

# 1. Introduction

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In searching for means of comparing one country's technological performance with another's, it is only to be expected that scholars would want to use patent counts. Patents exist in every country of any size, are well tabulated, are easily accessible and go back to the beginning of the industrial revolution. Indeed, there have been many studies which purport to use them in this way, as well as many others which are little more than vehicles for demonstrating econometric skills, making use of the large numbers which libraries of patents can provide.

However, when such collections of data are examined carefully, they are found to be less valuable than appears at first, and their use has drawbacks which have not always been properly recognised by researchers.<sup>1</sup> There are several reasons for this.

First patents only protect a small part of technology. Moreover, in many areas of it, they have now become little more than a reinforcement of large firms' primary means of protecting their inventions, which is the combination of manufacturing capability and speed to the market with anything new. This has been confirmed by several large-scale empirical studies of the actual mechanisms used by firms to protect the output of their investments in research and development.<sup>2</sup>

Even where patents are used, some technologies use them more than others. For example, out of a total of more than 2.3 million Utility patents issued by the United States Patent and Trademark Office to the end of 2001, 44 per cent were in the Mechanical classes, 27 per cent in the Electrical and 29 per cent in Chemical classes. In recent decades Chemical patents have become more numerous than they were in earlier periods. This could be because the modern patent system's criteria were established in the US 1952 Act, which was effectively written by lawyers for the pharmaceutical industry.<sup>3</sup> These criteria were then copied throughout the world. Invention in chemical firms may be especially market-driven, with researchers working towards technical targets which can be specified rather precisely by their managements. This could be reinforced still further by having developed a particularly precise vocabulary, thus making the results amenable to patenting. Other fields of technology, such as mechanical engineering and electronics, may not have similarly precise language, making it more difficult for inventions in them to be described so as

to 'precisely define the limits' of what is claimed as an invention, as the law requires.

Thirdly, patent *numbers* on their own mean little as indicators of patent *value*. The vast majority of issued patents are worthless, yet a tiny number of those that are valuable are extremely so. In countries where renewal fees have to be paid annually to keep patents in force, data on payment of these fees can be used as a means of measuring value very roughly. This depends on the reasonable assumption that if a renewal fee is *not* paid, the present value of the patent is considered by its owner to be less than the fee. Since, although fees do increase progressively, their cost even in the later years of a patent's life is not very great, this assumption may be taken to mean that owners have effectively written off their patents as worthless at the point where they abandon payment of renewal fees.

Unfortunately, the converse is not the case. Payment of a renewal fee may not necessarily represent an objective assessment, but may reflect undue optimism about the patent's future value on the part of its owner, which is most likely to be found in the cases of Individual or Small Firm patents. There must also be a bias *in favour* of payment of fees on portfolios of patents in large firms. Firstly, in such firms renewal payments may be routine, without any significant evaluation of the patent's present value. Secondly, the employed managers of patent departments will not be penalised for keeping worthless patents in force, but will certainly be blamed severely if they fail to renew a patent which the firm finds later on that it could have used to advantage. In these cases the risk to an individual career is perceived as a greater threat than the expenditure on maintenance.

In spite of these drawbacks, focusing attention on patents which have their renewal fees paid for the maximum possible number of years at least eliminates large numbers of valueless patents from consideration. It can fairly be assumed that all the most valuable patents will be found in this residual number. Among the studies which have used this technique are Schankerman,<sup>4</sup> Lanjouw, Pakes and Putnam,<sup>5</sup> and Scherer and Harhoff.<sup>6</sup> All of these writers found the distribution of patent value highly skewed, although their estimates of values varied widely.

