Patenting Biological Research in Brazil

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Abstract:

New Intellectual Property guidelines were recently adopted in Brazil (new 1996 Law). Until this moment, the scientific community showed no interest in patenting research results nor approved of a more organized patenting system. A population of Biological Research scientists that identified themselves as patenters in the National Research Group System of the National Council of Scientific Development (CNPq) was studied. This pioneer population's productivity was examined and some members were interviewed. The contents of these interviews were analyzed. The patents distribution by research area and institution was investigated. The main conclusions are that this population is different from their peers in their respective areas, showing greater productivity in many fields. Besides that, the study showed that patenting is not restricted to the applied areas of knowledge. This differentiated population may develop a leading role during the next period when industrial innovation policies will be implanted in the country.

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Introduction

Among the great public policy issues in Brazil, perhaps few are as controvertible and mobilize such wide range of political actors as industrial innovation. There is a struggle to approve a new innovation law - with harsh arguments as to its contents -, incentives were created to foster technology transfer and the subject was never as discussed as now. All this effort, however, unfortunately does not change the much ingrained condition of innovative immaturity in the country.

Considering National Innovation Systems (Nelson 1993, Patel & Pavitt 1994), institutional structures and incentive policies in the country, Brazil is, together with Mexico and India, among the immature countries. The cycle that leads from Research & Development (R&D) to industrial innovation and development has never been completed in Brazil and other Latin-American countries. Many offer explanations as to the origins of this condition.

Previous studies have shown that scientists have been secondary victims of the import substitution policy adopted in Brazil for decades. They would never have found a "space" for themselves and their science in society, insulating themselves in their relative irrelevance and ivory tower (Schwartzman 1991). Relative here refers to the proportion of significant contributions, since there were always those among Brazilian scientists who were bright and relevant, making important technical and theoretical contributions. Nevertheless, institutionally, Brazilian science has had its transfer arm of knowledge to society amputated. This is true both to the private sector and to public demands. It has become insulated.

The opening of Brazilian economy in the eighties, however, followed the many rounds of negotiations that resulted in the TRIPS. The country has changed, trade is opened and now Brazilians try to participate with the smallest possible shortfall in a globalized world and an increasingly technological economy.

The question now is how these previously amputated scientist have reacted to the new context. Since 1996, Brazil has a new patent law that regulates pharmaceutical and

biotechnological inventions. Do scientists now regard their research results as inventions? If so, can they see them as goods to be protected and therefore patented?

To answer these questions there is no other means as studying patents declared by scientists to the National Council for Scientific Development (CNPq) as innovativeness proxy. We understand this is not a good indicator, since there may and probably are a number of patents by Brazilian researchers that have not been declared to the CNPq, in what is called the Lattes system (which integrates information about productivity, institutional variables and much more). Since this system is becoming the main gatekeeper for grant requests, research visibility and other institutional activities, this is the best indicator we have for the moment.

We have used the Lattes system and observed that an increasing number of researchers declare their patent applications and granted patents, both in the country and abroad.

Today, the number of patent offices in universities is increasing. There is still, however, a great institutional insufficiency.

How did the pioneer patenters manage to patent their inventions? Is there something that distinguishes this population from their peers in their respective areas? Are their institutions different, favoring patenting activity?

These are the questions we wish to approach in this study. We adopt the hypothesis that we are dealing with a differentiated population, which may play a leading role in the next period of industrial innovation policy implantation in the country.

Patenting and Innovation in Brazil

Is the future globalized world one of corporative innovation with no space for other actors? In spite of the minimum State prophets which see the end of universities' role in the innovative process, there are reasons for a certain optimism: universities may be, if not THE locus, one of the privileged loci for industrial innovation (Etzkowitz & Leydesdorff 2000). Beis & Stahl (1999), for example, believe a considerable part of German industrial innovations are originated in public research institutions (PRI), which is in accord with Mansfield's (1998) data for the United States. Besides that, Daniels (1997) believes, in

contrast to the great majority of scholars, that globalization will contribute to *reduce*, and not increase the technological abyss between mature and immature countries.

