# Patents - the Viagra of innovation policy?

## Internal report to the Expert Group

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## 1. INTRODUCTION

Intellectual property rights (IPRs) such as patents, design registration and copyright have attracted considerable policy interest in the past decade, due to the belief that we are now living in a "pro-patent" era where IPRs are considerably more important than they were in the 1960s and 1970s.

Three factors are thought to lie behind an increase in the value of IPRs: changes in legislation to strengthen patents, changes in firm IPR strategies, and a shift in innovative activities from mechanical engineering towards "knowledge-based" activities such as information technology, software, and biotechnology.

Two main legislative changes have strengthened the value to firms of IPRs. New international agreements on the use of IPRs, as illustrated by WIPO or the EPO, have improved the ability of firms to extend IPRs to a larger number of jurisdictions. Second, the establishment, in 1982, of a Federal Court of Appeals for patents has made it easier for firms to protect their patents from infringement in the United States. This could be one factor behind the rise in patent applications in the United States after 1987, although Kortum and Lerner's (1997) analyses indicate that the main factor is a shift to more applied research, which has increased the number of inventions.

Possibly in reaction to these legal changes, there is anecdotal evidence to suggest that firms are more aggressively exploiting their IPRs. Several large firms, such as Texas Instruments and IBM, have set up their patent departments as 'profit centres' with a mandate to aggressively pursue licensing revenue from their patented inventions (Thurow, 1997).

The last factor is related to the rise of the "knowledge economy", which has increased the importance of competitive strategies based on innovation and proprietary knowledge. This has also involved changes in the structure of industry, as seen by the increase in investment in information-based industries such as pharmaceuticals, telecommunications, software and biotechnology. A characteristic of several of these industries is an enormous gap between the cost of discovering or developing a new innovation and the ease with which innovations can be copied. IPRs are therefore crucial to these sectors to permit firms to recoup the costs of their R&D investments. In addition, small firms have been one of the drivers of innovation in several new technologies such as biotechnology and information technology. These small firms partly rely on patents to signal expertise, either to attract research partners or investment (Mazzoleni and Nelson, 1998).

European policy makers have reacted to the apparent rise of a 'pro-patent' era with both unease and resolve. The unease comes from a widespread belief that the European 'innovation system' is unable to translate inventions into innovations as successfully as their American and Japanese competitors. And, once commercialised, European firms are unable to maintain and build upon the competitive advantages of their innovations. The resolve comes from the

belief that new IPR policies could stiffen the competitiveness of European firms. These policies include changes in patent law to strengthen the attraction of patents and policies to encourage European firms, particularly SMEs, to patent a higher percentage of their innovations[1]. In effect, these policies would provide a Viagra-like boost to the flagging competitiveness of European firms by helping them to develop and maintain their competitive advantages.

### 1.1 IPR policy, the public interest, and appropriation strategies

In some cases, the side effects of the cure can be worse than the disease. Policies to increase IPR protection conflict with other policy goals to maintain and invigorate competition and to ensure that the public interest in low prices is met by minimising monopoly pricing. This raises several well-known trade-offs. The social costs of monopoly pricing as a result of IPRs is balanced by the role of IPRs in providing an *a priori* incentive to innovate and an *ex post* ability to innovate and create economic growth, based on dynamic effects when firms reinvest their excess profits in more production and R&D. The disclosure requirement for patents should provide additional public benefits by assisting the innovative activities of other firms.

The best policy response to these trade-offs is made more complex by the fact that IPRs are not the only appropriation method available to firms. The policy question then becomes: how much IPR protection is optimal, given that firms can also appropriate their investments in innovation through secrecy, lead time advantages, technical complexity, complementary services, etc? There is no reason to strengthen IPRs when other appropriation methods provide an adequate incentive to innovate. Doing so would simply increase the ability of firms to extract monopoly profits without providing any social benefits.

Alternatively, are there situations in which the public interest would be better served if firms used patents rather than other appropriation methods? For example, the use of secrecy as an alternative to patents could decrease public welfare by reducing the flow of ideas among firms, thereby reducing the overall rate of innovation. The public interest could be better served by encouraging firms to use patents instead of secrecy, since the former require information disclosure. Furthermore, a dynamic rather than a static analysis might suggest that excess profits, if reinvested in additional innovation, could provide greater public benefits over the long term.

The role of patents versus other appropriation policies is not only an issue of public versus private interests. The exploitation of non-IPR appropriation strategies can be an essential component of the ability of firms to compete. For instance, a competitive strategy that places undue emphasis on patents could result in commercial failure if it leads to the neglect of complementary practices such as developing lead-time advantages, frequent technical improvements, skilful marketing, and after-sales support services. An unrealistic reliance on

[1] See the European Commission's proposed initiatives to support patenting, particularly by SMEs, in the *Green Paper on Innovation* and the *First Action Plan for Innovation in Europe*.

IPRs in the appropriation strategies of firms in many sectors could result in the very outcome that European policy makers are trying to avoid: the failure of European firms to successfully commercialise their innovations. IPR strategies must be placed firmly within the context of an overall appropriation strategy.

### 1.2 The empirical evidence

There are three methods for evaluating the issues raised above: theoretical models, anecdotal or case study evidence, and empirical evidence based on representative surveys. There is an extensive theoretical literature on the decision to patent and optimal patent length and width, but much of this literature is of limited use here because it either assumes that firms patent all of their inventions, or if they don't, that the only alternative to patenting is secrecy. Neither are realistic assumptions. Although it is vitally important to never underestimate the value of case studies to explain the motivations of firms, the strongest evidence is derived from representative surveys. Only surveys can provide representative answers, for firms across a wide swath of industries, to four empirical questions of relevance to IPR policy.

