



TrendChart
Innovation Policy in Europe

European Trend Chart on Innovation

2006 TrendChart report:

Patent applications by SMEs: An analysis of CIS-3 data for 15 countries

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The information contained in this report has not been validated in detail by either the Member States or the European Commission.

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Executive summary

European firms apply for fewer patents than American firms, suggesting that European firms benefit less from improved profitability that could stem from good intellectual property (IP) protection. Part of the difference is structural, with a lower share of European firms active in sectors where patents are widely used. However, part of the difference could be due to European firms being less likely than American firms to patent an invention that meets the requirements for a patent. If true, there could be a case for government intervention to promote patenting, particularly by SMEs (less than 250 employees) who might be less aware than large firms of the benefits.

This report uses CIS-3 data on the percentage of SMEs and large firms that used one of four types of IP in 2000: patents, design registration, trademarks and copyright. It then simulates the effect of policies to increase the number of SMEs that apply for a patent by 25%.

As noted in previous research, a higher percentage of large firms than SMEs applied for one or more patents in 2000 in each of 15 EU countries. The rate for large firms is, on average, five times that for SMEs. A higher percentage of large firms also use each of the other three types of IP and each of three non-formal appropriation methods (secrecy, design complexity, and lead time advantages). These results suggest that large firms develop more advanced and more profitable innovations that justify the costs of using both IP and non formal methods.

The best estimate from the simulations is that SMEs in six developed European economies accounted for 19% of all EPO patent applications from these countries in 2000. In 10 less developed countries, SMEs accounted for an estimated 80% of all EPO patent applications, largely because there are very few large firms in these countries.

The simulations show that policy actions to increase the number of SMEs that apply for at least one EPO patent by 25% would increase the SME share for developed countries from 19% to 23% by 2015 and from 80% to 84% in the less developed countries. In absolute terms, the effect is largest for the developed countries, which account for the vast majority of European applications for an EPO patent.

1. Introduction

Since the 1995 Green Paper on Innovation, the European Commission and the Governments of several member states have emphasized the role of Intellectual Property Rights (IPR) as an incentive to firms to invest in innovation and as a means of appropriating their investments in innovation. One of the main concerns over time has been a lower rate of patenting by European firms compared to American firms, as identified in several editions of the European Innovation Scoreboard¹.

The difference in patenting rates between the United States and Europe is partly due to a difference in industrial structures. For example, compared to the United States, a higher percentage of European value added and employment is from manufacturing sectors with low and moderate background patenting rates, such as transportation equipment. The United States, conversely, has a higher concentration of firms active in high-technology sectors with above average patenting rates such as pharmaceuticals, biotechnology, and IT equipment.

Another possibility is that European firms are less likely to patent an equivalent invention than American firms, due to possible differences in attitudes to IP, the cost of IP, or knowledge about how to apply for IP. In this case, there could be a policy case to promote greater use of IP by European firms. The argument for policy intervention is strongest for small and medium sized firms (SMEs) with less than 250 employees, since larger firms with 250 plus employees are more likely to have the financial resources to exploit IP. A high percentage of Europe's largest firms also have expert IP services in-house and also have experience applying for a patent.

In order to evaluate whether or not policy actions are likely to have beneficial effects, we first need to know current background rates for the use of IP by SMEs and the possible effect of an increase in IP use by SMEs on total IP use. For example, a concerted effort to increase patenting by SMEs would only have minor economic impacts if the background rate of IP use by SMEs is very low, with most IP use concentrated among large firms. In this short report we present estimates of the answers to the following questions:

1. What percentage of SMEs and large firms use IP?
2. How would an increase in IP by SMEs affect total IP applications?

Given strong differences by sector in the use of IP, particularly patents, it would also be of interest to provide results to these two questions at the sector level.

2. Data sources

The main challenge is to obtain data on IP use by firm size and sector. IP includes patents, trademarks, design registration, and copyright.² For example, we would like to know the average number of patent applications made by SMEs, the share of total patents due to these firms, and to have data disaggregated by the two-digit sector level and by country.

Table 1 summarizes data availability for each of four types of IP, using official sources. The European Patent Office (EPO) manages many European patents, while OHIM (Office for

¹ See <http://trendchart.cordis.lu/scoreboards/scoreboard2005/index.cfm> for the 2005 edition.

² IP also includes confidentiality agreements and plant breeder rights. We do not look at these two forms because of a lack of data for confidentiality agreements and the fact that plant breeder rights are only used by a very small percentage of firms.

Harmonisation in the Internal Market) is responsible for trademarks and industrial design registrations. One can see at a glance that there are no official data for copyright and that there are no data on firm size for any of the four forms of IP. In addition, it is not possible using publicly available data to obtain breakdowns of trademarks and industrial design for both sector and country.

Table 1: IP data availability by country, size and sector

	Country	Size	Sector	Notes
Patents	Yes, & sector by country	No	Yes	Sector is available by IPC class, which can be linked to the NACE sector using correspondence tables, although the match is imperfect. It is possible to get sector results by country. The EPO does not collect data on the size of patent applicants.
Trademarks	Yes No: sector & country	No	Yes	The 'sector' is based on the NICE class system, which is divided into 32 product classes. With a few anomalies, these can be matched with NACE sector classes. OHIM (Office for Harmonization in the Internal Market) does not publish data for product class by country. OHIM does not collect data on firm size.
Industrial Design	Yes No: sector & country	No	Yes	The 'sector' is based on the 'Eurolocarno' system, which applies a code to each type of product. There are 32 main classes and hundreds of sub-classes. It would be possible to construct a correspondence table between the Locarno class and the NACE sector. OHIM (Office for Harmonization in the Internal Market) does not publish data for product class by country. OHIM does not collect data on firm size.
Copyright	No	No	No	There is no official copyright registration system in Europe. In the United States firms are encouraged to register copyright to prevent future litigation.

The best alternative source of data on the use of IP by size, sector and country is the European Community Innovation Survey (CIS). CIS-3 collected data on whether or not a firm applied for at least one patent between 1998 and 2000 inclusive. This question was also repeated in CIS-4, which refers to 2002 to 2004 inclusive. CIS-3 also collected data on other types of IP using the following question:

“During the period 1998-2000, did your enterprise, or enterprise group, make use of any of the following methods [registration of design patterns, trademarks, copyrights] *to protect inventions or innovations developed in your enterprise?* (italics not in the original)

Of note, this CIS-3 question does not refer to actual IP registration between 1998 and 2000. Firms that are using trademarks or copyright that they obtained before 1998 should also reply positively to this question³.

³ The results provided by Eurostat (2004) show that a large number of non-innovators reported using design, trademarks and copyright as protection methods, which means that the registration of the IP probably occurred before 1998. For example, 18% of non-innovative large Greek firms reported the use of trademarks compared to 35% of innovative large Greek firms.

CIS-4 altered the question to a form that is more suitable for answering our two research questions:

During the three years 2002 to 2004, did your enterprise:

Apply for a patent Yes No

Register an industrial design Yes No

Register a trademark Yes No

Claim copyright Yes No

This format permits the calculation of statistics on the percentage of SMEs by country and sector that actively applied for or registered a new form of IP during this three year period.

Unfortunately, there are serious restrictions on the availability of CIS-3 and CIS-4 data for answering the two questions.

CIS-3: Eurostat has published data on the percentage of small, medium and large firms that have applied for a patent between 1998 and 2000 and which reported the use of the other forms of IP as a ‘protection method’. The results are also available by country and for all manufacturing and all service sector firms. However, they are only provided separately for innovative and non-innovative firms, with no data for all firms combined. This matters, since in some countries only a small percentage of firms innovate.

Eurostat has also made micro-aggregated CIS-3 data for 15 countries available for research purposes⁴. This is the main source of data in the results given below. It is possible to present results by firm size and for several aggregated sectors, but due to confidentiality limitations it is not possible to provide data at the two digit sector level. Furthermore, information on firm size is missing for some firms, for which the size class must be estimated using other available information (See Annex A).