Others, such as Bozeman, who has reviewed all the literature in technology transfer from Public Research Institutions (PRIs) to industry, believe that "the process of commercializing intellectual property is very complex, highly risky, takes a long time, cost much more than you think it will, and usually fails" (Bozeman 2000).

Even maintaining a respectful distance from Bozeman's pessimism and Daniels' optimism, Brazil's problems and its immaturity remain and are many (Albuquerque 2000, 2001). Brazil is not different from many other Latin-American countries where the distance between PRIs and industry is disconcerting. Public policies to overcome this condition look futile in face of the problem's dimensions (Alcorta & Peres 1998).

The issue becomes really visible when one considers technology transfer from PRIs to industry in micro-scale. The question we ask here is one that all countries have asked: to whom do the public interest research results, funded by public money and carried out in public institutions belong and what does it take to transfer it to industry (Ledermann 1994, Fujisue 1998; Licht and Nerlinger 1998)? In the United States, since the 1980's, the Congress has approved eight technology transfer incentive programs. Until then, there was little interest from researchers in developing "useful" research. Scholars have attributed such disinterest to what, until the eighties, was the compulsory licensing of publicly funded research. All such research results would necessarily be of public domain, therefore not patentable, and therefore of no commercial interest. In 1980 the Bayh-Dole Patent and Trademark Amendments Act, amended by Public Law 98-620 in 1984, was approved. This new legal system eliminated the compulsory licensing commitment. According to Sandelin (1994), at least 60% of all university inventions were supported by federal funds.

Research Institutions' inventive activity is concentrated since then in biotechnology. Technology transfer has been intensified and technology management offices have sprouted in every university. The financial gains secured by these agencies has increased substantially in the nineties (Mowery, Nelson, Sampat & Ziedonis 2001). Today, at least 70,0% of the resource generating licenses in American universities originate in the life sciences (Association for University Technology Managers 1998).

Specialized organisms to handle industrial property have increased in this period and the "technology transfer" professional has now a well defined role and position in most

American universities. There is even a journal devoted to the subject, the *Journal of Technology Transfer* (Bozeman 2000). Professional societies have appeared, the Association for University Technology Managers is one of them. It was created in 1994, has more than 2,700 members today and grows at a 10,0% rate/year. The Association for University Technology Managers (AUTM) members include university representatives, non-profit research institutions, government and industry.

In spite of the growing efforts in Brazil to network technology transfer offices, there is no such society and professionals feel isolated and frequently at a loss over their tasks. Brazil has a long history of medication and foodstuff patenting rejection. The first industrial property law in Brazil was approved as early as 1809. Nevertheless, in 1945 - when industry was in fact growing - medicines and foodstuff obtained by chemical means were excluded from patentability. In 1969, changes in legislation completely eliminated pharmaceutical patenting (Bermudez, Epsztejn, Oliveira and Hasenclever, pp 13-14). Therefore, a domestic industry specialized in the production of "similar" medicines flourished. Added to that, national research was unfamiliar with technology transfer - institutional immaturity had to be the rule.

A rather extensive literature discusses the technological immaturity problems in Brazil. Schwartzman (1991, Schwartzman, ed. 1995), for example, explores the issue of the Brazilian science and technology system evolution with chronic difficulties. Such difficulties made it more attractive and cheaper for industry to import technology. The absence of Intellectual Property Rights (IPR) made it more expensive and risky to get involved in the development of domestic technology (Vessuri 1990, 1997). This has resulted in the universities absorbing all the research functions, since the high costs and low reliability of developed technology turned industry's interest away from R&D.

Albuquerque (2000) has stated that Brazilian specificities (high proportion of individual patents, foreign firms with important activities, low involvement with R&D activities and lack of continuity of patenting activities) identify the country as an immature innovation system. His further studies reinforce such findings (Albuquerque 2001).

