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INNOVATION VERSUS IMITATION: EMPIRICAL EVIDENCE FROM SWISS FIRMS

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January 1991

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Abstract

The underlying theoretical assumption of this paper is that if firms can imitate an innovation at a cost that is substantially below the cost of the innovator to carry out the innovation, there may be little or no incentive to carry out the innovation. Cost and time required for imitating new products and processes have an important effect on the incentives for innovation in a market economy. The purpose of this paper is to investigate empirically, first the number of firms capable of duplicating several categories of innovations, secondly the typical level of cost, thirdly the typical amount of time it would take to duplicate innovations if they were developed by a competitor, and finally the relationship between those factors and patents. The findings are based on a survey I conducted among 358 firms in 127 (SIC-four-digit classification) industries in Switzerland in 1988. The results can be summarized as follows.

- The median estimated number of firms capable of duplicating a major process and product innovation is three per relevant market (mostly the international market, since the Swiss economy is very open). The corresponding figures for typical process innovations is five and for typical product innovations is six. In other words, there is a surprisingly small number of serious rivals for each firm and furthermore, there are almost twice as many firms capable of duplicating typical innovations as those capable of duplicating major innovations.

- The median estimated ratio of imitation cost to innovation cost is about 80% for major patented, 50% for major unpatented, 70% for typical patented, and 40% for typical unpatented innovations. Thus, it is less expensive for a firm to duplicate any category of innovation developed by a competitor than to carry it out itself.

- The estimated median of the time length required for duplicating major patented (process and product) innovations is about two years, for typical, patented innovations is about 18 months, for major unpatented innovations is about 16 months, and for typical unpatented innovations is about ten months. Since there is a significant correlation between cost and time of imitation, the conclusions are the same as under point 2).

- Patents tend, on average, to increase the cost and time required for duplicating an innovation.

CONTENTS

INNOVATION VERSUS IMITATION: EMPIRICAL EVIDENCE FROM SWISS FIRMS

INTRODUCTION

The economic performance of firms, industries, and nations depends among other things upon their willingness and ability to innovate. Innovations in general and particularly technical innovations, defined as the generation and diffusion of new or improved products and processes have become a panacea for the economic and social problems of our time. Understanding the nature, determinants, and effects of the innovation process is therefore of paramount importance.

There is a growing consensus among economists that technological opportunities, appropriability of returns from innovations, and market conditions are key determinants of technical change in market-oriented economies.

In addition to the firm itself as a primary source of technology, there are many external sources of technological opportunities. A firm can either generate its own, or imitate innovation of others. As Arrow (1962) has pointed out, if firms can imitate innovation at a cost that is substantially below the cost to the innovator to carry out the innovation, there may be little or no incentive for the innovator to carry out the innovation. The costs of imitating new or improved products and processes have an important effect on the incentives for innovation in a market economy.

The purpose of this paper is to investigate empirically some of these theoretical assumptions. The results are based on a survey I conducted among 358 firms in 127 (SIC-four-digit classification) industries in Switzerland in 1988. I asked R&D executives of Swiss firms, among other things, to indicate first the number of firms capable of duplicating an innovation in their own industry, secondly the typical level of cost, and thirdly the typical amount of time it would take to duplicate several categories of innovations if they were developed by a competitor. Furthermore, I shall look at the relationship between those factors and patents. Patents are considered as important determinant of imitation costs. Before presenting my own results, I will briefly review the empirical literature in this topic.

2) REVIEW OF THE LITERATURE

In their discussion of the innovation process, economists frequently have called attention to the major role played by the costs of imitation, but there has been little attempt to measure those costs, to test various hypotheses concerning the factors influencing them, or to estimate their effects.

In one of the first empirical studies of this topic (Mansfield et al, 1981) data were obtained from US firms in the chemical, drug, electronics, and machinery industries concerning the cost and time of imitating (legally) 48 product innovations. By imitation cost is meant in this study all costs of developing and introducing the imitative product, including applied research, product specification, pilot plant or prototype construction, investment in plant and equipment, and manufacturing and marketing start- up (if there was a patent on the innovation, the cost of inventing around it is included). By imitation time is meant the length of time that elapses from the beginning of the imitator's applied research (if there was any) on the imitative product to the date of its commercial introduction. The results of this study can be summarized as follows.