## INTERNATIONAL COMPARISONS

When attempting to make international comparisons, a serious problem is that patents do not mean the same thing everywhere, in terms of the protection they purport to give. As a matter of policy, the protection provided by Japanese patents has until recently been narrower than that of US and European patents. Even within the range of the European patent itself, because the scope of the

protection is adjudicated by national courts, a patent can mean quite different things in two member countries of the European Patent Convention.<sup>7</sup>

These differences are compounded by variations in the nature and quality of the examination which has led to the issuance of any particular patent. Until comparatively recently, for example, Belgian patents were not examined for anything other than conformity with formal requirements, all questions such as those of novelty or non-obviousness being left to the Courts to decide. At the other end of the scale, the examination standards of the German Office have traditionally been considered to be the highest of any of the National Offices. Standards may also change over time: for example, it is now widely held by practitioners in the United States that the great increase in patenting in recent years has been accompanied by lower patent quality, attributed to the difficulty of recruiting enough qualified examiners.

Indeed, it may well be that a simple measure of the value of any single patent cannot be achieved. Some research has attempted to establish a commercial value for patents by examining how inventors have benefited in direct financial ways through licensing their inventions to third parties or by exploiting the invention themselves. Other writers have pointed to the 'value' of patents as tactical or strategic ammunition, when used aggressively or defensively by larger firms. A startup firm seeking investment may use patents as a means of reassuring a venture capitalist or 'angel'. Even for an individual inventor, possession of a single patent in a particular field of expertise may provide additional credibility when seeking employment or consultancy work. Prospective employers are no better equipped than academics to measure the 'real' value of any patent.

In discussing patent values, account must also be taken of the way in which the recent explosion of interest in intellectual property rights has led to the use of patents strategically to *prevent* competitors putting products on the market that may not conform to the degree of closeness of substitution that the system allows. Competitors can be intimidated by implied threats to cause them large delays and costs in litigation. At the limit, such policies cause firms to avoid innovation altogether, because if they innovate, they can be sued for infringement by predators whose primary motive in obtaining patents is extortion, not innovation.<sup>8</sup>

It is clear that the various notions of patent value must be underpinned by some ultimate expectation, on the part of the patent holder, of future economic gain. The difficulty that writers have found in putting a precise measure on this value may be compared to the difficulties facing the accountancy profession in measuring 'goodwill' in the context of corporate investment. Nevertheless, even if arriving at an absolute measure is likely to prove difficult or impossible in individual cases, broad comparisons between groups of patents can be made if certain conditions apply.

## USE OF THE 'SMALL ENTITY' DATA

The database which the present book reveals and discusses meets these conditions. Consequently, it offers a means of throwing light on the ways in which countries differ in terms of their technological capability. It is a subset of the main database of the United States Patent and Trademark Office (USPTO) limited to patents whose applicants took advantage of a privilege which that Office offers to 'Small Entities': individuals, not for profit organisations, and small businesses. This privilege is a 50 per cent discount on the majority of fees.<sup>9</sup> The database contains all Small Entity patents issued from 1994 to 2003 inclusive,<sup>10</sup> matched with their full bibliographic data from the main US Patent database.<sup>11</sup>

## DEFINITIONS

The USPTO's Manual of Patent Examining Procedure, Section 1.27 (see Appendix A) provides definitions of these three types of 'Small Entity'. Individuals are self-defining, but 'Nonprofits' are not, so that a full discussion of their definition will be found at the beginning of Chapter 3, which is devoted to them. As for small businesses, to qualify under the Small Business Act, the general rule is that such a concern may not employ more than 500 staff. A firm of that size would be a substantial enterprise in most countries other than the US (the equivalent Canadian Small Entity regulation applies to firms with less than 50 staff).<sup>12</sup>

The USPTO's 500-employee limit for qualification of businesses as 'small' does at least serve to distinguish such firms from very large, multinational concerns. The remission of fees is not available to an entity which would normally qualify under the regulations if it has established a contractual relationship concerning the patent with an entity not entitled to the reduction in fees. Since the penalty for wrongfully claiming the fee remission includes a complete voiding of the patent, such 'fraud on the Office' is clearly a risk not worth taking.

