

PART 1

**PATENTS AND ECONOMIC PERFORMANCE:
ESTABLISHING THE LINKS**

Chapter 3

SCOPE AND NATURE OF THE PATENT SURGE: A VIEW FROM GERMANY

Knut Blind, Jakob Edler, Rainer Frietsch, Ulrich Schmoch
Fraunhofer Institute for Systems and Innovation Research
Karlsruhe, Germany

The patent surge in the 1990s – during which the number of German patent applications at the European Patent Office more than doubled - was not accompanied by similar development in R&D expenditure. This calls for explanations. Whilst acknowledging that there have been several institutional changes that affect the “supply side” of patents, this paper concentrates on the changing demand patterns for patents from the perspective of companies. Using a sample of more than 500 German companies active in patenting and responsible for 40% of German patent applications as a basis, we first investigate changes in the importance of patents and alternative instruments to protect intellectual property. As a second step, we ask whether the patterns in reasons for patenting have changed.

We found that in the last five years both formal patent protection and the role of informal protection strategies have become more important – especially for very large firms – whereas other formal IPRs have decreased in relative importance. Looking at motives for patenting, we observe several phenomena which may contribute to the explanation of the patent surge of the 1990s. First, the traditional motives to patent - protection from imitation or the exclusive use of intellectual property - are still the most important and have become even more so. In addition, patents are increasingly used to secure the technological space to develop new products (defensive use), but also to actively block competitors in their development activities (offensive use). Second, patents are recognised as part of companies’ intangible assets, and foster their reputation. Third, patents are assets in the trading of knowledge in the knowledge economy, as in cross-licensing agreements and patent pools. These aspects have great relevance for large and small companies. Fourth, patents serve as indicators for the performance of R&D departments, especially in large companies. Driven by increasing pressure to compete and to collaborate with other companies, the interplay of these rationales leads to increased patenting activity especially by the large companies, but also the small ones, and explains the breaking up of the direct relationship between R&D expenditures and patent applications.

The starting point of this analysis is the apparent discrepancy between the rather modest increase in R&D expenditure of German industry and the doubling of German patent applications in the 1990s.¹ The objective was threefold. First, on the basis of a patent database analysis, the study sought to analyse in depth the structure of the German industrial patentees and their patenting behaviour. Second, the study tried to reveal the driving forces for the increase in patenting in the 1990s. Accepting that some efficiency gains in corporate R&D have contributed to a growth in patenting, the major hypothesis was that the motives to file for a patent application have broadened and shifted in importance. A third purpose of the investigation was to determine the consequences such a potential shift might have for the usage of patents as an indicator for R&D activities and technological performance.

The analyses of patent statistics on European and international applications of German origin show unequivocally that since the mid-1990s in particular, there has been a massive upsurge in patent applications which cannot only be explained by a related extension of R&D activities. For patent intensities (*i.e.* patent applications per industrial R&D expenditure) in the 1990s, growth lies at 70% for the manufacturing industry in general and differs among sectors. Part of the increase in European and international patent applications can be explained by the growing orientation of the firms towards foreign countries, as their share of the sum of domestic and foreign applications grew from 50% in 1990 to 60% in 1999. A second important phenomenon of the 1990s, which played a crucial role in the design and interpretation of the survey, is the fact that in all technological fields, with the exception of chemistry, a further concentration of applications to very large applicants (thus very large enterprises) took place. This result also means that the large gap between patent applications and R&D activities is driven above all by the large enterprises.

In the survey, over 1 500 German enterprises which in 1999 had applied for a minimum number of three patents were contacted in writing in 2002. Due to great interest in the subject, there was a response rate of over 33% and thus over 500 completed questionnaires were received. In this random sample of enterprises actively involved in patenting, patents therefore have very high significance as a protective measure for inventions and innovations among alternative formal and informal protective mechanisms. Patents also had the highest growth in significance in the last five years. The survey also confirmed that the orientation towards patent applications abroad has become more important. Whereas differences between sectors are rather weakly marked, the survey results make it clear that company size matters. With increasing company size, the significance of patents grows and very large companies (over 2 000 employees) also indicate that the relevance of patents has grown most in recent years. This is also reflected in actual patent applications reported. More than two-thirds of the large enterprises and a majority of the very small firms report a growing number of applications in the past five years, while this is only true for half of the whole sample. With reference to future development, all enterprises with the exception of the very large ones anticipate a further increase in their patenting activities.

This estimate is confirmed by analysing the share of inventions for which patent applications are filed. Here, the very large enterprises do not expect further increases in the future, but rather stagnation. On the whole, the answers to the questions about the significance of patents and patenting activities suggest that the large enterprises find themselves at the beginning of a consolidation process, while the small and medium-sized enterprises still want to intensify their involvement. In view of the

1. K. Blind, J. Edler, R. Frietsch and U. Schmoch (2003), "Erfindungen kontra Patente. Schwerpunktstudie 'zur technologischen Leistungsfähigkeit Deutschlands'", Endbericht für das Bundesministerium für Bildung und Forschung (BMBF). Available at www.isi.fhg.de/publ/downloads/isi03b66/erfindungen-patente.pdf.

strong quantitative influence of the very large enterprises on the amount of total patent applications, there are indications of a slowdown compared to past increases.