The remainder of this report evaluates the empirical evidence from surveys. Due to data availability, the empirical evidence is regrettably limited to patents, with a secondary discussion of design registration. The four empirical questions are as follows:

- Do European firms lag behind their American and Japanese competitors in their use of patents?
- What is the relative value of patents and design registration compared to other means of appropriation?
- How important are patents as an incentive to innovation?
- How important are patent databases as an information source?

I have one apology to make here. I have been involved in much of the empirical research that is evaluated below, so there is an inordinate amount of self-citation. This is perhaps because MERIT has been involved in the few surveys that have looked at patenting issues. However, it is also highly likely that I have missed other relevant survey research. If so, I would greatly appreciate being informed about them.

## 2. ARE EUROPEAN FIRMS LAGGING IN THEIR USE OF PATENTS?

Underlying the policy debate is the belief that European firms are lagging behind their American and Japanese competitors in their use and exploitation of patents. One piece of evidence for this is the continued increase over the 1990s in patent applications at the American Patent and Trademarks Office (PTO) compared with a levelling off in patent applications at the European Patent Office (EPO). Nevertheless, this evidence is of limited value, since it depends on the number of foreign patent applicants, differences in industrial structure, and the patent propensity rate by sector.

The best method of answering this question is to determine if patent propensity rates vary between European firms and firms in other countries such as the United States and Japan. The patent propensity rate is defined here as the percentage of innovations that are patented. Such a comparison must control for differences in industrial structure, given the marked differences in patent propensity rates by sector. For example, the study by Arundel and Kabla (1998), based on the 1993 PACE survey of Europe's largest industrial firms, estimates that the average patent propensity rate[2] varies from a low of 15% in basic metals and steel (ISIC 27) to a high of 74% in pharmaceuticals (ISIC 2423). The patent propensity rate only exceeds 50% in four of twenty sectors: machinery (52%), precision instruments (53%), chemicals (57%), and pharmaceuticals. This means that national differences in patent propensity rates can be due to differences in industrial distributions. A country where the pharmaceutical sector accounts for half of all industrial output will have a much higher patent rate than a country where basic metals accounts for half of industrial output.

I am only aware of one method, although imperfect, of comparing patent propensity rates between European firms and firms in other countries. This uses data from the 1993 PACE and similar surveys in the United States and Japan that were conducted one year later in the United States, under the direction of Dr. Wes Cohen, and in Japan, under the direction of Dr. Akira Goto. The American survey is hereafter referred to the Carnegie Mellon Survey (CMS). The results presented here are based on a 1997 paper that is currently in submission for publication (Cohen *et al*, 1997). It was possible to compare patent propensity rates from PACE with the CMS survey, although no direct comparison has been made so far with the Japanese survey.

The comparison between patent propensity rates in Europe and the United States is limited to a comparable group of 418 PACE firms and 623 CMS firms[3]. The results for both countries are weighted to the same industrial distribution to control for differences in the sectoral distributions in the two surveys. The results, given in Table 1, show that American firms in the early 1990s patented a higher percentage of their innovations than European firms. The difference is most marked for process innovations, where American firms patented 44% of their innovations compared to a patent propensity rate of 26% for European firms.

[2] The estimates are for both product and process innovations and are weighted by firm size and the proportion of innovative effort expended on product and process innovations.

[3] The comparable PACE firms exclude firms from Italy and France, due to data limitations. The PACE firms met the following requirements for matching with the CMS survey: perform R&D on a continuous basis, more than 50 million US in annual sales, limited to sectors included in the US survey, and limited to European-owned firms.

**Table 1. Standardised patent propensity rates for large European and American firms**

| | Product innovations | Process innovations |
|---|---|---|
| Europe | 44% | 26% |
| United States | 52% | 44% |

Notes: Based on a standardised industrial distribution and weighted by R&D expenditures.

There are several caveats to these results. The CMS survey asked for a point estimate of patent propensity rates, while the PACE survey provided six categories: zero, 1 to 20%, 21 to 40%, etc. The PACE mid-points are used to estimate average propensity rates, with the highest possible percentage being 90%, or the mid-point of the highest category of 81% to 100%. Furthermore, the CMS survey sampled R&D laboratories while the PACE survey sampled R&D performing divisions. These differences between the PACE and CMS surveys could act to bias the PACE estimates downwards relative to the CMS estimates. Nevertheless, the differences between the CMS and PACE estimates are too large for process innovations for this explain the higher patent propensity rate in the United States. The results indicate that European firms probably *do* patent less than American firms.

The lower patent propensity rates in Europe do not, however, necessarily place European firms at a disadvantage in comparison with their American competitors. It is also important to know something about why firms patent. This issue is taken up in section 4.1 below.

## 3. THE VALUE OF PATENTS TO APPROPRIATION

Policies to encourage firms to patent more in order to improve their competitiveness make an implicit assumption that patents are the 'gold standard' of competitive strategies. Much of the theoretical literature on patenting, based on game theory, also makes this assumption. But, are patents the gold standard and therefore the best and most effective appropriation method?

Survey research has consistently shown, since 1987, that patents are less important than many other appropriation methods, with the exception of a few sectors such as pharmaceuticals. The results presented here focus on international comparisons, although a few results on the importance of patents to European firms, based on the 1993 CIS survey, are also provided.

Innovation surveys in the European Union, Switzerland, Australia, the United States, and Japan asked manufacturing firms about the value of several methods for earning or protecting their 'competitive advantages' from product and process innovation. The appropriation methods included in these surveys consist of patents, secrecy, lead-times, complementary sales and service, frequent technical improvements, and design registration. However, only patents, secrecy and lead times were asked in all surveys, which means that it is only possible to make comparisons for these three appropriation methods.

The exact format of the questions on appropriation and the method of measurement varies among the surveys, except for the 1993 CMS and Japanese surveys, where an identical questionnaire was used. With this exception, it is not possible to compare the absolute value of appropriation methods between countries. For example, we cannot determine that Japanese firms, on average, find patents to be more important than European firms. However, it is possible to compare the importance of secrecy and lead-time advantages *relative* to the importance of patents in most of these countries or regions[4].