As a member of the Paris Convention for the Protection of Industrial Property, the United States is bound to treat patent applications from citizens of other member countries of this Convention as if they were from its own citizens: consequently, such applications, too, are entitled to claim Small Entity status if they qualify. Considerable numbers of applicants from abroad take advantage of this, so that their records in the USPTO provide a unique opportunity of making international comparisons which do not have the disadvantages touched upon in the discussion above.

Although almost all of the research and development which leads to patents

today is carried out by firms, for Constitutional reasons, United States patents cannot be granted to these, but only to individuals. This makes no practical difference, since if the inventor is under a contract of employment, he will be bound to assign any patents granted to him to his employer firm. Each patent document records the names of all the individual inventors and their place of residence as well the name of the assignee, if any. In this database, the residence of the first named (or leading) inventor is designated as the patent 'source'. This is the practice followed by the USPTO when providing its own analyses of patent numbers by country of origin.

The boundary between patents belonging to individual inventors and those of small firms is inevitably fluid. All really small firms depend very largely on the entrepreneurial energy of a single individual, who may also be the firm's founder. But in terms of patent ownership, what may be called the 'exploiting entity' may appear as either that individual or his firm. In some cases, for taxation or other reasons, it may appear advantageous to such a person to have ownership of any patents kept outside the firm, in others they may be 'assigned' to the firm, and there does not seem to be any way of making useful and consistent distinctions.

## ADVANTAGES OF THE DATABASE

Use of this database allows valid and valuable comparisons between the levels of inventive activity in different countries for several reasons.

Since large multinational firms are excluded from the data both directly and indirectly, it is a reasonable assumption that organisations which avail of this remission in USPTO fees, the Small Entity patents, are more likely to represent the 'home grown' proportion of any country's 'patent-using' innovative activity, including technology startup firms.

Secondly, all of the patents in the database have been through the same examining procedure, so that to this extent, like is genuinely being compared with like.

Thirdly, at least subjectively, these patents relate to those inventions, from any country, which hold out the best prospect of being valuable. Applicants are more likely to consider that they need protection in the US for their better inventions, and also the cost of patenting in that country will deter them from making applications for their less important ones.

Fourthly, the coverage of the database can be expected to be particularly high for the inventions from the Nonprofit group – research institutes, universities, hospitals and the like. This is because any research carried on in these entities should be of global, rather than of local, significance. Consequently, if the results are considered to be patentable at all, they will have to be patented in

the United States. Indeed, there is a strong case that Nonprofit Small entities should not be researching in these 'patentable' areas at all if they do not intend to look for protection in that country. This is because if their results are free to a United States firm to copy, the advantages such a firm is likely to have in terms of size, whether measured in terms of productive assets or resources for marketing, are likely to be decisive eventually in the world market as well as in the US one.

Some confirmation of this point can be found in Section 2 of the database, which deals with countries which have very few US patents. It will be noted that almost all of the patents originating from these countries are in the pharmaceutical area. This is probably because the results of pharmaceutical research are intrinsically global in their effect, corresponding to the point just made, and also because of recognition that the best hope of reward for the research results would be from a US license.

A caveat which should be kept in mind when considering the data is that although comparisons between countries other than the United States can be fairly made from the Small Entity database for the reasons just discussed, this is not the case for comparisons between any of them and the United States itself. The reason is that the self-selection process which is at work in these other countries to eliminate the less valuable patents does not apply to United States applicants. Consequently, the US figures reflect large numbers of patents that have little chance of ever being innovated, of the kind that have been filtered out from the grants to applicants from other countries by factors such as the invention being of interest only in a local market, the cost of making an application in the United States, and so on.

Another cause of difference between the United States figures and those of other countries is that so many firms in the US are in complex technologies. Since Anti-Trust policy made patent pools illegal there, it is the practice of such firms to patent 'every blade of grass' so as to develop bargaining strength which will prevent them from being locked out from using incremental innovations of their competitors.<sup>13</sup> Once again, these causes of distortion should apply less to the Nonprofit section than to other types of patentee.

