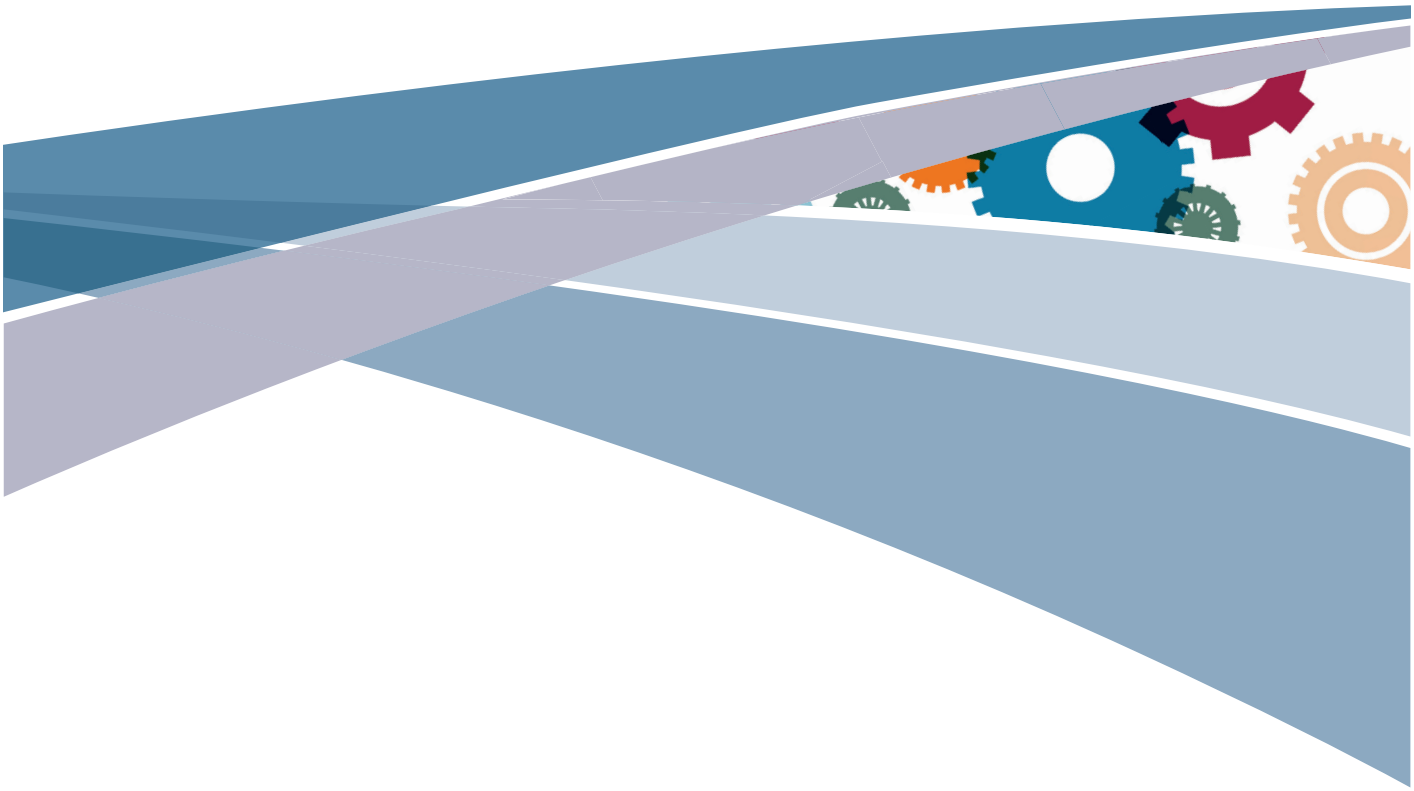
Intellectual Property Office

Building the Evidence Base on the Performance of the UK Patent System.



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Contents

Executive Summary

The patent system is an important part of the innovation ecosystem, playing a vital role in enabling innovators to realise the returns from their research and development. The Government has an ambition to be the most innovative country in the world. As such, there is a need for a better understanding of the performance of the UK patent system.

This report set outs a multi-faceted review of the UK patent system, considering how companies patent in the UK, who patents in the UK, and how the UK system compares to other countries. The report brings together evidence from a range of sources including stakeholder interviews, analysis of data, and existing academic literature in order to improve our understanding of the current UK patent system.

Stakeholder interviews and existing evidence on the operation of the UK patent system are positive overall. The number of patents covering the UK is high; however UK firms appear underrepresented in patent applications, with a lower proportion of domestic applicants than other countries. More work is required in understanding the reasons and wider implications of this.

Patent numbers in the UK

Global patent applications have increased sharply since the early 1990s, rising on average 5% between 1995 and 2006.

When European Patents (EPs) (patents granted through the European Patent Office) are included in UK patent counts, the UK was 6th in the world in terms of the number of patent applications in 2014, behind Germany (4th) and ahead of France (7th). Applications to the EPO have increased on average 7.7% between 1995 and 2006. Applications to the UK IPO excluding applications through the EPO have not grown as much as would be expected, declining on average 0.5% per year in the same time period, with the UK IPO 12th in the world in terms of number of patent applications. There was a similar trend in applications for France, although applications for Germany increased.

While an effective patent system is important, patent application numbers should not be taken as an indicator of innovation or the quality of the patent system. They do not show the number of inventions, levels of innovation or the benefits from innovation. Other aspects of the patent system should be looked at to better understand how the UK patent system is working.

Who patents in the UK?

93% of patents covering the UK (including EPs) are from foreign applicants (based on applicants listed address). This appears to be driven by both a low propensity for UK firms to patent, and the high number of foreign owned patents covering the UK.

Why do foreign firms patent in the UK?

International companies patenting decisions are driven primarily by where they are economically active; where they (and their competitors) sell, develop and manufacture their products. The differences between patent systems is of relatively minor importance compared with other factors in deciding where to patent. This came out in the interviews with international companies, and was supported by numbers of applications matching closely with relative level of GDP for most countries.

The UK is an attractive consumer market and this leads to high numbers of patent applications as firms protect their intellectual property in this important market.

Adjusting patent counts by GDP puts the UK fourth in the world in patent applications per GDP, and adjusting by population puts the UK at 2nd in the number of patent applications per million population.

How is the UK patent system viewed?

Overall, users of the UK patent system were happy with the service provided. Of key national offices studied, the UK had some of the lowest application and renewal costs, and the standards of patent examination and customer services were rated highly by stakeholders. There were some concerns raised in processing times increasing lately due to backlogs. This was a concern held in common with other major offices.

A common suggestion to improve the system was for more options to control the speed of the process, with more predictability on timing.

Legal services and the enforcement environment were mostly seen as high quality and were highly rated, however they are seen as expensive compared to other jurisdictions. The high cost of legal advice was seen as a barrier for small firms.

How do UK firms use the patent system?

UK companies appear to patent less than companies in comparator countries. SMEs in particular had low levels of patenting with less than one per cent of UK SMEs publishing patents in 2014 (compared with 4% of large companies).

It was suggested that increasing understanding of the role of patent attorneys and the wider benefits of patenting would support SMEs in their usage of the patent system.

Some of the reasons for lower UK patenting rates were due to differences in sector makeup, with the UKs larger service sector and smaller manufacturing sector a factor. Another factor was the level of R&D investment in the UK. Controlling for these factors, UK companies still had lower levels of patenting. Suggested reasons for this include wider cultural differences and market strategies.

Gaps in the evidence and areas for future research

While the research picked up many of the factors that differentiate patenting in the UK, the interviews highlighted other factors in patenting behaviour that are not just commercial considerations, but include cultural differences, institutional incentives, and individual behaviours. Further research in these areas could give a better explanation of why UK firms appear to patent less than firms in other countries.

The awareness and experience of patenting among UK SMEs was raised as an issue in stakeholder interviews. Research into how to support SMEs in best utilising the patent system could bring clarity to how significant of an issue this is.

Other questions raised are around the impact of such high rates of foreign patenting in the UK. What is the impact of this activity on the UK economy? While it could indicate investment and the attractiveness of the UK market, it could also reduce the freedom to operate for UK firms. A better understanding of these impacts would help in developing a patent system that best supports UK innovation and economic growth.

Introduction

The UK has the world's oldest continuous patent system with a history dating back to the 15th century[1]. While the system may have changed over the years the role of the patent system for inventors and innovators in protecting their inventions is as important as ever.

A successful patent system should encourage economic growth through incentivising innovation and idea sharing. Patents create the reward for innovation by granting the applicant the sole right to exclude others from making, using, or selling an invention for up to twenty years, which gives the inventor the opportunity to exploit the invention for profit. Patents facilitate the distribution of knowledge and ideas with the requirement that the patent will be published, putting the invention in the public domain and allowing society as a whole to benefit from the knowledge created.

While the evidence of a positive link between patenting and innovation is mixed (1) (2), it is clear the important role patents play in many sectors such as chemicals and pharmaceuticals in incentivising the research and investment necessary to create the innovations (3) (4) that drive our economic growth and improve our lives.

The government's ambition is to be the most innovative country in the world. The intellectual property system plays an important role in innovation, with patents a key part of the innovation ecosystem. It is therefore important to review the performance of our patent system, and ensure that it is working in the best interests of our inventors and society. This report seeks to review the UK patent system from multiple different angles, to build a rounded picture of patenting in the UK.

How to define and measure what makes a good patent system is not clear-cut. A multi-faceted approach is used to examine patenting in the UK. Topics include the propensity of UK companies to patent, the efficiency of the patent system in terms of cost and timing, and the enforcement environment. Although this research considers the link between patents and innovation, the focus of the research is within the existing patent framework, and maximising the benefits of that to UK patent applicants and the economy. This research looks at what the performance of the UK patent system, and where the UK stands in relation to other jurisdictions.

This project sets out to answer the following question:

"What are the factors driving differences between patenting in the UK and other countries?"

In order to analyse this question from the perspective of different user groups, sub-questions include:

- Who patents in the UK jurisdiction?
- How do UK firms patent?
- How is the UK patent system viewed by current and potential users?
- How is the UK jurisdiction viewed by international companies?

1 In 1449 Henry VI granted the earliest known English patent for a method of making stained glass that was new to England to John of Utynam, giving a 20 year monopoly on the method.

A note on the link between patents and innovation

It is important to note that patents on their own are not the sole factor in fostering innovation. It is hard to determine a historical link between patents and innovation empirically (5) Broad reviews of existing evidence such as Hall and Harhoff (1) and Baldrin and Levine (2) conclude that with the exception of some specific industries, evidence of a positive link between patenting and innovation is mixed. Both studies conclude that in general, a strengthening of the patent system increases the number of patents, but not necessarily innovation.

Other mechanisms and intellectual property rights are important. Many inventions are not protected by patents. Where patent laws are weak, innovation is guided towards industries where alternative mechanisms protect IP such as trade secrets (1). Patents have impacts beyond their effect on innovation. There is evidence in some industries that patents are used as a strategic tool rather than an as protection to trade or use their invention (1). Through licensing, the patent system changes the structure of business organisation by enabling activities that formerly needed to be kept within the firm due to secrecy. In countries with initially weak IP systems, strengthening IP increases the inward flow of FDI to sectors where patents are frequently used (6). This could be a positive effect but is not linked to an increase in innovation.

There is agreement across a substantial amount of existing evidence that in a lot of industries patents are viewed as less important than some other strategies for appropriating returns on investment to product innovation (7) (8) (9). First mover advantage, secrecy or superior sales and service are listed as market tactics which companies may rely on over and above patents. However the importance of patents in sectors such as pharmaceuticals should not be understated (10).

Despite this, public policy is important in ensuring the patent system is accessible and works as best as possible for those who choose to use it. Moser (2005) (11) highlights that policy cannot influence first mover advantage, and first mover advantage is not precluded by the existence of patents, although secrecy may be compromised.

Comparing the quality of patent systems across countries and analysis of the UK patent system is still useful in ensuring that the system works as best as possible, despite the reminder from the literature that patenting is often not the only or most important factor in companies innovation and that any changes to the patent system must be seen in terms of the wider context in which firms operate.

A note on the United Kingdom's vote to leave the European Union

On 23 June, the EU referendum took place and the people of the United Kingdom voted to leave the European Union. Until exit negotiations are concluded, the UK remains a full member of the European Union and all the rights and obligations of EU membership remain in force.

It is important to note that as a contracting state of the European Patent Convention the UK will still be a member of the European Patent Organisation, which is a separate organisation from the EU. Applicants will still be able to apply for patents that cover the UK jurisdiction through the European Patent Office, as is currently the case. This research does not consider any future implications that may arise from future changes in patenting behaviour that may occur as a result of the UK leaving the European Union, including the impact of any future unitary patent and a unified patent court.

Methodology

The research aims to inform how patenting in the UK is perceived from different angles. A range of sources (both qualitative and quantitative) were drawn together in order to inform on all aspects of patenting in the UK and give as broad an overview as possible of the UK patent system and patenting environment.

To supplement data analysis and existing evidence, interviews were conducted with a variety of key stakeholders in the UK and abroad. This added valuable insights into the behaviour behind the data results, gathered opinions on positive and negative characteristics of patenting in the UK and raised some areas for further investigation.

A dataset of UK company data linked to companies' patent portfolios was commissioned, in order to investigate the patenting behaviour of UK companies, and how company characteristics may affect patenting.

Stakeholder input

The 'best' place to patent is a multi-faceted question which can be approached from different viewpoints. Face-to-face and telephone interviews were conducted with a range of users of the patent system and representatives of stakeholder groups in the UK and abroad (including some who choose not to patent) in order to cover as many perspectives as possible.

The interviews cover over thirty stakeholders, including representatives of large international companies with UK headquarters and the UK IP Federation (8), stakeholders abroad (8), Patent attorneys and Chartered Institute of Patent Attorneys (CIPA) (4), UK small business advisers and growth hubs (11) and technology transfer offices of universities (3). Potential interviewees were targeted via a range of sources including those that were large users of patent system based on applicant data, existing contacts, web searches, cold contacts and suggestions from other interviewees. A full list of stakeholder groups and contributors is included at Annex 1.

Interviews were conducted by the research team both in person and via phone, between April and June of 2016. Interviews were semi structured, with initial standardised questions around how users used the patent system based on the sector, with follow up questions based on responses. Interviews lasted between 30 minutes to an hour.

Interview evidence proved invaluable in giving insights into behavioural decisions behind the data and aspects of the patenting environment such as cultural differences and institutional incentives that are not easily captured in quantitative analysis. It also raised areas for further research. Because decisions around patenting strategy are highly sensitive, direct quotes are not published here but an effort has been made to summarise opinions on each topic and explain where the opinion came from a particular stakeholder group.

Views were also sought through a questionnaire distributed by UK and overseas industry bodies, however a low response rate made the results insufficient to draw reliable conclusions representative of the population as a whole. The results of the questionnaire were therefore not included as part of the research.

Data analysis

A range of data sources were used to inform the analysis of the UK patenting system, a breakdown of which is given in figure 1. Analysis was both at the macro level, looking at how the UK compare with other countries, and at the firm level looking at how UK firms patented. In addition to existing datasets a matching exercise was undertaken that matched patenting data to company house records, to enable analysis of the characteristics of UK firms that patent.

'UK company' is difficult to define, particularly as many large companies spread their operations over different countries. In the IPO FAME-matched data, 'UK company' is defined as a company registered in the UK. In OECD data it is companies headquartered in the UK, although their R&D, manufacturing and 'controlled subsidiaries' (which are also included) may be located outside the UK.

Figure 1: Data sources

IPO FAME-matched

A new dataset commissioned by the IPO. This links UK company patent applicants to a corresponding company on the FAME database. The dataset allows patenting behaviour of UK companies to be examined by characteristics such as company size, industry sector and other variables recorded in the FAME database.

The analysis in this report is based on a subset of data from 2010 – 2014. As patents are only matched to those companies listed on the FAME database, individuals, universities and unregistered companies are not represented in the dataset. The size of the sample for 2014 is 2,637,178 companies, 99 per cent of which are SMEs. For more detail on the dataset and how it was constructed, see Annex 2.

WIPO

Publicly available patent data from the World Intellectual Property Organization (WIPO) (12) on counts such as application numbers was used to analyse the UK's position in global patenting activity. WIPO data is collected from patent offices through surveys. The latest available year is 2014.

PATSTAT

Patent data from the IPO's PATSTAT database. This is administrative patent data which can give details such as who patents in the UK. The latest year of data is 2012.

OECD 'Top 2000 R&D investors'

This dataset from OECD[2] matches the top 2000 R&D investing companies worldwide to their patent portfolios. Patents are counted by extended patent family[3] and single patents are excluded.

Patent families are counted in the dataset if they have a patent filed at an 'IP5 office'[4] and one other office worldwide. This means the number of patent families could be biased towards companies whose national office is an IP5 office. To assess whether this presented significant bias against UK companies, IPO analysis checked the GB patents[5] of UK companies who were listed in the 'Top 2000 R&D Investors' but were not matched to a patent family, and concluded the level of bias was not high enough to prevent the data from being used[6], with appropriate caveats.

IMF

GDP and population data from the IMF (13) were used to adjust WIPO patent application counts and measure 'patent applications per billion dollars GDP' and 'patent applications per million population'.

Eurostat

Eurostat provides data on economic variables which may affect patenting behaviour, e.g. sector makeup of the economy measured in gross value added, R&D expenditure and business expenditure on R&D (BERD) (14).

Indicators of innovation are measured in the Community Innovation Survey, also available through Eurostat. Caveats are that the CIS is self-reported, and may not be directly comparable across countries – particularly non-European countries – due to differences in the way the survey is conducted.

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2 Published in the 2013 edition of the EU Industrial R&D Scoreboard

3 all patents linked to the same priority date (whether they are filed in different jurisdictions or represent incremental steps linked to the original invention) are counted as one family

4 EPO, SIPO, KPO, JPO or USPTO

5 'GB' refers to patents applied for through the IPO

6 There were 13 UK companies who owned over ten GB patents which were not counted in the OECD data because they had not also been filed at an IP5 office, with the maximum patent portfolio size of 75 patents.

Chapter 1: Patent numbers in the UK and comparison countries

Global patent applications have increased sharply since the early 1990s, rising on average 5.3 per cent annually between 1995 and 2006 (14).

Applications to the UK IPO have not grown as much as would be expected within the context of the increasing global trend, declining around six per cent from 1995 to 2006. In 2014, the UK IPO was 12th in the world in terms of the number of patent applications. This was roughly on par with France but lower than Germany (6th) (12).

European Patents (EPs) can be included in UK patent counts to approximate the number of patents effective in the UK jurisdiction[7]. When EPs are included, the UK was 6th in the world in terms of the number of patent applications received in 2014, behind Germany (4th) and ahead of France (7th) (12).

Care should be taken when interpreting patent counts. They do not show the number of inventions, levels of innovation, or benefits from innovation. Differences in patenting cultures can also have an effect on the number of patent applications, However it is important to ensure that differences in patent numbers are not due to drawbacks in the patent system, or the UK jurisdiction as a patenting environment.