How, then, is the patent surge to be explained? To answer this question, a set of bivariate and multivariate statistical analyses have been conducted. If one takes a look at the explanatory factors and concentrates first of all on the developments in corporate R&D, it can be seen that two-thirds of the enterprises also report an increase in their R&D expenditure. Furthermore, the connection between the rise in R&D expenditure on the one hand, and the increase in patent applications on the other, is clearly positive and significant for the total sample. However, the developments regarding sector and enterprise size vary considerably. For the domestic patents, the correlation between R&D expenditure and patenting is clear cut and significant only for the three sectors: chemistry, mechanical engineering and electrical engineering, *i.e.* the three most patent-intensive sectors of the sample. For the other sectors in the sample, the increase in patent applications is not connected with the rise in the R&D expenditure. Concerning the connection between change in patenting and changes in R&D expenditure, there are no significant differences as regards company size, especially for the very large enterprises which have increased their patent applications most in recent years. This result corresponds to the conclusion from the analysis of patent statistics: the very large enterprises with a large number of applications are mainly responsible for the discrepancy in the development of patent applications and R&D expenditure.

A further aspect of corporate R&D in the context of the patent surge and almost stagnant R&D expenses is the assumption that increased R&D efficiency has led to more patents per euro spent for R&D. The data for this assumption are based on self-estimates of those questioned. Over 80% of the enterprises report increased R&D efficiency, in particular, firms in the motor vehicle and chemistry sectors and the group of very large enterprises reach very high rates of approximately 90%. It is true that R&D efficiency gains have a significant statistical correlation with the increase in patent applications. However, this picture is sharpened when possible influential variables are taken into consideration. For example, the propensity to patent - *i.e.* the share of inventions for which patents applications are filed - is also higher in firms which have increased their R&D efficiency, and considerably higher than in companies with stagnating R&D efficiency. In view of the fact that one-third of the enterprises measure R&D efficiency by using patents, a part of the efficiency gains can be explained by the increased propensity to patent. At the same time, the upsurge in patent applications correlates with the significance of patents in internal management. The enterprises for which patents also serve as an internal performance indicator report a significantly higher increase of patent applications in the past than companies for which patents do not play any role as an internal performance indicator. Likewise the increase of patent applications by firms which measure their R&D efficiency via patents is greater than for the enterprises which do not measure their efficiency via patents. Thus the conclusion that efficiency gains in R&D lead to more patents is to a certain extent a circular argument which is difficult to validate. The conclusion can also be that the patent applications rise because they are internal performance indicators. In any case, efficiency gains cannot sufficiently explain the patent surge.

Having identified the main actors and the R&D-relevant explanatory factors for the large rise in patent applications, the question arises as to what the reasons are for the partial uncoupling of patenting and R&D activities. Two sets of explanations emerged. First, the upsurge of patenting is simply an expression of the increased intensity of competition and of co-operation. Patents are a major and increasingly important instrument both for securing one's position in joint efforts to generate knowledge and for securing competitive advantages in the technological competition.

The second set of explanatory factors consists of the altered motivation structure regarding the use of patents. Although it must be recorded that patents above all are still used as protection from imitation and as a means to secure markets. These reasons have become more important in view of rising competition, and other motives which are only indirectly connected to the R&D activities have gained considerably in relevance. First, the blocking of competitors by means of patenting must be mentioned, as patents are used to maintain one's own room to manoeuvre and at the same time to limit that of the competitors. Patents also increasingly contribute to the reputation of the company and help to increase the value of the enterprise. Patents in the knowledge society also serve as currency for knowledge and intellectual assets, and they adopt an exchange function not only vis-à-vis co-operation partners and licensees, but also with capital investors. As the pressure to co-operate and the options for doing so have increased in the last years, the number of patent applications has also increased commensurately. Lastly, for many companies patents are appropriate instruments for controlling internal performance and motivations.

Although the utilisation of patents differs by sector, basically very similar patterns emerge with regard to ranking different motives reported by respondents with the only exception being the pharmaceutical and biotech sectors, where reputation and exchange motives are found to be relatively more significant. The rather uniform sectoral pattern means that the fundamental strategies and driving forces are very similar across the sectors and have also come closer, and therefore differentiated patenting strategies have become a phenomenon for the entire industry. Thus a current theory in the literature cannot be confirmed (Cohen *et al.*, 2002)² according to which sectors that are characterised by complex, modular technologies (*e.g.* electrical engineering) display other motivational structures than those with so-called distinct technologies (chemistry).

