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OECD Patent Statistics Manual

Chapter 8

Indicators of Patent Value

8.1. Introduction

The term "patent value" has several different meanings. It can mean the economic "private" value to the holder, defined as the discounted flows of revenue generated by the patent over its lifetime. It can mean the "social" value of the patent, that is, its contribution to society's stock of technology. The two concepts are closely related, as the revenue generated should be commensurate with the technological contribution, but they are not identical, as part of the social value is not appropriated by the patent holder (there are externalities): the published knowledge for instance can be used by other inventors and/or competitors to improve on the initial invention.

In addition, one should distinguish between the value of the patent itself and the value of the underlying invention. The former comprises only the value added by the fact that the invention is patented – it is the difference between the value of the invention as it is patented and the value it would have had if it had not been patented. The latter refers to the technological content or "quality" of the invention, that is, its contribution to the state of the art. An invention with a significant contribution to the state of the art will affect future technological developments. The two notions differ to the extent that the patent improves the appropriability of the benefits of certain inventions more than others.[1] Yet the capacity of patents to ensure appropriability of the income generated by inventions is known to differ, for instance, across technical fields.

Such considerations show that the value of a patent is a complex notion: it is necessary, however, to take it into account for patent statistics aimed at reflecting technological performance. All studies investigating the value either of patented inventions or of patent protection have shown that their statistical distribution is quite skewed: while some patents have high value, many others have little (*e.g.* they remain unexploited). As a result, patent counts, which give the same weight to all patents, can be misleading: a set of 100 patents can reflect various levels of technological performance depending on its composition in terms of high-value vs. low-value patents. If one has information on the value of patents, there are two ways of dealing with this problem in indicators: one solution is to compile weighted counts, with the value as a weight; the other is to count only patents of sufficient value, ignoring the rest.

One difficulty in estimating the value of a patent is timeliness, *i.e.* the need to have reliable indicators reflecting the economic or technological value

of an invention early enough so that they can be used to assess the recent position of a company or a country (in the patent value landscape). Three main lines of work have been followed by researchers to estimate or infer the private economic value of patents:

- Conducting surveys asking inventors (holders) about the economic value of their patents (*e.g.* Scherer *et al.*, 1999).
- Analysing data from the patenting procedure (*e.g.* grant or refusal of the application, *citations, renewal, g*eographical scope of protection, etc.).
- Estimating value from financial data (*e.g.* market value of companies, the value of initial public offerings, etc.; Hall et *al.*, 2005)

In the first methodology, patent holders or inventors are asked about the monetary value of their patents (the price at which they would be willing to sell the invention, including the revenues that the patent will generate in subsequent years).[2] Studies have shown that the size distribution of private value returns from patents is quite skewed with a peak at zero. A patent can generate economic returns in different ways: exploitation in-house, licensing, "strategic use" (to block others or to exchange technology), etc.

The second approach attempts to cast light on the value of patents by using patent information mainly provided by bibliographic sources (publications, search and examination reports, opposition, etc.) which can be correlated with the value of patents. Some of these indicators rely on the observed behaviour of patent owners in order to estimate the private value of patents (based on the renewal of patents, number of countries in which a patent is filed, decisions to sell [re-assign] patents, etc.). Other indicators that have been consistently found to be good predictors of patent value include forward citations, the number of claims, and patent oppositions or litigation.

The third approach involves the econometric estimation of the contribution of categories of patents or patent portfolios to the economic performance of companies (*e.g.* stock market valuations, spin-offs), after controlling for their stock of R&D and physical capital. For instance, the use of market value (*e.g.* Tobin's *q*)[3] to estimate rents attributed to patents assumes that investors' behaviour can reveal patent value. This research has consistently reported a positive and significant marginal value of patent stocks and their quality (*i.e.* citation-weighted patent stock).

This chapter reports major findings relating to the second approach. It aims at indicating possible avenues for patent statistics that would control for the dispersion of the value of patents and thus gain relevance in economic terms. This area of work is largely still at the research stage, and many of the results reported here are being debated among experts. It is, however, important for the design and interpretation of patent indicators to have value issues in mind.

Using proxies of patent value, patent-based indicators can be compiled which are less affected by the skewed value distribution of patents:

- Weighted counts: weight the count of patents by the number of forward citations, the number of family members, etc.
- Counts of selected patents (dropping lower value patents): triadic families, highly cited patents (top 10% of the distribution), grants (instead of applications), patents renewed until some age (*e.g.* five years); etc.

8.2. Forward citations

The prior art of the invention (patent and erature) cited in patent documents provides useful information about the diffusion of technologies (see Chapter 6 on the use of citations). The number of citations a patent application receives in subsequent patent applications (forward citations) has been found to be strongly associated with the economic value of patents (Scherer *et al.*, 1999) and the social value of inventions (Trajtenberg, 1990). The number of forward citations is one of the most frequently used value indicators.

Two main arguments support the validity of forward citations as indicators of patent value: first, they indicate the existence of downstream research efforts, suggesting that money is being invested in the development of the technology (and there is a potential market); and second, the fact that a given patent has been cited by subsequent patent applications suggests that it has been used by patent examiners to limit the scope of protection claimed by a subsequent patentee, to the benefit of society. In this sense, forward citations indicate both the private and the social value of inventions.

Nevertheless, the main difficulty in computing forward citations is that they appear over time, and sometimes a long while after the cited patent was filed, granted or even reached full term. For the sake of relevance it is important to ensure the timeliness of indicators. One remedy to this problem consists in counting citations received by patent applications within a given time window (*e.g.* within the first five years of publication).