This research takes a multi-faceted approach, looking at different aspects of patenting in the UK, to make sure that it is working as well as possible for the wide variety of stakeholder groups.

1.1 Global trends in patent numbers

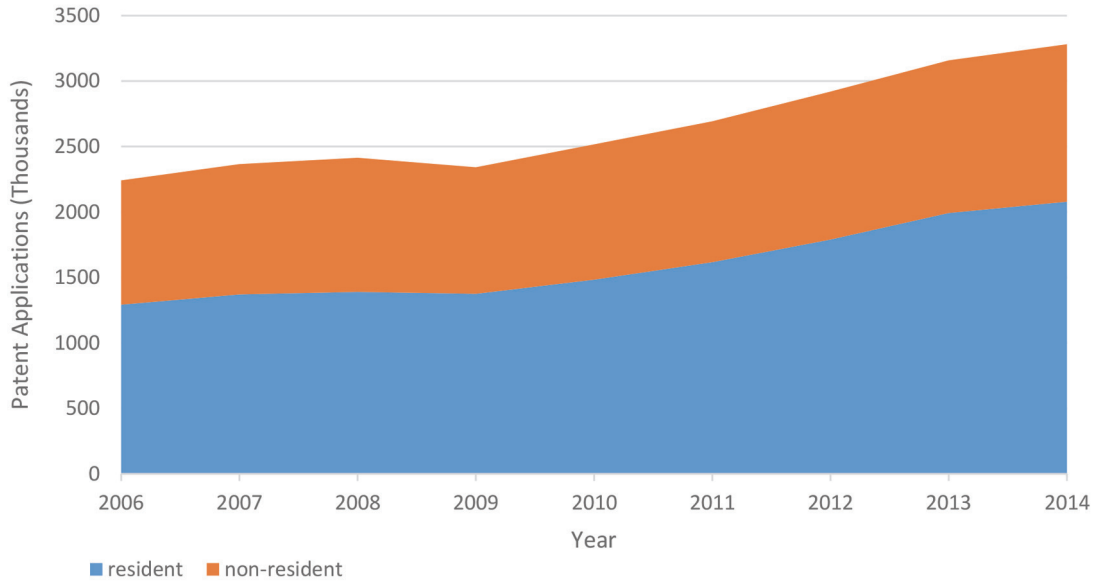
Patent applications as a whole have been rising sharply since the early 1990s. Between 1995 and 2006, the mean yearly growth rate of filings was 5.3 per cent (14). The OECD attributes this to changes in innovation processes (new subject areas such as communications and biotechnology), the economy (increased globalisation, integration of supply chains and trade), and patent systems themselves (an increase in what is defined as 'patentable subject matter') (15). The growth of patent filings is lower than that of other economic indicators. For example, the mean yearly growth rate of the volume of world trade was 7.2% over the same period (14).

Figure 2 shows the rise in patent applications globally between 2007 and 2014. Total world patent applications increased every year with the exception of 2008, which we can assume to be due to the recession in many developed countries.

7 EPs have been automatically validated in the UK jurisdiction since 2008. For more detail, see section 1.3 'Coverage in national jurisdictions through European Patents'.

Figure 2: Global increase in patent applications

World resident and non-resident patent applications 2007 - 2014



Source: WIPO data 'Total patent applications (direct and PCT national phase entries)' resident and non-resident applications – includes EPO and other trans-national offices separately.

Between 2006 and 2014, resident applications increased more than non-resident applications (figure 2), from 61% to 67% of total applications. At first this appears to be a reversal of the increasingly globalised patenting of the 1990s and 2000s (when non-resident applications rose more sharply than resident applications) (16). The trend in domestic patenting is driven by Chinese and Korean applications. During this period, the Chinese economy went through an unprecedented period of rapid expansion, and both Chinese and Korean applicants filed a large number of domestic patents. Removing these countries, the ratio of non-resident to resident applications has increased, indicating continued globalisation in patenting.

1.2 Number of patent applications by patent office

Figure 3 shows the IPO's global position in terms of the number of patent applications in 2014. The data measures the number of applications to each patent office, regardless of whether they go on to be published. 'Utility' patent applications are not counted from any country, as not all national systems provide this type of patent[8].

8 A 'utility' patent (also known as 'utility model' or 'petty patent') is a cheaper, more readily available version of a patent which is available in some countries including China, Japan, Korea, France and Germany. This is not to be confused with the US term 'utility patent' which refers to normal patents in the US, in order to distinguish them from a 'design patent' (which is similar to a 'registered design' in the UK).

Figure 3: Number of patent applications by patent office 2014

Number of patent applications by patent office 2014

Patent Office	Rank	Applications	Percentage of world total	Change on 2007	Change on 2013
			%	%	
China	1	928,177	35	+ 279	+ 12
US	2	578,802	22	+ 27	+ 1
Japan	3	325,989	12	- 18	- 1
Korea	4	210,292	8	+ 22	+ 3
EPO	5	152,662	6	+ 8	+ 3
Germany	6	65,965	3	+ 8	+ 4
India	7	42,854	2	+ 22	- 10
Russia	8	40,308	2	+ 2	0
Canada	9	35,481	1	- 12	2
Brazil	10	30,342	1	+ 40	- 2
Australia	11	25,956	1	- 3	- 13
UK	12	23,040	1	- 8	0
France	13	16,533	1	- 3	- 2
	World total	**2,680,900**			

Source: WIPO data 'total patent applications (direct and PCT national phase entries)'

In 2014, the IPO was the 12th patent office in the world in terms of number of applications (23,235). The number of applications to the IPO in 2014 had no change from 2013 and an eight per cent decline since 2007.

Comparing this to other patent offices in Europe, the German patent office (DPMA) (6th) and the European Patent Office (EPO) (5th) had higher numbers of applications in 2014 (65,965 and 152,662 respectively) and positive growth since 2007. The French patent office (INPI) (13th) had a slightly lower number of applications than the IPO in 2014 (16,533), but a smaller decline in applications (three per cent) between 2007 and 2014.

The number of applications to the Chinese patent office (SIPO) increased on average by 83,872 per year over the period 2005-2014 to 928,177 applications in 2014. The US (USPTO) and Japanese (JPO) patent offices had the highest levels of total patent applications over the period 2007 – 2014. However the increase in applications to China and other Asian offices such as Korea (KPO) led to a more balanced global picture by the end of the decade.

1.3 Coverage in national jurisdictions through European Patents

European Patents (EPs) allow the applicant to protect their invention in countries signed up to the European Patent Convention, through the European Patent Office (EPO). When looking at patenting in the UK jurisdiction[9], patents covering the UK which have been filed through the EPO should be considered.

Since the London Agreement came into force in 2008 a granted EP requires no action on the part of the applicant to enter into force in many EPC member states, including Germany, France and UK. This means that, if each of those states remain designated when the European patent is granted, it will automatically enter into force in these jurisdictions.

The cost of EP renewal and how long they are automatically validated for varies between jurisdictions, which is likely to have an effect on the difference in renewal patterns between countries. The first six years are outlined in Figure 4.

Figure 4: EPs automatically validated in UK until 4th year

EP renewal cost in UK, Germany and France first six years

	Cost of renewal in Euros		
Year	**UK**	**Germany**	**France**
1	-	-	-
2	-	-	€38
3	-	€70	€38
4	-	€70	€38
5	€96	€90	€38
6	€124	€130	€76

Source: European Patent Office (2016). GBP fees converted to Euros using the 2015 yearly average exchange rate http://www.ukforex.co.uk/forex-tools/historical-rate-tools/yearly-average-rates

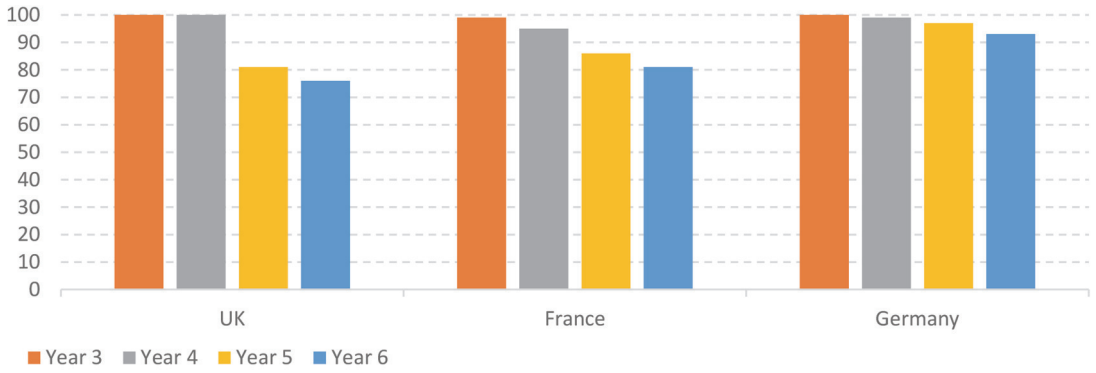
The first stage in the process where a decision is made to choose the UK is during the fourth year (figure 4). This is the first stage patent holders have to pay separately if they want to continue coverage of their patent in the UK jurisdiction.

Figure 5 shows the drop in 'active' patents in the UK between the fourth year and fifth year, from 100& to 81 per cent. Once a cost is incurred, EPs active in the UK drop more than in France and Germany, but the number of EPs that are renewed in the UK is still high (76% in the sixth year). This data is for patents filed in 2009 (so the sixth renewal year is 2015); the data shows similar trends in 2007 and 2008.

9 The jurisdiction is the national area the patent provides protection in. For example when looking at the UK jurisdiction we can include patents filed at the UK IPO and those filed at the EPO and then validated in the UK.

Figure 5: Over 80% of EPs renewed into 5th year in UK

Renewal Rates of EPs filed in 2009 in the UK, Germany and France



Source: IPO analysis of WIPO data and EP renewal rates provided by the EPO. Year Summary 2014 on the statistics of patent activity in the EPO and in the Patent offices of the EPC contracting states.

Figure 6 includes the number of applications to the EPO in the national patent counts of the UK, France and Germany. This is based on the assumption that all patents filed through the EPO are validated in these countries.

Figure 6: UK jurisdiction 6th in world

Number of patent applications by jurisdiction.

Patent Office	Rank	Applications	Percentage of world total	Change on 2007	Change on 2013
China	1	928,177	35	+279	+12
US	2	578,802	22	+27	+1
Japan	3	325,989	12	-18	-1
Germany	4	218,627	8	+8	+4
Korea	5	210,292	8	+22	+3
UK	6	175,702	7	+6	+3
France	7	169,195	6	+7	+3
India	8	42,854	2	+22	0
Russia	9	40,308	2	+2	-10
Canada	10	35,481	1	-12	+2
	World total	**2,680,900**			

European Patents (EPs) included in national counts for France, Germany and UK.
Source: WIPO data 'total patent applications (direct and PCT national phase entries)', with EPs added to national patent counts of France, Germany and UK where they have been automatically validated since 2007

This is an estimate based on applications not patents published, as such may not be fully representative of patenting behaviour. EP applicants may opt out of coverage in a jurisdiction, and once they have a patent renewal rates drop as shown in figure 5. However it is useful in approximating the number of patents that will cover the UK jurisdiction and can be enforced there regardless of whether they were applied for through the EPO or the IPO.

Including patents applied for through the EPO naturally increases the patent counts of national jurisdictions in Europe. The UK becomes the 6th largest national jurisdiction in terms of number of patent applications (175,702), behind Germany (218,627) and just ahead of France (169,195). The US, China, and Japan continue to dominate.

1.4 Interpreting patent counts

There are limitations to what patent counts show, and care should be taken when extrapolating meaning from the numbers.

Patent counts are often used as a proxy for the "level" of innovation, however there are significant issues with this approach. There are many different definitions of innovation; for example, the UK Government consider innovation to be the "successful exploitation of new ideas" (17). Patents represent inventions, but there may be innovation which does not produce a concrete invention, inventions that are not successfully exploited or inventions which do not go on to be patented[10].

The number of patents will also vary depending on filing strategy. For example, an inventor may obtain further patents to cover further inventive developments based on their original invention, or they may rely on a single patent. An innovation could therefore lead with multiple patents, a single patent, or no patent at all.

It is difficult to compare patent numbers between countries because national patent systems differ (Annexes 3 and 4 sets out more detail on how the patent system works in some key jurisdictions). For example one possible difference between systems is the 'scope' of the patent – whether a 'wide' scope that covers many aspects of an invention in one patent document, or a 'narrow' scope that needs many more patents to cover the same thing. Examination standards and therefore 'quality' of patents may also vary between countries.

While it should be stated that the relatively lower number of patent applications should not be interpreted to mean that the UK is a less attractive place to innovate and patent, it is important to ensure that differences in patent application numbers are not due to drawbacks in the patent system, or the UK jurisdiction as a patenting environment. This research takes a multi-faceted approach by looking at different aspects of patenting in the UK, to make sure that it is working as well as possible for the wide variety of stakeholder groups.

10 For further discussion of the limitations of patent counts in representing innovation, see the IPO Patent Guide at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/463319/The_Patents_Guide_2nd_edition.pdf

Chapter 2: International patenting strategies and effects on the UK

93 per cent of patents covering the UK jurisdiction (including EPs) are from foreign applicants (although 50 per cent of applications to the IPO are from UK applicants) (19). This could be due to a low propensity of the domestic population to patent, but also a high number of foreign-owned patents covering the UK, mainly through EPs validated in the UK jurisdiction.

Large international companies patent according to where the consumer market is, and also where they or their competitors produce. The UK is an attractive consumer market, and characteristics of the patent system itself are of less importance in attracting companies.

Companies patenting according to where the consumer market is fits with the fact that UK patent counts are higher than comparative countries, once adjusted by the size of the economy[11]. Adjusting patent counts by GDP and population puts the UK fourth and second in the world respectively in terms of number of applications in 2014, ahead of European comparison countries.

2.1 Countries patenting domestically and abroad

Figure 7 shows the number of 'patent applications subsequently published' by nationality of applicant for the US, Korean, German, French and UK jurisdictions in 2012. EPs are included in national patent counts of the UK, Germany and France.

The data is compiled from applicant nationality recorded in PATSTAT, the IPO's patent database[12]. This may not represent the applicant's location, or where the invention took place. The same analysis based on nationality of inventor (as opposed to applicant) yields very similar results. Data for the Chinese and Japanese jurisdictions is not available.

11 IPO analysis of WIPO data total patent applications (direct and PCT national phase entries). EPs included in UK, French and German counts. GDP and population data from IMF World Economic Outlook 2015. GDP measured in current prices, national currency converted to USD at annual average market exchange rates.

12 Not all patents in PATSTAT have the nationality of the applicant recorded, so the data presented in this sample is only those patents where this information is available, but the sample size should be sufficient to give an idea of overall patenting behaviour.

Figure 7: Most patent applications in the UK jurisdiction are from foreign applicants

Patent applications subsequently published by applicant nationality (2012)

	UK		Germany		France		US		Korea	
Applicant nationality		%		%		%		%		%
American	35,200	24	35,900	20	32,600	22	172,200	48	11,100	7
German	23,300	16	60,500	34	23,500	16	18,900	5	3,800	2
Japanese	22,000	15	23,500	13	21,600	15	60,600	17	15,100	9
British	10,000	7	4,200	2	4,200	3	6,900	2	800	0
French	9,200	6	9,200	5	22,300	15	7,500	2	2,000	1
Korean	5,500	4	6,600	4	5,400	4	20,300	6	124,000	76
Chinese	4,100	3	4,000	2	4,000	3	10,500	3	1,100	1
Other	24,500	17	25,000	14	23,700	16	39,900	11	3,800	2

Patent counts rounded to the nearest hundred.
Source: IPO analysis of PATSTAT data 'Patent applications subsequently published' by nationality of applicant, 2012
Reliable data on the nationality of applicants to the Chinese patent office (SIPO) and Japanese Patent Office (JPO) is not available.

Among the European countries studied, the UK has the lowest proportion of domestic applicants, at 7%. France has 15% domestic applicants and Germany 34%. In the data as a whole, the UK has the widest variety of nationalities patenting in its jurisdiction (although the spread is similar to France).

The presence of UK applicants patenting abroad is negligible, and does not mirror the large presence of foreign companies in the UK. For example in 2012 UK applicants filed 2% of total US patent applications (compared to 5% from German applicants and 17% from Japanese applicants), 2% of German patent applications and 3% of French patent applications (19). This is the lowest presence patenting abroad of the countries studied, although on par with France.

The French profile of interaction in patenting is similar to that of the UK's. It has a relatively low number of domestic patents, but more than the UK (17%). Germany dominates Europe in terms of patents, with a strong presence in the UK and France. In 2012, German applicants had 16% of patents in the UK jurisdiction (including those filed through the EPO).

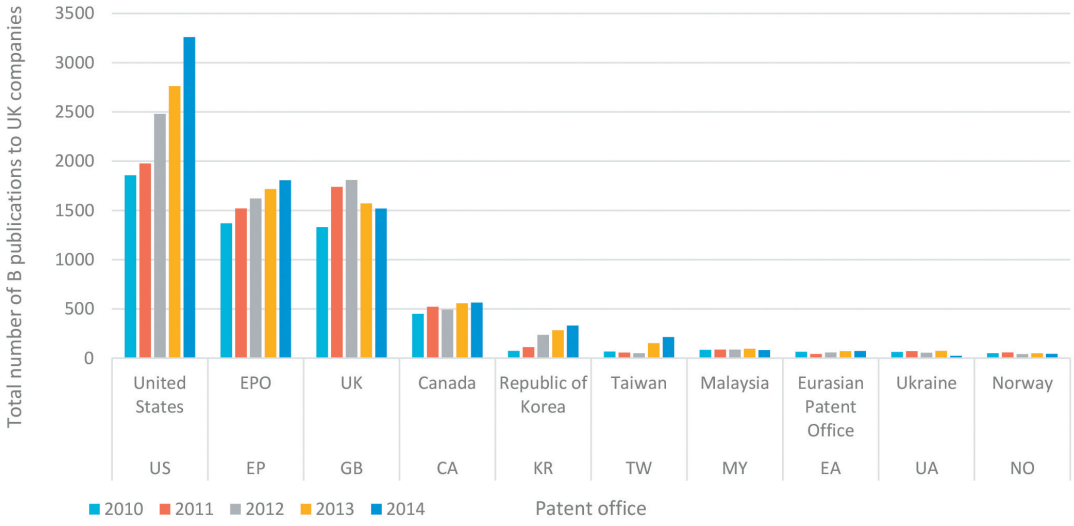
Unsurprisingly countries with a lot of patents have a strong presence in their domestic jurisdictions and abroad (e.g. the US, Japan, Germany). The exception to this is Korea which despite having a high number of patent applications, does not have a large presence abroad. The majority of Korean patent application are from domestic applicants (76%).