CIS-4: No general publication of CIS-4 results is currently available. Some individual countries can provide access to CIS-4 data through their national statistical offices, but the data must be analyzed on site. Eurostat should be able to provide access to micro CIS-4 data for some countries as of June 2007, but on-site in Luxembourg.

The result of these data access restrictions, plus the wording of the CIS-3 question on non-patent forms of IP, means that we can only answer both questions 1 and 2 for patent applications between 1998 and 2000.

3. IP use by firm size

Table 2 summarizes results from the Eurostat publication on the use of four legal forms of IP (patents, design registration, trademarks and copyright) and three informal protection methods (secrecy, design complexity and lead times) by *innovative* firms. Data are available for 13 of the 14 EU member states in 2000 plus Iceland and Norway. The results for patents are not fully comparable because the patent question refers to a patent application rather than the use

⁴ Eurostat has in the mean time also made available CIS-3 micro-data for 18 countries which can be accessed at Eurostat’s SafeCentre in Luxembourg. At the time of writing of this report these micro-data were not available.

of patents for protection⁵. Nevertheless, the results are consistent with other research in Europe and the United States on the importance of specific formal and informal protection methods which shows that each method is used more frequently by larger firms and firms place greater reliance on non-formal protection methods such as secrecy and lead time advantages than on patents⁶. The results in Table 2 also suggest that trademarks are more widely used by both small and medium sized firms than patents, whereas there is less reliance on copyright.

Figures 1 through 4 provide results for the four IP forms for *all* SMEs (small and medium firms⁷ and innovative and non-innovative firms combined), using the micro-aggregated CIS-3 plus other data sources for the UK. Data are available for Iceland, Norway and 14 EU member states, including six of the new member states⁸. The final two bars in each figure give aggregated results for 10 of the 'less developed innovative' countries in terms of innovative capabilities and for six 'developed innovative' countries⁹. A substantially lower percentage of firms in the less developed innovative countries use each form of IP, although the difference is less marked for trademarks. The importance of industrial design also stands out for the UK, with over three times as many SMEs using design registration as a protection method as the share that applied for a patent. The difference is much less marked in other countries.

Table 3 summarizes the data presented for all SMEs and also gives results for all large firms. The percent of all SMEs that have applied for at least one patent between 1998 and 2000 ranges from 0.9% for Bulgaria to 9.1% for Germany. In contrast, as shown in Table 3, a much higher percentage of all large firms applied for at least one patent, ranging from 6.1 percent in Romania to 37.5% for Latvia. In all countries a higher percentage of large than small firms applied for one or more patents.

⁵ Firms can have many other reasons to patent, such as in negotiations, to prevent legal infringement suits, etc.

⁶ See Arundel (2001) and Cohen et al (1999).

⁷ Due to data problems (see Annex A), it is not possible to give results separately for small and medium firms.

⁸ All results from CIS-3 are weighted to provide estimates of the entire population of firms in each country.

⁹ The 11 less developed innovative countries include Slovakia, Estonia, Portugal, Latvia, the Czech Republic, Hungary, Lithuania, Greece, Romania and Bulgaria. The six developed innovative countries include Germany, Belgium, Norway, Iceland, Spain and the UK.

Table 2. Percent of innovative firms by country and number of employees that applied for a patent and which reported the use of specific protection methods (1998-2000) S = 10 – 49 employees, M = 50 – 249 employees, L = 250+ employees

	Patent application			Design registration			Trademarks			Copyright			Secrecy			Design complexity			Lead time		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
Belgium	11	22	31	11	20	18	18	30	32	6	11	11	23	46	48	13	19	27	28	45	53
Denmark	10	17	40	15	10	19	21	31	41	6	5	21	14	20	33	10	14	19	23	33	38
Germany	15	21	-	13	19	93	16	20	87	6	8	33	30	35	-	20	18	71	40	44	-
Greece	7	5	9	5	6	13	20	30	35	6	7	16	11	12	40	9	8	15	1	4	3
Spain	10	16	21	10	16	21	14	18	26	2	4	8	15	25	31	14	24	31	16	26	33
France	18	29	49	14	17	26	28	35	48	6	5	11	13	20	30	16	19	23	25	30	34
Italy	10	26	42	7	19	33	14	27	40	2	4	8	23	39	55	13	21	21	31	45	52
Netherlands	10	17	29	8	8	10	12	21	22	7	7	7	12	17	23	20	24	32	39	44	50
Austria	11	20	54	11	19	42	14	27	48	8	12	20	33	45	67	25	30	41	39	58	77
Portugal	4	9	16	3	4	17	13	26	39	1	3	7	15	22	27	10	14	15	17	26	33
Finland	14	25	48	9	15	23	18	35	49	7	14	25	42	57	70	28	32	43	53	60	65
Sweden	23	35	56	16	19	33	38	43	65	18	29	40	26	25	49	17	19	29	39	39	57
UK	11	20	27	20	33	44	31	45	55	31	40	49	49	64	78	45	58	71	55	67	78
Iceland	5	4	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Norway	14	23	37	9	12	12	26	30	34	15	12	17	32	34	43	20	20	21	41	43	50

Source: Eurostat 2004, country pages Tables 14b and 15a.

Table 3. Percent of all firms by country and number of employees that applied for a patent and which reported the use of specific protection methods (1998-2000) SME = 10 – 249 employees, L = 250+ employees

	Patent application		Design registration*		Trademarks		Copyright		Secrecy		Design complexity		Lead time	
	SME	L	SME	L	SME	L	SME	L	SME	L	SME	L	SME	L
Belgium	7.6	14.3	9.4	12.7	13.2	24.4	4.2	6.3	16.5	32.1	8.0	24.6	18.6	43.7
Bulgaria	0.9	7.2	1.1	3.1	2.5	12.4	0.5	0.5	3.4	11.3	1.2	2.1	2.0	4.6
Czech R.	2.5	12.6	3.1	14.1	11.3	33.9	4.6	8.7	4.4	16.5	2.8	11.0	6.7	15.7
Germany	9.1	37.0	11.1	41.3	11.2	30.4	3.9	11.0	18.9	46.1	11.7	24.8	24.6	52.9
Estonia	4.0	-	2.0	-	15.0	-	2.9	-	12.6	-	10.7	-	22.7	-
Spain	4.8	15.0	7.1	19.6	7.7	17.3	1.4	5.2	7.4	20.6	6.9	21.3	7.7	22.6
Greece	1.8	6.8	2.0	6.5	10.5	29.8	2.5	9.3	3.9	12.4	3.2	5.6	0.5	2.5
Hungary	2.0	6.8	3.6	7.5	2.5	18.0	2.5	17.0	2.7	7.3	7.3	27.6	1.3	5.8
Iceland	2.7	23.5	2.4	0	7.7	11.8	3.9	11.8	7.9	23.5	3.5	0	6.7	17.6
Lithuania	1.9	11.3	4.5	22.6	11.1	37.1	3.4	9.7	9.3	27.4	5.3	16.1	10.8	33.9
Latvia	3.3	37.5	3.5	43.8	11.3	59.4	3.3	12.5	8.3	31.3	6.5	15.6	11.0	34.4
Norway	5.4	-	3.6	-	11.2	-	5.4	-	12.4	-	8.7	-	17.0	-
Portugal	3.7	11.9	2.1	8.7	11.8	29.9	1.1	3.7	10.1	20.9	6.3	11.2	11.5	24.8
Romania	1.0	6.1	2.2	10.1	3.8	14.1	1.6	3.0	2.5	6.8	1.9	4.6	2.7	5.4
Slovakia	1.1	4.8	2.1	10.4	3.5	17.3	1.7	2.9	2.1	8.7	1.5	4.8	1.6	12.5
UK	3.3	13.8	12.9	37.6	12.6	34.9	11.9	30.4	18.5	48.0	15.5	40.8	19.6	47.6
<i>Ratio L/SME</i>	5.2		3.9		3.5		2.9		3.0		2.5		3.2	

