of renewal fees. It is also limited in space, as the exclusionary power of patents can only be enforced within the jurisdiction of the granting state.

In Europe, inventors can apply for patent protection in the individual European states via the national patent systems and/or seek regional protection through a centralised procedure at the European Patent Office (EPO). A European patent granted by the EPO offers patent protection in up to 44 countries. Once the Agreement on the Unified Patent Court is fully ratified, applicants will be able to apply for a "unitary patent" covering most of the territory of the European Union.

There are two main ways in which patent rights promote the progress of technology, innovation and social welfare: they create incentives to innovate and they promote the dissemination and valorisation of new knowledge.²⁴

Patents drive innovation by creating a private reward for innovation in the form of the inventor or applicant's exclusive right to use or sell the patented invention ("reward function"). Why is there any need to introduce such an incentive mechanism? Innovation ultimately generates new knowledge. If this knowledge is not protected, rival firms could potentially exploit it, at little or no cost, reducing inventors' rewards to such an extent that it would no longer be worthwhile for them to innovate. Exclusive legal rights to inventions in the form of patents help to limit this risk by providing adequate incentives to engage in innovative activity.

The "contract function" describes the second main way in which patents can promote innovation: they grant inventors exclusive rights to a given invention in exchange for the disclosure of information on the underlying technical solution involved. The public availability of patent documents in national and international patent offices facilitates the dissemination of technical information which can then be used by others to develop other novel solutions, creating additional gains for society. The combination of disclosure and legal exclusivity also enables contractual arrangements (such as licences or R&D co-operation agreements) for the exploitation of patented inventions.

4.1.2 Overview of trade marks

A trade mark is a distinctive sign that identifies certain goods or services as those provided by a specific person or organisation and distinguishes them from those of other organisations. Trade marks are intended to reduce information and transaction costs in the marketplace by allowing customers to identify the nature and quality of goods and services before purchase. Among the most common signs eligible for trade mark protection are words, pictures, stylised words, logos, a colour or colour combination, a shape, a sound or some combination of those signs. Generally, a sign must fulfil the requirements of distinctiveness to serve as a trade mark. Distinctiveness means that consumers can recognise the sign as a trade mark and distinguish it from other trade marks in the same field. If trade marks are likely to deceive the public as to the nature, quality or any other characteristics of the goods and services to which they refer, they do not qualify for registration. Trade marks can be protected on the basis of either registration through a trade mark office (i.e. registered trade marks) or, in some countries, through their actual use in the marketplace (i.e. unregistered trade marks). Registering trade marks is not compulsory in all countries, but it makes it easier to enforce associated legal rights.²⁵ A registered trade mark owner has the exclusive right to use that trade mark on the goods and services in the product classes for which it has been registered; and to prevent others from exploiting, in the same fields, any sign that is identical or similar to it. The term of protection of a registered trade mark is typically ten years, but it can be renewed indefinitely for successive periods (typically, ten years), subject to payment of fees.

24 There is a rich body of economic literature dedicated to patents (see e.g. Hall and Harhoff, 2012 for a complete overview). This literature discusses the economic functions performed by patents and aims to assess their actual impact on the economy. It also explores the various ways in which patents are used across sectors and countries, and the economic impact of the legal design of patent systems.

25 To enforce the rights associated with an unregistered trade mark, proprietors must normally produce factual evidence to prove that they have an established trade mark that has acquired a reputation in the mind of the public.

The economic rationale underlying the protection of trade marks has its roots in economic theories of information and reputation.

Competing products available in the market may differ from one another in terms of several characteristics and attributes. This difference is not a problem *per se* if consumers can obtain, at no cost, all the relevant information about these products and evaluate them appropriately to guide their purchase decisions. However, that is typically not the case. A product's characteristics are often difficult or impossible for consumers to observe until they have actually purchased the product. In this context, a brand, protected by a trade mark, acts as signal that a given product is of the consistent quality that the consumer associates with that brand.

The legal protection of trade marks provides an incentive to develop and maintain distinguishing product features and create information about them for the benefit of market transparency. Creating this information and building up the reputation that the trade mark conveys is likely to require significant investments in product quality, service and advertising. In the absence of legal protection, and given the limited costs of imitating a competitor's trade mark, there would be limited incentives to incur such quality investments.

4.1.3 Overview of designs

Design protection²⁶ covers the visual appearance of a product, part of a product and/or its ornamentation. A product can be any industrial or handicraft item, including packaging, graphic symbols and typefaces. In other words, a design covers the appearance of a product, but cannot protect its functions, which fall under the regime of patent protection. The requirements that must be satisfied to register a design include that it must be new and have an individual character. It is new if no identical design has been made available to the public at the filing date. It has an individual character if the overall impression it produces on an informed user signifies that it differs from any previous designs. Industrial design protection is usually granted pursuant to a procedure for its registration (= registered design). Under certain laws, however, design rights may also be automatically acquired by disclosing the design in a document or product (= unregistered design). Like trade marks, registered designs provide more comprehensive cover than their unregistered counterparts. Registered design owners have exclusive rights to use the design and can prevent any third parties from using it. In the EU, the rights conferred by registered designs can apply for a maximum of 25 years. Registered Community designs have an initial life of five years from the date of filing and can be renewed for successive periods of five years, up to a maximum of 25 years.

The economic case for design registration builds primarily on the idea of promoting innovation. The production of new designs is a creative activity, requiring significant investments of time, skills and labour. If no exclusive rights were available, any party could replicate a creative design and directly compete with the original creator. Providing a legal mechanism to protect new designs should ultimately enhance investments in design production and creative work.

26 In this report the term "design" is to be understood to mean "registered design".

4.1.4 Overview of copyright

Copyright gives right holders exclusive rights to authorise or prohibit the use (e.g. reproduction, distribution, adaptation, translation) of their content (e.g. films, programmes, etc.). It is important to note that copyright is applicable only to the expression of ideas, not to the ideas themselves. No copyright registration is required at EU level;²⁷ protection is granted automatically from the moment a work is created. In this respect, copyright differs significantly from the other IP rights considered in this report.

Thirteen directives and two regulations have been adopted to harmonise substantive copyright law provisions in the EU Member States. Despite this considerable harmonisation, there are still some national differences in copyright protection in areas not harmonised at EU level. In addition, there are slight differences between copyright regimes as implemented in the EU and the three EFTA countries Iceland, Norway and Switzerland. However, certain standards of copyright and related rights protection apply in all these countries under international legislation such as, for example, the Berne Convention for the Protection of Literary and Artistic Works.

The most important economic rights granted to EU creators, performers, producers and broadcasters include:

- Right of **reproduction** for authors, performers, producers of phonograms and films and broadcasting organisations
- Right of **communication** to the public for authors, performers, producers of phonograms and films and broadcasting organisations
- Right of **distribution** for authors and for performers, producers of phonograms and films and broadcasting organisations
- Right of **fixation** for performers and broadcasting organisations
- Right of **rental** and/or lending for authors, performers, producers of phonograms and films, with an associated right of **equitable remuneration** for lending and/or rental for authors and performers
- Right of **resale** (droit de suite) for artists who work in visual art forms like sculpture, painting or photography
- Right of **broadcasting** for performers, producers of phonograms and broadcasting organisations
- Right of **computer program reproduction, distribution and rental** for authors

It should be noted, however, that not all rights are applicable to all right holders or may only be applicable if certain conditions are met.

²⁷ Voluntary registration is, however, possible in many Member States.

The types of works that are protected under all national copyright laws include the following:

- Literary works (including novels, short stories, poems, dramatic works and any other writings, irrespective of their content, both fiction and non-fiction)
- Dramatic works
- Musical works
- Artistic works (whether two-dimensional such as drawings, paintings, etc. or three-dimensional such as sculptures or architectural works)
- Maps and technical drawings (including cartographic works, plans, blueprints, diagrams, etc.)
- Photographic works
- Cinematographic works
- Computer programs and databases

The list is not exhaustive, as some copyright laws may protect other types of works as well.

Independently of the economic rights, authors are granted moral rights (the right of authorship, the right of integrity of work and the right of divulgation), but not through EU legislation. These rights can be asserted by the author even if the copyright has been transferred to a third party.

Related rights provide economic protection for performers, producers of phonograms and broadcasting organisations. In the EU, film producers and press publishers are also protected by related rights.

In the EU, copyright protection is currently valid for the author's lifetime and 70 years after their death. The protection conferred by related rights lasts for 50 years after the performance, film or transmission of a broadcast was published or communicated to the public. In 2011, the related rights term for performers and sound recordings producers in the EU was extended from 50 to 70 years under certain conditions.

The economic aspects of copyright are complicated, reflecting various trade-offs between the interests of creators, distributors, performers and consumers, and short-term versus long-term effects. The general objective of the system is to ensure appropriate remuneration for creators and other rights holders (so that a socially optimal level of creative activity takes place), while at the same time providing broad public access to the creative works and making it possible for other creators to build upon prior works.

4.1.5 Overview of geographical indications

A geographical indication (GI) is a name which identifies a product to link it to a specific geographical location or origin (e.g. place, region or country). The use of a GI may act as certification that a product has certain qualities, is made according to traditional methods or enjoys a certain reputation due to its geographical origin.

Their connection with the "territory" and the strict product manufacturing controls in place often lead to vertical integration in the different sectors involved in producing GI goods, starting with farmers and continuing to manufacturers and even wholesalers and retailers.

Since GIs are mainly used in Europe in the agriculture, food and beverage sectors, only those sectors are considered in the present report as regards GI intensity.

The two main types of GI for agricultural products and foodstuffs are summarised below.



Protected Designation of Origin (PDO): a name which identifies a product that is **produced, processed and prepared** in a defined geographical area using recognised know-how. Products owe their characteristics exclusively or essentially to their place of production and the skills of local producers.



Protected Geographical Indication (PGI): a name which identifies a product whose reputation or characteristics are attributable to its geographical origin. For PGI agricultural products and foodstuffs, at least one of the stages of production, processing or preparation takes place in the area. For PGI wines, at least 85% of the grapes come from the area.

Another difference between GIs and other IP rights is that while trade marks, designs, patents, plant variety rights and copyright are usually applied for and owned by private entities (mostly individual companies), GIs are typically applied for and managed by producer associations in the relevant geographical area. The GI can then be used by all individual producers located in the area and complying with a product specification including the defined production methods.

In terms of their economic function, GIs and trade marks both have the basic function of addressing information asymmetries between sellers and buyers and helping consumers to lower their search costs by certifying a product's origin and manufacturing methods used to make it. This is reflected in the fact that consumers are often prepared to pay a price premium for GI products.²⁸

4.1.6 Overview of plant variety rights

Plant variety rights or plant breeder's rights ("PVR") are an independent sui generis form of intellectual property right, tailored to protect new plant varieties (Article 27(3)(b) TRIPS).

A plant variety is a plant grouping within a single botanical taxon of the lowest known rank, which can be defined by the expression of the characteristics resulting from a given genotype or combination of genotypes; distinguished from any other plant grouping by the expression of at least one of the said characteristics and considered as a unit with regard to its suitability for being propagated unchanged.

The international legal framework for the protection of plant variety rights is provided by the International Convention for the Protection of New Varieties of Plants (the "UPOV Convention").

²⁸ See EUIPO: „Infringement of Protected Geographical Indications for Wine, Spirits, Agricultural Products and Foodstuffs in the European Union“, 2016. Available at https://euiipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/observatory/documents/Geographical_indications_report/geographical_indications_report_en.pdf.

As far as the European Union is concerned, the Community Plant Variety Rights (CPVRs) system represents the sole and exclusive form of intellectual property right for plant varieties at EU level. The CPVR system is managed by the Community Plant Variety Office (CPVO), responsible for granting CPVR titles. The granted titles can be obtained by means of a single procedure and have unitary effects throughout the whole territory of the European Union. The CPVR coexists with the Member States' respective own national PVR systems. However, if an EU PVR has been granted, a national right for the same variety cannot be enforced.

For a PVR to be granted, it is necessary to first file an application for examination before a national or regional designated authority. The candidate variety must then fulfil the technical criteria of distinctness, uniformity and stability (known as the "DUS" criteria). It must also be new and bear a suitable denomination. These criteria are tested by the CPVO following a formal, substantive and technical examination, the latter in co-operation with national authorities (entrusted examination offices).

A PVR certificate of protection will be granted for a fixed period if all the due requirements are fulfilled. The UPOV 1991 Convention provides for a minimum of 20 years. In the EU it is 25 years for most species and 30 years for vines, trees and potato species.

Right-holders can bring civil proceedings against any person infringing a CPVR.

The economic rationale for plant variety rights is similar to that for patents: to incentivise innovation while at the same time promoting the diffusion of knowledge across the economy.

4.2 Summary of the six IP rights

The main characteristics of patents, trade marks, registered designs, copyright, GIs and PVRs are summarised in Table 8.

Table 8:
Main characteristics of IP rights

IP right	Patents	Designs	Trade marks	Copyright	Geographical Indications	Plant variety rights
Subject-matter	Inventions (solutions to technical problems)	Appearance of an article or product or parts of it and/or its ornamentation	Distinctive signs that identify certain goods or services and distinguish them from those of other businesses	Artistic, literary, dramatic, musical, photographic and cinematographic works; maps and technical drawings; computer programs and databases	Product originating in a particular geographical area whose quality or reputation is linked to its geographical environment or origin	Plant varieties
Requirements for protection	Novelty; inventive step (non-obviousness); industrial applicability	Novelty; individual character	Distinctiveness	Originality of the work, irrespective of its literary or artistic merit	Technical specifications justifying the special characteristics of the product and their link to the geographical area	Distinctness, uniformity, stability and novelty.
Acquisition of right	Examination by the patent office, followed by grant and validation	For registered designs, examination by the IP office. For unregistered designs, automatically acquired by the act of disclosure	For registered trade marks, examination by the IP office. For unregistered trade marks, use in commerce	Automatic upon creation	Examination by the national authority (depending on the country), then by the European Commission	Examination by examination authority chosen by the CPVO, followed by grant
Conferred rights	Exclusive right to make, use and sell the patented invention	Exclusive right to use the design and to prevent any third party from using it without the right holder's consent	Exclusive right to use the trade mark in trade	Reproduction, communication to the public, including making the work available to the public, distribution, rental, resale, translation, adaptation, public performance	Collective right. Exclusive rights to commercialise comparable products and prevent imitation, misuse or evocation	Exclusive right to commercialise the protected plant variety
Duration	Typically 20 years from filing, subject to payment of annual renewal fees	For registered designs, the maximum term is 25 years. In the case of registered Community designs, up to 25 years (in successive five-year terms)	For registered trade marks, commonly 10 years from filing, but can be renewed indefinitely, on payment of fees, for successive periods	For authors, lifetime plus 70 years. For performers, generally 70 years from the date of first public performance, fixation, publication or transmission. For producers of phonograms, 70 years after the fixation is made, the phonogram is published or communicated to the public. For film producers, 70 years after the fixation is made, the film is published or communicated to the public. For broadcasters, 50 years after first transmission.	Indefinite; no need for renewal	For most plant varieties, 25 years; 30 years for vines, trees and potatoes, subject to payment of annual fees

05 / Methodology of the study

The purpose of the present study is to examine the economic characteristics of IPR-intensive industries. The methodology used for this study follows that applied in the 2016 and 2013 studies as closely as possible, in order to achieve maximum comparability.

Thus, the principles behind the methodologies of the studies are the same: first, determine which industries use IPRs more than others;²⁹ second, use industry-level economic statistics to determine employment and value added (GDP) generated in those industries; third, compare the industry-level economic aggregates to those for the overall economy in order to determine the weight in the economy of IPR-intensive industries.

However, while the 2013 and 2016 studies were both based on the matching of the ORBIS database and the EPO and EUIPO databases developed for the 2013 study, this time it was decided to carry out a new matching exercise to ensure that the classification of industries as IPR-intensive or non-IPR-intensive reflects today's economy as closely as possible. As explained in section 5.2 and in Appendix 11, the data matching methodology was also improved, requiring fewer manual checks than the previous method. All in all, the new methodology resulted in 353 industries being identified as IPR-intensive, 11 more than in the 2016 study. In order to analyse trends, the 2016 results have been re-calculated using the new set of IPR-intensive industries to ensure that the figures are comparable.

Three countries that are not members of the EU – Iceland, Norway and Switzerland – are included in the study this time. The calculation of the contribution of IPR-intensive industries in those countries was based on the assumption that industries that are IPR-intensive in the EU-28 are also IPR-intensive in those three countries. In other words, no separate matching exercise was carried out for them. This was done mainly to ensure the comparability of their results with those of the EU. In addition, given that all three countries are European economies at a similar level of economic development to many EU Member States, it is reasonable to assume that their economic structure will not differ from that of comparable EU Member States.

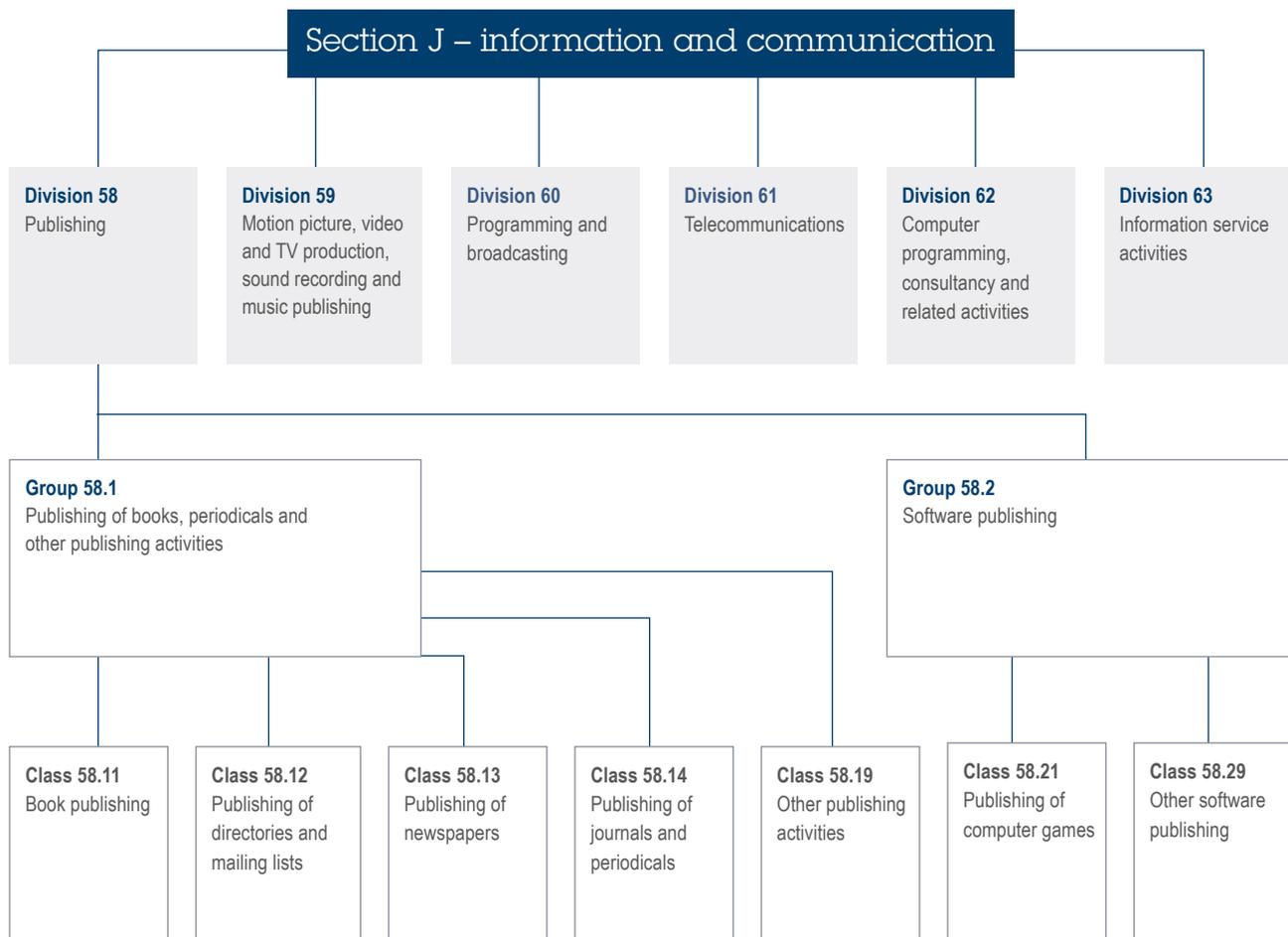
The basic unit of analysis in this study is the industry as defined in the NACE classification used by Eurostat.³⁰ In this classification, overall economic activity is divided into 22 sections, which are

29 This approach does not take into account the distribution of IPR use within the sector. In other words, an industry may be classified as IPR-intensive if a minority of firms in that industry use IPRs very intensively while the rest use them very little.

30 For details of the NACE classification, see <https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF>. It should be borne in mind that „industry“ as used here and in Eurostat literature simply means „economic activity“.

further subdivided into 88 divisions (often referred to as the two-digit level), 272 groups (three-digit level) and 615 classes (four-digit level). An example of the hierarchical NACE structure is shown in Figure 2.

Figure 2:
NACE structure, Section J – Information and Communication



The list of industries that are intensive in their use of copyright and GIs is pre-determined, as explained in sections 5.6 and 5.7. For patents, trade marks, designs and PVRs, IPR intensity is determined by examining the volume of IP rights obtained by all industries at the EUIPO, EPO and CPVO in relation to the level of employment in those industries. This was the most labour-intensive part of the study and is explained in section 5.2. How the data was used is explained in more depth in sections 5.3 for patents, 5.4 for trade marks and 5.5 for designs. Section 5.8 explains the methodology used for PVRs.

When calculating the IPR intensity of industries, IP rights were associated as far as possible with industries on the four-digit level. However, Eurostat employment data is not available on a sufficient level for all industries. For some industries, the most granular employment data available is NACE

division (two-digit) level. The source of the employment data for those industries is the Labour Force Survey (LFS).³¹ Calculation of the IPR intensity of those industries can only be performed on NACE division level.

Including those industries in the calculation of overall, employment-weighted average IPR intensity would lower the average, so that a higher number of industries would be classified as IPR-intensive. Therefore, the calculation of the weighted average of IPR applications per 1,000 is based solely on industries for which SBS employment data is available. On the other hand, once the average value had been calculated, for the purpose of selecting the group of IPR-intensive industries, all the NACE codes were considered, including those for which only LFS employment data was available.

5.1 Data sources and selection criteria

One of the distinguishing features of this study is the variety of databases and other data sources used to determine which industries are IPR-intensive, and to assess the contribution of these industries to employment, GDP and other economic indicators. They include:

- EUIPO's register of EU trade marks and registered Community designs
- EPO's PATSTAT database, containing information on patent applications that have been published and/or granted by the EPO
- CPVO's Register of Community Plant Variety Rights
- ORBIS, a commercial database containing industry classification and other information for more than 20 million European companies. Together with the EUIPO, EPO and CPVO databases, this was the basic database of registered property rights (patents, designs, trade marks and plant variety rights) used for the analysis. ORBIS is provided by a Brussels-based company, Bureau van Dijk, which compiles the data based on filings made by companies in company registers and similar government records in their respective countries.
- COMEXT, Eurostat's reference database for the EU's external trade. This data was used to quantify the contribution of IPR-intensive industries to external trade.
- Eurostat's structural business statistics (SBS) data, showing employment, labour costs and value added for each industry at EU and Member State level, as well as in the three non-EU countries included in this study, using the NACE classification of economic activity. This data was the main source for the contribution of IPR-intensive industries to employment and GDP (except for GIs).
- Eurostat's Labour Force Survey (LFS), used to estimate employment in certain industries not reported in the SBS.
- Eurostat's national accounts statistics, the main source for official data on total GDP and employment at EU level as a whole, for individual Member States and for non-EU countries that are members of the European Statistical System.
- Eurostat's input-output tables (IOT), showing flows of products and services between the different industries. This data was mainly used to quantify the indirect employment contribution of IPR-intensive industries.

31 For more information on the LFS, see <https://ec.europa.eu/eurostat/web/microdata/labour-force-survey>.

- Economic accounts for agriculture (EAA), Eurostat's main data source for statistics on EU agricultural sectors. This database was used in the analysis of GI-intensive industries.
- Farm structure survey (FSS), Eurostat's data source for employment in the agricultural sectors; used to quantify employment in GI and PVR-intensive sectors.
- Eurostat crop statistics, used to determine the area under cultivation of plants protected by PVRs.
- Economic data from national statistics offices in several EU Member States. This data was used to supplement the Eurostat data, particularly for some of the copyright-intensive sectors.
- Eurostat's foreign affiliates statistics (FATS), used to calculate the number of jobs in IPR-intensive industries created by companies based outside each Member State.
- E-Bacchus/E-Spirits-Drinks/DOOR: three databases of the European Commission's DG AGRI, showing all GIs registered in the EU.
- Data on sales of GI products provided by DG AGRI, used to quantify the GDP contribution of GI-intensive industries.

In addition, industry-specific data for non-EU countries were used where needed, in particular to estimate trade in GI products, as explained in section 5.7.1.

The IP rights chosen for the analysis were patents, trade marks, designs and PVRs applied for at the EPO, EUIPO and CPVO during the period 2010-2014 and subsequently granted.³² Using a five-year period rather than a single year has the advantage of avoiding bias resulting from factors that might have affected the economy in any particular year.

When selecting the sample of IP rights for the analysis, a time lag of 3-4 years was applied, as an innovation is expected to yield economic benefits only after a certain amount of time has elapsed. Accessing complementary assets such as marketing channels, cost-effective manufacturing and after-sales support takes time and is a prerequisite for successful commercialisation in a dynamic environment. Moreover, in the case of new products and services, negotiating licence agreements and attracting financing can be a lengthy process. This may explain why empirical research suggests that there may be a time lag between successful patent applications and subsequent changes in company performance.³³ A similar case can be made for trade marks and designs, since a newly registered trade mark or design may not confer the same benefits as one that has been in the market for several years, giving consumers time to gain confidence in that particular company or product.

The contribution made to the economy by the IPR-intensive industries identified according to the methodology described in this chapter was analysed using economic data for the period 2014-2016, thus updating the earlier study, which used economic data for 2011-2013.

The IP rights used were those registered at EU level and did not take into account national filings by the companies in the database. This approach, made necessary in part by data limitations, is nevertheless justified by the assumption that an industry which is defined as IPR-intensive based on its registration of EU-level IP rights would also be deemed IPR-intensive if national IP rights were included as well.

32 In other words, the application was filed during the period 2010-2014, but the corresponding IP right could have been granted at any time up to May 2019 (when the data used for the matching exercise were extracted from the underlying databases).

33 Holger Ernst (1999) examined the relationship between patent applications and subsequent changes in corporate performance for 50 German machine tool manufacturers between 1984 and 1992 and found that the time lag effect can be up to three years after priority in the case of European patents.

The EUIPO, EPO and CPVO data had to be matched to ORBIS, but only patents, trade marks, designs and PVRs with at least one EU-based owner were included in this exercise because the version of the ORBIS database used for this study contains data on EU-based companies, including affiliates of non-EU companies. However, the exclusion of non-EU IPR owners does not affect the ultimate goal of the data matching exercise, namely the selection of IPR-intensive industries. It is a fundamental assumption of this study that whether or not an industry is IPR-intensive is an inherent characteristic of that industry, irrespective of its geographical location. In the subsequent economic analysis of the employment and GDP contribution of IPR-intensive industries to the EU economy, all relevant industries are included, regardless of the ultimate ownership of the companies within each industry. For example, jobs at a Korean-owned car factory located in an EU Member State are included in Eurostat's statistics and in the quantification in Chapter 7.

5.1.1 Economic data

The primary source of employment and value added data is Eurostat's Structural Business Statistics (SBS) data series, which shows employment in each four-digit NACE sector for the EU and for each Member State, as well as for the three non-EU countries included in this study (Iceland, Norway and Switzerland). In practice, there are data gaps in the statistics published by Eurostat for some years, owing to one or more of the following factors:

- **Quality of data:** In some cases, Eurostat and/or the relevant national statistical office may decide that the data for a particular industry is of questionable quality. In those cases, Eurostat does not publish the data. However, it is important to note that even then, the data is included in Eurostat's aggregate estimate at EU-28 level.
- **Confidentiality:** It may be that only one company is active in a particular industry in a Member State (this is especially true for the smaller Member States). In such cases, in order to maintain confidentiality, Eurostat does not report the data at Member State level. However, the data is included in aggregate EU-level estimates, and for higher-level (two-digit) NACE industries.
- **Exclusion of certain industries:** For 16 IPR-intensive industries, no data at all is reported in SBS.³⁴

In some cases, where SBS data was not available, data from another Eurostat data series, national accounts employment data, was used instead. This series uses a slightly different definition than SBS but the impact on the results is minimal.³⁵

In the case of the remaining 14 IPR-intensive industries for which Eurostat does not collect data, the employment data was obtained from the national statistics offices of France, Spain and the United Kingdom. A ratio of employment in each of the industries to total employment and GVA in the

³⁴ These industries are all classes included in divisions 01 Crop and animal production, hunting and related service activities; 66 Activities auxiliary to financial services and insurance activities; 85 Education; 90 Creative, arts and entertainment activities; 91 Libraries, archives, museums and other cultural activities; 92 Gambling and betting activities; 93 Sports activities and amusement and recreation activities; and 94 Activities of membership organisations.

³⁵ Specifically, SBS data was missing for two two-digit industries: 01 Crop and animal production, hunting and related service activities, and 66 Activities auxiliary to financial services and insurance activities. For those two industries, employment data was obtained from national accounts.

corresponding divisions (85 and 90 to 94) was calculated for these three countries, and these ratios were then applied to the other EU countries in order to obtain the missing employment numbers. In effect, this procedure assumes that the share of the 14 industries in total employment and GVA of those six divisions in the EU is the same as that of France, Spain and the UK together.

All in all, for the EU as a whole, SBS data was available for 337 of the 353 IPR-intensive industries, while data for the remaining 16 industries was completed by imputation based on member state data, as described above.³⁶

The basic source of data on the EU's external trade is Eurostat's COMEXT database. One difficulty with trade data is that it is organised on the basis of products rather than industries or economic activities. COMEXT, however, provides a "translation" through its Classification of Products by Activities (CPA 2008) nomenclature, which is consistent with the NACE classification used throughout this report. The CPA classification includes both goods and services. In the present report, international trade in services has been included in addition to trade in goods, based on balance of payments data published by Eurostat. The correspondence between the Extended Balance of Payments Services Classification (EBOPS 2010) and the CPA 2008 nomenclature is available in RAMON, Eurostat's metadata database.

In the case of some of the copyright-intensive industries, trade data was obtained from Eurostat's input-output tables³⁷ because it was not available in COMEXT. This was the case for the following NACE divisions, which contain 25 relevant NACE classes:

- 58 Publishing activities
- 59 Motion picture, video and television programme production, sound recording and music publishing activities
- 60 Programming and broadcasting activities
- 62 Computer programming, consultancy and related activities
- 63 Information service activities
- 73 Advertising and market research

Since all the classes in divisions 58, 59, 60, 62 and 63 are copyright-intensive, the fact that trade data is only available at the two-digit (division) level does not give rise to any methodological issues. However, division 73 includes one non-copyright intensive industry: *73.20 Market research and public opinion polling*. While including this industry slightly overstates the trade share of copyright-intensive industries, it has no impact on the overall share of IPR-intensive industries, because the industry in question is trade mark-intensive.

36 In theory, 9,884 data points (employment or value added for 353 industries for 28 Member States) were needed at the level of the Member State. However, about one tenth of the total data needed at country level was missing from the published Eurostat statistics at four-digit level and was estimated based on two-digit data in SBS. The imputed data is only significant in the case of Malta, Luxembourg, the Netherlands and Switzerland.

37 <http://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/data/database>.

5.2 Data matching for patents, trade marks, designs and CPVRs

In order to determine which industries are IPR-intensive, the EUIPO and CPVO registers and the PATSTAT database were matched with the commercial database ORBIS, which contains industry classification and other information for more than 20 million European firms.³⁸ The first step in the data preparation process (name harmonisation) was carried out using an algorithm developed at the Catholic University of Leuven (KUL) and further refined by the project team.³⁹ The second part, the actual matching of databases, was based on an original methodology developed by the project team. The firms in all databases were matched using name, legal form, post code and other criteria, in order to overcome the inherent difficulties resulting from inconsistencies in spelling, abbreviations, etc. between the different databases.

The end result of this was a matched database containing data for more than 345,000 companies (ORBIS ids) with the number of EUTMs, RCDs, patents and CPVRs applied for by each company.