The results for patents, secrecy and lead-time advantages are given in Figure 1 for product innovations and in Figure 2 for process innovations. A value of '1' means that the importance of the method, averaged over all respondents to the survey, is equal to the average importance of patents, while a value greater than 1 indicates that the method is more important than patents. The actual value of the scale is not given in Figures 1 and 2 because it has no meaning in comparisons between countries, although the scale is described in the accompanying notes.

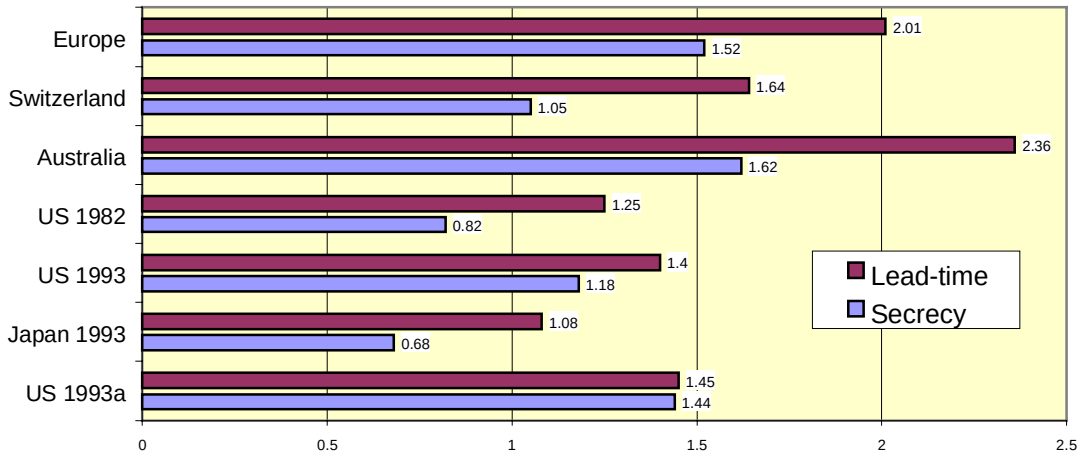
The results show that the average importance of secrecy and lead-time advantages is consistently *higher* than the importance of patents, with the exceptions of the 1982 survey in the US and the 1993 survey in Japan, where secrecy was less important than patents for product innovation.

The 1993 results for the US and Japan are based on an identical measurement scale and the results are standardised to an identical industrial distribution. We can conclude, therefore, that American firms find both lead-time advantages and secrecy to be of greater importance, relative to patents, than Japanese firms. In contrast, there is very little difference in the absolute value of patents for Japanese and American firms (results not shown). On average, patents are effective in protecting the competitive advantages of 38% of Japanese innovations and of 36% of American innovations (Cohen et al, 1998, figure 4).

A comparison of the US results for 1982 and 1993 also suggests that the relative importance of secrecy versus patents has increased, although an unknown part of this difference could be due to differences in the US industrial distribution over time or to sampling variation. Nevertheless, this result suggests that the increase in the number of patent applications in the US since 1982 (Kortum and Lerner, 1997) has *not* been due to an increase in the *relative* value of patents compared to secrecy. This conflicts with the common assumption that patents and secrecy are mutually exclusive methods for preventing competitors from copying an

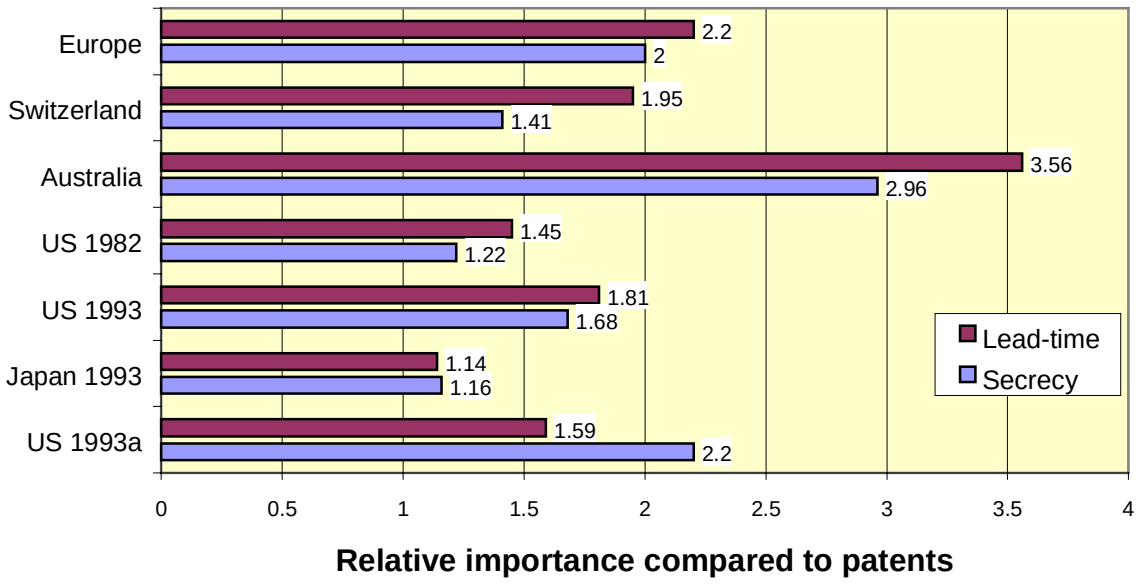
[4] Furthermore, the results cannot be directly compared between countries because the importance of each appropriation method depends on the distribution of respondent firms by sector, size, and R&D status. A direct comparison requires using a standard industrial distribution and limiting the analyses to firms of a specific size class and R&D status.

