

MPRA

Munich Personal RePEc Archive

Appropriability of Technical Innovations: An Empirical Analysis

Harabi, Najib

Institute of Economics at the University of Zurich

June 1994

Online at <https://mpra.ub.uni-muenchen.de/26267/>

MPRA Paper No. 26267, posted 03 Nov 2010 16:06 UTC

Reihe D

Arbeitspapier

Nr. 32

**Appropriability of
Technical Innovations:
An Empirical Analysis ***

Najib Harabi

Juni 1994

* Paper prepared for the International Conference on the Economics of Intellectual Property Rights to be held in Venice on October 6-8, 1994. A revised version is forthcoming in the journal "Research Policy".

Abstract	1
1 Introduction	2
2 Appropriability of Technical Innovations: Empirical Evidence from Swiss Industry	4
2.1 Data	4
2.2 Results	5
2.2.1 Appropriability of the Results of Innovations	5
2.2.1.1 Patents as a Means of Protection against Imitation	7
2.2.1.2 Patents as a Means of Securing Licensing Fees	8
2.2.1.3 Secrecy	9
2.2.1.4 Lead time	9
2.2.1.5 Capturing and Protecting Cost Advantages	9
2.2.1.6 Superior Sales and Service Efforts	10
2.2.2 The Question of Differing Effectiveness of Patents	10
2.2.3 Other Functions of Patents	12
3 Summary and Conclusion	14
Bibliography	17

List of Tables

1:	Effectiveness of alternative means of protecting the competitive advantages of new or improved processes and products	7
2:	Limits of effectiveness of patents on new or improved processes and products	12
3:	Motives for patenting product innovations	13
4:	Motives for patenting process innovations	14

Abstract

Appropriating the economic returns from technical innovations is very important for individual inventors and innovators, as well as for technical change in individual markets and for the whole economy. Since appropriability is difficult to measure directly, many researchers have been trying to investigate it indirectly and qualitatively by examining the effectiveness of various means of appropriability. The most important of these means are patents, secrecy and lead time and related advantages.

The purpose of this paper is to investigate empirically the effectiveness of different means of protecting the competitive advantages of technical innovations in Switzerland. The analysis is based on a survey conducted in 1988 among 358 Swiss experts, mainly R&D executives from selected firms. They represented 127 different lines of business, mainly in the manufacturing sector. The results can be summarized as follows:

1. For process innovations lead time is generally considered as the most effective means of appropriability. For product innovations superior sales and service efforts are viewed as the most effective means, followed by lead time.
2. For both product and process innovations patents are generally considered to be the least effective means of appropriability.
3. Patents as a means of appropriability in the Swiss context are only effective in a few industries: in chemicals, including drugs, and in some cases in the machinery and electrotechnics industries.
4. The ability of competitors to "invent around" patented innovations and the perception that patent documents require "disclosure of too much information" are considered as the most important constraints on the effectiveness of patents.
5. Inventors and innovators have manifold reasons for patenting their new ideas. Although patents may not provide adequate protection against imitation, they can contribute to enhancing the patent-holders' negotiating position towards third parties. This can be the case in negotiations either with other firms (for example about R&D-related agreements, fusions, take-overs etc.) or with governmental agencies (for example concerning access to foreign markets).

Appropriability of Technical Innovations: An Empirical Analysis

1 Introduction

Already in the 1960s, Arrow (1962) recognized the importance of appropriability of the results of innovations for the allocation of resources in innovative activities. Economic units are only interested in getting involved in the production of innovations, if ex-ante a high probability exists they can appropriate fully or at least partially the resulting returns. The microeconomic threshold for the expression "at least partially" is the condition that the discounted present value of profits derived from an innovation is at least equal to the innovation costs involved. At the margin, this condition means that in equilibrium the marginal innovation cost must be equal to the marginal revenue. Consequently, innovators must appropriate at least enough additional revenue to enable them to cover their additional costs.

