INNOVATIONS IN SLOVENIAN ELECTRONICS INDUSTRY

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Abstract: We conducted a survey-type research of innovation activity and the use of intellectual property instruments in Slovenian manufacturing companies in the period 2004-2006. The results show that companies in electronics industry have slightly more active innovation policy than companies in other industries. The electronic industry companies typically have larger R&D departments, are larger companies, and have on average more new patents and products then other companies in Slovenian economy. Other aspects of innovation characteristics and behavior of Slovene electronics companies are presented and put into broader perspective by comparison to other Slovenian companies.

Inovacije v slovenski elektronski industriji

Kjučne besede: inovacije, patenti, elektronska industrija, Slovenija

Izvleček: Opravili smo raziskavo o inovativni dejavnosti in uporabi instrumentov intelektualne lastnine v slovenskih podjetjih med leti 2004-2006. Rezultati so pokazali, da imajo podjetja, ki proizvajajo elektroniko značilno več aktivne inovacijske politike kot ostala podjetja. Podjetja, ki proizvajajo elektroniko imajo značilno večje RR oddelke, so večja podjetja in imajo v povprečju več novih patentov in produktov kot ostala podjetja v slovenski ekonomiji. V članku so predstavljene tudi ostale inovacijske značilnosti in obnašanje slovenskih podjetij, ki proizvajajo elektroniko v primerjavi z ostalimi slovenskimi proizvodnimi podjetji.

1 Introduction

Innovation is widely recognized as an important factor of firm profitability and long-term success. Innovation can be implemented in a new product or a new process. In the first case, the gains for an innovative firm come from a higher quality product (in terms of value added to consumers) for which a higher price can be charged. In the second case, gains come from input cost savings, which permit higher price-cost margins.

However, new scientific or technological knowledge embedded in innovations can easily spill out and end up in someone else's R&D effort. In economics, this property of new knowledge is called non-excludability and is typical for public goods. Arrow /1/ was the first to show that when it is not possible to exclude the use of a good with this property by individuals who did not pay for the good, the incentive to produce such a good is reduced. Without protection offered by intellectual property rights (IPR), new knowledge is very much like public good: it can be used by people or companies who did not originate (or pay) for it and the incentive to create new knowledge (in other words, to engage in R&D effort) is therefore undermined.

Legal instruments like patents, trademarks and licences (IPR) serve to protect the benefits arising from innovative products and processes. For example, Greenhalgh and Longland /2/ find empirical evidence for positive returns from doing R&D and also from registering patents and trademarks in UK. Also, Varsakelis (2001) /3/, Lederman and Maloney (2003) /4/, Kanwar and Evanson (2003) /5/, Basanini and Ernst (2002) /6/, Bebczuk (2002) /7/, and Falk (2006) /8/ empirically investigate the effect of patent protection on business R&D intensity and generally find some evidence that a stronger patent protection indeed has a positive effect on business R&D intensity. However, patents do not protect most of innovations and some of the reasons why firms decide not to patent are the following: innovations are not novel enough to be eligible for patent protection, too much information must be disclosed in a patent application, the cost of applying and defending a patent in court is too high, it is easy to legally invent around the patent, technology is moving so fast that patents are irrelevant.

Besides preventing unauthorized imitation, patents are used also to secure royalty income. Licensing is a common method of awarding the right to use a patent to other parties and earn additional revenue from innovation. Furthermore, it is also used for more "strategic" reasons such as deterring entry of potential competitors /9/, enhancing demand /10/, and facilitating collusion /11/. Kim and Vonortas /12/ find that licensing is more extensively used if a company has more technological knowledge, has used licensing before, the growth rate of its sector is higher, IPR protection is stronger, and the nature of technology is more "complex"[1]. However, Levin et al. /13/ find empirical evidence that patents are regarded less as a way to gain additional revenue through licensing than they are as a way to prevent imitation. Their study also revealed two other possible reasons to use patents which are not related to protecting returns from innovations: i) patents can be used as a measure of performance for R&D employees and ii) patents can open access to certain foreign markets which require the licensing of technology to domestic industry as a condition to enter the market. In addition, Hall and

Ziedonis /14/ found out that companies in US Semiconductor Industry were aggressively patenting since the early 1980's, but not so much to protect the returns to their innovation as to build patent portfolios which were aimed at reducing the danger of being held up by external patent owner and were later also used for cross-licensing, patent exchange and other negotiations.