A common approach used to count forward citations is as follows: $CIT_{i,T} = \sum_{t=P_i}^{P_i+T} \sum_{j \in J(t)} C_{j,i}$ where $CIT_{i,T}$ is the number of forward citations received by patent application i published in year P_i within T years from its publication. $C_{j,i}$ is a dummy variable which is equal to 1 if application j is citing application i, and 0 otherwise. $J(t)$ is the set of all applications published in year t. A time window frequently used is five years after publication of the cited patent, as it has been calculated with USPTO patents that more than 50% of the citations received in an entire life of a patent occur within the first five years.[4]

8.3. Indicators based on procedural information and applicants' behaviour

Information on the value of patents can be inferred using data from the patent application process (notably the fate of a patent application: withdrawal, refusal or grant) and applicants' behaviour in terms of the survival span of patents (renewal rates) and the geographical scope of protection (*e.g.* the number of jurisdictions in which patent protection has been sought, the number of international patent families; see Chapter 3).

8.3.1. The fate of the patent application

A first indicator of the quality of an invention is whether a patent is granted or not. A granted patent corresponds to an invention which is officially recognised as fulfilling the patentability criteria: novelty, inventive step (non-obviousness) and industrial applicability. Such patents are of higher technological and economic value than unsuccessful patent applications.[5] Pending applications may have some value on the market as they signal potential rights that may be enforced retroactively once granted. For instance, the European Patent Convention says that a published patent application provisionally confers upon the applicant the same rights in all designated states as that in which the patent was granted.

The USPTO used to publish granted patents only, and all patents used for indicators would then be similar from that perspective. However, as most indicators are now based on applications, not grants, one has to be aware of this source of heterogeneity: some of the applications counted have been/will be granted, others have not/will not be granted. Applications offer a notable benefit in terms of timeliness, as grant or refusal takes place years after the application.

By analysing characteristics of the patent application (*e.g.* type of ownership, number of inventors; domestic and international co-operation, technology class, date of priority or application, etc.) one can identify probabilistically factors underlying the refusal, withdrawal or grant of patent applications (see Guellec and van Pottelsberghe, 2000).[6]

8.3.2. Renewal of patents

Data on the renewal of patents and on family size (commonly defined in the economic literature as the number of countries in which protection has been sought; see Chapter 4 for definitions of patent families) have been widely used to draw inferences on the value of patents. Studies in this field exploit the fact that it is expensive to holders to maintain patent protection for an additional period of time and in additional countries. Hence it is hypothesised that the value of continuing patent protection over time and of expanding it

Table 8.1. **Main indicators of patent value discussed in the literature**

Indicator	Rationale	Main limitations
Granted	Limited legal protection if not granted; check by examiners.	Not very informative (large share: about 60% of patent applications are granted); USPTO: 95% of patents are granted.
Forward citations	Technological importance of inventions; impact on further technology developments.	Timeliness (availability over time), interpretation.
Family size (number of jurisdictions)	Costly to have protection in different jurisdictions; sign of market potential of an invention.	Representativeness issues; large share of patent applications are international.
Number of inventors	Proxy the cost of an invention (cost of research).	Rough measure which treats inventors equally; need for complementary information on the inventors (*e.g.* careers, patenting, etc.).
Renewals	Cost of maintaining a patent; renewal rates allow estimation of the distribution of value.	Timeliness, influence of technology life cycles, renewal rates different across technologies (different value).
Opposition	Market value of a patent. Costs and risks associated with legal disputes.	Timeliness, very small share (about 5% in EPO); how to detect mutual settlements.
Litigation	Costs and risks associated with legal disputes.	Timeliness, very small share, friendly settlements are frequent, data availability.
Firm market value, spin-offs, etc.	Patent value embedded as intangible asset.	Selected type of companies (stock markets, etc.).
Surveyed economic value	Patent value known by inventors or managers.	Subjectivity, selection issues, limited samples.

Source: Modified from Van Zeebroeck (2007).

geographically is associated with the economic importance of the invention. Not surprisingly, the two types of indicators have been found to be highly correlated.

In most patent systems, patent holders must pay a periodic fee in order to keep their patents in force. Typically, the renewal fee increases over time, and, at the end of every period, patent holders must decide whether or not to renew. Failure to do so results in the lapse of the patent, which releases the invention into the public domain. Observations of the proportion of patents that are renewed at different ages, together with the relevant renewal fee schedules, provide information on the distribution of the value of patents and the evolution of this distribution over a patent's lifespan (Griliches, 1990).

The rationale behind this approach is based on economic criteria. Patents are renewed only if the value of keeping the patent alive (based notably on the discounted expected stream of profits) is higher than the cost of renewing the patent: when the renewal fee is not paid, the patent has expected returns (in future periods) which are lower than the threshold. As the fees increase over time in most countries, patentees must consider the profitability of renewing for the following period during the current period (the protection "option";

Lanjouw and Schankerman, 1997) against the costs of maintenance. It is usually difficult for holders to know the expected returns of a patent. Frequently, it takes some time to learn the market potential of inventions as the decision to patent is frequently made at early stages of the innovation process.[7] In Japan and the United States, the renewal fees for the patents granted to universities and small and medium-sized enterprises (SMEs) as well as government entities may be reduced (preferential treatment).

Investigations in this field have confirmed the highly skewed distribution of patent values, with a median far below the mean. According to Pakes and Schankerman (1986), half of the estimated value belongs to about 5% of the entire patent population.[8] In a study of renewal of patents in Finland and Norway, Pakes and Simpson (1989) found that patents in the pharmaceutical sector and the lumber, wood and paper sector had the highest renewal rates, followed by patents for inventions in the machinery sector, the chemical sector, food products and the primary metals sector.

