DISCUSSION PAPER SERIES

No. 6499

PER UN PUGNO DI DOLLARI: A FIRST LOOK AT THE PRICE ELASTICITY OF PATENTS

Gaetan de Rassenfosse and Bruno van Pottelsberghe de la Potterie

INDUSTRIAL ORGANIZATION

Centre for Economic Policy Research

www.cepr.org

Available online at: **www.cepr.org/pubs/dps/DP6499.asp**

ISSN 0265-8003

PER UN PUGNO DI DOLLARI: A FIRST LOOK AT THE PRICE ELASTICITY OF PATENTS

Gaetan de Rassenfosse, FNRS, Université Libre de Bruxelles, ECARES and CEB
Bruno van Pottelsberghe de la Potterie, European Patent Office, Université Libre de Bruxelles, ECARES, CEB, DULBEA and CEPR

Discussion Paper No. 6499
October 2007

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 6499

October 2007

ABSTRACT

Per un Pugno di Dollari: A first Look at the Price Elasticity of Patents*

This paper analyzes the role of patent filing fees requested by the member states of the European Patent Convention (EPC). We provide a first empirical evidence showing that the fee elasticity of the demand for priority applications is negative and significant. Given the strong variation in absolute fees and in fees per capita across countries, this result witnesses a suboptimal treatment of inventors across European countries and suggests that fees should be considered as an integral part of an IP policy, especially in the current context of worrying backlogs. In addition, we show that the transfer rate of domestic priority filings to the EPO increases with the duration of membership to the EPO and the GDP per capita of a country, suggesting that member states experience a learning curve within the EPC. The high heterogeneity in the transfer rates casts some doubts on the practice that consists in relying on filings at the EPO or at the USPTO to assess innovative performance of countries.

JEL Classification: O30, O31, O38 and O57
Keywords: fees, patent filing and price elasticity

Gaetan de Rassenfosse
Université Libre de Bruxelles
CP139
50 av. F.D. Roosevelt
1050 Brussels
Belgium
Email: gderasse@ulb.ac.be

Bruno van Pottelsberghe de la Potterie
European Patent Office
27 Erhardtstrasse
80469 Munich
Germany
Email:
bruno.vanpottelsberghe@ulb.ac.be

* The views expressed in this article are purely those of the authors and may not in any circumstances be regarded as stating an official position of the EPO or of the ULB. The authors are particularly grateful to Alison Brimelow, Dominique Guellec, Bronwyn Hall, Dietmar Harhoff, Karin Hoisl and Nicolas van Zeebroeck for their useful comments as well as to the participants of the conference at Monte Verità, The Economics of Technology Policy, June 17-22, 2007. The paper was partly written when Gaétan de Rassenfosse was visiting scholar at the EPO.

Submitted 13 September 2007

1 Introduction

"*The number of applications has soared in recent years, but patent offices have been unable to keep up - resulting in huge backlogs and lengthy delays.*" [2] This quote perfectly summarizes the situation in all major patent offices, including the European Patent Office (EPO). [3] "Backlogs" or "lengthy delays" are worrying not only because they induce more uncertainty on the market, but also for the potential drop in quality they might be associated with. [4]

Various actions have been taken in order to reduce the number of pending applications. One of them consists in hiring more patent examiners. For instance, the USPTO hired a record 1,193 patent examiners in 2006 and plan to hire another 1,200 new examiners in 2007. [5] The EPO also favored a second approach that consists in "raising the bar", i.e. increasing the rigor of the examination process. Raising the bar is probably a long term answer to the problem as it will not directly reduce the backlog but rather the number of patents applied for, by lowering applicants' expectations about the probability of having their patents granted. Higher quality of the identification of the prior art is a third option that is under investigation at the USPTO. This "Peer to Patent" scheme consists in opening the process up to internet-based collaboration: anybody would be allowed to submit comments and prior art references related to the patent application.

A fourth possibility, although barely used so far, would be to leverage patenting fees in order to reduce the number of filings. The fee-elasticity issue is generally not at the forefront of the debates on patent systems. The current perception seems to suggest that there is no real impact of fees on the patenting behavior of firms. According to the economic literature, national patent applications are driven by the size of the economy, relative research efforts and the IP strategies adopted by applicants. One field of research, mainly based on surveys, has focused on companies' *perception* of patenting costs. This mi-

---

[2] The Economist, September 8th, 2007, p. 23

[3] Pending applications soared by 41%, 79% and 98% from 2000 to 2005 at the EPO, the Japanese Patent Office (JPO) and the United States Patent and Trademark Office (USPTO), respectively (Trilateral Statistical Reports, 2000 to 2005).

[4] For instance, Alison Brimelow, the President of the EPO, "*... has been very keen to stress the importance of patent quality and has also said that she is worried that there may be too many patents being granted.*" [Intellectual Asset Management, August/September 2007, p. 5]. Cfr Jaffe and Lerner (2004) and Guellec and van Pottelsberghe (2007) on the 'quality issue' and on the challenges faced by the USPTO and the EPO, respectively. van Pottelsberghe and van Zeebroeck (2008) provide empirical evidence suggesting that the average value of patents filed at the EPO has been constantly decreasing since the mid-eighties.

[5] USPTO, 2007-2012 Strategic Plan, p. 6.

croeconomic approach leads to the conclusion that firms' perception of high fees does not correlate with their patenting behavior (*e.g.*, Cohen et al. (2000) and Peeters and van Pottelsberghe (2006)).[6] This approach on perception does not however capture the *effective* impact of filing fees on the demand for patents.

The case of Europe is particularly interesting if one aims at understanding the potential role of fees on patent filings. Indeed, the large majority of EPO filings actually are second filings that come from its member states and other non-European countries. In other words, priority filings at national patent offices (NPOs) are the stepping stone of EPO applications. Understanding the role of patenting fees at NPOs is therefore of prime importance in the current context of patenting hype that translates into backlogs. Moreover, the costs associated with the patenting process vary significantly across countries. This heterogeneity has recently been exacerbated by Italy's decision to considerably lower its patenting fees... to finally reintroduce substantial fees in early 2007.[7] Other countries such as Switzerland or Belgium have also lowered their patenting fees or plan to do so in the near future.[8] This downward trend raises the question of whether and to what extent national filing fees affect the demand for patents.