Although Chinese data is not available through PATSTAT, WIPO World Intellectual Property Indicators (2015) suggests China follows a similar pattern to Korea. In 2014, China ranked first in terms of resident applications, which have been driving the strong growth of applications to the Chinese patent office (SIPO) (18). In the same year, Chinese residents filed only 36,700 applications abroad (19). China accounts for a lower share of applications in many offices, but these have increased in recent years e.g. from 3.2% (2010) to 6.1% (2014) of patents filed at the USPTO (a similar level to Korea in the 2012 data presented in Figure 7) (19).

Figure 8 uses the FAME-linked dataset of UK companies to show where UK companies patent abroad.

Figure 8: UK companies patent mainly in the UK, US and Europe

Patent granted to UK companies by year and patent office (top ten)



Source: IPO analysis of FAME-linked data – UK companies on Companies House database reporting assets in 2014

UK companies primarily patent in the US (3,259 patents in 2014) and Europe (including the UK which granted 1519 patents from UK companies in 2014). Stakeholder interviews reported that companies patent primarily on where their consumer market is, and patenting in these countries fits in with this.

A suggestion is that UK companies patent in places such as Taiwan, Malaysia and Eastern Europe because that is where they or their competitors manufacture, but the number of patents granted in most of these countries is low (e.g. 82 patents published in Malaysia in 2014), and does not increase between 2010 – 2014 (with the exception of Taiwan which grew from 67 patents granted in 2010 to 215 in 2014).

2.2 Foreign and domestic applicants in the UK jurisdiction

93 per cent of patent applications that cover the UK jurisdiction are from foreign applicants, and the UK has the lowest proportion of domestic applicants in any of the key countries studied (Figure 7). This imbalance in the proportions of domestic and foreign firms patenting in the UK could be due to a low propensity of UK residents to patent, or a high demand for UK patents by foreign applicants.

Figure 9 presents WIPO data on the number of resident applications to national patent offices. Of the key offices studied, the UK has the lowest number of resident applications per million residents (309 in 2014 compared to 379 in France and 913 in Germany). The trend is declining, whereas it is increasing in all other countries except Japan. As this data looks at national patent offices, it does not capture UK residents who patent in the UK through the EPO, although this is equally true of the German and French data.

Figure 9: UK has a low proportion of resident applications

Resident applications per million population 2007 - 2014

	Year							
	07	**08**	**09**	**10**	**11**	**12**	**13**	**14**
Korea	2648	2597	2589	2668	2773	2962	3186	3254
Japan	2605	2578	2306	2265	2250	2250	2134	2092
Germany	888	924	891	910	895	919	917	913
US	801	762	733	782	795	856	909	894
China	116	147	172	219	309	396	519	587
France	360	368	356	373	372	372	372	379
UK	365	349	334	333	318	316	305	309

Source: WIPO (2016). This count is by national office and does not include patents filed through the EPO.

This data suggests a low propensity of the domestic population to patent – this is explored further in Chapter 4: Patenting Behaviour of UK Companies.

The demand for UK patents by foreign applicants may also contribute to the discrepancy, and this is likely to be exacerbated by the use of EPs. Applicants from abroad are more likely to patent in the UK through the European route.

Figure 10 shows that in 2012 the number of US applicants patenting in the UK through the IPO was 2971, but the number of US applicants applying for EPs (which cover the UK jurisdiction) was 32,237. The US is the largest individual user of the European Patent system (24 per cent of EP applications subsequently published in 2012), and many of the US patent applications in the UK and France will be from European Patents validated in these jurisdictions.

Figure 10: EPO key route for foreign patents to UK

Patent applications subsequently published covering UK jurisdiction: IPO and EPO routes (2012)

	IPO		UK Jurisdiction		(IPO + EPO)	
Applicant nationality		**%**		**%**		**%**
American	3,000	25	32,200	24	35,200	24
German	400	3	22,900	17	23,300	16
Japanese	600	5	21,500	16	22,100	15
British	5,900	50	4,100	3	10,000	7
French	100	1	9,000	7	9,200	6
Korean	100	1	5,400	4	5,500	4
Chinese	200	1	4,000	3	4,200	3
Other	1,500	13	33,500	25	35,100	24
	11,800		**132,600**		**144,500**	

Source: IPO analysis of PATSTAT data 'European Patent applications subsequently published' by nationality of applicant, 2012. Applications rounded to the nearest hundred. Reliable data on the nationality of applicants to the Chinese patent office (SIPO) and Japanese Patent Office (JPO) is not available.

It may be that EPs increase the likelihood of foreign applicants filing patents that cover the UK jurisdiction, e.g. if they file through the EP route because they want to patent in another European country, but include UK as a jurisdiction initially until renewal fees are due, and there are no additional application costs.

The net benefit of foreign companies patenting in the UK depends on the activities foreign investors undertake here. Of the large international companies who contributed to our research, the majority had considerable investment in the UK, including investment in R&D. Normative conclusions on the strong presence of foreign companies in the UK patent system and the impact on the economy cannot be drawn without more information on how these patent applicants are operating in the UK.

2.3 Patenting strategies of international companies

Interviews with large international companies and patent attorneys confirm that the majority of large companies primarily decide where to patent on where their markets are, and therefore the quality of the patent system (e.g.in terms of speed and cost) is of less importance in attracting companies to patent in a jurisdiction.

Companies want to patent where the consumer market for their product is. Attractive markets have large populations, high GDP and consumer spending. Interviewees reported that although the UK is viewed as an attractive consumer market, companies see Germany as the most attractive consumer market in Europe, due to its larger population, wealth and role at the centre of the European market.

Secondary to the consumer market but also an important consideration is where production takes place, whether by the company or their main competitors. Within Europe, Germany's manufacturing base is more than twice the size of the UK's. Manufacturing contributed 23 per cent of German gross value added in 2014, but only 11 per cent of gross value added in the UK and France (this can be seen in Figure 28). So it is more likely that companies will manufacture in Germany, their competitors manufacture there or they may supply interim parts to supply chains, all of which increase the incentive to patent in the German jurisdiction. The effects of sectoral makeup are explored further in Chapter 4: Patenting Behaviour of UK Companies.

2.4 Adjusting for the size of the economy

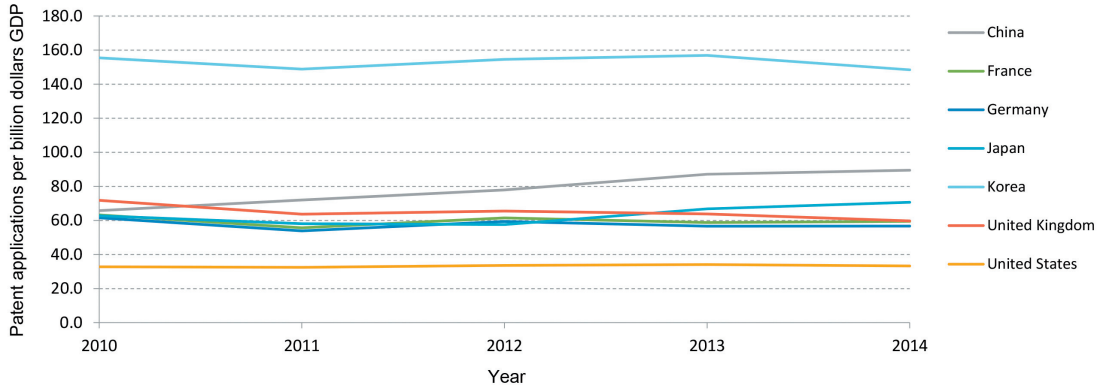
The size of the market being a key driver of patent applications is supported by data for the UK, Germany and France which have similar levels of patent applications when adjusted for GDP (Figure 11) and population (Figure 12). GDP and population can be seen as proxies for market size, and once this is controlled for the UK level of patenting is higher among comparison countries.

When patent application counts are adjusted for GDP[13] levels, the UK jurisdiction had the fourth highest number of patent applications per billion US dollars GDP in 2014 (Figure 11). The number of patent applications covering the UK jurisdiction was 60 applications per billion dollars GDP, similar to France and Germany, which had 59 and 57 patent applications per billion dollars of GDP respectively.

13 There are caveats to using GDP to measure the size of the economy, for example it does not take into account the level of debt or the contribution of unpaid work. Data collection can be difficult and not always reliable, for example Chinese GDP figures should be treated with caution.

Figure 11: UK 4th in world when applications adjusted for GDP

Patent applications by jurisdiction per billion dollars of GDP 2010-2014



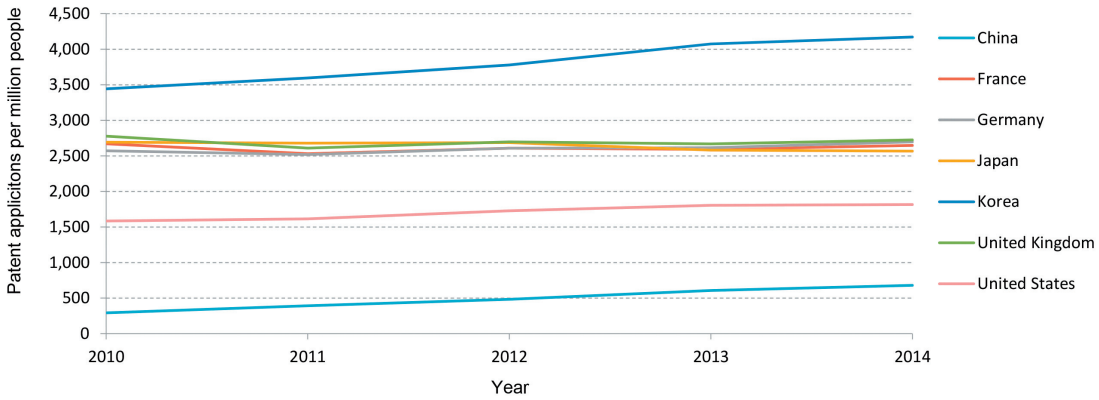
Source: IPO analysis of WIPO data total patent applications (direct and PCT national phase entries). EPs included in UK, French and German counts. GDP data from IMF World Economic Outlook 2015, measured in current prices, national currency converted to USD at annual average market exchange rates.

As a high patenting country with a relatively small population and economy, Korea is the number one patenting country when measuring patent activity compared to country size. The majority of Korean patents are from domestic applicants (76 per cent in 2012 – see figure 7). Patenting activity in the US is lower once adjusted for the high GDP and large population.

Figure 12 shows patent application counts adjusted by population. In 2014 the UK had the second highest number of patent applications after Korea.

Figure 12: UK 2nd in world when applications adjusted for population

Patent applications by jurisdiction per million population 2010-2014



Source: IPO analysis of WIPO data total patent applications (direct and PCT national phase entries). EPs included in UK, French and German counts. Population data from IMF World Economic Outlook 2015.

As this is measuring international and not only domestic patent applications, adjusting by population does not indicate the propensity of the population to patent. Using GDP to adjust patent counts is a more accurate proxy for the size of the country in terms of economic activity than population is, however the UK performs well in both measures.

Chapter 3: The UK patent system and legal environment

Overall, users of the UK patent system are happy with the service provided. This agrees with evidence and representations to the Hargreaves Review (2011). Of key national offices studied, the UK has the lowest application and renewal costs (19), and standards of patent examination and customer service are very high.

A concern among stakeholders is that processing times have increased lately due to backlogs (20), which is in common with other major patent offices (21).

Stakeholder opinion of the acceleration options is positive, although awareness of these options could be improved. Companies would like to see a mid-range option, with more predictability on timing, which could be a case of repackaging and increasing awareness of existing options.

Legal services in the UK are considered expensive compared to other jurisdictions, however the quality of legal services and the enforcement environment are rated among the best, for example in quality indexes (22).

3.1 Cost

The IPO is considered low cost and good value for money. Figure 13 sets out comparison costs of key national patent offices in Euros in 2011 (19). Published in 2014, this is one of the most recent comparisons of costs across offices. Administration costs to national patent offices include application, filing and examination fees. The UK is listed as the cheapest national patent office among comparison countries in terms of application and renewal fees, whether the patent is held for 10 years (€1,153 in 2011) or to maturity at twenty years (€5,567 in 2011).

Interview evidence reinforces the view that the IPO is low cost. Stakeholders said that the cost of both search and examination is low. The service is affordable and presents good value for money.

Figure 13: IPO has lowest costs of application and renewal

Patent office fees in Euros 2011

Years		20		10	10/20	20/GDP
	Application	Renewal	Total			
UK	320	5,240	5,570	1,150	0.21	3.1
France	740	5,610	6,350	1,560	0.25	3.2
Germany	550	13,170	13,720	1,970	0.14	5.3
US	3,450	5,450	8,900	5,940	0.67	0.8
Japan	2,120	13,970	16,100	4,920	0.31	3.8
China	380	9,160	9,540	2,190	0.23	1.8
Korea	880	9,230	10,110	3,290	0.33	11.7
EPO*	5,990	46,660	52,650	13,340	0.25	5.8

* Overall patent costs for a European patent validated in 6 countries (DE, FR, IT, NL, CH and UK)

Source: 'Patent Costs and Impact on Innovation', European Commission (2014). Application and renewal cost data from national patent offices, translated to Euros using World Bank exchange rate where necessary.

The column '20 years/GDP' shows the cost of filing and maintaining a patent for twenty years adjusted by GDP (measured in billion Euros)[14]. This approximates for the size of the consumer market in each country. By this measure, the US and China have the best value patents (0.8 and 1.8 patent cost to GDP ratios), due to their high GDP representing large consumer markets.

The UK and France have similar patent cost to GDP ratios (3.1 and 3.2 respectively). Germany has a less attractive patent cost to GDP ratio (5.3) due to the higher cost of patent maintenance and renewal. However, the study acknowledges that the German market may have attractive features that are not directly measured by GDP, such as market dynamism and the medium-high technology intensity of companies operating there (19). It could be argued that scaling GDP by billions of Euros and comparing to patent cost in Euros does not accurately reflect balance between cost and potential gain.

The ratio of the cost of holding a patent for ten years to the cost of holding a patent for twenty years is outlined in '10 years/20 years'. A lower ratio indicates a sharper cost increase in the second half of the patent life, which should incentivise patent holders to be more vigilant over their patent portfolios and maintain only highly valuable patents. This is designed to promote innovation by unlocking the use of IP which is less valuable to the inventor but may be of use to third parties.

The UK has cost weighted towards the second half of the patent lifespan more than many other countries (0.21 ratio), similar to France (0.25) but not as strongly as Germany (0.14)[15].

14 although GDP is a proxy and not a direct measure of consumption

15 The US has a high 10 year/20 year cost ratio by this measure due to a different structure where renewal fees are paid at 3.5, 7.5 and 11.5 years after grant.

The Hargreaves review (23) notes that increasing renewal fees could help to break down 'patent thickets'[16]: "The structure of patent renewal fees might be adjusted to encourage patentees to assess more carefully the value of maintaining lower value patents, so reducing the density of patent thickets." However the extent to which patent thickets are an issue is debatable, and varies by sector. An IPO commissioned study of patent thickets found that there is some evidence that thickets arise in specific technology areas, and that the density of a patent thicket in a particular area is associated with reduced entrance of patenting by firms in that area (24).

The interviews with large companies and patent attorneys acknowledged that companies are already being more vigilant about regularly reviewing their UK patent portfolios and cutting patents, leading to shorter patent lifespans. Pressure on patent holder's costs and internal budgets was the reason given for maintaining patents for a shorter time. This may mean that IPO renewal income is increasing less quickly.

Although the benefits of vigilance over patent renewals have been outlined (for example, by Hargreaves), the cost structure of the IPO (which is currently designed to meet running costs) is weighted towards the later end of the maximum renewal period. This may need to be reviewed in conjunction with shorter patent lifespans,

The Hargreaves review notes that the level of renewal fees needed to have an effect on patent thickets is quite significant. There is room to raise patent fees above the level needed to meet the running costs of the IPO, but this needs to be considered in the international context, and how any change in UK fees may have a disproportionate effect on UK patent holders.

3.2 Patent Box

Patent Box is a lower ten per cent rate of corporation tax which can be claimed on profits from patented inventions in the UK. In our qualitative research, Patent box was seen as a positive thing by large companies and attorneys. The consensus was that Patent Box in some cases attracts FDI and influences companies to undertake R&D in the UK, which benefits the UK economy. The tax incentive is one factor that companies will take into account in decisions about where to undertake R&D, however the monetary advantage of undertaking R&D and production abroad can still greatly outweigh the money saved through Patent Box. Companies said they would find proposed changes to the rules challenging, and would prefer more long-term certainty.

Small companies and individuals were in general not aware of Patent Box and large companies and attorneys said it would be difficult for small companies to use if they did not have their own accounts departments. Large companies already find the process complicated, and a specialist knowledge of R&D and IP is required.

The first year of Patent Box usage statistics were released in September 2016. In 2013-2014, 700 companies claimed relief under the Patent Box with a total value of £342.9 million. Just under one third were large (225 or 32.1% of total) but they claimed £327.2 million of relief (95.4% of the total) (25).

16 A 'patent thicket' is an overlapping set of patent rights which can stifle innovation in that area. Patent thickets can be caused by negative or defensive patenting. There is debate around the extent to which patent thickets exist and the impact of patent thickets.

3.3 Quality of services

In stakeholder interviews, the standard of the search and examination at the IPO was seen as very high, with a well-judged inventive step. Customer service was highly praised, particularly the approachability of examiners. This is supported by data on the overall average customer satisfaction measure of 84.4% in the year 2015 -16 (against a target of 80 per cent)[17].

In interview evidence with stakeholders in the UK and abroad, the UK was regarded as a strong influence on global patent policy. Building international relations was seen as a key strength of the IPO. One specific example of this was the UK-China symposium, which was mentioned as improving relations between businesses in the UK and China, and receiving positive coverage in Chinese media. Stakeholders mentioned that they value being consulted on proposed changes and appreciate the opportunity for open dialogue with the IPO.

Work that the IPO does on IP awareness and education is seen as helpful and appreciated, although there is always more that can be done. This was mentioned particularly with regards to IP awareness of SMEs and engineers and inventors within companies. There were comments that IP awareness is not solely the responsibility of the IPO and should also be done through trade and professional bodies and stakeholder groups.

3.4 Timing

The time frame for acquiring a patent in the UK is similar to that of comparison countries. Figure 15 shows the distribution of patents granted in 2012[18] by the number of years to grant for key patent offices. The data includes accelerated patent applications (that were subsequently granted), but not utility model patents.

Figure 14: UK processing times on par with comparison countries

Number of years from application to grant (patents granted in 2012)

	Patent office						
	UK	**Germany**	**France**	**Europe**	**US**	**Japan**	**China**
% of patents granted	IPO	DPMA	INPI	EPO	USPTO	JPO	SIPO
within 4 years	92	67	91	52	82	37	60
within 2 years	38	39	48	12	40	9	9

Source: IPO analysis of PATSTAT data (2012). Data includes accelerated applications but not utility models

Of patents granted at the IPO in 2012, 92% were granted within four years of application (Figure 14). This is a higher proportion granted within four years than other major comparison offices. France granted 91% of 2012 patents within four years, and Germany granted 67%.