Source: CIS 3 anonymised data. - = no data. * = Results from manufacturing firms only

Figure 1. Percent of SMEs that applied for at least one patent in the period 1998-2000

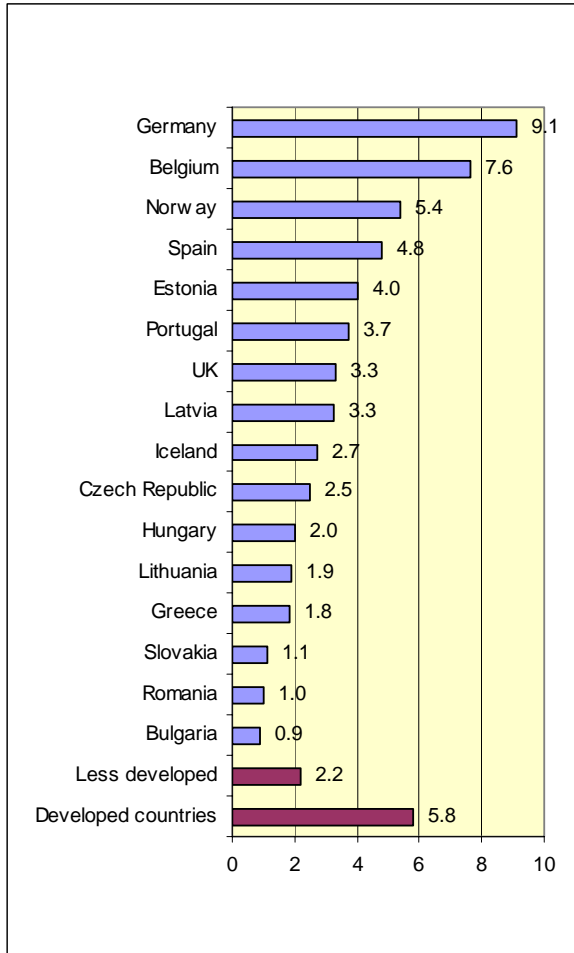


Figure 2. Percent of SMEs that made use of design in the period 1998-2000

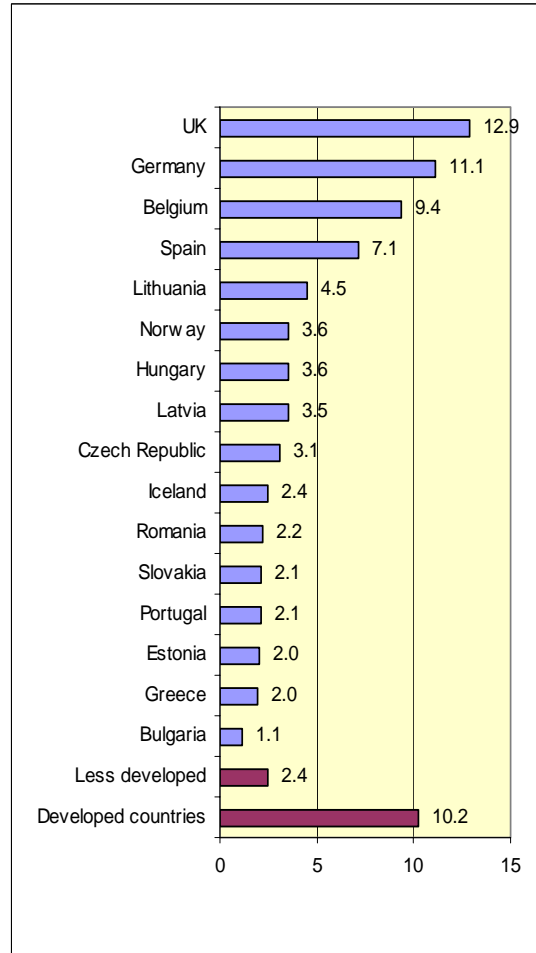


Figure 3. Percent of SMEs that made use of trademarks in the period 1998-2000

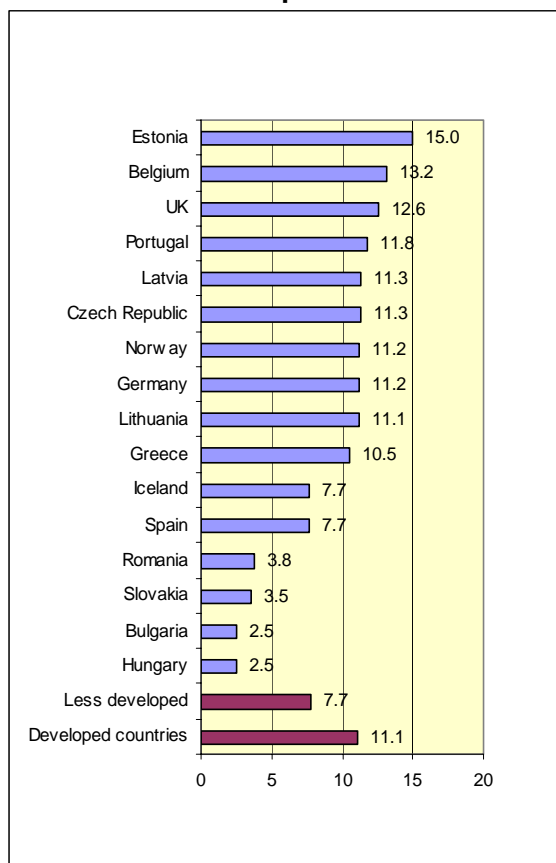


Figure 4. Percent of SMEs that made use of copyrights in the period 1998-2000

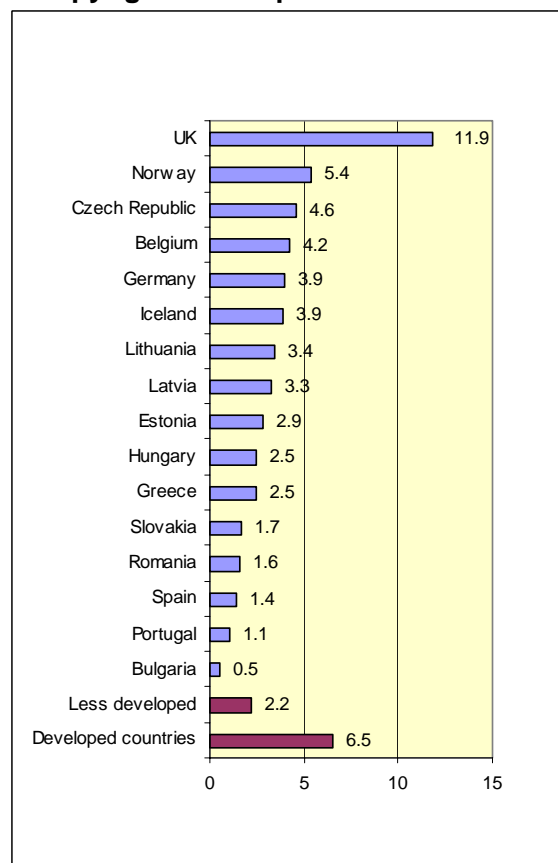


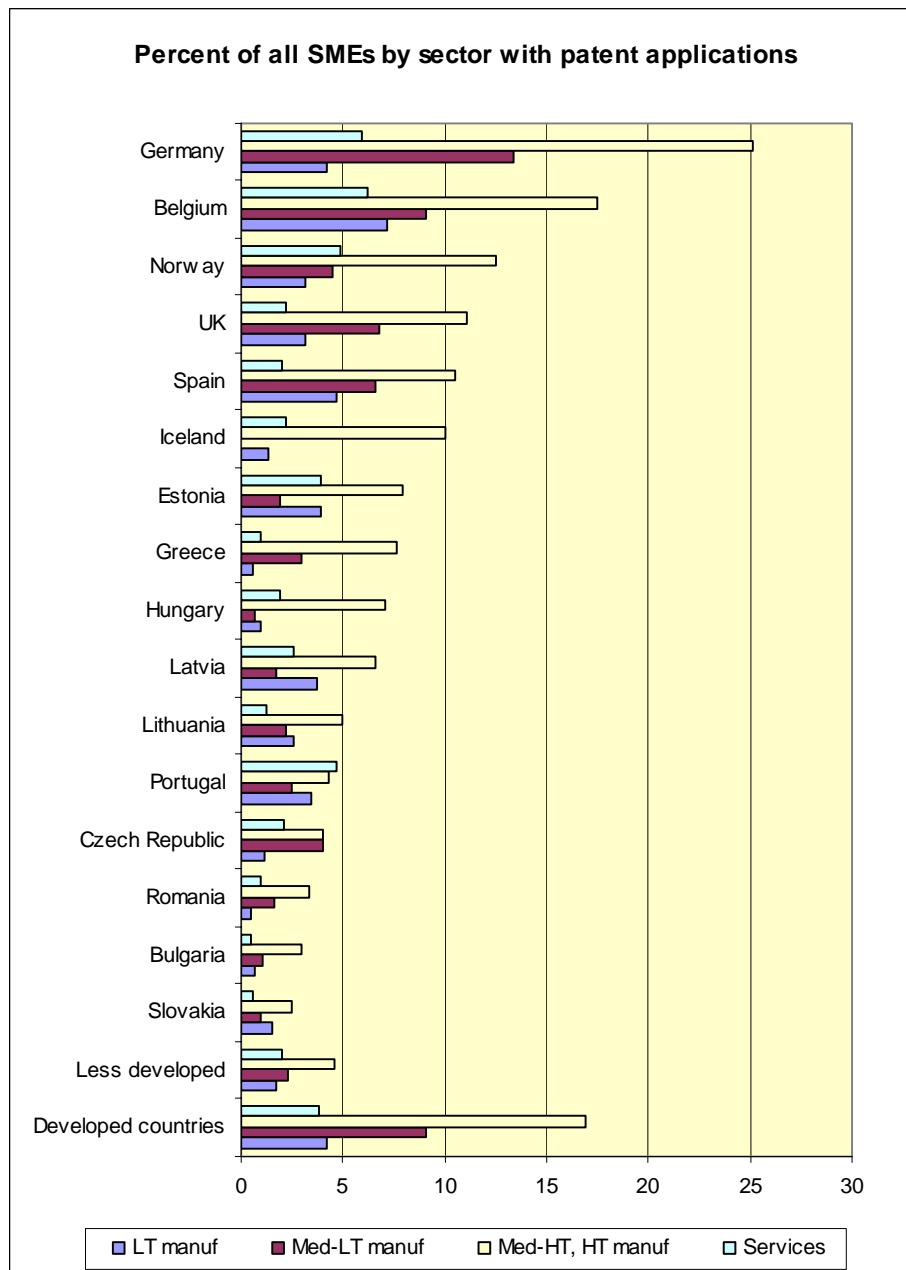
Figure 5 gives results by sector, grouped into four categories: Low tech manufacturing (Nace codes 15 to 22, 36 and 37), Medium-Low tech manufacturing (Nace codes 23, and 25 to 28), Medium-High tech and High tech manufacturing (Nace codes 24, 29 and 30 to 35) and Services¹⁰.

In all countries except Portugal, the sector combination Medium-High and High-Tech manufacturing has the highest percentage of SMEs that have applied for a patent. More than 10 percent of all SMEs in Medium-High and High-Tech manufacturing in Germany, Belgium, Iceland, Norway, the UK and Spain applied for at least one patent between 1998 and 2000. The highest percentage of SMEs applying for a patent in the low tech sector is in Belgium at 7.1%, followed by Spain at 4.7%. For medium-low tech manufacturing, the highest rate is in Germany

¹⁰ Services covered in CIS-3 do not include all NACE service classes but tends to include more innovative NACE service classes only: G51 Wholesale trade and commission trade, except of motor and motorcycles; I60 Land transport, transport via pipelines; I61 Water transport; I62 Air transport; I63 Supporting and auxiliary transport activities, activities of travel agencies; I64 Post and telecommunications; J65 Financial intermediation, except insurance and pension funding; J66 Insurance and pension funding, except compulsory social security; J67 Activities auxiliary to financial intermediation; K72 Computer and related activities; K73 Research and development and K74 Other business activities.

at 13.4%, while for services the highest rate is 6.2% for Belgium. In all countries except Portugal, the patent application rate in the service sector is lower than the rate in at least one of the three manufacturing sectors. In ten of the 16 countries, the patent application rate in the service sector exceeds that of the low tech or medium-low tech manufacturing sectors.

Figure 5. Percent of all SMEs with at least one patent application by sector



4. Simulating the effect of an increase in IP use by SMEs

This section estimates the SME share of EPO patent applications in 2000 for 15 countries (estimates cannot be calculated for Bulgaria) and forecasts the SME share to 2015. We estimate EPO patent shares because of the availability of consistent and comparable data on the number of EPO patent applications from each country.