**Figure 1. Relative importance of secrecy and lead-time for earning competitive advantages from PRODUCT innovation**




**Sources:** *Europe: 1993* Community Innovation Survey (Arundel, 1996); 5,147 innovative firms in Norway, Belgium, the Netherlands, Luxembourg, Ireland, Denmark, and Germany. The measurement scale is the percentage of firms that report that each appropriation method is 'moderately important' or higher on a five-point scale.
*Switzerland*: Harabi (1995); 358 innovative firms. The measurement scale is the mean for a seven-point importance scale.
*Australia*: McLennan (1995); 1,960 innovative firms. The measurement scale is the percentage of firms that report that each appropriation method is 'moderately important' or higher on a five-point scale plus an option of 'method not used'.
*US in 1982*: Levin et al (1987); 650 R&D performing firms. The measurement scale is the importance of each method in the firm's 'line of business' using a seven-point scale.
*US in 1993*: Rausch (1995); 236 innovative firms. The measurement scale is the percentage of firms that report that each appropriation method is 'moderately important' or higher on a five-point scale.
*US in 1993a and Japan*: Cohen *et al (1998):* 623 US firms and 497 Japanese firms, standardised to the same industrial distributions so that the results are directly comparable. The measurement scale is the average percentage of innovations for which the mechanism is considered effective.

**Figure 2. Relative importance of secrecy and lead-time for earning competitive advantages from PROCESS innovation**

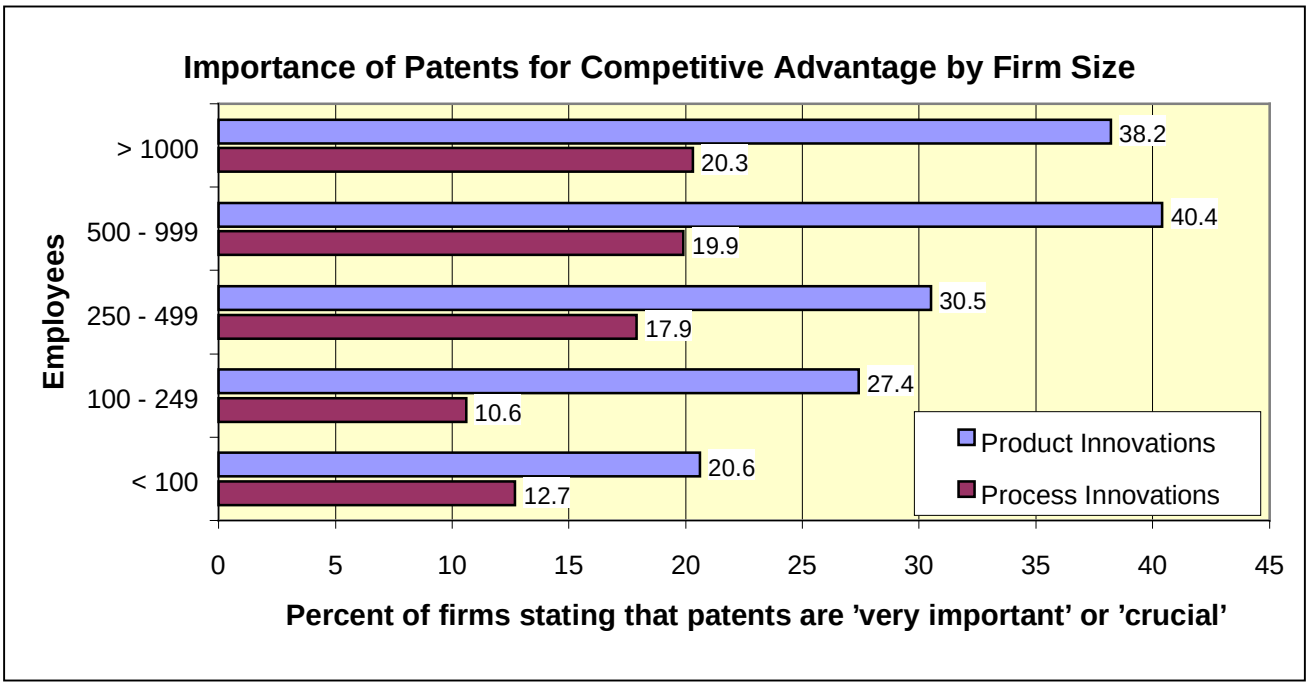


innovation. There are two possible explanations: they are not mutually exclusive or firms have other reasons for patenting. Both of these explanations are discussed below.

### 3.1 Factors influencing the importance of patents

In addition to large differences in the importance of patents by sector, as noted above in section 2, several other characteristics influence the importance of patents to firms as an appropriation method. Figure 3 gives the 1993 CIS results for seven European countries for the importance of patents by firm size for both product and process innovations. 38.2% of innovative firms with over 1000 employees state that patents are 'very important' or 'crucial' to their ability to maintain competitive advantages from their product innovations, compared to 20.6% of firms with less than 100 employees[5]. The effect of firm size is partly due to larger firms having in-house patent offices, which means that they tend to patent routinely, as long as the expected value of the patent does not outweigh the costs of disclosing information (Arundel and Kabla, 1998). Of course, some small firms find patents or other IPRs to be a crucial part of their business strategy. These firms tend to be in high technology areas such as biotechnology or software where IPRs are essential to attracting venture capital.

**Figure 3**




Source: CIS survey (Arundel, 1996; Arundel 1997). Results are for 5,147 innovative firms and are weighted to reflect the distribution of firms across sectors, firm size classes, and country.

[5] The responses to these questions are ordinal data where 1 = 'insignificant', 2 = 'slightly important', 3 = 'moderately important', 4 = 'very important', and 5 = 'crucial'. The percentage of firms that give a 'very important' or 'crucial' answer is reported here. The means are not given because this requires making the heroic assumption that the distance between the ordinal categories is identical. However, the relative importance of patents by firm size, R&D status, or sector is similar when the means are used or if the percentage of firms that report that patents are 'moderately' important or greater is used.