There are a number of limitations to the patent renewal approach. The results of these studies rely on assumptions about the functional form of the relationship and on an unobserved value of the most valuable patents – those which are renewed to full statutory term ("open-ended"). In some cases, the dropping of a patent may not be indicative of low value but of a change in a company's strategy, related for instance to an external shock. In technologies that change rapidly, many inventions are of high value when introduced but become obsolete shortly thereafter. Exogenous factors may also influence the decision to renew patents. For instance, Schankerman (1998) finds evidence of

Table 8.2. **Shares of countries in total patent applications under different indicators (priority date 2000)**

	PCT	Triadic	EPO	PCT most cited
Canada	0.02	0.01	0.01	0.01
France	0.05	0.05	0.06	0.06
Germany	0.13	0.13	0.19	0.17
Japan	0.10	0.31	0.19	0.17
Netherlands	0.03	0.02	0.03	0.03
United Kingdom	0.06	0.03	0.05	0.05
United States	0.40	0.33	0.27	0.31
World	1.00	1.00	1.00	1.00

Note: Criteria for counting are country of residence of inventor(s) and priority date. PCT patent applications at international phase, designating the EPO; EPO are direct EPO filings plus EURO-PCT in regional phase, and triadic patent families are a subset of patents all filed together at the EPO, at the JPO and granted by the USPTO (protecting the same set of inventions; same priority date). PCT most cited are PCT patent applications at the international phase (designating the EPO) which are among the most highly cited (at the top tenth percentile). Data on triadic patent families are mainly derived from PATSTAT.

oil shocks in French patent renewal data.[9] Finally, the time profile of revenues may depend upon the technical field and other characteristics of the invention; inventions are obsolete more rapidly in electronics than in pharmaceuticals.

8.3.3. Patent family size

The value of patents is also associated with the geographical scope of patent protection; that is, with the number of jurisdictions in which a patent grant has been sought (see Chapter 4 for definitions of patent families). The fact of applying for patent protection abroad already constitutes a sign of economic value, as the decision reflects the owner's willingness to bear the costs of international patent protection. The rationale is closely related to the decision to renew a patent; it is costly to make a patent valid in more than one country (as it implies applying for a patent directly or indirectly via regional or international offices) and to maintain the protection (Putnam, 1996).

In contrast with the data on renewal which are available over time (or data on forward citations, see Chapter 6), the number of countries in which protection is sought is available earlier in time (one year priority right according to the Paris Convention). An advantage of this source of information is that it allows the construction of indicators early in the life of a patent application.

The geographical scope of protection, as reflected in international patent grants for a given invention, reflects the *market coverage* of an invention: the higher the number of countries in which protection has been sought, the greater the potential for commercialisation and profit.[10] There is consistent evidence that family size reflects economic value. For instance, Lanjouw and Schankerman (2004) find a strong positive relationship between a quality index of patents and family size (in a sample of US patents). Guellec and van Pottelsberghe de la Potterie (2000) report a positive association between family size and the likelihood that a European patent will be granted. Harhoff *et al.* (2002) provide evidence that patents that are part of large international patent families are more strongly associated with economic value. In the group of pharmaceuticals and chemicals, this indicator carries the highest coefficient of all technology-specific sets of results.

In the European patent system, the list of EPC (European Patent Convention) countries in which protection is sought is provided in the application. The payment of application fees to the EPO depends on this list, although the relationship has become flatter over time. For European and international applications filed on or after 1 July 1999 at the EPO, the designation fees are deemed paid for all contracting states upon payment for at least seven countries. In fact, under the EPC 2000, applications will be deemed to designate all available contracting states through a single flat designation fee (see Box 3.2). From April 2009, European patent applications designate all contracting states as in the PCT procedure.[11]

Box 8.1. **Reforms concerning the designation of states**

When computing indicators on the size of geographical protection based on countries designated in EPO and PCT applications, it is important to know that these indicators will no longer be relevant as indicators of market coverage as procedures at the PCT and EPO have converged towards automatic designation (all contracting states) with a single flat fee. It is important to know when these reforms take place when working with time series of patent data:

Designation in the Patent Cooperation Treaty

For international applications with an international filing date on or after **1 October 1998**: for the first 11 national or regional offices designated there is a designation fee per country or region. There is no additional charge for each designation in excess of 11 offices. From April 2009, European patent applications designate all contracting states as in the PCT procedure.

For international applications with an international filing date on or after **1 January 2004:** the filing of an international application request constitutes the designation of all contracting states that are bound by the Treaty on the international filing date.

Designation at the EPO

Since **1 July 1999** and applicable to European and international applications entering the regional phase (filed on or after this date), each designated contracting state is subject to a designation fee up to seven designated states. There is no additional fee for designation in excess of seven offices.

As of **1 April 2009**: Automatic designation of contracting states under a single fee. A flat fee will be charged regardless of the number of designated contracting states. This decision applies to European patent applications filed on or after 1 April 2009 as well as to international applications entering the regional phase on or after that date.

After it has been granted, the family size of a European patent can be quantified as the number of EPC member states in which the patent was effectively validated. The size of the EPC family can diminish naturally over time as patents are abandoned in different countries, hence the need to observe the geographical scope at different points in time. Information on the renewal and geographical scope of protection can be used to produce more refined indicators that take into account the evolution of protection over time and across countries (as patents may lapse in some countries each year, see Box 8.2).