The main objective of this paper is to better understand the drivers of the national demand for patents and their transfer rate at the European Patent Office. More filings at national patent offices means potentially more patents transferred at the EPO, which would further increase the workload pressure on its examiners. The following research questions are to be investigated: i) do patenting fees vary significantly across countries?; ii) do the filing fees affect the patenting behavior of applicants within the member states of the European Patent Convention (EPC)? and iii) what are the determinants of the transfer rate of national priority filings towards the EPO?

---

[6] A second approach concerns *international patent filings* and has been conducted at the country-level. Here, costs have been found to play a significant role in explaining international patent flows (see Eaton et al. (2004) and Park (2003)). That is, once a patent has been filed in a country's national patent office, subsequent filings in foreign countries are partly explained by fees.

[7] See Financial Times, Jan. 17, 2006, *As Europe Tries for United Patents, Italy Moves Alone*, Section C, p.8. and Gazzetta Ufficiale della Repubblica Italiana, 6 April 2007, Serie generale - n. 81, p. 35.

[8] As of 1st January 2007, the Swiss patent office canceled 70 patenting taxes and lowered 11 taxes. The filing tax is nowadays of 200 CHF. See the *Règlement sur les taxes de l'Institut Fédéral de la Propriété Intellectuelle*, October 18, 2006. Regarding Belgium, see *Projet de loi* 51-2756/1 advising a decrease of search fee to make Belgian patents more "attractive". From cumulated patenting fees of about 1,000 EUR as of July 2007, the project consists of reducing them to about 300 EUR.

The paper is structured around the 3 research questions: section 2 presents the methodology used to compute patenting fees and compares them across the EPC member states. Section 3 investigates whether patenting fees affect the behavior of applicants and section 4 analyzes the determinants of the transfer rate of national priority filings towards the EPO. Section 5 concludes.

The main results can be summarized as follows. First, there is a strong variation in fees per capita across the EPC member states; inventors from smaller countries generally face (much) higher relative fees. Second, fees are an important determinant of the number of national priority filings. Added together, these results witness a suboptimal treatment of inventors across European countries. Third, the transfer rate of priority filings towards the EPO greatly differs across countries and depends on the wealth of the country and its duration as member of the EPC. This result casts some doubts on the practice that consists in using EPO or USPTO filings data to measure national innovative performances and calls for a cautious interpretation of patent-based indicators.

2 Do patenting fees vary across countries?

Estimating fees on a comparable basis is not straightforward as the structure of fees greatly differs from one country to another. Beyond the fact that each NPO has its own nomenclature and granting requirements, pricing schemes are almost unique to every country. For example, some NPOs name examination what is merely a search, some do not require a search and examination of the patent filed and some other charge special fees for drawings. The timing of fees also matters, as applicants might be asked to pay fees at various stages of the patenting procedure.

In order to compare patenting fees across countries, a single fee indicator that encompasses all fees to be borne up to the grant by applicants must be computed. The data was directly collected from national patent offices. [9] Since typical 'punitive' fees can be asked when the number of claims or pages exceeds a given limit, the fees are estimated for the representative patent in each country, for which characteristics were approximated using EPO data. For the patents filed at the EPO by all the applicants from a given country, the average number of claims per patent is divided by the average number of national priority filings included in the EPO filings; which gives an approximation

[9] When the information provided by national patent offices was unclear, we relied on Global IP, an online database that generates cost estimates for patents. Some additional working hypotheses are: one out of five pages is a drawing page, a courier service is used and filings are done in-time.

of the average number of claims per priority filings. The average number of pages is calculated on the assumption of a linear relation with the average number of claims. van Pottelsberghe and François (2006), Archontopoulos et al. (2007), and van Zeebroeck et al. (2006) provide evidence suggesting that such a methodology makes sense.

Table 1 details the various fees up to the grant for a sample of countries. [10] A typical structure composed of the three broad stages of the granting process is suggested: filing, search and examination, and granting. It is important to keep in mind that this is a simplified view that tries to best match the structure of different pricing schemes. This methodology was adopted to estimated fees up to the grant for 29 EPC countries. [11] Fees were converted into US PPP to allow for a proper international comparison, using the exchange rates provided by the World Economic Outlook Database (IMF, April 2006 database).

The strong variation in the fee structure across countries clearly appears in table 1. For instance, Great Britain has no filing fees as such, and Denmark has no search and examination fees even though a novelty search and a patentability examination is performed. Some countries do not request granting fees whereas it can reach as high as 30% to 45% of total patenting fees in countries such as the Czech Republic, Denmark or Sweden. In addition, extra fees may be added to the basic structure: Belgium has stamping fees for drawings, the Czech Republic has extra issue fees related to the number of pages and Denmark has extra filing fees for claims. In order to cope with the inherent complexity of the data, an indicator of cumulated patenting fees can usefully be computed. It is represented in the line *Total Fees*, which encompasses all the fees to be borne by applicants.

It appears that, not only do the structure of fees differ, but also the level of fees asked by national patent offices. It is interesting to note that Germany and the United Kingdom, also the largest countries in this sample, have a particularly low fee. A comprehensive picture of cumulated patenting fees for EPC members states is given in figure 1. It shows that the fees asked by

[10] Besides these administrative fees, applicants also have to bear the cost of professional representation requested by patent attorneys to prepare, file and prosecute patents. These costs are borne by applicants to various extents, as some companies have in-house resources to directly deal with patent authorities. The largest companies, which account for the large majority of patents applied for, generally have their own patent attorneys. Professional representation costs are not included in the present analysis because they are difficult to evaluate in an homogenous way across countries. van Pottelsberghe and François (2006) provide a recent evaluation of the various fees and filing costs (*i.e.* professional representations and translation costs) at the EPO, the USPTO and the JPO.

[11] The EPC includes 31 member states as of the 1st of January, 2006. Liechtenstein and Monaco were excluded from the sample due to lack of data.

Table 1
Detailed methodology adopted to estimate patenting fees, sample of countries.