The idea of a National Innovation System, which is a more or less diffuse network of technological innovation development fomenting public and private institutions, is not new. It has been gaining, however, additions and criticism. One of them comes from Arocena and Sutz's group (2000, 2001) from Uruguay. These authors claim that the mere application of neo-shumpeterian concepts to Latin America, with no regard for the region's peculiarities, do not help to solve local technological development problems. As an alternative, they propose

eight general modules about each region's economic dynamics. These, in turn, allow for the evaluation and comparability of local innovation systems. One of the outstanding characteristics of Latin-American innovation systems is, for example, its more frequent contribution to the public sphere. For some scholars, this would be an immaturity trace. Again, the issue of the State's involvement in patenting and innovation suggests that it will remain an important player. Even in developed countries the State is the chief investor in areas of great public importance. PRIs relationship with industry are presently different and universities are more "porous" to private sector interactions. As a result, innovation remains and increases in PRIs everywhere. Studies from Europe, United States and Australia corroborate this claim (Godin B. & Gingras, Y., 2000; McMillan G.S., Narin F. & Deeds D.L., 2000).

In the study conducted in the United States, for example, the authors claim that "...our results indicate that the biotechnology industry depends on public science much more heavily than other industries" (McMillan G.S., Narin F. & Deeds D.L., 2000). The fact that relationships are more flexible, frontiers less clear, imply that universities and PRIs in general must have even stronger technology transfer organisms to handle them.

Material and Methods

The material for the researchers' study was the on-line information provided by the Lattes system from the CNPq. We recovered socio-academic and technical productivity data for the selected individuals.

Sixty-seven patents and 48 pioneer patenters were identified. From this pool, 19 individuals answered a questionnaire about difficulties and other issues involved in patenting.

Research support agencies were studied through direct contact and interview with those that held leading positions or through information from the agency's publications.

Results

1. Research support agencies

Brazil has no institutionally structured system to support possible inventors. When researchers succeed in patenting their inventions, difficuties abound (financial, lack of information, etc.).

The two most significant agencies were approached: the federal CNPq and the São Paulo agency FAPESP. The information about CNPq was provided by the department head, Eury P. Luna Filho, who kindly described how patenting activities developed in the CNPq. According to him, patenting activities, which integrate CNPq's legal department, started some twenty years ago. Then, it was unsystematic and inventors were assisted in a haphazard way. Since the late 70's and early 80's, internal guidelines were established.

In this period, it was widely held among researchers that patents would not benefit the country's scientific progress and that the free communication of research knowledge should not be restricted. With the new patent law from 1996, which included pharmaceutical patenting, the department had to commit more constant and permanent assistance.

The Intellectual Property Support Service, in the legal department, was founded in the year 2000. Nevertheless, since 1998 the CNPq already provided assistance of this kind: information to the researcher, orientation as to the patenting activities and patent application and software registration writing.

The Service is composed of two full time staff members and one trainee. One of the staff members holds a law degree with specialization in Intellectual Property Rights. Still according to Mr. Luna Filho, the Service attends about eight requests each month.

The Center for Technology Patent and Licensing (NUPLITEC) was established by FAPESP with the intention of protecting the intellectual property of research results supported by the agency and to license the resulting products. Scientific Director J.F. Perez explained that patents are costly and what is really important is licensing.

NUPLITEC intends to do business with the patenting activity and for this reason they are pro-active in seeking commercial partners. The idea is immediately mobilizing the Center

as soon as the researcher and peer reviewer agree that the invention is original and has commercial potential. FAPESP has subscribed patent search engines such as Derwent. The engines are available to the firms that take part on the entrepreneurship programs supported by FAPESP as well as to researchers. If the referee reports are positive, NUPLITEC supports patent writing activity, applies for patents in Brazil and also PCT requests, explained director Edgar Dutra Zanotto.

NUPLITEC does not intend to assist just university and PRIs programs but high technology small businesses and partnerships between firms and PRIs as well. In these cases, the assignees should be the FAPESP and the firm (Izique 2000).

2. Pioneers' Institutional and Disciplinary profile

Sixty-seven patented products were retrieved from the Lattes system.