17 Internal IPO data

18 2012 is the latest complete year of data available through PATSTAT

38% of patents granted in 2012 at the IPO were granted within two years (this includes accelerated applications). This compares to 39% for Germany and 40% for the US. France granted a higher percentage of 2012 patents within two years, at 48%. The European and Japanese Patent offices on average take longer to grant patents. Of patents granted in 2012, the EPO granted 52% within four years, and the JPO 37%.

Applicants do not necessarily want their patent to be granted as quickly as possible (25)[19]. They may prefer it to be processed quickly or slowly depending on market conditions and what their competitors are doing. Differences between patent systems will affect data on processing times, for example the DPMA (German) application system makes it possible to effectively slow down an application once it is underway. This could explain Germany having a similar proportion of applications granted within two years (compared to other offices), but a lower proportion granted within four years (these could be patents where it is to the advantage of the applicant to process slowly).

The length of the standard process has increased at the IPO in recent years, and there are examination backlogs. This is a challenge in common with most major patent offices. The Hargreaves Review says "the increasing number of patent applications worldwide has led to large and growing backlogs at most major patent offices". This is due to factors such as a 'boom' in application numbers and the number of amendments required per application (in the UK this increased by an average of six from 2001 to 2013) (26), which can increase processing time per patent.

A 2013 joint IPO/USPTO report highlighted the difficulty of measuring backlogs and particularly comparing between systems where the responsibility to drive the application process switches between office and applicant at different times according to the application process (20). A 2014 report from IP Australia using the same methodology estimated inventories of around 198 applications per examiner at the IPO, compared to 169 at the USPTO and 278 at IP Australia (21)[20].

To tackle pendency times, the IPO/USPTO report recommends increasing examiner capacity (20). The IPO has recruited and is currently training a cohort of examiners. In interviews, stakeholders were aware of and welcomed this increase in capacity, but it will still take time to see the desired improvements in processing times.

The report also recommends targeting applications currently with applicants which have completed first examination but are still pending before grant or abandonment (20). Interview feedback agrees with this as stakeholders said they would like to see faster resolution of abandoned applications, which could make processing times quicker. This may also be helpful to third parties by releasing information and so increasing ideas available to stimulate new innovation.

19 IPO consultation on 'superfast service' (2013) proposed a service capable of delivering a patent in around 90 days. While some respondents were in favour, many raised concerns, and this services was not introduced. (61)

20 This is based on a measure of the number of pending applications at any stage between filing and grant or abandonment)

In interviews, large companies and particularly attorneys cited the speed of the standard process (not including acceleration options) as the aspect they would most like to change about the UK system. Changes to the standard option that stakeholders would like to see include more flexibility and choice on which patents are processed at different speeds, creating a tiered system with medium options between the acceleration options and the standard option. They also want the length of the process to be more predictable, e.g. a guarantee that the whole process will be completed within a certain timeframe. Although it is important to note that any increase in flexibility and ability to delay grants could have a negative impact on third parties, which would also need to be considered.

The acceleration options of accelerated CSE and Green Channel were very highly praised, and considered better than options available at some other major patent offices. In 2015-16, 96 per cent of requests for accelerated two month turnaround for search, publication and examination were met (against a target of 90 per cent)[21]. Stakeholders abroad and attorneys reported that processing speed was what they valued the most, but they were not always aware of acceleration options which could be more widely advertised. Some companies in the UK said they wanted to be able to patent more quickly to keep up with the market but also appeared unaware of acceleration options.

A guaranteed processing time of two years was suggested as an option, which is already very possible if applicants go through the Combined Search and Examination (CSE) route. Some stakeholders were not aware of this service, or cautious about giving away commercial information. Giving applicants a choice of guaranteed timeframes could possibly be met by expanding or categorising and increasing awareness of existing options.

The speed of the standard search was widely considered to be good and a good balance between pace and quality, at a low price. It is known that many companies use the UK search to test their application initially before going on to file at other patent offices (such as the EPO), and this came through in interviews.

From the interviews it appears that applicants did not consider the fees expensive and that there is room to raise fees which are low compared to other jurisdictions, and this would be particularly applicable to a guaranteed faster service. Companies who wanted faster processing and guaranteed processing times said they would be willing to pay a lot more for this in terms of application fees (some companies noted how large the monetary benefits of faster processing could be to them). The effects of any increase in price need to be managed carefully considering access for different stakeholder groups, including SMEs and individuals. However, direct administration fees are usually a small proportion of the overall cost of obtaining a patent.

21 From internal IPO data

3.5 Legal services and enforcement

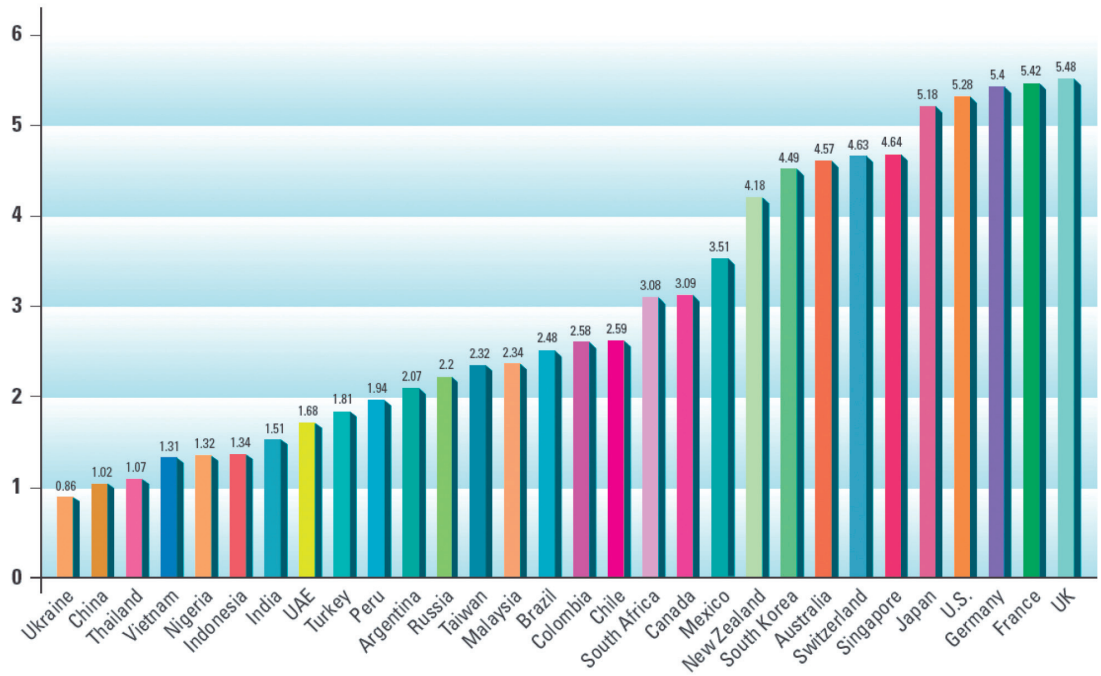
The UK is regarded among the best patent enforcement environments. In the Taylor Wessing GIPI4 Index (2015), the UK was listed as the top jurisdiction for patent enforcement (27), and in GIPI5 (2016) (22) it was second only to Germany, but the top jurisdiction for patenting overall. The Taylor Wessing indexes are a result of worldwide survey of IP owners and users, with responses weighted by empirical factors (such as numbers of patent filings). On the UK legal system the index explains:

"The courts of England & Wales have traditionally been well regarded for patent litigation. Apart from the availability of competent professional advisors, the factors most cited to support the high scoring were the competence, reputation and specialisation of the judges (including their technical backgrounds), the consistency, reliability and ease of predicting decisions and the influence that such decisions have in other jurisdictions." (22).

In 2015 the US Chamber of Commerce ranked the UK the best jurisdiction in the world in terms of the enforcement of IP rights, with a score of 5.48 out of 6 (Figure 16) (28). This was based on six variables including physical counterfeiting rates, civil and procedural remedies, pre-established damages, criminal standards and effective border measures. France and Germany were listed second and third with scores of 5.42 and 5.4.

Figure 15: UK scores highest for enforcement of IP rights

Comparing enforcement of IP rights across countries – index from US Chamber of Commerce



Source: GIPC International IP index, US Chamber of Commerce 2015

In GIPI5 the UK does not rate as well in terms of cost-effectiveness of enforcement (seventh) (22). However, respondents listed overall costs as less important for patents than for other IP rights, behind what they considered to be more important factors of 'competence, reputation and specialisation of judges' and 'ability of competent professional advisors' (cost was the most important factor for other IP rights) (22).

Patent ligation in the UK is mostly used for solving disputes about the scope and validity of patents rather than punishing outright infringement (29). In 2014 there were 72 EP and UK patent cases commenced in the Chancery Division, Patent High Court (PHC), and the Intellectual Property Enterprise Court (IPEC). Of these 53 were PHC cases, and 17 were IPEC cases (30).

Reforms at the Intellectual Property Enterprise Court (IPEC)[22] 2010 -2013 introduced a cap on recoverable costs and damages and reduced the length as well as complexity of court actions. Helmers et. al (2015) quantitatively and qualitatively analysed the reforms (31), and found the reforms led to a large increase in the quantity of cases filed at IPEC. SMEs substantially increased their case filings and the number of out-of-court settlements increased. They conclude that the cost caps were one of the most influential reforms, although lobbyists feel that the cost of taking a case to the civil court is still prohibitively expensive for inventors, mainly because of the risk of losing, which can run in to tens of thousands, although are capped to £50,000 in the IPEC multi claims track and £10,000 for the small claims track.

The topic of legal costs was raised in our qualitative interviews. The majority of stakeholders abroad said that UK legal costs in terms of application and enforcement could discourage companies from patenting there. Some said legal costs are one aspect of the general high cost of doing business in the UK, which can be exacerbated by exchange rates. However, stakeholders abroad consider the standard of the legal system to be high (i.e. they are paying a lot but get a good service), and the opportunity to work in the English language was a positive thing. A comparison of different legal costs of patent court cases highlights the high costs in the UK, with German court costs estimated at around €40,000 to €100,000 per party, compared with UK estimated costs of £1.5million for each side for cases that reach trial (32).

Interviewees compared the UK jurisdiction to Germany and the US. Relatively low legal costs were named as a key benefit of patenting in Germany, after attractive consumer and producer markets. The German legal profession is low cost but seen as high quality and attorneys could often work in more than one language, normally including English. Our IP attaches reported that German attorneys appear to advertise their business more abroad.

The US is seen as more litigious and companies are prepared to litigate more there. One company interviewed said that "patent trolls are seen as a cost of doing business in the US". This agrees with historic data which indicates that globally, most patent infringement suits are brought in the US: in 2001, 2,500 cases were filed there (33). As companies patent more in the US due to threat of litigation, this will increase patents filed there but this could be in a way that is detrimental to innovation.

22 Formerly the Patents Country Court

Within Europe, the most patent infringement filings take place in Germany. Between 1993 and 2003, 32 per cent of European patent infringement cases were brought in Germany, with 24 per cent of cases in the UK and 14 per cent in France (33). A substantially larger number of patent cases are counted in Germany, with a case load between 12 and 29 times larger than the UK (35).

The interviews report that the German legal system is thought to be friendlier towards patent holders. The dualistic system in German courts bifurcates infringement and validity into separate proceedings in different courts. This means a patent claim can be selected and presented in different ways – narrow in scope to gain validity and wide in scope to imply infringement. Injunctions are perceived as easy to obtain, hard to challenge for defendants and also run while a case is up on appeal.

Although this makes Germany an attractive place for patent holders to litigate, and therefore maybe a more attractive place to file patents, this does not necessarily contribute to a fair enforcement environment. UK attorneys we interviewed said they would prefer not to see bifurcation in the UK, as the benefits of bifurcation to strengthening the patent system and encouraging innovation are questionable. Taylor Wessing GIPI5 explains:

“As one respondent noted…’bifurcation provides a tactical advantage for the patentee in Germany because of the time taken for nullity disputes’. It suits defendants of charges of infringement less well, however….this explains the near-30 point gap between it and the UK in this [patent] sub-index.”

Chapter 4: UK companies and patenting

UK companies patent less than companies in comparator countries. For example, of large R&D investors, UK companies have an average of 87 patent families filed, compared to 353 and 440 patent families on average per French and German company respectively (37)[23].

SMEs have particularly low levels of patenting among UK companies. Less than one per cent of UK SMEs had granted patents in 2014 (37) (compared to around 4 per cent of large companies).

Companies and attorneys reported that increasing understanding of how to use patent attorneys and the benefits of patenting (including how to bring products to market), as well as making costs more predictable would support SMEs in their interaction with the patent system.

The low level of UK companies patenting could be mainly due to differences in sector makeup between countries, for example the smaller manufacturing sector. Levels of R&D investment are lower in the UK than other key patenting countries, which could also affect the number of patent applications filed.

Controlling for sector makeup, and R&D investment, UK companies patenting is still lower. Evidence from the Community Innovation Survey and stakeholder interviews suggests this could be due to wider cultural differences and market strategies.

4.1 Patenting propensity of UK companies

Companies in the UK do not have a high propensity to patent. The research analysed patent data of companies reporting assets in the FAME business database; see appendix 2 for further details on the dataset. In 2014, only 0.09% of UK companies in the sample had patents granted in that year (figure 16).

Figure 16: Patenting is very low among UK companies

UK companies with patents granted and applications published (2010 – 2014)

	2010		2011		2012		2013		2014	
UK companies		%		%		%		%		%
patents granted	1,730	0.07	1,960	0.07	2,090	0.08	2,170	0.08	2,300	0.09
applications published	2,880	0.11	2,860	0.11	2,910	0.11	3,070	0.12	3,410	0.13

Total companies reporting assets 2 637 178
Source: IPO analysis of FAME-linked data
Company data rounded

23 This counts patent families with a patent filed at an IP5 office and at least one other office

In 2014, 0.16 per cent of companies reporting assets held a GB patent and 0.1 per cent held a European patent (Figure 17)[24].

Figure 17: Very few UK companies hold UK or European patents

UK companies with UK and European patents in force (2010 – 2014)

	2010		2011		2012		2013		2014	
UK companies		%		%		%		%		%
UK patent	3,450	0.13	3,670	0.14	3,910	0.15	4,180	0.16	4,320	0.16
European patent	2,080	0.08	2,220	0.08	2,340	0.09	2,500	0.09	2,690	0.10

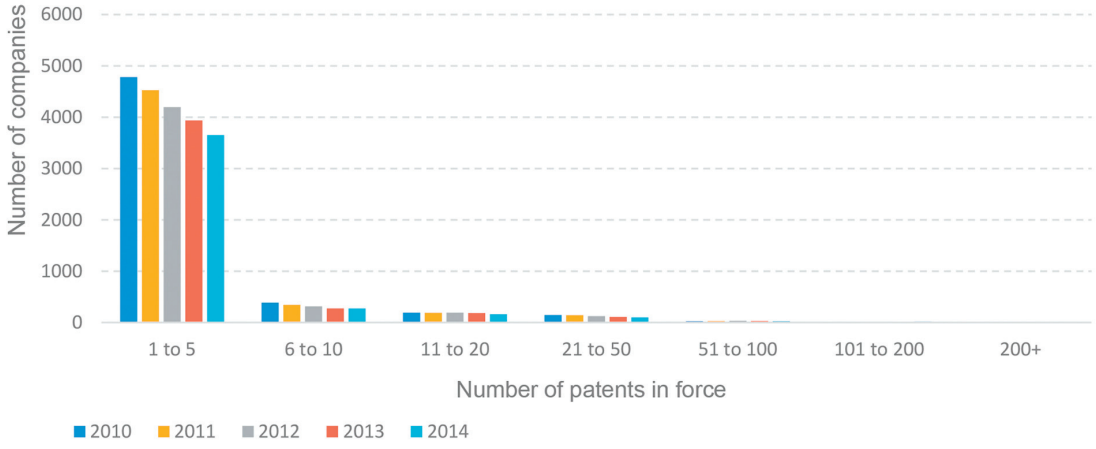
Source: IPO analysis of FAME-linked data
Total companies reporting assets 2 637 178

Other measures of the probability of a UK company patenting are slightly higher, but still low. Arora et al (2013) note that in the Community Innovation Survey (CIS) 7 (2008 - 2010) 2.6 per cent of all UK companies reported having patented. This is lower than in previous survey years; CIS 6[25] 2.8% (2006-2008)), CIS 3% (1998-2000) (34).

These measures differ from the FAME-matched measure because the sample is wider than those companies registering assets in the FAME business database and it is self-reported. The count includes companies that have held patents previously but no longer do, and counts a company that has a patent filed in any country, not limited to the UK. Although the counts differ it can be concluded that the probability of UK companies patenting is low.

Figure 18: UK companies' patent portfolios are usually small

Size of UK companies' patent portfolios, UK and European Patents only (2010 – 2014)



Source: IPO analysis of FAME-linked data. Patents have been moved to parent companies where accounts are consolidated to avoid double counting financial data.

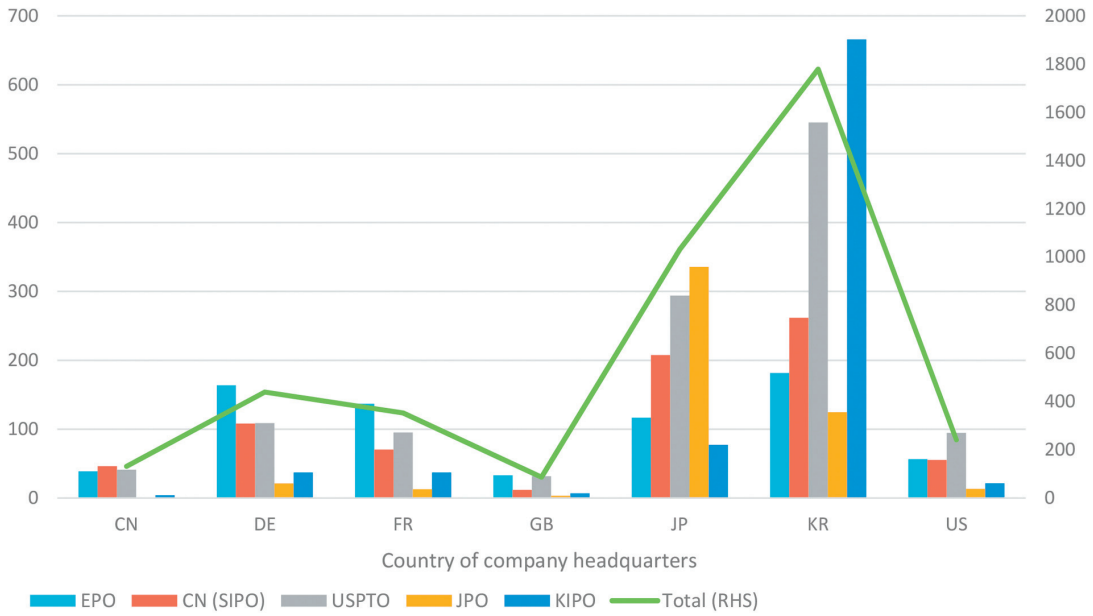
24 GB and EPs counted separately so some companies may be represented in both figures
25 2006 - 2008

Figure 18 shows the size of the patent portfolios for UK companies that filed assets in 2014. This count is of UK and European Patents only. The majority of companies have very small patent portfolios; in 2014, 4782 companies had one to five UK and European Patents, and even fewer companies have larger portfolios.