- The ratio of the imitation cost to innovation cost averaged about 0.65, and the ratio of the imitation time to the innovation time averaged about 0.70. There was considerable variation about these averages, however. For about half of the products, the ratio of imitation cost to innovation cost was either less than 0.40 or more than 0.90. For about half of the products, the ratio imitation time to innovation time was either less than 0.40 or more than 1.00. Products with a relatively high (low) ratio of imitation cost to innovation cost tended to have a relatively high (low) ratio of imitation time to innovation time.

- The imitation cost was no smaller than the innovation cost for about one-seventh of the products. This was, according to Mansfield' study, not due to any superiority of the imitative product over the innovation. Instead, in a substantial percentage of the cases, it was due to the innovator's having a technological edge over its rivals in the relevant field. Often this edge was due to superior "know-how" - that is, better and more extensive technological information based on highly specialized experience with the development and production of related products and processes. Such know-how is not divulged in patents and is relatively inaccessible (at least for a period of time) to potential imitators.

- Thus, the data of this study indicate that innovators routinely introduce new products despite the fact that other firms can imitate those products for about two-thirds (often less) of the cost and the time expended by the innovator. In some cases, this is because, although other firms could imitate these products in this way, there are other barriers to entry (for example, lack of well-known brand name) that discourage potential imitators. But to a greater extend (at least in Mansfield' firm sample), it seems to be due to a feeling on the part of the innovators that, even if imitation do begin to appear in a relatively few years, the innovation will still be profitable.

Furthermore, studying the question to what extent the ratio of imitation cost to innovation cost is affected by whether the innovator has patents on the new product, Mansfield and his associates come to the following conclusions:

- Contrary to popular opinion, patent protection does not make entry impossible, or even unlikely. Within 4 years of their introduction, 60% of the patented successful innovations were imitated.

-Nonetheless, patent protection generally increased imitation costs. To obtain information concerning the size of this increase, the firms were asked to estimate how much the imitation cost for patented product increased because it was patented. The median estimated increase was 11%. The firms were also asked to estimate how much the imitation cost for each unpatented product would have increased if it had been patented. The median estimated increase was only 6%. The fact that a patent resulted in a larger increase in the imitation costs of the patented products than of the unpatented products was, of course, a major reason why some products were patented and others not.

- Patents have a larger impact on imitation costs in ethical drugs than in other industries sampled. The median estimated increase in imitation cost due to patent protection was about 30% in ethical drugs, in contrast to about 10% in chemicals and about 7% in electronics and machinery. Without patent protection, it frequently would have been relatively inexpensive (and quick) for an imitator to determine the composition of a new drug and to begin producing it. These results are in accord with the conclusion of Taylor and Silberston (1973) that the lack of patent protection would reduce the rate of expenditure on innovative activity to a greater extent in drugs than in other industries.

Levin et al, (1987) have also explored, among other things, the number of firms capable of duplicating different categories of innovations, the cost and time required for imitation as well as the relationship between those factors and patents. In his empirical study data were obtained from 650 lines of business in 129 different (SIC four-digit classification) industries in the USA. Major results of this study are as follows.

- The median estimated number of firms in a specific industry capable of duplicating a major process innovation is 2.5. The corresponding figures for typical process innovations is five, for major product innovations is three, and for typical product innovations is six. In other words, there is first a small number of serious rivals for each firm, and secondly there are twice as many firms capable of duplicating typical innovations as those capable of duplicating major innovations. There is, however, a substantial variation around these averages, as it is reported in table 1.

- The median estimated ratio of imitation cost to innovation cost is about 80% for both major, patented process and product innovations. For typical, patented process and product innovations, the equivalent ratio is about 60%. The corresponding figure for typical unpatented process and product innovations is 40%. The variations about these averages are reported in table 2 .

- The median estimated time required for duplicating a major, patented innovation is about two years. Less time, around 16 months, is needed, on average, to duplicate major, unpatented innovations. Only about one year is estimated for imitating typical, patented innovations and far less time is required for duplicating typical, unpatented innovations. (For more details regarding the distribution of these averages see table 3).

