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THE COST FACTOR IN PATENT SYSTEMS

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THE COST FACTOR IN PATENT SYSTEMS

ABSTRACT
The objective of this paper is to assess whether and to what extent the cost of patenting affects the demand for patents. The empirical analysis, which focuses on the patent systems of the USA, Japan, and Europe during the year 2003, leads to the following methodological and empirical observations: *i)* after the grant, the translation, validation and transaction costs induced by an effective protection in several European countries witness a highly fragmented and very expensive European market for intellectual property; *ii)* for a proper international comparison, the size of the market and the average number of claims must be accounted for; *iii)* when the cost per claim per capita (the 3C-index) is considered, a negative linear relationship appears between the cost of patenting and the number of claims that are filed; *iv)* for a patent designating 13 European countries, the 3C-index is about 10 (2) times higher than in the US (Japanese) system (for process and translation costs up to the grant); *v)* The European market being more than twice as large as the US market in terms of inhabitants, the 3C-index suggests that there would be a clear justification for higher nominal examination fees at the EPO, that would ensure a rigorous granting process.

***Keywords**:* patents; cost elasticity; cost per claim per capita, patent systems.

JEL: **P14, P51, O34.**

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1. Introduction

On the 16th of January 2006 the Directorate General Internal Market and Services of the European Commission announced a consultation process on future patent policy in Europe. This public hearing focuses on three major issues: the community patent, how the current patent system in Europe could be improved; and possible areas of harmonisation: "*the Commission is seeking views on what action could be taken while work on the Community patent is continuing, in particular within the framework of the existing patent system, or by bringing national patent systems more closely in line with each other through either approximation of laws or mutual recognition of national patents.*" [Press Releases, IP/06/38].[1]

This consultation process can be considered as the cutting hedge of an escalating and long lasting debate on whether and how Europe should put in place a properly harmonized patent system. The past few years have indeed seen an intensifying politicization of intellectual property (IP) issues. Long considered as a technical/legal issue, intellectual property is increasingly embodied into business strategies, and the IP system is nowadays definitely established in the political arena due in part to the perception that innovation is a major source of economic growth (e.g., the recent survey by The Economist, October 22nd 2005; on "*patents and technology: a market for ideas"*; or Rivette and Klein's 2000 book *"Rembrandts in the attic: Unlocking the hidden value of patents"*). The need for a consultation process is even further exacerbated by the apparent failure of the European Union to reach the Lisbon agenda. According to its recently released *Innovation Scoreboard*, Europe suffers from a worrying large innovation gap as compared to the USA and Japan.[2]

One of the most sensitive and long lasting bones of contention regarding the European patent system is related to the high cost of patenting, which is partly due to the failure to effectively implement the European community patent or the more recent London Protocol.[3] The high opportunity cost of this failure, for firms and society at large, is perceived as one important factor hindering innovation in Europe, which explains why the European Union' commissioner of Directorate General Internal Market, Mr. McCreevy, wants to make "*one final effort*" to resolve the issue.[4]

This paper aims at contributing to the debate through an empirical and international perspective. The main argument that is put forward is that both the high fragmentation of the European market for intellectual property and the high patenting costs translate into a

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[1] The questionnaire can be downloaded on http://europa.eu.int/comm/internal_market/indprop/index_en.htm.
[2] Cf. the Financial Times, 13th of January 2006, EU '*is 50 years behind the US for innovation*'.
[3] Cf. Patent World (February 2006, Issue 179, p. 7) the declaration by Professor Alain Pompidou, President of the EPO, who urges action to be taken on the London Protocol, the EPLA (European Patent Litigation Agreement, designed to improve the enforcement of European patents, enhance legal certainty and promote the uniform application and interpretation of European patent law) and the Community Patent: "*The Protocol must be ratified by eight countries, of which England, France and Germany must be three, before it can come into force. If it comes into force it would mean that the claims of a patent would only be translated into English, French or German.*"
[4] See the Financial Times, 16th of January 2006, '*One final effort to create a low-cost EU patent*'.

relatively low demand for patent protection in Europe. The objective of the paper is to assess whether and to what extent the cost of patenting affects the demand for patents. The analysis focuses on the patent offices of the USA (U.S. Patent and Trademark Office, USPTO), Japan (Japanese Patent Office, JPO), and Europe (European Patent Office, EPO). The year 2003 is chosen for the sake of data availability.

The paper is structured as follows. The next section is dedicated to a broad presentation of the three regional patent offices and assesses the relative markets for technologies through the number of patent applications they receive each year. Section 3 presents a comparative analysis of the cost of having a patent granted and maintained in force for 10 or 20 years in the three patent systems (for the EPO, the simulation performed for the three and thirteen EPO member countries that are the most frequently designated for protection). As the three regional offices have different granting processes, the cost issue must indubitably be put in perspective with process/quality considerations, which are presented in section 4. Section 5 concludes with policy and methodological implications.

The results show first that the U.S. market for technology is three times more attractive (if measured with the number of filings) than the European market for technology. Second, the cost of a patent (claim) which designates 13 EPO Member countries is 4 to 8 (5 to 10) times more expensive than in the U.S., depending on the desired length for protection. Third, when the number of claims is taken into account instead of the number of patents, and when the size of the market is accounted for through the 3C-index (cost per claim per capita), there is a clear negative relationship between the cost of patenting and the demand for patents, witnessing a strong patent applications elasticity with respect to prices. Several indicators lead us to conclude that the EPO is more selective in its granting process (longer examination time and smaller granting rate). The higher rigor of the EPO granting process would justify higher examination costs but not the high complexity and cost burden induced by the current fragmented market for intellectual property.

The policy implication is that a better harmonization of the European patent system would drastically reduce the current costs and complexity burdens. These costs do not reflect the effectiveness of a patent system, but rather a selection mechanism strongly based on the financial resources of the inventors. The various possibilities for improvement range from a simple harmonization of the fee structure across the EPC member states to a real Community patent.

2. Patent offices and markets for technology

The mission statements of all patent offices in the world claim that they aim to stimulate innovation and hence economic growth. Patent systems reflect a compromise between the stimulation and the diffusion of innovations. On the one hand they are designed to stimulate R&D activities and innovation by granting a monopolistic power to the inventors. On the

other hand they ensure a worldwide diffusion of the inventions through the publication of patent applications. This is a common feature of all existing patent systems. However their designs differ sometimes to a very large extent, especially regarding the cost, granting process, scope of patent protection and patentability of subject matter.

A patent is an exclusive right granted for an invention, which is a product or a process that provides a new way of doing something, or offers a new technical solution to a problem. In order to be patented an invention has to fulfil the following four conditions.

1° It must be industrially applicable;
2° It must be novel: it must show some new characteristic which is not known in the body of existing knowledge in its technical field. This body of existing knowledge is called "prior art";
3° The invention must show an inventive step which cannot be deduced by a person with average knowledge of the technical field.
4° Its subject matter must be accepted as "*patentable*" under law. In many countries, scientific theories, mathematical methods, plant or animal varieties, discoveries of natural substances, business methods, or methods for medical treatment (as opposed to medical products) are generally not patentable.

A patent provides protection for the invention to the owner of the patent. The protection is granted for a limited period, generally 20 years. This patent protection means that the invention cannot be commercially exploited (used, distributed or sold) without the patent owner's consent. A patent owner has the right to decide who may - or may not - use the patented invention for the period in which the invention is protected. The patent owner may give permission to, or license, other parties to use the invention on mutually agreed terms. The assignee may also sell the right to use the invention to someone else, who will then become the new owner of the patent. Once a patent expires the invention enters the public domain and the owner no longer holds exclusive rights regarding the invention.

Patent systems are inherently dependent on Intellectual Property Regional Offices. The European Patent Office (EPO), the United States Patent and Trademark Office (USPTO) and the Japan Patent Office (JPO) differ in many respects, despite accelerating harmonization in patent legislations. Table 1 summarizes the broad characteristics of the three patent offices for the year 2003.

The European Patent Office

Established by the Convention on the Grant of European Patents (EPC) signed in Munich in 1973 and entered into force in 1977, the EPO is the outcome of the European countries' collective political determination to establish a uniform patent system in Europe. The EPO is the executive arm of the European Patent Organisation, an intergovernmental body set up under the EPC, whose members are the EPC contracting states. The activities of the EPO are supervised by the Organisation’s Administrative Council, composed of delegates from the

contracting states. As a centralised patent grant system administered by the European Patent Office on behalf of all contracting states, it is a model of successful co-operation in Europe.

"*The mission of the EPO is to support innovation, competitiveness and economic growth for the benefit of the citizens of Europe. Its task is to grant European patents for inventions, on the basis of a centralised procedure*". [5]

The EPO is nowadays composed of 31 contracting states (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LI, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR) and 6 states (AL, BA, HR, MK, YU) where patents can be extended at the applicant's request.

By filing a single application in one of the three official languages (English, French and German) and by a single patent grant procedure it is possible to obtain patent protection in some or all of the EPC contracting states, with the EPC establishing standard rules governing the treatment of patents granted by this procedure. The European Patent System becomes complex and costly just after the grant of a patent. Once granted by the EPO, a patent must be validated, put in force and renewed in each national patent system, which has its own legislation and its own renewal fees structure. Patent applications at the EPO are most often second filings from national priority applications of EPC (or non EPC) member states. Not all the domestic patent filings in Europe are transferred to the EPO.

The EPO, which relied on 5,821 employees in 2003, is entirely self-financing. Its operating and capital expenditures are defrayed out of procedural fees and a proportion of the renewal fees for granted European patents. Patent assignees pay their renewal fees directly to national patent offices at rates fixed by individual contracting states, 50% of the amount being transferred to the EPO. The revenue for 2003 exceeds EUR 1bn. Most of EPO's expenditures are oriented towards personnel expenses (75%).[6]

The United States Patent and Trademark Office (USPTO)

The USPTO is a federal agency in the Department of Commerce of the USA. For over 200 years, the basic role of the USPTO has remained the same: to promote the progress of science and the useful arts by securing for limited times to inventors the exclusive right to their respective discoveries. The office has two major functions: the examination and issuance of patents and the examination and registration of trademarks. The primary services the agency provides include processing patent and trademark applications and disseminating the corresponding information.