Figure 19 shows patent families per company for the top 2000 R&D investing companies in the world. UK companies have an average of 87 patent families per company filed at an IP5 office and one other office[26]. The US, Germany and France have an average of 241, 440 and 353 patent families per company respectively. Korea and Japan dominate in terms of the number of patents families per company. Korea has the lowest proportion of companies in the top 2000 (56), but the highest number of patent families per company at 1,779.

Figure 19: Large UK companies have fewer patent families than large companies in other countries

Patent families per company by country: patent office filed at and total



Source: IPO analysis of OECD data 'Top 2000 R&D Investors Database'
Number of companies in sample: US (658) Japan (353) Germany (130) UK (106) China (93) France (75) Korea (56)

26 OECD Top 2000 R&D investors (2015)

4.2 Patenting in the UK by company size

The FAME - linked data can be used to look at the patenting propensity of UK companies of different sizes. Companies were split by size measured by assets, number of employees and turnover. Definitions of company size are outlined in Figure 20.

Figure 20: Definitions of company size

	Employees	Turnover	Assets
Company size		**(£ million)**	**(£ million)**
Micro	< 9	< 1.6	< 1.6
Small	10 - 49	1.6 – 8	1.6 – 8
Medium	50 - 249	8 - 40	8 - 35
Large	> 250	> 40	> 35

Source: A combination of EU and UK definitions, converted to GBP where necessary using yearly average rates[27].

Figure 21: Only a small proportion of UK companies patent

Percentage of UK companies in 2014 with patents granted by company size

	Company size definition		
Company size	**By assets**	**By employees**	**By turnover**
Micro	0.0%	0.1%	0.1%
Small	0.4%	0.6%	0.6%
Medium	1.1%	1.6%	1.5%
Large	2.2%	4.2%	4.0%

Source: IPO analysis of FAME- linked data

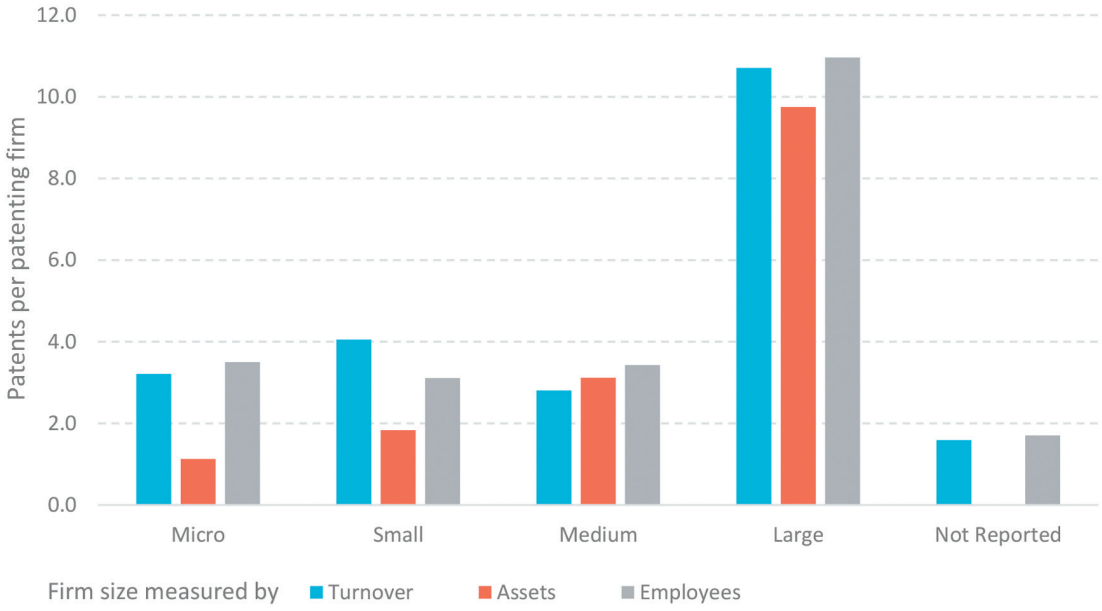
Figure 21 shows the percentage of companies in each group that had patents granted in 2014. UK companies have a low propensity to patent, regardless of their size and how company size is defined. Large companies are unlikely to patent, as only four per cent of companies with a turnover of over £40.3 million had patents published in 2014. Only 0.6 to 1.5% per cent of small and medium companies and less than one per cent of micro companies had patents published in 2014.

Figure 22 shows patent publications per patenting company in 2014. Measuring company size in terms of turnover, micro, small and medium companies published 3.2, 4 and 2.8 patents per company respectively. Medium companies that patented filed a disproportionately low number of patents (below that of small companies, although this does not control for differences such as sector makeup across the small and medium categories). Large companies that patented published on average ten patents per company.

27 See (52) (46) (51) (54) (53)

Figure 22: Even patenting firms have few patents

Patent publications per patenting company by company size (2014)



Source: IPO analysis of FAME-linked data

Interview evidence deems the main barrier to patenting for small companies to be cost, particularly the cost of legal advice (other application costs are described as 'cheap' and 'manageable'). This fits with evidence such as Arora, Athreye and Huang (35)[<?>] which found that company size (in terms of employment) does not affect patenting propensity once profits and innovation (in terms of bringing new products or service to market) are controlled for. In recent analysis of the Survey of Innovation and Patent Use (SIPU) data by Athreye and Fassio, 20 per cent of small companies that innovated but didn't patent said that their reason for not patenting was that the cost of application was too high (36). This compares to 7% of medium companies and 3 per cent of large companies giving the same answer. High costs were a significant factor in whether small companies patented, but if companies had any external finance, this reduced the likelihood of high costs stopping them from patenting (36).

The concerns of small companies and the cost of patenting centre around three areas:

Predictability of costs: It is hard to predict how much the patenting process will cost upfront, and this could escalate through the process e.g. depending on the number of objections. This is particularly difficult for small companies on limited budgets.

Misunderstanding about the role of patent attorneys: There is a lack of understanding about the role of patent attorneys, why they are needed and how to get the best out of the relationship. This was reported not only by small business advisors but also from some large companies and patent attorneys themselves.

28 See also Grilliches, Pakes and Hall (55)

Lack of understanding of the benefits of patenting: Almost all the small business advisors and inventors emphasised the need to present the use of patents to companies in terms of a business plan. This should include commercialisation of the product and how to bring it to market. This will help to prevent small companies from patenting when they do not need to and when they do not know how to bring a product to market, which is cited as a common problem. It also balances the perception of patenting as a large upfront cost with the benefits it can generate in the long run.

One option for commercialisation is licensing the invention to larger companies – although this is seen as a useful channel for small companies to bring products to market, it can be difficult to do. Small companies lack networks and barriers of size can restrict market entry even in terms of selling the invention and not producing it.

Although small companies are aware of the concept of patenting, levels of understanding vary. Small companies in some geographical areas (e.g. where they are part of a strong business network) and sectors (e.g. tech start-ups) often have better awareness of how to use the patent system. Examples of misconceptions include that the government will enforce their patents, and that an application receipt or technical drawing is a patent. There is very little awareness among small businesses of government incentives such as Patent Box and the IPO's Green Channel.

From the interviews it appeared that the level of patenting awareness among engineers and inventors varies a lot (even in medium and large companies and universities), down to an individual and team level. There is disagreement as to whether it is within the job description of engineers and inventors to be educated in intellectual property (as is generally perceived to be the case in Germany) and how to go about this, or if IP considerations are best placed in other job roles. What was important was that the organisation had the wider strategic skills needed to commercialise their IP effectively.

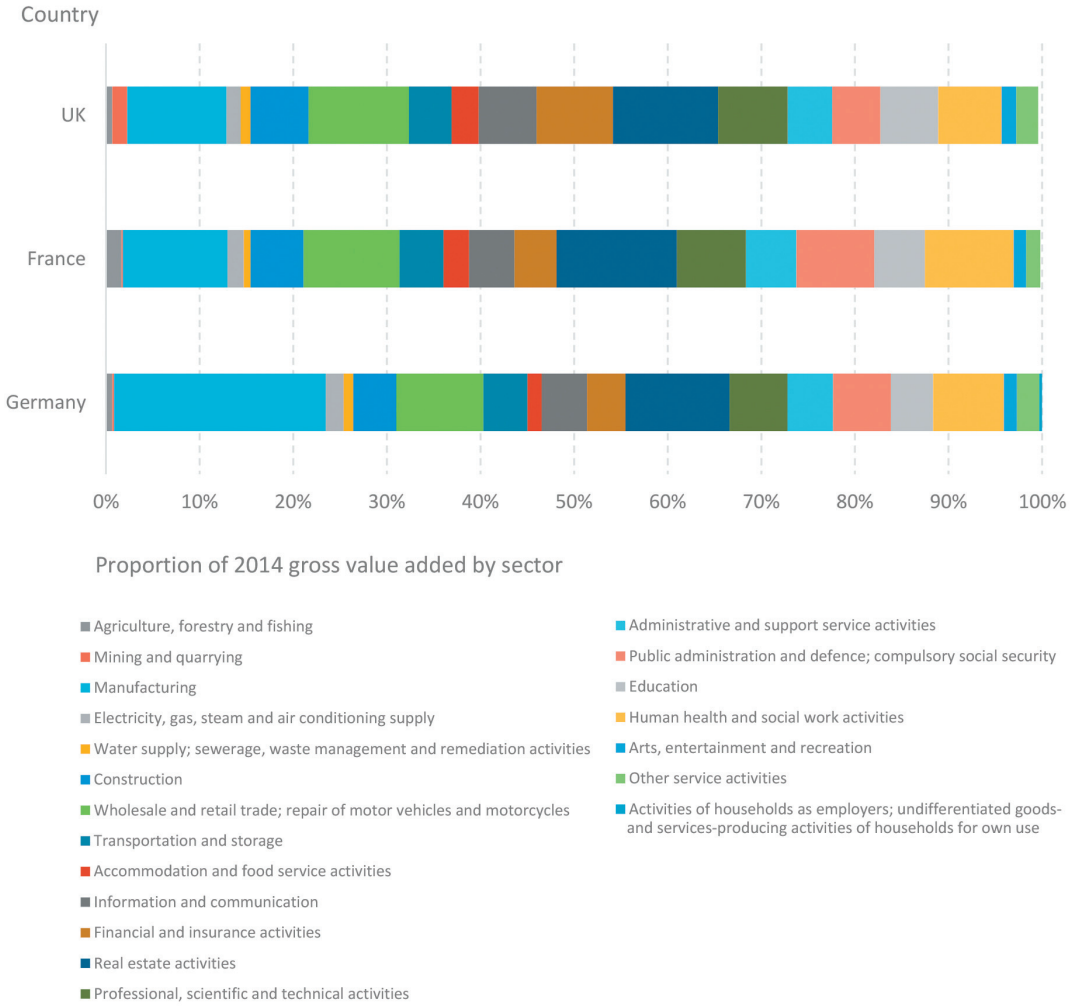
4.3 Sectors

The relatively smaller size of the UK manufacturing sector (in comparison with countries such as Germany) could go some way towards explaining why companies patent less in the UK. It means that UK companies manufacture less, and that foreign companies and their competitors are less likely to manufacture in the UK. Our qualitative evidence on patenting is that foreign firms will patent in a jurisdiction if they or their competitors manufacture there (and if there is a consumer market for the product).

The UK economy is business and services oriented, and has a relatively small manufacturing base compared to countries such as Germany (Figure 27). Germany's large manufacturing base contributed 23% of German GVA in 2014, compared to 11% for manufacturing in the UK and France. In absolute terms, this is €594,000 million in Germany and around €213,500 million in the UK and France. The UK has a strength in business services (particularly finance), a sector reported in the literature as having a low propensity to patent (34) (37). This was 8% of GVA in the UK in 2014 (€164,000 million), compared to 4% for Germany (€108,000 million) and France (€86,000 million).

Figure 23: UK manufacturing comparatively small

Industrial Sectors of UK, France and Germany: 2014 Gross Value Added



Source: IPO analysis of Eurostat data

Industry sector is highlighted in the literature as one factor affecting companies' propensity to patent (9) (34) (37). The US legal system criteria for a patentable invention as 'something which can be made or used' lends itself to some sectors over others. This is closely linked to technology used in the sector. Hall (2009) (9) noted that sectors which consider patents the most important contain technologies that can be relatively well defined by a patent document.

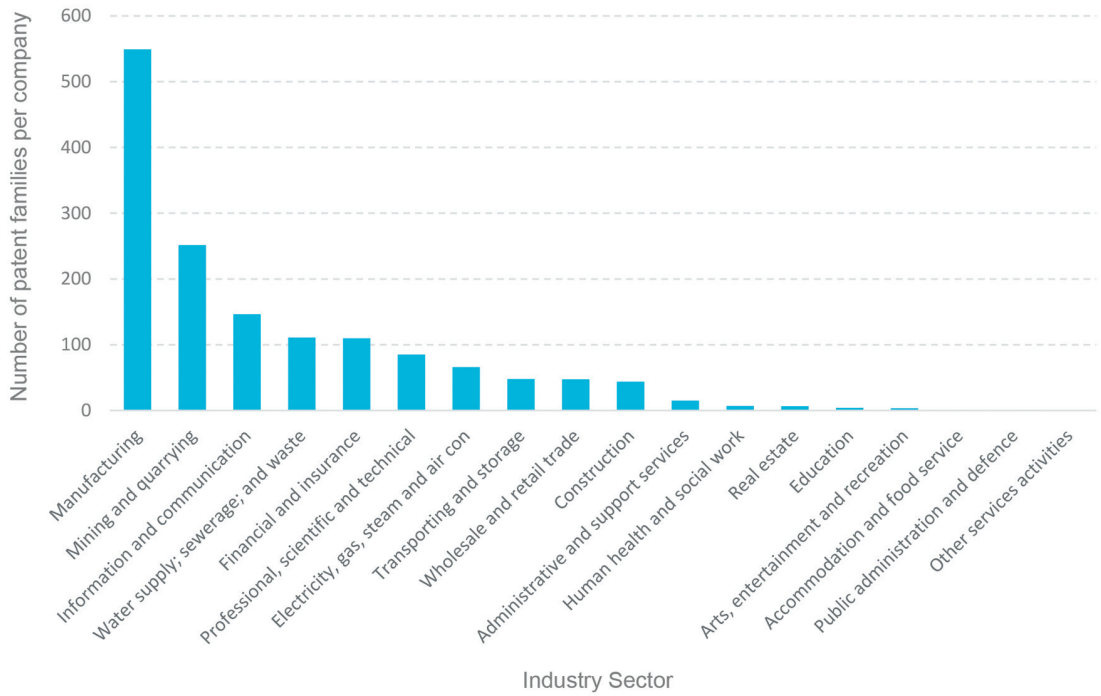
There are also differences in what is allowable in patenting differs between jurisdictions, and this will impact sectors differently. The limits on software and business method patents in the UK and Europe mean that firms in related sectors (such as service industries) will apply for fewer patents than they would in jurisdictions which allow more of such patents (such as the US). We therefore should expect less patenting activity in these sectors.

Arora and Athreye (2012) confirmed that companies operating in manufacturing and pharmaceuticals produce inventions which are particularly suited to patenting, whereas the service sector relies less on patents (37). This is confirmed by Hall (2009) who analysed the results of eight surveys to find which sectors value patents the most for appropriating returns to innovation. This was overwhelmingly pharmaceuticals and chemicals, but also included machinery, communication equipment and transport (9).

Hall et al (2013) analysed differences in intellectual property preferences between two major innovating sectors: manufacturing and Knowledge-Intensive Business Services (KIBS), which includes business services, computer services and R&D services. They found that manufacturing firms have a preference for patents where they are new-to-the market product innovators, but KIBS firms prefer trade secrecy to patents as a means of intellectual property protection (34).

Figure 24: Manufacturing companies patent far more

Patent families per large R&D investing company by industry sector (2014)



Source: IPO analysis of OECD data

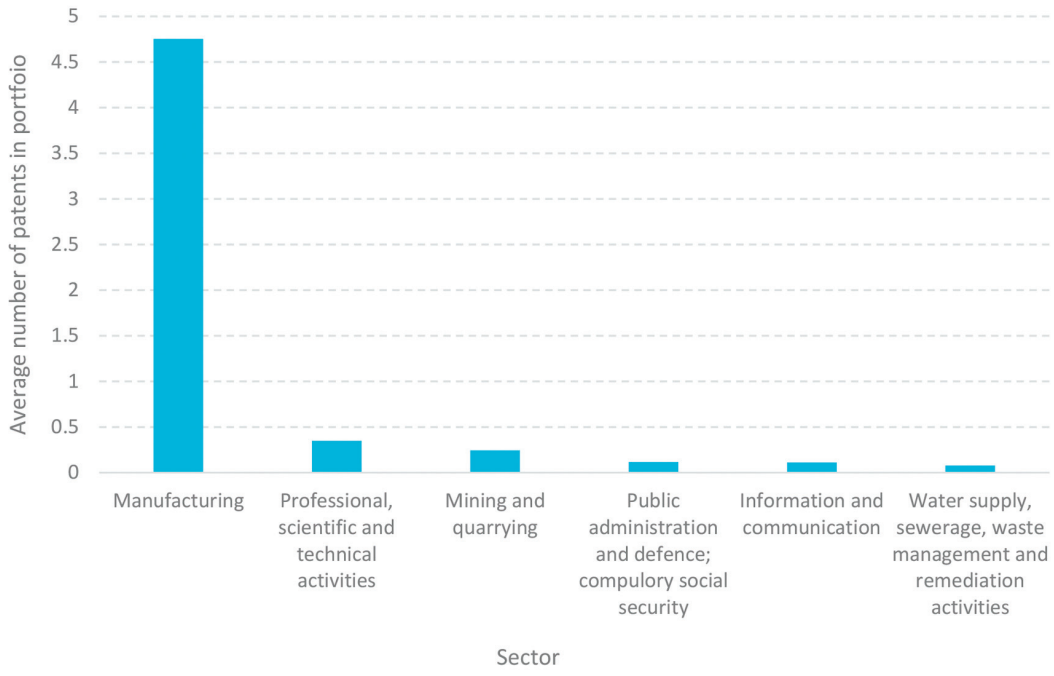
Analysis of OECD and FAME-matched data agrees with the broad conclusions drawn in the literature that manufacturing companies patent more than those in service-based sectors. The relationship between industrial sector and propensity to patent can be seen in the OECD data (Figure 23). Manufacturing companies have more patents per company (on average 549 patents per company) than any other sector. The sector with the second highest concentration of patents per company is mining and quarrying (251 patents per company).

The FAME-linked data for UK companies also reflects the importance of patenting to the manufacturing sector. In 2014, the manufacturing sector held the highest absolute number of patents, with 12,530 UK and European Patents, followed by 'professional, scientific and technical activities' (5,132 UK and European Patents held in 2014) (38).