Finally, Levin and his associates have found that there is a positive correlation between the effectiveness of patents and costs and time required for duplicating innovations. In other words, patents make it costlier for imitators to duplicate innovations developed by a competitor.

3) EMPIRICAL EVIDENCE FROM SWISS FIRMS

The empirical results presented so far were related to data of the United States of America. It would be interesting to compare these results with those of a small open, technologically highly competitive economy like the Swiss one.

3.1 DATA

As part of our empirical investigation of the determinants of the innovation process in Swiss Industry I asked R&D executives of Swiss firms to indicate first the number of firms capable of duplicating an innovation, secondly the typical level of costs, and thirdly the typical amount of time it would take to duplicate several categories of innovations if they were developed by a competitor. Following Levin et al (1987) I have distinguished in the questionnaire between different types of innovations: product versus process, major versus typical (or minor) and patented versus unpatented innovations. For each type of innovation, respondents were asked to identify (within a range) the cost of duplication as a percentage of the innovator's R&D cost. Intervals measured in months or years were used to classify the time typically required to imitate each type of innovation. In light of evidence that there exists a time-cost trade off in certain industries (Mansfield, 1968, Levin et al, 1987), we asked respondents to estimate the cost and time required" to have a significant impact on the market".

The practical administration of the survey took advantage of the fact that the Swiss Chamber of Trade and Industry, along with the Federal Office of Statistics had just finished the sixth R&D Survey in 1987. According to this source, 1157 firms had been actively involved in R&D activities. After eliminating about 217 firms from the French part of Switzerland which were not expected to be able to complete the German version of the questionnaire, I sent this to the remaining 940 firms. The response rate was 38%. Thus, 358 firms in 127 different (SIC-four-digit) industries participated in the survey. Table 4 displays their sectoral distribution. 38% of all completed questionnaires were from machinery and metal processing industries, 23% from electronics, 10% from chemicals, 2% from watch, 3% from textile and clothing, 6% from food, 5% from synthetics and paper, 4% from construction industries, 7% from technical services, and 3% from private research laboratories. Viewing the structure of the participating firms according to their

R&D expenditures, table 5 summarizes the results for 1986. Fifty five percent of all firms sampled spent less than one, 10.5% between one and two, 10.5% between two and five , 7% between five and ten , 9% between ten and fifty, and finally, around 8% over fifty million Swiss Francs for R&D. Knowing the identity of the participating firms, as the author of this paper does, one can conclude that the sample is substantively representative for the R&D active firms in Swiss industry.

3.2 RESULTS

3.2.1 NUMBER OF FIRMS CAPABLE OF DUPLICATING INNOVATIONS

The median estimated number of firms capable of duplicating a major process innovation is three. The corresponding figures for typical process innovations is five, for major product innovations is three, and for typical product innovations is six. In other words, there is, as in the Levin study, a small number of serious rivals for each firm and secondly there are almost twice as many firms capable of duplicating typical innovations as those capable of duplicating major innovations (see table 6).

A substantial variation around these averages exists however and is reported in table 7

3.2.2 COSTS OF IMITATION

The estimated median of the ratio of imitation cost to innovation cost is about 80% for both major, patented process and innovations (see table 8). There is considerable variation about this average, however (see table 9). The imitation cost was no smaller than the innovation cost for process and product innovations in around 20% of all industries sampled. A timely duplication of process and product innovations is even not possible in 16 to 17% of all industries. For major unpatented process and product innovations the estimated median of the ratio of the imitation cost to innovation cost is about 50%. It is worth noticing that only one of 127 industries said that a timely duplication of major unpatented (product and process) innovations is not possible. For typical, patented process and product innovations the estimated median of the ratio imitation cost to innovation cost is about 70%. The corresponding figure for typical unpatented process and product innovations is around 40%.