Following the matching, the data was filtered to include only those applications filed during the period 2010-2014 and subsequently registered/granted. Depending on the type of IPR, between 72% and 90% of IPRs were matched with the data on their owners.⁴⁰ There are various reasons why not all patent, EUTM, RCD or CPVR owners can be found:

- ORBIS does not contain data on private individuals (who may be owners of IP rights)
- Changes of name of applicants might not be communicated to IP offices
- There may be errors or gaps in the ORBIS data.
- There may be spelling differences that are not captured by the matching algorithms.

When combined with the industry classification (NACE) used by Eurostat, the data could be aggregated to show industries linked with those IP rights. This step is crucial in determining which industries are intensive in their use of trade marks, designs, patents and plant variety rights.⁴¹

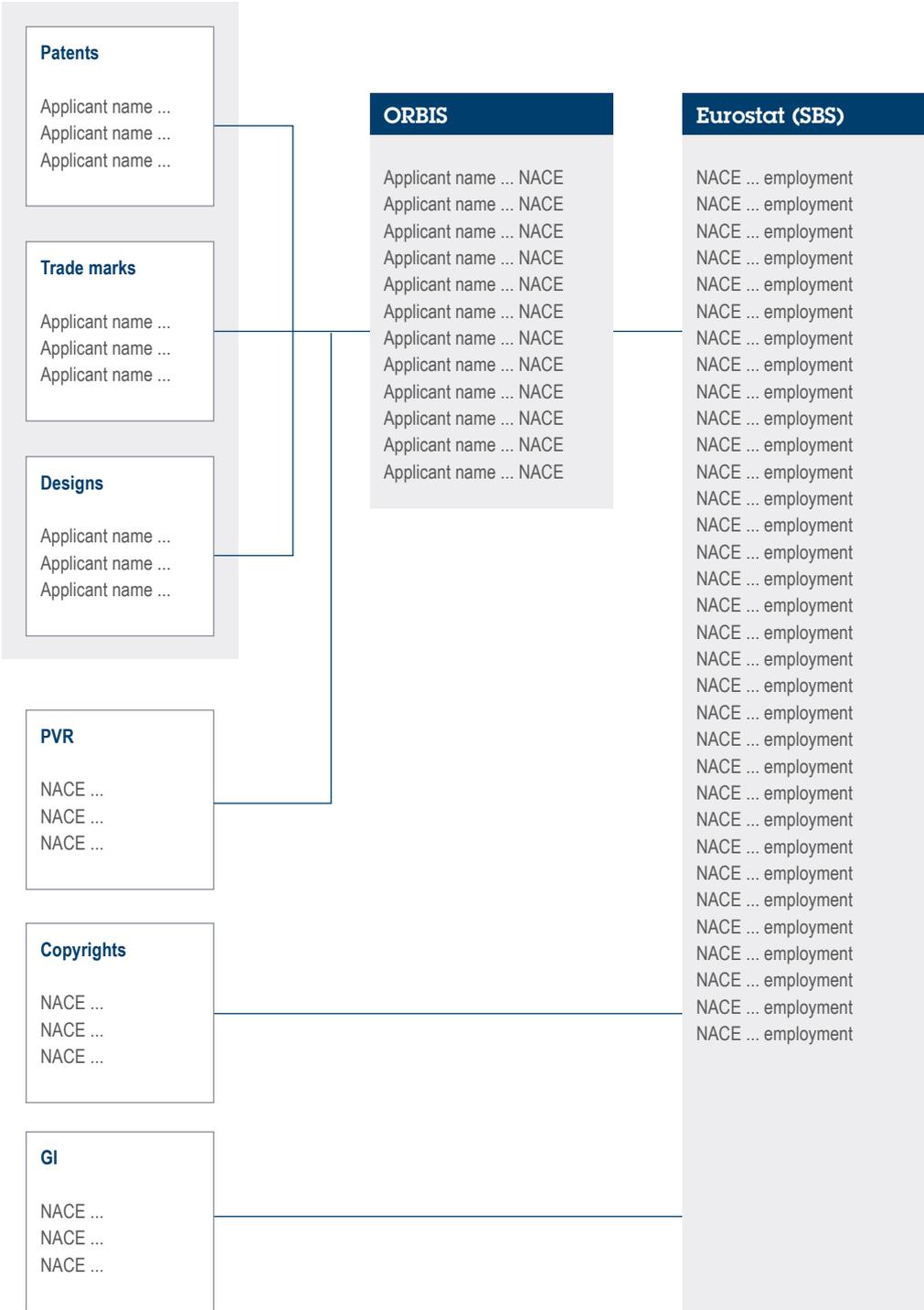
38 https://www.bvdinfo.com/en-gb/our-products/data/international/amadeus?gclid=CjwKCAjwscDpBRBnEiwAnQ0HQJ35Wl_C6EpmDJiWdpci7JBlyMECKD0tLkCDQZHty7KmhUVjeh6RoCaTMQAvD_BwE, retrieved on 18 July 2019.

39 For a detailed description of this step, see sections 1.1-1.3 in Appendix 11.

40 The last known owner of the registered IP right was used for the matching. For example, for patents, the applicant as mentioned on the publication of grant was used. No subsequent transfers of right were taken into account due to data availability. However, it can be assumed that most transfers of rights take place between entities active in the same industry and will therefore not have any major impact on the results of this study.

41 Although ORBIS is the best available data source for extracting information on companies' industrial activity, IP management practices and the nature of a company's business activity can sometimes distort information on the industrial application of IPRs. That will be the case, for example, if a company is active in several industries and protects the IPRs relevant to each industry in which it is active. In ORBIS, each company/branch can be associated with one principal industry only, so all its IPRs will be linked with the NACE code for that principal industry. Similarly, if a company is active in both manufacturing and wholesale trade but wholesale trade is indicated as its principal industry in ORBIS, its IPRs will count as related to wholesale trade although they may in fact relate to manufacturing only.

Figure 3:
Simplified illustration of the data matching process



5.3 Identification of patent-intensive industries

This section explains how the patent-intensive industries were identified. Intensity was determined at EU level in two steps. First, the total number of patents protected under the European Patent Convention (EPC) for each industry was calculated. This is known as **absolute patent intensity**. Secondly, for each industry, the total number of patents was divided by the number of persons employed in that industry at EU level, as reported by Eurostat in its Structural Business Statistics (SBS) series. The result is the **relative patent intensity** of that industry. Finally, the overall employment-weighted average of relative patent intensities was calculated for all the industries that have patents. Those industries whose relative patent intensities were above this average value were considered to be patent-intensive.

When calculating the absolute intensity for patents, trade marks and designs, two important issues had to be dealt with. The first was the head offices, i.e. the presence of general, non-specific industry codes in the ORBIS data: 6420 *Activities of holding companies*, 7010 *Activities of head offices* and 8299 *Other business support services*. This phenomenon reflects the common business practice of large companies of concentrating IP portfolios at their head offices. In order to avoid distorting the absolute intensity calculations, a procedure was developed and applied in order to allocate those IP rights to *bona fide* industry codes. This procedure is described in Appendix 11.

Another data limitation also common to patents, trade marks and designs is the assignment in ORBIS of NACE codes at a higher level of aggregation than the four-digit level used in the analysis. As in the case with the “head offices” issue, this problem was solved by reallocating the IP rights within the division (two-digit level) or group (three-digit level).

5.3.1 Absolute intensity

- The starting point for the calculation of absolute patent intensities was the PATSTAT database (version April 2019). The dataset was limited to published applications filed at the EPO between 1 January 2010 and 31 December 2014 by at least one applicant having its domicile in an EU Member State, yielding a total of 291,512 patent applications.
- The dataset was then filtered to include only applications that were ultimately successful, leaving only the applications that were granted between 2010 and 2019. That reduced the number of applications in the dataset to 144,981.
- As a next step, patent applications were merged with concordance tables linking patent applicants' data to company information in ORBIS. A match was found for 123,849 unique patent applications, i.e. 85% of all relevant applications.
- Where a patent had multiple owners, some of whom have their seat outside of the EU, the fraction of patents associated with third-country owners was discounted. The total sum of the patent fractions corresponding to the subset of patents matched with ORBIS data amounted to 122,605.8.
- For some firms, ORBIS does not contain information on the NACE industry of their activity. In such cases, this information was inferred based on the concordance table between NACE and IPC classes built upon the matched dataset. Patent applicants were assigned a NACE class with the highest probability, given a particular IPC class composition within the firm's patent portfolio.

- A significant share of firms in the matched dataset is associated with head office codes. In order to assign proper industry codes to those firms, ORBIS data was leveraged to retrieve the NACE codes of groups of firms linked to head offices within the same economic group. For a given head office, NACE codes were assigned proportionally to the number of firms representing various NACE industries within a head office economic group.
- For those firms associated with head office codes for which insufficient information on their economic group was available in ORBIS, IPC class information in their patent portfolio was used.
- Finally, for some firms ORBIS assigns NACE codes at a higher level of aggregation than the four-digit level used in the analysis, i.e. division or group code. This problem was solved by reallocating patents linked with those firms to the lower level of NACE. The reallocation was proportional to the number of patents assigned to each class in the subset of patents associated with correct four-digit NACE industries.

5.3.2 Relative intensity

To calculate relative patent intensity, Eurostat employment data was matched with the data on absolute intensities. Relative patent intensity is defined as the total number of granted patents assigned to an industry divided by the total employment figure for that industry (in thousands), leading to an indicator of patent numbers per 1,000 employees. Patent-intensive industries are defined as those industries where the value of this indicator is higher than the employment-weighted mean of patents per 1,000 employees, which amounts to 0.937 patents per 1,000 employees. Although divisions for which only LFS employment data was available were not taken into consideration when calculating the weighted average, those industries were compared with the cut-off point to determine whether they met the definition of patent intensity. None of those industries proved to be patent-intensive.

5.4 Identification of trade mark-intensive industries

5.4.1 Absolute intensity

- The starting point for the calculation of absolute trade mark intensities was the EUIPO trade mark register. The EUIPO dataset was limited to EUIPO trade mark applications filed between 1 January 2010 and 31 December 2014 with at least one applicant having its domicile in an EU member state, yielding a total of 386,324 trade mark applications (1,178,075 trade mark classes).
- The dataset was then filtered to include only applications that were ultimately successful, leaving only the applications that were granted between 2010 and 2019. That reduced the number of applications in the dataset to 337,198 (1,037,454 trade mark classes).
- As a next step, trade mark applications were merged with concordance tables linking trade mark applicants' data to company information in ORBIS. A match was found for 243,636 unique trade mark applications (743,409 trade mark classes), i.e. 72.25% of all relevant applications.
- Where a trade mark had multiple owners, some of whom have their seat outside of the EU, the fraction of trade marks associated with third-country owners was discounted. The total sum of trade mark fractions corresponding to the subset of trade marks matched with ORBIS data amounted to 243,553 (743,165.6 classes).

- For the subset of trade mark owners that were matched with ORBIS data but for which a NACE code was not available in ORBIS, the relevant information was inferred from patent data in cases where they filed for patent protection too. In total, NACE codes were not available for 9,228 trade mark applications for which a match with ORBIS was found. For 815 applications, NACE could be inferred on the basis of patent applications associated with their owners. The rest of the applications for which a NACE code was not available in ORBIS were discarded from further analysis. A total of 235,223 trade mark applications were considered for the analysis (716,033.1 trade mark classes assigned to fractions corresponding to EU owners).
- In order to assign proper industry codes to firms linked in ORBIS with head office status, NACE industry codes of firms linked with head offices within the same economic groups were used. For a given head office, the NACE codes were assigned proportionally to the number of firms representing various NACE industries within the head office economic group.
- For those firms associated with head office codes for which no information on its group structure was available in ORBIS, if they filed for a patent, the NACE code was inferred from patent data based on the IPC classes structure in their patent portfolio.
- The remaining trade marks associated initially with head offices' NACE codes were redistributed to other NACE codes proportionally to the distribution of valid NACE codes associated with head offices in the subset of data for which the assignment was possible, based on the two steps described above.
- Finally, for some firms, ORBIS assigns NACE codes at a higher level of aggregation than the four-digit level used in the analysis. This problem was solved by reallocating trade marks linked with those firms to the lower level of NACE based on the distribution of trade marks within the division or group based on the calculation done on the subset of firms correctly associated with the lowest NACE industry level.

5.4.2 Relative intensity

To calculate relative trade mark intensity, Eurostat employment data was matched with the data on absolute intensities. Relative trade mark intensity is defined as the total number of granted trade marks assigned to an industry, divided by the total employment figure for that industry (in thousands). Trade mark-intensive industries are defined as those industries where the value of this indicator is higher than the employment-weighted mean of trade marks per 1,000 employees, which amounts to 4.726 trade marks per 1,000 employees.

Although divisions for which only LFS employment data was available were not taken into consideration while calculating the weighted average, those industries were compared with the cut-off point to determine whether they met the definition of trade mark intensity. The following industries, defined at division level and with employment data available only from LFS, turned out to be trade mark-intensive: 66 *Activities auxiliary to financial services and insurance activities*; 92 *Gambling and betting activities*; and 93 *Sports activities and amusement and recreation activities*.

5.5 Identification of design-intensive industries

The methodology for identifying design-intensive industries was very similar to that used for trade marks described in section 5.4.

5.5.1 Absolute intensity

- The starting point for the calculation of absolute design intensities was the EUIPO design register. The dataset was limited to registered Community design applications filed between 1 January 2010 and 31 December 2014 with at least one applicant having its domicile in an EU Member State, yielding a total of 311,945 design applications.
- The dataset was subsequently filtered to include only applications that were ultimately successful, leaving only the applications that were granted between 2010 and 2019. That reduced the number of applications in the dataset to 297,786.
- As a next step, design applications were merged with concordance tables linking design applicants' data to company information in ORBIS. A match was found for 233,945 unique design applications, i.e. 78.56% of the initial dataset.
- Where a design had multiple owners, some of whom have their seat outside of the EU, the fraction of designs associated with third-country owners was discounted. The total number of design fractions corresponding to the subset of designs matched with ORBIS data amounted to 232,609.
- For the subset of design owners that were matched with ORBIS data, but for which NACE code was not available in ORBIS, the relevant information was inferred from patent data in cases where patent protection had been applied for too. In total, NACE codes were not available for 4,485 applications for which a match with ORBIS was found. For 919 applications, NACE was inferred on the basis of patent data associated with their owners. The remaining 3,566 applications for which a NACE code was not available in ORBIS were discarded from further analysis, leaving a final sample of 230,379 design applications (229,109 design fractions corresponding to EU owners).
- In order to assign proper industry codes to firms linked in ORBIS with head office status, ORBIS information on the structure of an economic group of firms associated with head offices was used. For a given head office, NACE codes were assigned proportionally to the number of firms representing various NACE industries within the head office economic group. For those firms associated with head office codes for which no information on group structure was available in ORBIS, if they had filed for patent protection, the NACE code was inferred from patent data based on the IPC classes structure within their patent portfolio. The remainder of the designs associated initially with head office NACE codes were redistributed to other NACE codes proportionally to the distribution of valid NACE codes associated with head offices in the subset of data for which the assignment was possible based on the two steps described above.
- Finally, for some firms ORBIS assigns NACE codes at a higher level of aggregation than the four-digit level used in the analysis. This problem was solved by reallocating design applications linked with those firms to the lower level of NACE based on the distribution of designs within the division or group based on the calculation done on the subset of firms correctly associated with the lowest NACE industry level.

5.5.2 Relative intensity

The methodology used to calculate relative intensity was the same as for patents and trade marks.

To calculate relative design intensity, Eurostat employment data was matched with the data on absolute intensities. Relative design intensity is defined as a number of granted designs assigned to an industry divided by the total employment figure for that industry (in thousands). Design-intensive industries are defined as those having the value of this indicator higher than the employment weighted mean of designs per 1,000 employees, which amounts to 1.655. Although divisions for which only LFS employment data was available were not taken into consideration when calculating the weighted average, those industries were compared with the cut-off point to determine whether they met the definition of design intensity. None of those industries proved to be design-intensive.

5.6 Identification of copyright-intensive industries

IPR intensity (number of rights per 1,000 employees) cannot be calculated for copyright in the same way as for trade marks, patents and designs, because copyright is not registered. Copyright registries do exist in some EU Member States, but their use is not mandatory and there is no EU-level registry. The approach taken to overcome this difficulty was to adapt a methodology developed by the World Intellectual Property Organization (WIPO) and documented in its *“Guide on Surveying the Economic Contribution of the Copyright-based Industries”* published in 2003.⁴²

The WIPO guidelines group industries into four categories according to the degree to which their activity depends on copyright. These four categories are: core copyright industries, inter-dependent industries, partial copyright industries and non-dedicated support industries.

Core copyright industries, as defined by WIPO, include:

- Press and literature
- Music, theatrical productions, operas
- Motion picture and video
- Radio and television
- Photography
- Software and databases
- Visual and graphic arts
- Advertising services
- Copyright collecting societies

Some examples of inter-dependent industries are the manufacture of TV sets or musical instruments. Partial copyright industries include furniture or museums, while non-dedicated support industries include, for example, general wholesale and transportation.

⁴² This methodology is referred to in the following as the „WIPO methodology“.

Specifically, in the core industries category, the WIPO guide clearly distinguishes between the types of works that can be copyrighted, the industries in which those works are created, and the distribution industries delivering the produced copyrighted works to the public. It defines core copyright industries as “*wholly engaged in creation, production and manufacturing, performance, broadcast, communication and exhibition, or distribution and sales of works and other protected subject-matter.*” The underlying idea is that core copyright industries as a category would not exist or would be significantly different without copyright in works.

The following industries identified by WIPO are included in this study:

- Core copyright industries
- Inter-dependent copyright industries
- Partial copyright industries with factors above 20%

Inter-dependent copyright industries are industries that are engaged in the production, manufacture and sale of equipment whose function is wholly or primarily to facilitate the creation, production or use of works and other protected subject-matter.

Partial copyright industries are industries in which some activities are related to works and other protected subject-matter and may involve creation, production and manufacturing, performance, broadcast, communication and exhibition or distribution and sale.

Non-dedicated support industries are industries in which some activities are related to facilitating the broadcast, communication, distribution or sale of works and other protected subject-matter, but whose activities have not been included in the core copyright industries.

Non-dedicated support industries have been excluded from this study, as all of them have a factor of 6%. Appendix 12 shows the complete list of copyright-intensive industries and associated factors.

EU-level employment and GVA data for copyright-intensive industries was obtained from Eurostat’s SBS dataset. However, for 12 industries, it has no data on either employment or value added. These industries include 85.52 *Cultural education*; 90.01 *Performing arts*; 90.02 *Support activities to performing arts*; 90.03 *Artistic creation*; 90.04 *Operation of arts facilities*; 91.01 *Library and recreation activities*; 91.02 *Museums activities*; 91.03 *Operation of historical sites and buildings and similar visitors attractions*; 93.21 *Activities of amusement parks and theme parks*; 93.29 *Other amusement and recreation activities*; 94.12 *Activities of professional membership organisations*; and 94.99 *Activities of other membership organisations n.e.c.* In order to include these activities in the study, data for those sectors was obtained from the national statistics offices of France, Germany, Spain and the United Kingdom.⁴³ By comparing the employment and value added for the sectors in question in those four countries with total employment and value added in the relevant divisions in the EU, ratios were obtained which can reasonably be assumed to be representative of the EU as a whole. Those ratios were then used to impute EU-level employment and GVA data for those industries.

43 Attempts were made to obtain such data from other Member States, but many national statistical offices do not have this data.

5.7 Identification of GI-intensive industries

Due to lack of updated information on sales of GI products, the methodology for GI-intensive industries is identical to that used in the 2016 study.

Geographical indications have two important characteristics which had to be considered when devising the methodology:

- GIs are not owned by private parties; they are usually applied for by regional producer associations. This means that there are no comparable databases that could be used for matching right-holder information with economic information. In this respect, there is a certain similarity between GIs and copyright, for which the approach likewise entails applying a pre-defined set of industries (defined by WIPO in that case). The set of industries to be considered in the context of GIs is determined by the relevant EU regulations and sources of information provided by the regulator, in this case the European Commission (DG AGRI).
- The proportion of a given NACE class corresponding to GIs varies significantly from one Member State to another.⁴⁴ This means that the same industry can be GI-intensive in one Member State but not in another. This is in contrast to the other four IP rights included in this study, for which the intensity in any given industry is a function of the inherent characteristics of that industry, and it can therefore be safely assumed that if a particular industry is, say, patent-intensive in one country, it will also be patent-intensive in others. This assumption cannot, however, be made for GIs, and GI-related employment and value added must be quantified on a country-by-country basis.

Furthermore, GI industries are often vertically integrated. For example, GI wine designation (by far the most important GI sector) is based on the grapes having been grown and processed in the particular area. This means, as will be discussed further in Chapter 6, that input-output tables are unsuitable for calculating indirect employment generated by GI industries. In fact, the employment figures for those industries already include both direct and indirect employment.

There are 3,258 registered GIs in the EU:

- 49.6% related to wines⁴⁵
- 42.9% related to agricultural products and foodstuffs⁴⁶
- 7.4% related to spirits⁴⁷
- 0.1% related to aromatised wines⁴⁸

Nearly 80% of GI products are produced in six member states: Italy, France, Spain, Greece, Portugal and Germany. GIs are mainly a European phenomenon, although their use in countries outside the EU is increasing.

44 For example, about 25% of German beer sales are protected by GI, while virtually no Belgian beer manufacturer uses this IP right.

45 Reg. (EC) No 1308/2013.

46 Reg. (EC) No 1151/2012.

47 Reg. (EC) No 110/2008.

48 Reg. (EC) No 251/2014.

The GI-intensive industries were identified, and their value added and employment subsequently calculated, on the basis of a study published by DG AGRI in 2012 entitled “Value of production of agricultural products and foodstuffs, wines, aromatised wines and spirits protected by geographical indication (GI)”,⁴⁹ coupled with data from Eurostat and other sources, as described below.

The DG AGRI study calculates the volume and sales of GI products by product and Member State. For the EU as a whole, GI products account for 5.7% of all food and drink sales, with significant variation among Member States, as shown in Table 9. Note that while all Member States have GIs, some are not shown in the table, because they do not appear in the DG AGRI data. Presumably, those GIs have insignificant sales volumes and their absence from the data does not affect the overall conclusions.

In order to estimate the employment and value added attributable to GI in each Member State, a factor for each industry and Member State was calculated, showing the percentage of industry sales accounted for by GIs. Since the DG AGRI study does not include data on total sales by industry, turnover data from Eurostat was used to calculate this sales ratio. In other words, the factor by country and product was computed by dividing the **sales of GIs** from the DG AGRI report by the **turnover for total product (GI+non-GI)** from Eurostat SBS. This ratio was then applied to employment and value added data from SBS in order to calculate the number of jobs and the value added supported by GIs.⁵⁰

49 http://ec.europa.eu/agriculture/external-studies/value-gi_en.htm

50 The underlying assumption is that the value added and employment ratios between GI and non-GI products are the same as the ratio between GI and non-GI in sales. This may not be accurate, given that GI products usually command a price premium over non-GI products. On the other hand, GI products may also cost more to produce, which would, at least partially, offset this error.

Table 9:
GI sales by country (2010)

Country	Total sales of food and drink industry (€ million)	Of which GI (€ million)	GI share
FR	143,600	20,854	14.5%
IT	124,000	11,806	9.5%
EL	11,100	1,058	9.5%
PT	14,000	1,158	8.3%
AT	11,600	932	8.0%
HU	7,400	496	6.7%
UK	88,900	5,506	6.2%
ES	80,700	4,578	5.7%
SK	3,600	165	4.6%
DE	151,800	5,728	3.8%
RO	9,800	268	2.7%
IE	22,200	607	2.7%
BG	4,100	99	2.4%
CZ	10,600	242	2.3%
LT	2,900	23	0.8%
NL	59,800	105	0.2%
BE	39,000	45	0.1%
TOTAL	956,200	54,346	5.7%

Source: DG AGRI (2012)

The most important GI industry – wine – required special treatment, because Eurostat does not publish SBS statistics for primary sectors such as agriculture. Therefore, data for value added and employment for NACE 01.21 *Growing of grapes* had to be obtained from other sources. Specifically, employment in the industry was estimated on the basis of farm structure survey (FSS) data from Eurostat. Production was taken from another Eurostat data series: economic accounts for agriculture (EAA). Subsequently, the value added/turnover ratio for NACE 11.02 *Manufacture of wine* from SBS was applied to the sum of 01.21 and 11.02 production to arrive at an estimate of value added related to wine production.⁵¹

51 Here again, it is assumed that the turnover/production ratio for the wine industry is the same in economic accounts for agriculture (EAA) as in SBS.

5.7.1 Contribution of GIs to external trade

Exports

The DG AGRI study referred to above contains data on exports by country and by GI industry in 2010, based on DG AGRI's own data and COMEXT, Eurostat's reference database on external trade. This data is used in the presentation of results in Chapter 6.

Imports

While exports of GI products from the EU to non-EU countries are easy to define, deciding what constitutes a "GI import" is more difficult. This is because, strictly speaking, the EU only recognises a limited number of GIs from outside the EU, the most significant of which are Napa Valley wine from California, Vale dos Vinhedos wine from Brazil, Darjeeling tea from India and Café de Colombia. However, in addition to the third-country GIs protected through direct application, the EU has international agreements with a number of countries which provide protection which is essentially equivalent to GIs.

Hence, "GI imports" are defined as imports from third countries of any wine, spirits, aromatised wine, agricultural products and foodstuffs which are protected in the EU either through direct application of a GI or as consequence of bilateral or multilateral international agreements.

The COMEXT database provides information on wine imports by country of origin, but does not distinguish between wines protected as GIs and those that are not. However, wine export statistics from Chile indicate that 72% of that country's wine exports are GIs, which can be considered a good estimate of the corresponding figure for the EU's wine imports.

Since, by definition, one jurisdiction's exports are another one's imports, it is reasonable to assume that the share of GI wine in Europe's wine imports from non-EU countries corresponds to the share of GI wine in Chile's wine exports. The overall wine import figures from the 13 countries with which the EU has relevant agreements were therefore multiplied by 0.72. Imports of other products from relevant countries (e.g. Tequila from Mexico, Pisco from Peru and Chile and GI cheese from Switzerland) were added to the result to arrive at an overall estimate of GI imports into the EU.

5.8 Identification of PVR-intensive industries

- For the identification of PVR-intensive industries, this study relies on register data from the Community Plant Varieties Office (CPVO). There were 12,357 PVR applications filed between 1 January 2010 and 31 December 2014, with at least one applicant domiciled in the EU Member States.
- In the next step, the dataset was filtered to include only applications that were subsequently granted, yielding 10,735 unique applications.
- Further, PVR applications' dataset was matched with concordance tables linking PVR applicants' with information available in ORBIS. A match was found for 9,625 applications, i.e. 89.6 % of all relevant CPVR applications.
- As the number of CPVR applications with owners originating both in the EU and third countries is relatively low, the fractional counts were not calculated for such applications, but all relevant applications have been analysed in their entirety.
- In total, NACE codes were not available for 125 applications for which a match with ORBIS was found. Those applications were discarded from the subsequent analysis. Ultimately, data of 9,500 CPVRs applications were used for the analysis of distribution of CPVRs between industries.
- In order to assign a proper industry code to firms linked in ORBIS with head offices' status, NACE industry codes of firms linked with head offices within the same economic groups were used. For a given head office, the NACE codes were assigned proportionally to the number of firms representing various NACE industries within the head office economic group. The rest of CPVRs associated initially with head offices' NACE codes were redistributed to other NACE codes proportionally to the distribution of valid NACE codes associated with head offices in the subset of data for which the assignment was possible based on the procedure described above.
- Finally, for some firms ORBIS assigns NACE code at a higher level of aggregation than the four-digit level used in the analysis. This problem was solved by reallocating CPVR applications linked with those firms to the lower level of NACE based on distribution of plant variety rights within the division or group based on the calculation done on the subset of firms correctly associated with the lowest NACE industry level.

Table 10 shows the industries with the greatest number of filings during the period 2010-2014, along with the number of countries from which the filings in each NACE code originated.

Table 10:
Top filing industries at the CPVO, 2010-2014

NACE code	NACE description	Filings	Countries
1.19	Growing of other non-perennial crops	1,693	8
1.3	Plant propagation	1,360	9
1.11	Growing of cereals (except rice), leguminous crops and oil seeds	1,025	8
46.21	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds	872	7
1.13	Growing of vegetables and melons, roots and tubers	641	7
72.19	Other research and experimental development on natural sciences and engineering	603	10
1.64	Seed processing for propagation	562	7
46.22	Wholesale of flowers and plants	546	8
77.4	Leasing of intellectual property and similar products, except copyrighted works	445	3
72.11	Research and experimental development on biotechnology	443	5
1.61	Support activities for crop production	409	5
1.24	Growing of pome fruits and stone fruits	85	2
74.9	Other professional, scientific and technical activities n.e.c.	74	4
1.5	Mixed farming	69	2
1.27	Growing of beverage crops	64	1

As can be seen in Table 10, agricultural and horticultural sectors are the main users of the CPVO registration system. However, the employment data available for those sectors from Eurostat is not sufficiently detailed. It is available on division level (two-digit NACE) only and LFS is the source of employment data. In order to determine which sector of agriculture is the most PVR-intensive, two types of analyses were conducted. The first analysis is based on distribution of PVRs for different types of crops.

The data on crops was linked to agriculture sectors as defined by Regulation (EC) No 1242/2008 establishing a Community typology for agricultural holdings. Table 11 presents the 20 crop products with the highest number of PVRs registered in 2010-2014.

Table 11:
Crops with the highest number of CPVR filings, 2010-2014

Eurostat code	Crop name	CPVR applications	Share of all applications
N0000	Flowers and ornamental plants	4,523	46.99%
C1500	Grain maize and corn-cob-mix	615	6.39%
C1100	Wheat and spelt	472	4.90%
V2300	Lettuces	454	4.72%
V3100	Tomatoes	287	2.98%
I1110	Rape and turnip rape seeds	281	2.92%
C1300	Barley	272	2.83%
R1000	Potatoes (including seed potatoes)	223	2.32%
F1210_1220	Peaches and nectarines	218	2.26%
C1210	Rye	175	1.82%
I1120	Sunflower seed	174	1.81%
V3600	Peppers (capsicum)	142	1.48%
P1100	Field peas	104	1.08%
V3200	Cucumbers	104	1.08%
V3000	Vegetables cultivated for fruit (including melons)	99	1.03%
P1200	Broad and field beans	86	0.89%
S0000	Strawberries	83	0.86%
C1120	Durum wheat	75	0.78%
J0000	Permanent grassland	65	0.68%
C2000	Rice	60	0.62%

The statistics for the number of crops per 1,000 ha under cultivation was then calculated to arrive at the relative CPVR intensity for each type of crop. The results of this calculation are shown in Table 12.

Table 12:
Top 20 crops with highest number of PVR applications per 1,000 ha

Eurostat code	Crop name	CPVR per 1,000 ha
N0000	Flowers and ornamental plants (excluding nurseries)	58.9572
G2910	Clover and mixtures	5.952381
V2300	Lettuces	4.844045
V3200	Cucumbers	3.021792
V2400	Endives	2.567394
V3600	Peppers (capsicum)	2.460721
V4500	Radishes	1.663074
V2500	Spinach	1.156015
V3100	Tomatoes	1.148735
F1210_1220	Peaches and nectarines	0.961199
V3410	Eggplants	0.907578
S0000	Strawberries	0.764202
V2100	Leeks	0.746176
V2200	Celery	0.714569
F3200	Raspberries	0.626096
F1230	Apricots	0.506971
V2700	Chicory	0.470588
V3420	Courgettes and marrows	0.444335
V2600	Asparagus	0.401606
I1140	Linseed (oilflax)	0.372928

Both analyses confirm that horticulture, comprising flowers and ornamental plants, vegetables and nurseries, is the main user of the CPVR system in Europe.

For the rest of the NACE industries for which information was available at class level (four-digits), the standard procedure involving calculation of employment weighted average of CPVRs per 1,000 employees was used to determine their CPVR intensity.

CPVR-intensive industries are defined as those having a CPVRs per 1,000 employees value which is higher than the employment weighted mean of CPVRs per 1,000 employees, which amounts to 0.19 CPVRs per 1,000 employees.

5.9 Limitations of data and methodology

Due to the size of the dataset, data limitations and the scope of analysis, the method of selecting IPR-intensive industries was necessarily based on a number of simplifying assumptions.