The vision of the USPTO is to "*lead the way in creating a quality-focused, highly productive, responsive organization supporting a market-driven intellectual property system for the 21st*

[5] European Patent Office website (http://www.epo.org).
[6] For the year 2003 (EPO annual report, 2003).

Century". As for its mission, it is to "*ensure that the intellectual property system contributes to a strong global economy, encourages investment in innovation, and fosters entrepreneurial spirit*". [7]

To support its mission, the office has adopted a "*21st century strategic plan*" which main objectives are to improve patent examination by reducing delays and optimizing search and classification processes. In 2003, the USPTO employed 6,723 federal agents including 3,637 patent examiners and 355 trademark examiners.[8] The USPTO has evolved into a unique government agency. Since 1991 – under the Omnibus Budget Reconciliation Act (OBRA) of 1990 – the agency has been fully fee funded. Annual revenue for the year 2003 reached $ 1.16bn (€ 950 Million), of which approximately 10% come from trademark revenues. Contrary to the EPO, the USPTO has less expenditure in personnel expenses (56%) because it calls for outside services and contracts (25%).

The Japan Patent Office (JPO)

The Japan Patent Office is attached to the Japanese Ministry of Economy, Trade and Industry (METI). It is committed to comprehensive development of industry through planning and carrying out examinations and appeals or trials under the system of industrial property rights, which includes patents, utility models, designs and trademarks.

Table 1. EPO, USPTO and JPO: Basic figures, 2003

	EPO[1]	**USPTO**	**JPO**
Total staff	5,821	6,723	2,479
Patent examiners	3,365	3,535	1,126*
Annual revenue, M €	1,022	950	839**
Total Patent Filings	116,613	342,441	413,092
Total Patent Granted	59,992	169,028	122,511
Geographical origins of patent filings (%)			
USA	27	55	5
Japan	16	18	88
EPC States	50	15	3
Others	7	13	4

1. European applications filed and Euro-PCT applications entering the regional phase, 2003.
*. JPO's examiners do not make any search or patent classification, this is outsourced.
**. This amount corresponds to total expenditures for the JPO.
Sources: 2003 Annual Reports of the three offices, Trilateral Statistical Report (2003).

The JPO's mission is to "*reinforce Japanese competitiveness by offering the best and fastest examination process possible*". Indeed, growing patent demands are slowing down the

[7] USPTO website (http://www.uspto.gov).
[8] USPTO, 2003 Performance and Accountability Report.

granting process. Therefore, JPO's goals are to improve the examination procedure and to optimize its system's structure to accelerate its global process.

In 2003, the Japanese office employed 2,479 agents, whom 70% (about 1,126) were examiners.[9] An important difference between the JPO and the two other patent offices is that the process of search and documentation in Japan is outsourced to the Industrial Property Coordination Center (IPCC), an exterior organization that employs 1,300 agents.[10] As the JPO is a branch of the METI, there are no figures available that show its annual revenue. However, the 2003 budget was of ¥ 115bn (€ 858 millions) and expenditure was mostly oriented towards patent processing computerization (24%) and the reinforcement of protection for intellectual property (29%). Personnel expenses accounted for about 25% of the budget.

An important difference between the three patent offices is illustrated in table 1. There are apparently much less applications at the EPO (nearly 120,000 in 2003) than at the USPTO or the JPO, which receive more than 342,000 and 410,000 filings per year, respectively. This difference may be explained by three main factors.

First, the filings at the EPO are mostly second filings – i.e. subsequent applications of existing priority filings. Contrarily to the European system, the numbers of domestic filings at the JPO and the USPTO are approximately equivalent to the number of domestic priority filings (The first time a patent is filed for an invention). In most EPC contracting states the priority filing is generally applied first at a National Office (although a substantial proportion is directly filed at the EPO). After the national priority filing an assignee has one year (Since the Paris Convention of 1883) to extend its application internationally (at the EPO and/or other foreign offices, directly or through the Patent Cooperation Treaty - PCT). Due to the differences in behaviour of the applicants from different countries (only a share of national priority applications are filed at the EPO), comparisons of the number of applications at the three offices requires a cautious interpretation.[11] Second, patent filings at the three offices are different. In 2003, the average number of claims in a Japanese patent was 7 whereas it was 23 for the USPTO and 18 for the EPO. In other words, a given invention would be protected through more patents in Japan (and less claims per patent) than in the United States and the European Union. Third, the European patent system might be less attractive than the other two patent systems, due to its cost and its complexity. We will come back to these issues in the next two sections.

Table 1 illustrates a second important difference. Domestic filings at the JPO formed 88% of total filings, which contrasts with the USPTO and the EPO, where domestic filings accounted for 55% and 50% of total filings, respectively. Foreign filings are much more important for

[9] JPO Annual Report, 2004.
[10] IPCC Report (The Industrial Property Cooperation Center), 2002, Tokyo.
[11] About 15,000 and 13,000 patent applications were filed in the early 2000s at the French patent office (INPI) and at the UK patent office (UKPTO), respectively. In France, about 80% of these national applications were filed by domestic residents, whereas in the UK 46% were filed by domestic residents. A substantial share of these domestic priority filings are subsequently applied at the EPO (source: OECD, 2005).

the USPTO and the EPO than for the JPO. The fact that the US and Europe similarly attract an impressive number of foreign patent filings (about half of the filings come from abroad) reduces to some extent the statistical bias mentioned here above. There are nearly 155,000 patent filings at the USPTO by non US applicants, and about 58,000 filings at the EPO by non European residents. The picture is similar with the patents filed by Japanese residents. Table 1 shows that only 19,000 filings were applied at the EPO by Japanese firms, against 61,000 filings at the USPTO.[12]

The three indicators of attractiveness (total patent filings, filings from abroad, and filings by Japanese assignees) suggest that the US market for technology is three times as attractive as the European market for technology. One explanation might be due to the lack of a homogenous market for technology in Europe.

Table 2. Frequency of designation of EPC Member countries, at examination stage, 2003

Country	Population	Cum. Pop.	Frequency of designation
	Million	Million	%
Germany	82,7	82,7	98
The UK	59,9	142,6	94
France	60,3	202,9	94
Italy	58,6	261,5	78
Spain	43,4	304,9	67
The Netherlands	16,3	321,2	66
Sweden	9,0	330,2	64
Switzerland	7,5	337,7	63
Belgium	10,4	348,1	62
Austria	8,2	356,3	62
Ireland	4,0	360,3	61
Finland	5,2	365,5	61
Denmark	5,4	370,9	61

Source: EPO Annual Report (2003) and http://www.internetworldstats.com

As already mentioned here above, one of the major differences between the European patent system on the one hand and the US and Japanese patent systems on the other hand, is that once a patent is granted it must be validated and put in force in each EPC member state. A patent that is granted by the EPO is not automatically valid all over Europe. This lack of direct Europe-wide market reach is illustrated in table 2. It shows the percentage of the patents applied at the EPO that designated the 13 most frequently designated states, at examination stage.[13] There is a clear preference for the three largest European countries (in

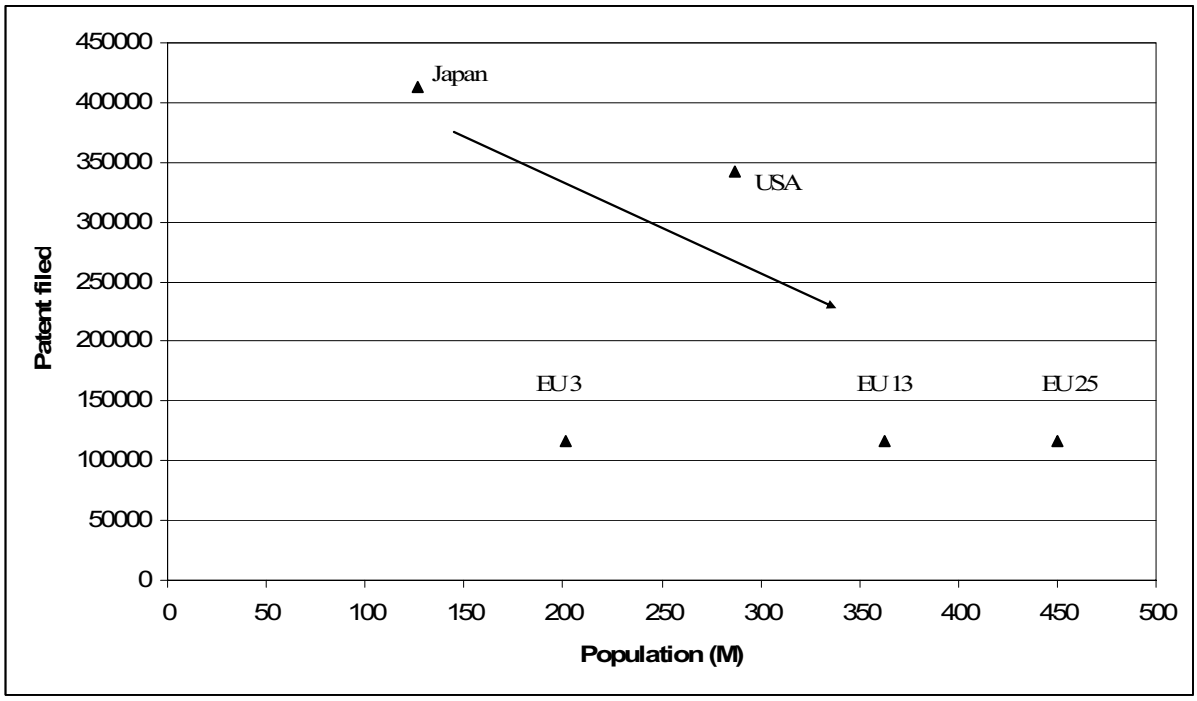
[12] Even if one takes into account the direct filings by Japanese at national patent offices in Europe the difference with the number of Japanese filings at the USPTO stays similar. Only about 1,000 and 570 patents were filed by Japanese assignees at the INPI and UKPTO, respectively. These figures cannot be added due to a large potential number of double counts (simultaneous applications by Japanese residents at the two patent offices).