Then again, a patent is not the only instrument of protecting innovation and the benefits arising from them. In fact, Cohen et al. /15/ and Levin et al. /13/ study U.S. manufacturing companies and empirically find that no industry, even pharmaceutical, relies exclusively on patents or see them as the most effective mechanism of protection. In spite of the existence of IPR, which do alleviate the problem of non-excludability, we can still observe practices of reverse engineering and industrial espionage resulting in imitation and inventing around legally protected products and processes. The existence and large magnitude of knowledge spillover has been documented by a number of empirical studies (for a review see /16,17/). Therefore, companies must use also other mechanisms that can protect the returns to their R&D effort more effectively. Among other mechanisms of protection secrecy, lead time (i.e. first mover advantage), complementary sales and service, and complementary manufacturing facilities and know how are the most general. Different mechanisms can be appropriate for effective protection in different industries and also in different stages of the innovation process. In the initial stages of innovation, prior to commercialization, companies can rely on secrecy, but later when the new product is introduced in the market, they may protect their competitive advantage by obtaining a patent or invest in aggressive marketing and increased lead time /15/.

Empirical studies find that companies typically use a combination of mechanisms to protect their inventions /13,15/ , where Cohen identified three common combination strategies employed by U.S. manufacturing companies: 1) they exploit complementary capabilities and lead time, 2) they use legal instruments (notably patents) or 3) they keep their innovations secret. Besides, their study has shown considerable differences in mechanisms deemed most effective among industries. For example, companies from drugs and medical equipment industries found all mechanisms highly effective in protecting their innovation, while companies from semiconductor, machine tools and aerospace industries believed that secrecy and lead time were most effective to protect benefits from product innovation, and companies from communications equipment, computer, steel, and car and truck industries thought lead time gave most protection. Interestingly, companies from electrical equipment industry indicated that none of these mechanisms is effective in protecting their innovation.

The effectiveness of a particular mechanism in a particular industry depends on a number of factors: the technology itself, the complexity of the product, the nature of the innovation (e.g. secrecy is more appropriate for process innovations), the nature of the production process (e.g. complex, capital-intensive production can rely on manufacturing capabilities as a mechanism of protection), the nature and intensity of competition within an industry (e.g. the importance of price versus other product characteristics), the organization and size of R&D department, and the financial resources and limitations of the company.

In this paper we investigate the protection mechanisms that are used by Slovenian electronics companies in order to protect and benefit from their innovations. Electronics industry is a high-tech industry with a complex technology that creates high value-added /18/. It is becoming evermore important for the growth of Slovenian economy and the effective protection of the knowledge it creates, develops and employs is crucial for its success. We claim that because of specific industry level characteristics, such as the ones in the above paragraph, electronics companies use different mechanisms than companies in other manufacturing sectors. Theory and existing empirical studies suggest that since the technology embodied in electronics industry products is complex, patents should not be seen as important and effective mechanisms of protecting innovation. Because of the nature of production process, complementary manufacturing facilities should be seen as more important in this respect. Nevertheless, patents are important not only as an instrument of IPR, but are used by companies also for other reasons (e.g. strategic reasons). Thus, our second aim is also to identify the reasons that hinder the use of patents and licences as means of commercial exploitation of innovations in Slovenian electronics companies. To answer our research questions, we employ statistical analysis and survey data on innovation activity and protection of intellectual property in Slovenian manufacturing companies that were collected for the first time by RCEF (Research Centre of the Faculty of Economics, University of Ljubljana) in 2007. To the best of our knowledge our paper is the first attempt to analyze the use of different mechanisms of intellectual property protection in Slovenian companies (and specifically electronics companies) by means of a survey carried out on a national level. Our findings give important insights into the nature of intellectual property protection of electronics companies and by pointing out major obstacles for not patenting and licensing provide an additional orientation to the policy-maker. We present data and methodology in more detail in the next section, followed by the results and discussion.