In sum, the data indicate that a) for all categories of innovations, the costs of imitation were viewed as lower than the innovator's R&D costs, b) duplication of major innovations tends to cost more than duplication of typical innovations, c) for a given category of innovation, the imitation costs are distributed very similarly for products and processes, and d) finally, patents tend, on average to increase the imitation costs for all types of innovations considered here (this last point will be further explored in section 3.2.4).

3.2.3 TIME REQUIRED FOR EFFECTIVELY DUPLICATING AN IMITATION

The estimated median of the time length required for effectively duplicating a major, patented process innovation is about two years. A similar figure is obtained for major, patented product innovations. Approximately six months less than that are needed for duplicating typical, patented product and process innovations. On the other hand, only about 16 months are on average required for imitating major, unpatented process and product innovations. Finally, typical, unpatented product and process innovations require least time to be duplicated by a competitor (see table 10).

However, there is considerable variation about these averages, as it is shown in table 11. If we take the case of major, patented process innovations as an example, 17% of all industries sampled considered a timely duplication as not possible, 9% would need more than five, 24% between three and five, 35% between one and three years, 10% between six months and on year, and finally about 3% would require less than six months.

The Swiss Data indicate furthermore, as in the above mentioned study of Mansfield et al, a statistically significant correlation between costs and time required for duplicating an innovation. Innovation with a relatively high (low) ratio of imitation cost to innovation cost tend to have a relatively high (low) length of time.

In sum, following conclusions can be drawn from tables 10 and 11. First, duplication of major innovations tends to take longer than the duplication of typical innovations. Second, for a given type of innovation, the time required to duplicate is distributed very similarly for products and processes. Finally, patents tend, on average, to raise imitation time for each type of innovation (this last point will be further explored in section 3.2.5).

3.2.4. PATENTS AND IMITATION COSTS

As indicated earlier, patent protection generally increases imitation costs of product and process innovations. Two issues will in this regard be empirically explored in this section. First, the size of the increase of the imitation costs for both major and typical innovations and secondly, correlation coefficients for patents and imitation costs will be estimated on the basis of our survey data.

The estimated median increase of imitation cost due to patent protection is 25% for both major and typical process innovations and 33% for major and typical product innovations. In other words, patent protection does increase the imitation costs substantially. To explore this point further, we coded the individual responds to the imitation cost (and time) questions on a six point interval scale, calculated the individual and industry mean increases in cost (and time) associated with the presence of patents, and correlated these, respectively, with individual and industry mean responses to our questions on the effectiveness of patents to prevent duplication.

As seen in the last four rows of table 12, for each category of innovation the reported effectiveness of patents is correlated with the increase in duplication cost (and time) associated with patents, although the correlations tend to be stronger for products than for processes. We also calculated the correlation between the absolute cost (and time) required for imitation and he reported effectiveness of patents to prevent duplication. We found some evidence at the individual respondent level that patent effectiveness is associated with absolute level of duplication cost for patented process and product innovations.

3.2.5 PATENTS AND IMITATION TIME

Patents also tend to increase the time required for effectively duplicating certain categories of innovations. The estimated median increase of imitation time of major process innovations is about 20%. On the other hand there is no increase for the reminding categories of innovations.

3.2.6 SUMMARY AND CONCLUSION

The underlying theoretical assumption of this paper is that if firms can imitate an innovation at a cost that is substantially be

low the cost of the innovator to carry out the innovation, there maybe little or no incentive to carry out the innovation. Cost and time required for imitating new products and processes have an important effect on the incentives for innovation in a market economy. The purpose of this paper was to investigate empirically, first the number of firms capable of duplicating several categories of innovations, secondly the typical level of cost, thirdly the typical amount of time it would take to duplicate innovations if they were developed by a competitor and finally the relationship between those factors and patents. The findings are based on a survey I conducted among 358 firms in 127 (SIC-four-digit) industries in Switzerland in 1988. The results can be summarized as follows.

- The median estimated number of firms capable of duplicating a major process and product innovation is three per relevant market (mostly the international market, since the Swiss economy is very open). The corresponding figures for typical process innovations is five and for typical product innovations is six. These findings are very similar to those of Levin and his associates for the USA and indicate that there is a surprisingly small number of serious rivals for each firm. Furthermore, there are almost twice as many firms capable of duplicating typical innovations as those capable of duplicating major innovations.