The estimates are based on several demanding assumptions, since the only data available for all countries, with the exception of the UK, is the percentage of SMEs that applied for one or more patents between 1998 and 2000 *in any patent jurisdiction*: national, EPO, USPTO, etc. The CIS-3 question also does not discriminate between a technically unique patent (a priority application) and multiple counts of the same patent in more than one jurisdiction. For instance, the EPO counts one application as a single patent, whereas the reporting firm could count the same patent five times if they wished to obtain patent rights in five different EU countries.

For the UK, we have an estimate of the total number of patent applications by all firms (42,116) and the total by SMEs (21,578). SMEs in the UK therefore account for an estimated 51% of all patent applications by British firms. On average, each UK SME that applied for a patent made 5.2 patent applications, for an average of 1.7 per year, compared to an estimated average of 9.5 patent applications per year for firms with over 249 employees.

4.1 Minimum estimate of SME share of EPO patent applications

Using the micro-aggregated CIS-3 data, a minimum estimate of the number of patent applications per firm is obtained by assuming that each firm that reported applying for a patent applied for only one patent between 1998 and 2000, or 0.33 patents per year. For instance, 954 Belgian SMEs applied for at least one patent over these three years and 99 large firms applied for at least one patent, for a total of 1,053 patents, as shown in Table 4. The minimum estimate per year for SMEs is 318 patent applications (954/3). The total number of Belgian patent applications at the EPO for 1998 to 2000 inclusive is 3,738 applications. The difference between the minimum estimate per firm and the total observed estimate is due to multiple patent applications by some firms.

In eight countries the minimum estimated number of patents by all firms exceeds the total number of observed EPO patent applications in the same period, probably due to patent applications at the national patent office. The overestimate is highest in the Czech Republic, Estonia, Lithuania, Latvia, Portugal and Romania where firms could be more likely to patent domestically (only Hungary and Greece in the less developed countries report fewer patent applicant firms than the total observed EPO patents). For example, the estimated minimum number of patent applications by Czech firms is 501 patents (1 patent per firm over 1998 to 2000 inclusive), whereas EPO records show only 191 Czech patents over these three years. When the ratio of A/B in Table 4 exceeds 1, we correct for this disparity by dividing the estimated minimum number of patents per year by SMEs (0.33 patents) by the 'A/B ratio' in Table 4. This assumes that some of the patents are not at the EPO. Annex B gives an example for the UK.