IPR-intensive industries were identified at EU level. This method may conceal important heterogeneities between countries regarding innovation level, propensity to register IPRs at European level and national industry structures.

To qualify as an IPR-intensive industry, an industry has to intensively use at least one of the IPRs covered in the present study. However the protected subject-matter, legal strength and other aspects differ across different IPRs. Therefore, IPR intensity has a different meaning for different IPRs.

The method of determining the IPR intensity of industries does not take into account the fact that the distribution of the economic value of individual IPRs is highly skewed. All the IPRs applied for are simply aggregated by industry and their individual values are not evaluated. As a result, some industries with few IPRs, which may nevertheless be very valuable for the operation of those industries, may not be considered as IPR-intensive. In addition, due to the specificity of the protected subject-matter, some industries may prefer other forms of IP protection which are not included in the present study, such as trade secrets.

Future research, taking into account national IP rights, national patterns of IPR intensity of industries or other richer datasets including non-registered IPRs, may lead to different conclusions as regards the set of IPR-intensive industries and their importance in the economies of the EU, Norway, Switzerland and Iceland.

Despite these caveats, this report allows for a thorough and systematic analysis of the differences between industries making intensive use of IPRs and those in which IPRs play a less important role.

06 / IPR-intensive industries at EU level

This chapter presents the main results of the analysis described in Chapter 5: the identification of IPR-intensive industries at EU level, separately for each of the six IP rights considered in this study, and in terms of overall IPR-intensity, i.e. taking the simultaneous use of more than one IP right into account.⁵²

6.1 Patent-intensive industries

Out of 615 NACE classes, 467 industries in the matched database filed successful patent applications during the period 2010-2014. Of those industries, 148 are patent-intensive.

Table 13 shows the 20 most patent-intensive industries. The full list of patent-intensive industries is shown in Appendix 11.2.

⁵² The industries identified as IPR-intensive in this report accounted for 73% of the EUTMs, 83% of the RCDs, 86% of the European patents and 96% of the CPVRs registered/granted during the period considered in this study.

Table 13:
The 20 most patent-intensive industries*

NACE code	NACE description	Patents per 1,000 employees
77.40	Leasing of intellectual property and similar products, except copyrighted works	74.01
26.30	Manufacture of communication equipment	27.29
72.11	Research and experimental development on biotechnology	21.84
28.91	Manufacture of machinery for metallurgy	20.03
20.59	Manufacture of other chemical products n.e.c.	19.46
21.10	Manufacture of basic pharmaceutical products	17.71
28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	16.06
23.11	Manufacture of flat glass	15.99
20.11	Manufacture of industrial gases	14.18
26.11	Manufacture of electronic components	14.03
27.51	Manufacture of electric domestic appliances	12.79
26.70	Manufacture of optical instruments and photographic equipment	12.00
26.60	Manufacture of irradiation, electromedical and electrotherapeutic equipment	11.75
24.45	Other non-ferrous metal production	11.51
72.19	Other research and experimental development on natural sciences and engineering	11.24
28.95	Manufacture of machinery for paper and paperboard production	10.71
28.99	Manufacture of other special-purpose machinery n.e.c.	10.54
30.30	Manufacture of air and spacecraft and related machinery	10.28
28.94	Manufacture of machinery for textile, apparel and leather production	10.23
28.93	Manufacture of machinery for food, beverage and tobacco processing	9.01

*Based on patent applications filed in 2010-2014 and subsequently granted.

The list of patent-intensive industries is dominated by manufacturing activities (often referred to as the secondary sector), accounting for 17 of the top 20 industries. There are three service industries (tertiary sector) on the list, including two research-related industries and industry 77.40,⁵³ which covers activities such as licensing and managing IP portfolios.

53 Official Eurostat definition of class 77.40: This class includes the activities of allowing others to use intellectual property products and similar products for which a royalty payment or licensing fee is paid to the owner of the product (i.e. the asset holder). The leasing of these products can take various forms, such as permission for reproduction, use in subsequent processes or products, operating businesses under a franchise, etc. The current owners may or may not have created these products. This class includes:
– leasing of intellectual property products (except copyrighted works, such as books or software)
– receiving royalties or licensing fees for the use of: patented entities, trade marks or service marks, brand names, mineral exploration and evaluation, and franchise agreements.
Qualitative analysis of the firms associated with NACE industry 77.40 showed that this industry is very heterogeneous. It comprises, *inter alia*, special entities within larger economic groups responsible for managing their IP portfolios, the technology transfer offices of educational institutions, facilitators of innovation development and commercialisation, small entities set up to commercialise one innovation, or, to a lesser extent, independent firms active in the area of valuation and management of IP assets. The group of companies associated with this class includes both standalone companies without any economic links to other companies as well as branches whose main activity consists of managing the IP portfolio of their parent companies.

6.2 Trade mark-intensive industries

Firms representing 508 industries in the matched database filed successful trade mark applications during the period 2010-2014. Of those industries, 280 are trade mark-intensive.

Table 14 shows the 20 most trade mark-intensive industries. The full list of trade mark-intensive industries is shown in Appendix 11.3.

Table 14:
The 20 most trade mark-intensive industries*

NACE code	NACE description	Trade marks/(classes) per 1,000 employees
77.40	Leasing of intellectual property and similar products, except copyrighted works	346.64
26.80	Manufacture of magnetic and optical media	72.25
10.86	Manufacture of homogenised food preparations and dietetic food	63.51
17.24	Manufacture of wallpaper	56.39
21.10	Manufacture of basic pharmaceutical products	54.25
11.01	Distilling, rectifying and blending of spirits	51.59
11.02	Manufacture of wine from grape	48.14
20.42	Manufacture of perfumes and toilet preparations	38.90
58.19	Other publishing activities	38.80
72.11	Research and experimental development on biotechnology	38.08
32.40	Manufacture of games and toys	37.33
32.30	Manufacture of sports goods	37.00
58.21	Publishing of computer games	35.91
59.20	Sound recording and music publishing activities	34.75
18.11	Printing of newspapers	33.98
11.03	Manufacture of cider and other fruit wines	31.56
59.13	Motion picture, video and television programme distribution activities	31.28
32.99	Other manufacturing n.e.c.	31.07
10.89	Manufacture of other food products n.e.c.	30.78
63.12	Web portals	30.24

*Based on trade mark applications filed in 2010-2014 and subsequently granted.

As is the case for patents, manufacturing (or secondary) industries are prominent in the top 20 list for trade marks, occupying 12 of the 20 spots. The remaining eight industries on the list belong to the service sector (tertiary industries).

6.3 Design-intensive industries

Firms representing 483 industries in the matched database filed successful design applications during the period 2010-2014. Of those industries, 184 were found to be design intensive.

Table 15 shows the 20 most design-intensive industries. The full list of design-intensive industries is shown in Appendix 11.4.

Table 15:
The 20 most design-intensive industries*

NACE code	NACE description	Designs/ 1000 employees
77.40	Leasing of intellectual property and similar products, except copyrighted works	104.22
27.40	Manufacture of electric lighting equipment	42.08
46.47	Wholesale of furniture, carpets and lighting equipment	41.57
25.71	Manufacture of cutlery	41.00
23.42	Manufacture of ceramic sanitary fixtures	30.51
32.40	Manufacture of games and toys	30.03
23.41	Manufacture of ceramic household and ornamental articles	29.12
26.52	Manufacture of watches and clocks	28.11
28.14	Manufacture of other taps and valves	26.95
27.51	Manufacture of electric domestic appliances	26.78
32.91	Manufacture of brooms and brushes	24.63
25.72	Manufacture of locks and hinges	22.96
46.48	Wholesale of watches and jewellery	22.56
46.15	Agents involved in the sale of furniture, household goods, hardware and ironmongery	19.76
32.30	Manufacture of sports goods	19.61
32.12	Manufacture of jewellery and related articles	18.82
46.42	Wholesale of clothing and footwear	17.77
14.19	Manufacture of other wearing apparel and accessories	16.85
32.99	Other manufacturing n.e.c.	16.82
23.19	Manufacture and processing of other glass, including technical glassware	16.23

*Based on design registrations filed in 2010-2014 and subsequently granted.

Design-intensive industries are also mostly in the manufacturing (secondary) sector of the economy, occupying 15 of the top 20 spots. The remaining five spots are taken up by service industries, including four wholesale/distribution industries. As is the case for patents and trade marks, sector 77.40 is also one of the most design-intensive industries.

6.4 Copyright-intensive industries

Tables 16 and 17 list the copyright-intensive industries included in this study, after being identified as described in section 5.6. The “type” column indicates whether the industry is core, interdependent or partially copyright-intensive according to the WIPO classification. For interdependent and partial copyright-intensive industries, the “factor” column shows the percentage of each sector’s activity considered to be related to copyright.

Table 16:
List of core copyright-intensive industries

NACE code	NACE description
58.11	Book publishing
58.13	Publishing of newspapers
58.14	Publishing of journals and periodicals
58.19	Other publishing activities
58.21	Publishing of computer games
58.29	Other software publishing
59.11	Motion picture, video and television programme production activities
59.12	Motion picture, video and television programme post-production activities
59.13	Motion picture, video and television programme distribution activities
59.14	Motion picture projection activities
59.20	Sound recording and music publishing activities
60.10	Radio broadcasting
60.20	Television programming and broadcasting activities
61.20	Wireless telecommunications activities
62.01	Computer programming activities
62.02	Computer consultancy activities
62.03	Computer facilities management activities
62.09	Other information technology and computer service activities
63.12	Web portals
63.91	News agency activities
63.99	Other information service activities n.e.c.
73.11	Advertising agencies
73.12	Media representation
74.10	Specialised design activities
74.20	Photographic activities
74.30	Translation and interpretation activities
90.01	Performing arts
90.02	Support activities to performing arts
90.03	Artistic creation
91.01	Library and archives activities
93.29	Other amusement and recreation activities

NACE code	NACE description
18.11	Printing of newspapers
18.12	Other printing
18.13	Pre-press and pre-media services
18.14	Binding and related services
18.20	Reproduction of recorded media
47.61	Retail sale of books in specialised stores
47.62	Retail sale of newspapers and stationery in specialised stores
47.63	Retail sale of music and video recordings in specialised stores
61.10	Wired telecommunications activities
61.30	Satellite telecommunications activities
61.90	Other telecommunications activities
63.11	Data processing, hosting and related activities
79.90	Other reservation service and related activities
82.19	Photocopying, document preparation and other specialised office support activities
85.52	Cultural education
90.04	Operation of arts facilities
93.21	Activities of amusement parks and theme parks
94.12	Activities of professional membership organisations

Table 17:
Interdependent and partial copyright-intensive industries

NACE code	NACE description	Type	Factor
17.11	Manufacture of pulp	Interdependent	25.0%
17.12	Manufacture of paper and paperboard	Interdependent	25.0%
20.59	Manufacture of other chemical products n.e.c.	Interdependent	25.0%
28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)	Interdependent	30.0%
26.20	Manufacture of computers and peripheral equipment	Interdependent	30.0%
26.30	Manufacture of communication equipment	Interdependent	30.0%
26.40	Manufacture of consumer electronics	Interdependent	30.0%
26.70	Manufacture of optical instruments and photographic equipment	Interdependent	30.0%
27.31	Manufacture of fibre optic cables	Interdependent	30.0%
32.20	Manufacture of musical instruments	Interdependent	35.0%
46.43	Wholesale of electrical household appliances	Interdependent	19.0%
46.76	Wholesale of other intermediate products	Interdependent	25.0%
46.51	Wholesale of computers, computer peripheral equipment and software	Interdependent	30.0%
46.52	Wholesale of electronic and telecommunications equipment and parts	Interdependent	25.0%
46.66	Wholesale of other office machinery and equipment	Interdependent	30.0%
47.43	Retail sale of audio and video equipment in specialised stores	Interdependent	33.3%
47.41	Retail sale of computers, peripheral units and software in specialised stores	Interdependent	33.3%
47.78	Other retail sale of new goods in specialised stores	Interdependent	33.3%
77.33	Rental and leasing of office machinery and equipment (including computers)	Interdependent	35.0%
77.39	Rental and leasing of other machinery, equipment and tangible goods n.e.c.	Interdependent	20.0%
77.22	Rental of video tapes and disks	Interdependent	20.0%
77.29	Rental and leasing of other personal and household goods	Interdependent	20.0%
32.11	Striking of coins	Partial	33.5%
32.12	Manufacture of jewellery and related articles	Partial	33.5%
32.40	Manufacture of games and toys	Partial	41.0%
91.02	Museums activities	Partial	46.0%
91.03	Operation of historical sites and buildings and similar visitor attractions	Partial	50.0%
94.99	Activities of other membership organisation n.e.c.	Partial	50.0%

6.5 GI-intensive industries

The methodology used to identify the GI-intensive industries was to some extent analogous to the WIPO methodology used to identify the copyright-intensive sectors. The data from DG AGRI showed that the core GI-intensive industries are those set out in Table 18.

Table 18:
GI-intensive industries

NACE code	NACE description	Total employment
10.51	Operation of dairies and cheese making	331,762
11.01	Distilling, rectifying and blending of spirits	55,461
11.02	Manufacture of wine from grape (including part of 01.21 <i>Growing of grapes</i>)	104,777
11.05	Manufacture of beer	139,856

Analogously to the industries considered copyright-intensive, the above industries are responsible for the *production* of GI goods, but not for wholesale or retail distribution. All four GI-intensive industries belong to the manufacturing (secondary) sector. Part of the primary sector 01.21 is also included.

Table 18 also shows total employment at EU level to indicate the overall size of each industry. However, as explained in section 5.7, because of the special nature of GIs, only part of that employment is defined as GI-intensive.

6.6 PVR-intensive industries

Firms representing 45 different industries filed successful CPVR applications between 2010 and 2014. Of those industries, 10 (with the exception of the horticulture sector) are CPVR-intensive.

The final list of PVR-intensive industries identified as described in section 5.8 is shown in Table 19.

Table 19:
PVR-intensive industries

NACE code	NACE description	PVR/1,000 employees
	Horticulture	n/a
77.40	Leasing of intellectual property and similar products, except copyrighted works	19.6
46.22	Wholesale of flowers and plants	7
72.11	Research and experimental development on biotechnology	6.6
46.21	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds	4.2
46.11	Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods	1.3
72.19	Other research and experimental development on natural sciences and engineering	1.2
10.61	Manufacture of grain mill products	0.44
11.06	Manufacture of malt	0.42
10.89	Manufacture of other food products n.e.c.	0.28

6.7 All IPR-intensive industries

It can be seen from the results that many industries are intensive in more than one of the IP rights analysed. For example, 10.32 *Manufacture of fruit and vegetable juice* is an intensive user of both trade marks and designs. Some industries, for example 10.83 *Processing of tea and coffee*, intensively use trade marks, designs and patents. Most of the copyright-intensive industries are also trade mark-intensive, and all four GI-intensive industries are trade mark-intensive as well. Table 47 in Appendix 10 summarises the preceding sections by listing all 353 IPR-intensive industries and indicating the IP rights used intensively by each of them. The overlaps are shown in Table 20.

Table 20:
Overlapping use of IP rights

IP right	Number of industries intensive in the IPRs
TM	59
PAT	17
DES	14
CR	28
PVR	1
TM and PVR	3
TM, PAT, CR	3
TM and PAT	29
TM and GI	2
TM, DES, PAT, PVR	4
TM, DES, PAT, CR	11
TM, DES, PAT	71
TM, DES, PVR	1
TM, DES, GI	2
TM, DES, CR	10
TM and DES	58
TM and CR	27
DES and PAT	13

Trade marks are used intensively by most of the industries (280 out of 353). Patents tend to be used more intensively in the manufacturing sector. A total of 71 industries are intensive in patents, trade marks and designs. Other significant overlaps are between trade marks and designs (58 industries), trade marks and patents (29 industries) and trade marks and copyright (27 industries).

Conversely, some industries use only one of the analysed IP rights intensively. Thus, 59 industries are trade mark-intensive only, 17 patent-intensive only, 14 design-intensive only and 28 copyright-intensive only. One industry is exclusively PVR-intensive.

It is worthwhile examining more closely the industries that are intensive in just one of the IP rights considered, since such industries can be considered to reflect the contribution of that particular IP right as opposed to IPRs in general. The 59 industries that are exclusively trade mark-intensive do not differ significantly from the larger group of 221 trade mark-intensive industries that also use another IP right intensively.

The 17 industries that are exclusively patent-intensive are concentrated in manufacturing, energy and technical services. Examples of such industries include 24.52 *Casting of steel*, 33.20 *Installation of industrial machinery and equipment* and 71.12 *Engineering activities and related technical consultancy*. What these industries have in common is that they sell their products and services to other industries, not to end consumers.

The 14 exclusively design-intensive industries are concentrated in manufacturing and services, including, for example, 31.02 *Manufacture of kitchen furniture* and 47.59 *Retail sale of furniture*. As a group, these industries market their products and services to both businesses and consumers.

The 28 industries that are exclusively copyright-intensive are in the service sector, with the exception of two manufacturing industries related to printing and manufacture of optical cables. Twenty of these industries are core copyright industries.

To prevent double-counting, the fact that some IPR-intensive industries use multiple rights intensively was taken into account when quantifying their employment and value added contributions in Chapter 7.

07 / Contribution of IPR-intensive industries to the EU economy

7.1 Contribution to employment, GDP and trade at EU level

The preceding chapter explained how the industries that use IP rights intensively were identified. In order to calculate the contribution made by those industries in terms of employment, GDP, wages and external trade to the economy of the EU as a whole and the economies of the individual Member States, the list of IPR-intensive industries was combined with data from Eurostat and, where necessary, other EU or national sources.⁵⁴

7.1.1 Employment

In total, approximately 215.5 million people were employed within the EU during the 2014-2016 period.⁵⁵ A significant proportion of these jobs, more than 50 million, are in NACE divisions O-Q (public administration, defence, education, human health and social work activities), services which are mostly provided in the public sector.⁵⁶

Table 21 shows the share of IPR-intensive industries in EU employment for each of the six IP rights.

54 In particular, as discussed in sections 5.7 and 5.8, in the case of GIs, extensive use was made of information from agricultural statistics published by DG AGRI. In addition, in the case of copyright, Eurostat data was supplemented with data from several national statistical offices.

55 The definition of „employment“ as used by Eurostat and other statistical agencies is as follows: Employed persons are persons aged 15 and over (with some country-specific exceptions) who, during the reference week, performed work, even for just one hour a week, for pay, profit or family gain, or who were not at work but had a job or business from which they were temporarily absent because of illness, holidays, industrial dispute or education and training.

56 If such non-market-based activities were excluded from the calculation, the share of employment and GDP would be significantly higher than shown in this report. However, it was considered more appropriate to err on the side of caution and base the calculations on total employment and GDP.

Table 21:
Direct and indirect contribution of IPR-intensive industries to
employment, 2014-2016 average

IPR-intensive industries	Employment (direct)	Share of total employment (direct)	Employment (direct+indirect)	Share of total employment (direct+indirect)
Trade mark-intensive	46,700,950	21.7%	65,047,936	30.2%
Design-intensive	30,711,322	14.2%	45,073,288	20.9%
Patent-intensive	23,571,234	10.9%	34,740,674	16.1%
Copyright-intensive	11,821,456	5.5%	15,358,044	7.1%
GI-intensive	n/a	n/a	399,324	0.2%
PVR-intensive	1,736,407	0.8%	2,618,502	1.2%
All IPR-intensive	62,962,766	29.2%	83,807,505	38.9%
Total EU employment			215,520,333	

Note: Due to overlapping use of IP rights, the sum of the shares of the individual IPRs exceeds the total share of IPR-intensive industries.

Thus, **IPR-intensive industries account for almost 63 million jobs, or 29% of total employment, in the EU.** Almost 22% of those jobs are in trade mark-intensive industries, 14% are in design-intensive industries and 11% in patent-intensive industries, with lower percentages for copyright-intensive, PVR-intensive and GI-intensive industries.

As noted above, many industries are IPR-intensive in respect of more than one IP right. Therefore, to avoid double-counting, total employment in all IPR-intensive industries is less than the sum of the individual employment figures for each IP right. In other words, for the purpose of calculating employment in all IPR-intensive industries, each industry was counted only once, even if it used more than one IP right intensively.

7.1.2 Indirect employment

Besides the direct employment shown above, IPR-intensive industries generate employment in non-IPR-intensive industries which supply them with goods and services as inputs. In order to calculate this indirect effect on employment in non-IPR-intensive industries, the EU-28 input-output tables published by Eurostat were used. These tables provide information on 65 industries at division level (NACE two-digit level).⁵⁷

In order to calculate indirect employment, the IPR-intensive industries were aggregated to the 65 divisions provided by the input-output framework. Some of these 65 divisions are completely intensive if all the four-digit level industries (classes) comprising the division are IPR-intensive. For instance, all 16 classes included in the division *Chemicals and chemical products* are considered trade mark-intensive and all six classes of the division *Rubber and plastic products* are patent-intensive. However, other divisions are only partially IPR-intensive because they contain both

⁵⁷ The information provided includes supply and use tables and symmetric input-output tables (domestic and total). In this context, „domestic“ refers to intra-EU supply relationships.

IPR-intensive and non-IPR-intensive industries. For such partially IPR-intensive divisions, information was available on total employment in the division and the share of employment accounted for by the IPR-intensive industries within the division. Accordingly, an “intensity coefficient” was calculated for each division in the input-output tables, corresponding to the share of employment in the IPR-intensive industries within each division. These coefficients were then used to adjust the level of employment in the upstream industries in the input-output framework to ensure that indirect employment really corresponded to demand stemming from IPR-intensive industries. For example, if division A is 40% IPR-intensive, then 40% of its purchases from division B are also considered to be IPR-intensive, and therefore 40% of the portion of employment in division B which supports division B’s sales to division A is considered to be indirectly supported by the IPR-intensive division A.

Employment data was obtained from the national accounts published by Eurostat.⁵⁸ For each IP right (except GI, for which the figures already include indirect employment, as explained in section 5.7), the indirect employment effect in non-IPR-intensive industries only was calculated in order to avoid the double-counting of employment in IPR-intensive industries.

The analysis shows that, in addition to the 63 million jobs in IPR-intensive industries themselves, another 21 million jobs in the EU economy are generated in non-IPR-intensive industries that supply goods and services to them. If those additional jobs are considered, then 83.8 million jobs, or almost 39% of all jobs in the EU, are directly or indirectly contributed by IPR-intensive industries.

7.1.3 GDP

Gross domestic product (GDP) is the total value of the goods and services produced in a given territory during a given time period. It is the most common measure of economic activity. It is calculated in the national accounts of a country (or the EU) by adding up the *value added produced* in each industry, including product-specific taxes and excluding product-specific subsidies. The value added equals the industry’s sales minus its purchases of goods and services from other industries. When these quantities are added up across the entire economy, the inter-industry purchases cancel each other out and what is left is the overall value added, or GDP, for the economy. Total EU GDP was approximately €14.6 trillion in the period 2014-2016.

The starting point for estimating the share of IPR-intensive industries in GDP was on the one hand the value added figures for each industry at four-digit level in Eurostat’s SBS, and on the other the overall GDP figure from the national accounts. However, before the sectoral figures could be compared with the overall economy-wide figure, they had to be adjusted in order to ensure that the numerators in the calculations of the weight of IPR-intensive industries in the economy were consistent with the denominator, i.e. overall GDP.

The industry-level value added in SBS is defined at factor cost, which excludes taxes linked to production. On the other hand, GDP is the sum of *gross value added (GVA) at basic prices* in all industries of the economy plus taxes less subsidies on products. The difference between factor cost and basic prices is that the latter (for each industry) include other taxes less subsidies on production.

58 For the purposes of calculating the indirect employment requirements of IPR-intensive industries, the Leontief matrix was calculated on the basis of domestic symmetric input-output tables to ensure that only employment generated within the EU was included.

Therefore, in order to obtain a homogenous ratio based on GDP, the figures from SBS had to be converted so as to be consistent with the GDP definition. Otherwise, the ratios of sectoral GDP to total GDP would be understated because the nominator and denominator would not be defined in the same way. In order to achieve consistency, the SBS data was adjusted as follows:

First, a factor was applied to the value added obtained from SBS for each IPR-intensive industry. This factor was calculated for each of the 65 industries (divisions) in national accounts as the ratio between value added at factor cost in SBS and GVA at basic prices in national accounts for each industry. All classes within each division were divided by the same factor.

Secondly, the ratio between GDP and GVA for the whole economy was applied to each adjusted value added figure from the first step.

The resulting adjusted industry-level value added figures are compatible with GDP. The contribution of IPR-intensive industries to the EU economy is shown in Table 22.⁵⁹ Almost 45% of total economic output in the EU is generated in the IPR-intensive industries. Trade mark-intensive industries contribute 37.3% of GDP, while design-intensive and patent-intensive industries contribute 16.2% and 16.1%, respectively, with smaller contributions coming from copyright-intensive, PVR-intensive and GI-intensive industries. As for the employment calculation described in the preceding section, for the purpose of calculating the total contribution of IPR-intensive industries to GDP, each industry was counted only once, even if it used more than one IP right intensively.

59 As in the case of employment, the value added/GDP figures are averages for the period 2014-2016.

Table 22:
Contribution of IPR-intensive industries to GDP, 2014-2016 average

IPR-intensive industries	Value added / GDP (€ million)	Share of total EU GDP
Trade mark-intensive	5,447,857	37.3%
Design-intensive	2,371,282	16.2%
Patent-intensive	2,353,560	16.1%
Copyright-intensive	1,008,383	6.9%
GI-intensive	20,155	0.1%
PVR-intensive	181,570	1.2%
All IPR-intensive	6,551,768	44.8%
Total EU GDP	14,621,518	

Note: Due to overlapping use of IP rights, the sum of the figures for the individual IPRs exceeds the total figure of IPR-intensive industries.

It is notable that the share of IPR-intensive industries in GDP is significantly higher than in employment, most likely reflecting the higher value added associated with their output. This difference is particularly pronounced in the case of trade mark-intensive industries, which account for 22% of employment but 37% of GDP, but the pattern is similar for designs, patents and copyright and, as will be seen in section 7.1.5, is also reflected in the wages paid to workers in IPR-intensive industries.

7.1.4 Trade

The third major economic variable to which IPR-intensive industries contribute is the EU's external trade. Indeed, the vast majority of both EU imports and exports are IPR-intensive.

Table 23 summarises trade in IPR-intensive industries, based on data from 2016. As in the case of the employment and GDP figures, the trade figures for the six IP rights add up to more than the overall figure for IPR-intensive industries because many industries are intensive in more than one IP right.

The bulk of EU trade is in IPR-intensive industries. It may be somewhat surprising at first glance that such a high share of imports is IPR-intensive. This is because even industries producing commodities such as energy are IPR-intensive,⁶⁰ whereas many non-IPR-intensive activities are also non-tradable. For that reason, 89% of EU goods imports consist of products of IPR-intensive industries. However, an even higher share of EU goods exports – 96% – is accounted for by IPR-intensive industries.

In recent years, Eurostat has begun to provide data on trade in services as well. In the case of trade in services, the share of IPR-intensive industries is lower, with imports accounting for 57.4% of total services imports, and exports at 53.7% of total services exports. Taking both goods and services trade into account, 80% of EU imports and 82% of EU exports were generated by the IPR-intensive industries in 2016.

60 Class 60.10 *Extraction of crude petroleum* is trade mark, design and patent-intensive.

Table 23:
EU external trade in IPR-intensive industries, 2016

IPR-intensive industries	Exports (€ million)	Imports (€ million)	Net exports (€ million)
Trade mark-intensive	1,613,366	1,600,703	12,663
Design-intensive	1,261,774	1,194,885	66,889
Patent-intensive	1,438,117	1,307,850	130,267
Copyright-intensive	294,856	202,738	92,119
GI-intensive *	12,490	1,360	11,130
PVR-intensive *	7,552	3,885	3,667
Total IPR-intensive	2,122,465	1,940,510	181,955
TOTAL EU TRADE	2,590,889	2,425,202	165,687

Note: Due to overlapping use of IP rights, the sum of the figures for the individual IPRs exceeds the total figure of IPR-intensive industries.

*Goods only

The EU as a whole had an overall trade surplus in 2016 of approximately €166 billion, or 1.1% of GDP. The surplus was €182 billion in IPR-intensive industries, thus helping to offset a small deficit in non-IPR-intensive trade.

Looking at the individual IP rights, the EU has a trade surplus in all IPR-intensive industries, with the largest surpluses in the patent-intensive, copyright-intensive and design-intensive industries.

Table 24 shows the top ten IPR-intensive industries involved in external trade, ranked by their net exports to the rest of the world. These ten industries account for 33.4% of IPR-intensive exports and 16.7% of IPR-intensive imports. They are heavily concentrated in the manufacturing sectors, in particular motor vehicles, pharmaceuticals and various types of advanced technology.

Table 24:
Top 10 IPR-intensive net exporting industries*, 2016

Rank	NACE/ EBOPS code	NACE/EBOPS description	Net exports (€ million)	Exports (€ million)	Imports (€ million)	Intensive IPR
1	29.10	Manufacture of motor vehicles	106,606	154,928	48,322	TM, DES, PAT
2	21.20	Manufacture of pharmaceutical preparations	65,195	127,137	61,942	TM, PAT
3	9.2	Computer services	61,150	89,575	28,424	TM, CO
4	7.1	Financial services explicitly charged and other financial services	33,986	72,136	38,151	TM
5	30.30	Manufacture of air and spacecraft and related machinery	24,739	101,800	77,060	PAT
6	29.32	Manufacture of other parts and accessories for motor vehicles	20,085	40,773	20,688	DES, PAT
7	28.99	Manufacture of other special-purpose machinery n.e.c.	18,850	27,855	9,005	TM, DES, PAT
8	10.3.1.2	Services Engineering services	18,593	26,337	7,744	PAT
9	28.29	Manufacture of other general-purpose machinery n.e.c.	17,509	25,686	8,176	TM, DES, PAT
10	26.51	Manufacture of instruments and appliances for measuring, testing and navigation	16,959	41,885	24,926	TM, DES, PAT
Top 10			384,469	708,112	324,438	
All IPR-intensive			181,955	2,122,465	1,940,510	

*NACE is the classification used in trade of goods and EBOPS the correspondent classification for trade of services used by Balance of Payments⁶¹

Several of the top exporters are also among the top importers, and vice versa. Given that the EU's main trading partners are other advanced economies (or emerging economies like China, where the bulk of the trade is in manufacturing products), this is in keeping with the general finding in studies of international trade that a significant proportion of trade is in similar goods flowing in both directions.

A comparison of the results of this study with those of the 2016 study reveals that the contribution of IPR-intensive industries to the EU economy was higher in the 2014-2016 period than in 2011-2013. However, the comparison is complicated by the fact that certain key components of the European system of national and regional accounts (ESA) used by Eurostat were updated between these two periods. In addition, in order to ensure that this report reflects the current structure of the EU economy, the matching exercise used to identify the IPR-intensive industries was updated, resulting in an increase of the number of these industries from 342 in the 2016 study to 353 in the present one. These updates had the effect of increasing the contribution to GDP and employment of IPR-intensive industries. In Table 25, the 2011-2013 figures have been re-calculated using the new definitions so as to illustrate the impact of these changes.

61 Correspondence between EBOPS 2010 and NACE Rev 2 (CPA 2008) can be found in RAMON, the Eurostat's Reference and Management of Nomenclatures available here: https://ec.europa.eu/eurostat/ramon/reasons/index.cfm?TargetUrl=LST_REL&StrLanguageCode=EN&IntCurrentPage=6

Table 25:
Comparison of the main results: 2016 study vs. 2019 study

Contribution of IPR-intensive industries	2016 study (original)	2016 study (new national account calculations, new IPR-intensive industries)	2019 study
Employment (direct)	27.8%	28.6%	29.2%
GDP	42.3%	44.0%	44.8%
Total trade in goods	89.3%	88.8%	92.5%
Total trade in goods and services	not calculated	78.1%	81.0%

The first column contains the results reported in the 2016 study for the period 2011-2013. The second column re-calculates the 2016 results for the same period, taking into account the new national accounting calculations and the new list of IPR-intensive industries. The third column presents the results of the present study (for the period 2014-2016) and is therefore directly comparable with the second column.

Thus, even after the effects of the statistical revisions have been taken into account, the contribution of IPR-intensive industries has increased between the two periods 2011-2013 (2016 study) and 2014-2016 (2019 study).

Exports of IPR-intensive industries also increased when compared to the previous study. This improvement was broadly based. For example, car manufacturing exports increased by 8%, from €143.9 billion to €154.9 billion, while exports of pharmaceuticals increased by 26% over the same period.