- The median estimated ratio of imitation cost to innovation cost is about 80% for major patented, 50% for major unpatented, 70% for typical patented , and 40%for typical unpatented innovations. These results are also quite similar to those obtained for the USA (Levin et al, 1987). In both countries, it is less expensive for a firm to duplicate any category of innovation developed by a competitor than to carry it out itself. This might have affected the innovative effort of firms in both countries.

- The estimated median of the time length required for duplicating major patented (process and product) innovations is about two years, for typical patented innovations is about 18 months, for major unpatented innovations is about 16 months, and for typical unpatented innovations is about ten months. Since there is a significant correlation between cost and time of imitation, the conclusions are the same as under point 2)

- Patents tend, on average, to increase the cost and time required for duplicating an innovation. From this perspective patents are effective in protecting innovations. Without patent protection, it frequently would have been relatively inexpensive and quick for an imitator for instance in the drug industry to determine the composition of a new drug and begin producing it.

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Table 1: Number of Firms Capable of Duplicationg an Innovation (Frequency Distribution of Median Responses for 129 Lines of Business), USA

	one	1 - 2	3 - 5	6 - 1 0	more than 10
1. A major new or improved process	2 (1%)	32 (25%)	75 (58%)	18 (14%)	2 (1%)
2. A typical new or improved process	1 (1%)	7 (5%)	41 (32%)	58 (45%)	22 (17%)
3. A major new or improved product	2 (1%)	25 (19%)	73 (57%)	25 (19%)	4 (3%)
4. A typical new or improved product	1 (1%)1	5 (4%)	33 (26%)	63 (26%)	6 (20%)

Source: Levin et al (1987)

Table 2: Cost of Effectively Duplicating an Innovation (Frequency Distribution of Median Responses for 127 Lines of Business), USA

	Cost of Duplication as a Percentage of Innovator's R&D Cost					
	Less than 25%	25%-50%	51%-75%	76%-100%	More than 100%	Timely Dublication not possible
New Process						
1. Major, patented new process	1 (1%)	5 (4%)	19 (15%)	66 (52%)	26 (20%)	10 (8%)
2. Major, unpatent new process	5 (4%)	10 (8%)	55 (43%)	49 (39%)	6 (5%)	2 (2%)
3. Typical, patented new process	2 (2%)	15 (12%)	61 (48%)	41 (32%)	6 (5%)	2 (2%)
4. Typical, unpatented new process	8 (6%)	43 (34%)	58 (46%)	14 (11%)	4 (3%)	0 (0%)
New Product						
5. Major, patented new product	1 (1%)	4 (3%)	17 (13%)	63 (50%)	30 (24%)	12 (9%)
6. Major, unpatented new product	5 (4%)	13 (10%)	58 (46%)	40 (31%)	7 (6%)	4 (3%)
7. Typical, patented new product	2 (2%)	18 (14%)	64 (50%)	32 (25%)	9 (7%)	2 (2%)
8. Typical, unpatented new product	9 (7%)	58 (46%)	40 (31%)	15 (12%)	5 (4%)	0 (0%)

Source: Levin et al (1987)

Table 3: Time Required to Effectively Duplicate an Innovation (Frequency Distribution of Median Responses for 129 Lines of Business), USA

	Less than 6 months	6 months to 1 year	1 to 3 years	3 to 5 years	More than 5 years	Timely Dublication not possible
New Process						
1. Major, patented new process	0 (0%)	4 (3%)	72 (56%)	37 (29%)	9 (7%)	7 (5%)
2. Major, unpatent new process	2 (2%)	20 (15%)	84 (65%)	17 (13%)	2 (2%)	4 (3%)
3. Typical, patented new process	0 (0%)	40 (31%)	73 (57%)	13 (10%)	0 (0%)	3 (2%)
4. Typical, unpatented new process	8 (6%)	66 (51%)	47 (36%)	6 (5%)	1 (1%)	1 (1%)
New Product						
5. Major, patented new product	2 (2%)	6 (5%)	64 (50%)	40 (31%)	8 (6%)	9 (7%)
6. Major, unpatented new product	3 (2%)	22 (17%)	89 (69%)	12 (9%)	1 (1%)	2 (2%)
7. Typical, patented new product	5 (4%)	39 (30%)	72 (56%)	6 (5%)	4 (3%)	3 (2%)
8. Typical, unpatented new product	18 (14%)	67 (52%)	39 (30%)	4 (3%)	1 (1%)	0 (0%)