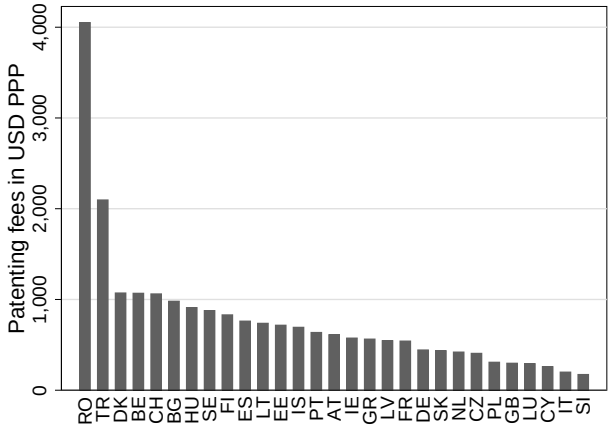
	BE	CZ	DK	DE	NL	SE	GB
Characteristics of the average patent:							
Nb. claims	20	9	20	15	20	18	18
Nb. pages (a)	28(6)	13(3)	28(6)	21(4)	28(6)	25(5)	25(5)
Currency	EUR	CZK	DKK	EUR	EUR	SEK	GBP
Estimated fees:							
Filing	70	1,200	3,000	60	90	1,000	130
+ Extra fees	6*5		300*(20-10)				
Search	887	3,000		250	340	3,000	
Examination				150			70
+ Extra fees						150*(18-10)	
Granting		1,600	2,850			1,100	
+ Extra fees		200*(13-3)				155*(25-8)	
Total Fees	**987**	**6,400**	**8,850**	**410**	**430**	**8,935**	**200**
Total EUR 2003	**987**	**200**	**1,190**	**410**	**430**	**979**	**289**

Fees are estimated for the year 2003. (a) The parentheses after the number of pages indicate the number of drawing pages. Notes: BE (Belgium): filing fees includes 20 EUR of stamping fees; extra filing fees of 5 EUR for each drawing page. CZ (Czech Republic): filing fees of 1,200 CZK if the applicant is not the inventor (600 CZK otherwise); extra issue fees of 200 CZK each further page above the 10th. DK (Denmark): extra application fees of 300 DKK for each further claim above the 10th. DE (Germany): total examination fees of 350 EUR if search has not yet been requested. NL (The Netherlands). SE (Sweden): extra search fees of 150 SEK each claim in excess of 10; extra granting fees of 155 each further page in excess of 8. UK (Great Britain): filing fees of 130 GBP should be more correctly denominated preliminary search fees: the application as such is free of charge. Sources: national patent offices and Global IP Estimator.

national patent offices range from 175 to 4,000 USD PPP, with a mean and median of 779 and 612 USD PPP, respectively. One should nevertheless not rely on this graph to compare how expensive patents are between countries. Indeed, the size of the national market matters as well. Since a patent provides a monopolistic grip on a geographically limited market, the larger the country, the more benefits are to be expected from the patent, or the lower the relative costs. Therefore, a more appropriate picture is given by expressing patenting fees relative to capita. This is what figure 2 shows. Relative patenting fees range from 3 to 2,400 USD PPP per million capita, with a mean and median of 210 and 92 USD PPP respectively. The ratio between the two extremes is of about 800, which witnesses extreme differences in patenting conditions across

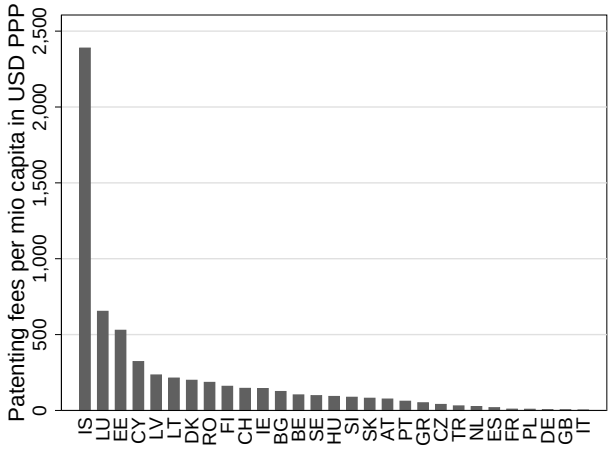
countries. It also raises the question of whether and to what extent patent filing fees affect the filing behavior of applicants.

Fig. 1. National patenting fees in EPC member states, 2003



Cfr. table 1 for an overview of the methodology and table A.1 for the data. Sources: national patent offices and Global IP Estimator.

Fig. 2. National patenting fees relative to capita in EPC member states, 2003



Cfr. table 1 for an overview of the methodology adopted to estimate fees. Sources: national patent offices and Global IP Estimator for the fees; IMF World Economic Outlook Database for the capita.

3 Fees and the filing behavior of applicants

An innovation function based on traditional technology driven growth models (Romer (1990) and Jones (1995)) can be used to explain the production of domestic patents. In its simple form, a *new ideas* production function can be written as $\dot{A} = \delta L_A^{\lambda} A^{\phi}$, where L_A represents the labor used to develop new knowledge (*i.e.* the number of researchers), λ being its productivity; A is the stock of knowledge in the economy and ϕ represents the returns to scale. δ is a constant corresponding to the rate at which new ideas are generated by research efforts. However, since new patents instead of new ideas are analyzed,

the driving forces of patenting behavior must also be taken into account, inducing the following *patent production function*:

$$\dot{A}_i = \delta I_i^{\alpha} L_{Ai}^{\lambda} A_i^{\phi}, \tag{1}$$

where I_i reflects the incentives (or propensity) to patent in country i. Our baseline model used in the econometric analysis directly results from equation 1, taken in natural logarithm:

$$\ln(\dot{A}_i) = \ln \delta + \alpha \ln(I_i) + \lambda \ln(L_{A_i}) + \phi \ln(A_i) + \varepsilon_i, \tag{2}$$

where ε_i is the error term. The econometric method used is heteroskedastic-consistent OLS.

3.1 The dependent variable(s)

The patent system in Europe is singularly complex and somewhat heterogenous: patent filings can be made through different routes (PCT, EPO-direct or national offices), corresponding to various targeted geographical scopes of protection, different time constraints and different cost structures. [12] In addition, counting patent numbers is not straightforward, especially in a cross-country comparison framework. Patent counts for a given country may substantially vary with respect to the adopted counting methodology and the origin of the data. [13]

The endogenous variable $\dot{A}$ is proxied by the total number of priority (or first) filings in national patent offices in 2003 (PF_NPO). The term priority filing refers to a patent that has been filed for the first time for a given invention.

[12] *cf.* Guellec and van Pottelsberghe (2007) for a detailed description of the European patent system.

[13] Four important choices for counting patents are i) the criterion used to identify the geographical origin (i.e., the country of residence of the applicants or the country of residence of the inventor, or the priority country); ii) simple or fractional counts when the patent involves inventors or applicants from different countries; iii) the choice of the reference date (i.e., the priority date, the application date at the EPO, or at the WIPO, or USPTO, or the grant date in a given patent office); and iv) the choice of a database (i.e., USPTO filings or EPO filings or triadic filings which include patents simultaneously filed at the USPTO, the EPO and the JPO). See Dernis et al. (2001) for an in-depth analysis of these counting methodologies, and Guellec and van Pottelsberghe (2001) for the substantial differences induced by counts by country of residence of the applicants and counts by country of residence of the inventors.