On the other hand, the differentiation according to company size reveals a few important differences. While protection from imitation and the blocking motive are equally important for enterprises of all sizes, for the large firms the exchange and incentive motives are much more important than for the medium-sized enterprises. Moreover, together with the blocking motive, these motives have also gained greatly in significance for the large companies compared to the total sample. For small companies, patents are obviously important assets in negotiations with capital investors, but also with large co-operation partners. Patents are therefore important for the market entry of small enterprises and their establishment in the market.

One dimension often overlooked in survey-based analyses is the relevance of internal institutionalisation of patenting activities. There is an obvious correlation between size and the existence of a patent department. And it makes a difference who is asked. Managers responsible for patenting rate the significance of patents and the increase of that significance in the last five years higher than R&D managers, while the latter, stressing the technological value of their work, rate the relevance of modular patenting, *i.e.* patenting of single technological modules as more important than patent managers.

The key finding of the analysis is that for the very large firms which determine the changes in patent numbers, there is no connection between increase in R&D expenditure and rise in patent applications. Large companies report that the blocking motive, internal performance incentives and technological exchange have been gaining more significance in the last few years in relation to the sample as a whole. Therefore, as the increase in patent applications cannot so much be traced back to

2. W.M. Cohen, A. Goto, A. Nagata, R.R. Nelson and J.P. Walsh (2002). "R&D Spillovers, Patents and the Incentives to Innovate in Japan and the United States", *Research Policy*, 31, 1349-1367.

R&D increases, it is rather determined by the fact that the large applicants for patents have been using patents in the technology competition in a targeted manner (blocking) and understand them as “currency” in the external technology market as well as an indicator in internal R&D management. The main result, therefore, is that patenting has become a multi-motive game, the dynamics of which are essentially the result of a patent race between large enterprises.

How can these results be interpreted as regards the trends in patenting behaviour? The statistical analysis and the enterprise survey have demonstrated that there is a partial uncoupling of patent applications and the R&D activities of enterprises, even if part of the increase in patents can be explained by the gains in R&D efficiency. The driving forces for this divide were mainly the very large enterprises, in which increasingly strategic and management-relevant considerations led to a more intensive patenting behaviour such that this group of enterprises can claim larger shares of the total patent applications for themselves. However, there are hints that the very large enterprises will not extend their patenting activities in the future, and instead the smaller and medium-sized companies will intensify their involvement somewhat. This means that the temporary distortions between the patenting activities of small or medium-sized enterprises and large firms will return to a new equilibrium. A process of adaptation can also be observed between the sectors. While the chemicals industry already distinguished itself in the past by its markedly intensive patenting practice, other sectors have meanwhile caught up or plan to undertake more efforts in patenting in the future, whilst chemistry will probably develop along average lines.

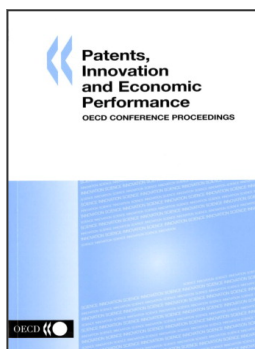
Finally, the results for Germany point toward interesting conclusions as regards international comparison, even if other countries have not been explicitly investigated in this study. In contrast to US and Japanese companies, which adopted strategic patenting in the 1980s, European enterprises developed a strategically designed patenting culture only in the mid-1990s and so followed the Japanese and American models. On the basis of the applications at the EPA, however, a clear increase in patenting intensities could be registered for all large applicant countries in relation to industrial R&D expenditure. Fundamentally parallel developments are to be observed. Furthermore, the large multinational enterprises in all Triad regions are not only active in R&D, but also in patenting, such that this group contributes to an international convergence of the R&D-patent relations not only by its own behaviour, but also by the reactions provoked from the competitors.

What conclusions can be drawn from these results for the use of patents to report on technological performance? If the strands of arguments on the various analytical levels are summarised, one can assume distortions in the relationship between R&D activities and patent applications in the past. The study has revealed that this discrepancy cannot be explained by one single factor, for there is a whole bundle of explanatory factors which are often interdependent. It is important, however, to note that in the meantime, numerous factors are working towards a new balance between R&D activities and patenting which will lead to a new, more stable relationship. Above all due to the strategic patenting motives this new relationship between R&D activities and patenting will be characterised by a higher patent propensity than in the past. As for the use of the patents as an indicator, it is clear that it is still very suitable for inter-sectoral and inter-territorial comparisons and will especially be so in the future. However, when interpreting intertemporal comparisons through and beyond the 1990s, the turbulent developments towards a new balance must be considered. At the same time, the interpretations of existing international comparisons in the Triad dating from the 1990s must take into account that the development within Europe obviously ran fairly parallel, but started later than in the United States and Japan.

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