Box 8.2. **A combined indicator (European protection): the scope year index**

Data on the interaction of the renewal and the geographical scope of protection of a patent can be used to produce a more refined index that takes into account the evolution of geographical protection over time (as patents may lapse in some countries each year). This indicator can reflect both the age reached and the European family size (van Pottelsberghe and van Zeebroeck, 2007):

$$SY_{CT,\,i} = \frac{\sum_{t=1}^{T}\sum_{c=1}^{C} G_i(c,t)}{CxT}$$

where $SY_{CT,i}$ stands for the scope year (SY) index of a given patent *i* over *C* countries and *T* years of maintenance, and *Gi(C,t)* is a variable that takes the value 1 if the granted patent *i* was active in country *c* in year *t* from its filing date, and 0 otherwise. The index is normalised to its maximum value representing *T* years of maintenance in *C* countries. In this way, the indicator sums for each year in a patent life the number of countries in which the patent was active in Europe. To enable the comparability of the indicator over time and to ensure its availability within ten years from the date of filing, the indicator proposed by the authors was based on ten countries over ten years. This makes it possible to overcome the institutional bias to family size (the institutional expansion of the EPC, from ten countries in 1977 to 32 in 2007).

Extensions of this indicator can consider weighing validation in jurisdiction by their economic importance, for instance, by the magnitude of their GDP. As such, the SY index score of non-granted applications is necessarily zero, since patents can be validated in EPC members only once they have been granted by the EPO. A provisional version of the SY index has been proposed, which takes into account the duration of the grant procedure (the number of years during which the application has been maintained). See van Pottelsberghe de la Potterie and van Zeebroeck (2007) for further details about this formulation.

8.4. Other indicators

8.4.1. The number of claims

The scope of a patent is an important determinant of its economic value, as it defines the legal dimensions of protection and thereby the extent of market power attributed to the patent. A broader scope refers to a broader area of technology from which others are excluded.

However, the "scope" or "breadth" of a patent is difficult to measure. The scope is reflected in its claims but also in conjunction with the backward

patent citations which define the patent's legal boundaries with respect to the prior art.[12] A number of economists have used the *number of claims* to proxy the legal scope of patents. It has been argued that, as each individual patent represents a bundle of inventive components, each reflected in a claim, the number of claims can be indicative of the value of the entire patent. Nevertheless, the tendency of certain applicants to "inflate" the number of claims for strategic purposes makes the relationship between scope and number of claims quite noisy. In addition, the claims that appear in granted patents are those that are included following the examination.

Empirical analysis on this matter is scarce but quite positive. In their factor model of patent quality used to analyse research productivity in the United States, Lanjouw and Schankerman (2004) found that the number of claims was the most important indicator of the quality of patents in six out of seven technological fields studied. It has also been found that the likelihood of a patent being litigated, which reflects its scope, increases with its number of claims (Lanjouw and Schankerman, 1997).

8.4.2. *The number of technical classes*

The number of technical classes (as indicated by the number of IPC classes) attributed to a patent application has also been used as a proxy for the scope, and hence the value, of a patent. This approach was proposed by Lerner (1994) in a study of the market value of biotechnology patents as a measure of the value of a patent portfolio. He finds a positive and sizeable correlation between the firm's market value and the average scope of its patents.

However, there is limited evidence of a correlation between the number of classes and the value of a patent. Lanjouw and Schankerman (1997) find that the number of IPC classifications has a small positive effect on the probability of infringement litigation relating to US patents. Using information from a survey on the perceived economic value of patents by German inventors, Harhoff *et al.* (2002) did not find the number of four-digit IPC classes informative of the patent value in any of the technology fields analysed.[13]

8.4.3. *The number of inventors in a patent*

Several economic studies have associated the number of inventors listed in a patent with the economical and technological value of patents. The number of inventors may proxy the cost of the research behind the invention, which itself is statistically related to the technical value of the invention: the more resources involved, the more research-intensive and expensive the project (Guellec and van Pottelsberghe, 2001; Gambardella *et al.*, 2005).

8.4.4. *Opposition and litigation*

Certain patent offices offer the possibility for third parties to oppose granted patents that they deem invalid. As opposing a patent is a costly move, it can be inferred that only patents with some damaging effects on competition, and thus some economic value, will be opposed. Hence the fact that a patent is opposed can be interpreted as a signal of value. Further, patents that survive such opposition are proven to be strong patents that offer their holders the prospect of high profitability.

Few patents are opposed. In 2006, the opposition rate at the EPO was around 5.4% (oppositions were filed against 2 990 patents). Of the patents opposed at the EPO, roughly one-third are revoked, one-third are maintained unchanged, and one-third are maintained amended. At the USPTO, interested parties wishing to challenge a US patent after it has been issued have two options: *i*) challenge the patent in federal court; or *ii*) request a "re-examination" of the patent by the USPTO. The opposition rate at the EPO is much higher than the re-examination rate at the USPTO for all technology classes (Merges, 1999; Graham *et al.*, 2002). The rate of re-examination at the USPTO between 1981 and 1998 was 0.3% (of grants), whereas at the EPO, the average opposition rate for the same period was 8.6% of grants. However, in absolute terms, patent litigation grew significantly in the United States from 1985 to 2000, although the rate of litigation relative to the number of issued patents has remained constant (Graham *et al.*, 2002).

Some authors have found that opposed and litigated patents are of higher than average value. Harhoff *et al.* (2002) find that successful defence against opposition (in the German patent system) is a particularly strong predictor of patent value.[14] They explain that stronger patent rights survive what amounts to a two-tier selection process (grant and survival of opposition), which provides a highly reliable indicator of their quality. According to Lanjouw and Schankerman (1998), patents that are litigated have particular characteristics. Compared to a random sample of US patents from the same cohorts and technology areas, the authors find that more valuable patents and those with domestic owners are considerably more likely to be involved in litigation. Patents owned by individuals are at least as likely to be the subject of a case as corporate patents and litigation is particularly frequent in new technology areas.