Table 4. Estimated and observed EPO patent applications (1998 – 2000 inclusive)

Country	A		B	Ratio A/B
	SME patent applicant firms	Total patent applicant firms	Total observed EPO patent applications	
Belgium	954	1053	3738	0.28
Czech Republic	424	501	191	2.62
Germany	9720	12543	62076	0.20
Estonia	122	123	18	6.80
Spain	3201	3383	2138	1.58
Greece	147	158	165	0.96
Hungary	246	273	290	0.94
Iceland	14	18	94	0.19
Lithuania	72	79	8	9.45
Latvia	121	133	14	9.71
Norway	238	238	1083	0.22
Portugal	819	883	105	8.42
Romania	204	287	19	15.16
Slovakia	64	69	38	1.82
UK	4054	4738	16672	0.28

As part of answering the second question on the effect of an increase in IP by SMEs, we develop a simple forecasting model of **total** future EPO patent applications and the expected growth rate of SME patents. For each country we forecast the number of EPO patent applications for the years 2004 to 2015 using three different methods: a linear prediction using the last 5 years of EPO patent application data (1999 to 2003 for the first observation), a linear prediction using the last eight years¹¹ (1996 to 2003 for the first observation) and a linear prediction using the last fourteen years (1992 to 2003). We then choose the forecast method that predicts middle values. This is based on eight years of EPO data for all countries except for Spain, Hungary and Portugal for which the 14-year estimate is used.

Figure 5 gives the total number of EPO patent applications in the six developed innovative countries combined (Germany, Belgium, Spain, Iceland, Norway and the UK) and the total estimated number from SMEs in these countries, using the **minimum estimate** method of no more than an average of 0.33 EPO patents per SME per year. Figure 6 gives comparable results for nine less developed innovative countries (Czech Republic, Estonia, Greece, Hungary, Lithuania, Latvia, Portugal, Romania and Slovakia).

For the developed innovative countries, SMEs in 2015 account for an estimated 19% of all EPO patents, whereas in the less developed innovative countries they account for an estimated 80% of all EPO patents in 2015. Part of the difference is due to a much larger share of patenting activity among SMEs in the smaller new member states, partly because there are fewer large firms in

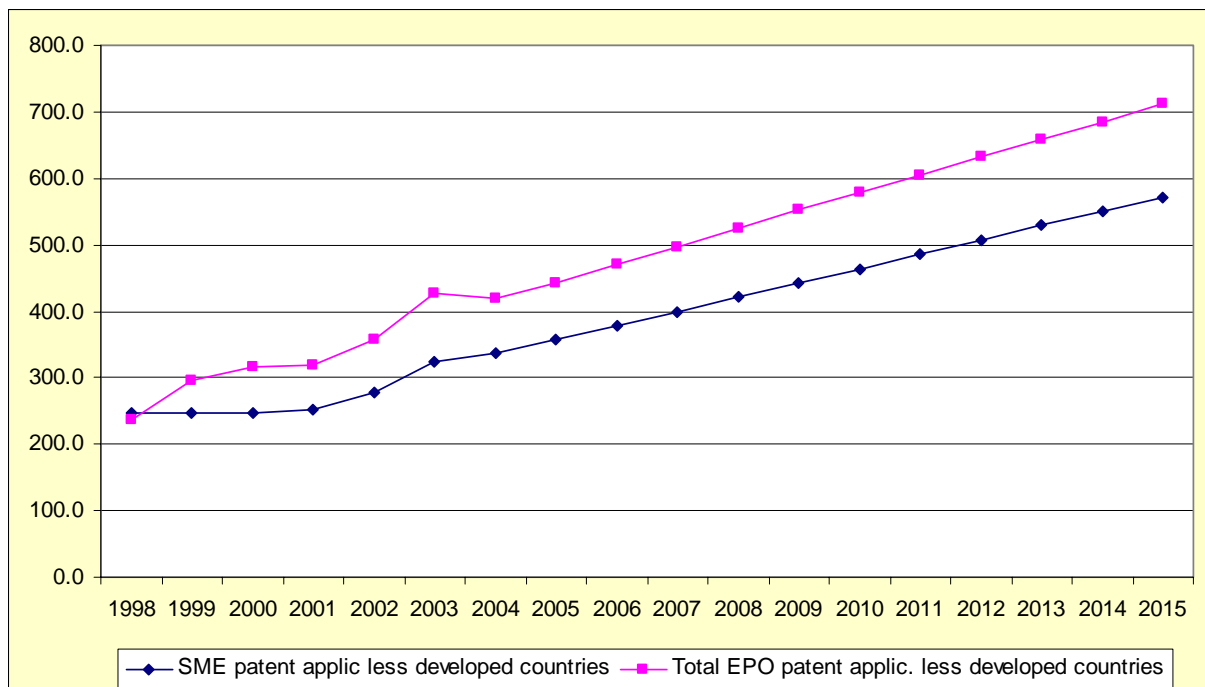
¹¹ The five and eight –year forecast use an smoothed series in which each observation is substituted by the average between itself, the previous and the next observation.

these countries. In these estimates the share of total patents from the less developed countries increases over time due to higher growth rates before 2003 that are extrapolated into the future.

Figure 5. Total and SME patent applications in ‘developed innovative countries’



Figure 6. Total and SME patent applications in ‘less developed innovative countries’



4.2 Maximum estimate of SME share of EPO patent applications

A maximum estimate of the number of patent applications by SMEs is obtained by dividing the total number of EPO patent applications in the period 1998-2000 by the number of firms (of all size classes) that reported one or more patent applications over the same period (See Annex C). For example, the number of EPO patent applications in Belgium was 3,738 between 1998 and 2000 and 1,053 firms (both SMEs and large firms) applied for at least one patent, which gives a maximum estimate of 3.55 patents over three years, or 1.18 patents per year (See Table 5). Instead of assuming that each of the 954 Belgian SMEs applied for 0.33 patents in 1998, as in the minimum estimate, we assume that these firms applied for 1.18 patents in 1998. The total number of estimated EPO patent applications is increased by the additional simulated patent applications. For countries where A is larger than B, the maximum number of patent applications (Column C in Table 5) is set to 1. However, as in the minimum estimate, the number of patent applications in countries with an A/B ratio greater than 1 (see Table 4) is corrected by the corresponding A/B ratio. Figures 7 and 8 give the results for the developed and less developed innovative countries respectively.

Table 5. Maximum estimate of average patent applications per year by SMEs (1998-2000)

	B	A	C	
	Total observed EPO patent applications	Total patent applicant firms	Maximum CIS-3 estimate of patent applications (maximum between B/A and 1)	Maximum CIS-3 estimate of patent applications per year (C/3)
Belgium	3738	1053	3.55	1.18
Czech Republic	191	501	1	0.33
Germany	62076	12543	4.95	1.65
Estonia	18	123	1	0.33
Spain	2138	3383	1	0.33
Greece	165	158	1.05	0.35
Hungary	290	273	1.06	0.35
Iceland	94	18	5.21	1.74
Lithuania	8	79	1	0.33
Latvia	14	133	1	0.33
Norway	1083	238	4.55	1.52
Portugal	105	883	1	0.33
Romania	19	287	1	0.33
Slovakia	38	69	1	0.33
UK	16672	4738	3.52	1.17

There is very little difference between the minimum and maximum estimates for the less developed innovative countries, whose SME share stays at 80%. This is due to six of the eight countries being set to the default of 0.33 patents per year, which is then adjusted downward by the A/B ratio. For these six countries, there is no difference between the minimum and maximum

estimate. The only increase in the minimum and maximum estimates are for Greece and Hungary. In contrast, the maximum estimate increases the SME share for developed innovative countries from 19% to 49% of all EPO patents.