Source: Levin et al (1987)

Table 4: Sectoral Distribution of the Responding Firms (n = 358) Compared with that of the Population (n = 1157)

Industries	Sample		Population	
	absolute	in %	absolute	in %
Machinery and metal processing	136	37.7	413	35.7
Electronics	83	23.2	208	18.0
Chemicals	35	9.8	109	9.4
Watch	6	1.7	32	2.8
Textile and clothing	11	3.1	46	4.0
Food	21	5.9	53	4.6
Synthetics and paper	17	4.7	53	4.6
Construction	15	4.2	82	7.1
Technical services	24	6.7	133	11.5
Private resarch labs	10	2.8	28	2.4
Total	358	100.0	1157	100.0

Table 5: R & D Expenditures of the Responding Firms, in Million Swiss Francs, 1986

R & D Expenditures (in Million sFr.)	Number of Firms Absolute	in %
Less than 1	196	55.4
1 to 2	37	10.5
2 to 5	37	10.5
5 to 10	25	7.1
10 to 50	31	8.8
More than 50	28	7.9
Total	354	100.0

Table 6: Estimated Median of Number of Firms Capable of Duplicatin an Innovation in USA and Switzerland

	USA	Switzerland
1. A major new or improved process	2.5	3.4
2. A typical new of improved process	5.1	5.3
3. A major new or improved product	2.8	3.4
4. A typical new or improved product	5.6	6.2

Source: Levin et al (1987), data for USA, Harabi, data for Switzerland

Table 7: Number of Firms Capable of Duplicating an Innovation (Frequency Distribution of Median Responses for 127 Lines of Business), Switzerland

	None	1 or 2	3 to 5	6 to 10	More than 10
1. A major new or improved process	1 (1%)	17 (14%)	56 (47%)	25 (21%)	21 (17%)
2. A typical new or improved process	0 (0%)	8 (7%)	40 (33%)	38 (32%)	34 (28%)
3. A major new or improved product	3 (2%)	13 (11%)	59 (48%)	30 (25%)	17 (14%)
4. A typical new or improved product	0 (0%)	4 (3%)	36 (29%)	41 (33%)	44 (35%)

Table 8: Median Estimated Ratio of Imitation cost to Innovation Cost in USA and Switzerland

	USA	Switzerland
Process Innovation		
1. Major, patented Innovation	0.77	0.76
2. Major, unpatented Innovation	0.60	0.53
3. Typical, patented Innovation	0.57	0.68
4. Typical, unpatented Innovation	0.43	0.41
Product Innovation		
1. Major, patented Innovation	0.79	0.79
2. Major, unpatented Innovation	0.57	0.50
3. Typical, patented Innovation	0.54	0.65
4. Typical, unpatented Innovation	0.36	0.42

Source: Levin et al (1987), data for USA, Harabi, data for Switzerland

Table 9: Cost of Effectively Duplicating and Innovation (Frequency Distribution of Median Responses for 127 Lines of Business), Switzerland

	Cost of Duplication as a Percentage of Innovator's R&D Cost					
	Less than 25%	25%-50%	51%-75%	76%-100%	More than 100%	Timely Dublication not possible
New Process						
1. Major, patented new process	8 (7%)	14 (13%)	14 (13%)	35 (31%)	22 (20%)	18 (16%)
2. Major, unpatente new process	18 (16%)	19 (16%)	33 (29%)	36 (31%)	8 (7%)	1 (1%)
3. Typical, patented new process	11 (10%)	11 (10%)	26 (23%)	37 (33%)	15 (14%)	11 (10%)
4. Typical, unpatented new process	22 (19%)	31 (27%)	32 (27%)	26 (22%)	2 (2%)	3 (3%)
New Product						
5. Major, patented new product	3 (3%)	15 (13%)	18 (15%)	34 (29%)	27 (23%)	20 (17%)
6. Major, unpatented new product	16 (13%)	26 (22%)	35 (29%)	34 (28%)	8 (7%)	1 (1%)
7. Typical, patented new product	7 (6%)	15 (13%)	33 (28%)	32 (28%)	18 (16%)	11 (9%)
8. Typical, unpatented new product	23 (19%)	31 (26%)	44 (36%)	16 (13%)	4 (3%)	3 (2%)

Table 10 : Estimated Median of the Imitation Time in the USA and Switzerland, in years.