Figure 24 shows that controlling for the number of companies in each sector by measuring patents per company, manufacturing continues to be the highest patenting sector, with 4.75 UK or European patents held per manufacturing firm in 2014[29]. Within the manufacturing sector, there is a wide spread of patents across subsectors.

Figure 25: Manufacturing has most patents per company in the UK

UK and European patents per company, top five sectors (2014)



Source: IPO analysis of FAME-linked data

The second-highest patenting sector is 'professional, scientific and technical activities', with 0.35 GB and EP patents per firm on average. Patenting in this sector is driven by 'scientific R&D', which accounts for 51% of patents in the sector. 'Mining and quarrying' had on average 0.24 GB and EP patents per firm in 2014. Patenting in this sector is driven by 'extraction of crude petroleum and natural gas', which hold 55% of patents in the sector.

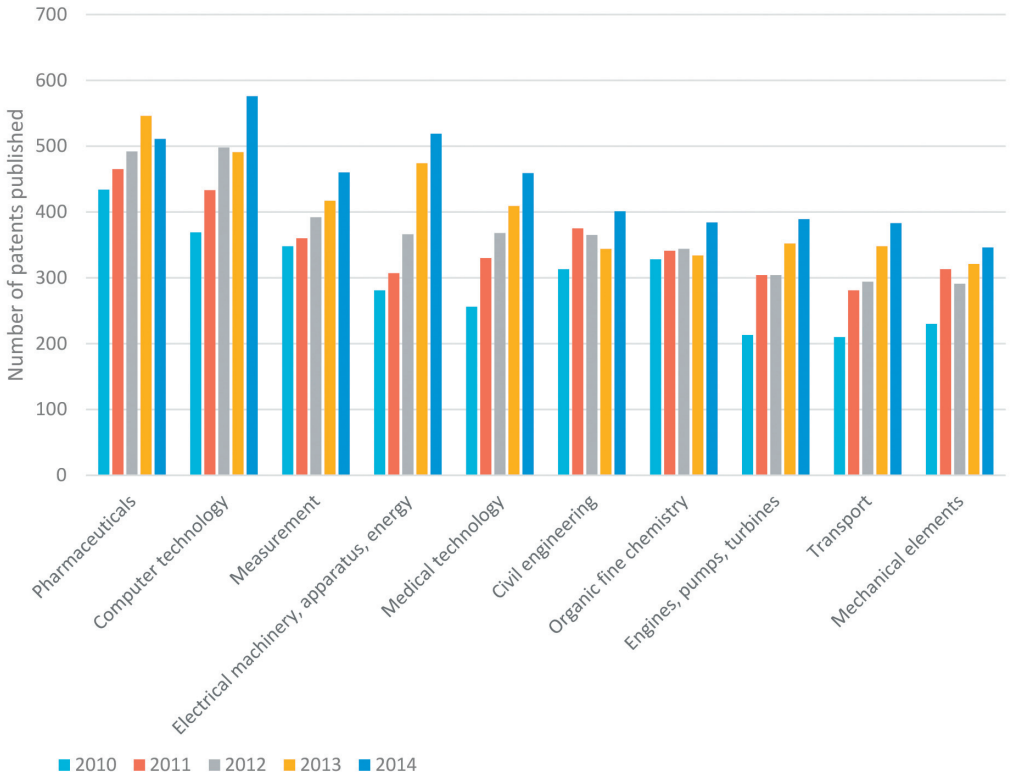
29 Of UK firms reporting assets in the FAME dataset

4.4 Technology

UK companies primarily patent in computer, electronic and pharmaceutical technology. Figure 25 shows technology classification of GB and EP patents published by UK companies. Pharmaceuticals was the most patented technology over the time period, with 2448 patents published between 2010 to 2014, although computer technology and electrical machinery were patented more in 2014.

Figure 26: UK patents most in computers and pharmaceuticals

UK companies' UK and European Patents published by WIPO technology classification (2010 – 2014)



Source: IPO analysis of FAME-linked data

The top patented technologies are closely linked to top patenting sector in the UK. Pharmaceutical technology drives the top two UK patenting sectors: 'manufacturing' and 'professional and scientific activities', particularly the subsector 'scientific R&D'. 'Electrical machinery technology' is used in the manufacture of computer and electronic products, which is also classified in the manufacturing sector.

Figure 26 shows the top technologies patented at national patent offices by all companies (domestic and foreign) in 2012. This is PATSTAT data which classifies technologies by International Patent Classification (IPC), in contrast to the WIPO classification system above. In contrast to the FAME-linked data, it allows for cross-country comparisons.

Figure 27: Computing most patented technology in UK and US

Patented technologies in selected countries International Patent Classification (2012)

	UK			US	
		%			%
Computing	1,300	12	Computing	62,100	18
Electric communication	1,200	10	Electric communication	38,400	11
Measuring instruments	700	6	Basic electric elements	33,000	9
Basic electric elements	700	6	Medical science	32,000	9
Medical science	600	6	Measuring instruments	16,000	5
	Germany			**France**	
		%			%
Vehicles	6,500	10	Vehicles	1,300	9
Engineering and machines	5,200	8	Medical science	1,100	7
Basic electric elements	5,100	8	Basic electric elements	1,000	6
Measuring instruments	3,700	6	Measuring instruments	800	6
Medical science	2,800	4	Computing	700	5

Source: IPO analysis of PATSTAT data (Applications to national patent offices, fractional count)

International Patent Classification from WIPO available at http://www.wipo.int/classifications/ipc/en/

Similar technologies are patented in the UK and US, in particular computing and electric communications. Together these technologies make up 22 per cent of UK patents and 29 per cent of US patents. France and Germany contrast to this as vehicle technology dominates with 10 per cent of patents filed in Germany in 2012 (6,501patents) and 9 per cent of patents filed in France (1,334 patents). The data on top patented technologies fits what would be expected from the literature, for example Greenhalgh and Rogers (2010) “the biggest users [of patents] are in the pharmaceutical industry, aerospace, motor vehicles, electronic goods and the extraction of oil and gas”.

Hall (2009) outlines the difference between discrete and complex industries and technologies, as described in studies by Cohen et. al (2000) and von Graevenitz et al. (2008) “a discrete technology is one where the typical product is covered by one or a few patents, usually held by a single firm. In contrast, a complex technology is one where a product is covered by many patents, usually held by several firms.” Pharmaceuticals are a discrete technology, whereas technologies such as computing, electronics and vehicles rely on complex systems which are more likely to be covered by a high number of patents. The UK has a mixture of industries that use discrete and complex technologies, for example pharmaceuticals and computing. This is in line with counterparts such as Germany and France.

Although computing technologies have the highest proportion of patents filed at UK and US national patent offices, in the US these technologies have a considerably larger proportion of patents (18% compared to 12% of patents filed). This could be due in part to the differences in patent policy and law between these countries in the treatment of software patents. Although other factors around the strengths of the USA in computing and the large domestic market are likely also important factors.

Software is a high growth area for patents; between 1987 and 1996, the number of software patents grew at 16% per year (16). US law is more liberal in this area and allows some software and algorithms to be patented, for example if they are considered to add to technology or make possible a new way of doing business. In Europe, the European Patent Convention does not generally allow software patents, but makes exceptions for Computer Implemented Inventions (CIIs), if they bring about a technical effect when running on a computer. While practice in both jurisdictions continues to develop the EPO generally grants fewer software patents than the USPTO. Differences in interpreting the law by UK courts mean that the IPO approach to granting software patents is more conservative than the EPO, which will grant patents irrespective of whether any granted patent would be found valid by the UK courts.

In a few instances differences in the treatment of software patents between countries were raised by stakeholders responding with qualitative evidence. International stakeholders reported that they would patent software in the US but were aware that it was more difficult to patent in the UK. If they want to apply for a software patent in the UK jurisdiction they would apply through the EPO which has a reputation for greater leniency in granting software patents.

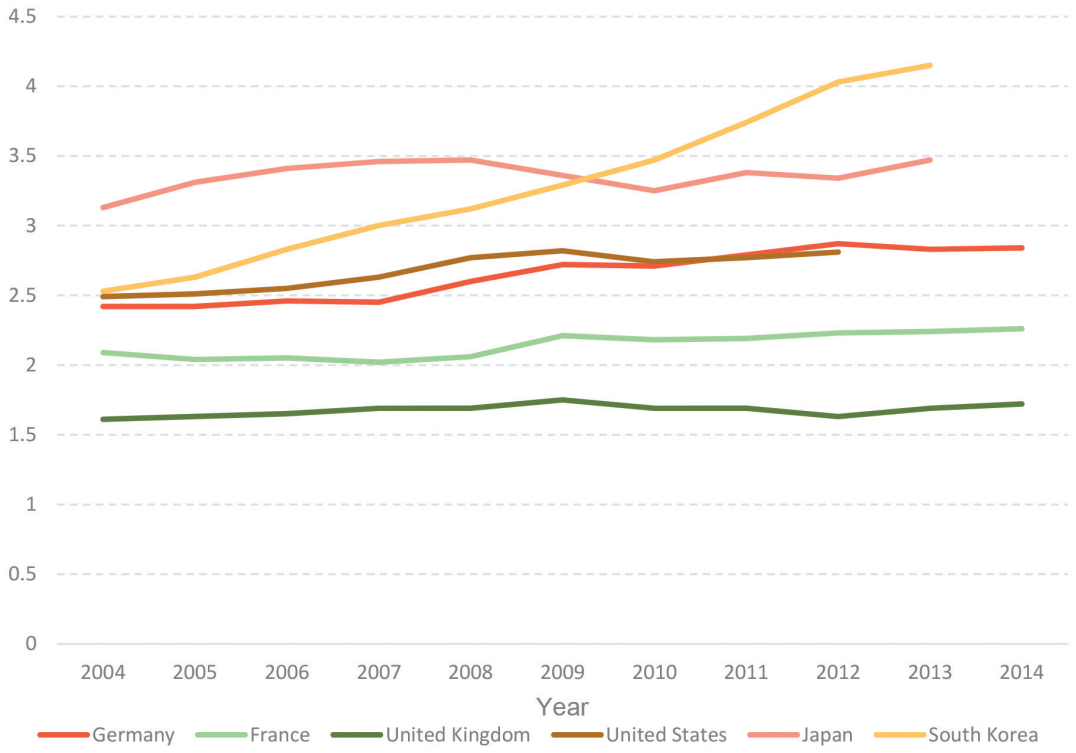
In computing, the top patented technology in the UK and US, the US is likely to have a lot more patents, but the evidence suggests that if this is due to more software patents it represents strategic patenting rather than higher levels of research inputs or productivity growth (16). The Hargreaves Review (2011) describes patent validity in technologies such as ICT as “inherently more uncertain than in other, less sequential technologies such as pharmaceuticals”. The Review warns that this can cause problems for companies by increasing ‘patent thickets’ and strategic patenting which hinders innovation. This agrees with research such as von Graevenitz et. al (2007) (38) which identifies technologies particularly impacted by patent thickets as electrical machinery, audio visual, telecommunications and ICT. In addition, the Hargreaves Review says that “the evidence that patenting supports innovation is weaker in computer technology and telecoms than in other areas. In these industries, inventions are nearly always “sequential,” where innovation builds cumulatively on previous inventions and innovations”. This can particularly cause problems for SMEs and market entrants, and therefore more patents in these technologies is not necessarily better and it should not be a policy aim to increase patents in these technologies.

4.5 R&D investment

Of the key jurisdictions in question, the UK has the lowest proportion of GDP spent on R&D, and UK R&D investment is more likely to be in sectors less suited to patenting.

Figure 28: UK has lower R&D expenditure than other countries

R&D Expenditure as a Percentage of GDP, selected countries (2005 - 2014)



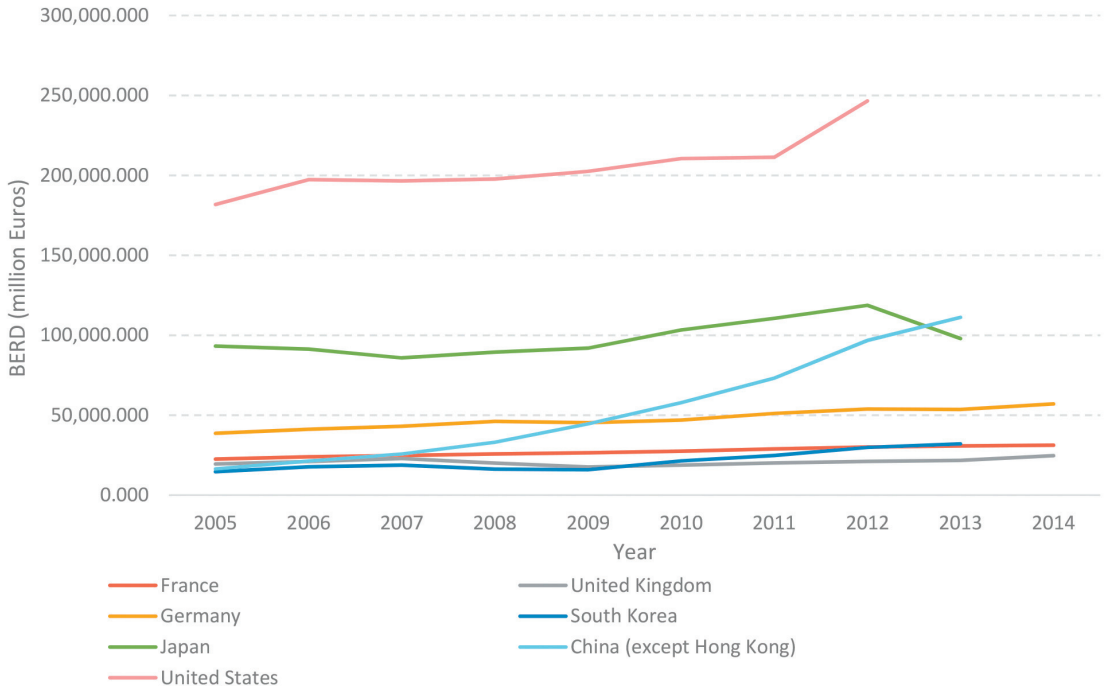
Source: IPO analysis of Eurostat data

At around 1.6 – 1.7% of GDP between 2003 and 2014, UK R&D expenditure is below EU and OECD average levels (39), and has not shown any significant increase in the last ten years (figure 27). The UK also had the lowest business expenditure on R&D in 2014 (Figure 28), at 25,000 million Euros. This was below France (31,000 million Euros) and Germany (57,000 million Euros). Data on BERD as a percentage of GDP is not readily available for all countries. Data for the UK, Germany and France shows a similar picture to absolute BERD; Germany is highest at 2%, France at 1.5% and the UK at 1.1%[30].

30 IPO analysis of Eurostat data: 'BERD by economic activity' and 'GDP current prices, million Euro' (40)

Figure 29: Business R&D expenditure also low in the UK

Business Expenditure on R&D (BERD) Selected Countries (2005 – 2014)



Source: IPO analysis of Eurostat data.

R&D has several different routes through which it conditions patenting. R&D expenditures determine whether (and how many) inventions the firm will produce, i.e. whether the firm is an innovator. Investment in R&D increases the expected number of inventions, and therefore the likelihood that the firm applies for at least one patent. R&D expenditures may also be related to the characteristics of inventions – if firms that invest more in R&D produce more patentable and/or higher value inventions, they will be more likely to patent.

Arora, Athreye and Huang (2013) found that R&D expenditures are positively associated with patenting. In this study R&D expenditure was the most consistent predictor of firm's patenting probability, whether the sample was conditioned on innovation or not. This confirms other literature (Pakes and Grilliches, 1980) which supports this conclusion.

As R&D spending and industrial structure are interlinked, R&D expenditure can be re-weighted by industrial sector to reflect the make-up of the economy. This does reduce the R&D expenditure of some countries, particularly Korea and Germany[31], but spending in these countries is still higher than the equivalent measure for the UK.

The type of activities R&D is invested in also follows patterns of sectoral make-up. The OECD says of the UK: "Investment in knowledge capital is high compared to other OECD countries, especially in economic competencies like organisational know-how, but investment in machinery and equipment has been persistently low." This can be seen in patterns of business enterprise R&D (BERD) spending. Germany leads BERD spending in manufacturing

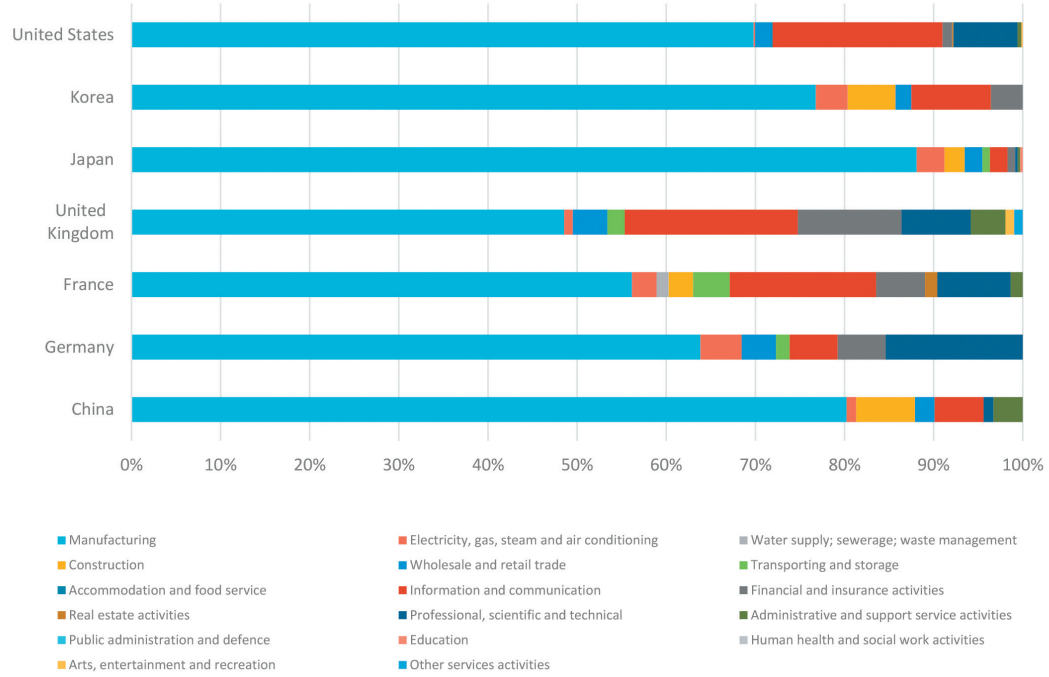
31 IPO analysis of OECD data (37)

(€46,000m in 2013), which was three times higher than France (€15,600m) and almost six times higher than the UK (€8,600m) (40). In contrast France leads BERD spending on 'services in the business economy' (€14,100m in 2013), which is closely followed by the UK (€12,300) and double that of Germany (€7,000). Differences in which sectors R&D spending is invested in reflect the sectoral makeup of the economy, and UK companies invest more in sectors less suited to patenting.