Figure 7. Maximum total & SME patent applications 'developed innovative countries'

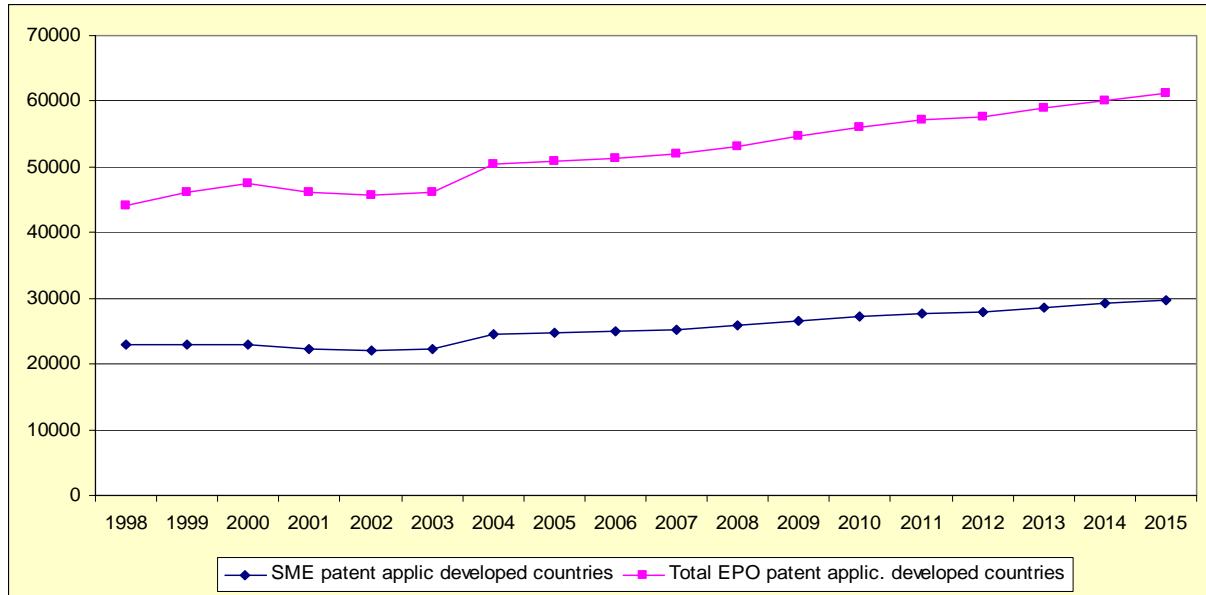
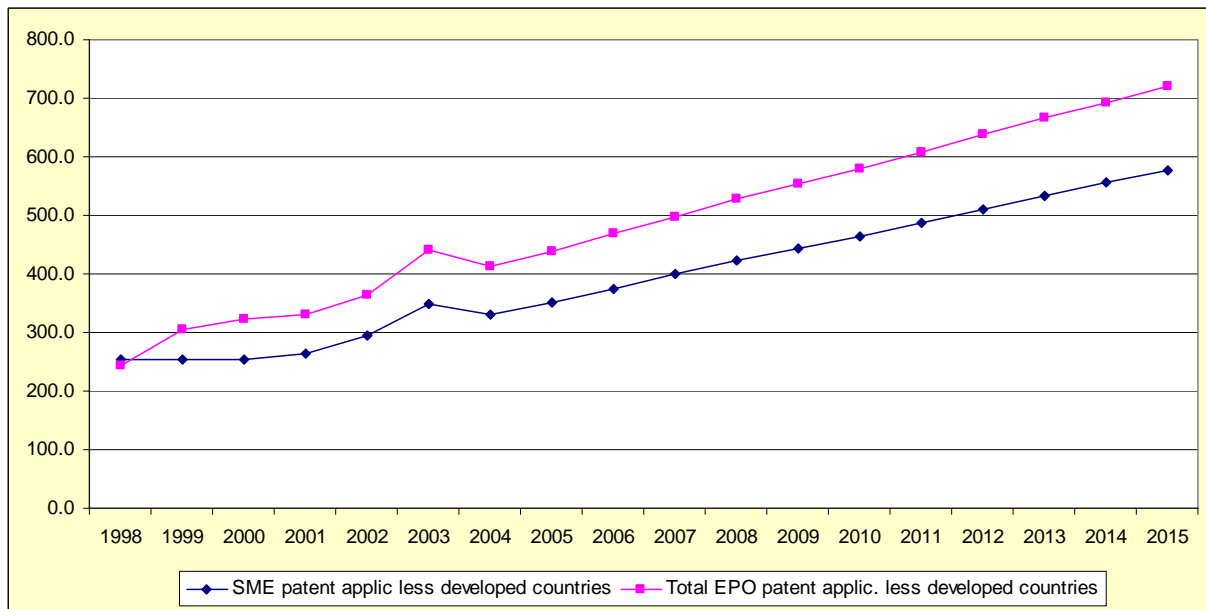


Figure 8. Maximum total & SME patent applications 'less developed innovative countries'



4.3 Policy push to increase patenting by SMEs

Over time, the number of patent applications by SMEs could increase due to 1) an increase in the intensity of patenting by SMEs that have already applied for a patent or 2) by patent applications made by SMEs that currently do not patent. The first option can be estimated by the difference above between the minimum and maximum estimates. In developed countries, this could increase the SME share of total patents from 19% to 49% of all EPO patents, which is likely to be unrealistic (see conclusions).

In this section we estimate the second option, where policy actions lead in 2007 to an increase of 25% in the number of SMEs that patent. In the first year these firms will patent at a maximum rate of one patent over three years, or 0.33 patents a year, using the minimum estimate method. Figures 7 and 8 show the effects of this simulation in the SME share of total patents by the less developed innovative and the more developed innovative groups of countries. For the developed innovative group of countries, the maximum SME share of total EPO patents increases from 19% to 23% of EPO patents after the ‘policy intervention’. In the less developed innovative group, policy intervention increases the SME share from 80% to 84%. Annex D gives an example of how the estimate of the increase in patents from a ‘policy push’ is calculated.

Figure 7. Effect of a 25% increase in the share of SMEs that apply for a patent: developed innovative group of countries.