[13] After the search report and the publication of the patent, the assignee must request a substantive examination of the patent and designate the EPC member countries in which the patent will be validated and put in force if granted. After the grant of the patent the assignee can effectively validate its patent only in these (or part of) countries that were designated at the examination stage. In other words, the numbers presented in table 2 should be considered as upper bounds.

terms of population size), as more than 90 per cent of the patents designate Germany, the UK and France. Italy and Spain attract nearly 80 and 70 per cent of the patents, respectively. Smaller countries are designated for protection by 60 to 70 % of the patents. In other words, there seems to be a broad positive relationship between the market size of an EPC member country and the number of patents designating it for protection.

One would expect to observe a similar positive relationship between market size and the number of patent filings when analysing the USA, Japan and Europe. Chart 1 shows that it is not the case. If one takes into account the market size of the European Union as a whole (EU25, with 25 member states), and if one assumes that all patent applications at the EPO concern the whole market, it clearly appears that there is a negative relationship between the size of the market and the number of patent applications. A positive relationship appears only if one takes into account only the US and the largest three countries of the EPC (EU3) that one can observe a positive relationship.

Chart 1. Market size and patent filings in the three patent offices, 2003[1]

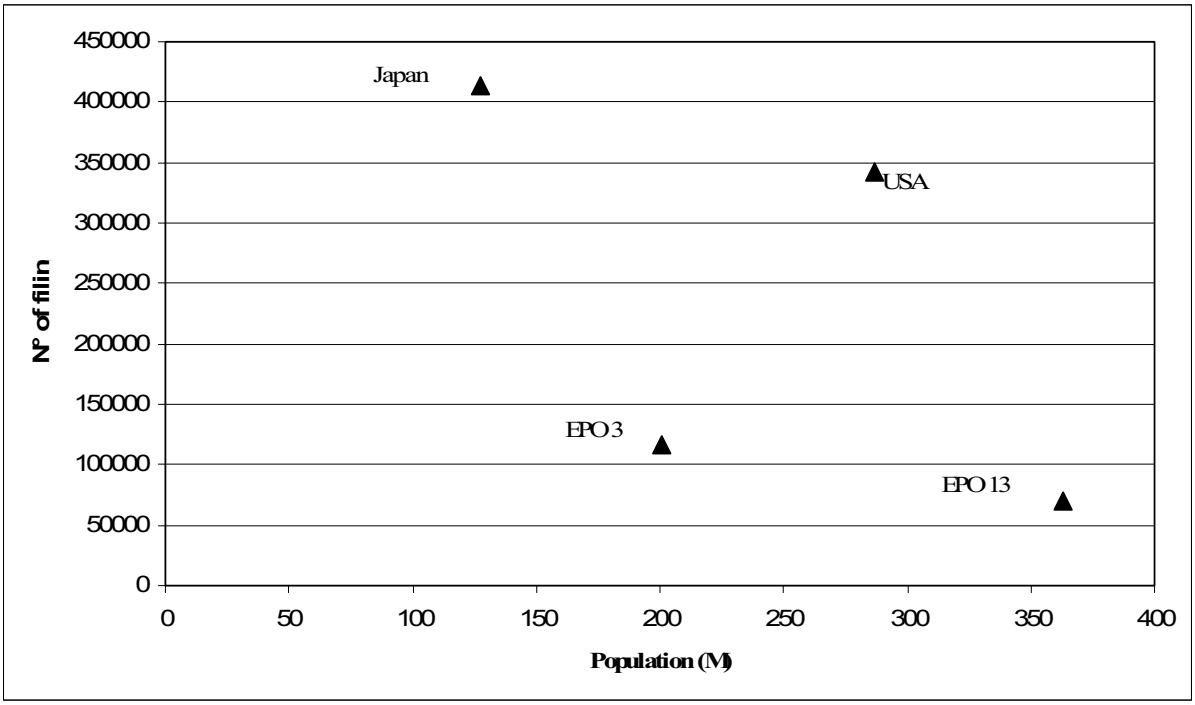


1. EU3 is composed of Germany, France and the UK; EU13 is composed of the countries that are effectively designated for protection by more than 60 per cent of the patent applications: Germany, Great Britain, France, Italy, Spain, The Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Finland and Ireland. EU25 is composed of the 25 EC Member countries.
Sources: cf. table 1.

Chart 1 implicitly assumes that all patent applications at the EPO designate the whole European market for protection. If the data on designated states presented in table 2 is taken into account, one should logically assume that a larger number of patent designate the three largest countries of the European Union. Chart 2 pictures the relationship between market size and the number of patent filings, for two sub-regions: the three largest countries (EPO3) and the 13 countries that are designated by at least 60 per cent of patent filings at the EPO. Again,

there is no clear, if not a negative one, relationship between market size and the number of patent filings. If one takes into account the 13 European countries (EPO13), there seems to be a negative relationship, Japan being the smallest region with the largest number of patent filings, and Europe being the largest region with the smallest number of patents. The US is in an intermediate position.

Chart 2. Market size and geographically designated patent filings, 2003[1]



1. EPO3 is composed of Germany, France and the UK; EPO13 is composed of the countries that are effectively designated for protection by more than 60 per cent of the patent applications: Germany, Great Britain, France, Italy, Spain, The Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Finland and Ireland. The information on the designated states is taken at the examination stage.
Sources: cf. table 1 and table 2.

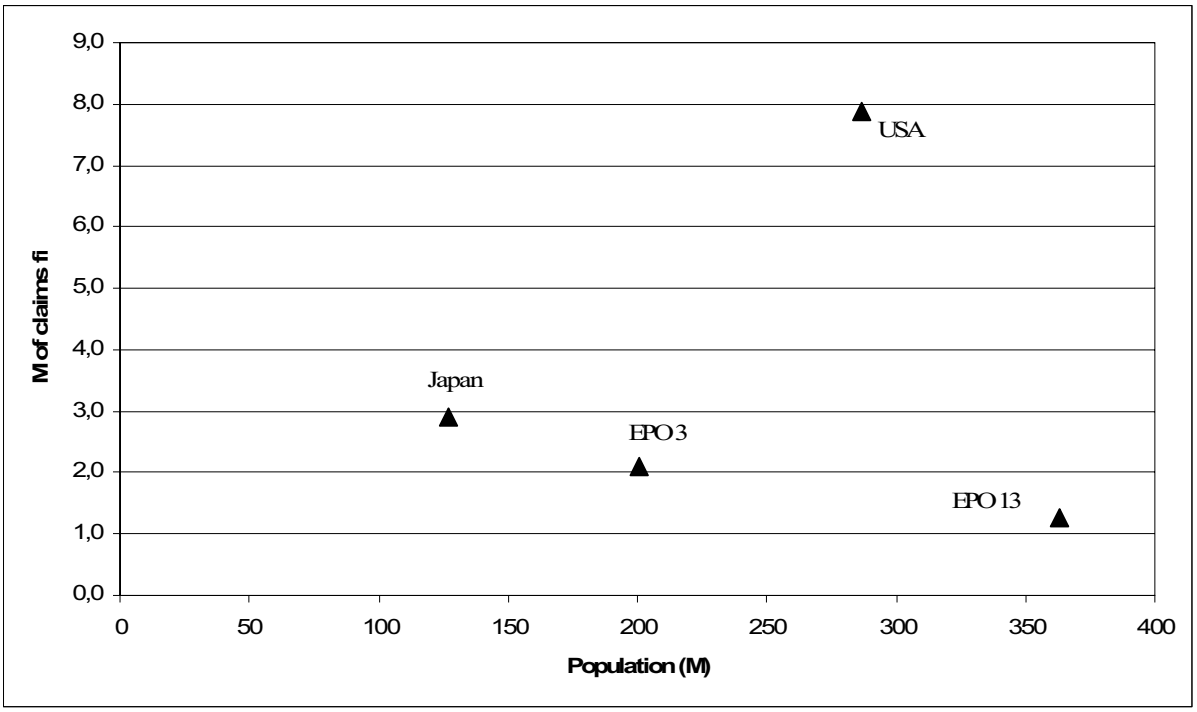
This lack of positive relationship between the number of patent filings and the market size might be due to the fact that patents are different across the triad. As mentioned above, an average Japanese patent is composed of about 7 claims, whereas at the EPO and the USPTO, the number of claims is about 18 and 23, respectively. The number of claims might be a more appropriate indicator because they are the lowest common denominator of patents. The idea to refer to the number of claims instead of the number of patents was put forward by Tong and Frame (1994). With a small sample of patents (7531 patents applied at the USPTO in 1970, 1980 and 1990), the authors show that claims consistently outperform patent counts as an indicator of national technological capacity. For Japanese patents, counting claims instead of the number of patents does indeed change the relative technological performance of Japan.[14]

[14] Dernis *et al.* (2001) show that a patent applied by a Japanese assignee at the EPO is composed of 4 to 7 Japanese priority applications. In order words, several Japanese patents are merged to create a single application at the EPO.

Over the past twenty years the average number of claims per patent has constantly increased (see Archontopoulos *et al.,* 2006).

When the number of claims, instead of the number of patents, is taken into account, the picture is somewhat different, as illustrated in chart 3. The larger market of the 13 EPO member countries accounts for slightly more than a million of claims filed, whereas the smaller market of Japan accounts for about 3 millions of claims. The USA, with an intermediate market size, attracts nearly 8 millions of claims in its patent applications. Chart 3 still suggests that, despite our expectations, there is no apparent relationship between the size of a market and the number of claims that are filed. The next section investigates whether this might be due to the cost of patenting.

Chart 3. Market size and (geographically designated) number of claims filed, 2003[1]



1. EPO3 is composed of Germany, France and the UK; EPO13 is composed of the countries that are effectively designated for protection by more than 60 per cent of the patent applications: Germany, Great Britain, France, Italy, Spain, The Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Finland and Ireland. The average number of claims per patent filed in 2003 is 7 for JPO, 18 for the EPO and 24 for the USPTO.
Sources: cf. table 1 and table 2.