The priority date has the advantage of being the closest date to the invention, or at least to the decision to file a patent application for the given invention. The choice of national priority filings as dependent variable deserves some justification. To the best of our knowledge, it has not been used so far in the empirical literature focusing on patent data for international comparisons.

Previous investigations of the determinants of the domestic demand for patents traditionally rely on patent filings at the USPTO or at the EPO, as a proxy for national innovative performance (see e.g., Furman et al. (2002), Bottazzi and Peri (2003) or Kang and Seo (2006)). These indicators are however subject to two main potential drawbacks. A first bias is related to the fact that the majority of filings at the EPO are second filings of national priority filings (i.e. subsequent filings of first filings at national patent offices). The same is true for the vast majority of filings at the USPTO from non US applicants. In other words these filings represent only a share of national priority filings, a share that probably increases with the applicants' resources and expectations regarding their business prospects in foreign markets. The general implicit assumption is that these patent counts reflect the number of 'valuable' inventions, i.e. those for which international filing fees are paid. A second and closely related drawback is that EPO or USPTO patents are characterized by a substantial 'home' bias. European applicants have a higher propensity to patent at the EPO than at the USPTO, and vice-versa for US applicants. In other words, relying on the EPO (USPTO) applications would strongly bias the results in favor of European (U.S.) applicants.

In a nutshell, the choice of national priority filings has the advantage of being much less affected by a potential 'home' bias and of reflecting the total number of patents filed in a country. These counts are however not yet straightforward to interpret, as applicants have the freedom to choose several alternative routes of protection — even for their priority filings. The many routes that are available to reach the EPO are extensively described in Stevnsborg and van Pottelsberghe (2007). For instance, it is possible to file a priority application directly at the EPO. In order to test whether taking into account the number of priority filings directly filed at the EPO would change the results, an alternative dependent variable is computed, the total number of priority filings (PF_TOT). It is the sum of the priority filings at the national patent office (PF_NPO) and of the priority filings at the EPO by national applicants (PF_EPO). The variables are presented in Appendix table A.1. The data was extracted from April 2007 edition of PatStat, a worldwide patent statistical database maintained by the EPO. [14]

[14] The count of priority filings excludes utility models. Regarding the variable PF_EPO, the country of the first applicant is used for identifying the geographical origin of the patent application. Note that the country of applicant has been identified for 66 % of EPO priority filings. The remaining 34% were not accounted

Table A.1 shows that priority filings at NPO's represent on average 90 per cent of a country's total priority filings (see column SH-PF). It is therefore legitimate to conclude that relying on national priority filings to measure a country's innovative performance is a fair choice, except maybe for the countries for which the share of EPO priority filings (PF_EPO) is relatively high (i.e. with a threshold at 15%): Cyprus, Belgium, Italy, Luxembourg, Switzerland and The Netherlands. [15]

An additional advantage of relying on national priority filings is that they ultimately constitute the roots for EPO (or USPTO) applications. Given the context of increasing backlogs in major patent offices, including the EPO, being able to understand the factors that drive national priority filings would also help to understand the origin of EPO filings. Indeed, the transfer rate of national priority filings towards the EPO varies substantially across countries, as illustrated in table A.1 (column TR-PF). On average, only about 26 per cent of the 2003 priority filings in national patent offices were subsequently transferred to the EPO (the median rate is about 23%). The weighted average however shows that 39% of the total national priority filings in 2003 were subsequently transferred to the EPO, a ratio actually pulled by the high transfer rate of German and French priority filings.

3.2 Explanatory variables

Data on the labor force devoted to research activities (FTE S&E, the number of full-time equivalent scientists and engineers, which approximates L_A) and the stock of knowledge (R&D capital stock, for A) come from the UNESCO Institute for Statistics. The R&D capital stock was calculated using the perpetual inventory method, assuming a yearly depreciation rate of R&D flows of 15%. When flows were not available for specific years, a country-specific growth rate of R&D flows was computed from observable data and used to approximate the missing years.

---

for.

[15] Grupp and Schmoch (1999) argue that the number of priority filings is "no more a good proxy for national comparable statistics on technological strength [especially for] small countries being located in the neighborhood of large and attractive markets for technology" [p. 383] such as Canada (for the USPTO), Mexico (for the USPTO), Austria (for Germany) and Belgium (for France). We however doubt that this factor would substantially bias our estimates, because the sample is limited to the EPC Member States and the European applicants who want to reach the EPO without filing a national priority application generally file directly at the EPO (this is taken into account in the PF_TOT variable). For instance, out of the 14,000 priority filings applied for at the French patent office, 7% come from foreign applicants.

Incentives to patent (I) are proxied with five variables: the strength of IP protection (IPRI), national filing fees (FEES), the GDP per capita (GDP_CAP), the duration of membership in the EPC (DUR) and a dummy variable capturing whether the country's national patent office requires a substantive search and examination of the patent filed (EXAM_OFFICE).

As the estimates are run at the macroeconomic level, it is difficult to include the traditional microeconomic determinants of patent propensity such as innovation strategies or patenting strategies (see e.g. Peeters and van Pottelsberghe (2006) or Guellec et al. (2007)). It is nevertheless possible to capture the broad characteristics of the IP system, which constitutes the framework within which firms elaborate their IP strategies. The measure of IP rights (IPRI) is taken from Ginarte and Park (1997) and subsequent updates. It is an index ranging from 0 to 5, 5 indicating the highest level of protection of IP rights. Since the index is computed once every five years, data from the year 2000 was used. It is a safe assumption given the low variability of the index over time. The index is composed of five categories related to the patent system of a country, each having a maximum score of 1: the coverage of subject matters that can be patented, the mechanisms for enforcing patents rights, the restrictions on the use of patents rights, the membership in international patent treaties, and the length of protection from the priority date. The higher the index is, the more patents are expected to be filed.

In order to compute a single fee indicator comparable across countries (FEES), filing-, search-, examination- and granting fees in 2003 were added together. In other words, fees are composed of cumulated administrative fees up to the grant. The methodology adopted to build the variable is described in depth in section 2. This variable is expected to have a negative impact on priority filings.

The GDP per capita (GDP_CAP) captures the wealth of a country and (implicitly) its level of technological knowledge. Furman et al. (2002) also use it as an alternative measure of the stock of knowledge, as it "*captures the ability of a country to translate its knowledge stock into a realized state of economic development*" [p. 914].