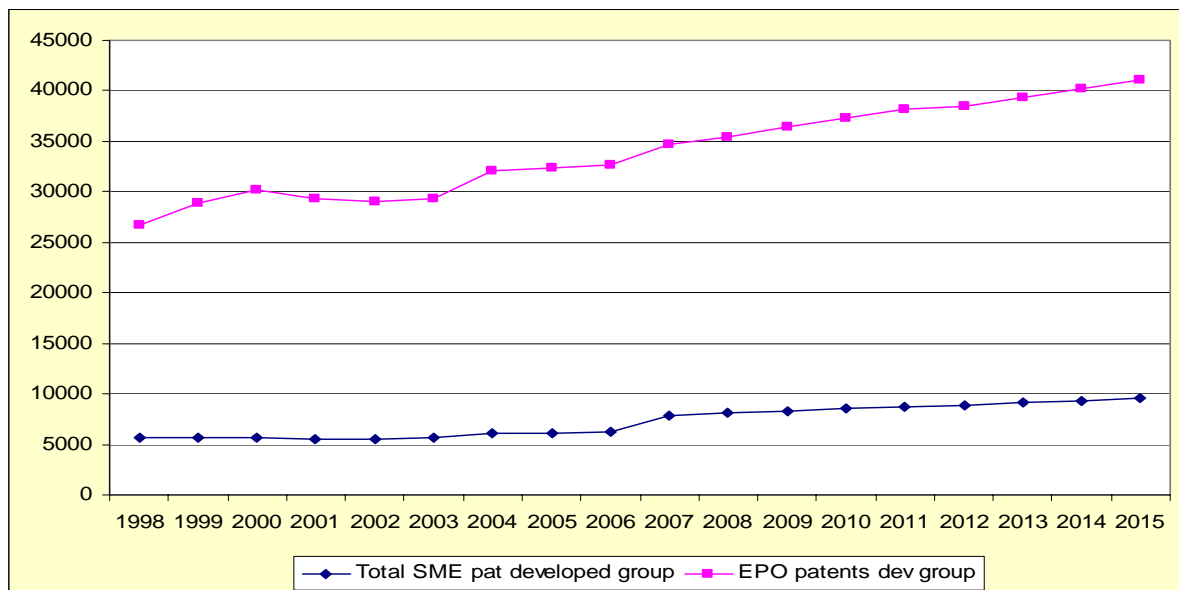
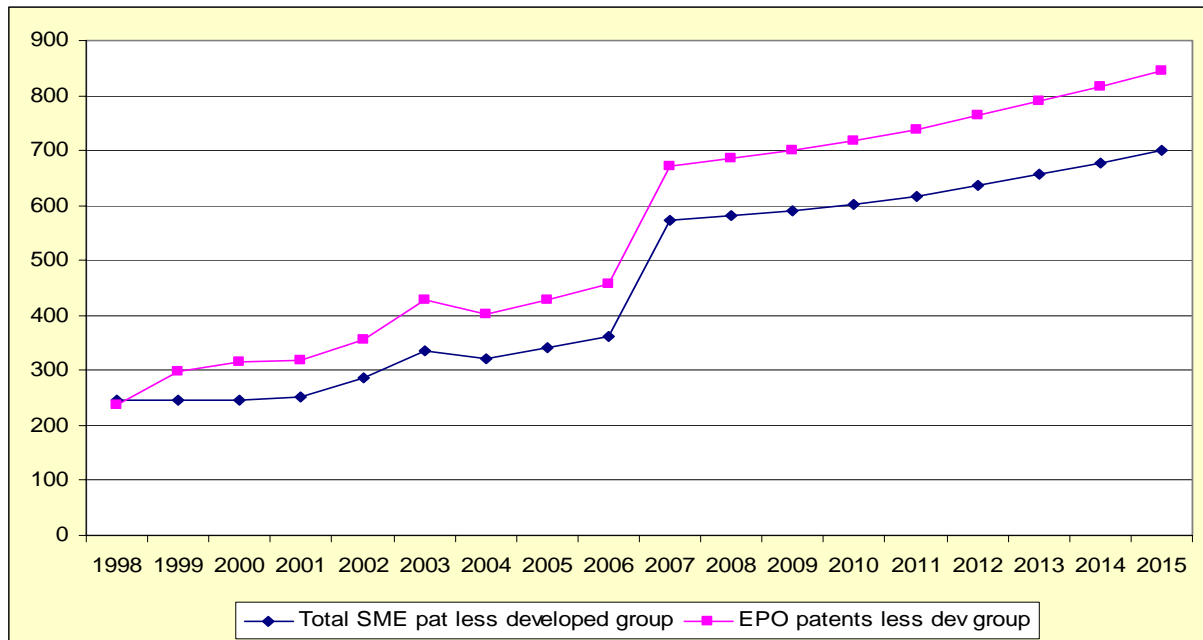


Figure 8. Effect of a 25% increase in the share of SMEs that apply for a patent: less developed innovative group of countries.



The simulation is also repeated using the maximum estimate method (results not shown). Using this technique, we assume that the patenting rate for new SMEs is no more than 0.33 per year, but increases over time to the rate observed in SMEs that already patented before the implementation of the policy, so that in 2015 new patenters apply for patents at the same rate as old patenters (see Annex D for the methodology used).

5. Conclusions

In all countries a higher percentage of large firms with 250 or more firms applied for a patent than SMEs. The difference in Table 3 between large firms and SMEs ranges from 1.9 times higher in large firms in Belgium to 11.4 times higher in Latvia, with an average of 5.2 times higher. The average ratio between the use rate for large firms and for SMEs is lowest for non-formal protection methods such as secrecy (3.0), design complexity (2.5) and copyright (2.9) than it is for the formal protection methods of design registration (3.9), trademarks (3.5) and lead times (3.2).

A large fraction of these differences is probably due to lower rates of innovative activity among SMEs compared to large firms, but these results also hold when limited to the innovative firms in Table 2. The countries are not the same, but the large/small firm ratio maintains the same pattern: 2.8 for patents, 2.7 for design registration, 2.2 for trademarks, 2.8 for copyright, 1.9 for secrecy, 1.7 for design complexity, and 1.6 for lead times. Again however, small innovative firms could be less likely to develop novel innovations than large firms, which could explain part of the lower

patent application rate and the lower use rate of other types of formal and informal protection methods. Nevertheless, a lower percentage of small firms use each other type of protection less frequently than they use patents, and a lower percentage use formal protection methods than informal methods. The same patterns apply to medium sized firms compared to large firms.

The simulations of the share of patenting by SMEs show that, depending on the estimation method, between 19% and 49% of all EPO patent applications from developed countries are from SMEs. This large difference also highlights the possible margin of error. The share is much higher for the less developed countries, at 80% for both the minimum and maximum estimation methods, largely because of a very low number of large firms.

Table 6 summarizes the estimated share of all EPO patents due to SMEs and the simulation results due to a policy intervention to increase the number of SMEs that apply for a patent by 25%. Using the minimum estimation method, policy intervention to create 25% more SMEs applying for a patent increases patent application rates by 4% points in both the innovative and the less innovative countries. However, in relative percentage terms, the increase is greater in the innovative countries (21%) than in the less innovative countries (5%). Using the maximum estimation method, the same policy intervention increases patent application rates by 5% points in the innovative countries and by 4% in the less innovative countries.

Table 6. Summary of estimates of patent application rates by SMEs

	Innovative countries	Less innovative countries
Minimum estimate: SME share of all EPO patent applications:	19%	80%
Maximum estimate: SME share of all EPO patent applications:	49%	80%
Policy intervention on minimum estimate: percentage point increase	+ 4%	+ 4%
Policy intervention on maximum estimate: percentage point increase	+5%	+4%

Independent data on the share of EPO patent applications from SMEs are available from the PATVAL study (Ceccagnoli et al, 2005), which randomly sampled EPO patents in major IPC classes from six countries between 1993 and 1997 and interviewed the applicant about several factors, including the size of the firm. The results of the PATVAL study for the percent of EPO patent applications from SMEs are given in Table 7, together with the minimum and maximum simulation estimates of the SME share. Table 7 shows that the PATVAL and minimum simulation estimates are very similar for Germany (14.6% and 14.9%), for the UK (26.6% and 23%), and for all innovative countries (the countries vary in the PATVAL and simulation studies) at 22% and 19%. Conversely, the minimum simulation estimate for Spain is 2.4 times higher than the share estimated by PATVAL. The maximum simulation results are much higher than the PATVAL estimates, strongly suggesting that the minimum estimate is a more accurate predictor of SME patenting behaviour. Consequently, the best estimate of the effect of a policy intervention to increase the number of SMEs that patent by 25% is for a 4% increase in total EPO patents from innovative countries and from less innovative countries.

Table 7. PATVAL and simulation estimates of EPO patent application share for SMEs

Results of the PATVAL study (1993 – 1997 average)					
Country	Number of patents	Share by inventors' employer*		Simulation results for SME share for 2000	
		Large firm (250+ employees)	SME (<250 employees)	Minimum estimate	Maximum estimate
Germany	3,346	80.0%	14.6%	14.9%	46%
Spain	269	54.0%	36.0%	85.7%	86%
France	1,486	66.2%	24.5%	-	-
Italy	1,250	64.4%	29.8%	-	-
Netherlands	1,124	69.2%	22.1%	-	-
UK	1,542	60.5%	26.6%	23%	51%
<i>Total</i>	<i>9,017</i>	<i>70.1%</i>	<i>22.0%</i>	<i>19%**</i>	<i>49%**</i>

(*): The shares do not sum to 100% because of patent applications by public research organizations, etc. For example, in Germany, 94.6% of applications were by firms and 5.4% by other types of organizations.

** : Six innovative countries (Belgium, Germany, Spain, Iceland, Norway and the UK).

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Annex A. Multiple size classes in CIS 3 micro-aggregated data

As shown in the table below, due to the micro-aggregation process, 24% of the weighted observations are assigned more than one size class.