One indicator for appropriability is the ratio of private returns to social returns resulting from innovations. This ratio varies between 0 and 100%, and the closer it is to 100%, the better is appropriability from the perspective of the innovators. Furthermore, there is a difference between appropriability ex-ante and appropriability ex-post (see Trajtenberg et al. (1992)). The ex-ante notion emphasizes the potential capability of an innovator, (or the organization which owns the innovation), to fully, or at least partially, appropriate the returns from the innovation. In other words, the question is: how large is the ratio of private returns to social returns resulting from an innovation, or how great are the returns which an innovator can expect to appropriate privately? The magnitude of this ratio depends on specific characteristics of the innovation itself (for example, on its scientific base). It also depends on the characteristics of the innovating firm and on the market structures within which it is operating. Arrow's concept of appropriability describes the ex-ante financial incentive system which enables the innovator to invest resources in innovations. The ex-post concept of appropriability, on the other hand,

defines the proportion of social returns that can be privately appropriated by the innovator after the innovation has been introduced.

Despite its theoretical and practical importance, it is still difficult to measure "appropriability" - both ex-ante and ex-post. One of the main difficulties is to implement a theoretically sound and an empirically precise method of measuring the private and social returns resulting from innovations. Nevertheless, a number of researchers have tried to overcome these difficulties by examining, indirectly and qualitatively, the effectiveness of different means of appropriability (see Levin et al. (1983 and 1987); for a survey of the literature see Dosi (1988), Cohen/Levin (1989) and European Patent Office/IFO-Institute (1993)). The most important of these means are: Patents; Secrecy ; Lead time; Moving quickly down the learning curve; Superior sales or service efforts; and Making imitation more difficult for competitors, i.e. raising imitation cost and imitation time.

Other means of appropriability exist. Some of them are related to economies of scale in manufacturing (integrated circuits and computer), in R&D (telecommunications) or in marketing and sales services (mainframe computers). In all these areas a minimal firm size is needed; having a critical mass of these capabilities acts as a market entry barrier and, therefore, as a protection from competition. Other means of appropriability are on the other hand linked to certain market structures. Although there is no definitive consensus on this issue, and economists are still debating the relationship between market structure and innovation, there is some theoretical and empirical evidence to suggest that oligopolistic market structures offer enough protection for innovators and therefore a better degree of appropriability for their innovations (Scherer/Ross 1990:628).

The above mentioned means of appropriability can be grouped in three sub-categories: (i) patents; (ii) secrecy and (iii) lead time and related advantages, so called "first-mover advantages" - for a summary see Scherer/Ross (1990). The latter means that lead time could be used to strive for further advantages in manufacturing (achieving and securing learning curve

advantages) and in marketing (building-up superior sales and service efforts). Lead time could also be used to either hinder or at least to delay the imitation of one's own innovation by competitors, i.e. by increasing the cost and time necessary.

In sum, there are numerous means of capturing and protecting the competitive advantages of technical innovations; the most important ones have been briefly mentioned above. In this paper I examine empirically the effectiveness of these means, using data from Switzerland. I seek to answer this question not only at the level of Swiss industry as a whole; I also look for interindustrial differences. My major motivation for undertaking this research is that - with the exception of the IFO studies for Germany (Greferman et al. (1974) and Täger (1989) - all presently known empirical studies are mainly based on Anglo-Saxon experience (on Great Britain: Taylor and Silberston (1973) and on the USA: Mansfield (1986) and Levin et al. (1987)). Until now, there is no empirical analysis of appropriability conditions in the context of the specific institutional characteristics of Switzerland. From this point of view we can consider Switzerland as an example of a small, open European economy with "first to file" rules in its patent law (as opposed to "first to invent" rules in the USA) and with a special industrial structure.

2 Appropriability of Technical Innovations: Empirical Evidence from Swiss Industry

2.1 Data

In the summer of 1988 experts were asked to answer questions related to the issue of appropriability of technical innovations in Swiss industry. Since an adequate completion of the questionnaire required solid knowledge of the technology as well as of the market conditions in a certain line of business, the experts questioned were mainly R&D-executives of selected firms.