7.1.5 Wages

As noted above, 45% of GDP (value added) in the economy and 29% of employment is generated in IPR-intensive industries. This implies that value added *per employee* is higher in IPR-intensive industries than in the rest of the economy. It is therefore relevant to examine whether this higher value added is reflected in relative remuneration in the IPR-intensive industries.

Using the SBS data from Eurostat, it is possible to calculate the average compensation paid by each industry to its workforce.⁶² In SBS, *personnel costs* are defined as the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the reference period. Personnel costs are made up of wages, salaries and employers' social security contributions, both compulsory and voluntary. *Average personnel costs (or unit labour costs)* equal personnel costs divided by the number of employees (persons who are paid and have an employment contract). This is the definition of "wages" used in this report.

Data is available in SBS for most industries for 2016. However, for 17 industries, no personnel cost data was available at all.⁶³ Those industries were omitted from the analysis.

Remuneration in IPR-intensive industries is indeed higher than in non-IPR-intensive industries. The average weekly compensation in IPR-intensive industries is €801, compared with €544 in non-IPR-intensive industries – a difference of 47%. This "wage premium" is 29% in GI-intensive industries, 40% in design-intensive industries, 48% in trade mark-intensive industries, 59% in copyright-intensive industries and 72% in patent-intensive industries. In most cases, the premium is higher than in 2013, when the overall difference was 45% (measured across the same 353 industries considered in the present study).

Table 26:
Average personnel costs in IPR-intensive industries, 2016

IPR-intensive industries	Average personnel costs (€ per week)	Premium (compared to non-IP intensive industries)
Trade mark-intensive	805	48%
Design-intensive	761	40%
Patent-intensive	934	72%
Copyright-intensive	867	59%
GI-intensive	705	29%
PVR-intensive*	n/a	n/a
All IPR-intensive	801	47%
Non-IPR-intensive	544	
All industries (included in SBS**)	654	

*Not calculated because of lack of wage statistics for agriculture.
**Structural business statistics published by Eurostat.

62 Because SBS employment and compensation data is not available for the main public-sector industries, the analysis in this section is confined to the private sector.

63 The industries for which no personnel cost data was available are: 66.00 *Activities auxiliary to financial services and insurance activities*; 85.52 *Cultural education*; 90.01 *Performing arts*; 90.02 *Support activities to performing arts*; 90.03 *Artistic creation*; 90.04 *Operation of arts facilities*; 91.01 *Library and archives activities*; 91.02 *Museums activities*; 91.03 *Operation of historical sites and buildings and similar visitors attractions*; 92.00 *Gambling and betting activities*; 93.00 *Sports activities and amusement and recreation activities*; 93.21 *Activities of amusement parks and theme parks*; 93.29 *Other amusement and recreation activities*; 94.12 *Activities of professional membership organisations* and 94.99 *Activities of other membership organisations n.e.c.*

7.2 The main IPR-intensive industries at EU level

So far, the analysis in this chapter has focused on the IPR-intensive industries aggregated by IP right or in total. In this section, the contributions to employment and GDP are broken down by industry. Table 27 shows the 20 IPR-intensive industries making the largest contribution to employment.

Table 27:
Top 20 IPR-intensive industries (employment, 2014-2016 average)

NACE code	NACE description	Type*	Employment	Intensive IPR
71.12	Engineering activities and related technical consultancy	SERV	2,135,860	PAT
70.22	Business and other management consultancy activities	SERV	1,817,953	TM
66.00	Activities auxiliary to financial services and insurance activities	SERV	1,678,643	TM
93.00	Sports activities and amusement and recreation activities excluding 93.29 <i>Other amusement and recreation activities</i>	SERV	1,612,963	TM
68.20	Rental and operating of own or leased real estate	SERV	1,527,601	TM
62.01	Computer programming activities	SERV	1,350,589	TM, CR
62.02	Computer consultancy activities	SERV	1,346,840	CR
29.10	Manufacture of motor vehicles	MAN	1,079,708	TM, DES, PAT
29.32	Manufacture of other parts and accessories for motor vehicles	MAN	957,862	DES, PAT
94.99	Activities of other membership organisations n.e.c.	SERV	916,233	CR
46.69	Wholesale of other machinery and equipment	SERV	883,493	TM, DES, PAT
46.73	Wholesale of wood, construction materials and sanitary equipment	SERV	856,841	TM, DES
73.11	Advertising agencies	SERV	835,100	TM, DES, CR
47.78	Other retail sale of new goods in specialised stores	SERV	807,050	TM
47.59	Retail sale of furniture, lighting equipment and other household articles in specialised stores	SERV	779,935	DES
25.11	Manufacture of metal structures and parts of structures	MAN	709,909	DES, PAT
01.00	Crop and animal production, hunting and related service activities		656,688	PVR
46.90	Non-specialised wholesale trade	SERV	651,968	TM, DES
46.46	Wholesale of pharmaceutical goods	SERV	642,232	TM, PAT
31.09	Manufacture of other furniture	MAN	634,016	DES
TOP 20			21,881,485	

*MAN = manufacturing industry; SERV = service industry

Employment in these 20 industries, at close to 22 million, accounts for 35% of total employment in the 353 IPR-intensive industries identified in this report. The list is dominated by trade mark-intensive (12 out of 20) and design-intensive (9 out of 20) industries. Patent-intensive industries (6 out of 20) play an important role only when we consider the weight of the exclusive patent-intensive industry 71.12 *Engineering activities and related technical consultancy* in the overall employment.

Table 28 shows the top 20 IPR-intensive industries, ranked according to their contribution to GDP.

Table 28:
Top 20 IPR-intensive industries (GDP, 2014-2016 average)

NACE code	NACE description	Type*	Value-added (in million €, adjusted to GDP)	Intensive IPR
68.20	Rental and operating of own or leased real estate	SERV	1,561,480	TM
29.10	Manufacture of motor vehicles	MAN	163,526	TM, DES, PAT
70.22	Business and other management consultancy activities	SERV	153,583	TM
71.12	Engineering activities and related technical consultancy	SERV	149,447	PAT
62.02	Computer consultancy activities	SERV	125,533	CR
66.00	Activities auxiliary to financial services and insurance activities	SERV	123,453	TM
62.01	Computer programming activities	SERV	118,933	TM, CR
21.20	Manufacture of pharmaceutical preparations	MAN	110,250	TM, PAT
35.11	Production of electricity	MAN	106,335	TM, PAT
72.19	Other research and experimental development on natural sciences and engineering	SERV	101,133	TM, DES, PAT
61.10	Wired telecommunications activities	SERV	89,308	CR
46.46	Wholesale of pharmaceutical goods	SERV	77,144	TM, PAT
46.69	Wholesale of other machinery and equipment	SERV	75,110	TM, DES, PAT
29.32	Manufacture of other parts and accessories for motor vehicles	MAN	66,636	DES, PAT
93.00	Sports activities and amusement and recreation activities excluding 9329 - Other amusement and recreation activities	SERV	61,541	TM
61.20	Wireless telecommunications activities	SERV	51,176	TM, CR
61.90	Other telecommunications activities	SERV	50,832	TM, DES, PAT, CR
30.30	Manufacture of air and spacecraft and related machinery	MAN	50,547	PAT
41.10	Development of building projects		49,748	TM
62.09	Other information technology and computer service activities	SERV	47,403	TM, CR
TOP 20			3,333,118	

*MAN = manufacturing industry; SERV = service industry

In total, these 20 industries account for 51% of the total GDP generated in the 353 IPR-intensive industries.⁶⁴ There is a great deal of overlap between the two top 20 lists, with 11 industries appearing on both lists. There are, however, some industries, for example 6120 *Wireless telecommunications activities*, which generate high value added relative to employment and hence appear in the top 20 GDP list but not in the top 20 employment list and others, for example 7311 *Advertising agencies*, which appear in the top 20 list for employment but not in that for GDP.

64 This very high share is partly due to the fact that the top-ranked industry, NACE 6820 *Rental and operation of own or leased real estate*, includes imputed rent on owner-occupied housing. This is in keeping with the national accounting standard applied by Eurostat and other statistical offices. It was decided to retain the imputed rent in order to ensure compatibility between the numerator and denominator in the calculation of GDP shares, since imputed rent is included in the overall GDP figure from national accounts.

7.3 Analysis by Member State

This section presents the contribution of IPR-intensive industries to employment and GDP in each Member State. This part of the analysis was challenging because the availability of data at Member State level is more limited than at EU level. Consequently, more estimates and imputations were required, so that some of the results in this section may be less robust than those in sections 7.1 and 7.2. It is also important to reiterate that the IPR-intensive industries were identified at the level of the EU, not the individual Member States. As stated above, this study makes the assumption that if an industry is IPR-intensive in one Member State, it is also IPR-intensive in every other Member State because IPR-intensity is considered to be an intrinsic characteristic of each industry. The accuracy of the results presented in this section depends on the validity of this assumption.

The contribution of each industry to a Member State's economy is measured in terms of the jobs and GDP generated by that industry in that Member State. For example, if a car company from Member State A builds an assembly plant in Member State B, then the resulting jobs and value added accrue to the economy of Member State B. In other words, the measure of IPR intensity employed does not address the **origin** of the IPR being used, only its deployment. Therefore, it cannot be concluded on the basis of this study that if patent-intensive industries contribute more in terms of jobs and value added in country A than in country B, then country A is more innovative. The higher contribution made by patent-intensive industries to employment or GDP in country A could equally be the result of decisions on where to site production that were made in country C. The issue of the origin of IPRs and their relationship with economic well-being is the subject of Chapter 8 and is an area for potential further study.

In this study, data for the EFTA member countries Iceland, Norway and Switzerland are included for the first time.⁶⁵ In addition, in keeping with the practice adopted by Eurostat following the decision by the UK to leave the European Union, in the country tables in this section averages for EU-28 as well as EU-27 (that is, the EU without the UK) are shown.

7.3.1 Patent-intensive industries

Patent-intensive industries contribute 10.9% of employment and 16.1% of GDP in the EU. Above-average shares of employment are found in Austria, the Czech Republic, Denmark, Finland, Germany, Hungary, Italy, Luxembourg, Slovakia, Slovenia and Sweden. When measured on their contribution to value added, however, patent-intensive industries are also very important in Ireland. Of the biggest EU economies, Germany has the highest shares of patent-intensive employment and GDP, reflecting the high share of manufacturing industries (which predominate among the patent-intensive industries) in the German economy. The high shares of employment and GDP in patent-intensive industries in several of the Member States that joined the EU in 2004 and 2007 could also be related to the high share of manufacturing in their economies.

Among the EFTA countries, Norway and Switzerland have higher GDP shares of patent-intensive industries than the EU average, while in terms of employment shares of those industries, Norway is virtually at the EU average while Switzerland is above. Patent-intensive industries in Iceland account for a share of GDP that is below the EU average.

⁶⁵ Due to lack of data, it was not possible to calculate the contribution of GI- and PVR-intensive industries for those countries.

Table 29:
GDP and employment shares in patent-intensive industries by
Member State, 2014-2016 average

Country	Value added (€ million)	Share of GDP	Employment	Share of employment
AT	59,736	17.4%	494,271	12.1%
BE	61,071	14.9%	405,326	9.0%
BG	8,064	17.8%	306,147	10.4%
CY	1,103	6.2%	18,501	5.2%
CZ	43,544	26.0%	980,284	19.8%
DE	720,017	23.6%	6,269,349	15.9%
DK	49,544	18.2%	338,856	12.6%
EE	2,649	13.0%	59,424	9.8%
EL	16,720	9.5%	276,885	7.8%
ES	131,600	12.2%	1,335,705	7.5%
FI	36,408	17.3%	277,860	11.7%
FR	291,645	13.3%	2,458,726	9.4%
HR	5,449	12.1%	136,691	8.8%
HU	25,631	23.3%	537,322	12.8%
IE	62,661	25.7%	168,185	8.4%
IT	231,371	14.0%	2,491,654	11.3%
LT	4,615	12.3%	99,735	7.7%
LU	6,383	12.3%	34,260	13.6%
LV	2,558	10.5%	58,393	6.8%
MT	935	9.9%	11,898	6.5%
NL	93,048	13.5%	667,957	8.2%
PL	68,638	16.3%	1,502,388	9.5%
PT	20,181	11.2%	324,732	7.5%
RO	24,650	15.4%	756,888	9.2%
SE	79,134	17.6%	573,251	12.3%
SI	8,399	21.6%	142,208	15.8%
SK	15,089	19.2%	323,611	13.4%
UK	282,716	11.6%	2,520,726	8.4%
EU-28	2,353,560	16.1%	23,571,234	10.9%
EU-27	2,070,844	17.0%	21,050,508	11.3%
IS	1,499	9.4%	11,561	6.6%
NO	100,543	28.4%	284,366	11.2%
CH	123,513	21.1%	588,563	13.5%

7.3.2 Trade mark-intensive industries

In the EU as a whole, trade mark-intensive industries contribute 21.7% of employment and 37.3% of GDP. Countries with above-average shares of employment in trade mark-intensive industries include Austria, Bulgaria, the Czech Republic, Denmark, Germany, Estonia, Hungary, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Portugal, Slovakia, Slovenia and Sweden. Bulgaria, the Czech Republic, Denmark, Germany, Finland, Hungary, Ireland, Italy, Luxembourg, Malta and Romania have above-average shares of GDP coming from trade mark-intensive industries.

Table 30:
GDP and employment shares in trade mark-intensive industries
by Member State, 2014-2016 average

Country	Value added (€ million)	Share of GDP	Employment	Share of employment
AT	124,518	36.2%	903,309	22.1%
BE	131,049	31.9%	879,108	19.5%
BG	19,956	44.0%	765,580	25.9%
CY	5,711	32.0%	67,941	19.2%
CZ	68,476	41.0%	1,322,925	26.8%
DE	1,230,340	40.4%	9,713,904	24.6%
DK	104,864	38.6%	653,419	24.3%
EE	6,887	33.8%	142,061	23.4%
EL	54,772	31.1%	709,591	20.0%
ES	355,216	32.9%	3,516,567	19.9%
FI	81,360	38.7%	487,073	20.5%
FR	774,987	35.4%	4,551,306	17.4%
HR	15,220	33.9%	311,567	20.0%
HU	42,137	38.3%	954,682	22.8%
IE	145,364	59.7%	434,004	21.7%
IT	661,634	40.1%	5,228,063	23.8%
LT	13,304	35.4%	298,960	23.0%
LU	20,848	40.3%	78,839	31.2%
LV	8,848	36.4%	195,052	22.6%
MT	3,590	38.2%	35,108	19.2%
NL	227,923	33.0%	1,767,197	21.8%
PL	138,741	32.9%	3,055,902	19.4%
PT	64,672	36.0%	946,837	22.0%
RO	60,494	37.7%	1,378,082	16.8%
SE	155,360	34.6%	1,091,803	23.4%
SI	14,261	36.6%	217,866	24.2%
SK	27,330	34.7%	562,108	23.3%

Country	Value added (€ million)	Share of GDP	Employment	Share of employment
UK	889,993	36.6%	6,432,094	21.4%
EU-28	5,447,857	37.3%	46,700,950	21.7%
EU-27	4,557,863	37.4%	40,268,856	21.7%
IS	5,267	33.1%	40,029	23.0%
NO	150,312	42.5%	477,143	18.8%
CH	200,892	34.4%	1,023,493	23.4%

Among the EFTA countries, Norway has a higher GDP share of trade mark-intensive industries than the EU average, while in terms of employment shares of those industries, Iceland and Switzerland are above the EU average.

7.3.3 Design-intensive industries

Design-intensive industries contribute 14.2% of employment and 16.2% of GDP in the EU. Austria, Bulgaria, the Czech Republic, Denmark, Estonia, Germany, Croatia, Hungary, Italy, Lithuania, Luxembourg, Poland, Portugal, Slovakia and Slovenia all have design-intensive employment shares above the EU average. A broadly similar pattern holds for GDP.

Table 31:
GDP and employment shares in design-intensive industries by
Member State, 2014-2016 average

Country	Value added (€ million)	Share of GDP	Employment	Share of employment
AT	61,332	17.8%	620,264	15.2%
BE	51,084	12.4%	500,026	11.1%
BG	7,256	16.0%	487,985	16.5%
CY	1,110	6.2%	34,060	9.6%
CZ	42,084	25.2%	1,147,627	23.2%
DE	689,830	22.6%	7,059,114	17.9%
DK	47,141	17.4%	405,128	15.1%
EE	3,676	18.0%	104,160	17.1%
EL	16,065	9.1%	385,243	10.9%
ES	127,318	11.8%	1,963,961	11.1%
FI	31,926	15.2%	297,107	12.5%
FR	260,276	11.9%	2,818,645	10.8%
HR	6,195	13.8%	223,103	14.3%
HU	24,630	22.4%	673,359	16.1%
IE	45,303	18.6%	204,630	10.2%
IT	279,250	16.9%	3,793,849	17.2%

Country	Value added (€ million)	Share of GDP	Employment	Share of employment
LT	6,895	18.4%	214,866	16.5%
LU	7,078	13.7%	42,209	16.7%
LV	3,177	13.1%	112,780	13.1%
MT	1,106	11.8%	19,123	10.4%
NL	108,604	15.7%	962,545	11.9%
PL	83,423	19.8%	2,360,934	15.0%
PT	30,254	16.9%	703,637	16.3%
RO	27,392	17.1%	1,074,489	13.1%
SE	70,837	15.8%	641,837	13.8%
SI	7,590	19.5%	167,040	18.6%
SK	16,209	20.6%	447,382	18.6%
UK	314,242	12.9%	3,246,218	10.8%
EU-28	2,371,282	16.2%	30,711,322	14.2%
EU-27	2,057,040	16.9%	27,465,103	14.8%
IS	1,060	6.7%	14,542	8.3%
NO	83,443	23.6%	256,256	10.1%
CH	114,456	19.6%	657,143	15.0%

Among the EFTA countries, Norway and Switzerland have a higher GDP share of design-intensive industries than the EU average, while in terms of employment shares of those industries, only Switzerland is above the EU average.

7.3.4 Copyright-intensive industries

Overall employment in copyright-intensive industries in the EU is 11.8 million, or 5.5% of the total, and those industries contribute 6.9% of the EU's GDP.

Table 32:
GDP and employment shares in copyright-intensive industries
by Member State, 2014-2016 average

Country	Value added (€ million)	Share of GDP	Employment	Share of employment
AT	18,680	5.4%	214,248	5.2%
BE	23,886	5.8%	227,100	5.0%
BG	3,365	7.4%	147,378	5.0%
CY	1,091	6.1%	17,588	5.0%
CZ	11,738	7.0%	241,668	4.9%
DE	203,310	6.7%	2,283,978	5.8%
DK	18,486	6.8%	186,825	6.9%

Country	Value added (€ million)	Share of GDP	Employment	Share of employment
EE	1,556	7.6%	37,549	6.2%
EL	8,413	4.8%	180,367	5.1%
ES	66,953	6.2%	948,047	5.4%
FI	16,566	7.9%	162,861	6.8%
FR	147,999	6.8%	1,409,508	5.4%
HR	2,848	6.3%	72,054	4.6%
HU	7,779	7.1%	215,592	5.2%
IE	31,658	13.0%	138,660	6.9%
IT	89,327	5.4%	1,041,661	4.7%
LT	2,082	5.5%	67,075	5.2%
LU	3,890	7.5%	24,398	9.7%
LV	2,036	8.4%	53,755	6.2%
MT	1,624	17.3%	13,967	7.6%
NL	46,084	6.7%	499,271	6.1%
PL	25,779	6.1%	617,817	3.9%
PT	9,098	5.1%	184,305	4.3%
RO	11,921	7.4%	281,393	3.4%
SE	41,081	9.2%	366,380	7.9%
SI	2,434	6.2%	45,351	5.0%
SK	5,137	6.5%	114,922	4.8%
UK	203,562	8.4%	2,027,737	6.8%
EU-28	1,008,383	6.9%	11,821,456	5.5%
EU-27	804,822	6.6%	9,793,719	5.3%
IS	1,017	6.4%	13,547	7.8%
NO	18,210	5.1%	146,977	5.8%
CH	37,902	6.5%	252,252	5.8%

Countries with above-average employment in copyright-intensive industries include Denmark, Germany, Estonia, Finland, Ireland, Luxembourg, Malta, the Netherlands, Sweden and the UK.

Bulgaria, the Czech Republic, Estonia, Finland, Hungary, Ireland, Latvia, Luxembourg, Malta, Romania, Sweden and the UK all have above-average GDP shares attributable to copyright-intensive industries. All three EFTA countries are above the EU average when it comes to employment but below the EU average in terms of GDP contribution.

7.3.5 GI-intensive industries

While the share of GI-intensive industries in either employment or GDP is below 1% in every Member State, and the EU averages are 0.2% and 0.1% respectively, the four GI-intensive industries

employ significant numbers of people in France, Italy, Spain, Portugal, Germany and the UK. France, with its large wine industry, accounts for almost one third of GI-intensive employment in the EU. The highest employment shares are found in Portugal at 0.6% and France at 0.5%.

Table 33:
GDP and employment shares in GI-intensive industries by
Member State, 2014-2016 average

Country	Value added (€ million)	Share of GDP	Employment	Share of employment
AT	262	0.1%	5,392	0.1%
BE	12	0.0%	102	0.0%
BG	14	0.0%	2,691	0.1%
CY	6	0.0%	76	0.0%
CZ	71	0.0%	575	0.0%
DE	1,865	0.1%	30,560	0.1%
DK	24	0.0%	302	0.0%
EE	n/a	n/a	n/a	n/a
EL	649	0.4%	10,326	0.3%
ES	2,151	0.2%	44,757	0.3%
FI	n/a	n/a	n/a	n/a
FR	6,949	0.3%	126,569	0.5%
HR	0	0.0%	348	0.0%
HU	115	0.1%	4,578	0.1%
IE	12	0.0%	58	0.0%
IT	3,893	0.2%	77,646	0.4%
LT	12	0.0%	159	0.0%
LU	16	0.0%	284	0.1%
LV	n/a	n/a	n/a	n/a
MT	n/a	n/a	n/a	n/a
NL	29	0.0%	216	0.0%
PL	n/a	n/a	n/a	n/a
PT	597	0.3%	25,277	0.6%
RO	401	0.3%	2,945	0.0%
SE	n/a	n/a	n/a	n/a
SI	28	0.1%	245	0.0%
SK	54	0.1%	1,506	0.1%
UK	2 995	0.1%	64,713	0.2%
EU-28	20,155	0.1%	399,324	0.2%
EU-27	17,160	0.1%	334,611	0.2%

It should also be noted that while their share in the national economies is modest, the GI-intensive industries are heavily concentrated in particular regions of the Member States, where they are an important part of the local economy.

As noted above, the estimates of value added and employment in GI-intensive industries were calculated using the shares of the relevant industries that produce the GI products. This is in contrast to the estimates for the other IP rights, which are predicated on the assumption that IPR intensity is a fundamental characteristic of an industry, irrespective of its geographical location.

7.3.6 PVR-intensive industries

Overall employment in PVR-intensive industries in the EU is 1.7 million, or 0.8% of the total, and those industries contribute 1.2% of the EU's GDP.

Table 34:
GDP and employment shares in PVR-intensive industries by
Member State, 2014-2016 average

Country	Value added (€ million)	Share of GDP	Employment	Share of total employment
AT	2,978	0.9%	37,593	0.9%
BE	3,999	1.0%	32,055	0.7%
BG	806	1.8%	31,135	1.1%
CY	42	0.2%	3,119	0.9%
CZ	1,973	1.2%	30,919	0.6%
DE	39,219	1.3%	295,939	0.8%
DK	3,242	1.2%	23,542	0.9%
EE	278	1.4%	2,966	0.5%
EL	1,577	0.9%	50,469	1.4%
ES	9,339	0.9%	184,589	1.0%
FI	2,298	1.1%	17,741	0.7%
FR	47,274	2.2%	193,437	0.7%
HR	505	1.1%	11,589	0.7%
HU	2,113	1.9%	49,878	1.2%
IE	8,441	3.5%	10,131	0.5%
IT	15,508	0.9%	183,748	0.8%
LT	400	1.1%	10,868	0.8%
LU	1,798	3.5%	2,568	1.0%
LV	247	1.0%	4,165	0.5%
MT	72	0.8%	2,239	1.2%
NL	6,098	0.9%	120,707	1.5%
PL	4,403	1.0%	115,762	0.7%

Country	Value added (€ million)	Share of GDP	Employment	Share of total employment
PT	1,270	0.7%	35,729	0.8%
RO	2,191	1.4%	61,071	0.7%
SE	4,038	0.9%	24,641	0.5%
SI	541	1.4%	7,066	0.8%
SK	610	0.8%	6,842	0.3%
UK	20,310	0.8%	185,900	0.6%
EU-28	181,570	1.2%	1,736,407	0.8%
EU-27	161,260	1.3%	1,550,507	0.8%

Countries with above-average employment in IPR-intensive industries include Austria, Bulgaria, Cyprus, Denmark, Greece, Spain, Italy, Hungary, Lithuania, Luxembourg, Malta, the Netherlands and Portugal. A similar pattern holds for GDP.

7.3.7 All IPR-intensive industries

If all six IP rights are combined and the overlaps eliminated, the overall contribution of IPR-intensive industries to the economies of the Member States is as shown in Table 35. At EU level, IPR-intensive industries contribute 29.2% of employment and 44.8% to GDP.

Table 35:
GDP and employment shares in all IPR-intensive industries by
Member State, 2014-2016 average

Country	Value added (€ million)	Share of GDP (%)	Employment	Share of employment (%)
AT	149,898	43.6%	1,208,456	29.6%
BE	160,756	39.1%	1,178,785	26.1%
BG	23,287	51.3%	952,196	32.3%
CY	6,407	35.9%	87,446	24.8%
CZ	85,882	51.4%	1,846,039	37.3%
DE	1,521,603	49.9%	13,138,181	33.3%
DK	122,770	45.2%	859,932	32.0%
EE	8,436	41.3%	193,497	31.8%
EL	63,254	35.9%	964,327	27.2%
ES	432,642	40.1%	4,785,962	27.0%
FI	94,731	45.0%	664,145	27.9%
FR	940,008	42.9%	6,400,813	24.5%
HR	18,435	41.1%	426,409	27.4%
HU	53,052	48.2%	1,288,546	30.8%
IE	158,317	65.0%	542,246	27.1%

Country	Value added (€ million)	Share of GDP	Employment	Share of total employment
IT	774,345	46.9%	6,938,887	31.5%
LT	16,157	43.0%	398,069	30.6%
LU	24,439	47.3%	103,139	40.9%
LV	10,370	42.7%	250,390	29.0%
MT	4,559	48.5%	49,779	27.2%
NL	271,187	39.3%	2,336,422	28.8%
PL	177,229	42.0%	4,183,406	26.5%
PT	76,271	42.5%	1,259,100	29.2%
RO	74,731	46.5%	1,930,445	23.5%
SE	192,419	42.9%	1,496,102	32.1%
SI	18,025	46.3%	298,778	33.2%
SK	34,866	44.3%	751,766	31.2%
UK	1,037,692	42.6%	8,429,503	28.1%
EU-28	6,551,768	44.8%	62,962,766	29.2%
EU-27	5,514,077	45.3%	54,533,263	29.4%
IS *	6,294	39.6%	50,939	29.2%
NO *	173,460	49.1%	669,540	26.3%
CH *	241,518	41.3%	1,341,482	30.7%

*Does not include GIs and PVRs.

Overall, IPR-intensive industries account for an above-average share of employment in Austria, Bulgaria, the Czech Republic, Denmark, Estonia, Germany, Hungary, Italy, Lithuania, Luxembourg, Slovakia, Slovenia and Sweden.

In terms of GDP, Bulgaria, the Czech Republic, Denmark, Finland, Germany, Hungary, Ireland, Italy, Luxembourg, Malta, Romania, and Slovenia have shares above the EU average.

Of the three EFTA countries, Norway has an above-EU average contribution to its GDP from IPR-intensive industries, while Switzerland lies above the EU average when it comes to employment contribution of those industries.

08 / Origins of IP rights and job creation in the Single Market

It is important to bear in mind that the shares in GDP and employment shown in this report do not necessarily reflect the degree to which a country's economy is innovative. For example, a country may be a good location for patent-intensive manufacturing industries due to low costs, a favourable business climate or the availability of natural resources. That country may then have a high share of employment in patent-intensive industries even though the manufacturing firms that built the factories and created the jobs in its territory have their headquarters and carry out their research and development (as opposed to production) elsewhere.

As discussed in this chapter, analysing the impact of the IPR at this more granular level is an important area for future research. Accordingly, what follows is an initial analysis of the **origins** of the IP rights whose contribution to the economies of the EU and its Member States is the subject of this report.

8.1 Origins of IPR within the EU

So far, this report has examined where jobs and economic activity in IPR-intensive industries are created. As already noted, this is not necessarily a reflection of the relative "IP-creating power" of the Member States. In the Single Market, companies may have their headquarters in one country, create their IPR in another country and manufacture the resulting products in yet another. In particular, decisions as to where to site production facilities depend on many factors, including the cost and availability of labour with the necessary skills, the cost and availability of land, raw materials and other resources, the business environment and tax regime in the various countries, and so on.

In this chapter, two basic questions are explored:

- Which EU Member States create the IPR analysed in this report?
- What proportion of jobs in IPR-intensive industries in each Member State is created by companies from other Member States?

This and the next section seek to provide some initial answers to these two questions.

Using the data on filings and employment, it is possible to explore where the trade marks and designs filed at the EUIPO, the patent applications filed at the EPO and the PVRs filed at the CPVO originate (as indicated by the nationality of the owner). The tables in this section show the number

of patents, trade marks, designs and PVRs originating in each Member State during the period 2014-2016. It should be noted that in order to provide a complete picture of the IPR-generating activities in each country, filings from companies in all industries are included in these tables. Therefore, the figures are not directly comparable with those in the previous chapters of this report, which analysed IPR-intensive industries only.⁶⁶

Table 36:
IPR filings by country of origin in all industries, 2014-2016 average

Country	PAT	PAT rank	TM	TM rank	DES	DES rank	PVR	PVR rank	EMPL ('000)	PAT per 1,000 empl.	TM per 1,000 empl.	DES per 1,000 empl.	PVR per 1,000 empl.
AT	1,995	8	2,988	8	2,324	7	19	9	4,082	0.49	0.73	0.57	0
BE	2,072	7	2,182	10	1,086	11	54	8	4,512	0.46	0.48	0.24	0.01
BG	30	24	665	18	817	14	n/a	n/a	2,952	0.01	0.23	0.28	n/a
CY	37	22	589	20	59	27	n/a	n/a	353	0.1	1.67	0.17	n/a
CZ	189	15	1,005	16	722	15	13	12	4,944	0.04	0.2	0.15	0
DE	25,012	1	19,818	1	18,884	1	377	3	39,416	0.63	0.5	0.48	0.01
DK	1,961	9	1,717	11	1,632	10	98	4	2,689	0.73	0.64	0.61	0.04
EE	37	23	346	24	96	24	1	19	608	0.06	0.57	0.16	0
EL	86	19	815	17	234	18	2	16	3,546	0.02	0.23	0.07	0
ES	1,507	11	9,280	4	3,680	6	89	6	17,704	0.09	0.52	0.21	0.01
FI	1,956	10	1,348	13	834	13	1	20	2,378	0.82	0.57	0.35	0
FR	10,562	2	7,743	5	6,026	4	463	2	26,157	0.4	0.3	0.23	0.02
HR	13	28	140	28	54	28	n/a	n/a	1,556	0.01	0.09	0.03	n/a
HU	106	18	545	21	179	21	9	13	4,185	0.03	0.13	0.04	0
IE	708	12	1,113	15	253	17	3	15	1,998	0.35	0.56	0.13	0
IT	3,926	5	10,353	3	10,325	2	82	7	22,008	0.18	0.47	0.47	0
LT	30	25	269	26	91	25	1	21	1,302	0.02	0.21	0.07	0
LU	496	13	1,223	14	562	16	1	22	252	1.97	4.85	2.23	0
LV	15	27	158	27	68	26	1	23	863	0.02	0.18	0.08	0
MT	74	20	419	22	224	20	n/a	n/a	195	0.38	2.15	1.15	n/a
NL	6,999	3	4,414	6	2,291	8	1,229	1	8,122	0.86	0.54	0.28	0.15
PL	485	14	3,496	7	4,483	5	18	10	15,768	0.03	0.22	0.28	0
PT	139	16	1,374	12	1,043	12	2	17	4,311	0.03	0.32	0.24	0
RO	30	26	649	19	229	19	1	24	8,218	0	0.08	0.03	0
SE	3,743	6	2,915	9	1,700	9	16	11	4,664	0.8	0.62	0.36	0
SI	119	17	335	25	157	23	2	18	899	0.13	0.37	0.17	0

66 As is the case throughout this report, the analysis is based on EU-level filings. Future studies could include national filings as well to provide a more complete picture.