This is also reflected in cross-country data for large R&D investing companies. Figure 29 shows the sector makeup of the top 2000 R&D investing companies in the world. The UK is relatively well represented among top R&D investing companies, with 106 companies in the top 2000, compared to 130 in Germany and 75 in France. The US and Japan have the most companies in the top 2000 (658 and 353 respectively).

Figure 30: R&D investment of large companies refl ects differences in sector makeup between countries

Percentage of top 2000 R&D investors in each sector, by country



Source: IPO analysis of OECD Top 2000 R&D Investors data

Only 50 top UK R&D investors operate predominantly in the manufacturing sector. This compares to 83 German R&D investing companies and 311 Japanese. The UK has the largest proportion of top R&D investing companies in 'information and communication' and 'finance and insurance activities'.

4.6 Level of innovation

There are difficulties in measuring the level of innovation between different firms, with definitions of innovation differing, sectors innovating differently, and innovation happening in an international context (41). Although UK companies report slightly less innovation than French and German companies, the difference in reported levels is relatively small (43), and higher than top patenting Asian countries[32]. The UK fares better in service sector innovations (43), where companies report more new-to market products than their German counterparts, but services may be less suited to patenting.

Arora, Athreye and Huang (2013) (35) conclude that many of the variables discussed in the literature as influencing patenting actually influence innovation. This agrees with studies such as Baldwin et.al (2000) (42), which found a strong relationship from innovation to patenting, however the survey data used was only from the manufacturing sector. Studies from the US such as Arora, Cohen and Walsh (2014) (43) recommend considering innovation support as a whole, including patent incentives.

'Innovation' as an intangible variable is difficult to measure, and many studies use investment in R&D to approximate it. Surveys such as the Community Innovation Survey (CIS) ask companies whether they have introduced new products to market. Figure 30 shows the percentage of manufacturing and service companies who reported new-to-market product innovations in 2010-2012.

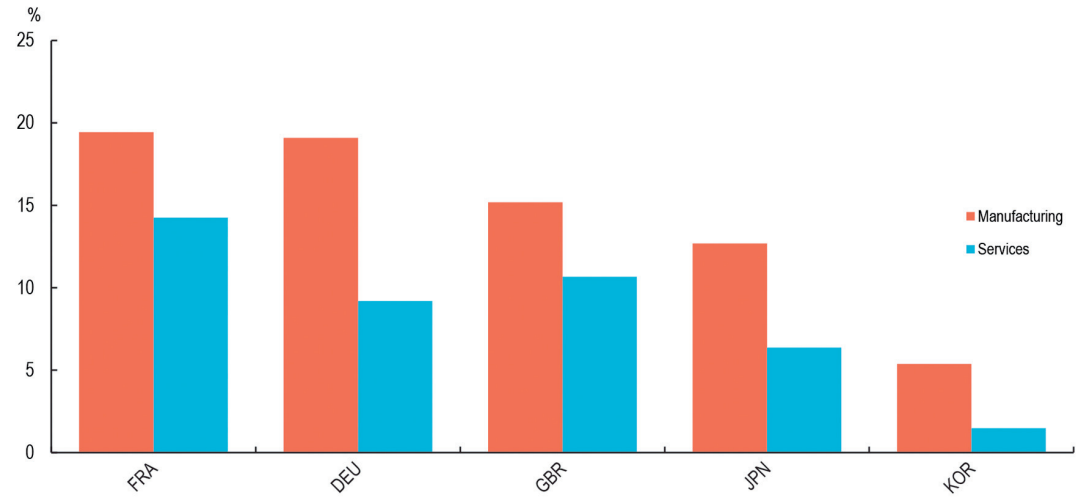
Manufacturing companies in each country reported more new-to-market product innovations than service sector companies. Of reported innovations, only a proportion will be inventions suited to patenting. We would expect new-to-market innovations in the manufacturing sector to be more likely to be patented than in the service sector, due to the definition of a patentable invention as 'something which can be made or used'.

15 per cent of UK companies in the manufacturing sector reported new-to-market product innovations. This compares to 19% of companies in the French and German manufacturing sectors. Although a lower proportion of companies in the UK manufacturing sector reported new-to-market product innovations, the proportion does not differ greatly, and top-patenting countries Japan and Korea report lower proportions of manufacturing companies with new-to-market product innovations (although this could be due to differences in the way the Community Innovation Survey is conducted between Europe and Asia).

32 This could be due to differences in the way the Community Innovation Survey is conducted in these countries.

Figure 31: UK competes better in services innovation

Companies that report introducing products new to the market in the manufacturing and services sectors (2010 – 2012)



Source: OECD analysis of Community Innovation Survey (CIS) data

For companies in the service sector the difference between the UK and France is smaller. UK companies reported more new-to-market product innovations than German companies in the service sector in 2010-2012.

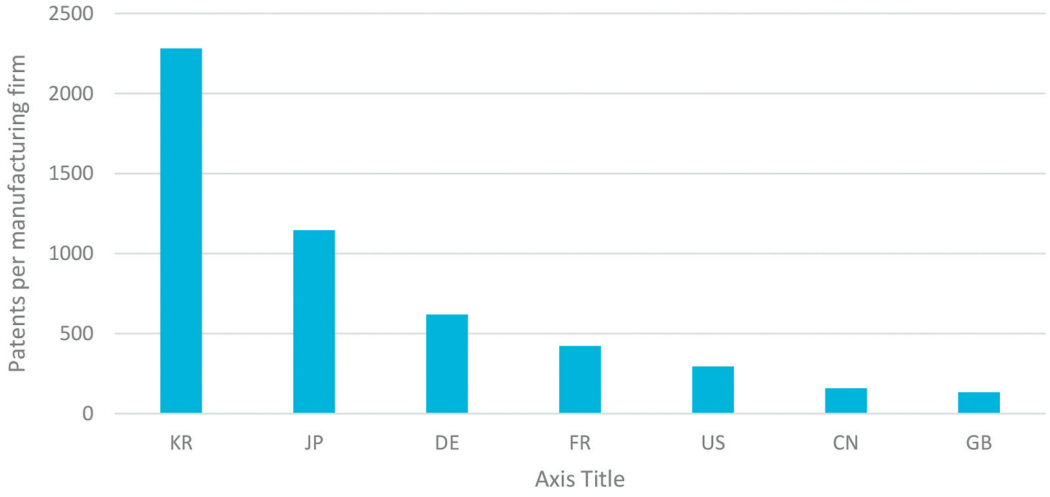
4.7 Cultural differences

In the OECD top investors data, UK manufacturing companies have fewer patents per R&D investment than their counterparts in other countries. This suggests there may be differences in patenting behaviour beyond sector and R&D influences. Interview reports of cultural differences in patenting between countries fit with literature such as Burk (2016) (44), which suggests that propensity to patent can be partly explained by conventions which are 'socially rational, but not necessarily economically rational'.

Measuring patents per company within a sector controls for differences in the sector makeup of the economy. Figure 31 shows the number of patents per manufacturing company in the top R&D investors' data. As the data is dominated by manufacturing companies, this is the only sector that provides a sample large enough to be reliably analysed. UK manufacturing companies have the lowest patent propensity, with 134 patents per company on average. This compares to Germany which had 619 patents per manufacturing company, and France which had 422 patents per manufacturing company.

Figure 32: Large UK manufacturing companies have fewer patents

Patents per manufacturing company in top 2000 R&D investors (2012)



Source: IPO analysis of OECD data

Measuring patents per million Euros of R&D investment, the UK companies have the lowest propensity to patent, with 0.4 patents per million Euros R&D. This compares with 1.0 for Germany and 0.9 for France. Companies in Korea and Japan had the highest propensity to patent at 5.7 and 3.6 patents per million Euros of R&D investment respectively.

Figure 33: Large UK companies have fewer patents per R&D investment

Patents per million Euros R&D investment per company in top 2000 R&D investors (2012)

	Manufacturing				All companies			
	Companies in sample	Patent families	R&D € million	Patent families /R&D	Companies in sample	patent families	R&D € million	Patent families /R&D
UK	50	6,700	14,100	0.5	106	9,200	22,500	0.4
Germany	83	51,400	49,300	1.0	130	57,100	56,400	1.0
France	41	17,000	17,600	1.0	75	26,500	28,100	0.9
Korea	43	98,000	16,100	6.1	56	99,600	17,500	5.7
Japan	311	356,300	96,200	3.7	353	364,000	102,000	3.6
China	73	11,600	10,600	1.1	93	12,200	16,100	0.8
US	458	135,000	142,000	1.0	658	158,900	189,400	0.8

Source: IPO analysis of OECD 'Top 2000 R&D Investors' data
Investment and patent data rounded to nearest hundred

The amount and type of R&D investment is closely linked to sector, and it is impossible to fully separate out the effect of the two variables on patenting without more in-depth regression analysis. The low amount of patents per million Euros of R&D investment is likely to be partly attributable to sector, as only 50 per cent of large UK companies in the data were manufacturing companies. The low amount of patents per manufacturing company could be due to lower investment in R&D, although in this sample of top R&D investors, UK companies have higher R&D investment than Korea and China, and a similar level to France.

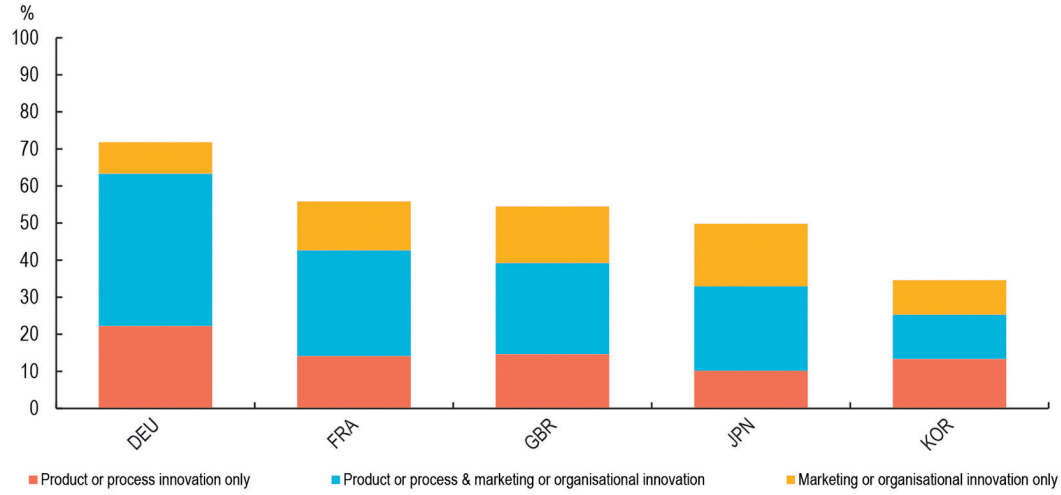
Measuring patents per million Euros of R&D solely within the manufacturing sector controls to some extent for differences in sector and levels of R&D investment. By this measure, UK companies still have lower patents, with 0.5 patents per million Euros of R&D compared to one patent per million Euros of R&D in Germany, France the US and China, 3.7 in Japan and 6.1 in Korea. This is a sample of large R&D investing companies, and differences in the economy as a whole could be larger. These cross-country differences between companies in the same sector and the lower amount of patents per R&D invested suggest a larger gap between the number of patents of UK companies and those in other countries than can be explained by these measurable factors alone.

In the Community Innovation Survey (CIS), UK manufacturing companies reported slightly lower levels of product innovation, as shown in Figure 33. 40 per cent of UK manufacturing companies reported a new-to-market product innovation (which are more suited to patenting than process innovations), compared to 43 per cent of French manufacturing companies and 63 per cent of German manufacturing companies. This may be one factor explaining the lower number of patents per manufacturing company. However in the CIS, companies in Japan and Korea reported lower levels of innovation than European companies, even though they have more patent families per manufacturing company in the OECD data. This could be due to the different sample (the OECD data is only the top R&D investors) and the way the survey is conducted in different regions, which makes comparison difficult.

UK manufacturing companies report more innovation in ‘marketing or organisational activity only’. 15 per cent of UK manufacturing companies reported this type of innovation between 2010 – 2012, compared to 13 per cent of French companies and nine per cent of German companies. Although UK manufacturing companies report more innovation in marketing and organisational activities, this is much less suited to patenting than product innovations.

Figure 34: Organisational innovation higher in UK companies

Innovation in the manufacturing sector 2010 - 2012



Source: OECD analysis of Community Innovation Survey (CIS) data

Further differences in the number of patents between companies within the same sector could be due to differences in market approach or cultural attitudes to patenting.

This fits in with the evidence from the OECD that in the UK, manufacturing is relatively service-focussed. The OECD STI Scoreboard (2015) says that 'due to the UK's position in global value chains, 37 per cent of UK gross exports of manufactured goods can be attributed to services value added content' (39). This proportion is similar to other European countries, but higher than Japan, China and Korea. Therefore a UK company that is classed in the manufacturing sector can be relatively more focussed on creating service value added than traditional manufacturing.

One large company that contributed to our qualitative evidence operated in a sector that traditionally would be expected to patent a lot. The company reported using patents very little and preferred other forms of IP such as trademarks. This was because the company operated a service-based model where they differentiated from their competitors on the service offered and not the product itself. The market moved fast and outpaced the time it would take to patent an invention. The company often did not use an invention more than once but moved on to a different project, which also reduced the incentive to patent. The prevalence of service-based business models in manufacturing or engineering markets could be influenced by the relatively large service sector of the economy in general.

Some of the differences in patenting behaviour can be attributed to patenting strategies. Interviews with international stakeholders from Germany, Japan and the US reported that it was the norm to patent around an idea, in order to create 'freedom to operate' and protect from litigation (which in the US and to some extent Germany can be linked to the more litigious enforcement environment). One stakeholder from abroad compared this directly to a leading UK patenting company, who were more selective in what they chose to patent but filed "strong patents".

UK companies referred to 'positive patenting' of an invention, and although patenting defensively does occur in the UK it appears less common. One medium-sized company reported that they felt increasing pressure to patent defensively in order to protect themselves from patent trolls, but were reluctant to do so and saw this as stifling to innovation in that market.

There are also wider cultural differences which could affect attitudes to patenting, for example the social status given to inventors, and attitudes to studying STEM subjects. Views on investment and return can affect the use of patents to raise finance, for example investment in Japan and Germany is seen as more long-term and therefore works better with the time it can take to secure a patent.

Qualitative examples of incentives to patent offered by companies abroad included targets, quotas and monetary rewards from the government. Although some UK companies often give some reward to employees for patenting, the rewards in countries such as Germany and the US were reported to be a lot higher. In Germany there is a legal requirement to remunerate the inventor, which means inventors can get an annual return for their patent for years after they leave the company.

Some differences in the number of patents also stem from the national patent system. For example, in Japan the scope of the patent is narrower and so companies will file more incrementally. These differences will have less effect on the OECD data (Figure 34: Patents per manufacturing company in top 2000 R&D investors), because this data counts patent families and not individual patents[33].

Cultural differences do not naturally lend themselves to data measurement, and there are few studies that look at this aspect of patenting. Burk (2016) looks at patenting behaviour from a sociological perspective, and suggests that "firms patent because other firms patent, because investors expect them to patent, and because patents validate the firm as innovative and reputable" (44). Burk notes that patenting behaviour such as this is socially rational rather than economically rational.

A quantitative study by Cohen et al. (2002) (10) compares patents and incentives to innovate in the manufacturing sector in Japan and the US using surveys. The study notes differences in patent use between the two nations, 'with strategic uses of patents, particularly for negotiations, being more common in Japan'. It notes that this leads to patents playing a more central role in diffusing information in Japan, and intra-industry spill overs there. The study attributes some of these differences to culture, saying:

"Our cross-national, within-industry comparisons suggest that not only industry characteristics differentiate appropriability conditions and R&D spillovers, but also factors that cut across industries, such as the institutions, policies, cultures or norms that are distinctive to nations."

33 The data counts extended patent families, i.e. all patents linked through a priority filing

Conclusions

This research brings together evidence from a wide range of sources that enable a better understanding of the current UK patent system; how the system is used, who uses it, and how it is viewed. This final section of the paper details the key conclusions and themes of the research, along with possible suggestions for future areas of research.

The primary motivation in where firms choose to patent is based on where their markets are. Differences between patent systems are of relatively minor importance.

The UK was found to have a large number of patents, with the 6th highest number of patent applications in the world in 2014 (including EPs). This high number of applications was also shown when adjusted for differences in GDP and Population with the UK 4th in the world and 2nd in the world respectively for GDP and population.

A key theme that emerged from the interviews with stakeholders and supported by the ranking of patent applications was that the primary motivation in choosing where to patent is based on where firms see the market is for their products, and where they or their competitors operated. The size of the market being the key driver of patent applications is supported by the fact that the UK, France, and Germany all had similar levels of patent applications when adjusted for GDP (2014). A vast majority (93%) of patents covering the UK are from foreign applicants indicating that the UK is seen as an important market to these foreign applicants, and that it is worthwhile for them to seek protection of their inventions in the UK. What is not known is the impact the high proportion of foreign applicants has on the wider UK economy.

Further research looking at the economic activity of patenting firms would help inform the impact of foreign patenting on the UK economy. It is likely that the impact is different between sectors so a sector based approach may be informative. Research that seeks to understand foreign patenting links to wider investment and activity in the UK, and possible effects on the wider innovation ecosystem of the UK would be useful. Foreign patenting data could also be tested as a signal of attractiveness of the UK market; with possible questions of how foreign patenting activity might change as patterns of trade and investment change.

The UK system is working well for those that currently use it, although more options and certainty around timing would be appreciated by users. SMEs face more barriers to patenting than larger firms, primarily in their awareness and understanding of the process and the costs of legal advice.

The overall positive views of the operation of the UK system, and the low relative costs indicate a system that is working well for its current users. However the concerns raised about backlogs, and timings indicate that there are improvements that could be made that would benefit applicants.

The challenges of SME patenting were highlighted in many of the interviews. The barriers of the high overall costs involved in applying and enforcing their patents were highlighted. Suggestions of how the system could be improve included improving awareness around the costs involved in application (including the legal costs), the services that legal advisors provide and access to support or services that help firms in commercialization their product. SMEs often need advice in determining if patenting is the right choice for their business.

More in-depth research looking at how SME in different sectors and localities patent would help in our understanding of the barriers faced by SMEs. The interviews indicated a variability in the local awareness and innovation infrastructure, exploring these differences may provide a guide to future policy. There is also an opportunity for further analysis using new firm level data linked with patenting data to better understand the effects of different factors.

There are many notable initiatives already aimed at addressing these issues. These include digital and online tools such as IP Equip (a free e-learning tool for advisors on identifying IP assets), the IP Health Check (an online tool that enables businesses to identify and value their IP), and the IP finance tool kit (that provides templates and guidance to help businesses accurately identify and describe their IP assets for financing). The IPO also offers face to face training for businesses and advisors through its IP master classes, and other seminars and events.