The sample frame for the survey was formed by R&D-experts working in 1157 firms which were characterized as "firms actively engaged in R&D" (in a publication of the head office of

the Swiss Federation for Trade and Industry, see Schweizer Handels- und Industrieverein 1987:11). Experts in 217 firms located in the French and Italian-speaking parts of the country could not complete the German-written questionnaire and were dropped from the survey. Nonetheless, experts in the larger firms in these regions (who could read German) did take part. Of the 940 experts questioned, 358, or 38 percent, completed the questionnaire. These 358 experts were active in 127 different lines of business (as defined by the Federal Office of Statistics (1985)). Taking the industrial structure of their activities at the 2-digit level, 38% of the respondents worked in the machinery and metals industry, 23% in the electrotechnics industry, 10% in the chemicals industry, 2% in the watch-making industry, 3% in the textile/clothing industry, 6% in the food industry, 5% in the synthetics/paper industry; additionally, 4% of the responses came from the construction industry, 7% from technical services and 3% from private research laboratories (cf. Harabi (1991) for a detailed description of this survey).

2.2 Results

2.2.1 Appropriability of the Results of Innovations

Table 1 summarizes the answers to the following question (see also Levin et al. 1988:3): "The points 1-6 listed below are means of capturing and protecting the competitive advantages of new or improved products. How effective is each of them in your line of business?"

1. Patents to protect against the imitation of new and improved products
2. Patents to secure licensing fees
3. Secrecy
4. Lead time
5. Moving quickly down the learning curve (capturing and securing cost advantages)
6. Superior sales and service efforts."

This question was asked once for product innovations and once for process innovations. The answers were to be given on a scale from 1-7: 1 = not effective; 2 = moderately effective; 7 = very effective.

The first two columns of Table 1 indicate the unweighted averages of the answers and the standard errors (in brackets). Columns 3 and 4 indicate the distribution of these averages. Q1 stands for the first quartile; similarly, Q3 represents the third quartile. That means the middle 50% of all the answers lies between these two values. The results of this table can be summarized as follows:

Lead time is considered as the most effective means of capturing and protecting competitive advantages of process innovations. The average response was 5.5 and the middle 50% of all responses showed a score between 5 and 6. As for product innovations, however, superior sales and service efforts received the highest score, followed by lead time. For both product and process innovations, lead time and related advantages in manufacturing and marketing represent the most effective means of capturing and protecting competitive advantages.

Furthermore, the results indicate that the second most important means of appropriability is secrecy. Secrecy is, in addition, as one can expect, more effective for process than for product innovations. Facing the decision of either patenting or keeping an innovation secret, innovators tended to choose secrecy in cases of process innovations and patenting in cases of product innovations. This empirical finding confirms the expectation: innovators in a market economy are interested in keeping their process innovations secret but spreading the word as widely as possible about their product innovations.

In general, patents are considered the least effective means of capturing and protecting competitive advantages of product and process innovations (exceptions are listed below). Their averaged score is below 4, and the middle 50% of all answers was between 2 and 3.5 for

process innovations and between 2 and 5 for product innovations. The results show, however, that product patents seem to be more effective than process patents.

Table 1: Effectiveness of alternative means of protecting the competitive advantages of new or improved processes and products (1 = not at all effective; 7 = very effective)

	Mean (standard error)		Q1 (25%) - Q3 (75%)	
	Processes	Products	Processes	Products
1. Patents to prevent duplication	2.76 (0.11)	3.44* (0.14)	2.0 - 3.5	2.0 - 5.0
2. Patents to secure royalty income	3.25* (0.14)	3.60* (0.15)	2.0 - 4.0	2.4 - 5.0
3. Secrecy	3.89 (0.14)	3.60* (0.15)	3.0 - 5.0	2.0 - 5.0
4. Lead time	5.37 (0.16)	5.63 (0.10)	5.0 - 6.0	5.0 - 6.4
5. Moving quickly down the learning curve	4.56 (0.12)	4.42 (0.11)	4.0 - 5.3	4.0 - 5.0
6. Superior sales or service efforts	5.20 (0.13)	5.70* (0.11)	4.2 - 6.0	5.0 - 6.5

* inter industry differences in means significant at the: 0.05 level

Q1: First quartile; Q3: third quartile

The overall results presented so far should, however, not obscure the fact that there are interindustrial differences with respect to the effectiveness of the different means of appropriability. Statistical tests, for example analysis of variance, show that significant interindustrial differences (significance level 0.05) regarding the effectiveness of the means "patents to prevent duplication", "patents to secure licensing fees", "secrecy" and "sales and service efforts" (points 1, 2, 3 and 6 in Table 1) exist. These interindustrial differences are further examined below.

2.2.1.1 Patents as a Means of Protection against Imitation

The general empirical finding that patents are an ineffective means of protection against imitation is confirmed when results are disaggregated at lower levels of industry classification.