1 Following Cohen et al. (2000), a complex technology is a technology that consists of many parts that are (or can be) separately patented; e.g. electronics products are typically considered as complex products. A simple technology is one which is comprised of only a few parts that are (or can be) patented under one patent; drugs or chemicals are typical examples of simple (or discrete) products.

2 Data and methodology

Data on innovation activities and protection of intellectual property in Slovenian companies were collected in a primary research performed by the RCEF from February to September 2007.

A survey questionnaire was constructed largely on the basis of questionnaires used by the Carnegie Mellon Study /15/ and Yale Study /13/ in order to ensure comparability of results; OECD's Oslo Manual for measuring scientific and technological activities was considered for measurement methodology /19/. Questionnaires were mailed to 716 Slovenian manufacturing companies: 272 (38%) were large companies, 302 (42%) were medium companies and 142 (20%) were small companies.[2] All large and medium manufacturing companies in Slovenia and a sample of small manufacturing companies [3]were included in the mailing list. The response rate was 23 percent, meaning that 166 questionnaires were returned.

In order to test the differences in innovation activities and protection of intellectual property in Slovenian electronics companies, the sample was divided in two sub-samples. In the first sub-sample are classified companies engaged in the industrial manufacturing of electrical, electronic and optical products. Those companies, in compliance with the Companies Act (1990), can be members of the Electronics and Electrical Industry Association of Slovenia and are classified under the activities: DL30, DL 31, DL32, DL 33 and DK 29.71. of the SKD[4] 2002 classification. The second sub-sample is composed from other manufacturing companies. In the first sub-sample we have 24 companies and in the second sub-sample the rest of 142 companies. Secondary data sources available from the Agency of the Republic of Slovenia for Public Legal Records and Related Services were used in order to obtain financial data. We used ROA (return on assets), DTS (total sales growth), VA/E (value added per employee) and DA (debt to assets) as financial measures of firm performance.

Methodology used is based on methods of statistical analysis. Differences in innovation activities and protection of intellectual property between electronics companies and other companies in Slovene economy were tested with independence sample t-tests.

3 Results

The existence of an R&D department in the company is the sign that company has innovation activities. As presented in Table 1 only 75 percent of Slovenian electronics companies have an R&D department. Those companies have on average 55 employees in R&D departments, which is significantly higher than in other manufacturing companies in Slovene economy. Other manufacturing companies on the other hand have a higher *relative* R&D budget in comparison to electronics companies. One very important difference between Slovenian electronics and other manufacturing industry is the size of the average company in electronics industry, which is twice as large as the average company from all other manufacturing industries. This fact must be taken into consideration when explaining results since it is well documented that firm size has important influences on R&D activity.

Table 1: *R&D departments in Slovenian electronics and other manufacturing companies in 2004 - 2006*

				T-test for equality of means	
		N	Mean	T	Sig.
R&D department	Electronics	24	75%	0.702	0.488
	Other	141	68%		
Number of employees in R&D department	Electronics	18	55	1.500	**0.101**[c]
	Other	95	26		
R&D costs in 2004 (in % of total sales)	Electronics	17	6.67%	-0.225	0.822
	Other	94	7.39%		
R&D costs in 2005(in % of total sales)	Electronics	17	6.83%	-0.498	0.619
	Other	94	8.88%		
R&D costs in 2006 (in % of total sales)	Electronics	17	6.59%	-1.731	**0.087**[c]
	Other	94	10.19%		
Total employees	Electronics	24	534	1.818	**0.07 1**[c]
	Other	137	281		

Note: (a). (b) and (c) represent statistical significant of coefficients for the level of risk of 1%. 5% and 10%.