Country	PAT	PAT rank	TM	TM rank	DES	DES rank	PVR	PVR rank	EMPL ('000)	PAT per 1000 empl.	TM per 1000 empl.	DES per 1000 empl.	PVR per 1000 empl.
SK	40	21	380	23	160	22	6	14	2,409	0.02	0.16	0.07	0
UK	5,048	4	11,963	2	6,186	3	98	5	30,000	0.17	0.4	0.21	0
EU-28	67,415		88,242		64,399		2,586		216,091	0.31	0.41	0.30	0.01

Note: The table shows the mean number of annual filings per country of origin of the applicant calculated from the dataset of all the applications filed in the period between 2014 and 2016. Applicants were linked with countries of origin based on the seat country as shown in the application. Calculations in this table take into account all the applications received by the respective IP offices, and not just those matched with ORBIS.

In absolute terms, Germany ranks first for patents, trade marks and designs, followed by France, the Netherlands, the UK, Italy and Spain. There is some variation between the various IP rights. For example, while Spain is in 4th place for trade marks and 6th place in designs, it is in 11th place for patents. The group made up of the largest economies is followed by a group of smaller northern European countries, including Austria, Belgium, Denmark and Sweden. The highest-placed among the 13 countries that joined the EU from 2004 onwards is Poland, which is also the largest of these countries. The pattern for plant varieties differs from that for the other IP rights: the Netherlands is the leader, followed by France, Germany, the UK and Spain.

Of course, all other things being equal, large countries will tend to have more IPR filings. Therefore, Table 36 also shows the number of IPR filings per 1,000 employees. This is the measure of IPR intensity employed throughout this report. The overall EU average is 0.41 EUTMs, 0.31 PATs, 0.30 RCDs and 0.01 PVRs per 1,000 employees. Viewed in this light, overall the countries above the EU average in terms of IPR creation per employee are Austria, Denmark, Finland, Germany, Luxembourg, Malta, the Netherlands and Sweden. Some countries have areas of particular strength. For example, Belgium is above the EU average in patents and trade marks, as is Ireland.

8.2 Job creation in the Single Market

Chapter 7 of this report revealed that many of the newer Member States have a relatively high proportion of employment and GDP in IPR-intensive industries. Section 8.1, however, showed that the IPRs being applied for at the EUIPO and EPO for the most part originate in the EU-15 Member States. Thus, it appears that while many companies continue to develop their IPR at home, the resulting production is often located in other Member States, particularly those that joined the EU from 2004 onwards. Indeed, cross-border job creation can be considered a positive manifestation of the Single Market.

This pattern of job creation in the Single Market is further illustrated by examining the extent to which jobs in each Member State are created by companies based in other member states or countries outside the EU.

Data on foreign ownership in each Member State is available from Eurostat's foreign affiliates statistics (FATS).⁶⁷ In Table 37, this information has been combined with the matched database in order to

67 For a detailed explanation, see <http://ec.europa.eu/eurostat/web/structural-business-statistics/global-value-chains/foreign-affiliates>.

determine how many jobs in IPR-intensive industries in each Member State have been created by companies from outside that state.

Thus, 40% of all IPR-intensive employment in Romania is in non-Romanian owned firms. Of those jobs, 30% are in firms based in other EU countries, while 10% are in firms headquartered outside the EU. Other Member States in which more than 30% of IPR-intensive job creation originates outside the country include Austria, the Czech Republic, Hungary, Ireland, Luxembourg, Slovakia and Sweden.

The highest share of jobs in IPR-intensive industries generated by companies from outside the EU is to be found in Ireland, at 20%. Estonia, Ireland, the Netherlands and the UK are the only Member States in which more jobs are created by companies from third countries than by companies based in other EU Member States.

Table 37:
Jobs in EU Member States attributed to foreign companies in all
IPR-intensive industries, 2014-2016 average

	Jobs attributed to companies based in:		Total employment in IPR-intensive industries*	Other EU Share	Non-EU share	Total non-domestic share
	Other EU Member States	Non-EU countries				
AT	227,644	119,454	1,133,957	20.1%	10.5%	30.6%
BE	138,911	105,341	1,100,663	12.6%	9.6%	22.2%
BG	138,164	73,247	905,728	15.3%	8.1%	23.3%
CY	2,152	2,478	75,262	2.9%	3.3%	6.2%
CZ	451,940	225,669	1,781,148	25.4%	12.7%	38.0%
DE	1,107,814	1,059,044	12,225,367	9.1%	8.7%	17.7%
DK	117,466	103,372	793,333	14.8%	13.0%	27.8%
EE	26,813	27,082	182,786	14.7%	14.8%	29.5%
EL	50,515	23,085	861,590	5.9%	2.7%	8.5%
ES	551,842	262,709	4,245,813	13.0%	6.2%	19.2%
FI	86,207	67,740	603,398	14.3%	11.2%	25.5%
FR	724,107	468,715	5,964,472	12.1%	7.9%	20.0%
HR	65,747	15,577	400,576	16.4%	3.9%	20.3%
HU	300,337	168,814	1,197,795	25.1%	14.1%	39.2%
IE	49,766	98,032	488,369	10.2%	20.1%	30.3%
IT	410,425	354,350	6,372,960	6.4%	5.6%	12.0%
LT	58,394	32,165	376,126	15.5%	8.6%	24.1%
LU	19,948	8,576	90,128	22.1%	9.5%	31.6%
LV	5,490	15,981	234,386	23.1%	6.8%	29.9%
MT	8,916	4,132	44,247	20.2%	9.3%	29.5%
NL	257,682	270,283	2,113,831	12.2%	12.8%	25.0%
PL	746,375	311,352	3,959,095	18.9%	7.9%	26.7%
PT	123,497	71,219	1,191,506	10.4%	6.0%	16.3%
RO	561,592	179,973	1,848,493	30.4%	9.7%	40.1%
SE	224,511	196,159	1,382,821	16.2%	14.2%	30.4%
SI	53,049	22,467	287,240	18.5%	7.8%	26.3%
SK	194,352	91,226	723,236	26.9%	12.6%	39.5%
UK	729,280	1,273,443	7,203,109	10.1%	17.7%	27.8%
EU-28	7,481,635	5,651,683	57,787,434	12.9%	9.8%	22.7%

*IPR-intensive industries included in FATS.

There are thus significant flows of job creation between EU Member States, and also to some degree between the EU and non-EU countries. However, to provide some perspective, even in Romania, the country with the highest share of non-domestic companies in IPR-intensive industries, the proportion of jobs in non-Romanian firms is 40%, so that almost two thirds of such jobs are still generated by indigenous companies. In the largest economies in the EU, the majority of jobs in IPR-intensive industries are generated domestically: 72% in the UK, 80% in France, 82% in Germany, 81% in Spain and 88% in Italy.

Table 38 indicates the share of jobs attributed to non-domestic companies in industries which are intensive in trade marks, patents and designs. As compared with the overall EU average of 22.7% for industries intensive in any one of the six IPRs, industries which are intensive in patents and designs account for a higher proportion of jobs in subsidiaries of foreign companies with 26.5% and 22.8% respectively at EU level. In countries such as Hungary, Romania and Slovakia, the share is more than 50%. Due to limited data availability, it is not possible to calculate precisely the share of jobs in subsidiaries of foreign companies for the other IPRs studied in this report. However, it can be inferred from available results that the share for copyright, GIs and PVRs is below the overall average of 22.7% for all IPR-intensive industries.

Table 38:
Jobs in IPR-intensive industries attributed to foreign companies
by EU Member State, 2014-2016 average, by IP right

	All IPR			Patents			Trade marks			Designs		
	Other EU share	Non-EU share	Total non-domestic share	Other EU share	Non-EU share	Total non-domestic share	Other EU share	Non-EU share	Total non-domestic share	Other EU share	Non-EU share	Total non-domestic share
AT	20.1%	10.5%	30.6%	19.2%	12.8%	32.0%	17.7%	9.8%	27.5%	19.3%	10.3%	29.6%
BE	12.6%	9.6%	22.2%	15.8%	17.1%	32.9%	10.8%	9.9%	20.7%	13.8%	10.9%	24.7%
BG	15.3%	8.1%	23.3%	15.7%	11.7%	27.4%	13.8%	6.8%	20.5%	16.3%	8.2%	24.5%
CY	2.9%	3.3%	6.2%	0.8%	2.7%	3.5%	2.2%	3.3%	5.5%	2.0%	2.9%	4.8%
CZ	25.4%	12.7%	38.0%	28.1%	16.0%	44.1%	22.2%	11.9%	34.1%	26.3%	13.0%	39.3%
DE	9.1%	8.7%	17.7%	8.9%	10.1%	19.1%	8.1%	8.5%	16.6%	8.0%	9.1%	17.0%
DK	14.8%	13.0%	27.8%	14.1%	12.1%	26.3%	14.2%	12.2%	26.4%	15.7%	12.5%	28.2%
EE	14.7%	14.8%	29.5%	17.3%	20.5%	37.9%	13.1%	13.6%	26.7%	16.8%	15.3%	32.1%
EL	5.9%	2.7%	8.5%	3.8%	2.8%	6.6%	5.3%	2.8%	8.1%	5.3%	2.7%	8.0%
ES	13.0%	6.2%	19.2%	18.1%	9.3%	27.4%	11.1%	5.9%	16.9%	13.1%	7.1%	20.2%
FI	14.3%	11.2%	25.5%	13.0%	12.5%	25.5%	11.9%	10.5%	22.4%	13.1%	11.8%	24.9%
FR	12.1%	7.9%	20.0%	13.2%	9.2%	22.4%	11.9%	8.4%	20.3%	13.7%	9.1%	22.8%
HR	16.4%	3.9%	20.3%	16.0%	4.9%	20.9%	14.9%	3.9%	18.8%	15.2%	3.4%	18.6%
HU	25.1%	14.1%	39.2%	31.7%	21.2%	52.9%	22.0%	13.3%	35.3%	27.7%	17.2%	44.8%
IE	10.2%	20.1%	30.3%	9.5%	34.4%	43.9%	8.8%	20.6%	29.4%	9.9%	26.8%	36.6%
IT	6.4%	5.6%	12.0%	7.4%	7.4%	14.8%	5.8%	5.0%	10.8%	5.4%	4.8%	10.1%
LT	15.5%	8.6%	24.1%	15.9%	11.5%	27.4%	13.2%	7.7%	20.8%	14.7%	8.4%	23.2%
LU	22.1%	9.5%	31.6%	13.1%	10.2%	23.2%	20.1%	8.3%	28.4%	17.0%	6.7%	23.6%
LV	23.1%	6.8%	29.9%	21.1%	7.7%	28.8%	19.7%	6.1%	25.8%	22.2%	6.7%	28.8%
MT	20.2%	9.3%	29.5%	60.3%	19.3%	79.6%	26.1%	9.0%	35.1%	39.8%	11.1%	50.9%
NL	12.2%	12.8%	25.0%	12.7%	16.4%	29.1%	10.6%	11.3%	21.9%	11.6%	12.5%	24.1%
PL	18.9%	7.9%	26.7%	23.7%	11.9%	35.6%	16.0%	7.0%	23.1%	19.0%	8.4%	27.4%
PT	10.4%	6.0%	16.3%	13.1%	11.0%	24.1%	8.6%	5.8%	14.4%	8.5%	6.1%	14.5%
RO	30.4%	9.7%	40.1%	37.1%	13.4%	50.5%	27.1%	8.9%	36.0%	32.8%	10.2%	42.9%
SE	16.2%	14.2%	30.4%	17.1%	17.2%	34.3%	14.9%	13.2%	28.0%	18.3%	15.2%	33.5%
SI	18.5%	7.8%	26.3%	19.3%	8.9%	28.2%	15.7%	8.2%	23.9%	19.3%	7.2%	26.5%
SK	26.9%	12.6%	39.5%	39.3%	17.4%	56.6%	23.7%	10.4%	34.1%	30.6%	12.8%	43.5%
UK	10.1%	17.7%	27.8%	10.4%	17.9%	28.3%	8.9%	15.5%	24.4%	9.6%	16.1%	25.6%
EU-28	12.9%	9.8%	22.7%	14.5%	12.0%	26.5%	11.5%	9.2%	20.6%	13.0%	9.8%	22.8%

Table 39 shows the cross-border flows of jobs within the Single Market from a different perspective, namely by looking at the origin of the more than five million jobs created in EU Member States by companies from other Member States. Thus, German companies create more than 1.7 million jobs – about 33% of the total – in other Member States. French companies create 1.2 million jobs

elsewhere in the EU, and so on. The top of the list is dominated by the large Member States, although Austrian and Scandinavian companies also create significant numbers of jobs in other Member States.

Table 39:
Jobs in EU Member States attributed to companies from other Member States (IPR-intensive industries, 2014-2016 average)

Member State	Jobs in the rest of EU attributed to companies based in the Member State	Share of all EU cross-border jobs
AT	209,120	3.9%
BE	93,635	1.8%
BG	n/a	n/a
CY	1,863	0.0%
CZ	9,552	0.2%
DE	1,746,387	32.9%
DK	248,197	4.7%
EE	n/a	n/a
EL	19,898	0.4%
ES	132,659	2.5%
FI	124,402	2.3%
FR	1,204,053	22.7%
HR	12,238	0.2%
HU	13,132	0.2%
IE	121,342	2.3%
IT	439,249	8.3%
LT	13,282	0.3%
LU	64,651	1.2%
LV	2,541	0.0%
MT	881	0.0%
NL	n/a	n/a
PL	26,789	0.5%
PT	39,229	0.7%
RO	1,114	0.0%
SE	330,064	6.2%
SI	9,282	0.2%
SK	6,117	0.1%
UK	440,337	8.3%
EU-28	5,310,012	100%

09 / Technology focus: Climate change mitigation technologies and Fourth Industrial Revolution technologies

This chapter focuses on two technology areas that are of particular importance for the future of the EU economy: technologies that help mitigate the effects of climate change (CCMTs) and technologies that support the digital transformation, also known as the Fourth Industrial Revolution (4IR). The purpose of this chapter is therefore twofold: first, to identify the IPR-intensive industries in the EU that have a leading position in CCMTs and 4IR, and second, to analyse the economic characteristics of those industries that make intensive use of these technologies and assess their overall contribution to EU employment, output, trade and wages, following the same approach as in previous chapters.⁶⁸

9.1 Climate change mitigation technologies

Climate change is clearly one of the biggest challenges of the 21st century. Under the Paris Agreement, adopted by 195 countries at the 2015 Climate Change Conference, Europe has committed itself to fighting global warming. Climate change mitigation technologies (CCMTs) will play an important role in achieving the ambitious goals set out in the Agreement. New and far-reaching inventions are needed to curb emissions without having a negative impact on the economic development. Besides, CCMTs can create considerable opportunities for future economic growth, with the worldwide market volume for environmental technology and resource efficiency predicted to almost double to €5,385 billion by 2025.⁶⁹ In this context, CCMTs are expected to transform a large array of businesses in the coming years and are already widespread across many industries in the EU. The previous edition of this study made a first attempt to identify these industries. What follows is an update of these findings.

68 The economies of Iceland, Norway and Switzerland have not been considered in this chapter

69 See BMUB (2014).

9.1.1 Inventive activity in the EU in CCMTs

The EPO and UNEP (2015) report showed that Europe is one of the main centres of inventive activity in the area of CCMTs and many companies operating in that area rely on IP rights to protect the value of their innovations.

In order to facilitate the identification of inventions that cover technical solutions related to controlling, reducing or preventing emissions of greenhouse gases, the EPO has developed the “Y02/Y04S” tagging scheme. This scheme, which was established by the EPO’s patent examiners with the help of external experts in the field, allows structured access to more than three million patent documents disclosing technical information on CCMTs relating to buildings, greenhouse-gas capture and storage, renewable-energy generation, transmission and distribution, industrial production activity and transportation, waste or wastewater treatment and smart grid technologies.⁷⁰

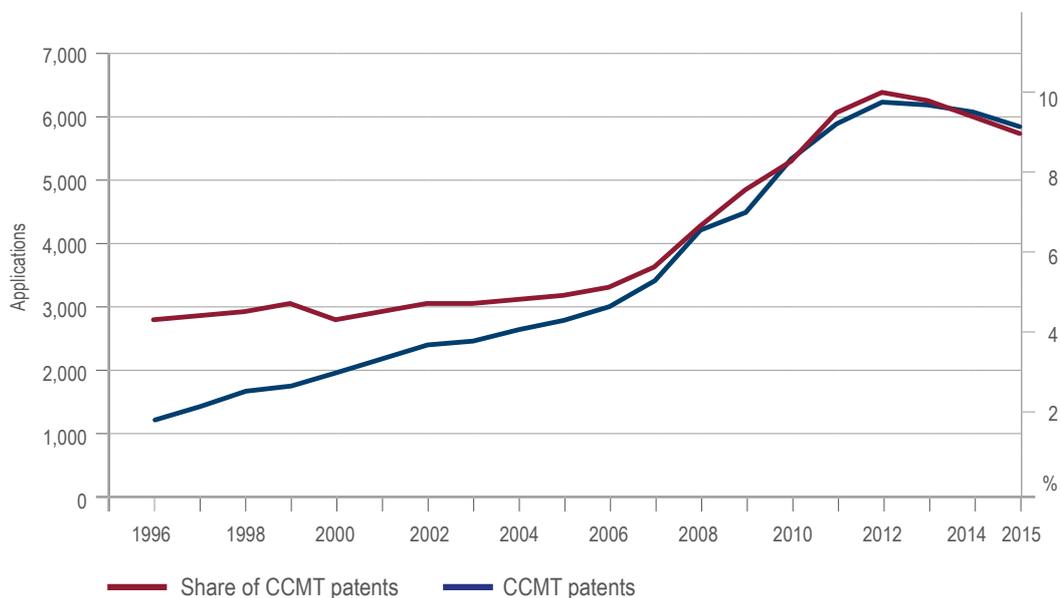
Table 40:
EPO’s Y02/Y04S tagging scheme for CCMTs

→	Y02B	CCMTs relating to buildings
→	Y02C	Greenhouse gas capture and storage
→	Y02D	Energy use reduction in ICT
→	Y02E	Energy generation, storage and distribution
→	Y02P	CCMTs in production
→	Y02T	CCMTs relating to transportation
→	Y02W	CCMTs in waste and wastewater treatment
→	Y04S	Smart grids

Figure 4, which was created using the Y02/Y04S tagging scheme, depicts the number of patent applications made at the EPO by EU applicants in the area of CCMTs. It shows that CCMT applications have grown strongly in both absolute and relative terms, particularly over the last decade. Thus, while the share of CCMT patent applications in overall patent applications made by EU applicants, which can be interpreted as a measure of the importance of CCMTs in the EU, was less than 5% in 2006, by 2015 it had increased twofold to 9%.

⁷⁰ This information is available free of charge via the EPO’s Espacenet online database. It can be used to find out about the latest technological developments in CCMTs and to generate statistics for evidence-based decision-making.

Figure 4:
Number and share of patent applications filed by EU applicants in climate change mitigation technologies at the EPO between 1996 and 2015



9.1.2 Identification of CCMT-intensive industries in the EU

Applying the methodology set out in Chapter 5, it is clear that in the EU, 375 out of 615 NACE classes in the matched database had at least one CCMT patent application filed during the period 2010-2014 and then granted by the EPO. Overall, 9.4% of the total European patents considered in our analysis were related to CCMTs. Compared with the previous study published in 2016, the number of industries which applied for a CCMT patent increased by 143 NACE classes, while the share of CCMTs increased by 3.5 percentage points. These positive developments reflect improvements in the matching methodology and support the view that CCMTs have a transversal effect and can be applied to a wide range of economic activities across many sectors.

In order to identify industries which can be considered as being intensive users of CCMTs, the following criteria are applied. First, only those industries which are IPR-intensive are selected. In the next step, the relative CCMT-patent intensity measure is calculated. This is defined as the number of granted CCMT patents per 1,000 employees in the same NACE class. To account for the importance of CCMT patents within the overall patent portfolio of the industry, the CCMT patent share is also calculated for each NACE class. The set of CCMT-intensive industries is then defined as those industries which are IPR-intensive and in which both the relative CCMT patent intensity and the CCMT patent share are above the overall, employment-weighted average for all industries with at least one CCMT patent.⁷¹ A successive application of the criteria reveals that while CCMT patents are used in many NACE classes, the majority of them are concentrated in relatively few, and CCMT patents account for a significant part of an industry's patent portfolio in a small number of sectors only.

⁷¹ The intermediate steps in the CCMT identification approach, together with a list of NACE classes meeting the identification criteria, can be found in Appendix 13.

Overall, 25 industries fulfil all the criteria, and these are shown in Table 41. Together, they represent 57% of all matched CCMT patents in EU industries. In comparison with the previous study, not only has the number of CCMT-intensive industries increased by 11, but the turnover of industries has gone up too, with only eight industries from the previous edition making it to this year's list. Given that the identification was based on patent information, all CCMT-intensive industries are also patent-intensive. However, most of them do not belong to the group of the most patent-intensive industries in the EU. With few exceptions, e.g. NACE classes 29.31 and 30.30, most CCMT-intensive industries are also trade mark-intensive and/or design-intensive.

Finally, the majority of CCMT-intensive industries are in the manufacturing sector. Exceptions include industries in the extraction of crude petroleum (61.10) and the production of electricity (35.11). Although most of the industries cannot be regarded as environmentally friendly in the conventional sense, this shows that European companies in these industries are innovating to reduce the negative impact of their economic activity on the climate.

Table 41:
CCMT-intensive industries in the EU

NACE code	NACE description	CCMT patents / 1,000 employees	CCMT patent share	Patent-intensity rank	Intensive IPR
06.10	Extraction of crude petroleum	0.96	28.3%	69	P, TM, D
20.11	Manufacture of industrial gases	3.29	23.2%	9	P, TM
20.51	Manufacture of explosives	0.57	11.4%	45	P, TM, D
20.59	Manufacture of other chemical products n.e.c.	2.15	11.1%	5	P, TM, D
23.11	Manufacture of flat glass	1.76	11.0%	8	P, TM, D
23.14	Manufacture of glass fibres	0.56	11.5%	47	P, TM
23.19	Manufacture and processing of other glass, including technical glassware	0.99	16.4%	36	P, TM, D
23.51	Manufacture of cement	0.74	56.6%	124	P, TM
24.34	Cold drawing of wire	0.91	11.9%	27	P, TM, D
24.45	Other non-ferrous metal production	1.63	14.1%	14	P, TM, D
25.21	Manufacture of central heating radiators and boilers	0.50	42.5%	132	P, TM, D
27.11	Manufacture of electric motors, generators and transformers	0.47	19.5%	81	P, TM
27.20	Manufacture of batteries and accumulators	1.29	27.7%	52	P, TM, D
28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	4.80	29.9%	7	P, D
28.21	Manufacture of ovens, furnaces and furnace burners	0.56	17.8%	71	P, TM, D
28.96	Manufacture of plastics and rubber machinery	0.44	12.0%	66	P, D
29.10	Manufacture of motor vehicles	0.87	21.7%	59	P, TM, D
29.31	Manufacture of electrical and electronic equipment for motor vehicles	0.79	19.1%	57	P
29.32	Manufacture of other parts and accessories for motor vehicles	0.70	10.9%	34	P, D
30.30	Manufacture of air and spacecraft and related machinery	2.70	26.2%	18	P
35.11	Production of electricity	1.06	70.1%	116	P, TM
35.21	Manufacture of gas	0.56	54.2%	142	P, TM
45.19	Sale of other motor vehicles	0.63	16.9%	64	P, D
72.19	Other research and experimental development on natural sciences and engineering	1.43	12.7%	15	P, TM, D, PV
74.90	Other professional, scientific and technical activities n.e.c.	0.59	18.9%	72	P, TM, D

9.1.3 Economic contribution of CCMT-intensive industries to the EU's economy

As shown in Table 42, CCMT-intensive industries accounted for 2.5% of total EU employment in the period 2014-2016. Compared with the period 2011-2013 analysed in the 2016 study and taking into account the new national accounting calculations and the new list of 25 CCMT-intensive industries, the share has marginally increased by 0.1 percentage points. In absolute terms, the number of employees in the relevant NACE classes has outperformed overall EU labour force developments for that period, registering a 5.2% increase over the previous study.

Table 42:
Economic contribution of CCMT-intensive industries to EU employment, GDP and wage premium

	2016 study (original)	2016 study (new national account calculations, new CCMT- intensive industries)	2019 study
Share EU employment (direct)	1.2%	2.4%	2.5%
Share EU GDP	2.1%	4.6%	4.7%
Average personnel costs (€ per week)	1,007	969	1,052

The contribution of CCMT-intensive industries to the EU's GDP in the period covered by the present study was 4.7% and almost twice as large as their contribution to EU employment. These industries have also increased their economic output compared with the earlier period, albeit at a marginal rate. Furthermore, their performance exceeds the overall performance of EU industries over the same period. Thus, the total output in millions of euros generated by CCMT-intensive industries alone increased during the two periods by 10.9%, whereas the increase of output generated by all EU industries was 9.2%. Finally, the CCMT-intensive industries were paying an average weekly wage of €1,052, which exceeds the average wage of all IPR-intensive industries by 31% and that of non-IPR-intensive industries by 93.3%.

In terms of trade, Table 43 shows the contribution of CCMT-intensive industries to the EU's external trade in goods and external trade in goods and services. Considering that CCMT-intensive industries are predominantly trading in goods, the share of the EU's exports attributable to these industries was 22.9%, above the share of the EU's imports, which was calculated at 21.2%. CCMT-intensive industries have generated a significant surplus for the EU in the trade of goods. This surplus exceeds the deficit created by these industries in the trade of services, thus ensuring an overall surplus for the EU in the trade in goods and services.

Table 43:
Economic contribution of CCMT-intensive industries to EU trade

		2016 study (original)	2016 study (new national account calculations, new CCMT-intensive industries)	2019 study
Trade in goods	Share EU imports	11.1%	25.8%	21.2%
	Share EU exports	17.4%	21.3%	22.9%
	EU trade balance (€ million)	102,471	-88,996	35,064
Trade in goods and services	Share EU imports	n/a	21.1%	18.1%
	Share EU exports	n/a	16.4%	17.1%
	EU trade balance (€ million)	n/a	-84,420	3,838

9.2 Fourth Industrial Revolution technologies

A new era of technological developments characterised by digital transformation is gathering momentum – one which is frequently referred to as the Fourth Industrial Revolution (4IR). Driven by the emergence of the Internet of Things, 4IR encompasses a number of other technologies, such as cloud computing and artificial intelligence (AI). The latest trends in and scope of the current “AI explosion” impacts the scale and speed of innovation in every area, making it possible to fully exploit the potential of smart objects in most sectors of the economy. These technologies are already creating massive economic value in the world today and continue to develop and transform industry after industry, from manufacturing to healthcare and agriculture, to mention but a few. In this rapidly changing technological context, trends in 4IR can be discerned through patent analytics and the impact of these technologies on businesses and economic activities can be assessed.

9.2.1 Inventive activity in the EU in 4IR technologies

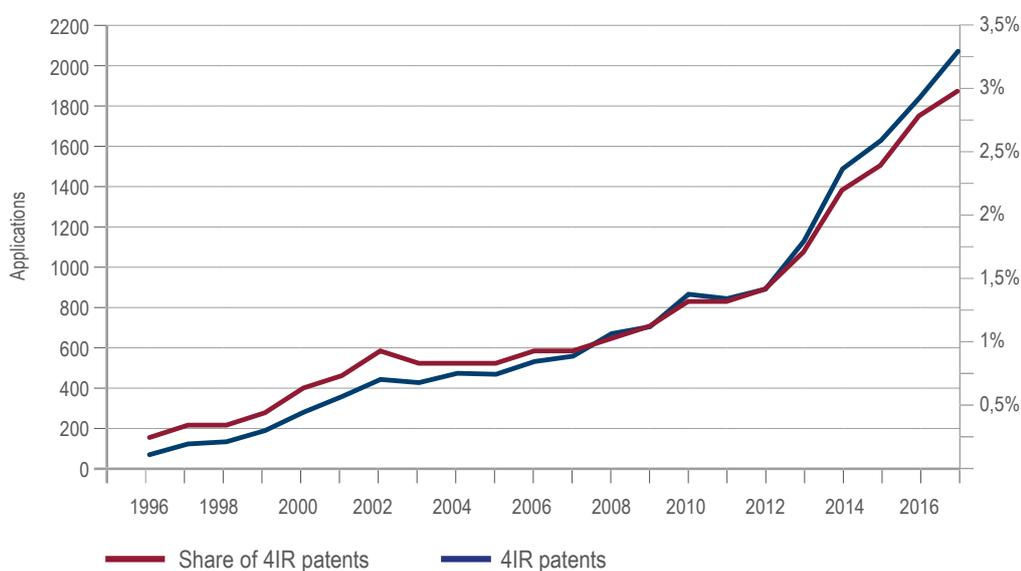
In 2017 the publication of a landscaping study conducted by the EPO in co-operation with Handelsblatt Research Institute revealed that Europe, the United States and Japan were the main innovation centres of 4IR.⁷²

To capture developments in this important technology trend, the EPO used the expertise of its patent examiners to develop a cartography that covers all related technologies and classifies them in a systematic way. The cartography is based on a rigorous selection of inventions that combine features of computing, connectivity, data exchange and smart devices. These 4IR inventions are further divided between three main sectors, namely “core technologies”, “enabling technologies” and “application domains”, each of which is subdivided into several technology fields. Using the above cartography, more than 58,000 published and unpublished patent applications relevant to 4IR and filed at the EPO before 2018 were identified.

72 European Patent Office, 2017, Patents and the Fourth Industrial Revolution: The inventions behind digital transformation, Munich, Germany.

Figure 5 uses the latest updates of the cartography and monitors the development of 4IR patent applications made at the EPO by EU applicants between 1996 and 2017. Overall, during this period 16,229 4IR applications were filed with an average annual growth rate of 20%. This emerging trend has been growing stronger in the last five years, easily outperforming the average annual growth rate of all applications filed by these countries in the same period. Figure 5 also shows that the share of 4IR applications in total applications has steadily increased from a mere 0.2% in 1996 to 3% in 2017.

Figure 5:
Number and share of patent applications filed by EU applicants in 4IR technologies at the EPO between 1996 and 2017



9.2.2 Identification of 4IR-intensive industries in the EU

Following the same methodology used throughout this study, 242 out of 615 NACE classes in the matched database had at least one 4IR patent application filed during the period 2010-2014 and subsequently granted by the EPO. Overall, 2% of the total European patents considered in our analysis were related to 4IR. In order to identify industries which can be considered as being intensive users of 4IR, the same criteria as described in section 9.1.2 and in Appendix 14 are applied.

Overall, 16 industries fulfil all the criteria, and these are shown in Table 44. Together, they represent 59% of all matched 4IR patents in EU industries. As with CCMTs, the identification of 4IR was based exclusively on patent information; consequently, all 4IR-intensive industries are also patent-intensive. However, these industries do not necessarily rank among the most patent-intensive industries in the EU. With some exceptions, e.g. NACE classes 29.31, most 4IR-intensive industries are also trade mark-intensive and/or design-intensive. Two industries, NACE classes 58.29 and 61.90, are core copyright-intensive.

Finally, the overwhelming majority of 4IR-intensive industries are in the manufacturing sector and concentrated within division 26 *Manufacture of computer, electronic and optical products*.