It is well known that Fundação Oswaldo Cruz (FIOCRUZ) and Empresa Brasileira de Pesquisa Agro-pecuária (EMBRAPA) are the only research institutions in Brazil with experienced technology transfer offices: the GESTEC and EMBRAPA's Intellectual Property Secretary. Patents were expected to be concentrated in research institutes. Nevertheless, data shows otherwise: there is a concentration of patents in the universities (Table I).

Table I: Patent distribution among institutions

	Frequency	Percent
UFMG (Universidade Federal de Minas Gerais	11	16,4
UFRJ (Universidade Federal do Rio de Janeiro)	9	13,4
EMBRAPA (Empresa Brasileira de Pesquisa Agro-pecuária)	7	10,4
USP (Universidade de São Paulo)	7	10,4
FIOCRUZ (Fundação Oswaldo Cruz)	5	7,5
UFRGS (Universidade Federal do Rio Grande do Sul)	5	7,6
ULBRA (Universidade Luterana do Brasil)	3	4,5
UNIFESP (Universidade Federal do Estado de São Paulo)	3	4,5
UFV (Universidade Federal de Viçosa)	2	3,0
UnB (Universidade de Brasília)	2	3
UERJ (Universidade do Estado do Rio de Janeiro)	2	3,0
FUNED (Fundação Ezequiel Dias)	1	1,5
UFSM (Universidade Federal de Santa Maria)	1	1,5
UFSC (Universidade Federal de Santa Catarina)	1	1,5
UPF (Universidade de Passo Fundo)	1	1,5
IPA (Associação Brasileira pelo Direito de Brincar)	1	1,5
UENF (Universidade Estadual do Norte Fluminense)	1	1,5
UFRRJ (Universidade Federal Rural do Rio de Janeiro)	1	1,5
IBU (Instituto Butantã)	1	1,5
UFSCAR (Universidade Federal de São Carlos)	1	1,5
UFAL (Universidade Federal de Alagoas)	1	1,5
Missing System	1	1,5
Total	**67**	**100,o**

Another surprising result was the disciplinary concentration in areas such as biochemistry and ecology. We did not expect to find these areas more concentrated than pharmacology, veterinary sciences and chemical engineering (Table II).

Table II - Patent distribution according to disciplinary field

	Frequency	Valid Percent
Biochemistry	7	24,1
Veterinary Sciences	4	13,8
Ecology	3	10,3
Public Health	2	6,9
Pharmacology	2	6,9
Parasitology	2	6,9
Genetics	2	6,9
Zootechnic Sciences	1	3,4
Physiology	1	3,4
Medicine	1	3,4
Mechanical engineering	1	3,4
Immunology	1	3,4
Chemical engineering	1	3,4
Agronomy	1	3,4
Total	**29**	**100,0**

Our study indicated that, unlike expected, this new pioneer inventor is concentrated in universities.

It is always possible, however, that this is a method artifact: institutes may be under-represented because, for many reasons, their researchers are self-reporting patents less than their university peers.

3. Pioneers' production

Pioneers are in general more productive than the average researcher from their respective areas, as shown in Table III, IV and V. Many factors may contribute to this condition: pioneers have more students, as shown by the number of defended dissertations. Thus, their laboratories are operated with more students and therefore become faster in production. This feeds back into the pioneers' merit and their attractiveness to students, more grants and better general infra-structure.

Table III - Pioneers' production since 1997

Production - total (since 1997)	Bibliographical production	Technical production	Dissertations from advised students	Other works
3052	2201	417	311	123

Data obtained from the CNPq.

Table IV - Productivity in each researcher's area since 1997

Bibliographical production	Technical production	Dissertations from advised students - average for each area	Other works - average for each area
963	124	119	38,5

Productivity in each researcher's area. Data since 1997. Data obtained from the CNPq.

Table V - Relationship between pioneers' production and area productivity

Bibliographical productions/Area productivity	Technical production/ Area technical productivity	Dissertations/ Area average dissertations per researcher
2,29	3,36	2,61

Data obtained from the CNPq.