	USA	Switzerland
Process Innovation		
1. Major, patented new process	1.80	2.07
2. Major, unpatented new process	1.38	1.30
3. Typical, patented new process	1.20	1.56
4. Typical, unpatented new process	0.68	0.84
Product Innovation		
1. Major, patented new product	1.85	1.88
2. Major, unpatented new product	1.30	1.24
3. Typical, patented new procuct	1.11	1.45
4. Typical, unpatented new product	0.60	0.86

Source: Levin et al (1987), data for USA, Harabi, data for Switzerland

Table 11: Time Required to Effectively Duplicate an Innovation (Frequency Distribution of Median Responses for 129 Lines of Business)

	Less than 6 months	6 months to 1 year	1 to 3 years	3 to 5 years	More than 5 years	Timely Dublication not possible
New Process						
1. Major, patented new process	4 (3%)	12 (10%)	41 (35%)	28 (24%)	11 (9%)	20 (17%)
2. Major, unpatente new process	7 (6%)	28 (24%)	58 (49%)	17 (14%)	4 (3%)	4 (3%)
3. Typical, patented new process	7 (6%)	20 (17%)	47 (41%)	20 (17%)	8 (7%)	13 (11%)
4. Typical, unpatented new process	14 (12%)	42 (35%)	43 (36%)	13 (11%)	3 (3%)	3 (3%)
New Product						
5. Major, patented new product	7 (6%)	14 (12%)	42 (36%)	24 (20%)	12 (10%)	19 (16%)
6. Major, unpatented new product	12 (10%)	24 (20%)	61 (51%)	15 (12%)	4 (3%)	4 (3%)
7. Typical, patented new product	12 (10%)	19 (16%)	50 (42%)	16 (14%)	10 (8%)	11 (9%)
8. Typical, unpatented new product	16 (13%)	40 (33%)	51 (42%)	7 (6%)	4 (3%)	3 (2%)

Table 12: Correlation between Effectiveness of Patents to Prevent Dupliction and Imitation Costs and Time+

	Correlation with Patent Effectiveness	
	Process	Product
Cost of dublication:		
Major, patented innovation	0.08 /-0.04	0.13 / 0.08
Major, unpatented innovation	0.03 /-0.06	0.07 / 0.03
Typical, patented innovation	0.03 /-0.08	0.11 / 0 .11
Typical, unpatented innovation	0.02 /-0.03	-0.04 /-0.04
Time to duplicate:		
Major, patented innovation	0.08 / 0.11	0.19*/ 0.27*
Major, unpatented innovation	-0.02 / 0.17	0.11 / 0.25*
Typical, patented innovation	0.03 / 0.02	0.14 / 0.19
Typical, unpatented innovation	0.004/ 0.09	0.07 / 0.15
Differences in duplication cost:		
Patented v. unpatented major innovation	0.04 /-0.02	0.09 / 0.07
Patented v. unpatented typical innovation	0.03 /-0.05	0.17*/0.19
Differences in dupliction time:		
Patented v. unpatented major innovation	0.13 /-0.02	0.14 /-0.08
Patented v. unpatented typical innovation	0.02 / 0.09	0.09 / 0.09

+ First entry in each cell indicates correlation of individual responses. Second entry indicates correlation of industry means.

* significant at 0.01% - level

ARBEITSPAPIERE 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
1884	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: Empirial Evidence from Swiss Firms	Najib Harabi
1991	16	Determinanten des technischen Fortschritts - Eine empirische Analyse für die Schweiz	Najib Harabi