Table 44:
4IR-intensive industries in the EU

NACE code	NACE description	4IR patents/ 1,000 employees	4IR patent share	Patent intensity rank	Intensive IPR
21.10	Manufacture of basic pharmaceutical products	0.387	2.2%	6	P,TM,D
26.11	Manufacture of electronic components	0.297	2.1%	10	P,TM,D
26.20	Manufacture of computers and peripheral equipment	0.469	5.7%	24	P,TM,D
26.30	Manufacture of communication equipment	2.545	9.3%	2	P,TM,D
26.40	Manufacture of consumer electronics	0.395	8.8%	54	P,TM,D
26.51	Manufacture of instruments and appliances for measuring, testing and navigation	0.098	1.8%	41	P,TM,D
26.60	Manufacture of irradiation, electromedical and electrotherapeutic equipment	0.272	2.3%	13	P,TM,D
26.70	Manufacture of optical instruments and photographic equipment	0.217	1.8%	12	P,TM,D
28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	0.238	1.5%	7	P,D
29.10	Manufacture of motor vehicles	0.122	3.0%	59	P,TM,D
29.31	Manufacture of electrical and electronic equipment for motor vehicles	0.109	2.6%	57	P
32.50	Manufacture of medical and dental instruments and supplies	0.274	3.3%	25	P,TM,D
58.29	Other software publishing	0.212	12.3%	101	P,TM,C
61.90	Other telecommunications activities	0.596	9.1%	33	P,TM,D,C
72.19	Other research and experimental development on natural sciences and engineering	0.371	3.3%	15	P,TM,D
77.40	Leasing of intellectual property and similar products, except copyrighted works	2.183	2.9%	1	P,TM,D

9.2.3 Economic contribution of 4IR-intensive industries to the EU's economy

As shown in Table 45, 4IR-intensive industries accounted for 1.9% of total EU employment in the period 2014-2016. Compared with the period 2011-2013 analysed for the same set of 16 4IR-intensive industries, the share has marginally increased by 0.1 percentage points. Yet, similar to the CCMT-intensive industries, the number of employees in the relevant NACE classes has outperformed overall EU labour force developments for that period.

For the period under review, the contribution of 4IR-intensive industries to the EU's GDP was 3.9%. Compared with the earlier reference period, these industries have been able to increase their economic performance by 0.4 percentage points. This difference is magnified when comparing it against the overall performance of EU industries over the same period. Finally, the 4IR-intensive industries were paying an average weekly wage of €1,112, more than double the average wage of non-IPR-intensive industries and 39% above the wage in all IPR-intensive industries.

Table 45:
Economic contribution of 4IR-intensive industries to EU employment, GDP and wage premium

	2019 study Reference period 2011-2013	2019 study Reference period 2014-2016
Share EU employment (direct)	1.8%	1.9%
Share EU GDP	3.5%	3.9%
Average personnel costs (€ per week)	1,026	1,112

In terms of trade, Table 46 shows the contribution of 4IR-intensive industries to the EU's external trade in goods and external trade in goods and services. Whether considering goods only or goods and services together, the share of 4IR-intensive industries in total EU trade is high in relation to the number of industries they represent. Like CCMT-intensive industries, 4IR-intensive industries generated a significant trade surplus. This surplus is, however, offset by a trade deficit in services, resulting in a slightly negative contribution to the EU's balance of trade in goods and services.

Table 46:
Economic contribution of 4IR-intensive industries to EU trade

		2019 study Reference year 2013	2019 study Reference year 2016
Trade in goods	Share EU imports	15.9%	20.2%
	Share EU exports	19.6%	21.3%
	EU trade balance (€ million)	57,065	24,957
Trade in goods and services	Share EU imports	13.5%	17.3%
	Share EU exports	15.3%	16.1%
	EU trade balance (€ million)	63,893	-1,706

10 / Appendix:

List of all 353 IPR-intensive industries

Table 47:
List of all 353 IPR-intensive industries

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
01.00	Crop and animal production, hunting and related service activities						•
06.10	Extraction of crude petroleum	•	•	•			
07.10	Mining of iron ores	•					
07.29	Mining of other non-ferrous metal ores			•			
08.11	Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate	•					
08.91	Mining of chemical and fertiliser minerals	•		•			
08.92	Extraction of peat	•					
08.93	Extraction of salt	•					
08.99	Other mining and quarrying n.e.c.	•	•	•			
09.10	Support activities for petroleum and natural gas extraction	•		•			
10.20	Processing and preserving of fish, crustaceans and molluscs	•					
10.31	Processing and preserving of potatoes	•					
10.32	Manufacture of fruit and vegetable juice	•	•				
10.39	Other processing and preserving of fruit and vegetables	•					
10.41	Manufacture of oils and fats	•	•				
10.42	Manufacture of margarine and similar edible fats	•					
10.51	Operation of dairies and cheese making	•	•			•	
10.52	Manufacture of ice cream	•	•				
10.61	Manufacture of grain mill products	•					•
10.62	Manufacture of starches and starch products			•			
10.72	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes	•	•				
10.73	Manufacture of macaroni, noodles, couscous and similar farinaceous products	•	•				

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
10.81	Manufacture of sugar	•					
10.82	Manufacture of cocoa, chocolate and sugar confectionery	•	•				
10.83	Processing of tea and coffee	•	•	•			
10.84	Manufacture of condiments and seasonings	•					
10.86	Manufacture of homogenised food preparations and dietetic food	•	•	•			
10.89	Manufacture of other food products n.e.c.	•	•	•			•
10.91	Manufacture of prepared feeds for farm animals	•					
10.92	Manufacture of prepared pet foods	•	•				
11.01	Distilling, rectifying and blending of spirits	•	•			•	
11.02	Manufacture of wine from grape	•				•	
11.03	Manufacture of cider and other fruit wines	•	•				
11.04	Manufacture of other non-distilled fermented beverages	•					
11.05	Manufacture of beer	•				•	
11.06	Manufacture of malt	•					•
11.07	Manufacture of soft drinks; production of mineral waters and other bottled waters	•	•				
12.00	Manufacture of tobacco products	•	•	•			
13.10	Preparation and spinning of textile fibres	•	•				
13.20	Weaving of textiles	•	•				
13.30	Finishing of textiles		•				
13.91	Manufacture of knitted and crocheted fabrics	•					
13.92	Manufacture of made-up textile articles, except apparel	•	•				
13.93	Manufacture of carpets and rugs	•	•	•			
13.94	Manufacture of cordage, rope, twine and netting	•	•	•			
13.95	Manufacture of non-wovens and articles made from non-wovens, except apparel	•		•			
13.96	Manufacture of other technical and industrial textiles	•	•	•			
13.99	Manufacture of other textiles n.e.c.	•	•	•			
14.11	Manufacture of leather clothes	•	•				
14.12	Manufacture of workwear	•	•				
14.13	Manufacture of other outerwear	•	•				
14.14	Manufacture of underwear	•	•				
14.19	Manufacture of other wearing apparel and accessories	•	•				
14.20	Manufacture of articles of fur	•					
14.31	Manufacture of knitted and crocheted hosiery	•	•				
14.39	Manufacture of other knitted and crocheted apparel	•	•				
15.12	Manufacture of luggage, handbags and the like, saddlery and harness	•	•				

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
15.20	Manufacture of footwear	●	●				
16.21	Manufacture of veneer sheets and wood-based panels		●	●			
16.22	Manufacture of assembled parquet floors	●	●				
16.23	Manufacture of other builders' carpentry and joinery		●				
16.29	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	●	●				
17.11	Manufacture of pulp				●		
17.12	Manufacture of paper and paperboard	●	●	●	●		
17.21	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard		●				
17.22	Manufacture of household and sanitary goods and of toilet requisites	●	●	●			
17.23	Manufacture of paper stationery	●	●				
17.24	Manufacture of wallpaper	●					
17.29	Manufacture of other articles of paper and paperboard	●					
18.11	Printing of newspapers	●			●		
18.12	Other printing				●		
18.13	Pre-press and pre-media services	●			●		
18.14	Binding and related services				●		
18.20	Reproduction of recorded media	●	●		●		
19.10	Manufacture of coke oven products	●					
19.20	Manufacture of refined petroleum products	●					
20.11	Manufacture of industrial gases	●		●			
20.12	Manufacture of dyes and pigments	●		●			
20.13	Manufacture of other inorganic basic chemicals	●		●			
20.14	Manufacture of other organic basic chemicals			●			
20.15	Manufacture of fertilisers and nitrogen compounds	●					
20.16	Manufacture of plastics in primary forms	●	●	●			
20.17	Manufacture of synthetic rubber in primary forms	●		●			
20.20	Manufacture of pesticides and other agrochemical products	●	●	●			
20.30	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	●		●			
20.41	Manufacture of soap and detergents, cleaning and polishing preparations	●	●	●			
20.42	Manufacture of perfumes and toilet preparations	●	●	●			
20.51	Manufacture of explosives	●	●	●			
20.52	Manufacture of glues	●	●	●			
20.53	Manufacture of essential oils	●		●			
20.59	Manufacture of other chemical products n.e.c.	●	●	●	●		

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
20.60	Manufacture of man-made fibres	●		●			
21.10	Manufacture of basic pharmaceutical products	●	●	●			
21.20	Manufacture of pharmaceutical preparations	●		●			
22.11	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	●	●	●			
22.19	Manufacture of other rubber products	●	●	●			
22.21	Manufacture of plastic plates, sheets, tubes and profiles	●	●	●			
22.22	Manufacture of plastic packing goods	●	●	●			
22.23	Manufacture of builders' ware of plastic	●	●	●			
22.29	Manufacture of other plastic products	●	●	●			
23.11	Manufacture of flat glass	●	●	●			
23.13	Manufacture of hollow glass		●				
23.14	Manufacture of glass fibres	●		●			
23.19	Manufacture and processing of other glass, including technical glassware	●	●	●			
23.20	Manufacture of refractory products	●					
23.31	Manufacture of ceramic tiles and flags	●	●				
23.32	Manufacture of bricks, tiles and construction products, in baked clay	●	●				
23.41	Manufacture of ceramic household and ornamental articles	●	●				
23.42	Manufacture of ceramic sanitary fixtures	●	●				
23.43	Manufacture of ceramic insulators and insulating fittings		●	●			
23.44	Manufacture of other technical ceramic products	●		●			
23.49	Manufacture of other ceramic products	●	●	●			
23.51	Manufacture of cement	●		●			
23.52	Manufacture of lime and plaster			●			
23.61	Manufacture of concrete products for construction purposes		●				
23.62	Manufacture of plaster products for construction purposes	●					
23.64	Manufacture of mortars	●					
23.65	Manufacture of fibre cement	●		●			
23.69	Manufacture of other articles of concrete, plaster and cement	●	●				
23.70	Cutting, shaping and finishing of stone		●				
23.91	Production of abrasive products	●	●	●			
23.99	Manufacture of other non-metallic mineral products n.e.c.	●	●	●			
24.32	Cold rolling of narrow strip	●		●			
24.33	Cold forming or folding	●		●			
24.34	Cold drawing of wire	●	●	●			
24.41	Precious metals production	●		●			
24.42	Aluminium production			●			

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
24.43	Lead, zinc and tin production	●					
24.45	Other non-ferrous metal production	●	●	●			
24.52	Casting of steel			●			
24.53	Casting of light metals		●				
24.54	Casting of other non-ferrous metals	●					
25.11	Manufacture of metal structures and parts of structures		●	●			
25.12	Manufacture of doors and windows of metal		●				
25.21	Manufacture of central heating radiators and boilers	●	●	●			
25.30	Manufacture of steam generators, except central heating hot water boilers			●			
25.40	Manufacture of weapons and ammunition	●		●			
25.71	Manufacture of cutlery	●	●	●			
25.72	Manufacture of locks and hinges	●	●	●			
25.73	Manufacture of tools	●	●	●			
25.91	Manufacture of steel drums and similar containers		●				
25.92	Manufacture of light metal packaging		●				
25.93	Manufacture of wire products, chain and springs	●	●	●			
25.94	Manufacture of fasteners and screw machine products			●			
25.99	Manufacture of other fabricated metal products n.e.c.	●	●	●			
26.11	Manufacture of electronic components	●	●	●			
26.20	Manufacture of computers and peripheral equipment	●	●	●	●		
26.30	Manufacture of communication equipment	●	●	●	●		
26.40	Manufacture of consumer electronics	●	●	●	●		
26.51	Manufacture of instruments and appliances for measuring, testing and navigation	●	●	●			
26.52	Manufacture of watches and clocks	●	●	●			
26.60	Manufacture of irradiation, electromedical and electrotherapeutic equipment	●	●	●			
26.70	Manufacture of optical instruments and photographic equipment	●	●	●	●		
26.80	Manufacture of magnetic and optical media	●	●	●			
27.11	Manufacture of electric motors, generators and transformers	●		●			
27.12	Manufacture of electricity distribution and control apparatus		●	●			
27.20	Manufacture of batteries and accumulators	●	●	●			
27.31	Manufacture of fibre optic cables				●		
27.32	Manufacture of other electronic and electric wires and cables		●	●			
27.33	Manufacture of wiring devices		●	●			
27.40	Manufacture of electric lighting equipment	●	●	●			
27.51	Manufacture of electric domestic appliances	●	●	●			

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
27.52	Manufacture of non-electric domestic appliances	●	●				
27.90	Manufacture of other electrical equipment	●	●	●			
28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines		●	●			
28.12	Manufacture of fluid power equipment			●			
28.13	Manufacture of other pumps and compressors	●	●	●			
28.14	Manufacture of other taps and valves	●	●	●			
28.15	Manufacture of bearings, gears, gearing and driving elements			●			
28.21	Manufacture of ovens, furnaces and furnace burners	●	●	●			
28.22	Manufacture of lifting and handling equipment	●	●	●			
28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)	●	●	●	●		
28.24	Manufacture of power-driven hand tools	●	●	●			
28.25	Manufacture of non-domestic cooling and ventilation equipment	●	●	●			
28.29	Manufacture of other general-purpose machinery n.e.c.	●	●	●			
28.30	Manufacture of agricultural and forestry machinery	●	●	●			
28.41	Manufacture of metal forming machinery	●	●	●			
28.49	Manufacture of other machine tools	●	●	●			
28.91	Manufacture of machinery for metallurgy	●	●	●			
28.92	Manufacture of machinery for mining, quarrying and construction	●	●	●			
28.93	Manufacture of machinery for food, beverage and tobacco processing	●	●	●			
28.94	Manufacture of machinery for textile, apparel and leather production	●		●			
28.95	Manufacture of machinery for paper and paperboard production	●		●			
28.96	Manufacture of plastics and rubber machinery		●	●			
28.99	Manufacture of other special-purpose machinery n.e.c.	●	●	●			
29.10	Manufacture of motor vehicles	●	●	●			
29.20	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers		●	●			
29.31	Manufacture of electrical and electronic equipment for motor vehicles			●			
29.32	Manufacture of other parts and accessories for motor vehicles		●	●			
30.11	Building of ships and floating structures			●			
30.12	Building of pleasure and sporting boats	●	●				
30.20	Manufacture of railway locomotives and rolling stock			●			
30.30	Manufacture of air and spacecraft and related machinery			●			
30.40	Manufacture of military fighting vehicles		●	●			
30.91	Manufacture of motorcycles	●	●	●			
30.92	Manufacture of bicycles and invalid carriages	●	●	●			

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
30.99	Manufacture of other transport equipment n.e.c.	•	•	•			
31.01	Manufacture of office and shop furniture	•	•				
31.02	Manufacture of kitchen furniture		•				
31.03	Manufacture of mattresses	•	•				
31.09	Manufacture of other furniture		•				
32.11	Striking of coins	•		•	•		
32.12	Manufacture of jewellery and related articles	•	•	•	•		
32.13	Manufacture of imitation jewellery and related articles	•	•				
32.20	Manufacture of musical instruments	•	•		•		
32.30	Manufacture of sports goods	•	•	•			
32.40	Manufacture of games and toys	•	•	•	•		
32.50	Manufacture of medical and dental instruments and supplies	•	•	•			
32.91	Manufacture of brooms and brushes	•	•	•			
32.99	Other manufacturing n.e.c.	•	•	•			
33.14	Repair of electrical equipment			•			
33.19	Repair of other equipment	•					
33.20	Installation of industrial machinery and equipment			•			
35.11	Production of electricity	•		•			
35.12	Transmission of electricity	•					
35.14	Trade of electricity	•					
35.21	Manufacture of gas	•		•			
41.10	Development of building projects	•					
45.19	Sale of other motor vehicles		•	•			
45.31	Wholesale trade of motor vehicle parts and accessories	•	•	•			
45.40	Sale, maintenance and repair of motorcycles and related parts and accessories	•					
46.11	Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods	•	•				•
46.12	Agents involved in the sale of fuels, ores, metals and industrial chemicals	•		•			
46.13	Agents involved in the sale of timber and building materials	•	•				
46.14	Agents involved in the sale of machinery, industrial equipment, ships and aircraft	•	•	•			
46.15	Agents involved in the sale of furniture, household goods, hardware and ironmongery	•	•				
46.16	Agents involved in the sale of textiles, clothing, fur, footwear and leather goods	•	•				
46.17	Agents involved in the sale of food, beverages and tobacco	•					
46.18	Agents specialised in the sale of other particular products	•	•				
46.19	Agents involved in the sale of a variety of goods	•	•				

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
46.21	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds	•					•
46.22	Wholesale of flowers and plants	•					
46.24	Wholesale of hides, skins and leather	•	•				
46.31	Wholesale of fruit and vegetables	•					
46.32	Wholesale of meat and meat products	•					
46.33	Wholesale of dairy products, eggs and edible oils and fats	•					
46.34	Wholesale of beverages	•					
46.35	Wholesale of tobacco products	•	•				
46.36	Wholesale of sugar and chocolate and sugar confectionery	•					
46.37	Wholesale of coffee, tea, cocoa and spices	•	•				
46.38	Wholesale of other food, including fish, crustaceans and molluscs	•					
46.39	Non-specialised wholesale of food, beverages and tobacco	•					
46.41	Wholesale of textiles	•	•				
46.42	Wholesale of clothing and footwear	•	•				
46.43	Wholesale of electrical household appliances	•	•	•	•		
46.44	Wholesale of china and glassware and cleaning materials	•	•				
46.45	Wholesale of perfume and cosmetics	•	•				
46.46	Wholesale of pharmaceutical goods	•		•			
46.47	Wholesale of furniture, carpets and lighting equipment	•	•				
46.48	Wholesale of watches and jewellery	•	•				
46.49	Wholesale of other household goods	•	•				
46.51	Wholesale of computers, computer peripheral equipment and software	•			•		
46.52	Wholesale of electronic and telecommunications equipment and parts	•	•		•		
46.62	Wholesale of machine tools	•					
46.64	Wholesale of machinery for the textile industry and of sewing and knitting machines	•		•			
46.65	Wholesale of office furniture	•	•				
46.66	Wholesale of other office machinery and equipment				•		
46.69	Wholesale of other machinery and equipment	•	•	•			
46.71	Wholesale of solid, liquid and gaseous fuels and related products	•					
46.72	Wholesale of metals and metal ores		•				
46.73	Wholesale of wood, construction materials and sanitary equipment	•	•				
46.74	Wholesale of hardware, plumbing and heating equipment and supplies	•	•				
46.75	Wholesale of chemical products	•		•			

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
46.76	Wholesale of other intermediate products	●	●		●		
46.90	Non-specialised wholesale trade	●	●				
47.29	Other retail sale of food in specialised stores	●					
47.41	Retail sale of computers, peripheral units and software in specialised stores	●			●		
47.43	Retail sale of audio and video equipment in specialised stores	●			●		
47.51	Retail sale of textiles in specialised stores	●					
47.54	Retail sale of electrical household appliances in specialised stores		●	●			
47.59	Retail sale of furniture, lighting equipment and other household articles in specialised stores		●				
47.61	Retail sale of books in specialised stores				●		
47.62	Retail sale of newspapers and stationery in specialised stores				●		
47.63	Retail sale of music and video recording in specialised stores				●		
47.64	Retail sale of sporting equipment in specialised stores	●					
47.65	Retail sale of games and toys in specialised stores	●	●				
47.72	Retail sale of footwear and leather goods in specialised stores	●	●				
47.74	Retail sale of medical and orthopaedic goods in specialised stores	●					
47.75	Retail sale of cosmetic and toilet articles in specialised stores	●					
47.78	Other retail sale of new goods in specialised stores	●			●		
47.91	Retail sale via mail order houses or via Internet	●	●				
50.30	Inland passenger water transport	●					
58.11	Book publishing	●	●		●		
58.12	Publishing of directories and mailing lists	●			●		
58.13	Publishing of newspapers	●			●		
58.14	Publishing of journals and periodicals	●			●		
58.19	Other publishing activities	●	●		●		
58.21	Publishing of computer games	●			●		
58.29	Other software publishing	●		●	●		
59.11	Motion picture, video and television programme production activities	●			●		
59.12	Motion picture, video and television programme post-production activities	●			●		
59.13	Motion picture, video and television programme distribution activities	●			●		
59.14	Motion picture projection activities				●		
59.20	Sound recording and music publishing activities	●			●		
60.10	Radio broadcasting	●			●		
60.20	Television programming and broadcasting activities	●			●		
61.10	Wired telecommunications activities				●		

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
61.20	Wireless telecommunications activities	•			•		
61.30	Satellite telecommunications activities	•		•	•		
61.90	Other telecommunications activities	•	•	•	•		
62.01	Computer programming activities	•			•		
62.02	Computer consultancy activities				•		
62.03	Computer facilities management activities	•			•		
62.09	Other information technology and computer service activities	•			•		
63.11	Data processing, hosting and related activities	•			•		
63.12	Web portals	•			•		
63.91	News agency activities	•			•		
63.99	Other information service activities n.e.c.	•	•		•		
66.00	Activities auxiliary to financial services and insurance activities	•					
68.10	Buying and selling of own real estate	•	•				
68.20	Rental and operating of own or leased real estate	•					
70.21	Public relations and communication activities	•	•		•		
70.22	Business and other management consultancy activities	•					
71.12	Engineering activities and related technical consultancy			•			
72.11	Research and experimental development on biotechnology	•	•	•			•
72.19	Other research and experimental development on natural sciences and engineering	•	•	•			•
72.20	Research and experimental development on social sciences and humanities	•		•			
73.11	Advertising agencies	•	•		•		
73.12	Media representation	•			•		
73.20	Market research and public opinion polling	•					
74.10	Specialised design activities	•	•		•		
74.20	Photographic activities				•		
74.30	Translation and interpretation activities				•		
74.90	Other professional, scientific and technical activities n.e.c.	•	•	•			
77.21	Renting and leasing of recreational and sports goods	•					
77.22	Rental of video tapes and disks				•		
77.29	Rental and leasing of other personal and household goods				•		
77.33	Rental and leasing of office machinery and equipment (including computers)	•			•		
77.35	Rental and leasing of air transport equipment	•					
77.39	Rental and leasing of other machinery, equipment and tangible goods n.e.c.	•			•		
77.40	Leasing of intellectual property and similar products, except copyrighted works	•	•	•			•

NACE code	Description	Trade mark-intensive	Design-intensive	Patent-intensive	Copyright-intensive	GI-intensive	PVR-intensive
79.11	Travel agency activities	●					
79.12	Tour operator activities	●					
79.90	Other reservation service and related activities	●			●		
82.11	Combined office administrative service activities	●					
82.19	Photocopying, document preparation and other specialised office support activities				●		
82.30	Organisation of conventions and trade shows	●					
82.91	Activities of collection agencies and credit bureaus	●					
82.92	Packaging activities	●	●				
85.52	Cultural education				●		
90.01	Performing arts				●		
90.02	Support activities to performing arts				●		
90.03	Artistic creation				●		
90.04	Operation of arts facilities				●		
91.01	Library and archives activities				●		
91.02	Museums activities				●		
91.03	Operation of historical sites and buildings and similar visitors attractions				●		
92.00	Gambling and betting activities	●					
93.00	Sports activities and amusement and recreation activities excluding 9329 - Other amusement and recreation activities	●					
93.21	Activities of amusement parks and theme parks				●		
93.29	Other amusement and recreation activities				●		
94.12	Activities of professional membership organisations				●		
94.99	Activities of other membership organisations n.e.c.				●		

11 / Appendix: Methodology

11.1 Data matching methodology: detailed description

Intellectual property registers are valuable sources of data for analysing individual firms, industries or countries. However, researchers using such data face many challenges. The two main ones are:

→ Lack of harmonised names

IP registers tend to have many double or multiple entries for the same applicant, as filers do not always use their existing identification numbers but rather create a new ID with the same or slightly changed applicant data on subsequent filings. In these circumstances it is very difficult to tabulate the list of the biggest filers, as the filings of one company could be distributed over many different IDs in the registers.

Duplicates can also arise as a result of the different registration routes. At the EUIPO, for example, applicants can choose between direct applications and the international route (Madrid Protocol).

→ Lack of comprehensive information about applicants

The ownership data stored in the IP registers is very limited and usually consists of name, address and contact details. It does not include information that would allow for IP-related economic research.

In recent years, efforts have been made to harmonise names in IP registers (mostly patent registers) and to match them with company register data.⁷³ The present study has benefited from the experience and knowledge gained by researchers and organisations involved in these efforts. However, due to the extended geographical reach of the study (EU-28) and the scope of the IP rights it covers (patents, trade marks, designs and plant variety rights), the results of previous harmonisation and matching projects could not be directly applied and a new methodology of name harmonisation and data matching had to be developed and implemented.

The algorithms used in the first phase – name harmonisation – were based to a large extent on the KUL Leuven/Eurostat methodology.⁷⁴

73 Examples include the KUL Leuven/Eurostat methodology for harmonising names in the PATSTAT database, the OECD's HAN database and the UK IPO's OFLIP database.

74 Data Production Methods for Harmonised Patent Statistics: Patentee Name Harmonisation, Eurostat 2006.

The second phase consisted of matching cleaned and harmonised EUIPO, CPVO and PATSTAT data (IPR owners' datasets) with the ORBIS database. ORBIS is a source of comprehensive demographic and financial data gathered from national company registers. It is commonly used to analyse the economic performance of business entities.⁷⁵ The information available in ORBIS is sourced in each country from various information providers which deliver data collected by national or local public institutions to meet legal or administrative requirements.

The name harmonisation and matching process consisted of the following stages:

- Capitalisation and cleaning of names (double spaces, no printable characters)
- Normalisation of special characters using NFKD⁷⁶ and transliteration equivalence (Greek)
- Extraction of national legal information
- Cleaning of national non-distinctive and weak words
- Correction of post codes

These processes were applied to IPR owners in the ORBIS, EUIPO, PATSTAT and CPVO databases.

11.1.1 Data pre-processing

Before name harmonisation and data matching could be carried out, the data first had to be pre-processed, i.e. problems relating to the use of different cases in names (upper, lower or title case) had to be eliminated. Even if the content of the name string in the various datasets was the same, it would not be treated as such if two different case conventions were used. To deal with this problem, applicant names in the EUIPO and EPO datasets were converted to upper case.

By default, IP registers can record applicant names using the alphabets of their official country languages, such as Latin, Greek and Bulgarian Cyrillic. In the case of the Latin alphabet, several specific extensions are used to represent national characters, letters with tone and other diacritics. Nevertheless, applicants or their legal representatives sometimes file new applications with the name already converted into its basic Latin equivalent, without any specific national characters. In such cases, automatic algorithms cannot recognise this basic Latin form of the name as equivalent to the original one. This problem was dealt with by applying the Unicode normalisation transformation procedure. This allowed for automatic conversion of names into normalised basic Unicode forms.

Greek names had to be treated specifically in order to ensure that names that may have been transliterated differently in the different registers were represented identically. For example "αυ" (alpha-upsilon) may have been transliterated as "av", "af", "au" or "ay".

In a further pre-processing step, all characters other than a-zA-Z0-9&@\$+ were replaced with a space, and full stops were removed. Leading and trailing whitespaces were also removed, and multiple whitespaces reduced to one space.

75 A recent example is Pinto Ribeiro, S., S. Menghinello and K.D. Backer, The OECD ORBIS Database: Responding to the Need for Firm-Level Micro-Data in the OECD, OECD Statistics Working Papers, 2010/01.

76 Normalization Form Compatibility Composition, a specification of Unicode Equivalence.

11.1.2 Legal form cleaning

After the initial data pre-processing, proper name cleaning begun, in order to eliminate any non-distinctive information that could impede the correct grouping of individual IDs and the subsequent matching with the external data source. The key part of the name cleaning was the standardisation and division of the name field into base and legal form denomination(s). Due to the specific challenge of processing owner data from 28 different countries, it was essential to avoid a situation in which character strings that indicate legal forms in some countries but are a distinctive part of the names in others were erroneously deleted. That is why it was decided to deal with legal form denominations on a country-by-country basis. A dictionary was created, containing 540 regular expressions (regex) allowing for identification and removal of legal forms typical in each EU Member State. Regex is a very powerful way to capture in one line several variations of a string describing the same legal form. Thus, with 540 lines of code, it was possible to capture, remove and assign to a separate column the standardised version of almost all the legal form denominations used in every EU Member State.

Legal form cleaning was done by filtering only the regex legal form relevant for the given country and looping the names of applicants having their seat in that same country over each regex.

For some countries (BE, DE, PL), an additional step was needed. In the case of Belgium, the purpose was mainly to look for cases where the legal form was indicated in both French and Dutch. Cleaning only one legal form denomination was not effective in those cases as the same legal form could be indicated in the second official language and still be part of the name field after cleaning. For Germany and Poland, the second cleaning loop was designed to deal with composite legal forms such as GMBH CO KG or Spółka z ograniczoną odpowiedzialnością spółka komandytowo-akcyjna, which are composed of two or more legal forms that are also used in the legal context as separate stand-alone legal forms.

In some countries, legal form descriptions are separated by other words which are distinctive to the companies. In such cases, as a first step before the legal form cleaning, the legal form was standardised as the final part of the string, leaving all other words as an integral part of the normalised name.

The legal form cleaning procedure was conducted on the four datasets (EUIPO, EPO, CPVO and ORBIS) separately.

After completion of this step, there were separate tables (four tables for each country, corresponding to the four data sources) containing the normalised name field, without legal form denominations, for each company present in the original EUIPO, EPO, CPVO and ORBIS datasets. A further column was then added, containing the standardised legal form(s) derived from the information present in the original name field and deleted from the normalised name field during the cleaning process.

11.1.3 Preparing data for the matching algorithm

As with the legal form cleaning, the direct preparation for matching and the matching phases were carried out on a country-by-country basis. For each country, the tables containing the results from the previous step (legal form cleaning) were the starting point.

As a first step, each country was assigned a code specific to that country/language, and non-distinctive words were removed from the normalised names. The list of non-distinctive words was based on a calculation of the presence of words within company names, e.g. the words “the”, “of” or “UK” in the United Kingdom.

A substantial number of applicants in the EUIPO and EPO datasets are natural persons. It was decided not to filter them out of the respective datasets to allow for matching if there was a corresponding ID in ORBIS. However, there is no separate field in PATSTAT for indicating whether or not an applicant is a natural person. In addition, natural persons’ names are formatted differently in PATSTAT than in ORBIS. To deal with this problem, the person_name field from the EPO dataset was split into two parts, using a comma as a delimiter. Then the order of the two parts was reversed, making it similar to the ORBIS formatting. Next, a check was performed to match this rearranged field to the EUIPO and ORBIS datasets. If a match occurred, the name was converted into the normalised name, identical in the three databases.

In the next step, the “trading as” denominations within each of three datasets were examined. “Trading as” indications are also country/language-specific. If a name contained the “trading as” type of denomination, two additional fields were created, NormCompany_short being the part preceding the “trading as” string, and TradingAs being the part after the trading as expression. For example, the name “European Union Intellectual Property Office trading as EUIPO” would be converted into three fields: the normalised field EUROPEAN UNION INTELLECTUAL PROPERTY OFFICE TRADING AS EUIPO, the NormCompany_short field EUROPEAN UNION INTELLECTUAL PROPERTY OFFICE and the TradingAs field EUIPO.

After creating these two additional fields, a check was carried out to determine whether companies that could not be matched/grouped on the basis of the normalised name had a match with other IDs based on the NormCompany/NormCompany_short comparison.

After dealing with “trading as” expressions, all the spaces between the words were removed, forming a normalised name, thus creating one string composed of all the words left from the name after the processing in the previous stages.

The last step in the process of data preparation for the final match consisted of grouping each of the datasets from the EPO, EUIPO and ORBIS by normalised name. In doing so, the individual record ID numbers, address and legal form information were retained in the concatenated format.

11.1.4 Matching EUIPO, PATSTAT and CPVO datasets with ORBIS

The aim of the procedure was to match IPR owners' datasets with ORBIS. In the first iteration, possible matches were checked using NormCompany IPR owner's datasets and NormCompany field from ORBIS. All the matches were assigned to a separate dataset and subsequent search iterations were performed for matches using the TradingAs and NormCompany_short fields originally stemming from each of the three datasets. This was done by first taking the NormCompany_short field from the ORBIS dataset and checking for matches with the NormCompany IPR owner's datasets. In case of a match, the matched records were assigned to a matched dataset. Then, a match between TradingAs fields with the NormCompany in the IPR owner's datasets was carried out for those records that had not been matched in the preceding stages.