4. Interviews content analysis

There are 67 patented technical productions but the number of patenters is 48 because many researchers have more than one patent. These 48 researchers were contacted and 19 responded our questionnaire. Only 16 were analyzed here because three of them demanded confidentiality.

One of the observations is that a large number of them have written their own patent document. Those that wrote the document with the research group are also in this category.

Among the other nine researchers, only two had their documents entirely written by their institutions. The rest affirmed that they had other forms of participation (Table VI).

Table VI - Distribution of patenters according to who wrote the patent document

Question 1			
Who wrote the patent document			
Researcher		Others	
Frequency	%	Frequency	%
7	43,75	9	56,25

One of the most intriguing results is that about half the patents do not have the researcher's institution as the assignee (nor any corporation). This is a lawful obligation in Brazilian public service. Stranger yet is that these researchers have self-reported. There is a possibility that they are confusing authorship with assignee (Table VII).

Table VII - Distribution of patenters according to patent assignee

Question 2					
Assignee					
Researcher		Institution		Others	
Frequency	%	Frequency	%	Frequency	%
2	12,5	9	56,25	5	31,25

There was a question about the difficulties researchers had in the patenting process. We created a general categories for these problems. They are, however, diverse. This accounts for the fact that some researchers fit into more than one category. Interestingly, 33.3% have reported no problem for patenting their inventions. Other 22.2% had problems with lack of information in their own institutions. It is important to stress that those researchers who reported no problem in patenting seem to concentrate in Fundação Oswaldo Cruz (FIOCRUZ) and Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), which have experienced technology transfer organisms (Table VIII).

Table VIII - Distribution of patenters according to difficulty in patenting invention

Question 3							
Difficulties in Patenting Invention							
Writing document		**Lack of information**		**No problem**		**Other**	
Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
2	11,1	4	22,2	6	33,3	6	33,3

As to institutional support, 43,8% reported having received partial support. Under this category are those who received some kind of orientation. This category masks the fact, however, which appears in the interviews, that the support has come too late, frequently compromising paper originality and impairing the commerciability of the product (Table IX).

Table IX - Distribution of patenters according to institutional support during patenting

Question 4					
Institutional Support					
Partial		**Total**		**None**	
Frequency	%	Frequency	%	Frequency	%
7	43,75	6	37,5	3	18,75

Curiously, 50,0% of interviewed researchers affirmed that their publications were affected by patenting. This is interesting since the pioneer patenters are, in general, more productive than their area peers, as already shown. Only one researcher reported having produced more during the patenting process (Table X).

Table X - Distribution of patenters according to their opinion as to interference in publishing activity

Question 5					
Bibliographical production					
Interfered		**Indifferent**		**Increased**	
Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
8	50	7	43,75	1	6,25

5. Descriptive analyzes of the Interviews

Each researcher is identified by a letter. The case studies bellow (Yin 1994) refer to a non-representative part of the population, and not a sample: there are more respondents from research institutes than in the population, for example.

Researcher "a"'s response shows the pro-active importance of technology transfer organisms. Technology transfer notions that she had are due to GESTEC's (FIOCRUZ's technology management office) efforts. This was one of the cases in which the researcher reported having had no problems in elaborating the patent document and where she has felt supported by the institutions. She is fully satisfied with her institution.

- Did you have any previous knowledge about concepts such as assignee, authorship, licensing, patentability, inventiveness and invention commercialization? If not, how did you feel having to handle documents that involved such concepts?
- *I had knowledge because of the many seminars and laboratory visits promoted by GESTEC in each unit of the FIOCRUZ.*
- What kind of difficulty did you face (you may write as much as you like)?
- *I am being very sincere when I say I had no difficulty. In the occasion, I sent a complimentary letter to GESTEC's activity. In less than two months, we had local application and now we have applications in eight countries, thanks to GESTEC.*

Researcher "b" is also from FIOCRUZ, from the Belo Horizonte campus (René Rachou Institute). She also reported much institutional support. She seems to be mixing "assignee" with "author". She has reported that FIOCRUZ has strategic guidelines in the patent game: special grants are destined to patent competition and there is a central effort directed to this end. Researcher "b" reports having had her publishing activities impaired by patenting. A closer examination of her response shows a concern over possible obstacles between commercializion and students activity, which require publication in well defined time limits.