Notes

1. Inventions with high technical value might be widely appropriable (*e.g.* because a patent is easy to circumvent in the invention's particular field of technology). Inventions with small technical value may generate high economic value, *e.g.* if the inventor, for various reasons, already has a monopoly position on the market.

2. The merit of this approach is to gather information directly from the source. However, it may be subject to bias, as the inventor or the patent owner might not have, or might not be willing to provide, accurate information.

3. Tobin's *q* is defined as the ratio of the market value of a firm's assets to the replacement cost of the firm, which is typically measured as the replacement value of firm's physical assets.

4. Lanjouw and Schankerman (1998) suggest that limiting the time period subsequent to a patent's issuance to five years is sufficient to construct meaningful measures of a patent's "importance" based on "forward" citations.

5. However, the grant is not always a good indicator. For instance, a better knowledge of the European system can lead to higher grant rates for EP countries than for US applicants at the EPO (Hinze and Schmoch, 2004).

6. Some studies (*e.g.* Reitzig, 2004; Burke and Reitzig, 2007) suggest that a "request for accelerated examination" at the EPO (similar procedures exist at the JPO and USPTO) may signal high-value inventions for which the owner wants protection as soon as possible.

7. Few patents are renewed through the end of their term. For instance, Pakes and Schankerman (1986) found that only 10% of all patents survive the entire renewal period. According to Lemley (2001), using renewal data for United States patents in 1998, nearly two-thirds of all issued US patents lapse before the end of their term owing to failure to pay renewal fees, and nearly half of all patents are abandoned before their potential lifespan is half over.

8. Pakes (1986) explained that the stream of revenues behaves differently along the cycle of patent protection and that the earlier years of the patent are frequently characterised by a high level of economic uncertainty. As learning about the profitability of the invention increases, the uncertainty gradually fades as patents reach an age threshold of four to five years (Pakes, 1986; Lanjouw, 1998).

9. In the pharmaceutical industry, institutional factors such as long regulatory delays between drugs development and their introduction on the market may make renewal rates intrinsically higher than in other industries.

10. Measures of family size (or number of inventors) depend on the country of origin, *e.g.* the family size of European countries is always higher than that of Japanese applicants (due to the high number of neighbouring European countries).

11. Applying through the PCT may already be seen as an indicator of inventions with higher market expectations. This indicator can be broken down into PCT I and PCT II. Further insight can be obtained by looking at the time elapsed between two stages, *i.e.* if the period of time between filing date and entry into the regional phase is 20 months or less (PCT I) or exceeds 20 months (PCT II). One argument would be that the greater the applicant's willingness to pay for the delay of cost-intensive decisions during the application, the higher the applicant's uncertainty about the patent's commercial value (see Burke and Reitzig, 2007).

12. As evidenced in interviews with patent lawyers and examiners, a patent application seeking to protect an invention with broad scope might induce the examiner to delineate the patent claims by inserting more references to the relevant patent literature. Such backward citations reflect the scope of a patent as well as the existence of subject matter that may restrict its scope (Harhoff *et al.*, 2002).

13. The authors explained that the difference in results may be due to the use of patents that cover a broad set of technical areas, while Lerner's study focuses only

on biotechnology patents. They also pointed out that there may also be important differences in the way the German and the US patent offices assign the IPC classification.

14. They find that a patent which has defeated opposition in Germany (*"Einspruchsverfahren"*) is considerably more valuable – as measured by the monetary value of inventions estimated by inventors (by a factor of 11.2) – than a patent that was never attacked. Further, if the patent has been under attack in the more expensive annulment procedure, its value is again much higher than the value of unchallenged patent rights, in this case by a factor of 42.6.

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Acronyms

AFA	Activity of Foreign Affiliates Database
ARIPO	African Regional Intellectual Property Organization
BEA	Bureau of Economic Analysis (United States)
CAFC	Court of Appeals of the Federal Circuit (United States)
CIP	Continuation-in-Part
CIPO	Canadian Intellectual Property Office
DPMA	Deutsches Patent- und Markenamt (Germany)
ECLA	European Classification System
EPC	European Patent Convention
EPLA	European Patent Litigation Agreement
EPO	European Patent Office
EU	European Union
FhG-ISI	Fraunhofer Institute for Systems and Innovation Research
GATT	General Agreement on Trade and Tariffs
ICT	Information and communication technologies
IIP	Institute of Intellectual Property (Japan)
INID	Internationally agreed numbers for the identification of bibliographic data
INPI	Institut National de la Propriété Intellectuelle (France)
IPC	International Patent Classification
IPRP	International preliminary report on patentability
ISA	International search authorities
ISIC	International Standard Industrial Classification
ISR	International search report
NACE	Classification of Economic Activities in the European Community
NAICS	North American Industry Classification System
NBER	National Bureau of Economic Research (United States)
NISTEP	National Institute of Science and Technology Policy (Japan)
NSF	National Science Foundation (United States)
NUTS	Nomenclature of territorial units for statistics (*Nomenclature des unités territoriales statistiques*)
OECD	Organisation for Economic Co-operation and Development
OST	Observatoire des Sciences et des Techniques (France)

PATSTAT	Worldwide Statistical Patent Database (EPO)
PCT	Patent Co-operation Treaty
SIC	Standard Industrial Classification
SIPO	State Intellectual Property Office of the People's Republic of China
SMEs	Small and medium-sized enterprises
STAN	Structural Analysis Database
TL	Territorial level
TRIPS	Trade-related intellectual property rights
USPC	United States Patent Classification System
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organization
WOISA	Written opinion of the international search authorities
WTO	World Trade Organization

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Glossary

Appeal: A procedure by which the applicant or patent holder can request reversal of a decision taken by the patent office.