Viewing the results at the (2-digit) level, the following comments can be made:

- For process innovations the effectiveness of patents to prevent duplication is regarded as low in all industries surveyed. In none of these industries is the mean response higher than 4 on a

seven point scale. The highest score is given to the chemicals and synthetics industries and the lowest score is given to industries providing technical services.

- For product innovations the picture seems to be similar. Product patents, though on the average fairly ineffective in protecting innovations, tend to be, nonetheless, more effective than process patents. Experts from private research laboratories gave the highest score for patents as a means to prevent duplication, followed by those from machinery, metals processing and chemicals industries. In all other industries they are considered less effective.

Viewing the results at the lower level of the 4-digit industry classification, the overall empirical finding that patents are effective only in a few industries is confirmed. In the Swiss context this is especially the case in the following industries: chemical products for plant protection (industry no. 3129), cosmetic products (3127), chemical products (3100) and agricultural tools and equipment (3461).

2.2.1.2 Patents as a Means of Securing Licensing Fees

As shown in Table 1, patents are also considered on the average as ineffective in securing licensing fees. A variation around this average exists, however. For product innovations patents are considered as a moderately effective means of securing licensing fees in some industries - private research laboratories, machinery, metals processing and chemicals - and ineffective in the others. Interindustrial differences are less obvious for process innovations.

From the point of view of individual respondents the results regarding the effectiveness of patents in their double function - as a means to prevent duplication and as a means to secure licensing fees - it is remarkable that

- for product innovations only one expert rated patents to prevent duplication higher than all other means of appropriability. Furthermore, only six experts (four from the machinery and metals processing industry; one from electrotechnics and one from the synthetics and paper industry) rated patents to secure licensing fees higher than all other means of appropriability.

Looking at patents as a means both to prevent duplication and to secure licensing fees, only seven experts rated patents higher than the other means of appropriability. In sum, 14 experts, or 4 percent of all respondents, considered patents to be more effective in protecting product innovations than all other means of appropriability.

- for process innovations 6 percent of all respondents, mainly from the machinery and electrotechnics industries, viewed patents as more effective in protecting process innovations than all other means of appropriability.

2.2.1.3 Secrecy

Again, the results suggest that there are some interindustrial differences. The respondents from the following industries, listed in descending order of importance, consider secrecy as a relatively effective means of protecting process innovations against imitation: private research laboratories, chemicals, electrotechnics and the food industry. It is considered less effective in the construction and watch-making industries. As for product innovations, the results vary only minimally among industries. All experts agree secrecy is on the average a relatively weak means of appropriability.

2.2.1.4 Lead time

The responding experts concur that lead time is the most effective means of appropriating the returns from both product and process innovations. Lead time has, on the average, a score of 5 or more. In addition, there are no significant interindustrial differences. Only in the construction industry is it below average. This could be explained by the fact that in Switzerland this industry is dominated by cartels, in particular if compared with, for example, the watch-making or the machinery industry, which are subject to stronger international competition.

2.2.1.5 Capturing and Protecting Cost Advantages

Here the various industries do not significantly differ in their assessment of the effectiveness of this means of appropriability. However, with regard to product innovations the following industries rated this factor above average in importance: electrotechnics, machinery, metals

processing, food and synthetics. It was also rated above average by private research laboratories. On the other hand, it was scored below average by the remaining industries, especially by the textile and clothing industries. For process innovations, the industry specific results are similar.

2.2.1.6 Superior Sales and Service Efforts

Superior sales and service efforts capture and protect competitive advantages primarily of product innovations. They are relevant to process innovations only if these are product innovations as well and can be marketed as such. But in this case they should be considered as product and not as process innovations. As for the effectiveness of this means of appropriability, there is a consensus among all experts that it is, on the average and in all industries, strong. Interindustrial differences exist, but they are relatively small. For product innovations the only exception is the textile/clothing industry, where this is given a below average score. On the other hand its score is above average in synthetics/paper, watch-making, electrotechnics and in private research laboratories.