The duration of membership in the EPC (DUR) is a measure on how familiar the country is with the European patent system. The oldest member states would logically be the most aware of the benefits of patent protection and are therefore expected to exhibit a higher number of priority filings. The data is available on the EPO website. Finally, a dummy variable (EXAM_OFFICE) taking the value of 1 if the country requires a substantive search and examination of the patent filed provides a measure of the relative rigor of national patent systems and a negative impact is expected.

The sample comprises 29 EPC member states. From the 31 countries that were member of the EPC in 2006, Monaco and Lichtenstein have been excluded due to the lack of data on R&D. All variables are summarized in table 2.

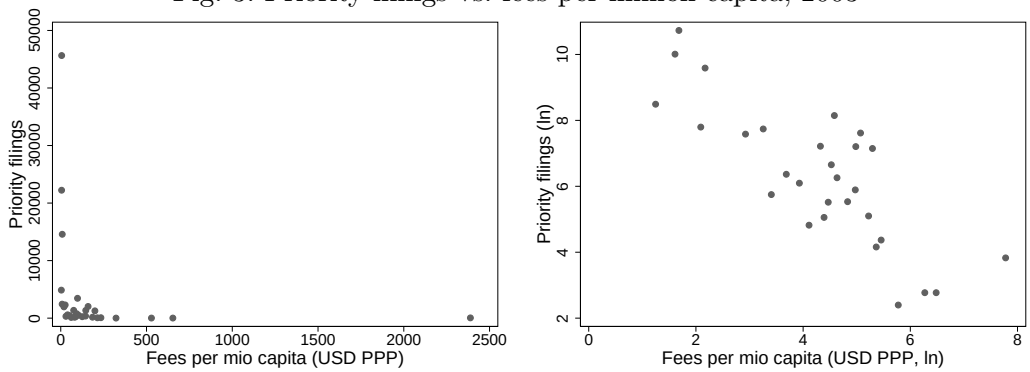
Table 2
Descriptive statistics, 2003, 29 EPC member states

Variables		Min	Mean	Max	Std. dev.
$\dot{A}$	PF_NPO	11	3,712	45,637	9,358
$\dot{A}$	PF_TOT	16	3,967	47,817	9,741
L_A	FTE S & E	490	42,674	268,943	62,487
A	R&D capital stock (000's US PPP)	183	37,200	296,000	67,200
$I(FEES)$	Fees up to the grant (US PPP)	174	779	4,051	736
$I(IPRI)$	IP Index	2.24	3.56	4.71	0.69
$I(DUR)$	Years of membership	-2	11.72	26	11.43
$I(GDP\_CAP)$	GDP per capita (US PPP)	6,807	22,752	62,554	11,514

PF_TOT = PF_NPO + PF_EPO

Figure 3 shows the number of priority filings on the y-axis and the fees per capita on the x-axis, in level (left-hand side) and in natural logarithm transformation (right-hand side). A typical non-linear relationship between relative prices and the total number of patent filings can be observed: countries with relatively low fees per capita enjoy a high number of filings whereas countries with relatively high fees per capita have a low number of filings. This graphical evidence corroborates the results obtained by van Pottelsberghe and François (2006) for the trilateral offices (USPTO, JPO and EPO).

Fig. 3. Priority filings vs. fees per million capita, 2003



Cfr. table 1 for an overview of the methodology adopted to compute cumulated fees. Sources: national patent offices and Global IP Estimator for the fees; IMF World Economic Outlook Database for the capita; PatStat April 2007 for the number of priority filings.

This observation must be interpreted with some caution as it does not account

for the other factors that drive patent filings. In addition, it is difficult to infer a causal relationship: the negative relationship between relative fees and the number of priority filings may depict an inverse causality. It is more likely, however, that the impact of fees is rather on the number of filings than the reverse, as the setting of fees is more exogenous — and more stable over time — than the number of patent filings.

3.3 Empirical results

Equation 2 aims at estimating the simultaneous impact of several factors on the number of priority filings at national patent offices. The estimated parameters are presented in table 3.

Table 3
Measuring the impact of fees on the domestic demand for patents, estimates of equation 2

		(1)		(2)		(3)		(4)		(5)		(6)	
Innovation function													
L_A	ln(FTE S&E)	0.96	***	1.38	***	1.15	***	1.15	***	1.12	***	1.14	***
		(3.25)		(17.24)		(10.08)		(10.01)		(8.52)		(10.79)	
A	ln(R&D capital stock)	0.34	*										
		(1.57)											
Incentives to patent													
I(FEES)	ln(Fees up to the grant)	-0.45	***	-0.56	***	-0.47	**	-0.50	***	-0.51	***	-0.48	***
		(-3.58)		(-4.29)		(-3.57)		(-4.09)		(-3.44)		(-3.23)	
I(IPRI)	IP Index					0.64	***	0.82	***	0.76	*	0.65	***
						(3.25)		(3.10)		(2.02)		(3.14)	
I(DUR)	Years of membership							-0.02					
								(-1.11)					
I(GDP_CAP)	ln(GDP per capita)									-0.17			
										(-0.45)			
I(EXAM_OFFICE)	Exam. required?											0.09	
												(0.38)	
Controls													
Intercept		-5.73	***	-3.64	***	-4.26	***	-4.52	***	-2.40		-4.08	***
R-squared		0.92		0.91		0.93		0.93		0.93		0.93	

The dependent variable is the number of priority filings (excluding utility models) in 2003 at national patent offices in 29 EPC countries, in natural logarithm. The econometric method is Ordinary Least Squares (robust estimates), t-values are in brackets. Liechtenstein and Monaco have been excluded due to lack of data. ***,** and * denote significance at the 1%, 5% and 10% probability threshold respectively.

Column (1) shows that the research effort L_A as well as a country's own R&D capital stock A have both a positive and significant impact on the number of patent filings. The number of researchers is the most significant parameter, with an elasticity not significantly different from 1. This result illustrates a linear relationship between the number of researchers and the number of patent filings. The estimated price elasticity of priority filings is -0.45, which suggests that a 10 percent increase in fees would lead to a decrease of 4.5 percent in the total number of first filings.

This result may however be biased by the presence of multicollinearity between the explanatory variables. The number of scientists is indeed highly correlated with the R&D capital stock. Column (2) shows the result without the stock of knowledge. Fees still have a negative and significant impact and the number of researchers is now associated with an elasticity greater than 1.