The importance of patents is also greater among firms that perform R&D. 26.6% of R&D performers find product patents to be very important or crucial, compared to 18.2% of non R&D-performers. Similarly, 15.5% of R&D performing firms versus 8.3% of non R&D performing firms find process patents to be of importance to competitive advantage. Patents are also more important to firms that export to the United States or Japan, suggesting that patents play an important role in the ability of firms to enter foreign markets.
is approximately half the respective rates for patents.

### 3.2 Who finds design registration of importance?

Design registration is reported by 10.1% of CIS respondents to be 'very important' or 'crucial' for product innovations and by 7.8% of the respondents for process innovations. This is approximately half the respective rates for patents. Again, these rates are higher among R&D performing firms and increase by firm size. For product innovations, the rate increases from 11% of firms with less than 100 employees to 22.3% of firms with more than 1000 employees, while the rates increase for process innovations from 5.7% to 7.9% across these firm size classes.

### 3.2 The disadvantages of patents

The European Commission's *Green Paper on Innovation* cites application and defence costs as important barriers that prevent firms from patenting their innovations. These costs – particularly defence costs – could be of importance for SMEs[6]. However, for large firms, the PACE results show that limits to the effectiveness of patents in preventing imitation and the disclosure of information are considerably more important reasons not to patent. These latter two reasons are cited by approximately 60% of PACE respondents that decided not to patent an innovation, compared to 26% who cited application costs and 13% who cited defence costs (Arundel and Kabla, forthcoming).

Econometric analyses of the factors that influence the patent propensity rate found that application and defence costs had no effect, after controlling for the influence of firm size, sector, and the importance of patents to prevent copying. The most important brake on patenting was the ease of imitation, followed by information disclosure (Arundel and Kabla, forthcoming)[7].

It is important to note that the recent EPO decision to reduce application costs is unlikely to have a significant impact on the percentage of innovations that are patented. This is because the greatest effect of lower application costs will be on marginal innovations, for which the

[6] A survey of innovative Dutch SMEs in five high technology sectors supports the greater importance of application and defence costs as a reason not to patent for smaller firms (Arundel *et al*, 1997). The cost of a patent application was the most frequently cited reason (40% of firms), followed by ease of circumvention (35%), information disclosure (34%), and defence costs (27%).

[7] It is very difficult to compare the PACE and CMS questions on the reasons why firms do not patent because of differences in the structure of the question. The PACE survey uses a five-point ordinal scale to ask about the importance of four reasons not to patent, while the CMS survey uses a simple 'yes' or 'no' option. Furthermore, none of the questions can be used to calibrate the responses.

expected financial benefits of a patent were approximately the same as the application costs. Furthermore, interviews with Dutch SMEs showed that the specific costs of the patent application, *per se*, were of less concern than the additional costs of employing a patent attorney and the time spent by staff on preparing the application.

## 4. PATENTS AS AN INCENTIVE TO INNOVATE

The incentive function of patents is perhaps the primary justification for their provision. It is therefore surprising that only a few empirical studies have addressed the importance of patents as an incentive to innovate. I am only aware of two.

The first is the study by Mansfield (1986) which asked a sample of 100 US R&D managers about the percentage of their firm's innovations that would not have been developed without patent protection. On average, a lack of patent protection would have prevented the development of 60% of pharmaceutical and 38% of chemical inventions. In most sectors, a lack of patent protection would have had little impact, resulting in 17% fewer inventions in machinery, 12% less in fabricated metals, 11% less in electrical equipment, and no effect at all in office equipment, motor vehicles, rubber, and textiles.

The problem with the Mansfield estimates is that the results are based on a 'what if' scenario. These types of questions are very difficult to answer. In addition, firms that benefit financially from patents could tend to give biased, pro-patent responses. An alternative method for evaluating patent incentives is to look at imitation lags, or the time it takes a competitor to market a competitive alternative to a *significant* product or process innovation. This approach is used by the PACE and CMS surveys. Unfortunately, the PACE survey does not divide the questions on imitation lags into patented and non-patented innovations. This division is made, however, in the US and Japanese surveys.

The relevant pair of questions in the US and Japanese surveys ask:

> "For your most significant product and process innovations introduced over the last ten years which you **did patent [did not patent]**, approximately how long was it until another firm introduced a competing alternative?"

The question is designed to directly measure the difference in imitation lags between patented and unpatented significant innovations. The difference provides a measure of the incentive value of patents. The results are given below in Table 2, which also includes results for Europe from the PACE survey. The percentages provide the comparative increase in imitation lags provided by a patent. The European figures are standardized to the same industrial distribution as in the American and Japanese results, but do not differentiate between unpatented and patented innovations.

Table 2 clearly shows that the mean incentive value of a patent is rather small – only 7 months for product innovations in Japan and 10 months in the United States. In both cases, this is an increase of about 30% in the imitation lag compared to unpatented innovations. The greatest advantage for patents is for process innovations in Japan, where they increase the imitation lag by 71%. Of note, imitation lags for both unpatented and patented innovations are longer in the United States than in Japan.

**Table 2. Mean imitation lags in months for the firm's most significant product and process innovations**

| | Japan | | United States | | Europe |
|---|---|---|---|---|---|
| | Unpatented | Patented | Unpatented | Patented | Combined |
| **Products** | 24 | 31 (30%) | 34 | 44 (29%) | 34 |
| **Processes** | 24 | 41 (71%) | 41 | 50 (22%) | 32 |

These results on imitation lag times show that lag times are mostly due to appropriation methods other than patents, possibly secrecy or lead-time advantages, as shown by the fact that patents only provide a 30% increase in imitation lags over unpatented innovations. These results suggest that the incentive provided by patents is relatively small on average, and less than the incentive provided by other appropriation methods[8]. At the same time, patents can provide a financially important edge. The question refers to 'significant' product and process innovations, so it is highly likely that the firms are able to recoup more than cost of the patent during the additional seven months of effective protection from imitation.