3. The cost of patenting

Patent offices examine patent applications based upon novelty, inventive step and industrial applicability. The steps of the granting process may be described as follows:

- The filing of a patent
- search for anteriority (state of the art)
- patent publication (after 18 months)

- examination
- grant, refusal or withdrawal
- possibility of appeal and opposition process

The cost of patenting can be decomposed into 4 main categories associated with the granting process:

- Process costs are composed of procedural fees (filing fees, search, examination, country designation, grant fees and validation fees).
- Translation costs consist in the translation services often provided by patent attorneys. These costs occur mainly once a patent is granted, and depend on the size of the patent (the number of pages) and on the strategy regarding the geographical scope for protection. The larger the number of countries, the higher is the cost induced by translation services.[15] Measuring these costs is not straightforward as they include translation and transaction (intermediation by patent attorneys) costs.
- External expenses consist in the services costs associated with the writing of the patent and the filing to a patent office. While large firms often have their own IP department, with officially accredited patent attorneys, small firms must always rely on the services provided by legal advisors and accredited patent attorneys. The costs of these services include the expenses associated with all actions implemented for a patent : filings, payment of fees, monitoring translations and procedural actions (time spent in oral or written communication with the patent office).
- Maintaining costs which are renewal fees to keep the patent valid during a maximum period of 20 years. They are due each year at the JPO and at the national patent offices of the EPC member countries or after a certain period at the USPTO; they are generally increasing progressively over time. Once a patent is granted by the EPO, it must be validated and put in force in each desired national patent office of the EPC member countries. The renewal fees vary significantly across countries.

Calculating patent costs is far from being straightforward, as several components are not easy to quantify and depend on the applicant's strategy for filing a patent. Indeed, several factors enter into the total cost of a patent (e.g., the number of claims, the number of pages, the route, the quality of external services, the desired speed, the geographical scope for protection). Larger patents (i.e. with more claims and/or more pages) and patents that intend to be protected in a large number of EPC member states are more expensive in terms of both procedural and external cost. The cost is further linked to the delay of the procedure (especially if a significant number of written communications take place between the patent attorney and the patent office) and to the desired speed of the granting process. Whereas administrative or procedural expenses are easy to quantify (official fees), the external services

[15] One reason for the high cost of obtaining patents through the EPO is the reservation made by most EPC member states under Article 65 requiring the proprietor to translate the description of a European Patent into their official national language in order to validate the European Patent on their territory.

and translation costs must be approximated, as they depend more on the quality of the services provided by attorneys.

Table 3. Cost Structure of direct patent filings and maintenance, 2003

	EPO-3[1]	**EPO-13**[2]	**USPTO**	**JPO**
Hypotheses	EURO	EURO	US$	JP Yen
Type of firm	all	all	large	all
Median number of claims	18	18	23	7
Time to grant (number of months)	44	44	27	31
Designated countries for protection	3	13	1	1
Number of translations[3]	2	8	0	0
Procedural fees				
Filing	160	160	225	16000
Search	690	690	375	
Design. states (75 per country, up to 7)	225	525		
3rd year of application	380	380		
4th year of application	405	405		
Examination	1,430	1,430	150	168,600
Granting	715	715	1,300	
Claim tax[4]	320	320	54	28,000
Administrative cost	250	250	300	
Translation cost[5]	3,400	13,600		
Validation cost	95	1,700		
TOTAL Procedural cost	8,070	20,175	2,404	212,600
	EURO	**EURO**	**EURO**	**EURO**
Procedural costs without translation	***4,670***	***6,575***	***1,856***	***1,541***
Procedural costs with translation	***8,070***	***20,175***	***1,856***	***1,541***
External services cost[7]	***12,500***	***19,500***	***8,000***	***4,000***
After grant				
Maintaining costs 10 years (fees)	***2,975***	***16,597***	***2,269***	***2,193***
Maintaining costs 20 years (fees)	***22,658***	***89,508***	***4,701***	***11,800***
TOTAL filing process[6]	***20,570***	***39,675***	***9,856***	***5,541***
TOTAL 10 years	***23,545***	***56,272***	***12,125***	***7,734***
TOTAL 20 years	***43,228***	***129,183***	***14,556***	***17,341***

1. The three EPC member countries that are the most frequently designated for protection are also the largest European countries; Germany, Great Britain and France.

2. According to the EPO annual report of 2003, 13 countries that are effectively designated for protection by more than 60 per cent of the patent applications: Germany, Great Britain, France, Italy, Spain, The Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Finland and Ireland.

3. Only 8 translations would be required for an effective protection in 13 countries, as some countries accept applications written in English or share a common language with other countries (The Netherlands, Belgium, Switzerland).

4. The cost per claim is EUR 40 if more than 10 claims are included in an EPO patent application; US$ 18 if more than 20 claims are included in a USPTO patent application; and Yen 4000 for the claims included in a patent application at the JPO.

5. It is assumed that translation costs are of EUR 1,700 per language. This amount includes the translation and attorneys' intermediation.

6. These cost estimates for the EPO correspond to the cost of the so-called EP-direct applications (a patent directly applied at the EPO). They should be considered as a lower bound of the average patent, as they do not include the costs associated with national priority applications (from an EPC member state or from abroad) or with PCT applications.

7. There is no existing comparisons of external services costs in the US, Japan and Europe. The Roland Berger (2005) survey provides a reliable estimate for applications at the EPO (see table A1 in the appendix). We assume a base of 8,000 for a patents and EUR 1,500 per designated states (for the EPO). As the patents applied at the JPO are much smaller (7 claims against 18), we assumed half the base cost, i.e., EUR 4,000.

In what follows the cost of patenting is estimated for the "average patent" (in terms of the number of claims) of each of the three offices. As far as patent filings at the EPO are concerned, it is worth mentioning that the costs of priority filing in a national patent office are not taken into account. Similarly, the costs induced by the PCT route are not taken into account here.[16] In short, the PCT route provides more time to the applicants to assess the real value of their patent and slightly increases the total cost of a patent filing. It is important to keep in mind that not taking into account the costs associated with national priority filings and PCT filings means that the cost evaluation that follows should be considered as a lower bound of the real cost that an applicant would have to bear.

Table 3 shows the patenting costs induced by the granting processes of the three patent offices. For the EPO two different scenarios have been developed. In the first one the patent aims at designating the three largest countries (EPO-3: Germany, France and the UK). In the second scenario, it is assumed that the patent will designate 13 countries (the countries that are actually designated by at least 60 per cent of the patent filed at the EPO). The first rows of table 3 describe the hypotheses that have been used. It is implicitly assumed that a patent is first granted and then renewed for 10 or for 20 years (in other words, if a patent is withdrawn before the grant, or refused by the patent office, the cost would be lower). This hypothesis is made in order to reflect the costs that an applicant must be ready to bear when starting an application. The number of claims corresponds to the average number of claims observed in each patent office (see Archantopoulos *et al.*, 2006).

Procedural costs consist of filing, search, examination, designation (exclusively for the EPO), grant and administrative fees. A total of EUR 4,670 is due to have a patent granted at the EPO when three countries are designated. Contrary to the European patent, filing a patent at the USPTO or the JPO does not need to be translated (except for foreign applications written in another language than English or Japanese; respectively) and no validation fees are required. For the European patent, translation costs, national taxes and validation charges have to be accounted for once the patent is granted. After the grant, the applicants have to pay validation fees to each national office in order to put the patent into force. Validation fees are of EUR 1,700 for the 13 designated countries.

When a patent is granted by the EPO, it transforms itself into a bundle of national patents (in all or a selection of the countries that were designated by the applicant). National laws stipulate that a patent written in a foreign language has no effect, legally speaking. Applicants need therefore to translate their patent documents. These translation costs are considerable and mandatory if the patentee wants a protection in every European country. For the 13

[16] See Dernis *et al.* (2001), van Zeebroeck *et al.* (2006) and Grupp and Schmoch (1999) for a more in-depth description of the filing routes and the impact of the Patent Cooperation Treaty (PCT) on the measurement of technological performances with patent data. The Patent Cooperation Treaty consists in filing a patent at the World Intellectual Property Office (WIPO); it can be used before the effective filing in any foreign patent office and allows applicants to wait for the international phase up to 30 months after the priority date, instead of 12 months. The Paris Convention stipulates that any priority filing can be extended abroad no more than 12 months after the priority filing.

European countries 8 translations are required and would cost the applicant about EUR 13,600.[17]

A patent application is most often performed with the help of patent attorneys who guide the assignees through the whole procedure. These external services inevitably lead to additional expenses which can hardly be precisely quantified. They depend on multiple factors related to the quality of the services, the complexity of the technical domain, the procedural delays and the geographical scope of protection. Hence, only a rough estimation of these costs can be suggested. A gross estimate of these costs is displayed in table 3, it should be cautiously interpreted as there is no existing reliable and comparable evaluations of these costs in the US, Japan and Europe. The amounts presented in table 3 must be taken as a crude approximation, as many informal contacts with small firms, universities and patent attorneys led us to conclude that such external services vary significantly across firms, industries and countries. In addition, a significant share of these external costs can be considered as internal expenses for large firms (i.e. depending on the number of staff in the IP department), which makes them further complicated to measure. So far, and to the best of our knowledge, the Roland Berger (2005) survey implemented for the EPO is the most reliable source of information on external expenses, especially for patent applications at the EPO. For the external expenses, in order to fit with the Roland Berger study, we decided to rely on a base of EUR 8,000 for the three patent offices plus EUR 1,500 per designated states for the EPO.

The costs for maintaining the patent in force are complex to calculate. For each country and each year the renewal fees must be added. For the 13 (3) countries and for a period of 10 years, the maintaining fees add up to EUR 16,597 (EUR 2,975).[18] This amount is more than four time as high for a period of 20 years (EUR 89,508). For the US and Japanese market, these costs vary between EUR 2,000 and EUR 2,500.

The USPTO offers a 50% reduction in fees for small entities. Maintaining fees are due 3.5, 7.5 and 11.5 years after first filing, which means that a patent maintained for 20 years does not cost more than a patent maintained for 12 years. A patent that is maintained for 20 years at the USPTO would cost about EUR 14,556 for a large firm.

The fees in Japan depend much more on the number of claims (at the EPO claim-based fees start from the 11th claim onwards, whereas at the USPTO it starts at the 21st claim onward). Procedural costs are quite low for a patent application at the JPO. An average Japanese patent (with 7 claims) that is renewed for 20 years would cost about € 21,000.