Innovation activity of the company can go in the direction of development of new products or processes. New products in Slovenian electronics companies represent on average one quarter of the total company sales, while new processes represent one third of the total company sales. As expected, companies from electronic industry have a

2 We divide companies into large, medium and small according to the criteria in the Slovenian Companiess Act. Large companies are those satisfying at least two of the following three criteria: more than 250 employees, more than 29.2 million EUR in total sales, and more than 14.6 million EUR in total assets. Medium companies have two of the following: more than 50 employees, more than 7.3 million EUR in total sales, and more than 3.65 million EUR in total assets. Other companies are categorized as small.

3 The sample of small manufacturing firms was constructed by randomly selecting small companies from the register of companies. The industry structure of this sample was matched to the industry structure of the population of slovenian small manufacturing companies.

4 SDK is short for Standard Classification of Activities (Industries) which is used in Slovenia, the version from 2002 is harmonized with NACE rev 1.1.

significantly higher share of new products as percentage of their total sales than other manufacturing companies (Table 2).

Table 2: *Share of new products and processes in Slovenian electronics and other manufacturing companies in 2006*

				T-test for equality of means	
		N	Mean	T	Sig.
Share of new products (in % of total sales)	Electronics	24	25.88%	1.917	**0.057**[c]
	Other	142	17.21%		
Share of new processes (in % of total sales)	Electronics	24	33.42%	0.825	0.416
	Other	142	28.08%		

Note: (a). (b) and (c) represent statistical significance of coefficients for the level of risk of 1%. 5% and 10%.

So far the data showed that electronics industry in comparison to other manufacturing industries has a higher number of employees and a higher share of new products in their total sales, which can indicate a slightly more active innovation policy in those companies. In order to get a further understanding of their innovation activities, we analyzed how electronics companies protect their innovations.

We asked the respondents to estimate the percentage of innovations for which each of the following mechanisms has been effective in protecting the company's competitive advantage from those innovations: i) secrecy, ii) patents, iii) lead time, iv) complementary marketing capabilities, v) complementary manufacturing capabilities, and vi) know-how. The five point response scale was: 1) less than 10%, 2) 10% through 40%, 3) 41% through 60%, 4) 61% through 90%, and 5) more than 90%.[5] The particular response scale reflects how important a mechanism is to companies in terms of *frequency* and *effectiveness* of its use and was selected in order to obtain comparable results with the Carnegie Mellon Study (Cohen et al., 2000). The results are demonstrated in Table 3.

Overall, the specific know-how, which cannot be transferred, is regarded as the most important mechanism to protect innovations in both groups of companies; on average 10 to 40 percent of innovations is effectively protected by this mechanism. Besides know-how, other manufacturing companies see also secrecy as an equally important mechanism. The least important mechanism in both groups of companies are patents, but there is a statistically significant difference between electronics and other manufacturing companies. Electronics companies on average consider patents to be effective protection for less

Table 3: *Mechanisms for protection of innovations in Slovenian electronics and other manufacturing companies in 2006*

				T-test for equality of means	
		N	Mean	T	Sig.
Secrecy	Electronics	12	1,75	-2,339	**0,035**[b]
	Other	154	2,37		
Patent	Electronics	12	1,25	-2,440	**0,027**[b]
	Other	154	1,73		
Lead time	Electronics	12	1,33	-2,430	**0,028**[b]
	Other	154	1,83		
Complementary marketing capabilities	Electronics	12	2,00	-0,518	0,613
	Other	154	2,16		
Complementary manufacturing capabilities	Electronics	12	1,92	-1,298	0,217
	Other	154	2,34		
Know How	Electronics	12	2,08	-0,878	0,396
	Other	154	2,37		

Note: (a). (b) and (c) represent statistical significance of coefficients for the level of risk of 1%. 5% and 10%.

than 10% of their innovation, while other manufacturing companies on average estimate that more than 10% (but less than 40%) of their innovations are effectively protected by patents. This finding suggests that patents are less important mechanisms in electronics industry than in other manufacturing industries and it is consistent with the findings of most empirical studies /13,15/ and our theoretical prediction based on the specific characteristics of the industry (complexity, production process).