2.2.2 The Question of Differing Effectiveness of Patents

In practice, the question of the protective capacity of patents is very complex. In addition, issues related to the legal and economic aspects of patents are difficult to catalogue and to categorize for questionnaires in mail surveys. Nevertheless, I attempted to investigate systematically the possible reasons for the low effectiveness of patents as a means of protecting competitive advantages from innovations in the Swiss context. The following question was asked (see also Levin et al. 1988:4): "The points 1-8 listed below are possible limits on the effectiveness of patents as a means of protecting competitive advantages of new or improved products. To what extent is this the case in your line of business?"

1. Not all new and improved products are readily patentable
2. If challenged, patents can lose their validity
3. Firms do not attempt to enforce patents
4. Competitors can legally "invent around" patents

5. The technology is moving so rapidly that patents become irrelevant
6. Patent documents require disclosure of too much information
7. Legal limits on licensing (mandatory registration, compulsory licensing , etc.)
8. Cooperation in R&D-projects, also between competitors (through, for instance, joint R&D ventures or R&D-related information exchanges)."

The question was asked once for product innovations and once for process innovations. The scale ranged from 1 (does not limit the effectiveness of patents) through 4 (moderately important limit on effectiveness of patents) to 7 (very important limit on effectiveness of patents).

Table 2 summarizes the responses. For both process and product innovations the ability of competitors to "invent around" patents is regarded as the most important constraint on the effectiveness of patents. The next important perceived limit is that patent documents require disclosure of too much information. For both factors fifty percent of all responding experts gave a score of 4 or more. The least limiting factors are the legal restrictions on licensing (such as compulsory licensing etc.) and the growing phenomenon of R&D cooperation, even among rivals (joint R&D projects, R&D-related information exchange). Table 2 also indicates that at least the three major limits 4, 5 and 6 are generally more severe for processes than for products, which is consistent with the earlier finding that product patents are more effective than process patents.

Table 2: Limits of effectiveness of patents on new or improved processes and products
(1 = not an important limit; 7 = very important) (n = 127)

	Mean (standard error)		Q1 (25%) - Q3 (75%)	
	Processes	Products	Processes	Products
Limits of effectiveness				
1. Not all products/processes readily patentable	4.13 (0.15)	4.49* (0.15)	3.0 - 5.0	3.5 - 5.9
2. Patents unlikely to be valid if challenged	3.98* (0.14)	4.19 (0.14)	3.0 - 5.0	3.3 - 5.0
3. Firms do not enforce patents	4.11 (0.14)	4.03 (0.13)	3.3 - 5.0	3.4 - 5.0
4. Competitors legally "invent around" patents	5.32 (0.14)	5.26 (0.14)	4.7 - 6.6	4.6 - 6.0
5. Technology moving so fast that patents are irrelevant	4.34 (0.16)	4.05* (0.16)	3.0 - 5.7	3.0 - 5.0
6. Patent documents disclose too much information	4.85 (0.14)	4.63 (0.15)	4.0 - 6.0	4.0 - 6.0
7. Legal restrictions on licensing (necessity for registration, compulsory licensing)	3.76 (0.13)	3.67 (0.13)	3.0 - 4.5	3.0 - 4.1
8. R&D-Cooperation also with competitors (joint research, exchange of r&d-related information)	3.78 (0.14)	3.62 (0.14)	3.0 - 4.7	3.0 - 4.3

* Interindustry differences in means significant at the 0.05 level
Q1: First quartile; Q3: third quartile

In sum, the experts' responses indicate that patents are weak in some industries because they can be easily avoided and because patent documents reveal important technical information that can be easily used by competitors. This raises a puzzle: on the one hand, patents are relatively ineffective, but, on the other hand, in practice, patents statistics show that they are widely used. Why?

2.2.3 Other Functions of Patents

Presumably, this question can be answered by the fact that inventors and innovators, especially those organized in firms, have other reasons for patenting than just those of protecting their ideas from duplication or for securing royalty incomes. In current literature these other reasons are described as follows:

- Patents as a means of disrupting R&D or product lines of competitors
- Patents as a means of evaluating the performance of R&D employees
- Patents as a means of achieving or maintaining a desirable negotiating position with other firms

- Patents as a means of entry into foreign markets (directly through direct investment and production or indirectly through granting a licensing agreement).

In order to empirically investigate these hypotheses, I asked patent-attorneys (in a separate survey) about their assessment of the above mentioned motives for patenting. Since the sample of the participating attorneys was not representative, the results have only case study character and are mainly of an explorative nature.