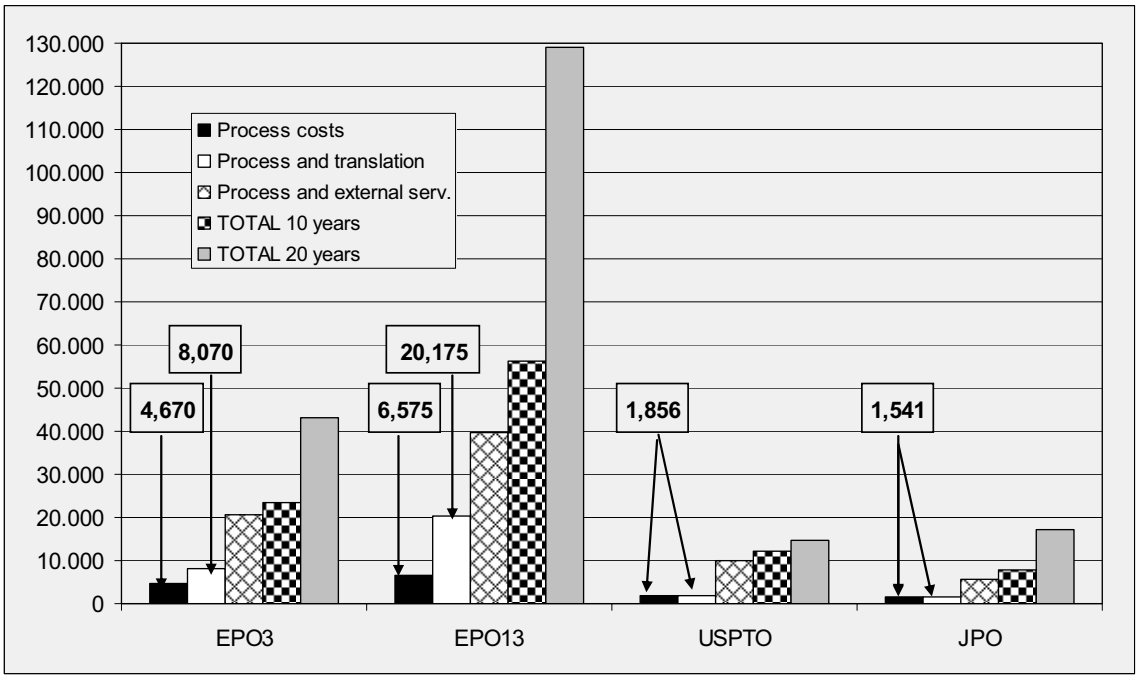
Chart 4 illustrates the cost differences across the three patent systems. The European patenting cost is clearly higher than in the US or in Japan. This is mainly due to translation

[17] In 2003, the European Commission estimated for 6 languages a cost of 10,200 €. Our cost estimate for translations include the intermediation of attorneys, and therefore is higher than the pure translation costs provided on the survey performed by Roland Berger (2005).

[18] Renewal fees are calculated for the 4th to the 10th year since patent is delivered after 44 months on average. Fees are also required for the search and examination processes which take place during the first three years.

and validation costs as well as to the renewal fees that the EPO applicant has to fulfil. The more the number of designated states for protection, the more expensive the patent is, as both renewal fees, translation costs, validation fees and external services increase with the number of countries. A European patent that is renewed for 20 years in 3 (13) EPC Member states costs more than EUR 43,000 (129,000), against about EUR 16,000 and EUR 21,000 for the US patent system and the Japanese patent system, respectively. The Japanese patent system is the least expensive for the process costs. For a 20 years protection the US system is the least expensive.

Chart 4. Comparative cost structure of patent application and maintenance, 2003 (EURO)



1. Source: cf. table 3.

This type of comparison has to be taken with caution because *(i)* it is calculated for the 'average' patent in each patent office and *(ii)* external services expenses are rough estimates and can vary substantially according to the technology and the strategy adopted by the firm. The figures presented in table 3 and chart 4 can be compared with the estimates performed by Roland Berger (2005) for the EPO. Table A1 in the appendix shows that the cost estimates are very similar.[19]

The previous section suggests that it might be more relevant to perform a comparison on the basis of claims, rather than on the basis patents. Table A.2 and chart A.1 in the appendix show that the process and translation costs of a claim that is granted by the EPO goes from more than EUR 400 for three designated states to more than EUR 1,000 for 13 designated states, as

[19] The costs induced by the professional representations - or external services - that are used in this paper have been derived from the Roland Berger survey for patent applications in Europe. For the USPTO and the JPO some simple assumptions have been used, as shown in table A1 in the appendix.

compared to about EUR 80 and EUR 220 per claim in the US and Japan, respectively. The cost structure of a patent applied in the three EPO countries is similar to the one of Japan (cf. chart A1). The difference between 3 and 13 designated EPO countries is striking.

The patenting costs relative to the US are presented in table 4 for the EU and for Japan. It shows that a European patent designating 13 (3) countries is about 11 (4) times more expensive than a U.S. patent if process and translation costs are considered. For the total costs with up to 20 years of protection the European patents would be nearly 9 (3) times more expensive. Japanese patents are less expensive than US patents, except for a 20 year protection, were they are similar. If the analysis focuses on the claims, the cost differences increase, as there is less claims on average in an EPO patent, and especially in a Japanese patent, than in a US patent. One claim, the lowest common denominator of a patent, is 6 to 11 times more expensive in Europe (with 13 designated states) than in the US, depending on the type of cost considered. The Japanese claims are now 2 to 4 times more expensive than the US ones.

Table 4. European and Japanese patent costs relative to the US

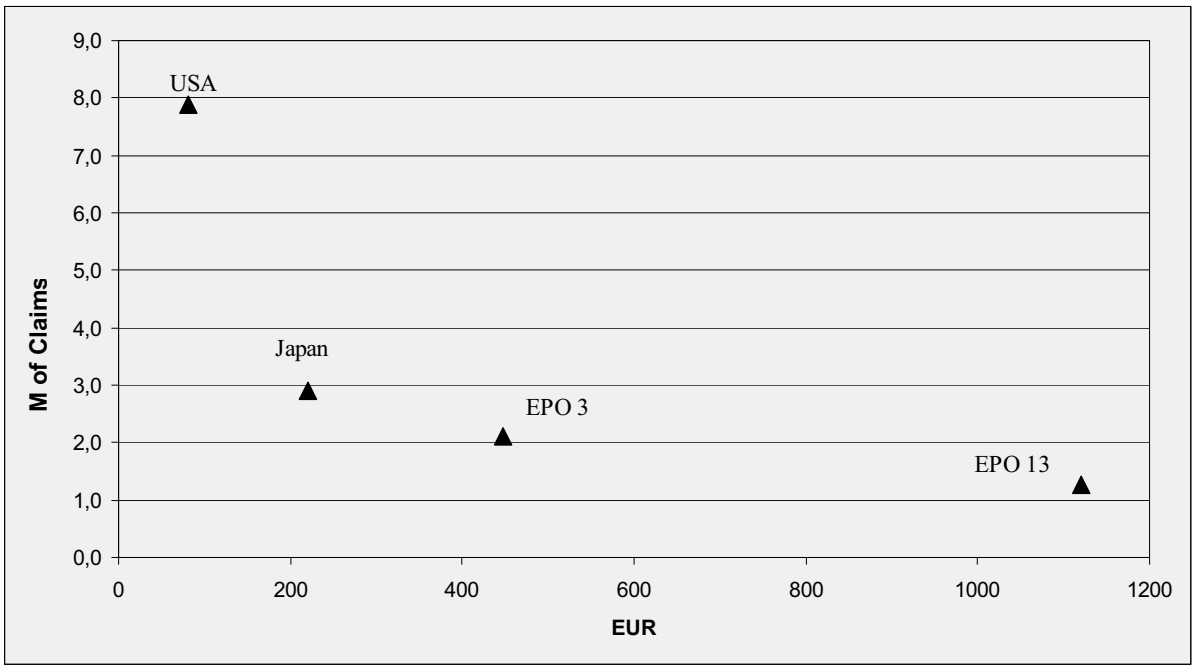
relative to US patents	**Process and translation**	**TOTAL 10 years**	**TOTAL 20 years**
EPO3	4,3	1,9	3,0
EPO13	10,9	4,6	8,9
JPO	0,8	0,6	1,2
relative to US claims			
EPO3	5,6	2,5	3,8
EPO13	13,9	5,9	11,3
JPO	2,7	2,1	3,9

Source: own calculation, from table 3 and table A.2 in the appendix. These figures represent the cost of a European patent divided by the cost of a US patent.

Attempting to measure the relationship between the cost of patenting and the number of patent applications is complex, for two reasons. First, one element in the equation, cost, is clearly not easy to approximate. Second, the literature seems to suggest that what drives firms' patent behaviour is not related to the cost of patenting (see e.g., Peeters and van Pottelsberghe (2006) or Duguet and Kabla (1998)) but rather to internal strategic factors. Applying for a patent can be considered as entering into a step by step process, similar to a real option approach. In what follows we take into account all the costs that have to be supported until the grant of a patent and its validation in the designated states (including procedural costs and translation costs) and we exclude external expenses (attorneys and professional representations). This choice is made because procedural costs and translation costs are easier to estimate, they vary much less than external services. They correspond to the expenses an assignee will have to foresee when she applies for a patent. External expenses (attorneys, professional representations) also have to be accounted for in the USA and Japan, and it is difficult to have a reliable comparison of these costs for the three patent offices.

Chart 5 shows the relationship between the number of claims that have been filed in each of the three patent offices and the process cost per claim (see table 3 and table A.2 in the appendix). There is a negative non linear relationship between the demand for patents and their perceived price, which looks like a traditional non linear demand curve. The USPTO receives the largest number of claims through its patent filings, and has the lowest cost per claim of about EUR 81 per claim. If the 13 most frequently designated countries are taken into account, the cost is up to more than EUR 1,100 per claim; which might explains why only about 1 million of claims are applied at the EPO and designate these countries. The cost per claim in Japan is of EUR 220.