Other incentives to patent might also explain differences in the number of filings; they are taken into account in columns (3) to (6). Column (3) includes the strength of IP protection. The positive and significant parameter suggests that a stronger IP system leads to more patent filings. [16] This result confirms that the legal framework within which firms monitor their patent portfolio do influence their patenting behavior.

Column (4) shows that the duration of membership in the EPC has no effect on the number of priority filings. In other words, older EPC member states do not distinguish themselves from newer ones regarding their domestic priority filings. The number of priority filings is apparently not related to the wealth of the country (variable GDP_CAP in column 5). Keeping in mind that the number of researchers is already taken into account, the level of GDP per capita does not influence the propensity to patent. Finally, no significant impact is found regarding the variable EXAM_OFFICE (see column 6). In other words, applicants do not seem to be more or less keen to seek for patent protection in countries where the patent office is 'only' a registration office.

The dependent variable does not include the patents directly filed at the EPO, without a domestic priority filing. As already mentioned in section 3.1, these filings represent only a small share of total national priority filings by EPC member states in 2003 (about 10%, see table A.1 in appendix). Several robustness tests were however performed in order to check for the consistency of the results. First, priority filings at the EPO were taken into consideration in the dependent variable: the regressions presented in table A.2 in appendix use

[16] This index may however not be fully exogenous: if it is reasonable to assume that a country without any IP protection would have very few filings, it is not obvious that raising IP protection would lead to more patent filings, especially in countries where the level of IP protection is amongst the highest. Instead, IP protection may be a consequence of the ever rising IP awareness.

PF_TOT (= PF_NPO + PF_EPO) as endogenous variable and the estimated parameters are very similar to the one presented in table 3. Second, the countries that rely on EPO first filings for at least 15% of their total first filings (Belgium, Cyprus, Italy, Luxembourg, Switzerland and The Netherlands) have been excluded from the regressions and similar results were obtained. Third, the results are robust to the exclusion from the sample of the three largest countries in terms of first filings (France, Germany and the United Kingdom) or the four smallest countries (Cyprus, Estonia, Iceland, and Luxembourg). [17]

Nonlinear Least Squares (NLS) is an alternative econometric method that can be directly applied to equation 1 to estimate the various parameters without relying on the logarithmic transformation. This methodology has been tested and yields similar results. Nevertheless, including dummies and negative variables into the NLS model comes at the cost of greater complexity. OLS estimates of equation 1 taken in naturel logarithm is therefore more appropriate. Moreover, the logarithm transformation helps reducing the effect of potential outliers.

4 The transfer rate at the EPO

This section investigates the factors explaining the heterogeneity observed in the transfer rate of domestic priority filings towards the EPO. Two types of transfer may occur: a transfer through a priority filing (a German applicant filing directly at the EPO), or through a second filing (a German applicant filing first at the German patent office and who later uses his priority right to subsequently file his patent application at the EPO, either directly or via the PCT route). This second type of transfer is the most frequent.

The equation used in the econometric analysis aims at understanding the heterogeneity in the transfer rate of patent filings to the EPO (tr). The dependent variable tr can be computed from the share of second filings at the EPO in the priority filings at the national patent office (SF_NPO / PF_NPO) and from total filings ((PF_EPO + SF_EPO)/(PF_NPO + PF_EPO)).

Most of the variables used to capture the incentives to patent in equation (2) can also be used to explain the rate of patent filings at the EPO. In this respect, we consider a simple linear model:

$$tr_i = \sum_j \alpha_j T_{j_i} + \varepsilon_i, \tag{3}$$

[17] The results are available upon request.

where T_j captures the potential incentives to transfer a patent application at the EPO: the GDP per capita (GDP_CAP), the duration of membership in the EPC (DUR) and a dummy taking the value of 1 if the country requires a substantive search and examination of the patent filed (EXAM_OFFICE). In addition, the distance (DIST) between a country's capital city and Munich, where the EPO headquarter is located, will be tested. The literature on international patenting flows often takes the distance between capital cities into consideration and finds a negative effect on foreign patenting (see e.g. Eaton and Kortum (1996) and Gallini et al (2003)). [18]

The results are presented in table 4. The parameters presented in part (A) of table 4 investigate the drivers of the transfer rate of priority filings in NPO's to the EPO and the parameters in part (B) investigate the drivers of total filings at the EPO.

[18] Moreover, including the variable DIST allows to control for the significance of the variable DUR. Indeed, it could be argued that membership to the EPC slowly expanded from the 'Old Europe´ to Eastern Europe; the variable DUR could therefore possibly capture the distance from the EPO instead of a 'membership´ effect.

Table 4
Determinants of the transfer rate of priority filings towards the EPO

		National priority filings only (A)			National and European priority filings (B)		
		(1)	(2)	(3)	(4)	(5)	(6)
T(GDP_CAP)	GDP per '000 capita	1.49 ***	1.11 ***	1.10 ***	1.80 ***	1.24 ***	1.27 ***
		(8.46)	(5.70)	(5.67)	(9.19)	(5.61)	(6.23)
T(DUR)	Years of membership		0.60 ***	0.54 **		0.79 ***	0.77 ***
			(3.01)	(2.61)		(3.29)	(3.06)
T(EXAM_OFFICE)	Exam. required?		2.35			-2.69	
			(0.64)			(-0.61)	
T(DIST)	Distance in hundreds of km			-0.26			-0.07
				(-1.14)			(-0.21)
Controls							
Intercept		-7.50 *	-7.14	-2.12	-8.29 *	-3.44	-4.62
Adjusted R^2		0.74	0.81	0.81	0.73	0.81	0.81

Dependent variable (A) is TR-PF, the share of priority filings at national patent offices in 2003 subsequently transferred to the EPO [SF_EPO / PF_EPO], for 29 EPC countries. Dependent variable (B) is TR-TOT, the share of total priority filings in 2003 transferred to the EPO [(PF_EPO + SF_EPO)/(PF_NPO + PF_EPO)], for 29 countries. Liechtenstein and Monaco have been excluded due to lack of data. The econometric method is Ordinary Least Squares (robust estimates), t-values are in brackets. ***,** and * denote significance at the 1%, 5% and 10% probability threshold respectively.

Table 4 shows that the results do not depend on the way the dependent variable is computed: the parameters presented in columns A are indeed very close to the parameters presented in columns B. In other words, the factors impacting the transfer rate of priority filings towards the EPO also impact the transfer rate of total filings towards the EPO.