### 4.1 Strategic Reasons to Patent

The traditional, and most important reason for European, American, and Japanese firms to patent is to prevent copying. The ability of patents to prevent copying is what creates imitation lags and the possibility of earning monopoly profits. Firms also patent for strategic reasons, including to block competitors from applying for a patent, to reduce their risk of being sued for infringement, and to use in cross-licensing negotiations with other firms.

How important are these strategic reasons for patenting? The CIS did not include questions on these reasons, but results are available from the PACE survey for Europe and from the similar CMS surveys in the United States and Japan. The results, given in Table 3, show that there is

[8] An alternative method is to look at the correlation between R&D intensity and patent propensity. The study by Arundel and Kabla (1998) found that R&D intensity had no effect on patent propensity, meaning that R&D intensive firms did not patent a higher percentage of their innovations than firms with low R&D intensity. The problem here is that there is no time lag and what we would really like to know is if strong patent protection leads to higher R&D spending. An analysis of the factors that influence the number of patent applications found that the strength of patent protection, as measured subjectively by the respondent, had no effect once dummy variables for industry sector were entered into the regression (Arundel and Kabla, forthcoming). This shows that the apparent strength of patents are strongly influenced by the sector of activity and that apparent correlations between R&D spending and patenting activity must adjust for sectoral differences.

a fair amount of diversity between these three regions in the importance of strategic reasons to patent[9].

**Table 3. Percentage of European, American and Japanese firms that rate each reason to patent as 'important'[1].**

| Reason to patent | United States | Japan | Europe |
|---|---|---|---|
| **Products innovations** | | | |
| Evaluate performance of staff | 7 | 51 | 17 |
| Obtain license revenue | 30 | 42 | 36 |
| Use in negotiations | 48 | 63 | 69 |
| Prevent infringement suits | 61 | 89 | 73 |
| Prevent copying | 96 | 92 | 94 |
| Block competitors | | | -[2] |
| **Process innovations** | | | |
| Evaluate performance of staff | 7 | 47 | 16 |
| Obtain license revenue | 26 | 35 | 32 |
| Use in negotiations | 40 | 52 | 58 |
| Prevent infringement suits | 50 | 80 | 63 |
| Prevent copying | 81 | 79 | 83 |
| Block competitors | | | -[2] |

1: Adjusted to the same industrial distribution. The PACE survey uses a five-point ordinal scale for the question while the US and Japan versions use a 'yes' or 'no' nominal response. The PACE results are calibrated to the US and Japanese results by dividing the ordinal scale into two categories that most closely matches the US and Japanese results for 'prevent copying'. This is equal to a scale of 'moderately important' (3) and above as equal to 'yes' and a scale of 1 or 2 as equal to 'no'.
2: Option not included in the PACE survey.

The patenting strategies of American firms appear to be strongly driven by the wish to block competitors and to prevent copying. The use of patents as a means of sharing information, for example through licensing or in negotiations, is less important for American firms than for European and Japanese firms. This data suggests that American firms follow a more independent approach to innovation and appropriation than their European and Japanese competitors, with less emphasis placed on using patents to share information.

Cohen *et al*'s (1998) analysis of the results for the United States and Japan led them to conclude that 'The prominence of strategic motives for patenting such as blocking, use in negotiations and prevention of suits suggest that the rapid increase in patent rates may at least partly reflect the outcome of a dynamic noncooperative game across both national and international rivals, initiated perhaps by changes in patent policy, infringement suits, or by other competitive interactions. Resembling the outcome of an arms race, firms in both nations could well be accumulating more patents than what is collectively optimal".

[9] See Cohen et al (forthcoming) for the United States and Japan. Comparable results for Europe are available using the PACE data, but these results have not been published. Other relevant PACE results are in Arundel *et al*, 1995.

## 5. PATENT DISCLOSURES AS AN INFORMATION SOURCE

An important objective of European Science and Technology policy is to encourage the diffusion of scientific and technical knowledge. One option is to use the patent system for this purpose, both by encouraging firms to patent their inventions instead of keeping them secret, and to encourage firms to search patent databases in order to support the diffusion of new knowledge and to reduce the amount of 'wasteful' duplicative R&D.

David and Foray (1994) suggest that these twin goals could be achieved by strengthening the public disclosure aspect of the patent system so that patents act as a clearing house for new knowledge[10]. This would require encouraging firms to patent a much higher percentage of their innovations than they patent today and improving disclosure. The latter would require 1) the disclosure of complementary information that is necessary to replicate the invention and 2) improving public access to patent databases.

There are two problems with using the patent system to further the diffusion of information. First, patent databases already contain an enormous amount of data, but are they being used? The second concerns the problems of disclosure.

### 5.1 Who uses patent databases?

A major empirical question of relevance to the value of patent databases is how valuable are they to firms as a source of information? The European CIS asked respondents from innovative firms about the importance of eleven external information sources for their firm's innovation activities during 1990 to 1992. One of these sources is 'patent disclosures'. The importance of each information source is evaluated through a five-point Likert scale ranging from 1 for 'insignificant' to 5 for 'crucial'.