The results of this survey are summarized in Tables 3 and 4. They show that the motivational structure for patenting product and process innovations are manifold and therefore very complex. In addition to the well-known and obvious reasons - protection from duplication and securing royalty income - motives 5 and 6 below play an important role. They appear more relevant for product patents than for process patents. On the other hand, motives 3 and 4 appear least relevant in Switzerland.

Table 3: Motives for patenting product innovations (1 = not relevant; 7 = very relevant). Responses from 9 patent attorneys

	Arithmetic Mean	Q1 (25%) - Q3 (75%)
1. Patents to prevent duplication of new products	6.55	6.00 - 7.00
2. Patents to secure licensing fees	6.55	6.00 - 7.00
3. Patents as a means of disrupting R&D lines of competitors	4.00	3.00 - 4.00
4. Patents as a means of evaluating the performance of R&D employees	3.00	2.00 - 4.00
5. Patents as a means of achieving a desirable negotiating position with other firms	6.00	6.00 - 7.00
6. Patents as a means of entry into foreign markets	5.00	4.00 - 7.00

Table 4: Motives for patenting process innovations (1 = not relevant; 4 = somewhat relevant; 7 = very relevant). Responses from 9 patent attorneys

	Arithmetic Mean	Q1 (25%) - Q3 (75%)
1. Patents to prevent duplication of new processes	6.00	5.00 - 7.00
2. Patents to secure licensing fees	6.50	6.00 - 7.00
3. Patents as a means of disrupting R&D lines of competitors	3.50	2.00 - 4.00
4. Patents as a means of evaluating the performance of R&D employees	3.00	2.00 - 4.00
5. Patents as a means of achieving a desirable negotiating position with other firms	6.00	6.00 - 7.00
6. Patents as a means of entry into foreign markets	5.00	4.00 - 6.00

3. Summary and Conclusion

Appropriating the economic returns from technical innovations is very important not only for individual inventors and innovators, but also for technical change in individual markets and for the whole economy. Since appropriability is difficult to measure directly, many researchers have been trying to investigate it indirectly and qualitatively by examining the effectiveness of various means. The most important of these means are patents, secrecy and lead time and related advantages.

The purpose of this paper is to investigate empirically the effectiveness of different means of protecting the competitive advantages of technical innovations in Switzerland. The analysis is based on a survey conducted in 1988 among 358 Swiss experts, mainly R&D executives from selected firms. They represented 127 different lines of business, mainly in the manufacturing sector. The results can be summarized as follows:

1. For process innovations lead time is generally considered as the most effective means of appropriability. For product innovations superior sales and service efforts are viewed as the most effective means, followed by lead time.
2. For both product and process innovations patents are generally considered to be the least effective means of appropriability.

3. Patents as a means of appropriability in the Swiss context are only effective in a few industries: in chemicals, including drugs, and in some cases in the machinery and electrotechnics industries.
4. The ability of competitors to "invent around" patented innovations and the perception that patent documents require "disclosure of too much information" are considered as the most important constraints on the effectiveness of patents.
5. Inventors and innovators have manifold reasons for patenting their new ideas. Although patents may not provide adequate protection against imitation, they can contribute to enhancing the patent-holders' negotiating position towards third parties. This can be the case in negotiations either with other firms (for example about R&D-related agreements, fusions, take-overs etc.) or with governmental agencies (for example concerning access to foreign markets).

These empirical results are relevant for both governments and firms involved in designing and implementing innovation policies. Since lead time and related advantages are the most effective means of capturing and protecting competitive advantages of innovations and therefore the key factor for long term success of firms and industries, it is necessary for both government and firms to take all measures to speed up the whole innovation process. Lead time is more important than legal protection provided by patents. These are in general weak and only in a few industries effective in protecting the economic fruits resulting from new products and processes - an industry specific patent policy would be the right policy conclusion. A patent system taking into account interindustrial differences, could, however, create some problems for traditional lawyers who, normally, advocate uniform legal rules in this area.