Columns (1) and (4) suggest that the level of GDP per capita has a positive and significant impact on the share of patent filings that are transferred to the EPO. Possible interpretations would be that richer countries i) also host more international companies, more prone to seek for patent protection at the European level, or ii) conduct research with higher economic potential, for which an international patent protection is needed, or iii) have on average more resources to file abroad. This factor does not induce a higher inventive output (see column (5) of table 3), but impacts the transfer rate of priority filings towards the EPO. An analysis that would have solely relied on filings at the EPO to estimate the patent production function of equation (2) would possibly have wrongly concluded that the GDP per capita explains variations in the underlying inventive output of countries, whereas its effect is rather on the share of national priority filings that are transferred to the EPO.

The results of columns (2) and (5) show that the duration of membership in the EPC also positively affects the number of patents that are transferred to the EPO: the oldest countries are also the one with the highest transfer rate. In other words, it seems that experience in the European patent system is a key factor that affects the share of national patent filings which are transferred to the EPO. Countries seem to go through a learning curve of the European patent system.

Whether the country requires a substantive search and examination of the patent filed (dummy EXAM_OFFIE) plays no role on the share of priority filings that are transferred to the EPO. Finally, the estimated parameters of columns (3) and (6) suggest that the distance between the country's capital city and Munich has no impact on the rate of filings transferred. [19]

In a nutshell, the rate at which national priority filings are transferred to the European Patent Office partly depends on the wealth of the country and on its institutional settings such as the duration of its membership in the EPC. These variables do not explain differences in the underlying inventive output of countries but rather affect the extent to which they rely on the European Patent System.

[19] There are several entry doors to file a patent application at the EPO. Alternative estimates with the shortest distance between the capital city and The Hague or Munich have also been tested. No significant effect was found.

5 Concluding remarks

Patent offices around the world actively search for solutions that would allow to reduce their backlogs while keeping a decent quality of their examination. Recruiting more examiners, raising the bar of the examination process, and allowing third parties to help identifying the prior art are schemes that have been implemented to various extent. One additional solution, although barely used so far, is to leverage patenting fees.

The main objective of this paper was to test whether patent filing fees have an effect on the demand for patents. Relying on the 2003 number of priority filings in 29 EPC member states, and controlling for the number of researchers as well as for the broad strength of the IP system, the econometric analysis yields two important results.

First, there is a strong variation in absolute and relative patent fees across European countries: smaller countries generally display higher fees per capita. It is more expensive to protect a market unit in small countries than in large countries. Second, and contrarily to a common believe, patent filing fees have a significant and negative impact on the number of priority filings. A 10 per cent increase in filing fees would lead to a reduction of about 5 per cent in the demand for patents. Added together, these results witness a suboptimal treatment of inventors across European countries, which in turn substantially affects their filing behaviour.

This 'fee' issue is generally not at the forefront of the debates on patent systems. The results presented in this paper however suggest that filing fees could be effectively considered as an integral part of an IP policy. This is especially true in the current context of the boom in patent filings and backlogs of pending applications observed at regional patent offices. Priority applications at the national patent offices of EPC member states constitute a stepping stone towards subsequent filings at the EPO. Therefore, understanding the determinants of the transfer rate from the former to the latter is an important concern, which has been investigated in the final part of the present paper.

It turns out that there is a high level of cross-country heterogeneity in the transfer rate of domestic priority filings to the EPO and that this heterogeneity can be partly explained. The empirical analysis reveals that two main factors do not have any impact on the number of priority filings but rather significantly affect the transfer rate of national priority filings towards the EPO. These factors are the relative wealth of a country (measured with its GDP per capita) and its age of membership within the EPC.

The wealthier a country is and the older its membership in the EPC, the higher is the share of its priority filings that are transferred to the EPO.

These results suggest first that more resources allow bearing the cost of an effective internationalisation of priority filings. Second, the member states of the EPC go through a learning curve, which predicts a continued increase in the workload of the EPO. As a side effect, the degree of predictability of the transfer rates to the EPO casts some doubts -or calls for a very cautious interpretation- on the practice that consists in relying on second filings (be it at the EPO or at the USPTO) to assess the innovative performance of countries.

References

Archontopoulos E., D. Guellec, N. Stevnsborg, B. van Pottelsberghe de la Potterie, and N. van Zeebroeck, 2007, *When Small is Beautiful: Measuring the Evolution and Consequence of the Voluminosity of Patent Applications at EPO*, Information Economics and Policy, 19(2), 103-132.

Bottazzi L. and G. Peri, 2003, *Innovation and Spillovers in Regions: Evidence from European Patent Data*, European Economic Review, 47(7), 687-710.

Cohen W., R. Nelson and J. Walsh, 2000, *Protecting their Intellectual Assets: Appropriability Conditions and Why US Manufacturing Firms Patent (or Not)*, NBER Working Paper 7553, NBER, Washington D.C.

Dernis H., D. Guellec and B. van Pottelsberghe de la Potterie, 2001, *Using patent counts for cross-country comparisons of technology output*, STI Review, 27, OECD, 129-146.

Eaton J. and S. Kortum, 1996, *Trade in ideas: Patenting and productivity in the OECD*, Journal of International Economics, 40(3-4), 251-278.

Eaton J., S. Kortum and J. Lerner, 2004, *International Patenting and the European Patent Office: A Quantitative Assessment*, Patents, Innovation and Economic Performance: OECD Conference Proceedings, Paris, 27-52.

Furman J., M. Porter and S. Scott, 2002, *The determinants of national innovative capacity*, Research Policy, 31(6), 899-933.

Gallini N., J. Putnam and A. Tepperman, 2003, *Intellectual property rights and the propensity to patent*, In: Putnam J. (Ed), Intellectual Property Rights and Innovation in the Knowledge-Based Economy, University of Calgary Press, Calgary, 8.1-8.40.

Ginarte J. and W. Park, 1997, *Determinants of Patent Rights: A Cross National Study*, Research Policy, 26(3), 283-301.

Grupp H. and U. Schmoch, 1999, *Patent statistics in the age of globalisation: new legal procedures, new analytical methods, new econometric interpretation*, Research Policy, 28(4), 377-396.

Guellec D. and B. van Pottelsberghe de la Potterie, 2001, *The internationalisation of technology analysed with patent data*, Research Policy, 30(8), 1256-1266.

Guellec D. and B. van Pottelsberghe de la Potterie, 2007, *The Economics of the European Patent System*, Oxford University Press, Oxford, 250 p.