Despite the supposed unimportance of patenting as a protection mechanism for electronics industry, our survey data show that electronics industry in fact has more patents than other manufacturing industries. As it can be seen from Table 4 electronics companies have on average 2.88 patents per company, which is significantly higher that the average for other manufacturing companies (0.93 patent per company). The share of international patents in electronics companies is the same as the average in the other manufacturing companies, which is very low (2.31 percent of all patents are international). Other manufacturing companies are investing a larger share of their sales in patents applications than electronics companies, even if they have on average twice as less patents. Furthermore, other manufacturing companies have on average more patent application in procedure than electronics companies (differences are not statistically significant), which could indicate that patents can generally be obtained faster in electronics industry.

5 To ensure that our respondents understand correctly each of the mechanisms of protection, a description of the way it is used to protect competitive advantages from innovations was used instead of just a list of mechanisms (as in Table 3). Also, an example of the response was provided: »If you believe secrecy (as a protection mechanism) effectively protects competitive advantages from around 20% of your innovations, mark response 2) 10% through 40%«.

Table 4: *Patents in Slovenian electronics and other manufacturing companies in 2006*

				T-test for equality of means	
		N	Mean	T	Sig.
Number of patents	Electronics	24	2.88	2.515	**0.013[b]**
	Other	142	0.93		
Share of international patents	Electronics	9	2.56%	0.413	0.682
	Other	32	2.31%		
Share of RD costs for patents	Electronics	9	1.40%	-2.205	**0.033[b]**
	Other	32	6.07%		
Number of patent applications in procedure	Electronics	9	5.89	-0.467	0.643
	Other	32	9.66		

Note: (a). (b) and (c) represent statistical significance of coefficients for the level of risk of 1%. 5% and 10%.

Although these results imply that companies in electronics industry could be more efficient in their patenting activity, we must be careful with the interpretation of absolute numbers. The average number of patents of patents per employee or per R&D employee is actually (significantly) lower for electronics industry, as well as the ratio of number of patents to % of R&D in sales.

In order to investigate the reasons that prevent companies from patenting, we asked the respondents to estimate the importance of the following reasons for not patenting in the last three years for their companies: i) no innovation, ii) innovation is not novel enough, iii) information disclosed in patent, iv) cost of patent application, v) cost of defending the patent in court, and vi) ease of legally inventing around the patent (patent is not an efficient mechanism of protection). The respondents were asked to estimate the reasons on a five-point subjective Likert response scale where 1 was "not important at all" and 5 was "very important".

Table 5 shows that the most important reason for not patenting in both groups of companies was the fact that innovation was not novel enough to be eligible for patent protection. Both groups of companies on average think that the quantity of information disclosed in patents is not very problematic. The only significant difference between electronics industry and other manufacturing industries with respect to reasons for not patenting is the ease of legally inventing around the patent. Electronics companies on average believe this was not an important reason for not patenting, while other manufacturing companies on average believe it was. This last result suggests that patents offer a better protection from imitation in electronics industry than in other manufacturing industries, which is somewhat contradictory to the previous finding about the unimportance of patents as means of protecting innovation. However, this could indicate that patents do offer a reasonably effective protection from imitation in electronics industry, but because of the high cost involved in obtaining them and enforcing them in court, they are not used as much as the companies would want to and are consequently a less important mechanism for protection in terms of the frequency of use.