It is also to be recommended that firms, which in market economies are the main actors in the innovation process, implement a strategy capable of protecting their innovations. They are advised to design a patent policy that takes into account the technical nature and life-cycle of their products, as well as existing market conditions and structures (see Teece 1986). This recommendation is particularly important for small and medium-sized enterprises, which

usually lack the necessary technical know-how. At a conference of the European Community this is pointed out as follows: "...small and medium-sized businesses were unable to develop their own property rights strategies satisfactorily, since they rarely had the necessary competence and special experience" (Täger/Witzleben, 1991:225).

Bibliography

- Arrow, K.J. (1962), "Economic Welfare and the Allocation of Resources for Invention", in: *the Rate and Direction of Inventive Activity*, ed. R.R. Nelson. Princeton: Princeton University Press.
- Bundesamt für Statistik (1985), *Allgemeine Systematik der Wirtschaftszweige*. Bern.
- Cohen, W.M., Levin, R.C. (1989), "Empirical Studies of Innovation and Market Structure", In: *Handbook of Industrial Organization*, Vol 2, ed. R. Schmalensee and R. Willig. Amsterdam: North Holland.
- David, P.A. (1992), "Intellectual Property Institutions and The Panda's Thumb. Patents, Copyrights, and Trade Secrets in Economic Theory and History" Discussion Papers Series CEPR No. 287. Stanford University.
- Dosi, G. (1988), "Sources, Procedures, and Microeconomic Effects of Innovation", *Journal of Economic Literature*, 26:1120-1171.
- European Patent Office, IFO Institute for Economic Research (1993), *Results and Methods of Economic Patent Research. Proceedings of the 1st EPO-IFO-Workshop on March 19/20, 1992 at the European Patent Office. Munich.*
- Grefermann, K., Röthlingshöfer (1974), *Patentwesen und technischer Fortschritt, Teil II: Patent- und Lizenzpolitik der Unternehmen*. Göttingen: Verlag Otto Schwarz & Co.
- Harabi, N. (1988), *Einflussfaktoren von Forschung und Entwicklung (F&E) in der Schweizer Industrie. Schriftliche Befragung zu einer laufenden Untersuchung*. Zürich: *Handelwissenschaftliches Seminar der Universität Zürich*.
- Harabi, N. (1991), "Einflussfaktoren von Forschung und Entwicklung in der Schweizer Industrie. Ergebnisse einer schriftlichen Expertenbefragung", *Die Unternehmung - Schweizerische Zeitschrift für betriebswirtschaftliche Forschung und Praxis*, 45:349-368.
- Kitch, E. W. (1977), "The Nature and Function of the Patent System", *Journal of Law and Economics*, 20:265.
- Levin, R.C. (1986), "A New Look at The Patent System", *American Economic Association Papers and Proceedings*, 76:199-202.
- Levin, R.C., Klevorick A.K., Nelson, R.R., Winter, S.G. (1983), *Questionnaire on Industrial Research and Development. Technical Report*, Yale University.
- Levin, R.C., Klevorick A.K., Nelson, R.R., Winter, S.G. (1987), "Appropriating the Returns from Industrial Research and Development", *Brookings Papers on Economic Activity*, S. 783-821
- Mansfield, E. (1986), *Patents and Innovation: An Empirical Study*. *Management Science*, 32:173-181.
- Ordober, J.A. (1991), "A Patent System for Both Diffusion and Exclusion", *Journal of Economic Perspectives*, 5: 43-60.
- Schweizerischer Handels- und Industrieverein (1987), *Forschung und Entwicklung in der Schweizerischen Privatwirtschaft 1986. Bericht zur sechsten Erhebung des Vorortes in Zusammenarbeit mit dem Bundesamt für Statistik, Zürich*
- Scherer, F.M., Ross, D. (1990), *Industrial Market Structure and Economic Performance* (third Edition). Boston: Houghton Mifflin
- Täger, U. (1989), *Entwicklungstendenzen im Patentverhalten deutscher Erfinder und Unternehmen*. Ifo-Schnelldienst 23/89, 14-26.
- Täger, U., von Witzleben, A. (Eds.) (1991), *PATINNOVA '90. Strategies for the Protection of Innovation. Proceedings of the First European Congress of Industrial Property Rights*

and Innovation. Dordrecht/Boston/London: Kluwer Academic Publishers and Deutscher Wirtschaftsdienst (Cologne).

Taylor, C.T. and Silberston, Z. A.(1973), *The Economic Impact of the Patent System: A Study of the British Experience*. Cambridge: Cambridge University Press.