- Who has applied for your patent at the INPI (local patent office)? What was your level of participation and who else participated?
- *FIOCRUZ did the application and the bibliographical survey (she probably means anteriority search) for patents and similar technical products, related with malaria and antigens. This was kindly done by FIOCRUZ in an excelent, fast and very profound work. I was impressed by their personel. Our participation at this level was minimum. We only re-wrote (the contents) according to the forms they*

sent us, detailing technical and scientific issues - this was all done by us. In this case, I wrote most of the document.

Researcher "w" deposited her patent in the United States. She did not write the patent and the commercial partner is already the assignee, aparently involved since the beginning of the research. Her report shows the level of professionalism in technology transfer offices abroad. They defend themselves from all sides, imposing that the reseach be protected since the beginning by contracts with detailed predictions as to the possible commercial benefits. She had no knowledge of any concept related to patenting.

Since she began her doctorate, she conceded all assignee rights to benefited parties.

- How was the assignee established?
- *Through a contract signed with the University (Technische Universitaet Hamburg-Harburg) in the beginning of my doctorate. It predicted conceding all rights over my research results.*

Researcher "c" exhibits the pattern of those which do not belong to strong institutions such as FIOCRUZ or EMBRAPA: they have to run through the burocracy procedures themselves. They frequently write their own patent documents. If they will be able to license them some day, it is doubtful. It is hard to judge the quality of these documents, since they were not elaborated by professionals, too expensive for these researchers.

Researcher "d" is from EMBRAPA's staff, member of REPICT (the intellectual property licensing network) and therefore familiar with the language and problems related to intellectual property. She has not commented on her particular difficulties, but on what she sees as the difficulties faced by the scientific community. She believes the community resists the idea of commercializing their research results:

- What were the chief difficulties you faced (write as much as you want)?
- *The first difficulty a researcher faces - I think - is to accept that his/her work may be commercialized (in this aspect, some of research's romanticism is lost). This is because it has to be original and not published, discussed and presented to the community. We feel pleasure in showing what we are doing and remaining silent for too long is complicated. Another important thing is writing the patent document, which is peculiar. Here I think that the difficulty is in part because of the type of writing and also because we don't have the habit of reading patents. This is a pity because it is the best source for the state of the art for any kind of research.*
- Do you feel that patenting has in any way interfered in your publishing activity (decreased, increased, delayed)?

- *It didn't interfere because we were working in other projects and we could publish other results. For those who work in only one project and depends on its results for patenting, it is hard since the most important evaluation item in most institutions is publishing.*

This researcher seems to understand the process of patenting-publishing: one publishes what has already been applied for as a patent document. For this reason one must have many on-going projects. This shows a high degree of innovative maturity.

Researcher "e" is another FIOCRUZ researcher for whom all problems are solved by GESTEC. The researcher made it very clear that his participation was limited to carrying out the research.

Researcher "f" is a case in which a university has an embryonic technology transfer organism. The reseacher herself helped the organism, offering her experience abroad. The difficulty mentioned by this resercher was peculiar, since it concerns an innovation on the traditional methods by trying to obtain reports from the industry and the academy. This procedure delayed the whole process:

- Who wrote the patent document, oriented the elaboration and applied for the patent at the INPI? What was your level of participation and who else participated?
- *Our patent was the third obtained by UFRGS after initiating the activities of the Technology Transfer Office (EITT). Therefore, my participation in writing the patent was great since they still did not have the forms and patent models. I used the forms I knew from the University of Arizona, where I did my post-doc. Today I am preparing a new application and the EITT already has all the manuals and models for that, which is very handy.*
- What were the main difficulties you faced (write as much as you want)?
- *The main difficulty was finding specialists to write referee reports, and one had to come from industry. The other could come from a higher education/research institution. I don't know if this demand comes from the INPI or from the UFRGS. The EITT sent the material to two specialists, one from Copersucar (industry) and another one from EMBRAPA. Both returned the material claiming they were not competent to write the report. This delayed the process in at least six months, since we had the first report, from academy, but lacked the one from industry. Finally, FIOCRUZ's president wrote the report.*

Researcher "h" confirms the pattern where researchers from universities lack any support and have to "learn by doing".