Chart 5: Millions of claims filed vs. process cost per claim[1]



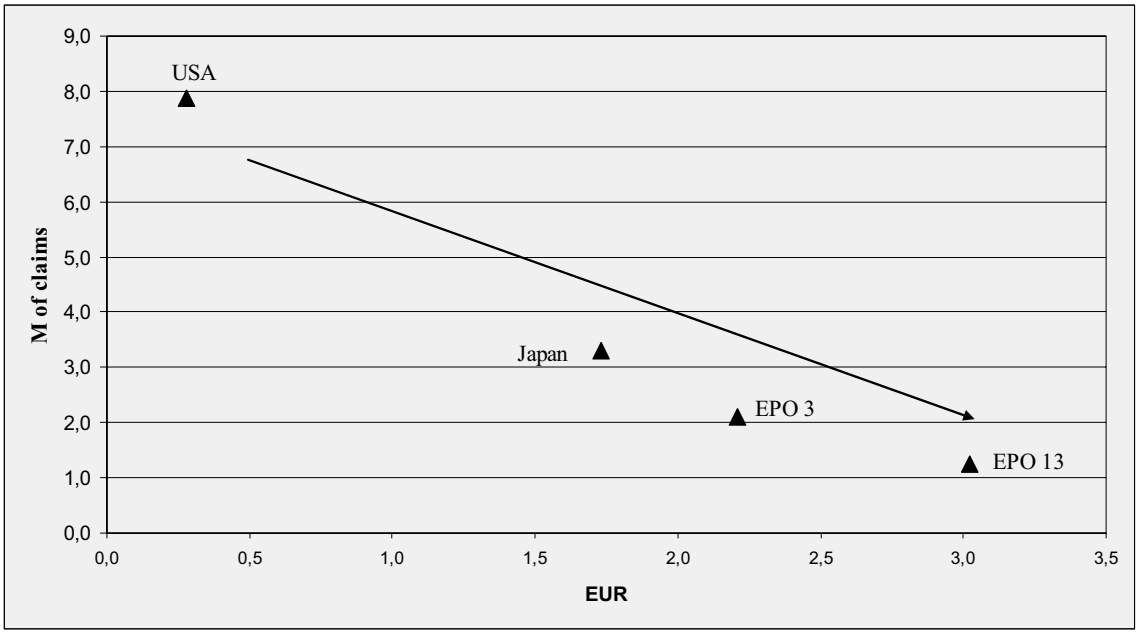
1. The x-axis shows the cost per claim, expressed in EURO, and includes the procedural fees and translation costs. The y-axis shows the number of claims filed (millions) in each patent office. EPO3 is composed of Germany, France and the UK; EPO13 is composed of the countries that are effectively designated for protection by more than 60 per cent of the patent applications: Germany, Great Britain, France, Italy, Spain, The Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Finland and Ireland.
Source: cf. table 3 and table A.2 in the appendix, own calculation.

These results do not yet provide the most reliable picture of relative costs, as the size of the markets has not been taken into account. In order to have a more reliable picture of the relationship between the cost of the patent process and the number of patent filings, one would logically take into account the market size associated with a patent. If two patent systems offer the same cost structure for the granting of a patent (with the same number of claims), and if the two regions are of different size, the assignee would have a clear preference for the region with the largest market size. In other words, the largest region would offer protection for each unit of the market (i.e., a consumer) at a lower cost. This approach requires to compute the cost per claim per capita, or the 3C-index.

Chart 6 and chart 7 take into account the market size that is at stake with the three patent offices. Chart 6 shows the relationship between the process cost per claim per million capita

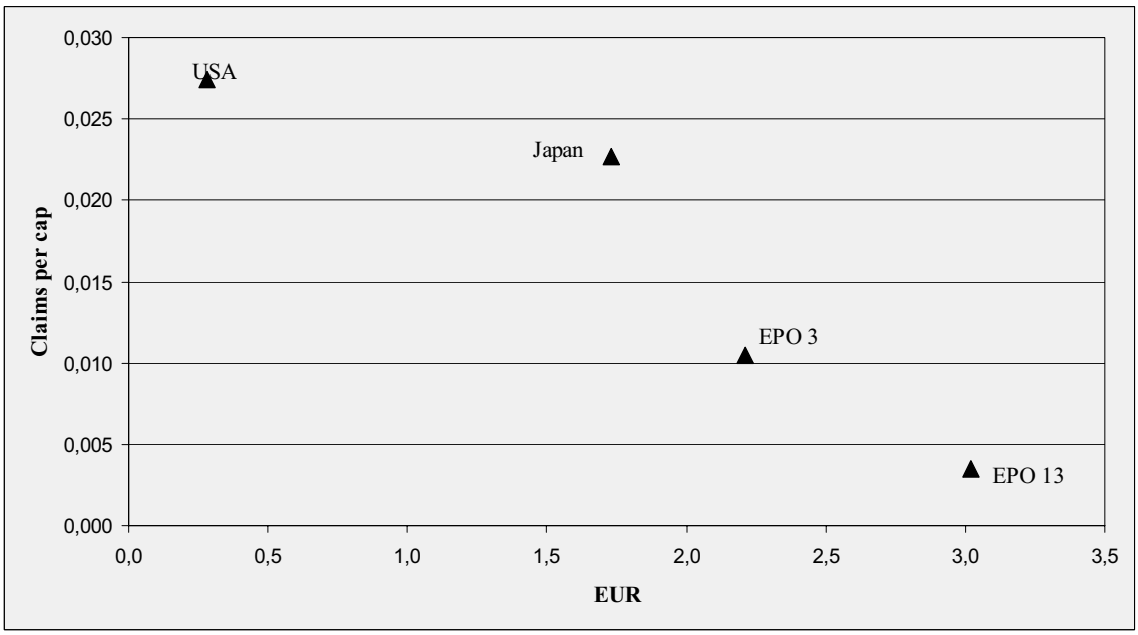
and the total number of claims that have been filed in the patent offices. A negative and linear relationship clearly appears. The USA being a large market, its relatively low cost per claim becomes even lower 'per capita', about EUR 0.3 per million of inhabitants, which explains its high attractiveness. In Japan the cost per claim per million capita is about EUR 1.7, whereas it is about EUR 2.2 and EUR 3 for the 3 and 13 most frequently designated states in Europe, respectively. The higher the patenting cost per claim per capita, the lower is the demand for patent. With the 3C-index, a claim applied for 13 European states is about 10 times more expensive than in the USA, and there is 6 to 7 times less claim filings. This relationship is also confirmed if the number of claims filed per capita is analysed instead of the total number of claims filed (see chart 7).

Chart 6: Millions of claims filed vs. process cost per claim per million capita[1]



1. The x-axis shows the cost per claim per million capita, expressed in EURO, and includes the procedural fees and translation costs. The y-axis shows the number of claims filed (millions) in each patent office. EPO3 is composed of Germany, France and the UK; EPO13 is composed of the countries that are effectively designated for protection by more than 60 per cent of the patent applications: Germany, Great Britain, France, Italy, Spain, The Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Finland and Ireland.
Source: cf. table 2, table 3 and table A.2 in the appendix, own calculation.

Chart 7: Number of claims filed per capita vs. process cost per claim per million capita[1]



1. The x-axis shows the cost per claim per million capita, expressed in EURO, and includes the procedural fees and translation costs. The y-axis shows the number of claims filed (millions) in each patent office per capita. EPO3 is composed of Germany, France and the UK; EPO13 is composed of the countries that are effectively designated for protection by more than 60 per cent of the patent applications: Germany, Great Britain, France, Italy, Spain, The Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Finland and Ireland.
Source: cf. table 2, table 3 and table A.2 in the appendix, own calculation.

A direct implication of this cost analysis is that the number of patent applications in Europe might substantially increase if the cost of patenting is reduced. Several avenues are currently being investigated to lighten the burden of patent costs and the complexity of the patent system in Europe. These potential solutions range from a soft 'harmonisation' of national fees, a more significant London Protocol and/or European Patent Litigation Agreement (EPLA), and the most striking progress that would occur through the Community Patent.

A first solution would be to harmonize the current fee systems of each national patent office. So far there is no homogenous approach to national application fees and to national renewal fees. The 3-C index developed in this paper could be a relevant and easy-to-implement methodology to build a harmonized European patent 'fee' system.

A second solution for reducing translation costs is put forward by the 'London Protocol' which stipulates that "*any state having an official language in common with one of the official languages of the EPO shall dispense with the translation requirements provided for in Art. 65 of the EPC*". And "*any state having no official language in common with one of the official languages of the EPO shall dispense with translation requirements if the European patent has been granted in the official language of the EPO prescribed by that state, or translated into that language*".[20] This protocol, if ratified, would obviously drastically reduce translation costs.

The EPLA is a third solution aiming at simplifying the European patent system. It is designed to improve the enforcement of European patents, enhance legal certainty and promote the uniform application and interpretation of European patent law. Although not tackled in the present paper, litigation costs are an important component of the total expenses associated with a patent filing. The implementation of the EPLA would contribute to reduce the fragmentation of the European market for intellectual property.

The fourth and most important potential progress in this respect would be to implement the Community Patent. Such a system, which has been under intensive debates for about 30 years, would have the following advantages : *i)* a uniform and autonomous patent system for the

[20] Agreement on the application of Article 65 of the EPC (http://www.ige.ch/E/jurinfo/pdf/epc65_e.pdf)

whole European Union market – one unique gateway all along the life of the patent; *ii)* a much cheaper process for patentees; and *iii)* a more simple and less expensive linguistic regime. With such a system, a patentee would reach the 25 EU Member countries, at a cost that would be roughly similar to the current cost that has to be supported for the three largest European countries for instance.

These four potential solutions would all lead to a reduced cost of patenting in Europe and to a less complex system. It is important to keep in mind that what makes a Europe-wide patent more expensive is mainly the translation costs (including intermediation with patent attorneys) and the validation fees in each national patent office that occur just after the grant of the patent by the EPO. These costs do not correspond to the search and examination process of the EPO, and hence do not witness a more rigorous examination process. They only affect the demand side of patents, through an implicit self selection process.