Table 5: *Reasons for not patenting innovations*

				T-test for equality of means	
		N	Mean	T	Sig.
We do not have innovative products	Electronics	12	2,92	-0,197	0,844
	Other	151	3,01		
Innovation is not novel for the market	Electronics	12	3,42	0,026	0,980
	Other	153	3,41		
Too much information is disclosed	Electronics	12	2,83	0,021	0,984
	Other	153	2,82		
The costs of patent application	Electronics	12	3,08	-0,449	0,661
	Other	153	3,31		
The cost of defending a patent in court	Electronics	12	3,00	-0,345	0,736
	Other	153	3,17		
Easy to invent legally around the patent	Electronics	12	2,58	-1,751	**0,101[c]**
	Other	153	3,24		

Note: (a). (b) and (c) represent statistical significance of coefficients for the level of risk of 1%. 5% and 10%.

Patents are not used only for protection; they can be also a source of additional revenue. Licensing is related to the use of patents as revenue generators. Slovenian companies on average have very low number of licences agreement for their products or processes (Table 6). On average only 8 percent of other manufacturing companies in our survey have licence agreements for their products. On the other hand, 17 percent of electronics companies have licence agreements for their products, which is significantly higher than the average for other industries. Only 4 percent of companies from both sub-groups have the licence agreements for their processes.

Table 6: *Licences in Slovenian electronics companies and in all Slovenian companies in year 2006*

				T-test for equality of means	
		N	Mean	T	Sig.
Licences for products	Electronics	24	17%	1.610	**0.10 1[c]**
	Other	131	8%		
Licences for processes	Electronics	23	4%	-0.013	0.990
	Other	136	4%		

Note: (a). (b) and (c) represent statistical significance of coefficients for the level of risk of 1%. 5% and 10%.

To understand better what keeps companies from not using licences, we asked the respondents about the importance of the following possible reasons: i) no innovations that can be licensed, ii) additional competition, iii) disclosure of important information, iv) reputation damage by bad practising of the licensee, v) unappealing legislation on licensing, vi) no demand for licenses, and vii) failed negotiations for licensing. A five-point subjective Likert response scale was used to measure the importance of these reasons where 1 was "not important at all" and 5 was "very important".

Table 7: *Reasons for not licensing innovations.*

				T-test for equality of means	
		N	Mean	T	Sig.
We do not have innovations that can be licensed	Electronics	12	3,83	1,152	0,251
	Other	154	3,27		
We would create additional competition	Electronics	12	2,17	-0,819	0,414
	Other	154	2,51		
We would loose the control over the important information	Electronics	12	2,50	-0,030	0,977
	Other	154	2,51		
The licence buyer could ruin the reputation of our products	Electronics	12	2,92	0,772	0,455
	Other	154	2,53		
The unappealing legislation in that field	Electronics	12	2,92	1,802	**0,073**[c]
	Other	154	2,19		
There is no demand for licencing our products	Electronics	12	2,58	-0,692	0,501
	Other	154	2,90		
The negotiation on licensing our products have failed	Electronics	12	1,67	-0,194	0,849
	Other	153	1,74		

Note: (a). (b) and (c) represent statistical significance of coefficients for the level of risk of 1%. 5% and 10%.

The responses indicate that the most important reason for not licensing in both groups of companies was the fact that companies did not have innovations that could be licensed (Table 7). The least important reason was therefore failed negotiations in both groups of companies. The main difference between electronics companies and others is with respect to legislation. For electronics industry legislation was more important as a reason for not licensing their innovations as for other manufacturing industries.

To exclude financial reasons for differences in innovation activities between electronics industry and other manufacturing industries, we further tested the differences in financial performance of electronics and other manufacturing companies. The results presented in Table 8 confirmed that there are no statistically significant differences between electronics and other manufacturing industries in this respect.