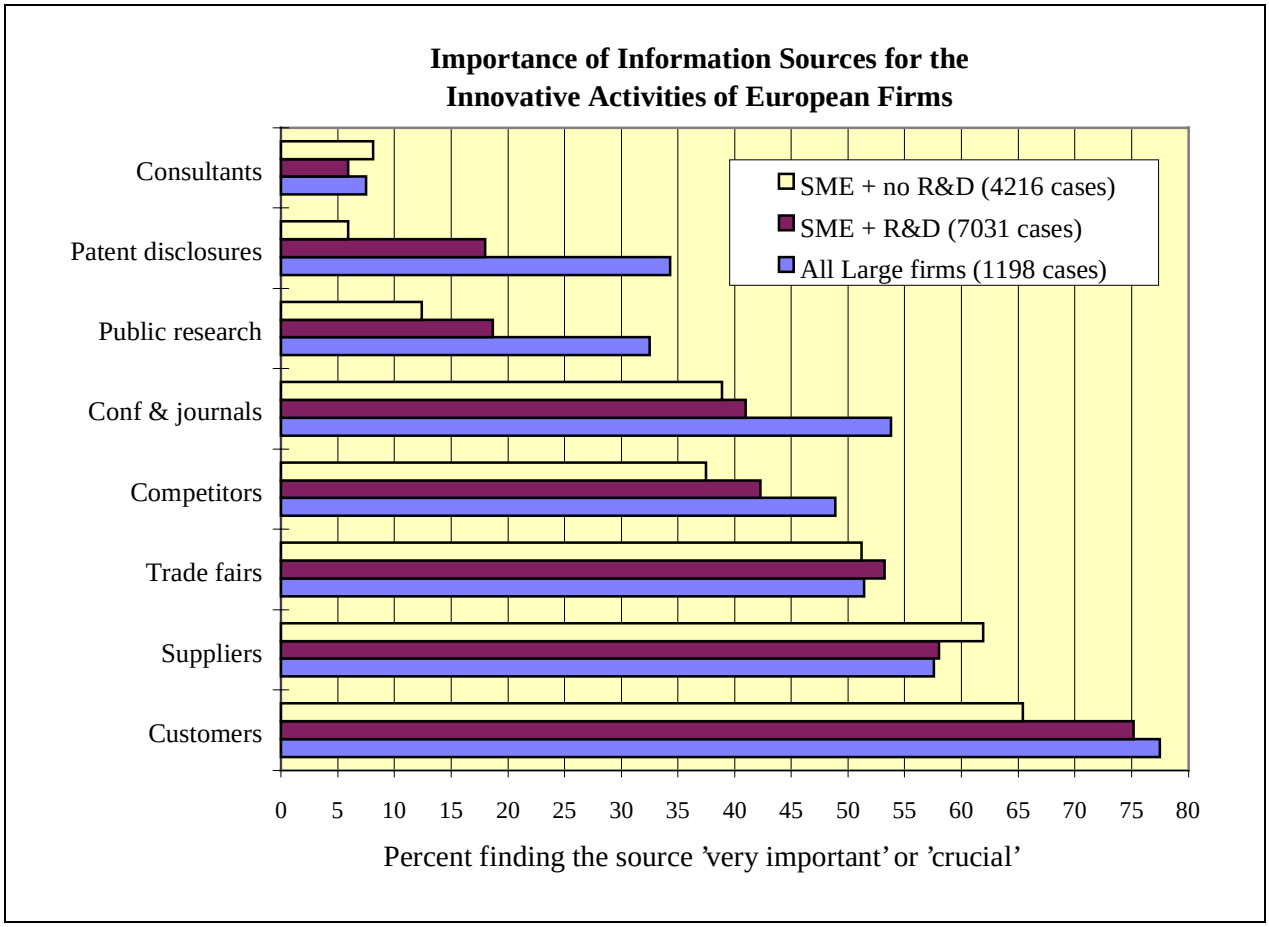
Figure 4 gives the percentage of firms that find patent disclosures plus seven other information sources of importance, defined as a score of 4 (very important) or 5 (crucial).

(Several information sources are combined, which reduces the total number of sources from eleven to eight). SMEs, defined as firms with 10 to 499 employees, are divided into two groups: those that perform R&D on an occasional or regular basis and those that innovate but do not perform R&D. The results show that both groups of SMEs find patent disclosures to be the second *least* important information source, after consultancy firms, with only 5.9% of non R&D performing and 18% of R&D performing SMEs finding patent disclosures to be important information sources. In contrast, over 50% of both types of SMEs find trade fairs,

[10] This argument is relevant for process innovations, but it is much weaker for product innovations because firms can reverse engineer their competitors' products once they are on the market. (In fact, the PACE survey shows that reverse engineering is one of the most important information sources used by firms). The argument is strengthened, however, if we assume that there is a lot of tacit knowledge in innovation that is not transmitted by the patent. Although tacit knowledge has been receiving a lot of attention lately, I am not aware of any empirical research that has attempted to measure it and determine its role in innovation.

suppliers, and customers to be an important information source[11]. Patent disclosures are much more likely to be used by large, R&D performing firms, with 34% stating that they find patent disclosures of value.

**Figure 4**




*Public research:* Based on the highest score given to separate questions on universities, government laboratories, and technical institutes. *Suppliers*: Based on the highest score given to separate questions on equipment and material suppliers.

Econometric analyses of the factors that influence the importance of patent disclosures, using the CIS data, show that firm size, whether or not the firm performs R&D, the importance of patents as an appropriation method (a proxy for patent activity) and the sector of activity have a significant impact on the importance attributed to patent disclosures as an information source (Arundel & Steinmueller, 1998)[12]. At the sectoral level, the average importance of patent databases as an information source is correlated with the sectoral patent propensity rate. This implies that part of David and Foray's (1994) model is correct – firms will use patent databases more intensively *if* these databases contain valuable information.

[11] The relative importance of patent disclosures compared to other information sources is robust and changes very little when based on a score of 3 or higher or on the means.
[12] These analyses use an ordered logit model in which the dependent variable can take three values: 1 = insignificant or slightly important, 2 = moderately important, and 3 = very important or crucial.