11.1.5 Post-match data processing (disambiguation)

After the initial matching phase described above, one-to-one matches (where one IPR owner's dataset record matched with one ORBIS record) were filtered out, and one-to-many matches (where one IPR owner's dataset record matched several ORBIS records) were selected for further processing. At this stage, additional information (other than the company name) was used. This information was either available in the original four datasets or had been created in the process of legal form cleaning.

The ORBIS dataset contains a field called DUO (domestic ultimate owner). As a first step, all the companies from the ORBIS dataset were grouped by their normalised name and a check was carried out to establish how many unique DUO numbers corresponded to each group. If there was only one DUO number associated with several ORBIS firms with the same normalised name, then the record associated with that company was taken as a potential match. Before matching those records, the completeness of the DUO company record was compared with that of the other companies in the group, in terms of turnover and employment reported. This was necessary because no information was available on whether the DUO company was consolidating accounts of its subsidiaries. Therefore, the IPR owner's dataset record was matched to one relevant ORBIS record (DUO or subsidiary) only, namely the one with the highest turnover and employment figures within the group.

In the next step, groups of ORBIS records with the same normalised name and the same Bureau van Dijk76 (BvD) ID root were identified. Sometimes ORBIS branches or subsidiaries have the same number as the parent company, with additional digits separated from the root number with a hyphen. This hyphen and all digits following the hyphen were stripped off to check whether all the ORBIS companies with the same normalised name had the same root BvD ID number. If so, the IPR owner's dataset record was linked with the company whose BvD ID number was the root number for all ORBIS companies with the same normalised name.

Subsequently, the algorithm checked whether, of the ORBIS companies with the same normalised name, there was only one company with the same legal form as at least one company in the IPR owner's dataset.

In a final attempt to find a unique match, the post codes in the IPR owner's dataset record were compared with those in the various ORBIS records matched to it. If only one ORBIS record matched the post code in the IPR owner's dataset record, it was added to the matched dataset.

Post code information is often inconsistent, poorly formatted or hidden in the address field. For this reason, an algorithm was created to look up country-by-country the correct post code information in the address or post code field. Post codes found in this way were then properly formatted. A separate module for Ireland had to be developed since formal post codes are not used systematically there.⁷⁷ Finally, to implement the algorithm, a database with more than two million post codes was created for the entire European Union.

The final stage of the disambiguation process consisted of concatenating the initial matched dataset (one-to-one matches between IPR owners' datasets and ORBIS records) with the datasets created during the various stages of the disambiguation process described above. The resulting dataset contained all the records with a one-to-one relationship between IPR owners' datasets and ORBIS tables. The matched records which still had one too many relationships following the disambiguation process were disregarded.

In total, matches were found with nearly 470,000 unique companies in ORBIS (several IPR owner matches per ORBIS company) and, after verifying the quality of the best match (using criteria such as post code, same legal forms and others), more than 350,000 were retained, following a conservative criterion, that is to say, retaining only those with the highest probability that they were the same company.

For some countries (BG, CY, GR, IE, RO) and specific IPRs, the number of companies found was not considered to be sufficient and an additional manual matching exercise was performed. As a result, 771 companies were added to the automatic matching. A random manual check on automatic matching confirmed the reliability of the results.

11.1.6 Preparing the final concordance tables

After finalising the disambiguation process and the manual check, various concordance tables were created, serving as a bridge between the data stored in the various data repositories needed for economic analysis of the IP rights. The link between IPR register and ORBIS records in the concordance tables is one-to-one.

There are three main concordance tables:

- The ORBIS-EPO concordance table: the primary key was the person_id number from the tls206_person table of PATSTAT and the BvD ID number from the ORBIS dataset. This table was used to link the patent information in PATSTAT to the demographic and financial data on the European companies in the ORBIS dataset.
- The ORBIS-EUIPO concordance table: the primary key was the owner_code from the dim_owner table of the EUIPO's data warehouse and the BvD ID number from the ORBIS dataset. This table was used to link trade mark and design information in the EUIPO register to demographic and financial data on European companies in the ORBIS dataset.
- The ORBIS-CPVO concordance table: a primary key for the CPVO (created ad hoc) and the BvD ID number from the ORBIS dataset. This table was used to link plant varieties registered at the CPVO with demographic and financial data on European companies in the ORBIS dataset.

⁷⁷ It is normal to write "Dublin 2" as "D02" or "Wicklow" as "A67", for example.

11.2 Patent-intensive industries

Table 48:
Patent-intensive industries

NACE code	NACE description	Patents/1,000 employees
77.4	Leasing of intellectual property and similar products, except copyrighted works	74.006
26.3	Manufacture of communication equipment	27.293
72.11	Research and experimental development on biotechnology	21.836
28.91	Manufacture of machinery for metallurgy	20.031
20.59	Manufacture of other chemical products n.e.c.	19.458
21.1	Manufacture of basic pharmaceutical products	17.711
28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	16.057
23.11	Manufacture of flat glass	15.985
20.11	Manufacture of industrial gases	14.185
26.11	Manufacture of electronic components	14.028
27.51	Manufacture of electric domestic appliances	12.788
26.7	Manufacture of optical instruments and photographic equipment	11.997
26.6	Manufacture of irradiation, electromedical and electrotherapeutic equipment	11.754
24.45	Other non-ferrous metal production	11.515
72.19	Other research and experimental development on natural sciences and engineering	11.236
28.95	Manufacture of machinery for paper and paperboard production	10.707
28.99	Manufacture of other special-purpose machinery n.e.c.	10.536
30.3	Manufacture of air and spacecraft and related machinery	10.280
28.94	Manufacture of machinery for textile, apparel and leather production	10.232
28.93	Manufacture of machinery for food, beverage and tobacco processing	9.013
25.72	Manufacture of locks and hinges	8.897
28.3	Manufacture of agricultural and forestry machinery	8.474
20.16	Manufacture of plastics in primary forms	8.440
26.2	Manufacture of computers and peripheral equipment	8.295
32.5	Manufacture of medical and dental instruments and supplies	8.184
20.41	Manufacture of soap and detergents, cleaning and polishing preparations	7.940
24.34	Cold drawing of wire	7.678
30.99	Manufacture of other transport equipment n.e.c.	7.584
27.9	Manufacture of other electrical equipment	7.405
30.4	Manufacture of military fighting vehicles	7.306
21.2	Manufacture of pharmaceutical preparations	7.025
20.13	Manufacture of other inorganic basic chemicals	6.571
61.9	Other telecommunications activities	6.515
29.32	Manufacture of other parts and accessories for motor vehicles	6.414
28.24	Manufacture of power-driven hand tools	6.184
23.19	Manufacture and processing of other glass, including technical glassware	6.006
10.89	Manufacture of other food products n.e.c.	5.663
28.49	Manufacture of other machine tools	5.635

NACE code	NACE description	Patents/1,000 employees
28.15	Manufacture of bearings, gears, gearing and driving elements	5.561
28.29	Manufacture of other general-purpose machinery n.e.c.	5.463
26.51	Manufacture of instruments and appliances for measuring, testing and navigation	5.432
28.92	Manufacture of machinery for mining, quarrying and construction	5.420
28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)	5.242
20.53	Manufacture of essential oils	5.200
20.51	Manufacture of explosives	4.964
32.3	Manufacture of sports goods	4.882
23.14	Manufacture of glass fibres	4.869
20.6	Manufacture of man-made fibres	4.737
27.4	Manufacture of electric lighting equipment	4.726
20.14	Manufacture of other organic basic chemicals	4.714
23.44	Manufacture of other technical ceramic products	4.705
27.2	Manufacture of batteries and accumulators	4.634
28.41	Manufacture of metal forming machinery	4.558
26.4	Manufacture of consumer electronics	4.467
9.1	Support activities for petroleum and natural gas extraction	4.424
32.99	Other manufacturing n.e.c.	4.189
29.31	Manufacture of electrical and electronic equipment for motor vehicles	4.145
28.14	Manufacture of other taps and valves	4.137
29.1	Manufacture of motor vehicles	4.010
10.86	Manufacture of homogenised food preparations and dietetic food	3.952
20.42	Manufacture of perfumes and toilet preparations	3.939
22.11	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	3.810
28.22	Manufacture of lifting and handling equipment	3.777
45.19	Sale of other motor vehicles	3.746
10.62	Manufacture of starches and starch products	3.732
28.96	Manufacture of plastics and rubber machinery	3.665
28.13	Manufacture of other pumps and compressors	3.637
20.52	Manufacture of glues	3.598
6.1	Extraction of crude petroleum	3.386
13.94	Manufacture of cordage, rope, twine and netting	3.157
28.21	Manufacture of ovens, furnaces and furnace burners	3.118
74.9	Other professional, scientific and technical activities n.e.c.	3.105
30.92	Manufacture of bicycles and invalid carriages	2.981
25.73	Manufacture of tools	2.813
25.71	Manufacture of cutlery	2.800
22.22	Manufacture of plastic packing goods	2.687
25.4	Manufacture of weapons and ammunition	2.539
32.11	Striking of coins	2.480
46.75	Wholesale of chemical products	2.448
46.43	Wholesale of electrical household appliances	2.407

NACE code	NACE description	Patents/1,000 employees
27.11	Manufacture of electric motors, generators and transformers	2.389
27.32	Manufacture of other electronic and electric wires and cables	2.338
20.12	Manufacture of dyes and pigments	2.335
45.31	Wholesale trade of motor vehicle parts and accessories	2.201
24.52	Casting of steel	2.199
23.99	Manufacture of other non-metallic mineral products n.e.c.	2.175
20.17	Manufacture of synthetic rubber in primary forms	2.153
46.46	Wholesale of pharmaceutical goods	2.138
20.2	Manufacture of pesticides and other agrochemical products	2.137
25.99	Manufacture of other fabricated metal products n.e.c.	2.046
10.83	Processing of tea and coffee	1.994
25.93	Manufacture of wire products, chain and springs	1.967
25.94	Manufacture of fasteners and screw machine products	1.934
26.8	Manufacture of magnetic and optical media	1.877
12	Manufacture of tobacco products	1.872
27.33	Manufacture of wiring devices	1.837
23.49	Manufacture of other ceramic products	1.827
28.25	Manufacture of non-domestic cooling and ventilation equipment	1.818
22.29	Manufacture of other plastic products	1.815
17.12	Manufacture of paper and paperboard	1.723
58.29	Other software publishing	1.723
71.12	Engineering activities and related technical consultancy	1.721
17.22	Manufacture of household and sanitary goods and of toilet requisites	1.717
22.19	Manufacture of other rubber products	1.703
13.95	Manufacture of non-wovens and articles made from non-wovens, except apparel	1.699
23.65	Manufacture of fibre cement	1.682
72.2	Research and experimental development on social sciences and humanities	1.631
22.21	Manufacture of plastic plates, sheets, tubes and profiles	1.624
28.12	Manufacture of fluid power equipment	1.604
46.69	Wholesale of other machinery and equipment	1.593
27.12	Manufacture of electricity distribution and control apparatus	1.578
33.2	Installation of industrial machinery and equipment	1.556
47.54	Retail sale of electrical household appliances in specialised stores	1.536
8.99	Other mining and quarrying n.e.c.	1.529
25.3	Manufacture of steam generators, except central heating hot water boilers	1.525
35.11	Production of electricity	1.506
32.91	Manufacture of brooms and brushes	1.485
13.93	Manufacture of carpets and rugs	1.467
20.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	1.424
23.91	Production of abrasive products	1.392
24.41	Precious metals production	1.373
46.64	Wholesale of machinery for the textile industry and of sewing and knitting machines	1.344

NACE code	NACE description	Patents/1,000 employees
30.91	Manufacture of motorcycles	1.318
23.51	Manufacture of cement	1.307
24.42	Aluminium production	1.303
30.11	Building of ships and floating structures	1.299
32.12	Manufacture of jewellery and related articles	1.279
13.99	Manufacture of other textiles n.e.c.	1.278
23.43	Manufacture of ceramic insulators and insulating fittings	1.252
46.12	Agents involved in the sale of fuels, ores, metals and industrial chemicals	1.252
46.14	Agents involved in the sale of machinery, industrial equipment, ships and aircraft	1.187
25.21	Manufacture of central heating radiators and boilers	1.186
61.3	Satellite telecommunications activities	1.178
32.4	Manufacture of games and toys	1.153
7.2	Mining of non-ferrous metal ores	1.149
13.96	Manufacture of other technical and industrial textiles	1.119
30.2	Manufacture of railway locomotives and rolling stock	1.095
16.21	Manufacture of veneer sheets and wood-based panels	1.091
25.11	Manufacture of metal structures and parts of structures	1.067
22.23	Manufacture of builders' ware of plastic	1.065
8.91	Mining of chemical and fertiliser minerals	1.055
35.21	Manufacture of gas	1.037
23.52	Manufacture of lime and plaster	1.024
26.52	Manufacture of watches and clocks	1.006
29.2	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	1.000
24.32	Cold rolling of narrow strip	0.997
33.14	Repair of electrical equipment	0.968
24.33	Cold forming or folding	0.949

11.3 Trade mark-intensive industries

Table 49:
Trade mark-intensive industries

NACE code	NACE description	EUTM/1,000 employees
77.4	Leasing of intellectual property and similar products, except copyrighted works	346.641
26.8	Manufacture of magnetic and optical media	72.249
10.86	Manufacture of homogenised food preparations and dietetic food	63.510
17.24	Manufacture of wallpaper	56.386
21.1	Manufacture of basic pharmaceutical products	54.250
11.01	Distilling, rectifying and blending of spirits	51.586
11.02	Manufacture of wine from grape	48.138
20.42	Manufacture of perfumes and toilet preparations	38.895
58.19	Other publishing activities	38.803
72.11	Research and experimental development on biotechnology	38.083
32.4	Manufacture of games and toys	37.331
32.3	Manufacture of sports goods	36.997
58.21	Publishing of computer games	35.906
59.2	Sound recording and music publishing activities	34.752
18.11	Printing of newspapers	33.979
11.03	Manufacture of cider and other fruit wines	31.564
59.13	Motion picture, video and television programme distribution activities	31.275
32.99	Other manufacturing n.e.c.	31.072
10.89	Manufacture of other food products n.e.c.	30.775
63.12	Web portals	30.236
20.52	Manufacture of glues	29.672
10.92	Manufacture of prepared pet foods	29.560
30.99	Manufacture of other transport equipment n.e.c.	28.652
20.41	Manufacture of soap and detergents, cleaning and polishing preparations	27.952
26.52	Manufacture of watches and clocks	26.858
20.59	Manufacture of other chemical products n.e.c.	26.722
30.92	Manufacture of bicycles and invalid carriages	26.655
20.53	Manufacture of essential oils	26.244
46.42	Wholesale of clothing and footwear	26.225
10.83	Processing of tea and coffee	25.231
11.06	Manufacture of malt	25.040
46.37	Wholesale of coffee, tea, cocoa and spices	25.027
46.41	Wholesale of textiles	24.944
14.19	Manufacture of other wearing apparel and accessories	24.886
30.91	Manufacture of motorcycles	23.501
77.35	Rental and leasing of air transport equipment	22.714
13.99	Manufacture of other textiles n.e.c.	22.579
10.73	Manufacture of macaroni, noodles, couscous and similar farinaceous products	22.416

NACE code	NACE description	EUTM/1,000 employees
58.11	Book publishing	22.366
20.2	Manufacture of pesticides and other agrochemical products	22.295
59.11	Motion picture, video and television programme production activities	22.261
46.45	Wholesale of perfume and cosmetics	22.250
58.29	Other software publishing	22.112
46.48	Wholesale of watches and jewellery	21.359
46.49	Wholesale of other household goods	21.323
31.03	Manufacture of mattresses	21.019
25.71	Manufacture of cutlery	20.852
12	Manufacture of tobacco products	20.714
27.51	Manufacture of electric domestic appliances	20.496
46.43	Wholesale of electrical household appliances	20.484
20.11	Manufacture of industrial gases	20.416
47.91	Retail sale via mail order houses or via Internet	20.401
8.91	Mining of chemical and fertiliser minerals	20.239
10.52	Manufacture of ice cream	20.236
21.2	Manufacture of pharmaceutical preparations	20.136
6.1	Extraction of crude petroleum	19.952
8.99	Other mining and quarrying n.e.c.	19.887
26.6	Manufacture of irradiation, electromedical and electrotherapeutic equipment	19.880
10.42	Manufacture of margarine and similar edible fats	19.816
10.32	Manufacture of fruit and vegetable juice	19.183
20.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	19.042
23.41	Manufacture of ceramic household and ornamental articles	18.696
26.2	Manufacture of computers and peripheral equipment	18.668
68.1	Buying and selling of own real estate	17.993
46.16	Agents involved in the sale of textiles, clothing, fur, footwear and leather goods	17.571
62.09	Other information technology and computer service activities	17.538
61.9	Other telecommunications activities	17.434
46.38	Wholesale of other food, including fish, crustaceans and molluscs	17.390
26.4	Manufacture of consumer electronics	17.253
46.34	Wholesale of beverages	17.179
32.11	Striking of coins	17.001
63.99	Other information service activities n.e.c.	16.955
28.91	Manufacture of machinery for metallurgy	16.873
11.07	Manufacture of soft drinks; production of mineral waters and other bottled waters	16.865
11.05	Manufacture of beer	16.803
46.11	Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods	16.593
72.19	Other research and experimental development on natural sciences and engineering	16.534
46.75	Wholesale of chemical products	16.511
70.21	Public relations and communication activities	16.313
82.3	Organisation of conventions and trade shows	15.849

NACE code	NACE description	EUTM/1,000 employees
74.9	Other professional, scientific and technical activities n.e.c.	15.480
61.3	Satellite telecommunications activities	15.273
27.9	Manufacture of other electrical equipment	15.261
26.7	Manufacture of optical instruments and photographic equipment	15.029
62.01	Computer programming activities	14.758
23.11	Manufacture of flat glass	14.627
46.9	Non-specialised wholesale trade	14.507
28.24	Manufacture of power-driven hand tools	14.501
23.49	Manufacture of other ceramic products	14.409
28.99	Manufacture of other special-purpose machinery n.e.c.	14.346
20.13	Manufacture of other inorganic basic chemicals	14.293
58.14	Publishing of journals and periodicals	14.219
24.45	Other non-ferrous metal production	13.968
13.94	Manufacture of cordage, rope, twine and netting	13.728
35.21	Manufacture of gas	13.654
46.46	Wholesale of pharmaceutical goods	13.579
28.14	Manufacture of other taps and valves	13.506
32.5	Manufacture of medical and dental instruments and supplies	13.237
28.93	Manufacture of machinery for food, beverage and tobacco processing	13.227
46.15	Agents involved in the sale of furniture, household goods, hardware and ironmongery	13.157
60.2	Television programming and broadcasting activities	13.095
82.91	Activities of collection agencies and credit bureaus	13.047
46.47	Wholesale of furniture, carpets and lighting equipment	13.006
10.82	Manufacture of cocoa, chocolate and sugar confectionery	13.003
46.14	Agents involved in the sale of machinery, industrial equipment, ships and aircraft	12.983
10.41	Manufacture of oils and fats	12.979
20.6	Manufacture of man-made fibres	12.969
46.18	Agents specialised in the sale of other particular products	12.951
32.12	Manufacture of jewellery and related articles	12.950
46.17	Agents involved in the sale of food, beverages and tobacco	12.937
23.69	Manufacture of other articles of concrete, plaster and cement	12.913
59.12	Motion picture, video and television programme post-production activities	12.907
26.11	Manufacture of electronic components	12.715
13.95	Manufacture of non-wovens and articles made from non-wovens, except apparel	12.545
10.84	Manufacture of condiments and seasonings	12.523
25.72	Manufacture of locks and hinges	12.429
10.91	Manufacture of prepared feeds for farm animals	12.406
28.21	Manufacture of ovens, furnaces and furnace burners	12.225
46.76	Wholesale of other intermediate products	12.209
20.15	Manufacture of fertilisers and nitrogen compounds	12.200
27.4	Manufacture of electric lighting equipment	12.192
79.9	Other reservation service and related activities	11.958

NACE code	NACE description	EUTM/1,000 employees
46.44	Wholesale of china and glassware and cleaning materials	11.877
32.2	Manufacture of musical instruments	11.802
13.1	Preparation and spinning of textile fibres	11.542
72.2	Research and experimental development on social sciences and humanities	11.539
46.33	Wholesale of dairy products, eggs and edible oils and fats	11.348
10.61	Manufacture of grain mill products	11.334
23.44	Manufacture of other technical ceramic products	11.330
16.22	Manufacture of assembled parquet floors	11.314
23.14	Manufacture of glass fibres	11.294
58.12	Publishing of directories and mailing lists	11.064
25.21	Manufacture of central heating radiators and boilers	11.062
15.12	Manufacture of luggage, handbags and the like, saddlery and harness	10.906
23.65	Manufacture of fibre cement	10.715
74.1	Specialised design activities	10.713
9.1	Support activities for petroleum and natural gas extraction	10.633
14.11	Manufacture of leather clothes	10.567
26.3	Manufacture of communication equipment	10.459
13.93	Manufacture of carpets and rugs	10.441
23.99	Manufacture of other non-metallic mineral products n.e.c.	9.946
28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)	9.923
46.22	Wholesale of flowers and plants	9.877
24.41	Precious metals production	9.733
46.12	Agents involved in the sale of fuels, ores, metals and industrial chemicals	9.670
70.22	Business and other management consultancy activities	9.604
18.2	Reproduction of recorded media	9.474
79.11	Travel agency activities	9.419
20.16	Manufacture of plastics in primary forms	9.384
46.21	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds	9.339
46.13	Agents involved in the sale of timber and building materials	9.328
13.2	Weaving of textiles	9.314
46.35	Wholesale of tobacco products	9.170
45.4	Sale, maintenance and repair of motorcycles and related parts and accessories	9.168
46.39	Non-specialised wholesale of food, beverages and tobacco	9.149
14.12	Manufacture of workwear	9.112
92	Gambling and betting activities	9.105
28.29	Manufacture of other general-purpose machinery n.e.c.	9.003
46.19	Agents involved in the sale of a variety of goods	8.965
46.74	Wholesale of hardware, plumbing and heating equipment and supplies	8.964
8.92	Extraction of peat	8.896
32.13	Manufacture of imitation jewellery and related articles	8.818
20.51	Manufacture of explosives	8.741
17.23	Manufacture of paper stationery	8.720

NACE code	NACE description	EUTM/1,000 employees
82.92	Packaging activities	8.704
73.11	Advertising agencies	8.684
7.1	Mining of iron ores	8.656
46.69	Wholesale of other machinery and equipment	8.633
32.91	Manufacture of brooms and brushes	8.617
28.3	Manufacture of agricultural and forestry machinery	8.592
26.51	Manufacture of instruments and appliances for measuring, testing and navigation	8.576
25.99	Manufacture of other fabricated metal products n.e.c.	8.539
14.31	Manufacture of knitted and crocheted hosiery	8.539
46.64	Wholesale of machinery for the textile industry and of sewing and knitting machines	8.515
23.19	Manufacture and processing of other glass, including technical glassware	8.425
10.72	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes	8.391
46.52	Wholesale of electronic and telecommunications equipment and parts	8.378
19.2	Manufacture of refined petroleum products	8.366
17.12	Manufacture of paper and paperboard	8.348
63.11	Data processing, hosting and related activities	8.346
15.2	Manufacture of footwear	8.332
62.03	Computer facilities management activities	8.185
47.51	Retail sale of textiles in specialised stores	8.111
79.12	Tour operator activities	8.025
60.1	Radio broadcasting	7.999
47.43	Retail sale of audio and video equipment in specialised stores	7.875
13.92	Manufacture of made-up textile articles, except apparel	7.867
73.2	Market research and public opinion polling	7.814
8.93	Extraction of salt	7.722
10.81	Manufacture of sugar	7.720
61.2	Wireless telecommunications activities	7.697
46.36	Wholesale of sugar and chocolate and sugar confectionery	7.677
50.3	Inland passenger water transport	7.650
28.25	Manufacture of non-domestic cooling and ventilation equipment	7.628
23.91	Production of abrasive products	7.616
14.39	Manufacture of other knitted and crocheted apparel	7.592
22.29	Manufacture of other plastic products	7.529
20.17	Manufacture of synthetic rubber in primary forms	7.505
22.11	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	7.484
27.2	Manufacture of batteries and accumulators	7.470
10.39	Other processing and preserving of fruit and vegetables	7.469
28.13	Manufacture of other pumps and compressors	7.456
22.21	Manufacture of plastic plates, sheets, tubes and profiles	7.451
46.65	Wholesale of office furniture	7.441
30.12	Building of pleasure and sporting boats	7.362
45.31	Wholesale trade of motor vehicle parts and accessories	7.352

NACE code	NACE description	EUTM/1,000 employees
24.43	Lead, zinc and tin production	7.340
24.32	Cold rolling of narrow strip	7.315
13.96	Manufacture of other technical and industrial textiles	7.272
47.65	Retail sale of games and toys in specialised stores	7.255
27.52	Manufacture of non-electric domestic appliances	7.216
35.11	Production of electricity	7.216
17.29	Manufacture of other articles of paper and paperboard	7.152
35.12	Transmission of electricity	7.134
22.22	Manufacture of plastic packing goods	7.061
10.51	Operation of dairies and cheese making	7.028
20.12	Manufacture of dyes and pigments	6.958
28.95	Manufacture of machinery for paper and paperboard production	6.896
46.31	Wholesale of fruit and vegetables	6.808
28.49	Manufacture of other machine tools	6.806
47.75	Retail sale of cosmetic and toilet articles in specialised stores	6.796
23.31	Manufacture of ceramic tiles and flags	6.772
24.33	Cold forming or folding	6.730
24.34	Cold drawing of wire	6.630
14.14	Manufacture of underwear	6.609
47.29	Other retail sale of food in specialised stores	6.605
41.1	Development of building projects	6.522
47.41	Retail sale of computers, peripheral units and software in specialised stores	6.462
13.91	Manufacture of knitted and crocheted fabrics	6.399
22.23	Manufacture of builders' ware of plastic	6.314
46.71	Wholesale of solid, liquid and gaseous fuels and related products	6.297
25.93	Manufacture of wire products, chain and springs	6.294
77.21	Rental and leasing of recreational and sports goods	6.254
47.74	Retail sale of medical and orthopaedic goods in specialised stores	6.236
25.4	Manufacture of weapons and ammunition	6.229
8.11	Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate	6.195
77.39	Rental and leasing of other machinery, equipment and tangible goods n.e.c.	6.111
28.41	Manufacture of metal forming machinery	6.111
31.01	Manufacture of office and shop furniture	6.064
58.13	Publishing of newspapers	6.033
25.73	Manufacture of tools	6.004
11.04	Manufacture of other non-distilled fermented beverages	5.865
23.62	Manufacture of plaster products for construction purposes	5.850
14.13	Manufacture of other outerwear	5.834
47.72	Retail sale of footwear and leather goods in specialised stores	5.763
46.73	Wholesale of wood, construction materials and sanitary equipment	5.737
14.2	Manufacture of articles of fur	5.730
24.54	Casting of other non-ferrous metals	5.713

NACE code	NACE description	EUTM/1,000 employees
63.91	News agency activities	5.684
23.2	Manufacture of refractory products	5.679
23.64	Manufacture of mortars	5.670
29.1	Manufacture of motor vehicles	5.657
73.12	Media representation	5.615
93	Sports activities and amusement and recreation activities	5.609
35.14	Trade of electricity	5.600
46.51	Wholesale of computers, computer peripheral equipment and software	5.583
17.22	Manufacture of household and sanitary goods and of toilet requisites	5.561
46.62	Wholesale of machine tools	5.488
47.64	Retail sale of sporting equipment in specialised stores	5.453
23.42	Manufacture of ceramic sanitary fixtures	5.424
28.92	Manufacture of machinery for mining, quarrying and construction	5.414
46.32	Wholesale of meat and meat products	5.342
10.31	Processing and preserving of potatoes	5.308
19.1	Manufacture of coke oven products	5.305
82.11	Combined office administrative service activities	5.287
22.19	Manufacture of other rubber products	5.283
23.51	Manufacture of cement	5.248
16.29	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	5.240
18.13	Pre-press and pre-media services	5.194
10.2	Processing and preserving of fish, crustaceans and molluscs	5.141
66	Activities auxiliary to financial services and insurance activities	5.043
28.22	Manufacture of lifting and handling equipment	5.037
23.32	Manufacture of bricks, tiles and construction products, in baked clay	4.966
47.78	Other retail sale of new goods in specialised stores	4.927
33.19	Repair of other equipment	4.910
28.94	Manufacture of machinery for textile, apparel and leather production	4.880
27.11	Manufacture of electric motors, generators and transformers	4.877
77.33	Rental and leasing of office machinery and equipment (including computers)	4.862
46.24	Wholesale of hides, skins and leather	4.858
68.2	Rental and operating of own or leased real estate	4.784

11.4 Design-intensive industries

Table 50:
Design-intensive industries

NACE code	NACE description	Designs/1,000 employees
77.4	Leasing of intellectual property and similar products, except copyrighted works	104.218
27.4	Manufacture of electric lighting equipment	42.078
46.47	Wholesale of furniture, carpets and lighting equipment	41.571
25.71	Manufacture of cutlery	41.002
23.42	Manufacture of ceramic sanitary fixtures	30.511
32.4	Manufacture of games and toys	30.027
23.41	Manufacture of ceramic household and ornamental articles	29.121
26.52	Manufacture of watches and clocks	28.112
28.14	Manufacture of other taps and valves	26.947
27.51	Manufacture of electric domestic appliances	26.785
32.91	Manufacture of brooms and brushes	24.635
25.72	Manufacture of locks and hinges	22.955
46.48	Wholesale of watches and jewellery	22.560
46.15	Agents involved in the sale of furniture, household goods, hardware and ironmongery	19.762
32.3	Manufacture of sports goods	19.614
32.12	Manufacture of jewellery and related articles	18.823
46.42	Wholesale of clothing and footwear	17.773
14.19	Manufacture of other wearing apparel and accessories	16.855
32.99	Other manufacturing n.e.c.	16.817
23.19	Manufacture and processing of other glass, including technical glassware	16.225
46.49	Wholesale of other household goods	16.193
31.09	Manufacture of other furniture	16.174
30.99	Manufacture of other transport equipment n.e.c.	15.944
30.92	Manufacture of bicycles and invalid carriages	15.375
15.2	Manufacture of footwear	14.443
13.94	Manufacture of cordage, rope, twine and netting	13.680
46.44	Wholesale of china and glassware and cleaning materials	13.301
31.01	Manufacture of office and shop furniture	12.366
25.99	Manufacture of other fabricated metal products n.e.c.	12.163
30.91	Manufacture of motorcycles	11.948
46.43	Wholesale of electrical household appliances	11.882
20.41	Manufacture of soap and detergents, cleaning and polishing preparations	11.408
28.24	Manufacture of power-driven hand tools	11.397
14.14	Manufacture of underwear	11.333
15.12	Manufacture of luggage, handbags and the like, saddlery and harness	11.319
14.39	Manufacture of other knitted and crocheted apparel	11.087
32.2	Manufacture of musical instruments	11.047

NACE code	NACE description	Designs/1,000 employees
23.31	Manufacture of ceramic tiles and flags	10.826
14.12	Manufacture of workwear	10.784
26.8	Manufacture of magnetic and optical media	10.444
74.1	Specialised design activities	10.408
26.4	Manufacture of consumer electronics	9.955
26.7	Manufacture of optical instruments and photographic equipment	9.469
22.29	Manufacture of other plastic products	9.423
10.32	Manufacture of fruit and vegetable juice	9.340
25.21	Manufacture of central heating radiators and boilers	9.024
27.9	Manufacture of other electrical equipment	8.868
23.69	Manufacture of other articles of concrete, plaster and cement	8.559
12	Manufacture of tobacco products	8.506
46.65	Wholesale of office furniture	8.380
22.22	Manufacture of plastic packing goods	8.325
26.6	Manufacture of irradiation, electromedical and electrotherapeutic equipment	8.250
23.11	Manufacture of flat glass	7.983
22.19	Manufacture of other rubber products	7.966
32.5	Manufacture of medical and dental instruments and supplies	7.939
28.93	Manufacture of machinery for food, beverage and tobacco processing	7.738
13.93	Manufacture of carpets and rugs	7.464
11.07	Manufacture of soft drinks; production of mineral waters and other bottled waters	7.414
82.92	Packaging activities	7.280
14.13	Manufacture of other outerwear	7.210
46.41	Wholesale of textiles	7.193
13.2	Weaving of textiles	7.188
26.11	Manufacture of electronic components	6.882
14.11	Manufacture of leather clothes	6.813
28.92	Manufacture of machinery for mining, quarrying and construction	6.661
10.89	Manufacture of other food products n.e.c.	6.435
23.49	Manufacture of other ceramic products	6.343
27.52	Manufacture of non-electric domestic appliances	6.209
13.92	Manufacture of made-up textile articles, except apparel	6.204
23.13	Manufacture of hollow glass	6.075
21.1	Manufacture of basic pharmaceutical products	5.941
10.82	Manufacture of cocoa, chocolate and sugar confectionery	5.918
26.2	Manufacture of computers and peripheral equipment	5.908
27.33	Manufacture of wiring devices	5.876
46.11	Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods	5.677
31.03	Manufacture of mattresses	5.664
13.99	Manufacture of other textiles n.e.c.	5.550
16.29	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	5.494