4 Discussion

This paper investigates the nature of innovative activity in Slovenian electronics industry. Specifically, our hypothesis was that companies in this industry use different mechanisms of protection for their innovations than companies in other manufacturing industries. Based on questionnaire survey results we find enough evidence to support this hypothesis. The study exposed a seemingly paradoxical behaviour of electronics companies. Even though patents are not the most important mechanism of protection in this industry and are also deemed as less important than in

Table 8: *Performance indicators in Slovenian electronics and other manufacturing companies in 2006*

				T-test for equality of means	
		N	Mean	T	Sig.
ROA	Electronics	24	3.99%	0.046	0.964
	Other	137	3.88%		
DTS	Electronics	24	9.35%	-0.053	0.958
	Other	136	9.69%		
VA/E	Electronics	23	8.954 EUR	-0.441	0.660
	Other	140	10.659 EUR		
DA	Electronics	24	0.53	-0.616	0.539
	Other	137	0.57		

Note: (a). (b) and (c) represent statistical significance of coefficients for the level of risk of 1%. 5% and 10%. ROA is return on assets, DTS is total sales growth, VA/E is value added per employee, DA is debt to assets ratio.

other manufacturing industries, electronics companies have significantly more patents and are also more active in patenting and licensing their intellectual property than other manufacturing industries. Electronics companies think that complementary marketing and manufacturing capabilities with know-how protect their innovations most effectively. We believe there are three reasons for such results: 1) the nature of technology and products in electronics industry is complex, 2) the average company in electronics industry as well as R&D departments are considerably larger than in other manufacturing industries, and 3) the nature of competition in electronics industry requires fast technological change.

Electronics technology and products consist of numerous parts that come from several suppliers, also from other industries, and many of them can be patented individually. Besides, the technological change in this industry has a rapid pace and the innovation process is cumulative, meaning that innovations typically overlap with existing technologies /14/. Complete patenting is extremely costly and the novelty of innovation is easily questioned in such complex circumstances. Indeed, Slovenian electronics companies named the lack of novelty and cost of patent application and defence in court as most important obstacles to patenting. The build-up of specific manufacturing or marketing capabilities and know-how therefore protects innovations better as these capabilities are not easy to copy because they have high fixed costs and are typically non-transferable.

In spite of this, electronics industry has a considerably larger number of patents than other manufacturing industries. We can explain this by considering several facts about companies in Slovenian electronics industry. Firstly, they rely more on R&D departments to carry out their innovative activities than companies in other manufacturing industries. This makes the process of innovation more systematic and productive as opposed to spurious innovation attempts in companies without R&D departments. Second-

ly, because they are on average larger than companies in other manufacturing industry, they can exploit economies of scale related to R&D costs better and have a lower cost per patent than other manufacturing industries. Furthermore, their R&D departments are also proportionally larger than departments in other manufacturing industries and more people are working on activities leading to more patents and licenses. Thirdly, the above average complexity of the technology involves more patentable components (related to one product or process) than in a simpler technology. Lastly, the considerably higher share of new products and processes in electronics industry could be interpreted as a sign that companies in this industry are also forced to be more innovative because market and competitive pressures demand constant technological change. Consequently, more innovations lead to more patents.

At this point we would like to stress that one of the most important reasons for not patenting and licensing in both groups of companies was the fact that companies do not have innovations. This is particularly worrying in the light of globalization processes that move production facilities to more favourable locations in terms of costs, but increasingly also in terms of technological knowledge. It is not uncommon anymore for firms to move R&D departments in India, Taiwan or other countries, known for cheaper but technologically skilled labour. If it was once possible for Slovenian companies to rely on higher value-added and better technological skill as competitive advantage vis-à-vis cheaper, mass-production rivals, our survey reveals this could not be possible anymore already in the near future.

5 Conclusions

On average Slovenian electronic companies have more employees in R&D department than other Slovenian manufacturing companies. Even if their R&D budget is lower, they have more patents and new products than other companies in Slovene economy. In general, we concluded that electronic companies in Slovenia conduct slightly more active innovation policy than other manufacturing companies. In spite of a larger number of patents, electronic companies consider them as a less important and less effective mechanism for protecting innovations than companies in other manufacturing companies. Electronic companies think that complementary manufacturing and marketing capabilities or know-how are more effective mechanisms for protecting innovations than patents. We believe this inconsistency arises because of greater firm (and R&D department) size, technological complexity and pressure for fast technological change.

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