The missing part of any policy activity to encourage firms to make greater use of patent databases is why firm's *don't* patent, since the value of patent databases depends on the amount of information that they contain, which depends on patent propensity rates. The analyses mentioned above by Arundel and Kabla (forthcoming) point to concerns over disclosure as the major reason not to patent. In order to encourage firms to patent more, something would have to be offered in return, such as broader patents that would reduce the ability of competitors to 'invent around'. This could have the contradictory effect of *reducing* the amount of information freely available in the public knowledge pool. The end result could be more publicly available knowledge, but greater restrictions on its use.

## 6. CONCLUSIONS

The importance of patents to the competitive advantages of a firm depends on the sector of activity, the firm's business strategy, and interactions with the business strategies of the firm's competitors. Patents are essential to the competitive advantage of some firms, particularly in sectors where innovations are easy to copy, such as pharmaceuticals, chemicals and instruments. In many sectors patents only confer minor advantages. Other appropriation methods, particularly secrecy and lead-time advantages, are more effective.

There is no 'optimum' appropriation strategy, nor do firms always need to make trade-offs between appropriation methods. Many firms, for example, find both patents and secrecy to be important for appropriating their investments in product innovation. One explanation of this apparent contradiction is that these appropriation methods are used at different times during the innovation process. Secrecy can be used in the early stages in order to ensure lead-time advantages, while patents can help maintain product differentiation and lead times once the product is on the market.

There is some evidence from the US to show that secrecy is growing in importance, relative to the alternative of patents. One explanation is that imitation lag times are so short, even for patented innovations, that firms are better able to profit from innovation by maintaining secrecy in the development stages. Of course, once the product is on the market competitors can use reverse engineering to learn about the innovation. At this point, patents could complement secrecy by providing the firm with some extra lead-time to introduce new innovations before their competitors catch up.

The available data on incentives, although sparse, combined with data on the relative value of other appropriation methods, suggests that stronger patents are <u>not</u> required to encourage firms to invest in innovation. Competitive pressures and the existence of alternative appropriation methods already provide a strong motivation to innovate in most sectors.

What is the appropriate policy response? Clearly, there is no short-term public benefit in increasing patent protection if non-patent incentives to invest in innovation are adequate.

Patents can create monopolies and interfere with the diffusion of new inventions. The latter is of particular concern in respect to enabling technologies, although there is very little evidence, outside of the biotechnology sector, that patents have interfered with technology diffusion[13].

At the same time, the comparison between European and American patent propensity rates in the early 1990s, which is the most recent data available, indicates that European firms are lagging behind their American competitors in their propensity to patent. Their American competitors also appear to be using patents more aggressively in ways that could be destructive both to the public interest and to the self-interest of the firms. The use of patents to block competitors interferes with the use of information, while patenting to prevent an infringement suit is a waste of the firm's resources if the firm can obtain the same end by publishing the details in trade or scientific journals[14].

Over the short term, European firms could have little choice but to play the same non-cooperative strategic game as their American competitors. However, the medium and long-term policy goal should be to discourage such misuses of the patent system. This cannot be done by strengthening patents, in the sense of making them easier to obtain. In fact, a good argument can be made for weakening patents and for making it more difficult to obtain them. This could be achieved by limiting patent width for new technologies in order to reduce the ability of patents to block competitors from using and further developing enabling technologies. In the same line, it may be worth increasing the level of the inventive step to prevent nuisance patents.

In return for limiting patents, a better system for resolving patent infringement cases would be worthwhile. In particular, the system should be designed so that large firms do not have a distinct advantage over small firms. This would provide a better incentive for small firms to invest in innovation.

What advice can be given in response to European policy documents that suggest introducing educational programmes to promote patents, particularly to SMEs? Are patents the only available prescription for flagging competitiveness? The answer, based on the empirical evidence on appropriation methods, is clearly no. IPR strategies must be placed firmly within the context of an overall *appropriation* strategy. The danger of policies to emphasise the value of patents is that they could cause firms to neglect other factors that are essential to the ability to profit from innovation: secrecy, building lead-time advantages, and other methods such as frequent technical improvements. Educational materials aimed at SMEs need to carefully delineate the conditions where patents are of value and where they are unlikely to offer

[13] A 1998 survey by Statistics Canada asked biotechnology firms if they had had to abandon an important research project because progress was blocked by patents held by other firms. 15% responded yes.
[14] The real motivation here may be to maintain secrecy as long as possible while simultaneously preventing future infringement suits.

substantial advantages. A similar argument is made in a recent ETAN report on patent policy[15].

### 6.1 Patent disclosures

There are two general policy options to improve the value of patent databases to SMEs. The first is to improve the value of the information held in patent databases and the second is to improve access.

The value of patent databases can be increased by improving the quantity and quality of the technical information. The quantity can be increased through policies to encourage firms to patent a higher percentage of their inventions, as suggested by David and Foray (1994). This is already under consideration in many countries as a means of improving the competitiveness of SMEs by strengthening their use of intellectual property.

The quality of the technical information contained in patent databases could be improved through strengthening the disclosure requirement. Another variant, suggested by Bloch and Markowitz (1996), is to introduce a policy of mandatory disclosure of basic inventions that produce a large number of downstream discoveries, although it is difficult to imagine how such a policy could be implemented, since the value of a 'basic' invention only becomes evident over time.

Policies to increase the quality and quantity of the information available in patent databases, and to encourage their use, confront several difficulties. One is that higher patent propensity rates could limit the diffusion of innovations to SMEs by reducing the pool of technologies that can be adopted without paying license fees. It could also interfere with the use of technologies that are developed independently by different firms. A more thorny problem is due to the fact that the major barrier to patenting is the disclosure requirement, so it is not clear how more patenting could be encouraged. Reducing patent application fees, for example, is only likely to have a small effect on patent propensity rates because these costs largely discourage the patenting of marginal inventions or patenting by very small firms.

The greatest room for policy action is to help SMEs access patent data. The most effective policy option is to reduce the relative cost of using patent databases compared to alternative information sources. The EPO is, fortunately, moving in this direction by establishing a free Internet site for its patent database.

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