The IPO collaborates with other organisations such as the PatLib network, and the Business & IP Centre Network, which provide qualified and experienced staff offering practical assistance on IP issues, many of which we spoke to as part of this research, and the Growth Hubs. Other work undertaken by the IP legal sector is also important in assisting SMEs, through open surgeries run by Patent Attorneys, and

the recently launched IP pro bono scheme designed to help small businesses and individuals in IP disputes. Understanding how users engage with the various services and support offered to SMEs and evaluation of different models to determine the most effective activities in supporting SMEs in their patenting will help in further developing the support aimed at SMEs.

Another area that should be explored is in providing options that allow applicants to have more control over the timings of the application system. Companies would like more predictability around timing of the standard patent application and the introduction of a tiered approach where applicants would have more control over how long their application will take. This could include researching how changes in processing times are valued by applicants, and options around paying for faster processing.

UK applicant underrepresentation in patenting numbers cannot solely be explained by sector differences. Other aspects such culture, business models, and incentives should also be explored.

The research identified that UK firms have a lower propensity to patent compared to other countries. While some of this can be linked to the sectorial composition of the UK economy, and the differences in levels of business R&D, this did not explain all the differences between UK firms patenting rates and comparator countries. The importance of company culture,

individual incentives, and levels of awareness of patenting seemed to differ. This highlights an important factor in that the decision to patent does not appear to be solely driven by the economic rationale, but also by wider factors.

This highlights a need for more research into the non-economic factors that lead applicants to patent. As highlighted by Burk (2016) fields of research outside of economics such as sociology and institutional analysis could add to our understanding of patenting behaviour. More research looking at the motivations of UK applicants and how these differ between those in other firms or countries may help to explain how UK users use the patent system. This research should include reviewing existing evidence on the impacts of different employee incentives and how this differ between countries. Research that seeks to understand the reason why some firms and countries appear to have a culture of patenting may also explain differences between firms. Research that looks at the impact of a pro-patenting culture, and if it helps or hinders firms innovation would help in setting future policy.

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Annex 1: List of stakeholder interviews

Category	Number of Contributors	Description	Contributors
Large companies with UK headquarters and the UK IP Federation	8	Companies ranged from those that frequently patent in the UK and abroad to those that had very few patents	UK IP Federation GlaxoSmithKline Dyson AGCO Costain Ricardo Maybourne Group Taylor Wessing
Stakeholders abroad	8	Industry body representatives and IPO IP attachés	IP Attache India IP Attache China IP Attache SE Asia IP Attache Brazil US IPO / Lilly US IPO / Lakshimarian JIPA / Panasonic JIPA / Showadenko
The UK legal profession	4	Patent attorneys and representatives of CIPA	AA Thornton HGF Attorneys Haseltine Lake CIPA / Kilburn and Strode
UK SMEs	11	Small business advisors and growth hubs	Invest Northern Ireland Enterprise Europe Network (EEN) Coventry and Warwick growth hub Welsh Assembly Patlib Aberdeen Patlib Northern Ireland Patlib Belfast Patlib Glasgow Patlib Plymouth Patlib Sheffield Roger Tipple - Innovator in residence, inventor and small business owner
Universities	3	Technology transfer offices and IP offices of universities	Oxford University (Isis Innovation) Southampton University UCL

Annex 2: Linking FAME business data to companies' patent data

To improve our understanding of the patenting behaviour of companies, the IPO commissioned a new dataset. This links UK companies' patent data to their corresponding registration number on the Fame business database.

Patent data for GB and European patents was taken from the IPO's internal patent registration and management system. A second source of data which includes patents from jurisdictions abroad is PATSTAT[34], a patent data product produced by the EPO.

The data match only used patents registered to UK addresses to match to UK companies. The company address when filing for a patent is self-reported, so may not always be accurate, for example if the company are filing through a legal adviser.

Patent holders could only be matched to those companies listed on the Companies House database. This means individuals and universities that hold patents are not represented in the resulting dataset. Figure 1 shows numbers of patents and owners matched.

Figure 1: Numbers of patents and owners matched

	Total patents from UK applicants on database	UK applicants identified as companies	Total patents from UK companies on database	Number of UK company patents matched to owner on FAME database
OPTICS	400,564	112,681	284,277	162,605
		(55% of UK applicants)		(57% of patents from UK companies)
PATSTAT	1,077,017	164,128	676,886	481,035
		(43% of UK applicants)		(71% of patents from UK companies)

Source: IPO analysis of FAME - linked data

57 per cent of patents from UK companies in the OPTICS database and 71 per cent of patents from UK companies in the PATSTAT database were matched to a UK company.

34 https://www.epo.org/searching-for-patents/business/patstat.html#tab1

Matching Strategy

The matching was performed in 5 steps

1. Standardisation of applicant and company names in the patent and companies house datasets.

2. Isolation of companies in the patent data. Using identifying keywords and an iterative search strategy applicants in the patent data were identified as companies or individuals.

3. Perfect matching on the standardised patent and companies house datasets. Primarily between applicant and company names, and postcodes where available.

4. Matching on similarity of names using OpenRefine. Records unmatched after step 3 were matched by algorithm assessing similarity. After some quality assurance matches were accepted other than those with the lowest similarity scores.

5. Clerical matching of unmatched patent owners with more the 50 patents.

Quality assurance

Matched and unmatched records in the patent datasets were randomly sampled to see if the matching strategy could be improved on. False positives were found to be low, only one sample contained any and this rate was lowered through iterations of the matching process.

Sampling of unmatched records found that around half of the owners could be clerically matched. The most common reasons for these failed match were that the patent holder is an individual, the company is dissolved, the company has merged with another company or the name record of the company was of such quality that it couldn't be matched. The final clerical matching process focused on owners with many patents, thus minimising the impact of false negatives on the patent match rate.

The analysis in this report is based on a recent subset of data from 2010 to 2014. The match rates for this subset of data are likely to be higher than the match rates for the dataset as a whole. This is to be expected as recent data will be up to date more and contain fewer discrepancies such as inactive companies.

Annex 3: Patent Systems in Selected Jurisdictions

This section sets out the key features of the patent systems in place in the UK and other selected jurisdictions – namely Europe (including the national patent systems of France and Germany), China, Japan, Korea and the United States.

Types of patent

- **Invention patents:** An "invention patent", usually referred to simply as a "patent", is the standard form of patent protection offered in all major jurisdictions, generally providing its holder a monopoly of up to 20 years over a new and inventive development in exchange for publication of details of the invention. It should be noted that in the US an invention patent is sometimes referred to as a "utility patent", not to be confused with a "utility model" (see below).

- **Utility models:** A number of countries offer some form of "utility model" patent, sometimes referred to as a "petty patent", "small patent" or "innovation patent". Utility model rights vary from country to country but they are generally a similar form of right to a patent, but subject to less rigorous assessment procedures and resulting in a monopoly for a shorter duration (usually between 6 and 10 years). As a result, they are generally cheaper and quicker to secure, but compared to standard patents create weaker protection which may be more easily overturned in court. Of the jurisdictions in question, utility models are available in China, Germany, Japan and Korea (10 years), and France (6 years). In our data analysis we have not included utility model patents in order to compare 'like for like' as there is no UK equivalent UK.

- **Design patents:** "Design patent" is the term used in the US for an industrial design right – equivalent to a "registered design" in the UK and most other jurisdictions. These rights are unrelated to patents in the usual sense, and so are only mentioned here for clarification.

Common features of patent systems

The major patent systems of the world are similar in many respects.

Patentable inventions

The TRIPS Agreement[35] dictates that patents shall be available for any inventions in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application. TRIPS allows certain types of invention to be excluded from patentability, and in addition jurisdictions may place further limits on what is classed as an "invention". As such, broadly speaking, the following types of development cannot be patented:

- Inventions contrary to public policy or morality
- Discoveries, scientific theories and mathematical methods
- Creative works and aesthetic creations
- Mental acts or mental processes

35 The Agreement on Trade-Related Aspects of Intellectual Property Rights, administered by the World Trade Organization: https://www.wto.org/english/tratop_e/trips_e/t_agm0_e.htm

Meanwhile, the approaches taken in the jurisdictions in question are more diverse when it comes to the patentability of the following types of development:

- Computer programs/software
- Business methods
- Diagnostic, therapeutic and surgical methods for the treatment of humans or animals
- Biological material

The patent term in all the jurisdictions in question is 20 years from the filing date (another requirement of TRIPS). Extensions to the patent term, or additional patent-like protection, are available in some jurisdictions in certain circumstances.

Patent applications must generally be published before a patent can be granted. The standard timescale for publication is 18 months from the filing date.

Once a patent application is filed in one jurisdiction, patent applications for the same invention filed in other jurisdictions within 12 months can "claim priority" from the first application and effectively benefit from its filing date. The filing date of the first application is known as the "priority date".

All jurisdictions will generally carry out a search of public documents ("prior art") to determine whether the invention is new, and conduct an examination to assess whether the invention meets the other specific requirements of the patent law in that jurisdiction. However, the timing of search and examination, and other details of the patenting process, differ from system to system.

Key features of individual patent systems in the jurisdictions in question, including search and examination times, which technologies are patentable and maximum patent terms are outlined in Figure 2: Key Features of International Patent Systems.

Supra-national routes to patenting

- European Patent Convention (EPC): The European Patent Office (EPO) is responsible for processing and granting patents under the European Patent Convention (EPC). The EPC is a multilateral treaty with 38 members, including all members of the European Union. A European patent granted by the EPO creates a bundle of national patents, each of which must be separately renewed and enforced in the individual jurisdictions.

- Unitary Patent (UP): The forthcoming "European patent with unitary effect", or "unitary patent", will create a single patent valid across 26 EU member states.[36] Unitary patents will follow the same pre-grant procedure as existing European patents, with unitary effect being registered at the option of the applicant upon grant. Unitary patents will be renewable upon payment of a single annual renewal fee and enforceable before a single court, the Unified Patent Court.

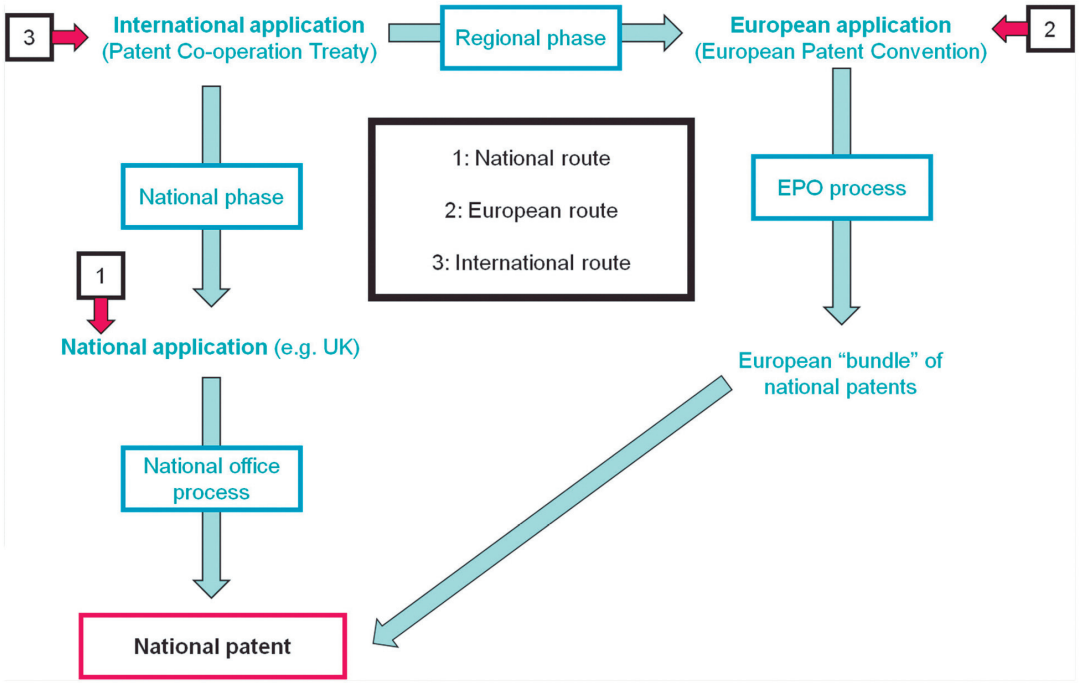
- Patent Cooperation Treaty (PCT): The Patent Cooperation Treaty (PCT) is an international treaty administered by the World Intellectual Property Organisation (WIPO). The system

36 All current members of the EU except Croatia and Spain.

allows patent protection to be sought in up to 148 countries worldwide through a single application. Initial work on the application, including search, is carried out centrally by one of 20 International Authorities (national/regional patent offices). This stage of the process is known as the "international phase". The applicant then enters the "national phase" in the jurisdictions in which they wish to pursue patent protection. The national office in each jurisdiction uses the work done in the international phase to determine whether or not a patent should be granted. Where applicable, it is possible to enter a "regional phase" instead of the national phase, in which case the regional office (e.g. the EPO) will determine whether or not a patent should be granted based on the work done in the international phase.

Figure 1: Routes to protection in Europe

The figure below illustrates the various routes to patent protection currently available in Europe.



Annex 4: Key features of individual patent systems

Jurisdiction	Search and Examination	Patentable Technologies	Maximum Patent Term
UK (UKIPO)	Search and examination are usually carried out separately. A search request must be made within 12 months of the filing/priority date, and search will usually take place within 6 months of the request. An examination request must be made within 6 months from publication of the application, and examinations are generally carried out in order of request. If the requests for search and examination are filed at the same time, examination will be combined with the search (within 6 months of the request). Accelerated search and examination are also available if the applicant provides a reason, or if the application falls into one of several special categories.[1]	Business methods are specifically excluded from patentability. Computer programs per se are also excluded, but case law has determined that this does not prevent the grant of patents for computer-implemented inventions. (There is a very strong lobby in UK/Europe against any increase in protection available for software.) Diagnostic, therapeutic and surgical methods for the treatment of humans or animals are excluded. Inventions concerning biological material, including gene sequences, may be patented, but there are limitations concerning cloning and use of human embryos.	The patent term of 20 years cannot be extended. However, a supplementary protection certificate (SPC) offering an additional monopoly of up to 5½ years may be granted in respect of a medical or plant protection product where the regulatory approval process has delayed the product being put on the market.
European Patent Office (EPO)	Search and examination are carried out separately. A search request is not required, and search will usually take place within 24 months of the filing/priority date. A request for examination must be made within 6 months from publication of the application, and examinations are generally carried out in order of request. Accelerated search and examination are available on request.[2]	Business methods are specifically excluded from patentability. Computer programs per se are also excluded, but this does not prevent computer-implemented inventions from being patented. Diagnostic, therapeutic and surgical methods for the treatment of humans or animals are excluded. Inventions concerning biological material, including gene sequences, may be patented.	Since a European patent creates a bundle of national patents, any extensions to patent term will be determined by the individual jurisdictions. However, SPCs are available in all European Economic Area countries, covering the majority of EPC member states.
France (INPI)	Search and examination are carried out separately, but the initial search report will include a "written opinion" on the patentability of the invention. The search fee must be paid upon filing or within one month. When the application is a first filing (no priority claimed), the search is carried out by the EPO on behalf of the national office, and the search report will usually be issued within 9 months of the filing date. Where the application claims priority, the national office invites the applicant to submit information on prior art around two years after the priority date, and then carries out a search taking account of the information provided by the applicant. The applicant must file a response to the search report if documents showing lack of novelty or inventive step have been found.	While inventive step is a requirement of French patent law, the office can only reject applications for lack novelty. At examination stage, however, a "final search report" is produced identifying any documents considered relevant for inventive step. Therefore, while lack of inventive step will not prevent grant, the applicant is encouraged to overcome any documents showing lack of inventive step to avoid the validity of their patent being questioned. The definition of patentable inventions given in the French Intellectual Property Code is the same as in the EPC, so for example business methods and computer programs per se are not patentable.[3]	SPCs are available in France in the same way as the UK.

Jurisdiction	Search and Examination	Patentable Technologies	Maximum Patent Term
Germany (DPMA)	Search and examination are generally carried out together, but a separate search is available on request. An examination request must be made within 7 years of the filing date.[4] If the examination request is made within 4 months of the filing date then the patent procedure takes 24 to 30 months on average.[5] Accelerated examination is available under certain circumstances.[6]	Business methods are specifically excluded from patentability. Computer programs as such are also excluded, in so far as they do not contain a technical teaching. Methods for treatment of the human and animal body by surgery or therapy and diagnostic methods are excluded. Inventions concerning biological material, including gene sequences, may be patented.[7]	SPCs are available in Germany in the same way as the UK.
China (SIPO)	Search and examination are carried out together. An examination request must be made within 3 years of the filing date. Accelerated examination is available in certain circumstances.[8]	Chinese patent law does not contain an explicit exclusion to business method inventions, but they may be rejected for lacking a technical solution.[9] Computer programs as such cannot be patented, but a combination of software and hardware may be patentable.[10] Methods for diagnosis and treatment of diseases are excluded.[11] Inventions concerning biological material are patentable as long as they do not violate the law or social ethics – this prevents cloning of human beings and commercial use of human embryos from being patented, for example.[12]	The patent term of 20 years cannot be extended, and no SPC-type protection is available.[13]
Japan (JPO)	Search and examination are carried out together. An examination request must be made within 3 years of the filing date. Accelerated examination is available in certain circumstances.[14]	Computer software inventions are patentable, including those which carry out business methods, but business methods per se are not patentable.[15] Methods of surgery, therapy or diagnosis of humans are excluded.[16] Inventions concerning biological material are generally patentable.[17]	SPC-type "patent term extensions" of up to five years each are available to compensate for delays in the regulatory approval process in respect of pharmaceutical, veterinary and agrochemical inventions.[18]
Korea (KIPO)	Search and examination are carried out together. An examination request must be made within 5 years of the filing date. Accelerated examination is available on request.[19]	Computer programs as such are not patentable, but a combination of hardware and software may be patented.[20] Business methods are not patentable.[21] Methods for treatment of the human body by surgery or therapy and diagnostic methods practiced on the human body are excluded.[22] Inventions concerning biological material are generally patentable.[23]	A single SPC-type term extension of up to five years is available in respect of pharmaceutical and agrochemical inventions where the regulatory approval process has delayed the product being put on the market.[24] Extensions are also available in all technical fields to compensate for delays by the office if it results in the examination procedure taking longer than four years from the filing date or three years from the examination request, whichever is later.[25]
United States (USPTO)	Search and examination are carried out together. No examination request is required. Accelerated examination is available in certain circumstances.[26]	US patent law has no prescribed exclusions, so any exclusions to patentability are decided by case law. Inventions excluded by case law include abstract ideas, natural phenomena and laws of nature.[27] Recent case law has also led to more business method and software-related patents being refused.	Extensions to the patent term are available in respect of inventions where the regulatory approval process has delayed the product being put on the market.[28] Extensions are also available to compensate the applicant for delays by the USPTO in processing the patent application.[29]

Annex 4 - Annex References

1 See https://www.gov.uk/guidance/patents-accelerated-processing for further information.

2 Patent Backlogs and Mutual Recognition pp.8-1

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4 Patent Backlogs and Mutual Recognition pp.8-11

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