Guellec D., B. van Pottelsberghe de la Potterie and N. van Zeebroeck, 2007, *Patent as a Market Instrument*, In: Guellec D. and B. van Pottelsberghe de la Potterie (Eds.), The Economics of the European Patent System, Oxford University Press, Oxford, |Chapter 4| 85-113.

Jaffe A. and J. Lerner, 2004, *Innovation and Its Discontents*, Princeton University Press, Princeton, 256 p.

Jones C., 1995, *R&D-Based Models of Economic Growth*, The Journal of Political Economy, 103(4), 759-784.

Kang S. and H. Seo, 2006, *Do Stronger Intellectual Property Rights Induce More Patents?*, In: van Pottelsberghe de la Potterie B. and C. Peeters (Eds.),

Economic and Management Perspectives on Intellectual Property Rights, Palgrave Macmillan, |Chapter 6| 129-148.

Park W., 2003, *European Innovation and Technology Diffusion: Evidence from Patenting Data*, Working paper, American University.

Peeters, C. and B. van Pottelsberghe de la Potterie, 2006, *Innovation Strategy and the Patenting Behavior of firms*, Journal of Evolutionary Economics, 16(1-2), 109-135.

Romer P., 1990, *Endogenous Technological Change*, Journal of Political Economy, 89(5), 71-102.

Stevnsborg N. and B. van Pottelsberghe de la Potterie, 2007, *Patenting Procedures and Filing Strategies at the EPO*, In. Guellec D. and B. van Pottelsberghe de la Potterie (Eds.), The Economics of the European Patent System, Oxford University Press, |Chapter 6| 155-183.

van Pottelsberghe de la Potterie B. and D. François, 2006, *The Cost Factor in Patent Systems*, CEPR Discussion Paper 5944.

van Pottelsberghe de la Potterie B and N. van Zeebroeck, 2008, *A Brief History of Space and Time: the Scope-Year Index as a Patent Value Indicator Based on Families and Renewals*, Scientometrics, 75(2), forthcoming.

van Zeebroeck N., B. van Pottelsberghe de la Potterie and D. Guellec, 2006, *Claiming More: The Increased Voluminosity of Patent Applications and its Determinants*, CEPR Discussion Paper 5971.

A Appendices

Table A.1

Country	PF_NPO (1)	PF_EPO (2)	SF_EPO (3)	SH-PF (4)	TR-PF (5)	TR-TOT (6)	FEES (7)	DUR (8)
AT Austria	1,361	112	635	92	47	51	612	24
BE Belgium	523	347	168	60	32	59	1,069	26
BG Bulgaria	253	7	14	97	6	8	981	1
CH Switzerland	1,346	1,142	697	54	52	74	1,062	26
CY Cyprus	11	5	1	69	9	38	260	5
CZ Czech Republic	581	6	65	99	11	12	407	1
DE Germany	45,637	2,180	20,137	95	44	47	444	26
DK Denmark	1,271	173	775	88	61	66	1,072	13
EE Estonia	16	0	1	100	6	6	717	1
ES Spain	1,965	190	445	91	23	29	762	17
FI Finland	2,031	178	740	92	36	42	831	7
FR France	14,576	885	6,386	94	44	47	542	26
GB United Kingdom	22,234	202	6,036	99	27	28	298	26
GR Greece	444	6	56	99	13	14	564	17
HU Hungary	776	3	76	100	10	10	911	0
IE Ireland	362	28	117	93	32	37	575	11
IS Iceland	46	0	13	100	28	28	694	-1
IT Italy	4,869	962	2,811	84	58	65	200	25
LT Lithuania	64	0	1	100	2	2	738	-1
LU Luxembourg	16	62	12	21	75	95	293	26
LV Latvia	79	1	3	99	4	5	546	-2
NL Netherlands	2,298	495	778	82	34	46	421	26
PL Poland	2,432	1	95	100	4	4	309	-1
PT Portugal	124	12	19	91	15	23	637	11
RO Romania	164	1	11	99	7	7	4,051	0
SE Sweden	3,452	414	1,434	89	42	48	878	25
SI Slovenia	249	10	53	96	21	24	174	1
SK Slovakia	157	2	10	99	6	8	436	1
TR Turkey	314	23	58	93	18	24	2,097	3
Mean	3,712	256	1,436	89	26	33	779	12
Median	523	23	76	94	23	28	612	11

PF_NPO refers to priority filings at national patent offices in 2003 (excluding utility models), PF_EPO is the number of priority filings directly filed at the EPO in 2003 by country of first applicant and SF_EPO is the number of PF_NPO that were subsequently transferred to the EPO. SH-PF (4) = (1)/[(1) + (2)], TR-PF (5) = (3)/(1), and TR-TOT (6) = [(2)+(3)]/[(1)+(2)]. Fees are expressed in USD PPP. DUR is the number of years since the EPC has been enforced in the country.

Table A.2
Robustness test: measuring the impact of fees on the domestic demand for patents, estimates of equation 2

		(1)		(2)		(3)		(4)		(5)		(6)	
Innovation function													
L_A	ln(FTE S&E)	0.55	***	1.33	***	1.03	***	1.03	***	1.08	***	1.04	***
		(2.80)		(15.29)		(9.32)		(9.43)		(7.82)		(10.45)	
A	ln(R&D capital stock)	0.63	***										
		(3.65)											
Incentives to patent													
I(FEES)	ln(Fees up to the grant)	-0.43	***	-0.62	***	-0.50	***	-0.48	***	-0.44	***	-0.49	***
		(-3.54)		(-4.86)		(-4.30)		(-3.99)		(-3.49)		(-3.24)	
I(IPRI)	IP Index					0.82	***	0.69	**	0.62	*	0.82	***
						(3.88)		(2.51)		(1.95)		(3.93)	
I(DUR)	Years of membership							0.01					
								(1.03)					
I(GDP_CAP)	ln(GDP per capita)									0.28			
										(1.11)			
I(EXAM_OFFICE)	Exam. required?											-0.09	
												(-0.37)	
Controls													
Intercept		-6.41	***	-2.55	**	-3.33	***	-3.14	***	-6.35	**	-3.52	***
R-squared		0.94		0.90		0.93		0.93		0.93		0.93	

The dependent variable is the total number of priority filings in 2003 in 29 EPC countries (PF_NPO + PF_EPO), in natural logarithm. The econometric method is Ordinary Least Squares (robust estimates), t-values are in brackets. Liechtenstein and Monaco have been excluded due to lack of data. ***,** and * denote significance at the 1%, 5% and 10% probability threshold respectively.