Researcher "x" has patented his material in the U.S.A. Again, it is shown that the institution has provisions and clear agreements since the beginning of the research. A

commercial partner was also involved since the beginning (Diatide Inc.). The researcher not only knew very little about patenting itself but is not interested in the subject: he is concerned with the fact that his benefits are garanteed by the agreement and that is sufficient.

- *The assignee was obviously the principal investigator (Dr. F. S. M). He prepared all the documents under the supervision of the Patent and Trade Mark Office together with Diatide Inc. The assignee agreement was made between Dr. M. and the University and the Royalty Income Agreement was the following: 50% to the University of Southern California, 50% to be distributed among the authors. As you can see, I had no clear notions about patents. Nevertheless, I did not have to deal with the documents that involve all these demands.*

Researcher "l" was the only one that reached out to an Industrial Property private office. Therefore, she had no difficulty at all, since the office took care of everything.

- *The patent document was originally written by F. and I made the necessary corrections (F. is Colombian and is not fluent in Portuguese). After this first version, the document was sent to a specialized Industrial Property office that belongs to a retired professor from our Department. The office made the necessary changes, submitted the document to our approval and proceeded with the bureaucratic steps.*
- What were the main difficulties that you faced (write as much as you want)?
- *In truth, for writing and applying for the patente, NONE. All the procedures are being carried out by (the firm) and the only difficulty is the payment for the services provided by the office to take care or our interests.*
- What kind of support did you receive from your institution? From any specific organism?
- *Concerning the patent, I received no support, neither from my institution nor from any other organization.*

Researcher "y" deposited her patent in the United States, with her research group. Her participation, like the other Brazilian reserchers in her situation, was very limited. Technology Transfer offices take care of everything. The commercial parter was again involved since the beginning of the research and took care of the patenting costs. The researcher herself was not very certain in answering the questions - she has had little interest in the details, since they were all established by an agreement in the beginning of the research. She felt a cultural shock when she returned to Brazil, where she had to assume many of the responsibilities that the Technology Transfer Office in her American University took care of. She was not prepared for that to the point of declaring she will never apply for a patent again.

- Who wrote, oriented the writing and applied for the patent at the INPI?

- *My most recent patent project was written by my German collaborator. Other patents where I am the author were written and applied for by my doctorate advisor in the United States. I take part in five patents.*
- What was your level of participation and who participated the most?
- *The German patent has only two authors: the professor who collaborated and myself. The American patents have many authors and I have 10% participation.*
- Who is the assignee? How was the assignee agreement established?
- *The American patents were applied for by my advisor and I think that the assignees are himself and the University where the work was carried out. The patents are licensed to biotechnology companies who pay royalties for their use. The German patent has a patent company as the assignee. This company paid for all the expenses and marketed the product to biotechnology firms.*
- Did you have any notions about assignee agreements, authorship, licensing, patentability, inventivity and commercialization of inventions? If not, how did you feel having to deal with documents that implied such knowledge?
- *It was a very difficult experience because I don't have - or didn't have - any knowledge about this subject. In my American patents my advisor took care of everything. In my German patent, things were more complicated because there the professor may choose to patent his invention without the University, taking care of all the expenses, or through university (which is more bureaucratic). Here, the patent has to be done through the university, who doesn't offer any support for the professor.*
- What were the main difficulties you faced (write as much as you want)?
- *I had many problems. At the USP, there is the CECAE, which should help us. There are excellent people there that try to help the professors, Dr. S. O. and Dr. A. F. were very considerate, but there are no fixed rules for patenting - each case is a new one and they are professors that serve the community but it doesn't work. The USP's legal department is very complicated and everything is more difficult. My project was all in English since it was a cooperative German-Brazilian international project. The legal department demanded translation, I know nothing of legal translations and without that they didn't accept anything and wouldn't forward the project to any competent organism to take care of the translation. They did so many absurd demands that the process took 10 months to be signed by the university's president - this is unacceptable.*
- What kind of support did you receive from your institution? From any specific organism?
- *I was supported by the Research Chancellor and by Dr. S. O. from the CECAE, but many decisions depended on USP's legal department and the support was insignificant. Considering all the difficulties I have been through, I do not intend to apply for any other patent.*