- *USPTO:* An applicant for a patent dissatisfied with the primary examiner's decision in the second rejection of his or her claims may appeal to the Board of Patent Appeals and Interferences (BPAI) for review of the examiner's rejection. The Board is a body of the USPTO which reviews adverse decisions of examiners in patent applications and determines priority and patentability of invention in interferences. Decisions of the Board can be further appealed to the *Court of Appeals for the Federal Circuit* (CAFC) or to a district court.
- *EPO:* Decisions of the first instances of the EPO can be *appealed* before the Boards of Appeal of the EPO, in a *judicial* procedure (proper to an administrative court), as opposed to an *administrative* procedure. These boards act as the final instances in the *granting* and *opposition* procedures before the EPO. In addition to the Boards of Appeal, the European Patent Office has an Enlarged Board of Appeal. This instance takes decisions only when the *case law* of the Boards of Appeal becomes inconsistent or when an important point of law arises.
- *JPO:* An applicant who receives a rejection can appeal. The panels consist of three or five trial examiners in the Appeals Department of the JPO. Decisions of the panels can be further appealed to the Intellectual Property High Court, a special branch within the Tokyo High Court.

Applicant: The holder of the legal rights and obligations on a patent application. It is most often a company, a university or an individual.

Application date: The date on which the patent office received the completed patent application. A unique number is assigned to a patent application when it is filed.

Assignee: In the United States, the person(s) or corporate body to whom all or limited rights under a patent are legally transferred by the inventor (equivalent to "applicant" in this context).

Citations: References to the prior art in patent documents. Citations may be made by the examiner or the applicant. They comprise a list of references which are believed to be relevant prior art and which may have contributed to defining the scope of the claims of the application. References can be made to

other patents, to technical journals, textbooks, handbooks and other sources. *USPTO:* Applicants before the USPTO are required to disclose prior art known to them that is material to patentability; *EPO:* No such obligation for the applicant; *JPO:* The requirement for disclosure of information on prior art documents was introduced as of 1 September 2002 and entered into full force on 1 May 2006.

Claim(s): Definition of the scope of the invention and the aspects of the invention for which legal protection is sought.

Continuation(s) *(USPTO)***:** Second or subsequent applications for the same invention claimed in a prior non-provisional application and filed before the first application is abandoned or patented. Continuations must claim the same invention as the original application to gain the benefit of the parent filing date. At the time of filing the claims are often the same but the claims may change during prosecution so that they are not exactly the same but not patentably distinct. There are three types of continuing applications: division, continuation and continuation-in-part.

Designated countries: In international and regional patent systems, countries in which patent applicants wish to protect their invention if/when the patent is granted. International application filing automatically includes the designation for all PCT contracting countries that are bound by the PCT on the international filing date (since 2004). A similar rule will apply to the EPO from April 2009, as European patent applications designate all contracting states as in the PCT procedure.

Direct European route (application): A patent application filed under Article 75 EPC (also known as an "Euro-Direct application"). With the direct European route, the entire European patent grant procedure is governed by the EPC alone while with the Euro-PCT route, the first phase of the grant procedure (the international phase), is subject to the PCT.

Division: If the patent office decides that an application covers too broad an area to be considered as a single patent, the application is split into one or more divisional applications, which may or may not be pursued by the applicant. A division can also be requested at the initiative of the applicant.

Equivalent: A patent that protects the same invention and shares the same priority application as a patent from a different issuing authority.

Euro-PCT route: A way to obtain a European patent by designating the EPO in a PCT application (Article 11 PCT). The first phase of the grant procedure (the international phase) is subject to the PCT, while the regional phase before the EPO as designated or elected office is governed primarily by the EPC.

- **Euro-PCT application** – international phase (or Euro-PCT application or PCT international): A PCT application designating the EPO [Article 150(3) EPC]. With

the Euro-PCT route, the first phase of the grant procedure (international phase) is subject to the PCT, while the regional phase before the EPO as designated or elected office is governed primarily by the EPC.

- **Euro-PCT application – regional phase (or PCT regional):** PCT application entering the European (or regional) phase once the applicant has fulfilled the conditions under Article 22 or 39 PCT, Article 158 and Rule 107 EPC.

Euro-PCT search (or PCT Chapter I): Search carried out by the EPO acting as International Searching Authority for a Euro-PCT application in the international phase (Article 16 PCT).

European patent: A European patent can be obtained for all EPC countries by filing a single application at the EPO in one of the three official languages (English, French or German). European patents granted by the EPO have the same legal rights and are subject to the same conditions as national patents (granted by the national patent office). It is important to note that a granted European patent is a "bundle" of national patents, which must be validated at the national patent office in order to be effective in member countries. The validation process may include submission of a translation of the specification, payment of fees and other formalities of the national patent office (once a European patent is granted, competence is transferred to the national patent offices).