Teece, J. D.(1986), "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy", *Research Policy*, 15:285-305.

Trajtenberg, M., Henderson, R. and Jaffe, A. (1992), "Quantifying Basicness and Appropriability of Innovations with the Aid of Patent Data: A Comparison of University and Corporate Research", Paper presented at the INSEE Seminar on Technological Appropriation, Paris, 9.-10. Juni 1992

ARBEITSPAPIERE REIHE D / WWI
1978 bis

JAHR	NR.	TITEL	AUTOR
1978	1	Der schweiz. kommunale Finanzausgleich	Peter Bohley (Festschrift Haller)
1981	2	Zur Hochschulfinanzierung in der Schweiz	Armin Jans
1983	3	Studiengebühren mit Zertifikaten und Steuerrechnung: Eine Weiterentwicklung des schweiz. Hochschullastenausgleichs	Peter Bohley
1984	4	Optimales Wachstum und Auslandverschuldung - ein Diskussionsbeitrag -	Helmut Schneider
1985	5	Spezielle Faktorensteuern in einer kleinen offenen Volkswirtschaft	Helmut Schneider
1986	6	Altersicherung in einer kleinen offenen Volkswirtschaft - zur Wirkungsweise des Kapitaldeckungsverfahrens -	Helmut Schneider
1987	7	Die Zukunft der Altersvorsorge	Helmut Schneider
1989	8	Moralische Forderungen an Wirtschaft und Unternehmung	Jean-Louis Arni
1989	9	Zum Verhältnis von Rationalität und Moralität: Eine Auseinandersetzung mit David Gauthiers "Morals by Agreement"	Jean-Louis Arni
1990	10	Entschuldung der III. Welt	Helmut Schneider
1990	11	Die Oekonomie - und ihre unrealistischen Annahmen	Jean-Louis Arni
1990	12	Bietet die Oekonomie "praktische" Orientierungen?	Jean-Louis Arni
1990	13	Einflussfaktoren von Forschung und Entwicklung in der Schweizer Industrie / Ergebnisse einer schriftlichen Expertenbefragung	Najib Harabi
1991	14	Wirtschaftswissenschaft und Ethik	Jean-Louis Arni
1991	15	Innovation versus Imitation: Empirical Evidence from Swiss Firms	Najib Harabi
1991	16	Determinanten des technischen Fortschritts - Eine empirische Analyse für die Schweiz	Najib Harabi

JAHR	NR.	TITEL	AUTOR
1991	17	Perspektiven des interkommunalen Finanz- ausgleichs	Peter Bohley
1991	18	Ist das Rational-Choice-Modell in Auflösung begriffen?	Jean-Louis Arni
1991	19	Nocheinmal: Das Verhältnis zwischen Wirt- schaftswissenschaft und Ethik	Jean-Louis Arni
1992	20	Was ist Ethik? - Eine Antwortskizze	Jean-Louis Arni
1992	21	Determinanten des technischen Fortschritts - Eine empirische Analyse für die Schweiz 2. Version	Najib Harabi
1992	22	Appropriability, technological opportunity, market demand, and technical change - Empirical evidence from Switzerland	Najib Harabi
1992	23	Handlungserklärung - Handlungsrationalität	Jean-Louis Arni
1992	24	Technischer Fortschritt in der Schweiz: Empirische Ergebnisse aus volkswirtschaftlicher Sicht	Najib Harabi
1993	25	EWR-Beitritt: Der Weg in eine andere Schweiz	Peter Bohley
1993	26	Technischer Fortschritt in der Schweiz: Ein kurzer Ueberblick	Najib Harabi
1993	27	Aneignung der Erträge aus technischen Innovationen: Eine Empirische Analyse	Najib Harabi
1993	28	Technologische Chancen und technischer Fortschritt: Eine empirische Untersuchung	Najib Harabi
1993	29		Najib Harabi
1993	30	Präliminarien zu einer Ethik der Umverteilung	Jean-Louis Arni
1993	31	Sources of Technological Progress: An Empirical Investigation	Najib Harabi
1993	32	Appropriability of Technical Innovations: An Empirical Analysis	Najib Harabi
1993	33	Facteurs déterminants la recherche et le développement dans l'industrie	Najib Harabi