4. Total cost is not the only issue

The previous section demonstrates that the European patent system is more expensive than the US and the Japanese patent systems, and shows that costs are one important cause of the relatively low attractiveness of the European patent system. Although the broad objectives of the three patent offices are similar, the way they are implemented and their economic role as policy tools aiming at fostering innovation differ. One might therefore wonder whether the much higher cost of patenting in Europe is associated with a higher quality service offered by the EPO? This section investigates this issue. It underlines some important differences between the three patent offices, regarding the procedural steps and their potential impact on quality or on the rigor of the granting process. These differences, which might be considered as rough indicators of the rigor of a granting process, are illustrated by the workload, the speed of the process, the grant rate and the patentability of specific subject matters. Table 5 summarizes some of the differences across the three patent offices.

The workload

The numbers presented in table 5 shows that with approximately the same number of examiners (and similar annual revenue), the USPTO tackles about three times more patent applications and grants than the EPO. If the number of claims is considered, it appears that the USPTO tackles, in terms of applications or grants, about four times more workload than the EPO. At the EPO (the USPTO) about 618 (2200) claims are filed per examiner, and 324 (1100) are granted each year. These figures suggest that both the incoming workload of examiners (number of claims filed per examiner) and their output (number of claims granted per examiner) is three to four times higher at the USPTO than at the EPO. One explanation of this significant difference might be due to the time spent by an examiner on each patent.

The speed of the process

The length of the procedure is an important factor for applicants as it shows the time needed to grant a patent. The EPO has the greatest average delay (49 months) compared to the JPO (31 months) and the USPTO (27 months). One must be cautious with these figures because both the EPO and the JPO have to wait for an answer from the applicant (after the search process and the publication of the application, the EPO and the JPO have to wait for a request for examination by the applicant; it is allowed to wait for up to 3 years to answer to the JPO and 6 months to the EPO). It is however well known that the EPO takes more time in the search and examination process than the USPTO and the JPO.

One reason for this longer delay was raised by an EPO official: "*USPTO and JPO examiners can take only 3 to 4 hours for the search process, whereas at the EPO, it can last for more than 3 days. Because of being a complete step in the procedure, the search for prior art is more precise and hence improves patent quality*".[21] Examination is done faster at the JPO, partly because the search is done by the IPCC and that a Japanese patent application only consists of an average 7 claims, which obviously lightens the search and examination process. Regarding the USPTO, Lemley (2001, foot note 5) reports that "*there are strong structural and psychological pressures on examiners to issue patents rather than rejecting applications, no matter how weak the alleged invention seems.*" Examiners at the USPTO have only 18 hours for the whole examination process.[22]

A slower process means that examiners spend more time on a patent application. Assuming similar analytical skills, it can logically be inferred that the EPO examiners' decisions are based on a broader knowledge of the prior art and a deeper analysis of the patented invention, that would lead to a higher quality of the granted patents (i.e., a higher refusal rate).

The grant rate and opposition process

The substantive examination is a crucial step in the process. The examiners analyze every characteristics of the invention in order to make a statement on its patentability. Interpretations of the three traditional conditions for granting a patent (non obviousness, novelty and industrial applicability) can differ from an office to another. Filing of an application at the EPO is taken to imply a request for the search procedure, and does not automatically imply a request for substantive examination. For the latter, a separate request has to be filed not later than six months after the publication of the search report. The filing of a patent at the JPO does not imply a request for examination; this may be filed up to three years after the date of filing (this delay was reduced from a seven years delay in October 2001). Filing of a national application with the USPTO is taken to imply a request for examination. The implications induced by these procedures are shown in table 5. The examination rate at the USPTO is 100% because the filing of the application implies an

[21] Interview of G. Minnoye, one of the EPO's vice-presidents, by Didier François in July 2004.
[22] The 18 hours include the time spent to read the application and the submitted prior art, to find and read additional prior art, to compare the prior art to the application, to write an action and answer to the replies (with some iterations), to implement interviews and make sure that the granted diagrams and claims are in form of allowance.

examination, which is not the case at the EPO or the JPO. Indeed, for the latter offices the examination rates are smaller since the applicant has to make a specific request for examination, which explains the lower rates of 87% and 54%, respectively.

When an examiner intends to grant a patent or if a patent cannot be granted as such, the information is communicated to the applicant. The latter may then make amendments to the application, generally in the number and content of claims, after which examination is resumed. This procedural step is iterated as long as the applicant continues to make appropriate amendments. Then, the patent is either granted or the application is finally refused (or withdrawn by the applicant). An applicant may always withdraw the application, at any time before the decision of the patent office.

The examination process at the EPO and the JPO is further reinforced by the pre-grant opposition systems that allow third parties to challenge the patent applications before they are effectively issued (at the EPO an opposition can be filed for nine months after the grant of a patent). An opposition process is much less costly than a litigation, and induces a fast proceeding of the cases, which in turn reduces uncertainty regarding the patentability of the invention. One could consider the opposition process as a clear upgrade in the rigor of a patent system, as it generally adds useful information (new prior art) about the invention and its patentability, and would clearly contribute to reduce the grant rate of a patent office.

The JPO has the lowest grant rate (50%), making it the less 'applicant-friendly' office compared to the two others. The USPTO's grant rate (64%) is slightly higher than the one of the EPO's (59%). However, according to Quillen and Webster (2001) and Quillen *et al.* (2002) this rate is biased because it does not include the continuous applications in its calculation: the USPTO's grant rate should be corrected and would fluctuate between 87% and 97%, making the American office the most 'applicant-friendly'.[23] This corrected grant rate should be compared with the grant rates of 67% and 64% for the EPO and the JPO (for the period 1995-1999), respectively.[24] These figures tend to show that the JPO and the EPO have adopted a much higher level of rigor than the USPTO.

Domains of patentability

[23] See Quillen and Webster (2001) and Quillen *et al.* (2002). There are three types of continuing patent applications available in the U.S. pursuant to the patent statutes: continuations, continuations in part (CIPs), and divisionals. Continuation and CIP applications are unique to the U.S., and permit patent assignees to refile their patent applications and hence restart the examination process with a newly filed patent application claiming the benefit of an earlier filing date. A continuation application is a second application for the same invention claimed in a prior copending nonprovisional application that claims the benefit of the filing date of the prior application. The prior application is normally abandoned after the second application is filed (see Quillen and Webster (2001), p. 4).

[24] Regarding the grant rate of the EPO, it varies significantly according to the country of applicant (see Guellec and van Pottelsberghe, 2000). For instance, the patents applied by US applicants have a much lower grant rate at the EPO than the patents applied by Japanese applicants, suggesting that countries have different propensities to file patent applications for their inventions at the EPO.

Domains of patentability can vary depending of the region. Historically, patentable subject matter has been restricted first to mechanic devices and their manufacturing processes and then extended to chemicals and pharmaceuticals. Subject matter now covers biotechnological inventions and software in most countries, but changes have not occurred everywhere at the same pace and differences remain in several dimensions.[25]

One of the first differences across jurisdictions in this regard lies on the legal definition of patentability, and in particular what is considered a technical invention. Patent laws also differ as regards exclusions from patentability. In the US, only laws of nature, natural phenomena, and abstract ideas have been traditionally excluded from patentability. In Japan the exclusion extends to medical methods, laws of nature and discoveries. In contrast, apart from medical methods, the EPC excludes a long list of items if they are claimed as such. This list includes scientific theories, mathematical methods, aesthetic creations, schemes, rules and methods for performing mental acts, playing games or doing business, programs for computers and presentations of information. The long list of domains that are excluded from patentability is probably one factor underlying the smaller number of patent applications at the EPO.

Table 5. Qualitative indicators in the three regional offices, 2003

	EPO	USPTO	JPO
Patent examiners	3,365	3,535	2,426*
Examination rate	87%	100%	53.8%
Procedure pendency (in months)	Search: 12 Examination: 38	27	Examination: 31
Total Patent Filings	116,613	342,441	413,092
Total Patent Granted	59,992	169,028	122,511
Pre-grant opposition process	YES	NO	YES
Total number of claims filed	2.1 Million	7.9 Million	2.9 Million
Total number of claims granted	1.1 Million	3.9 Million	0.9 Million
Filings per examiner	34.6	96.9	170.3*
Grants per examiner	17.8	47.8	50.5*
Claims filed per examiner	624.1	2,235	1,195*
Claims granted per examiner	326.9	1,103	371*
Grant rate[2]	59% (QW: 67%)	64% (QW: 87 to 97%)	50% (QW: 64%)

*. In Japan the search process is outsourced to an external organization composed of about 1,300 employees, which would bias a "per examiner" comparison. In this table we added the total number of examiners (1,126) to the approximated total number of employees devoted to the search process (about 1,300).
2. Quillen and Webster (2001) and Quillen et al. (2002) put forward grant rates for the period 1995 to 1999 for the EPO and the JPO, and for the period 1993 to 1998 for the USPTO. The authors show that the USPTO grant rate (allowances divided by total disposals, i.e., the sum of allowances and abandonments), corrected for the

[25] See Guellec and Martinez (2003).

continuous applications, ranges from 87% to 97%, depending on the extent to which prosecution of abandoned applications was continued in refilled applications.
Sources: 2003 Annual Reports of the three offices, Trilateral Statistical Report (2003), Quillen and Webster (2001) and Quillen *et al.* (2002).

In a nutshell, the USPTO has much less restrictions on subject matters, is faster, is more 'applicant friendly' and grants a much higher number of patents per examiner than the EPO. The slower speed of the EPO and the lower apparent 'productivity' of patent examiners can be explained by a more important rigor of the EPO, and a higher perceived quality of the granting process. This rigor requires longer search and examination processes and induces a more stringent selection rate - or lower grant rate. The lower the grant rate, the more the process can be seen as strict and severe.[26]

This dichotomy is somewhat confirmed by Jaffe and Lerner (2004)'s assessment of the current US patent system (as opposed to the late seventies and early eighties): "*Now that it is possible to get a patent on unoriginal ideas, many more dubious applications are being filed […the current system provides incentives for applicants to file frivolous patents applications, and for the patent office to grant them […Patents in Europe and Japan remain harder to get ….*" [pp. 5-6].

5. Concluding summary

The objective of the paper is to assess to what extent the cost of patenting differs across three major patent offices and whether significant differences would affect the demand for patents. The analysis focuses on a comparison of the three largest developed regions in the world and their patent offices: Europe, the United States and Japan.