NACE code	NACE description	Designs/1,000 employees
46.9	Non-specialised wholesale trade	5.485
20.42	Manufacture of perfumes and toilet preparations	5.483
28.3	Manufacture of agricultural and forestry machinery	5.436
23.7	Cutting, shaping and finishing of stone	5.425
10.83	Processing of tea and coffee	5.404
31.02	Manufacture of kitchen furniture	5.278
25.91	Manufacture of steel drums and similar containers	5.272
26.3	Manufacture of communication equipment	5.251
23.43	Manufacture of ceramic insulators and insulating fittings	5.052
25.73	Manufacture of tools	4.907
10.92	Manufacture of prepared pet foods	4.549
47.54	Retail sale of electrical household appliances in specialised stores	4.315
28.13	Manufacture of other pumps and compressors	4.168
17.22	Manufacture of household and sanitary goods and of toilet requisites	4.136
28.21	Manufacture of ovens, furnaces and furnace burners	4.105
17.23	Manufacture of paper stationery	4.094
22.23	Manufacture of builders' ware of plastic	4.059
11.01	Distilling, rectifying and blending of spirits	3.946
29.1	Manufacture of motor vehicles	3.871
29.32	Manufacture of other parts and accessories for motor vehicles	3.865
20.51	Manufacture of explosives	3.837
74.9	Other professional, scientific and technical activities n.e.c.	3.812
20.59	Manufacture of other chemical products n.e.c.	3.745
25.93	Manufacture of wire products, chain and springs	3.665
28.99	Manufacture of other special-purpose machinery n.e.c.	3.590
27.12	Manufacture of electricity distribution and control apparatus	3.559
32.13	Manufacture of imitation jewellery and related articles	3.434
46.74	Wholesale of hardware, plumbing and heating equipment and supplies	3.417
46.76	Wholesale of other intermediate products	3.386
16.21	Manufacture of veneer sheets and wood-based panels	3.378
46.72	Wholesale of metals and metal ores	3.353
72.19	Other research and experimental development on natural sciences and engineering	3.311
47.59	Retail sale of furniture, lighting equipment and other household articles in specialised stores	3.182
22.11	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	3.165
46.37	Wholesale of coffee, tea, cocoa and spices	3.160
20.2	Manufacture of pesticides and other agrochemical products	3.101
63.99	Other information service activities n.e.c.	3.091
46.45	Wholesale of perfume and cosmetics	3.085
13.1	Preparation and spinning of textile fibres	3.066
23.99	Manufacture of other non-metallic mineral products n.e.c.	3.012
13.96	Manufacture of other technical and industrial textiles	2.989
16.23	Manufacture of other builders' carpentry and joinery	2.976

NACE code	NACE description	Designs/1,000 employees
46.19	Agents involved in the sale of a variety of goods	2.944
28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)	2.942
26.51	Manufacture of instruments and appliances for measuring, testing and navigation	2.935
28.91	Manufacture of machinery for metallurgy	2.896
70.21	Public relations and communication activities	2.876
10.72	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes	2.836
68.1	Buying and selling of own real estate	2.808
24.45	Other non-ferrous metal production	2.801
46.18	Agents specialised in the sale of other particular products	2.706
25.12	Manufacture of doors and windows of metal	2.684
10.41	Manufacture of oils and fats	2.683
46.24	Wholesale of hides, skins and leather	2.593
46.35	Wholesale of tobacco products	2.551
14.31	Manufacture of knitted and crocheted hosiery	2.505
10.73	Manufacture of macaroni, noodles, couscous and similar farinaceous products	2.497
13.3	Finishing of textiles	2.476
47.91	Retail sale via mail order houses or via Internet	2.453
29.2	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	2.391
30.12	Building of pleasure and sporting boats	2.389
25.92	Manufacture of light metal packaging	2.377
46.73	Wholesale of wood, construction materials and sanitary equipment	2.375
28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	2.373
22.21	Manufacture of plastic plates, sheets, tubes and profiles	2.366
16.22	Manufacture of assembled parquet floors	2.311
28.41	Manufacture of metal forming machinery	2.309
28.29	Manufacture of other general-purpose machinery n.e.c.	2.285
10.86	Manufacture of homogenised food preparations and dietetic food	2.266
23.91	Production of abrasive products	2.246
47.65	Retail sale of games and toys in specialised stores	2.229
46.14	Agents involved in the sale of machinery, industrial equipment, ships and aircraft	2.224
11.03	Manufacture of cider and other fruit wines	2.211
23.61	Manufacture of concrete products for construction purposes	2.200
46.13	Agents involved in the sale of timber and building materials	2.198
46.16	Agents involved in the sale of textiles, clothing, fur, footwear and leather goods	2.192
24.34	Cold drawing of wire	2.173
28.25	Manufacture of non-domestic cooling and ventilation equipment	2.170
46.52	Wholesale of electronic and telecommunications equipment and parts	2.158
10.51	Operation of dairies and cheese making	2.121
46.69	Wholesale of other machinery and equipment	2.077
28.22	Manufacture of lifting and handling equipment	2.052
27.2	Manufacture of batteries and accumulators	2.045

NACE code	NACE description	Designs/1,000 employees
18.2	Reproduction of recorded media	2.017
20.52	Manufacture of glues	2.008
6.1	Extraction of crude petroleum	1.983
58.19	Other publishing activities	1.978
61.9	Other telecommunications activities	1.969
17.12	Manufacture of paper and paperboard	1.927
24.53	Casting of light metals	1.926
28.96	Manufacture of plastics and rubber machinery	1.889
58.11	Book publishing	1.856
20.16	Manufacture of plastics in primary forms	1.855
17.21	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	1.847
72.11	Research and experimental development on biotechnology	1.823
23.32	Manufacture of bricks, tiles and construction products, in baked clay	1.780
8.99	Other mining and quarrying n.e.c.	1.773
73.11	Advertising agencies	1.759
27.32	Manufacture of other electronic and electric wires and cables	1.738
30.4	Manufacture of military fighting vehicles	1.737
10.52	Manufacture of ice cream	1.701
25.11	Manufacture of metal structures and parts of structures	1.691
28.49	Manufacture of other machine tools	1.673
45.19	Sale of other motor vehicles	1.672
47.72	Retail sale of footwear and leather goods in specialised stores	1.659
45.31	Wholesale trade of motor vehicle parts and accessories	1.659

11.5 PVR-intensive industries

Table 51:
PVR-intensive industries

NACE	NACE description	PVR/1,000 employees
00.00	Horticulture	n/a
77.40	Leasing of intellectual property and similar products, except copyrighted works	19.598
46.22	Wholesale of flowers and plants	7.043
72.11	Research and experimental development on biotechnology	6.626
46.21	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds	4.152
46.11	Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods	1.319
72.19	Other research and experimental development on natural sciences and engineering	1.198
10.61	Manufacture of grain mill products	0.442
11.06	Manufacture of malt	0.423
10.89	Manufacture of other food products n.e.c.	0.280

12 / Appendix: Copyright-intensive industries according to the WIPO methodology

As explained in Chapter 6, the copyright-intensive industries presented there were selected on the basis of the WIPO methodology. This appendix sets out the standard WIPO methodology as outlined in WIPO (2003) in more detail.

WIPO divides copyright-intensive industries into four main categories:

- Core
- Inter-dependent
- Partial
- Non-dedicated support

12.1 Core copyright industries

Core copyright-intensive industries as defined by WIPO are industries that are wholly engaged in the creation, production, manufacture, performance, broadcast, communication, exhibition, distribution or sale of works and other protected subject-matter.

According to WIPO, core copyright industries “as a category would not exist or would be significantly different without copyright in works or other subject-matter.” Therefore, all of the value added and employment generated in these industries should be considered to be copyright’s contribution to the economy.

Thus, all in all, the 49 industries listed below are defined as core copyright-intensive by WIPO.

Table 52:
List of core copyright-intensive industries according to WIPO

NACE code	NACE description
58.11	Book publishing
58.13	Publishing of newspapers
58.14	Publishing of journals and periodicals
58.19	Other publishing activities
58.21	Publishing of computer games
58.29	Other software publishing
59.11	Motion picture, video and television programme production activities
59.12	Motion picture, video and television programme post-production activities
59.13	Motion picture, video and television programme distribution activities
59.14	Motion picture projection activities
59.20	Sound recording and music publishing activities
60.10	Radio broadcasting
60.20	Television programming and broadcasting activities
61.20	Wireless telecommunications activities
62.01	Computer programming activities
62.02	Computer consultancy activities
62.03	Computer facilities management activities
62.09	Other information technology and computer service activities
63.12	Web portals
63.91	News agency activities
63.99	Other information service activities n.e.c.
73.11	Advertising agencies
73.12	Media representation
74.10	Specialised design activities
74.20	Photographic activities
74.30	Translation and interpretation activities
90.01	Performing arts
90.02	Support activities to performing arts
90.03	Artistic creation
91.01	Library and archives activities
93.29	Other amusement and recreation activities
18.11	Printing of newspapers
18.12	Other printing
18.13	Pre-press and pre-media services
18.14	Binding and related services
18.20	Reproduction of recorded media
47.61	Retail sale of books in specialised stores
47.62	Retail sale of newspapers and stationery in specialised stores
47.63	Retail sale of music and video recordings in specialised stores
61.10	Wired telecommunications activities

NACE code	NACE description
61.30	Satellite telecommunications activities
61.90	Other telecommunications activities
63.11	Data processing, hosting and related activities
79.90	Other reservation service and related activities
82.19	Photocopying, document preparation and other specialised office support activities
85.52	Cultural education
90.04	Operation of arts facilities
93.21	Activities of amusement parks and theme parks
94.12	Activities of professional membership organisations

12.2 Non-core copyright industries

In addition to the core copyright industries, WIPO also defines three groups of industries whose activity is related to copyright industries to some degree: inter-dependent, partial and non-dedicated support industries. Because these industries are only partly engaged in copyright-related activities, only part of their employment and value added should be considered copyright-intensive. The definitions of the three groups are as follows:

Inter-dependent copyright industries are industries that are engaged in the production, manufacture and sale of equipment whose function is wholly or primarily to facilitate the creation, production or use of works and other protected subject-matter.

Partial copyright industries are industries in which some activities are related to works and other protected subject-matter and may involve creation, production and manufacturing, performance, broadcast, communication and exhibition or distribution and sale.

Non-dedicated support industries are industries in which some activities are related to facilitating the broadcast, communication, distribution or sale of works and other protected subject-matter, and whose activities have not been included in the core copyright industries.

In order to capture the fact that only a portion of each non-core industry's activities can be related to copyright, each industry is assigned a factor. This factor is used to scale that industry's employment and value added when tabulating the total contribution of the non-core copyright industries to the economy. The copyright factors assigned to each industry in inter-dependent, partial and non-dedicated support industries have been adopted from a Dutch study entitled "The Economic Contribution of Copyright-Based Industries in the Netherlands"⁷⁸ and a Finnish study entitled "Economic Contribution of Copyright-Based Industries in Finland 2005-2008",⁷⁹ both published in 2011. These studies are considered authoritative by many authors and are available from WIPO.

Table 53 shows the inter-dependent industries and the factors assigned to each industry.

78 http://www.wipo.int/export/sites/www/copyright/en/performance/pdf/econ_contribution_cr_nl.pdf.

79 http://www.wipo.int/export/sites/www/copyright/en/performance/pdf/econ_contribution_cr_fi.pdf.

Table 53:
Interdependent copyright-intensive industries

NACE code	NACE description	Factor
17.11	Manufacture of pulp	25.0%
17.12	Manufacture of paper and paperboard	25.0%
20.59	Manufacture of other chemical products n.e.c.	25.0%
28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)	30.0%
26.20	Manufacture of computers and peripheral equipment	30.0%
26.30	Manufacture of communication equipment	30.0%
26.40	Manufacture of consumer electronics	30.0%
26.70	Manufacture of optical instruments and photographic equipment	30.0%
27.31	Manufacture of fibre optic cables	30.0%
32.20	Manufacture of musical instruments	35.0%
46.43	Wholesale of electrical household appliances	19.0%
46.76	Wholesale of other intermediate products	25.0%
46.51	Wholesale of computers, computer peripheral equipment and software	30.0%
46.52	Wholesale of electronic and telecommunications equipment and parts	25.0%
46.66	Wholesale of other office machinery and equipment	30.0%
47.43	Retail sale of audio and video equipment in specialised stores	33.3%
47.41	Retail sale of computers, peripheral units and software in specialised stores	33.3%
47.78	Other retail sale of new goods in specialised stores	33.3%
77.33	Rental and leasing of office machinery and equipment (including computers)	35.0%
77.39	Rental and leasing of other machinery, equipment and tangible goods n.e.c.	20.0%
77.22	Rental of video tapes and disks	20.0%
77.29	Rental and leasing of other personal and household goods	20.0%

Based on the average of these 22 industries' factors, it can be concluded that 28% of their employment and value added can be considered copyright-related.

Table 54 shows the 42 industries classified by WIPO as partially copyright-intensive industries and their factors.

Table 54:
Partial copyright-intensive industries

NACE code	NACE description	Factor
13.91	Manufacture of knitted and crocheted fabrics	0.55%
14.31	Manufacture of knitted and crocheted hosiery	0.55%
14.39	Manufacture of other knitted and crocheted apparel	0.55%
16.29	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	0.55%
23.11	Manufacture of flat glass	0.55%
23.13	Manufacture of hollow glass	0.55%
23.19	Manufacture and processing of other glass, including technical glassware	0.55%
25.71	Manufacture of cutlery	0.55%
25.99	Manufacture of other fabricated metal products n.e.c.	0.55%
47.53	Retail sale of carpets, rugs, wall and floor coverings in specialised stores	0.55%
47.59	Retail sale of furniture, lighting equipment and other household articles in specialised stores	0.55%
13.93	Manufacture of carpets and rugs	1.90%
17.23	Manufacture of paper stationery	1.90%
17.24	Manufacture of wallpaper	1.90%
13.92	Manufacture of made-up textile articles, except apparel	2.70%
14.11	Manufacture of leather clothes	2.70%
14.12	Manufacture of workwear	2.70%
14.13	Manufacture of other outerwear	2.70%
14.14	Manufacture of underwear	2.70%
14.19	Manufacture of other wearing apparel and accessories	2.70%
15.20	Manufacture of footwear	2.70%
46.41	Wholesale of textiles	2.70%
46.42	Wholesale of clothing and footwear	2.70%
47.51	Retail sale of textiles in specialised stores	2.70%
47.71	Retail sale of clothing in specialised stores	2.70%
47.72	Retail sale of footwear and leather goods in specialised stores	2.70%
46.44	Wholesale of china and glassware and cleaning materials	5.00%
46.47	Wholesale of furniture, carpets and lighting equipment	5.00%
46.48	Wholesale of watches and jewellery	5.00%
46.49	Wholesale of other household goods	5.00%
31.01	Manufacture of office and shop furniture	6.70%
31.02	Manufacture of kitchen furniture	6.70%
31.03	Manufacture of mattresses	6.70%
31.09	Manufacture of other furniture	6.70%
71.11	Architectural activities	9.00%
71.12	Engineering activities and related technical consultancy	9.00%
32.11	Striking of coins 33.50%	33.50%
32.12	Manufacture of jewellery and related articles	33.50%
94.99	Activities of other membership organisations n.e.c.	41.00%

NACE code	NACE description	Factor
32.40	Manufacture of games and toys	46.00%
91.02	Museums activities	50.00%
91.03	Operation of historical sites and buildings and similar visitor attractions	50.00%

Only the portion of these industries' activities which is attributable to copyrighted works and other protected subject material, ranging from 0.55% to 50%, should be included in their employment and value added contributions. For example, museum activities and the manufacture of games and toys have a significant copyright component, whereas only a very small portion of employment and value added in industries such as the manufacture of carpets or wholesale of furniture is directly related to copyright activities or copyrighted materials.

Finally, the non-dedicated support industries are shown in Table 55.

Table 55:
Non-dedicated support copyright-intensive industries

NACE code	NACE description	Factor
46.1	Wholesale on a fee or contract basis	6%
46.4	Wholesale of household goods	6%
46.6	Wholesale of other machinery, equipment and supplies	6%
46.9	Non-specialised wholesale trade	6%
47.1	Retail sale in non-specialised stores	6%
47.4	Retail sale of information and communication equipment in specialised stores	6%
47.5	Retail sale of other household equipment in specialised stores	6%
47.7	Retail sale of other goods in specialised stores	6%
47.8	Retail sale via stalls and markets	6%
47.9	Retail trade not in stores, stalls or markets	6%
49.1	Passenger rail transport, interurban	6%
49.2	Freight rail transport	6%
49.3	Other passenger land transport	6%
49.4	Freight transport by road and removal services	6%
50.1	Sea and coastal passenger water transport	6%
50.2	Sea and coastal freight water transport	6%
50.3	Inland passenger water transport	6%
50.4	Inland freight water transport	6%
51.1	Passenger air transport	6%
51.2	Freight air transport and space transport	6%
52.1	Warehousing and storage	6%
52.2	Support activities for transportation	6%
53.1	Postal activities under universal service obligation	6%
53.2	Other postal and courier activities	6%
79.1	Travel agency and tour operator activities	6%
79.9	Other reservation service and related activities	6%

The inclusion of the above industries is attributable to backward linkages, generally business services and delivery modes. For example, it is estimated that 6% of employment and value added in postal and courier services is generated by deliveries of copyrighted materials, such as magazines, manuscripts and audiovisual recordings.

In this study, only core and non-core industries with a factor of at least 20% are included as copyright-intensive.

13 / Appendix: Identification of CCMT-intensive industries

13.1 Absolute intensity

- The starting point for the calculation of CCMT patent intensities was the dataset of 144,981 relevant granted patents as described in section 9.1.
- As a next step, the dataset was reduced to a set of 13,483 CCMT relevant patents.⁸⁰
- This dataset was then merged with a concordance table linking patent applicants' data to company information in ORBIS. A match was found for 11,624 unique CCMT patent applications, i.e. 86.21% of the total relevant CCMT applications.
- Where a patent has multiple owners, some of whom have their seat outside of the EU, their associated fraction of patents was discounted. The total sum of the patent fractions corresponding to the subset of CCMT-relevant patents matched with ORBIS data amounts to 11,480.5. This represents 9.4% of the total European patents in the matched dataset. Of the 615 NACE classes, 375 (232 in the previous study) had a CCMT patent application filed and then granted.
- The matching and assignment of company units to NACE industries was carried out in the same way as described in section 5.3.1.

13.2 Relative intensity

The method of calculation of relative intensities in the case of CCMT-relevant applications was the same as for the general patent intensity of industries, and involved calculating the indicator of the number of CCMT patents per 1,000 employees. However, the determination of CCMT patent intensive industries was done as follows:

- Only IPR-intensive industries with CCMT-related patents (137 in total) were pre-selected.

⁸⁰ Defined as patents associated with the following IPC classes: Y02B, Y02C, Y02E, Y02F, Y02G, Y02H, Y02I, Y02J, Y02K, Y02L, Y02M, Y02N, Y02O, Y02P, Y02Q, Y02R, Y02S, Y02T, Y02U, Y02V, Y02W, Y02X, Y02Y, Y02Z, Y02AA, Y02AB, Y02AC, Y02AD, Y02AE, Y02AF, Y02AG, Y02AH, Y02AI, Y02AJ, Y02AK, Y02AL, Y02AM, Y02AN, Y02AO, Y02AP, Y02AQ, Y02AR, Y02AS, Y02AT, Y02AU, Y02AV, Y02AW, Y02AX, Y02AY, Y02AZ, Y02BA, Y02BB, Y02BC, Y02BD, Y02BE, Y02BF, Y02BG, Y02BH, Y02BI, Y02BJ, Y02BK, Y02BL, Y02BM, Y02BN, Y02BO, Y02BP, Y02BQ, Y02BR, Y02BS, Y02BT, Y02BU, Y02BV, Y02BW, Y02BX, Y02BY, Y02BZ, Y02CA, Y02CB, Y02CC, Y02CD, Y02CE, Y02CF, Y02CG, Y02CH, Y02CI, Y02CJ, Y02CK, Y02CL, Y02CM, Y02CN, Y02CO, Y02CP, Y02CQ, Y02CR, Y02CS, Y02CT, Y02CU, Y02CV, Y02CW, Y02CX, Y02CY, Y02CZ, Y02DA, Y02DB, Y02DC, Y02DD, Y02DE, Y02DF, Y02DG, Y02DH, Y02DI, Y02DJ, Y02DK, Y02DL, Y02DM, Y02DN, Y02DO, Y02DP, Y02DQ, Y02DR, Y02DS, Y02DT, Y02DU, Y02DV, Y02DW, Y02DX, Y02DY, Y02DZ, Y02EA, Y02EB, Y02EC, Y02ED, Y02EE, Y02EF, Y02EG, Y02EH, Y02EI, Y02EJ, Y02EK, Y02EL, Y02EM, Y02EN, Y02EO, Y02EP, Y02EQ, Y02ER, Y02ES, Y02ET, Y02EU, Y02EV, Y02EW, Y02EX, Y02EY, Y02EZ, Y02FA, Y02FB, Y02FC, Y02FD, Y02FE, Y02FF, Y02FG, Y02FH, Y02FI, Y02FJ, Y02FK, Y02FL, Y02FM, Y02FN, Y02FO, Y02FP, Y02FQ, Y02FR, Y02FS, Y02FT, Y02FU, Y02FV, Y02FW, Y02FX, Y02FY, Y02FZ, Y02GA, Y02GB, Y02GC, Y02GD, Y02GE, Y02GF, Y02GG, Y02GH, Y02GI, Y02GJ, Y02GK, Y02GL, Y02GM, Y02GN, Y02GO, Y02GP, Y02GQ, Y02GR, Y02GS, Y02GT, Y02GU, Y02GV, Y02GW, Y02GX, Y02GY, Y02GZ, Y02HA, Y02HB, Y02HC, Y02HD, Y02HE, Y02HF, Y02HG, Y02HH, Y02HI, Y02HJ, Y02HK, Y02HL, Y02HM, Y02HN, Y02HO, Y02HP, Y02HQ, Y02HR, Y02HS, Y02HT, Y02HU, Y02HV, Y02HW, Y02HX, Y02HY, Y02HZ, Y02IA, Y02IB, Y02IC, Y02ID, Y02IE, Y02IF, Y02IG, Y02IH, Y02II, Y02IJ, Y02IK, Y02IL, Y02IM, Y02IN, Y02IO, Y02IP, Y02IQ, Y02IR, Y02IS, Y02IT, Y02IU, Y02IV, Y02IW, Y02IX, Y02IY, Y02IZ, Y02JA, Y02JB, Y02JC, Y02JD, Y02JE, Y02JF, Y02JG, Y02JH, Y02JI, Y02JJ, Y02JK, Y02JL, Y02JM, Y02JN, Y02JO, Y02JP, Y02JQ, Y02JR, Y02JS, Y02JT, Y02JU, Y02JV, Y02JW, Y02JX, Y02JY, Y02JZ, Y02KA, Y02KB, Y02KC, Y02KD, Y02KE, Y02KF, Y02KG, Y02KH, Y02KI, Y02KJ, Y02KK, Y02KL, Y02KM, Y02KN, Y02KO, Y02KP, Y02KQ, Y02KR, Y02KS, Y02KT, Y02KU, Y02KV, Y02KW, Y02KX, Y02KY, Y02KZ, Y02LA, Y02LB, Y02LC, Y02LD, Y02LE, Y02LF, Y02LG, Y02LH, Y02LI, Y02LJ, Y02LK, Y02LL, Y02LM, Y02LN, Y02LO, Y02LP, Y02LQ, Y02LR, Y02LS, Y02LT, Y02LU, Y02LV, Y02LW, Y02LX, Y02LY, Y02LZ, Y02MA, Y02MB, Y02MC, Y02MD, Y02ME, Y02MF, Y02MG, Y02MH, Y02MI, Y02MJ, Y02MK, Y02ML, Y02MN, Y02MO, Y02MP, Y02MQ, Y02MR, Y02MS, Y02MT, Y02MU, Y02MV, Y02MW, Y02MX, Y02MY, Y02MZ, Y02NA, Y02NB, Y02NC, Y02ND, Y02NE, Y02NF, Y02NG, Y02NH, Y02NI, Y02NJ, Y02NK, Y02NL, Y02NM, Y02NN, Y02NO, Y02NP, Y02NQ, Y02NR, Y02NS, Y02NT, Y02NU, Y02NV, Y02NW, Y02NX, Y02NY, Y02NZ, Y02OA, Y02OB, Y02OC, Y02OD, Y02OE, Y02OF, Y02OG, Y02OH, Y02OI, Y02OJ, Y02OK, Y02OL, Y02OM, Y02ON, Y02OO, Y02OP, Y02OQ, Y02OR, Y02OS, Y02OT, Y02OU, Y02OV, Y02OW, Y02OX, Y02OY, Y02OZ, Y02PA, Y02PB, Y02PC, Y02PD, Y02PE, Y02PF, Y02PG, Y02PH, Y02PI, Y02PJ, Y02PK, Y02PL, Y02PM, Y02PN, Y02PO, Y02PP, Y02PQ, Y02PR, Y02PS, Y02PT, Y02PU, Y02PV, Y02PW, Y02PX, Y02PY, Y02PZ, Y02QA, Y02QB, Y02QC, Y02QD, Y02QE, Y02QF, Y02QG, Y02QH, Y02QI, Y02QJ, Y02QK, Y02QL, Y02QM, Y02QN, Y02QO, Y02QP, Y02QQ, Y02QR, Y02QS, Y02QT, Y02QU, Y02QV, Y02QW, Y02QX, Y02QY, Y02QZ, Y02RA, Y02RB, Y02RC, Y02RD, Y02RE, Y02RF, Y02RG, Y02RH, Y02RI, Y02RJ, Y02RK, Y02RL, Y02RM, Y02RN, Y02RO, Y02RP, Y02RQ, Y02RR, Y02RS, Y02RT, Y02RU, Y02RV, Y02RW, Y02RX, Y02RY, Y02RZ, Y02SA, Y02SB, Y02SC, Y02SD, Y02SE, Y02SF, Y02SG, Y02SH, Y02SI, Y02SJ, Y02SK, Y02SL, Y02SM, Y02SN, Y02SO, Y02SP, Y02SQ, Y02SR, Y02SS, Y02ST, Y02SU, Y02SV, Y02SW, Y02SX, Y02SY, Y02SZ, Y02TA, Y02TB, Y02TC, Y02TD, Y02TE, Y02TF, Y02TG, Y02TH, Y02TI, Y02TJ, Y02TK, Y02TL, Y02TM, Y02TN, Y02TO, Y02TP, Y02TQ, Y02TR, Y02TS, Y02TT, Y02TU, Y02TV, Y02TW, Y02TX, Y02TY, Y02TZ, Y02UA, Y02UB, Y02UC, Y02UD, Y02UE, Y02UF, Y02UG, Y02UH, Y02UI, Y02UJ, Y02UK, Y02UL, Y02UM, Y02UN, Y02UO, Y02UP, Y02UQ, Y02UR, Y02US, Y02UT, Y02UU, Y02UV, Y02UW, Y02UX, Y02UY, Y02UZ, Y02VA, Y02VB, Y02VC, Y02VD, Y02VE, Y02VF, Y02VG, Y02VH, Y02VI, Y02VJ, Y02VK, Y02VL, Y02VM, Y02VN, Y02VO, Y02VP, Y02VQ, Y02VR, Y02VS, Y02VT, Y02VU, Y02VV, Y02VW, Y02VX, Y02VY, Y02VZ, Y02WA, Y02WB, Y02WC, Y02WD, Y02WE, Y02WF, Y02WG, Y02WH, Y02WI, Y02WJ, Y02WK, Y02WL, Y02WM, Y02WN, Y02WO, Y02WP, Y02WQ, Y02WR, Y02WS, Y02WT, Y02WU, Y02WV, Y02WW, Y02WX, Y02WY, Y02WZ, Y02XA, Y02XB, Y02XC, Y02XD, Y02XE, Y02XF, Y02XG, Y02XH, Y02XI, Y02XJ, Y02XK, Y02XL, Y02XM, Y02XN, Y02XO, Y02XP, Y02XQ, Y02XR, Y02XS, Y02XT, Y02XU, Y02XV, Y02XW, Y02XX, Y02XY, Y02XZ, Y02YA, Y02YB, Y02YC, Y02YD, Y02YE, Y02YF, Y02YG, Y02YH, Y02YI, Y02YJ, Y02YK, Y02YL, Y02YM, Y02YN, Y02YO, Y02YP, Y02YQ, Y02YR, Y02YS, Y02YT, Y02YU, Y02YV, Y02YW, Y02YX, Y02YY, Y02YZ, Y02ZA, Y02ZB, Y02ZC, Y02ZD, Y02ZE, Y02ZF, Y02ZG, Y02ZH, Y02ZI, Y02ZJ, Y02ZK, Y02ZL, Y02ZM, Y02ZN, Y02ZO, Y02ZP, Y02ZQ, Y02ZR, Y02ZS, Y02ZT, Y02ZU, Y02ZV, Y02ZW, Y02ZX, Y02ZY, Y02ZZ.

- For this set of industries, the employment-weighted mean share of CCMT-related patents per 1.000 employees was calculated. The value of this indicator amounts to 0.4395 (0.18 in the previous study).
- For the same set of industries, the employment-weighted mean share of CCMT-related patents in the overall number of patents was calculated. The value of this indicator was 10.53% (8.9% in the previous study).
- The set of CCMT-relevant industries was defined as those industries which are IPR-intensive and have a value of CCMT-related patents per 1,000 employees and share of CCMT-related patents which is above the respective employment-weighted mean.
- Overall, 25 NACE industries meet the criteria, as shown in Table 41. The sum of CCMT-related patents from these 25 industries is 6,503 and accounts for 57% of all 4IR patent applications filed during the period (30.4% in the previous study).

14 / Appendix: Identification of 4IR patent-intensive industries

14.1 Absolute intensity

- The starting point for the calculation of 4IR patent intensities was the dataset of 144,981 relevant granted patents as described in section 9.2.
- As a next step, the dataset was reduced to a set of 2,675 4IR relevant patents.⁸¹
- This dataset was then merged with a concordance table linking patent applicants' data to company information in ORBIS. A match was found for 2,372 unique 4IR-relevant patent applications, i.e. 88.67% of applications. Of the 615 NACE classes, 242 had a 4IR-related patent application filed and then granted.
- Where a patent has multiple owners, some of whom have their seat outside of the EU, their associated fraction of patents was discounted. The total sum of the patent fractions corresponding to the subset of 4IR-relevant patents matched with ORBIS data amounts to 2,332.42. This represents 1.9% of the total European patents in the matched dataset.
- The matching and assignment of company units to NACE industries was carried out in the same way as described in section 5.3.1.

14.2 Relative intensity

The method of calculation of relative intensities in the case of 4IR-relevant applications was the same as for the general patent intensity of industries. However, 4IR patent-intensive industries were determined as follows:

- Only IPR-intensive industries with 4IR-related patents (in total) were pre-selected.
- For this set of industries, the employment-weighted mean of 4IR-related patents per 1,000 employees was calculated. The value of this indicator amounts to 0.0869.

81 Defined as patents associated with the following IPC classes: A1, A2, A3, A4, A5, A6, B1, B2, B3, B4, B5, B6, B7, C1, C2, C3, C4.

- For the same set of industries, the employment-weighted mean share of 4IR-related patents in the overall number of patents was calculated. The value of this indicator was 1.48%.
- The set of 4IR-relevant industries was defined as those industries which are IPR-intensive and have a value of 4IR-related patents per 1,000 employees and a share of 4IR-related patents above the respective employment-weighted mean.
- Overall, 16 NACE industries meet the criteria, as shown in Table 44. The sum of 4IR-related patents from these 16 industries is 1,386 and accounts for 59% of all 4IR patent applications filed during the period.

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