European Patent Convention (EPC): The Convention on the Grant of European Patents was signed in Munich in 1973 and entered into force in 1977. It is a multilateral treaty instituting the European Patent Organisation and providing an autonomous legal system according to which European patents are granted. The EPC provides a legal framework for the granting of European patents, via a single, harmonised procedure before the European Patent Office. It enables the patent applicant, by means of a single procedure, to obtain a patent in some or all of the contracting states. As of January 2008 there are 34 EPC member countries. In addition, extension agreements exist with five countries, offering the possibility to extend European patents to those countries upon request. EPC member countries are Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, the Netherlands, Norway, Poland, Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom. EPC extension countries are Albania, Bosnia and Herzegovina, Croatia, Former Yugoslav Republic of Macedonia, and Serbia.

European Patent Office (EPO): The European Patent Office (a regional patent office) was created by the EPC to grant European patents, based on a centralised examination procedure. By filing a single European patent application in one of the three official languages (English, French or German), it is possible to

obtain patent rights in all EPC member and extension countries. The EPO is not an institution of the European Union.

Family: a set of patents (or applications) filed in several countries to protect the same invention. They are related to each other by one or several common priority numbers. There are different definitions of patent families (*e.g.* triadic patent families, extended families including continuations, etc.). Depending on the use sought, a different family concept can be chosen, *e.g.* equivalents, triadic family or trilateral family.

First to file: A patent system in which the first inventor to file a patent application for a specific invention is entitled to the patent. This law is increasingly becoming the standard for countries adhering to the Trade-related Aspects of Intellectual Property (TRIPs) guidelines. In the EPO and the JPO, patents are awarded on a first-to-file basis, whereas in the USPTO the patent is awarded on the first to invent basis.

First to invent *(USPTO)***:** A system in which a patent is awarded to the first person who made the invention, even if another person filed for a patent before the person who invented first.

Grant: A patent application does not automatically give the applicant a temporary right against infringement. A patent has to be granted for it to be effective and enforceable against infringement.

Grant date: The date when the patent office issues a patent to the applicant.

Infringement: Unauthorised making, using, offering for sale or selling any patented invention in the country in which the patent is enforceable or importing that invention into said country during the term of the patent.

Intellectual property rights (IPR): The exclusive legal rights associated with creative work, commercial symbols or inventions. There are four main types of intellectual property: patents, trademarks, design and copyrights.

International patent application: See "PCT application". A patent application filed under the Patent Cooperation Treaty (PCT) is commonly referred to as an "international patent application". However, international patent (PCT) applications do not result in the issuance of "international patents" (*i.e.* at present, there is no global patent system that issues and enforces international patents). The decision of whether to grant or reject a patent filed under PCT rests with the national or regional (*e.g.* EPO) patent offices.

International Patent Classification (IPC): The IPC is based on an international multilateral treaty administered by WIPO. The IPC is an internationally recognised patent classification system, which provides a common classification for patents according to technology groups. The IPC is a hierarchical system in which the whole area of technology is divided into eight sections broken down into classes, subclasses and groups. IPC is periodically revised in order to

improve the system and to take account of technical development. The eighth edition of the IPC entered into force on 1 January 2006.

International Searching Authority (ISA): An office with competence to carry out the international search for a PCT application. It may be either a national office (Australia, Austria, Canada, China, Finland, Japan, Korea, the Russian Federation, Spain, Sweden, the United States) or an intergovernmental organisation (EPO), (Article 16 PCT, Article 154 EPC).

Inventive step: At the EPO and JPO, an invention is considered to include an inventive step if it is not obvious to a person skilled in the art. Inventive step is one of the criteria (along notably with novelty and industrial applicability) that need to be fulfilled in order to obtain a patent. See also "non-obviousness"*(USPTO)*.

Inventor country: Country of residence of the inventor.

Japan Patent Office (JPO): The JPO administers the examination and granting of patent rights in Japan. The JPO is an agency of the Ministry of Economy, Trade and Industry (METI).

Lapse: The date when a patent is no longer valid in a country or system owing to failure to pay renewal (maintenance) fees. Often the patent can be reinstated within a limited period.

Licence: The means by which the owner of a patent gives permission to another party to carry out an action which, without such permission, would infringe the patent. A licence can thus allow another party to legitimately manufacture, use or sell an invention protected by a patent. In return, the patent owner will usually receive royalty payments. A licence, which can be exclusive or non-exclusive, does not transfer the ownership of the invention to the licensee.

National application: A patent application that is filed at a national patent office according to a national procedure.

Novelty: An invention cannot be patented if certain disclosures of the invention have been made.

Non-obviousness *(USPTO)***:** Something is obvious if the differences between the subject matter to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person with ordinary skills in the art to which said subject matter pertains. See also "inventive step"*(EPO, JPO)*.

Opposition: This is a procedure usually before the issuing patent office, initiated by third parties to invalidate a patent:

- *EPO:* Opposition to the grant of a European patent can be filed within nine months of the mention of the grant in the European Patent Bulletin.

- *JPO:* Opposition to a grant could be filed within six months of the issue of the grant before the reform of appeals for invalidation was introduced in January 2004.

Paris Convention: The Paris Convention for the Protection of Industrial Property was established in 1883 and is generally referred to the Paris Convention. It established the system of priority rights, under which applicants have up to 12 months from first filing their patent application (usually in their own country) in which to make further subsequent applications in each signatory country and claim the original priority date. There are 172 countries party to the treaty (March 2008).

Patent: A patent is an intellectual property right issued by authorised bodies which gives its owner the legal right to prevent others from using, manufacturing, selling, importing, etc., in the country or countries concerned, for up to 20 years from the filing date. Patents are granted to firms, individuals or other entities as long as the invention satisfies the conditions for patentability: novelty, non-obviousness and industrial applicability. A patent is known as a utility patent in the United States.