Contrarily to what could logically be expected, there is no apparent relationship between the market size of a country or region and the number of patent applications it receives each year. Even if the number of claims is taken into account instead of the number of patent filings, being a larger economic area does not translate into the filing of a larger number of claims. The reason underlying this lack of relationship between market size and patent applications is partly due to the cost of patenting, which is not straightforward to measure.

Evaluating the cost of a patent is a complex matter, especially for the purpose of an international comparison. For a single region, the cost of patent will depend on the size and technological complexity of the patent, on the chosen patent procedure, on the desired duration for the patent protection, on the quality of professional services and on the targeted geographical coverage (within the European patent system, once a patent is granted, it must be translated and validated in each targeted national patent office). In other words, any evaluation of the cost of a patent is tentative and must be considered as a broad average.

[26] See Quillen and Webster (2001).

We have put forward a method for cost evaluation that consists in taking first the 'procedural' costs, which include all official fees up to the grant of a patent and its validation in the desired countries for protection. The second component is related to the translation costs. It occurs exclusively for the EPO, once the patent is granted, and is required in order to be validated in each national patent office. The third component is the most difficult to approximate. It is related to the external services (professional services, attorneys, etc..) that companies can either outsource or bear in-house. The fourth component varies with the duration of the protection. Renewal fees are required to keep the patent in force in each designated country.

In this paper the cost of a 10 year and 20 year protection have been computed. In addition, as the cost of a patent applied at the EPO depends on the desired geographical scope for protection, we have computed the average cost for a protection in the three most frequently designated EPC states and for the 13 EPC states that were designated by at least 60% of the patent filing.

The results clearly show that the European patent system is much more expensive than the US or Japanese patent systems. A European patent that is renewed for 20 years in 3 (13) EPC Member states costs more than EUR 40,000 (120,000), against about EUR 14,500 and EUR17,300 for the US patent system and the Japanese patent system, respectively. The Japanese patent system is the least expensive for the process costs. For a 20 years protection the US system is the least expensive. As Japanese patents are composed of much less claims (on average, about 7) than European (18) or American patents (23), we argue that it is more appropriate to analyse the cost per claim. For instance, the process and translation costs of a claim that is granted by the EPO goes from more than EUR 400 for 3 designated states to more than EUR 1,100 for 13 designated states, as compared with EUR 80 and EUR 220 per claim in the US and Japan, respectively.

A European patent designating 13 countries appears to be nearly 11 times more expensive than a U.S. patent if process and translation costs are considered. For the total costs with up to 20 years of protection the European patents would be nearly 9 times more expensive. Japanese patents are less expensive than US patents at the beginning of the process and become gradually more expensive. If the analysis focuses on the claims, the cost differences increase. One claim, the lowest common denominator of a patent, is 6 to 14 times more expensive in Europe (with 'only' 13 designated states) than in the US, depending on the type of cost considered.

These results do not yet provide a clear picture of relative costs, as the size of the market has not been taken into account. In this respect, the relevant relative cost measure should be the cost per claim per capita, or the 3C-index put forward in this paper. If the focus is put on process and translation costs, the U.S. has the lowest cost per claim per million capita of EUR 0.3, which explains its high attractiveness. In Japan the cost per claim is about EUR 1.7 per million capita, whereas it is about EUR 2.2 and EUR 3.0 for the combined 3 and 13 most frequently designated states in Europe, respectively. With the 3C-index, a clear negative and

linear relationship appears between the relative cost of a patent and the number of filings. A European patent designating 13 countries for protection is about 10 times more expensive than an American patent, and less than 2 times more expensive than a Japanese patent.

Cost is not the only issue. As demonstrated by Jaffe and Lerner (2004) and Quillen and Webster (2001), quality, or rigor, also matters. The last section of this paper shows that the USPTO grants more patent, and faster than the EPO, which witnesses a lower quality: the substantive examination is much faster and the grant rate is substantially higher. If the patents granted by the EPO are indeed of a higher quality, then one would obviously expect a higher cost, and less applications. However, what makes a European patent more expensive is not the higher quality of its examination process, but rather the cost of translation once the patent is granted, and the complexity of its validation and maintenance in each national patent office.

The European market, which is nowadays composed of 25 countries, is more than twice as large as the US market in terms of inhabitants. Taking into account the cost per claim per capita index, there would be a clear justification for higher nominal examination fees at the EPO, that would ensure a rigorous granting process thanks to significant economies of scale. The current high quality process of the EPO takes place in the frame of a complex, expensive and fragmented European market for intellectual property. These costs do not reflect the effectiveness of a patent system, but rather a selection mechanism strongly based on the financial resources of the inventors.

Several attempts to reach a more integrated market are currently tackled by policy makers. A first, although incremental, possibility for improvement would be to harmonize the validation and renewal fees across the EPO member states. In this respect the 3-C index could be a useful tool. A second and significant potential improvement of the system lies in the current proposals of the European Patent Litigation Agreement (EPLA) and/or the London Protocol. While the former would simplify the complexity and the cost of litigation in Europe (through a centralized court) the latter would substantially reduce the translation requirements, and hence the cost of patenting. Finally, the most important advance in reducing the complexity and the cost of patenting in Europe would be reached through the Community Patent - i.e., a unique gateway for patenting, with an automatic reach of the whole European market, one fee structure and lower translation costs.

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Table A.1. Comparisons of the cost evaluations of the RB (2005) survey and table 3, for 10 years of protection.

	This paper, Table 3		RB (2005)[1]	
	All	**All**	**Euro-PCT**	**Euro-Direct**
Hypotheses				
Designated states	3	13	8	6
Number of claims	18	18	15	6
EPO fees	4,670	6,575	6,300	4,400
Prof. representation			12,150	9,630
Validation, including:			12,100	6,650
Attorney			*4,000*	*2,850*
Translation costs	*3,400**	*13,600**	*7,400*	*3,400*
Renewal fees, including:			16,000	10,900
Fees	*2,975*	*16,597*	*9,200*	*5,600*
Attorneys			*6,800*	*5,300*
TOTAL, including:	23,545	56,272	46,550	31,580
Attorneys and prof. rep.	*12,500***	*19,500***	*22,100*	*17,780*

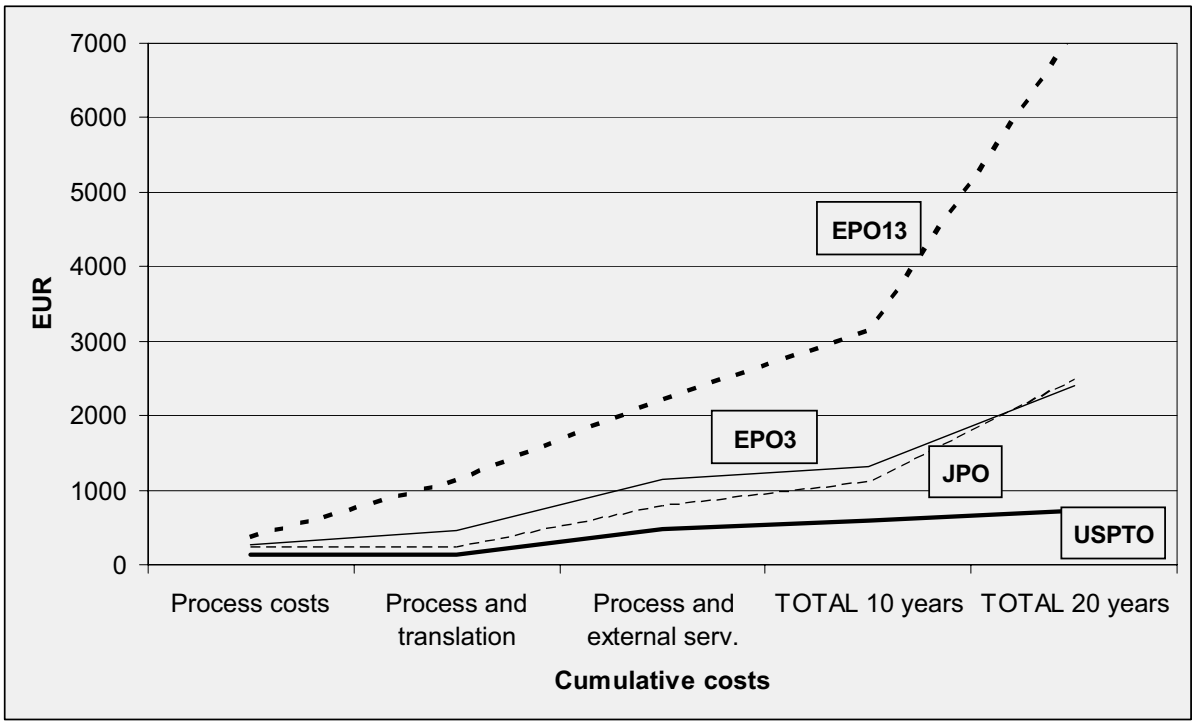
1. RB stand for the Roland Berger (2005) survey sponsored by the EPO.
*. It is assumed a cost of EUR 1,700 for each language. It includes the translation costs and the transaction costs induced by the intermediation of attorneys.
**. The Roland Berger (2005) survey provides a reliable estimate for the cost of patent applications at the EPO. These costs vary according to the number of designated states for protection, the number of claims and the length of protection. We decided to rely on a base of EUR 8,000 and EUR 1,500 per designated states for patents applied at the EPO. The Roland Berger survey shows slightly higher costs as they include national priority applications and PCT fees for PCT applications.
Source: see table 3 and Roland Berger (2005).

Table A.2. Patent costs per claim in the three patent offices, in Euro

	EPO3	**EPO13**	**USPTO**	**JPO**
Process costs	259	365	81	220
Process and translation	448	1121	81	220
Process and external services	1143	2204	429	792
TOTAL 10 years	1308	3126	527	1105
TOTAL 20 years	2402	7177	633	2477

Source: own calculation based on table 3

Chart A.1. Patent costs per claim in the three patent offices, in Euro[1]



1. The x-axis shows the cumulative cost structure. The y-axis shows the cost per claim, expressed in EURO. EPO3 is composed of Germany, France and the UK; EPO13 is composed of the countries that are effectively designated for protection by more than 60 per cent of the patent applications: Germany, Great Britain, France, Italy, Spain, The Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Finland and Ireland.
Source: cf. table 2, table 3 and table A.2 in the appendix, own calculation.