Size class	Frequency
1 (10-49 employees)	72.6%
2 (50-249)	0.8%
3 (250+)	2.6%
1-2	0.1%
1-3	15.7%
2-3	4%
1-2-3	4.1%
Total number of observations	309,722

Firms with size class 1-2 do not constitute a problem since they still fall under the category of SMEs. We have run some simple statistics on the rest of the firms (size classes 1-3, 2-3 and 1-2-3) in order to see if their behavior is more similar to one of the two categories of SMEs or of larger firms. The variables used to compare these three groups of firms are the following: whether the firm had some innovation activities (yes to one of the following: introduced a product/process innovation, had not completed innovation activities, had abandoned innovation activities), introduction of a product innovation, introduction of a process innovation, internal R&D, external R&D and whether or not the firm applied for at least one patent. The following table summarizes the results.

Table A1. Percentage of firms involved in the following activities

	Innovation activities	Introduced product innovation	Introduced process innovation	Internal R&D	External R&D	Applied for a patent
SME	41.2	28.4	24.1	23.2	9.4	5.7
Large firm	74.9	62.3	55.4	57.0	31.6	26.9
Small-Large	43.7	30.9	38.4	30.7	14.3	5.6
Medium-Large	42.7	32.3	28.4	30.8	14.3	6.6
Small-Medium-Large	29.7	21	17.3	17.2	8.7	2.5

The frequencies for the group of firms with size class Small-Large are (much) higher than the SME group, so this group must contain a larger number of large firms than of small ones. We assign this group to the category of Large firms. The opposite occurs with the group of Small-Medium-Large firms, where all frequencies are (much) lower than those of the SME group. We assign this group to the SME category. Firms in the Medium-Large group are closer to the SME group for 4 out of 6 variables (terms of innovation activities, product innovation, process innovation, and patent applications), so we also assign this group to the category ‘SME’.

Annex B. Minimum estimate

Annex Table B1 gives an example of how the SME share is forecast using data from the UK. The number of SMEs applying for at least one patent application in the period 1998-2000 was 4054, which gives a minimum estimate of 1351 applications per year. The value of (B) for the following years is predicted using the growth rate of EPO patent applications between the corresponding year and the previous one. For example, the number of SME applications in 2001 is predicted using the growth rate of EPO patent applications between 2000 and 2001 (C) is obtained dividing (B) by the corresponding 'A/B' ratio in Table 3 if this is larger than one. In the case of the UK, this ratio equals 0.28, which implies that (C) equals (B). Finally, (D) equals (C) divided by (A).

Annex C. Maximum estimate

The maximum estimate of the number of patent applications by SMEs for the UK is 1.14 patents per year (see Table 4). (E) is obtained by multiplying 4054 (number of SME applicants between 1998 and 2000) by 1.14. The value of (E) for the following years is predicted using the growth rate of EPO patent applications between the corresponding year and the previous one. As mentioned above, (F) equals (E) because the ratio 'A/B' is smaller than one for the UK.

(G) gives the number of EPO patent applications corrected by the difference between the SME patent applications obtained using the maximum and the minimum estimates, that is, (F)-(C).

Annex D. Policy push

We assume that policy actions lead in 2007 to an increase of 25% in the number of SMEs that patent. In the first year these firms will patent at a rate of one patent over three years, or 0.33 patents a year. However, we assume that this patenting rate increases over time so that in 2015 new patenters patent at the same rate as previous patenting firms¹². Total EPO patent applications are adjusted to include these new patent applications.

In the UK 4,054 SMEs applied for at least one patent between 1998 and 2000. In 2007, 25% more firms (that is, 1014 new patenters) start to patent at a rate of 0.33 patents a year, which means 338 additional patents in 2007. (J) and (N) give the number of patent applications by the new patenters using the minimum and maximum estimate, respectively. Using the minimum estimation method, the rate at which old patenters will be patenting in 2015 is equal to 0.35 (1437 divided by 4054). By solving the equation $\frac{338 * R_{\min}^{(2015-2007)}}{1014} = \frac{1437}{4054}$, we obtain that

$R_{\min} = 1.100772$ is the rate of growth at which the number of patent applications of the new patenters grows over time such that in 2015 these firms will be applying for 0.35 patents a year

¹² The number of patent applications by SMEs increases over time at the same rate EPO applications increase (see A).

(359/1014=0.35). For instance, the number of patent applications by new patenters in 2010 equals $338 * R_{min} = 340$.

Using the maximum estimation method, the new 1014 patenters will start patenting at a rate of 1.17 patents per year, that is, 1189 new applications in 2007. R_{max} solves the equation

$$\frac{1189 * R_{max}^{(2015-2007)}}{1014} = \frac{5057}{4054}.$$

TABLE B1																		
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Minimum estimate: 0.33 patents per year																		
(A) EPO pat. applications	5132	5703	5836	5428	5302	5159	5789	5763	5711	5691	5751	5861	5969	6014	5986	6059	6138	6206
(B) SME pat. applic. minimum	1351	1351	1351	1257	1228	1195	1340	1334	1322	1318	1332	1357	1382	1393	1386	1403	1421	1437
(C) SME pat. applic. adj. = (B) / 'A/B' ratio	1351	1351	1351	1257	1228	1195	1340	1334	1322	1318	1332	1357	1382	1393	1386	1403	1421	1437
(D) SME share = (C)/(A)	26%	24%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%
Maximum estimate: the maximum between 1/3 and ('B/A' ratio)/3 (see Table 4)																		
(E) SME pat. applic. maximum	4755	4755	4755	4423	4320	4204	4716	4695	4653	4637	4686	4776	4864	4900	4877	4937	5001	5057
(F) SME pat. applic. adj. = (E)/ratio	4755	4755	4755	4423	4320	4204	4716	4695	4653	4637	4686	4776	4864	4900	4877	4937	5001	5057
(G) EPO applications corrected = (A)+(F-C)	8536	9107	9239	8594	8395	8169	9165	9124	9041	9010	9105	9280	9451	9522	9477	9592	9718	9826
(H) SME share = (F)/(G)	56%	52%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
Policy push-minimum. In 2007 25% more SMEs start to patent																		
(I)=(C) SME applic. old patenters	1351	1351	1351	1257	1228	1195	1340	1334	1322	1318	1332	1357	1382	1393	1386	1403	1421	1437
(J) SME applic. new patenters										338	340	343	346	348	351	354	357	359
(K) Total SME applications = (I) + (J)	1351	1351	1351	1257	1228	1195	1340	1334	1322	1656	1672	1700	1728	1741	1737	1757	1778	1796
(L) EPO applications corrected = (A) + (J)	5132	5703	5836	5428	5302	5159	5789	5763	5711	6029	6091	6204	6315	6362	6337	6143	6494	6565
SME share = (K) / (L)	26%	24%	23%	23%	23%	23%	23%	23%	23%	27%	27%	27%	27%	27%	27%	27%	27%	27%
Policy push-maximum In 2007 25% more SMEs start to patent																		
(M)=(E) SME applic. old patenters	4755	4755	4755	4423	4320	4204	4716	4695	4653	4637	4686	4776	4864	4900	4877	4937	5001	5057
(N) SME applic. new patenters										1189	1198	1207	1216	1226	1235	1245	1254	1264
(O) Total SME applications = (M) + (N)	4755	4755	4755	4423	4320	4204	4716	4695	4653	5826	5884	5983	6080	6126	6113	6182	6255	6321
(P) EPO applications corrected = (G) + (N)	8536	9107	9239	8594	8395	8169	9165	9124	9041	10199	10303	10487	10667	10748	10712	10837	10972	11090
SME share = (O) / (P)	56%	52%	51%	51%	51%	51%	51%	51%	51%	57%	57%	57%	57%	57%	57%	57%	57%	57%