## REFINEMENTS OF THE BASIC DATABASE

Apart from straightforward comparison between patent numbers by country, some further refinements have been incorporated into the database. The first of these adds data on patent 'citations'. Trajtenberg and others have shown that when one patent is cited as prior art during the examination of another, it shows that the later patent is building on the information in the earlier one, and hence it testifies to the quality of the latter. Citation levels may thus be an

indication of value.<sup>14</sup> Harhoff found that each citation in a later patent of one of the most valuable German patents which he had identified in his earlier work was associated with a significant value for the earlier patent.<sup>15</sup> Jaffe and Trajtenberg have pointed to a correlation between the growth of investment in a specific industry and the associated growth in the number of citations of patents in that industry.<sup>16</sup>

Secondly, as the database covers patents issued over a full ten year period, it has been possible to incorporate information on what proportion of Small Entity patents were renewed by paying the appropriate fee after the initial four year period, and for a smaller subset of those, what proportion were renewed after eight years.

Thirdly, further insight into the relative strength of indigenous invention in different countries is provided by including the proportions of patents where the first inventor is resident in a country other than the United States, but the patent is assigned to a United States firm.

## NOTES

1. See for example, Desrochers, P. (1998) 'On the abuse of patents as economic indicators' *The Quarterly Journal of Austrian Economics* 1 (Winter) 51–74.
2. See in particular: R. Levin, et al. (1987) 'Yale study of R&D appropriability methods', *Brookings Economic Papers*; A. Arundel, A. van de Paal, and L. Soete (1995) *Innovation strategies of Europe's largest industrial firms: Results of the PACE survey*; Cohen, W., R. Nelson, and J. Walsh (2001) 'Appropriability mechanisms: use and change over time' Paper presented to the Swedish International Symposium on Law, Economics and Intellectual Property, Gothenburg, June 26–30.
3. See Judge Rich (1978) quoted in P. J. Federico, 'Origins of Section 103', in John F. Witherspoon, ed. *Nonobviousness – The Ultimate Condition of Patentability*, Bureau of National Affairs, Washington, DC, 1, 109.
4. Schankerman, M. (1998) 'How valuable is patent protection? Estimates by technology field' *Rand Journal of Economics* 29, 77–107.
5. Lanjouw, J., A. Pakes, and J. Putnam (1998) 'How to count patents and value intellectual property: the uses of patent renewal and application data' *Journal of Industrial Economics* 46, 405–432.
6. Scherer, F., and D. Harhoff (2000) 'Technology policy for a world of skew-distributed outcomes' *Research Policy* 29, 559–566.
7. Discussed in David Cohen (1998) 'Article 69 and European patent integration' *Northwestern Law Review* 92, 1083–1129.
8. Macdonald, Stuart (2004) 'When means become ends: considering the impact of patent strategy on innovation' *Information Economics and Policy* 16, 135–158.
9. See Sterba, R. (1997) 'Small Entity status: who's "small", who isn't, who should be, and why?' *American Intellectual Property Law Association Quarterly Journal* 25, 425–437.
10. Provided by the USPTO in May 2004.
11. USPTO Patents BIB for December 2003.
12. Canadian Intellectual Property Office, Glossary, accessed 22 July 2003, available at [http://strategis.ic.gc.ca/sc\\_mrksv/cipo/patents/e-filing/gloss.htm](http://strategis.ic.gc.ca/sc_mrksv/cipo/patents/e-filing/gloss.htm)
13. Kash, D., and W. Kingston (2001) 'Patents in a World of Complex Technologies' *Science and Public Policy* 28, 11–22.

14. Trajtenberg, M. (1990) 'A penny for your quotes. Patent citations and the value of innovations' *Rand Journal of Economics* 21, 172–187.
15. Harhoff, D., et al. (1999) 'Citation frequency and the value of patented inventions' *Review of Economics and Statistics* 81(3), 511–515.
16. Jaffe, A. B., and M. Trajtenberg (2002) *Patents, Citations, and Innovations: a window on the knowledge economy*, Cambridge, MA, The MIT Press.