Researcher "m" said he had no knowlede about patenting in his first two patents. There was lack of technical and legal support in his university. He said that the university tried to help, but it lacked experience with these matters.

- Did you have any notions about assignee agreements, authorship, licensing, patentability, inventivity and commercialization of inventions? If not, how did you feel having to deal with documents that implied such knowledge?
- *They were gained during the process.*
- What were the main difficulties you faced (write as much as you want)?
- *Lack of technical and legal support, especially in the first two patents.*

Researacher "n" is from EMBRAPA, therefore, she had the same behavior as the other Large Institutes' researchers. The only comment is that she found it difficult to keep the originality of the research and proceed with the patenting process.

Reserchер "o" did all his patents through the firm he worked in. Thus, he had no significant difficulties since the firm had experience in patenting.

Researcher "p" is from an university, but claimed not to have had any difficulty during the process, in spite of having no previous knowledge of patenting. His only comment was that publications were delayed.

Concluding remarks

The present data corroborates the answers to the national survey we applied in the population of biotechnology research leaders (Vêncio, Patrão, Silva, Marin, Reis, Lucatelli, Santos and Coutinho 2002). Part of the population found it "expensive" to patent and part found it "cheap". The reason seems to be that if the researcher herself writes the document alone or if the institution does it for her and applies for the patent, the process is cheap. If a special service is seeked, one that will take care of anteriority searches, with business intelligence perspective and which will apply for the patent not only locally but also under PCT, the process is expensive.

The naivité of Brazilian researchers also seems to show: they don't know what is correct in terms of institutional procedures and the theme is very new.

The lack of experience in Brazilian research institutions goes to the point of sending students abroad who give up all their (and their institutions') assignee rights as soon as they receive complementary grants from the new lab. No agreement is made between the Brazilian institution and the foreign host institution.

Most Brazilian research is applied in theme and vocation. Nevertheless, it rarely reaches the application objective or "client". The reasons for this failure are numerous and varied, from structural institutional problems, research quality to budgetary ones. The pioneer population studied here represents a sub-group in the scientific community that succeeded in another step in the hurdle race of applying Brazilian "applied research". This group has succeeded at least to accomplish the transformation - still rather symbolic - of "research result" into "invention". The patent is the proof of the inventive process.

Naturally, after that technological management is necessary: patents must be matched with commercial partners, additional tests must be done and finally, the disired commercialization must take place. We know we are far from this.

In their report *National Biotechnology Firms*, however, the Fundação BioMinas (Mascarenhas 2001) identified 304 Biotechnology firms in Brazil. This fact impressed even the most optimistic observers. Therefore, with a pioneer patenter population in biotechnology that is apparently just starting to expand and a growing national biotechnology industry, it is possible that this combination may give the necessary impulse to this strategic economic sector.

We will not fool ourselves with the perspective of competing with huge pharma-companies such as Squibb, Merck, Glaxo-Wellcome or Schering. But considering the kind of inventiveness of this pioneer population and the new national biotechnology industry activity, many of them recently incubated, it is possible that there is a biotechnological inventive niche to be explored in the near future. Brazilian biotechnological capability might be enough for that.

Bottom line: it is possible that this pioneer population is a component, together with the new biotechnological firms, of a new National Technology Innovation System based on the differential exploration of this technological niche. This idea is modified from those already presented by authors such as Freeman (1987), Lundval (1992), Nelson (1993), Patel & Pavitt (1994) and Metcalfe (1995).

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