Patent Cooperation Treaty (PCT): As of March 2008, there were 138 countries party to the treaty, which was signed in 1970 and entered into force in 1978, enabling a patent applicant, by means of a single procedure, to obtain a patent in some or all of the contracting states. The PCT provides the possibility to seek patent rights in a large number of countries by filing a single international application (PCT application) with a single patent office (receiving office). PCT applications do not result in the issuance of "international patents". The decision on whether to grant or reject patent rights rests with national or regional patent offices. The PCT procedure consists of two main phases: *i*) an "international phase"; and *ii*) a PCT "national/regional phase". PCT applications are administered by the World Intellectual Property Organization (WIPO).

PCT international search: A search carried out by a designated office (international searching authority) for PCT applications.

Pending application: An application has been made at the patent office, but no decision has been taken on whether to grant or reject the patent application

Prior art: Previously used or published technology that may be referred to in a patent application or examination report. In a broad sense, this is technology that is relevant to an invention and was publicly available (*e.g.* described in a publication or offered for sale) at the time an invention was made, In a narrow sense, it is any technology that would invalidate a patent or limit its scope. The process of prosecuting a patent or interpreting its claims largely consists of identifying relevant prior art and distinguishing the claimed invention from that prior art. The objective of the search process is to identify patent and non-

patent documents constituting the relevant prior art in order to determine whether the invention is novel and includes an inventive step.

Priority country: Country where the patent is first filed worldwide before being extended to other countries. See "Paris Convention".

Priority date: The priority date is the first date of filing of a patent application, anywhere in the world (usually in the applicant's domestic patent office), to protect an invention. The priority date is used to determine the novelty of the invention, which implies that it is an important concept in patent procedures. Among procedural data, priority date can be considered as the closest date to the date of invention. In the United States the date of conception comes into play during interferences.

Priority rights: see "Paris Convention".

Processing time: Duration of a process in the patent procedure (*e.g.* search, examination, grant, and possible opposition and appeal).

Publication: In most countries, a patent application is published 18 months after the priority date:

- *EPO:* All patent applications are published in this manner, whether the patents have been granted or not.
- *JPO:* Patent applications that are no longer pending in the JPO, *e.g.* granted, withdrawn, waived or rejected, are not published. While official patent gazettes are only published in Japanese, the abstracts and bibliographic data of most of the unexamined patent applications are translated into English, and are published as the Patent Abstracts of Japan (PAJ).
- *USPTO:* Prior to a change in rules under the American Inventors Protection Act of 1999, USPTO patent applications were held in confidence until a patent was granted. Patent applications filed at the USPTO on or after 29 November 2000 are required to be published 18 months after the priority date. However, there are certain exceptions for the publication of pending patents. For example, an applicant can ask (upon filing) for the patent not to be published by certifying that the invention disclosed in the application has not and will not be the subject of an application filed in another country. Also, if the patent is no longer pending or subject to a secrecy order, then the application will not be published.

Renewal fees: Once a patent is granted, annual renewal fees are payable to patent offices to keep the patent in force. In the USPTO they are referred to as "maintenance fees". In most offices, renewal fees are due every year. USPTO-granted (utility) patents are subjected to maintenance fees which are due three-and-a-half years, seven-and-a-half years, and eleven-and-a-half years from the date of the original patent grant.

Request for examination: Patent applications filed at the EPO and JPO do not automatically enter the examination process. The applicant has to submit a request for examination within six months of the transmission of the search report at the EPO, and within three years of filing at the JPO. Patent applications filed at the USPTO are automatically examined by a patent examiner without the need for a separate request by the applicant.

Revocation: A patent is revoked if after it has been granted by the patent office, it is deemed invalid by a higher authority (appeal body within the patent office or a court).

Search report: The search report is a list of citations of all published prior art documents which are relevant to the patent application. The search process, conducted by a patent examiner, seeks to identify patent and non-patent documents constituting the relevant prior art to be taken into account in determining whether the invention is novel and includes an inventive step.

Triadic patent families: The triadic patent families are defined at the OECD as a set of patents taken at the European Patent Office (EPO) and the Japan Patent Office (JPO) and granted by the US Patent and Trademark Office (USPTO) which share one or more priorities. Triadic patent families are consolidated to eliminate double counting of patents filed at different offices (*i.e.* regrouping all the interrelated priorities in EPO, JPO and USPTO patent documents).

Trilateral patent families: A trilateral patent family is part of a filtered subset of patent families for which there is evidence of patenting activity in all trilateral blocs. It is then similar to a triadic family, except that it would also include applications filed in any EPC state that do not go to the EPO (in addition to going to the JPO and USPTO). Trilateral patent families are usually counted in terms of individual priorities, without consolidation.

United States Patent and Trademark Office (USPTO): The USPTO administers the examination and granting of patent rights in the United States. It falls under the jurisdiction of the US Department of Commerce.

Utility model: This type of patent, also known as a "petty patent", is available in some countries. It usually involves less stringent patentability requirements than a traditional patent, it is cheaper to obtain and it is valid for a shorter time period.

Withdrawal: Under the European Patent Convention, the applicant can withdraw an application at any stage of the procedure either by informing the office or by abstaining from one or more of the following: pay fees in due time, file a request for examination within the given time period, or reply in due time to any communication within the examination procedure.

World Intellectual Property Organization (WIPO): An intergovernmental organisation responsible for the administration of various multilateral treaties dealing with the legal and administrative aspects of intellectual property. In the patent area, the WIPO is notably in charge of administering the Paris Convention, the Patent Cooperation Treaty (PCT) and the International Patent Classification system (IPC).

Table of Contents

List of Boxes

List of Tables

List of Figures